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Peripheral Blood Changes in Canada Geese and the Reproductive Condition of Three Michigan Flocks

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PERIPHERAL BLOOD CHANGES IN CANADA GEESE AND THE REPRODUCTIVE CONDITION OF THREE MICHIGAN FLOCKS

by

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TABLE OF CONTENTS

LIST OF TABLES

TABLE Page

LIST OF FIGURES

LIST OF APPENDICES

INTRODUCTION

According to Hanson and Smith (1950), wild populations of the Canada goose (Branta canadensis) from the Mississippi Flyway normally leave their wintering grounds in mid-March and reach their nesting areas by the third week in April. Within a period of two weeks after arrival, breeding pairs have established territories, selected a nesting site, constructed a nest, and started laying a clutch of eggs. Wild migrant birds show a definite lag (a delay from the onset of development to oviposition) in reproductive timing compared to local semi-domestic birds. Local birds lay eggs earlier than wild birds (at Kellogg the local birds lay eggs starting approximately April 1), even though both appear to be similarly stimulated reproductively in late March. Proposed in this study, which was part of a two year investigation, were several objectives. The first was to determine if the laboratory techniques used by Johnson (1967) were applicable to mobile flocks. The second was to examine several methods of trapping (drop-trap, herding, cannon net, and drugging) to determine their applicability for use in future studies. The third was to use the reproductive index values for confined semi-domesticated Canada geese set forth by Johnson (1967) as a basis for

determining this applicability to semi-domesticated, non-confined birds and to wild, free-flying birds in subsequent studies. The fourth and final objective was to gather, bring up to date, and compare breeding and non-breeding data from the three Michigan flocks studied (Kellogg, Mason and Seney).

Prior to and during the time of the spring migration of wild populations, potential breeding female geese of local Michigan flocks (Kellogg Bird Sanctuary, Hickory Corners, Michigan, and the State Conservation Game Farm, Mason, Michigan) progress from a state of sexual quiescence (non-breeding condition) to one of sexual activity (breeding condition). Johnson (1967) indicated that there were distinct changes in the levels of certain blood chemical constituents (serum calcium, total protein, albumin, globulin, and the albumin/globulin ratio) which represent the transition from a non-breeding to a breeding condition. These changes in peripheral blood constituents were related to the reproductive state in the Canada goose, and analysis of these could be used as an index to reproductive condition of the female Canada goose.

The Canada goose tends to be migratory, and its natural geographic range is in temperate North America and the Arctic. The gonadal and behavioral changes associated with reproduction in the Canada goose are probably regulated by endogenous hormones which are triggered in response to external stimuli as described by Witschi (1959) and Lehrman

(1959). Benoit et al., (1956 and 1959) postulated that there was an endogenous rhythm within a bird's system, which is acted upon by temperature and photoperiod in a way that actuates this rhythm. Much evidence has been presented to substantiate this postulate (Bissonette, 1937; Burger, 1949; Benoit and Ott, 1938; Farner, et al., 1953; Farner, 1950, 1955, 1959 and 1964; and Wolfson, 1952 and 1959). It may be possible that this endogenous rhythm and its determinant factors (photoperiod and temperature) play roles in Canada geese, but the timing and circumstances of their effects seem to be different in migrating and non-migrating Canada geese. The non-migrating local birds of Michigan appear to come into reproductive condition (the potential for nesting and laying eggs) long before the free-flying migrants even reach their nesting areas.

Marshall (1955) stated that the anterior pituitary, controlled by the hypothalamus, is the site of gonadotropin secretion that affects ovarian growth and egg production. In fowl there are two gonadotropins, follicle-stimulating hormone (FSH) and luteinizing hormone (LH). Follicle-stimulating hormone stimulates ovarian follicular growth with results in increased amounts of gonadal hormones, specifically the estrogens, which have been demonstrated to have marked effect on avian metabolism (Nalbandov, 1953; Lorenz, 1956; and Sturkie, 1965). Dorst (1924) suggested that the thyroid regulates metabolic changes in preparation for the migratory

flight. Wolfson (1945) has demonstrated that there was an inter-muscular and sub-dermal fat deposition prior to the migratory flight, which was postulated to be the result of a slowing down of the metabolic rate. These physiologic changes were believed to be possible indications that the bird was in preparation for the long migratory flight northward. If so, a possible relationship may exist between reproductive stimulation and the slowing down of the metabolic rate (thyroid activity), perhaps exerting some type of influence on the rate of sexual development.

Hofman (1966) demonstrated that estrogen treatments of the mallard duck (Anas platyrhynchos) resulted in enlargement of the oviduct and pronounced changes in total protein, serum calcium, and the globulin fraction of the blood. It has been noted in the mallard duck, that a marked increase in serum calcium occurred when daily doses of 17-"B"-estradiol were administered (Hofman, 1966, and Rickless, 1967). Johnson (1967) reported similar findings in the Canada goose. Similar increases in serum calcium have been noted by a number of other investigators in domestic fowl of both sexes when estrogen treatments were administered (Landauer, et al., 1941; Polin and Sturkie, 1958; Fleischman and Fried, 1945; Common, et al., 1948; and Urist, et al., 1960). The increases in serum calcium were believed to be caused by the estrogen in the presence of parathormone from the parathyroid. Benoit, et al., (1938) stated that parathyroidectomized ducks did

not demonstrate an elevation in serum calcium in response to estrogen treatment. Similar results were reported in the chicken (Polin and Sturkie, 1958, and Urist, et al., 1960).

Estrogen has also been reported to have a significant effect on serum protein. Johnson (1967) demonstrated a marked increase in total protein following estrogen treatment in the Canada goose. Hofman (1966), Rickless (1967), and Smyrnios (1967) have reported a similar increase in the mallard duck. The increase in the total protein was related to the globulin fraction; the albumin fraction remained stable or slightly lower (0.5 gram) than pre-treatment values (Hofman, 1966, and Johnson, 1967). Rickless (1967) working with the mallard duck and Johnson (1967) with the Canada goose, demonstrated that exogenous and endogenous estrogen stimulation increased the total globulin. This increase was attributed to the beta globulin fraction. However, under stress conditions (a pituitary, adrenal cortical response), the alpha and gamma globulin fractions increase (Rickless, 1967). Because increase in total protein and decrease in A/G ratio occur both under estrogenic stimulation and stress conditions, these two parameters alone may not be used to indicate the reproductive state. However, an examination of the subdivisions of the globulin fraction of the serum protein can be used to determine whether the total protein and A/G ratio are responding to stressors or estrogen (Rickless, 1967, and Johnson, 1967). This was done

by looking for an increase in the alpha and gamma globulin fractions indicating stress and an increase in the beta globulin fraction indicating estrogenic stimulation. Therefore, analysis of the globulin fraction along with quantitative changes in serum calcium, total protein, albumin, globulin and the A/G ratio were used in this study to determine the reproductive potentials and patterns of the birds sampled. This study was conducted from February 29, 1968, to June 30, 1968. The blood serum samples obtained were taken from three Michigan local flocks, a group of birds gathered at Sand Lake, South Dakota, and from wild birds that had stopped at Kellogg during their migratory flight.

The overall purpose of this study was to gain insight into the normal reproductive patterns as indicated by the change in blood constituent levels of semi-domesticated and wild Canada geese under field conditions. Along with this was a specific goal of understanding the influences of trapping and handling procedures on these blood parameter levels.

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METHODS AND MATERIALS

Semi-domestic and wild Canada geese were used in this study. Blood samples were taken from February 29, 1968, to May 6, 1968. This period of time was believed to approximate the time of the egg laying season of the flocks studied. Two-year-old and non-nesting individuals were also sampled during the same period of time, but those birds which did lay eggs were not sampled again.

Wild birds were captured and sampled at Kellogg while they stopped over from their migratory flight northward (March 1, 1968, to April 14, 1968). Blood samples were taken from birds that wore bands and were of known ages (some wild birds in the area were also sampled). Sexing of the birds was accomplished by cloacal examination.

Three types of local flocks were sampled: A non-migratory non-confined flock, maintained at the Kellogg Bird Sanctuary, Hickory Corners, Michigan; a non-flying, confined flock at the State Conservation Game Farm, Mason, Michigan; and a free-flying migratory (non-breeding portion) flock at the Seney National Wildlife Refuge, Seney, Michigan. Also, 16 Canada goose blood samples were taken at Sand Lake, South Dakota, on March 21, 1968, and submitted for study from the Northern Prairie Wildlife Research Station, Jamestown, North Dakota.

Trapping Techniques

At the Kellogg Bird Sanctuary three methods of trapping were employed for both the wild and non-migratory birds sampled there.

1. A drop-trap was utilized from February 29, 1968, to March 25, 1968, while the ground was covered with ice and snow. The trap was constructed of a pipe frame covered with wire mesh. The trap measured 40' X 20' X 5'. The front of the trap had a swing door hinged at the top. The door could be raised and connected to two solenoid switches. A cable connecting the two solenoid switches was operated by remote control from a laboratory unit approximately 150 yards away. The trap was constructed on the west shore of Wintergreen Lake (the Kellogg Bird Sanctuary) between two small wooded areas. The front portion of the trap was in three feet of water, while the rear portion was on land. A door at the rear of the trap allowed entrance in order to scatter corn and mixed grain feed on the ice and snow as bait. Entry was also gained through the same door to drive the captured birds into a small partitioned corner of the trap. This led to a 5' X 3' X 3' holding crate from which the geese were easily removed. Once baited and set, the trap was observed through

a telescope from the laboratory unit. When an arbitrarily sufficient number of birds had entered the trap, the door was closed. The birds were then removed within five minutes (except in a few instances when they were allowed to remain in the trap for a few hours).

2. Prior to the egg-laying period (beginning approximately April 1) three men equipped with nets went into the territories of the geese and cornered all the females available, trying to avoid a chase. Once caught the geese were sampled and released.
3. Upon the arrival of migrants (March 14, 1968) a drug, alpha-chloralose (Nutritional Biochemicals Corp.) was utilized in securing the wild geese. The drug was mixed with the feed and placed out for consumption. Once the feed was eaten the geese were watched closely for signs of mobility loss. When the birds showed signs of this condition, they were gathered, sampled, and held in a pen until effects of the drug had worn off.

The State Conservation Game Farm, Mason, Michigan, maintains a small flock of Canada geese, all of which are clipped or pinioned for easy maintenance and kept in one large field until the onset of the breeding season. In one corner of the field was a large wooden framed walk-in trap (65' X 12' X 7'). The frame was covered with wire mesh and partitioned internally. A small area (12' X 12' X 7')

was completely encloseable within the trap. Once the birds had been herded from the field into the trap, they were driven into the small enclosed area and held there. It was from this area that the birds were cornered and captured by hand.

At the Seney National Wildlife Refuge, a cannon net was utilized to capture a sample of the non-reproductive portion of the flock (those in a larger group at a different area of the refuge than the breeders).

At Sand Lake, South Dakota, a cannon net was used to capture the Canada geese gathered there.

Blood Sampling Technique

Blood sampling was done entirely at the site of the capture using the procedure employed by Decker (1965) as modified by Johnson (1967). The goose was grasped at the base of the wings, the head was tucked under a wing, the bird was then held ventral side up, and placed in a helper's lap. Because of its size and easy accessibility, the metatarsal vein, on the inside of either leg was used to obtain most blood samples. The brachial vein was used on the birds captured by alpha-chloralose due to the extreme hypersensitivity (expressed in the difficulty of immobilizing the birds foot) of the birds under the influence of the drug. An alcohol solution, applied with cotton, served as a cleanser and disinfectant. Pressure was applied to the metatarsal vein proximal to the knee joint. A sterile

disposable syringe with a hypodermic needle was inserted into the metatarsal vein distal to the heel. The blood was allowed to flow into the syringe by slowly withdrawing the plunger. Approximately two milliliters of blood were collected for each sample. In transferring the blood sample from the syringe to a plastic ampule, the hypodermic needle was removed. If necessary, the metatarsal vein was clamped with the thumb and forefinger distal to the puncture to stop the bleeding and coagulant (Gelfoam Powder, Upjohn Company) was applied to the wound.

The blood sample was allowed to clot which usually occurred in transport from the site of the sampling back to the laboratory. The clot was loosened and the blood sample was then centrifuged at 3,000 rpm for five minutes in a small clinical centrifuge. Immediately following this, the supernatant serum was removed with clean pipettes and transferred to clean plastic vials. The serum samples were stored at -15°C until the time of analysis.

Calcium Analysis

Levels of calcium expressed in mg per 100 ml of blood (mg%) were obtained by the use of a Turner Fluorometer with a primary filter 110-816 (2A) and a secondary filter 110-818 (2A-12). A calcein reagent (fluorescent media) was prepared by mixing 30 mg of calcein with 30 ml of 0.8 N KOH, then a seven ml portion of the calcein reagent mixture was diluted to 1,000 ml with 0.8 N KOH yielding a 1 mg/ml

concentration. Calcein, 3,6-dihydroxy-2,4-bis [N,N-carboxy-methyl-aminomethyl] fluran, is a product of the Fisher Scientific Company.

Five mixtures of known calcium concentrations (8, 10, 11, 15 and 21 mg%) were used to establish standard curves. The fluorometer was adjusted to zero with the 8 mg% mixture and checked against the curve for the remaining four mixtures. A commercial serum (Versatol, 10.7 mg% calcium) was used as a control during the analysis.

Five ml of the calcein reagent were placed in a plastic ampule along with a 20 lambda serum sample. This was shaken ten times and placed in a 27°C water bath and oscillated for ten minutes prior to recording fluorescence.

Protein Analysis

Total protein values were quantatively obtained with the use of an American Optical T. S. Meter and expressed in grams per 100 ml (g%) of blood. Serum protein fractions, albumin and globulin, were separated using cellulose acetate electrophoresis in a Gelmen cell (1.5 ma per strip for one hour) with barbitone barbitol buffer solution (pH 8.6). The strips were then placed in Ponceau S stain for five minutes, destained with 12% acetic acid in 95% ethanol and placed on glass to dry. A Densicord densitometer and integrator were used for the albumin and globulin determinations. These concentrations were expressed in grams per 100 ml (g%) of serum.

RESULTS AND DISCUSSION

In sampling the local flocks of Kellogg and Mason it was found that the conventional traps (drop-trap and walk-in trap), along with hand nets at Kellogg, yielded reasonable catches which consisted of one third of the population of birds at Kellogg, as based on a total population of approximately 135 birds. These birds were used to represent their respective flocks.

Sampling a wild population was much more difficult. Wild birds are free-flying and roam vast areas at stopover points along their migratory flight northward (Hanson and Smith, 1950). This, as well as many other factors (weather and trapping techniques) played a part in the low capture rate of wild geese throughout the study (because the capturing methods used were not adequate for wild birds). Only one successful method, the use of a drug (alpha-chloralose) was found. Its use was limited due to the possibility of its effects on the birds' blood chemistry. This will be discussed later.

The technique, described previously, used to obtain the blood lent itself to field operations very well. Sampling was done easily at the site of capture. The technique was faciliated when an assistant held the goose during sampling.

Trapping

At the Kellogg Bird Sanctuary three different methods of trapping were used with limited success. The first method used was a beach drop-trap. This particular trap yielded a number of samples during the study but not as many as its potential indicated. The trap itself was in poor condition and often more than 60% of the birds trapped would escape through holes in the wire mesh sides and through the openings at the corners of the trap where the door closed. Nevertheless, 20 birds of the 45 bird sample of the Kellogg flock were obtained via this method.

Timing and weather played important roles in the success of the drop-trap in association with the number of birds captured. Timing was involved in catching the birds, for they came to the trap only to feed. Therefore, determination of the feeding times was made through observation of the geese. The birds usually fed twice a day, just after sunrise and again just before sunset. Once this was learned the trap was observed specifically at these times and when significant numbers of birds had entered the trap, it was set off. Weather, the other factor, as it turned out, played a major role in the limited number of birds captured in all of the traps utilized throughout the entire study. The spring of this year (1968) was an early one and a rather warm one (Appendix B, Table 1). The high temperatures (manifested in a decreased food availability) may have caused

both wild and local birds to be dispersed over wide areas making trapping difficult and, in some instances, nearly impossible. At Mason the weather played no known role since the birds maintained there were all flightless and in a single large field making it easy to walk them into the trap regardless of the weather.

Capture by the drop-trap probably had little or no effect on the blood samples taken if the sampling was done relatively soon (not more than an hour) after the trap was set off. Table 1, samples G-3, 5, and 11 as examples, demonstrated typical preseason values as compared to values established by Johnson (1967): Calcium values around 11 and 14 mg%, total protein about 5.0 g%, and A/G ratios slightly above 1. When the birds remained in the trap for longer periods of time, two hours or more, analysis of their serum blood samples showed very high gamma globulin fractions, which suggests some type of "stress" response (Rickless, 1967, and Johnson, 1967). This high gamma fraction is shown in Table 1 by samples G-7, 8, 12 and 13.

The second method used at Kellogg was capture by hand with the aid of nets. This method was only used once and then only to capture known breeders from their territories. The method worked well but in many instances required a minor chase (not more than five minutes). Samples G-22 through G-28 (Table 1) showed very high beta and gamma globulin fractions, possibly denoting an impending

Table 1. Kellogg local flock blood serum analysis values for calcium (mg%), total protein (g%), albumin (g%), gamma, beta, and alpha globulins (g%), and the A/G ratio. February 29, 1968, to April 4, 1968.

Bird No.	Date	Age	T.P.	Calcium	Gamma Glb.	Beta Glb.	Alpha Glb.	Alb.	A/G
G-1	2-29-68	ATY	5.0	9.2	1.288	.337	.890	2.485	1.125
G-2	"	8	4.8	11.0	.439	.912	.912	2.535	1.119
G-3	"	5	4.6	14.3	.133	.668	1.043	2.755	1.493
G-4	"	6+	4.4	8.0	.600	.900	.966	2.366	.959
G-5	"	ATY	5.0	14.2	.596	.950	.992	2.562	1.051
G-7	3- 4-68	10	4.5	8.0	1.014	.838	.573	2.073	.855
G-8	"	2	6.0	15.0	2.797	.743	.743	2.133	.500
G-10	3-14-68	6	6.9	34.4	.528	3.376	.616	2.202	.620
G-11	3-14-68	6+	5.5	12.0	.530	1.236	1.259	1.877	.620
G-12	"	3	6.2	15.6	1.913	1.482	.531	2.183	.620
G-13	3-16-68	12+	6.8	8.0	4.302	.688	.258	2.150	.410
G-14	"	3	6.7	32.0	.673	2.753	.917	2.355	.542
G-15#	3-20-68	4+	6.7	21.0	.212	3.580	.531	2.304	.533
G-16	"	11	7.5	39.6	1.184	3.445	.610	2.261	.431
G-18	3-21-68	ASY	3.9	8.0	.516	.773	.870	1.740	.806
G-19	3-23-68	ASY	4.6	8.0	.357	1.277	.489	2.556	1.250
G-15#	"	4+	5.5	21.0	.282	.987	1.410	2.491	1.040
G-21	"	2	5.8	15.0	1.588	.759	.414	3.090	1.100
G-22	3-28-68	4+	8.5	21.0	2.304	2.780	.079	3.336	.646
G-23	"	3	12.5*	37.2	.857	2.400	1.887	7.155	1.433
G-24	"	4+	13.0	32.0	11.365*	.388	.233	1.011	.084
G-25	"	6	7.0	37.2	.543	2.242	.068	4.145	1.452
G-26	"	7	9.3	30.2	5.483	1.754	.044	2.017	.277
G-27	"	6	14.0	34.0	10.706*	.696	.063	2.543	.221
G-28	"	3	12.5	34.0	10.204*	.319	.446	1.530	.140
G-29	4- 4-68	4	7.4	28.8	.596	1.850	1.432	3.401	.877
G-30	"	2	7.4	30.8	.489	2.874	.122	3.914	1.123

Seney Bird

* Possibly due to extreme hemolysis

ATY = 1965 Hatch or Before

ASY = One or More Years Old

ovulation (Johnson, 1967). Close examination of the high beta globulin fraction coupled with a high total protein, elevated serum calcium, and a reversal of the A/G ratio suggests a reproductively stimulated bird. Johnson (1967) stated that when a female Canada goose is in a reproductive state the serum calcium level rises above 14 mg%, the total protein rises above 5.4 g%, and the A/G ratio drops below 1. On this basis birds G-22 through G-28 (Table 1) captured by the hand nets did show both high beta and gamma globulin values, undoubtedly because of being in a definite reproductive condition (high beta globulin). The applicability of this method of capture is limited. Its success relies on the accessibility of the birds and ideal circumstances in obtaining, handling, and sampling the birds to assure minimum stress.

Also at Kellogg a third method of capture, a drug (alpha-chloralose) was used. Once the drug was consumed, it took five or ten minutes to begin acting, causing the bird to become groggy. Once in this condition the bird was easily captured for sampling. The drugged birds appeared to be hypersensitive and they were hard to handle when an attempt was made to puncture their skin with a hypodermic needle. Therefore, the blood sampling of birds drugged with alpha-chloralose was a more difficult procedure than sampling birds not under its influence.

Timing in the use of alpha-chloralose was difficult.

It was hard to know exactly when the consumption of the drugged feed took place. Once in the bird's system it took only five or ten minutes to act, but for maximum effect one or two hours were usually needed. When the birds were under the drug's influence, water became a real hazard because of the possibility of drowning. Pilot studies showed that mallard mortality occurred at dose levels (per gram/Kg body wt.) of alpha-chloralose well below goose anesthesia. The use of the drug alpha-chloralose had to be carefully planned even though the pilot studies show the probability of goose mortality by over anesthesia to be low.

To determine the effect of the drug on the birds' blood chemistry, two experiments were conducted. The blood samples were taken from two local female Canada geese. Samples were taken prior to ingestion of the drugged feed by the bird and then again after the bird was well under the influence of the drug. Upon analysis of the two sets of samples (Table 2, samples G-45 and G-46) it was found that the serum calcium level was depressed by the drug while total protein showed little or no change. The electrophoretic strip analysis showed almost superimposable integrated graphs between the pre-treatment and post-treatment groups. Therefore, the drug, alpha-chloralose, did not prohibit the use of samples for these analyses taken from Canada geese under its influence.

The flightless condition of the birds at Mason made

Table 2. Blood serum analysis values for calcium (mg%), total protein (g%), albumin (g%), gamma, beta and alpha globulins (g%), and the A/G ratio, for the birds sampled at Kellogg under the influence of alpha-chloralose. April 8, 1968, to April 30, 1968.

Bird No.	Date	Status	Age	T.P.	Calcium	Gamma Glb.	Beta Glb.	Alpha Glb.	Alb.	A/G
G-31	4- 8-68	Wild	1	9.3	38.6	1.221	3.625	1.260	3.192	.523
G-32	"	"	ASY	5.9	18.7	.562	1.123	1.461	2.753	.875
G-33	"	"	ASY	6.0	17.1	.535	1.352	1.774	2.338	.638
G-34	"	"	ASY	6.2	18.4	.594	2.093	1.395	2.118	.519
G-35	"	"	ASY	6.3	10.4	1.141	1.301	1.656	2.218	.543
G-36	"	"	ASY	6.8	21.0	.742	2.266	1.263	2.562	.591
G-37	4- 9-68	Pre-treat	5	7.3	28.4	.392	2.583	.112	4.211	1.364
G-37	"	Post-treat	5	6.0	12.0	.361	1.590	.361	3.686	1.594
G-38	"	Wild	ASY	6.5	20.0	.450	1.277	1.540	3.231	.989
G-39	"	"	ASY	6.3	17.0	.219	.767	1.150	4.108	1.923
G-41	4-10-68	"	ASY	6.1	20.5	.961	1.548	1.712	1.876	.444
G-42	"	"	ASY	9.5	38.0	1.420	1.452	3.724	2.903	.440
G-43	"	"	ASY	6.0	16.1	.275	1.483	1.483	2.620	.775
G-44	"	"	12+	5.8	28.0	.898	2.245	.599	2.058	.550
G-45	4-24-68	Pre-treat	2	5.1	13.0	.248	.497	.373	3.980	3.555
G-46	4-24-68	"	2	4.7	10.4	.798	.748	.956	2.204	.883
G-45	4-29-68	"	2	5.6	12.0	.236	.589	.766	4.008	2.518
G-46	"	"	2	5.1	10.8	.749	1.229	1.139	1.980	.634
G-46	4-30-68	Confined	2	4.5	11.5	.468	1.193	.936	1.742	.632
G-45	"	"	2	5.3	10.0	1.101	1.816	.834	1.548	.413
G-45	"	Post-treat	2	4.9	11.9	.319	.745	.532	3.302	2.066
G-46	"	"	2	4.8	9.8	.508	1.462	.922	1.907	.659

ASY = One or more years old

them readily accessible, therefore contributing to the effectiveness of trapping. Use of the herding technique (described earlier) allowed for sampling the whole female population at one time. Examination of Tables 3 and 5 shows that in 90% or more of the birds sampled the gamma globulin fraction was low, suggesting a minimum "stress" response.

The cannon net used at Seney was subject to the same variables as were discussed for the drop-trap at Kellogg. Use of the cannon net tended to be dependent on the feeding habits of the birds and the weather. To use this type of trap, groups or concentrations of birds were necessary and successful use was very time consuming. The rapid response of the net, within split seconds of detonation, coupled with immediate sampling, probably eliminated stress responses in this group of birds.

Reproductive Trends

Johnson (1967) reported a pre-reproductive season mean of 11.3 mg% for serum calcium in the female Canada goose three years and older. This value is only slightly higher than the serum calcium level of 10.8 mg% for the pre-reproductive season female mallard duck (Wood and Hofman, 1967). The other parameters, total protein and the A/G ratio, showed mean values for the three-year-old and older geese as follows: 4.6 g% total protein, composed of 2.9 g% albumin, 1.6 g% globulin and an A/G ratio of 1.9 (Johnson, 1967). These again are very close to the figures established

by Wood and Hofman (1967) for the non-laying female mallard: 4.8 g% total protein, consisting of 3.2 g% albumin, 1.6 g% globulin and an A/G ratio of 2.0.

Upon reproductive stimulation, female Canada geese undergo a shift in their peripheral blood constituents. Johnson (1967) reported that the reproductive state can be identified when the total protein rises above 5.4 g%, the serum calcium level rises above 14 mg%, and the A/G ratio drops below 1, due to a drop in albumin and a rise in globulin.

The geese three years old and older sampled at Kellogg first showed signs of reproductive stimulation on March 4, 1968. Sample G-8, Table 1, showed a total protein of 6.0 g%, a serum calcium level of 15 mg%, and an A/G ratio of 0.5. By March 14, 15 and 16, 1968, the reproductive stimulation of the Kellogg birds was enhanced. G-10, sampled on March 14, 1968, demonstrated a total protein of 6.9 g%, a serum calcium level of 34.4 mg%, and an A/G ratio of 0.48 (Table 1).

At Mason the birds showed signs of reproductive stimulation on March 7, 1968. An example from Table 3 shows this initiation of stimulation: G-14-379 sampled on March 7, 1968, showed a total protein of 5.8 g%, a serum calcium level of 15.2 mg%, and an A/G ratio of 1.5. At the time of the next sampling (March 21, 1968) the Mason birds were well-stimulated reproductively. Table 3 shows, for example,

Table 3. Mason local flock blood serum analysis values for calcium (mg%), total protein (g%), albumin (g%), gamma, beta, and alpha globulins (g%), and the A/G ratio. March 7, 1968, to March 21, 1968.

Bird No.	Date	Age	T.P.	Calcium	Gamma Glb.	Beta Glb.	Alpha Glb.	Alb.	A/G
G-4-90	3-7-68	4	6.4	23.0	.559	1.366	.559	3.914	1.550
G-2	"	2	6.4	13.0	1.295	1.183	.887	3.033	.901
G-14-379	"	14	6.0	15.2	.483	1.189	1.153	2.974	1.053
G-2-1	"	2	5.2	13.2	.578	.794	1.047	2.780	1.149
G-14-71	"	14	6.5	14.5	.910	.943	1.593	3.055	.887
G-2-2	"	2	6.3	13.5	1.089	.848	.788	3.574	1.311
G-13-57	"	13	5.6	12.5	.055	.388	1.331	3.825	2.156
G-2-3	"	2	5.9	12.6	.778	.648	1.167	3.307	1.275
G-3-1	"	3	5.2	14.0	.783	.965	.819	2.635	1.028
G-5	"	5	5.1	10.2	1.020	1.581	.510	1.989	.639
G-2-8	"	2	4.9	10.0	.428	.367	.490	3.614	2.809
G-3-2	"	3	6.8	18.8	.829	.580	.414	4.976	2.727
G-18-35	"	18	6.2	14.0	.663	1.794	.389	3.353	1.178
G-16-32	"	16	4.2	9.8	.309	1.339	.825	1.726	.698
G-3-4	"	3	4.4	10.0	.823	1.199	.823	1.553	.545
G-2-7	"	2	4.5	10.4	.225	.450	.450	3.375	3.000
G-5-93	"	5	5.6	13.0	.795	1.452	.968	2.385	.742
G-4-74	"	4	6.7	18.6	2.802	.904	.729	2.364	.533
G-2-4	"	2	6.2	16.0	1.703	.340	.477	3.679	1.459
G-3-5	"	3	6.0	15.4	1.492	1.370	.974	2.162	.563
G-18-271	"	18	5.0	11.0	.730	.730	.620	2.920	1.404
G-2-5	"	2	5.8	15.6	.986	.767	.713	3.234	1.311
G-3-3	"	3	5.6	15.2	.545	.842	.743	3.469	1.628
G-2-6	"	2	6.8	17.4	1.511	1.113	.795	3.374	.989
G-3	"	3	5.8	12.6	1.914	.522	.232	3.132	1.174
G-2-9	"	2	5.6	8.0	.377	.692	.629	3.901	2.297
G-5-1	"	5	5.6	8.9	1.304	.652	.681	2.963	1.124

Table 3. Continued

Bird No.	Date	Age	T.P.	Calcium	Gamma Glb.	Beta Glb.	Alpha Glb.	Alb.	A/G
G-16-69	3-7-68	16	4.9	8.9	1.033	1.165	.847	1.854	.609
G-15-275	"	15	5.5	12.1	.563	.909	.996	3.031	1.228
G-15-1	3-21-68	15	6.0	37.4	.849	2.199	.450	2.499	.714
G-16-2	"	16	5.5	18.5	.520	1.367	1.399	2.213	.673
G-2-4	"	2	5.6	20.0	1.112	1.112	1.075	2.298	.697
G-3-4	"	3	4.4	12.3	.341	.726	1.132	2.200	1.000
G-2-10	"	2	4.5	9.4	.317	.662	.926	2.594	1.361
G-4-1	"	4	5.8	11.0	.366	1.233	1.599	2.599	.813
G-15-2	"	15	5.4	23.0	.457	2.057	.371	2.514	.871
G-3-8	"	3	3.8	10.9	.259	1.198	.617	1.624	.746
G-14-2	"	14	6.7	25.0	1.380	2.491	.303	2.356	.168
G-3-5	"	3	4.4	8.0	.554	1.247	.866	1.732	.649
G-3-3	"	3	5.5	17.2	.688	1.194	1.266	2.352	.747
G-2-7	"	2	5.5	19.2	.661	1.269	1.454	2.115	.625
G-3-1	"	3	5.6	9.4	.535	.823	.988	3.252	1.386
G-5-2	"	5	6.3	28.0	.349	2.275	.350	3.908	1.634
G-2-3	"	2	5.6	11.3	.414	.622	.207	4.355	3.500
G-14-1	"	14	5.5	11.3	.312	1.437	.250	3.450	1.750
G-16-1	"	16	4.4	9.4	.330	.275	.660	3.135	2.478
G-3-7	"	3	5.7	19.0	.154	.808	1.271	3.461	1.552
G-2-2	"	2	5.4	12.3	.265	.929	.752	3.452	1.773
G-3-2	"	3	7.8	12.1	.803	1..848	.322	5.225	1.157
G-2-9	"	2	4.5	8.4	.338	.338	.532	3.290	2.720
G-2-6	"	2	6.2	20.6	.463	1.912	.289	3.534	1.326
G-2-5	"	2	4.5	8.0	.365	.608	.304	3.223	2.523

Table 3. Continued

Bird No.	Date	Age	T.P.	Calcium	Gamma Glb.	Beta Glb.	Alpha Glb.	Alb.	A/G
G-2-6	3-21-68	3	4.3	9.2	.502	.614	.167	3.015	2.348
G-2-1	"	2	5.7	10.6	.403	.748	.461	4.088	2.536
G-4-2	"	4	8.0	33.4	.408	2.694	.916	4.082	1.042
G-5-2	"	5	5.5	21.0	.567	1.397	.305	3.231	1.423
G-4-3	"	4	4.9	8.6	.374	1.122	.972	2.431	1.161

that G-15-1 had a total protein of 6.0 g%, a serum calcium level of 37.4 mg%, and an A/G ratio of 0.71.

When comparing the two flocks, Kellogg and Mason, it can be seen that the reproductive patterns and values were very similar to those described by Johnson (1967). The timing appears similar; the degree of stimulation was markedly increased within a week's time and within two to three weeks the birds appeared ready to lay.

Johnson (1967) stated that the start of the egg-laying period for the female Canada goose at Kellogg was from March 24 to April 7 in any given year. This period of time coincided with the first appearance of eggs in all of the flocks that were studied: Kellogg had its first egg on March 27, 1968, Mason had its on March 31, 1968, and Seney had its first egg on April 1, 1968. Therefore, the laying sequences that occurred in these localities were similar to Johnson's findings. This has significance in that it shows that the free-flying and non-flying Canada geese that were sampled were all similar in the timing of the appearance of their first eggs.

At Seney, only one-year-old and two-year-old Canada geese were sampled, part of a loafing flock in that area of the refuge that is characteristically used by the non-reproductive portion of the population; at Mason two-year-old females were sampled along with the adults. Sampling took place throughout the egg-laying period of the adults.

Johnson (1967) in his study utilized only two two-year-olds he reported no marked changes from preseason blood parameter levels. However, a number of investigators have reported that in the populations they studied a percentage of the two-year-old female geese are mature and successfully nest (Wood, 1964 - less than 5%; Balham, 1950 - less than 7%; and Sherwood, 1965 - more than 70%). Most of the two-year-olds sampled at Seney showed no reproductive stimulation. Table 4 shows that most of the birds demonstrated "preseason" values during the breeding season. This was expected because the samples from Seney were taken from a non-breeding group of birds. However, a few samples (525, 172 and 683, Table 4) showed some blood parameter levels similar to reproductively stimulated birds: their total protein levels were 7.1, 6.2, and 5.6 g%, their serum calcium levels were 9.0, 14.6, and 9.7 mg%, and their A/G ratios were 0.33, 0.48, and 0.18, respectively. The lack of reproductive stimulation demonstrated in most of the one-year-olds (Table 4) was expected, for one-year-old female Canada geese are considered immature (Wood, 1964). Even though this may be the case, Table 4 demonstrates that two of the one-year-old birds, numbers 172 and 560, did show signs of being reproductively stimulated birds. Their total protein levels were 6.2 g% and 7.1 g%, their calcium levels were 14.6 mg% and 12.9 mg% and their A/G ratios were 0.48 and 0.40 respectively. At Mason (where eight two-year-olds were sampled) two of the two-year-olds sampled showed signs of reproductive stimulation. In

Table 4. Seney local flock blood serum analysis values for calcium (mg%), total protein (g%), albumin (g%), gamma, beta, and alpha globulins (g%), and the A/G ratio. April 23, 1968, to May 6, 1968.

Bird No.	Date	Age	T.P.	Calcium	Gamma Glb.	Beta Glb.	Alpha Glb.	Alb.	A/G
322	4-23-68	1	5.5	10.0	.980	1.497	1.170	1.851	.507
028	"	2	4.8	8.0	1.635	1.258	.566	1.341	.388
090	"	1	5.5	8.0	.595	1.140	.842	2.923	1.135
480	"	2	5.8	8.0	.999	1.880	.640	2.280	.645
M-1*	"	2	6.8	10.0	1.507	2.813	.703	1.775	.353
F-1	"	2	7.0	11.2	1.211	2.019	1.413	2.355	.507
5.9	5- 6-68	1	4.5	-	.673	.986	.449	2.288	1.085
564	"	1	7.0	8.2	1.347	2.144	1.320	1.876	.390
683	"	1	5.6	9.7	1.015	2.306	1.248	.821	.180
468	"	1	4.9	8.0	1.196	1.161	1.054	1.480	.434
493	"	1	5.0	9.0	.734	1.306	.994	1.757	.570
572	"	1	5.5	9.4	1.201	1.472	.853	1.664	.472
322	"	1	4.9	9.1	1.015	1.410	.588	1.683	.558
564	"	1	5.2	8.3	.585	1.755	.925	1.725	.528
525	"	1	7.1	9.0	.994	3.493	.795	.796	.339
172	"	1	6.2	14.6	1.153	1.632	1.445	2.066	.484
566	"	1	5.0	11.4	.825	1.420	1.158	1.585	.466
573	"	1	5.3	10.9	1.129	1.611	.869	1.680	.464
565	"	1	5.1	10.7	1.209	1.505	.541	1.836	.564
562*	"	2	5.0	10.0	.865	1.365	.900	1.865	.595
560	"	1	7.1	12.9	.931	3.213	.812	2.030	.409

*Male Geese

Table 5. Mason two-year-old flock blood serum analysis values for calcium (mg%), total protein (g%), albumin (g%), gamma, beta, and alpha globulins (g%), and the A/G ratio. April 4, 1968 to April 18, 1968.

Bird No.	Date	T.P.	Calcium	Gamma Glb.	Beta Glb.	Alpha Glb.	Alb.	A/G
G-2-4	4- 4-68	4.8	10.8	.178	.712	.652	3.259	2.115
G-2-2	"	5.3	9.2	.568	1.325	1.041	2.366	.806
G-2-5	"	5.1	10.8	.578	1.156	1.224	2.041	.690
G-2-1	"	4.7	8.0	.476	1.398	.981	1.844	.664
G-2-7	"	4.3	8.0	.209	.626	.543	2.922	2.122
G-2-6	"	6.9	15.5	.555	2.359	.347	3.539	1.085
G-2-3	"	5.6	8.0	.783	1.958	.783	2.075	.588
G-2-8	"	6.5	18.9	.505	1.444	.433	4.117	1.727
G-2-1	4-18-68	5.0	11.8	.317	.714	.555	3.413	2.150
G-2-2	"	3.9	12.1	.213	1.064	.709	1.915	.964
G-2-3	"	6.3	11.8	.567	1.021	1.305	3.405	1.176
G-2-4	"	6.2	11.6	.391	1.098	.863	3.845	1.633
G-2-5	"	6.5	11.6	.229	.919	1.207	4.141	1.756
G-2-6	"	5.2	13.9	.121	.967	.725	3.386	1.866
G-2-7	"	4.7	12.1	.810	.648	.567	2.431	1.200

Table 5 this stimulation can be seen. Samples G-2-6 and G-2-8 demonstrated high total protein levels (6.9 g% and 6.5 g%), rising serum calcium levels (15.5 mg% and 18.9 mg%), and marginal A/G ratios (1.08 and 1.72). According to Johnson's (1967) values these birds would be stimulated reproductively. At the time of the next sample (April 18, 1968) the two birds had been removed from the rest of the confined two-year-old birds in order to let them nest in the breeding pond.

Some migrants normally delay their migratory flight and stop at Kellogg between the last two weeks in March and the first two weeks in April. During this time limited samples were taken to determine their reproductive condition as compared to the local birds (local birds had a Kellogg Bird Sanctuary band and the wild birds had a federal band). All of the wild migrants sampled showed definite signs of reproductive stimulation (Table 6). Upon comparison with the local birds, the two show remarkable similarity; both appeared to be well-stimulated reproductively. To demonstrate this, an arbitrary selection showed that from Table 1, birds numbered G-29 and G-30 showed signs of being in a definite reproductive condition. Their values were: total protein - 7.4 g% and 7.4 g%, serum calcium - 28.8 mg% and 30.8 mg%, and the A/G ratio - 0.87 and 1.12. In comparison, Table 6 showed that the wild birds at Kellogg were in approximately the same reproductive condition as the local birds. Again,

Table 6. Kellogg wild birds blood serum analysis values for calcium (mg%), total protein (g%), albumin (g%), gamma, beta, and alpha globulins (g%), and the A/G ratio. March 20, 1968, to April 10, 1968.

Bird No.	Date	Age	T.P.	Calcium	Gamma Glb.	Beta Glb.	Alpha Glb.	Alb.	A/G
G-17	3-20-68	1	5.4	18.2	.974	1.642	.779	2.004	.590
G-31	4- 8-68	1	9.3	38.6	1.221	3.625	1.260	3.192	.523
G-32	"	ASY	5.9	18.7	.562	1.124	1.461	2.753	.875
G-33	"	ASY	6.0	17.1	.535	1.352	1.774	2.338	.638
G-34	"	ASY	6.2	18.4	.594	2.093	1.305	2.118	.519
G-35	"	ASY	6.3	10.4	1.130	1.301	1.656	2.218	.543
G-36	"	ASY	6.8	21.0	.743	2.266	1.263	2.526	.591
G-38	4- 9-68	ASY	6.5	20.0	.451	1.277	1.540	3.231	.989
G-39	"	ASY	6.3	17.0	.219	.767	1.150	4.108	1.923
G-41	4-10-68	ASY	6.1	20.5	.961	1.548	1.712	1.876	.444
G-42	"	ASY	9.5	38.0	1.420	1.452	3.724	2.903	.440
G-43	"	ASY	6.0	16.1	.275	1.621	1.483	2.620	.776
G-44	"	12+	5.8	28.0	.898	2.245	.599	2.058	.550

ASY = One or more years old

to demonstrate this similarity, birds numbered G-31 and G-36 (Table 6) were arbitrarily selected and had the following values: total protein - 9.3 g% and 6.8 g%, serum calcium - 38.6 mg% and 21.0 mg% and the A/G ratio - 0.52 and 0.59. From these data it can be seen that this set of local and wild birds did show similar reproductive conditions, but it must be taken into consideration that the wild birds were still hundreds of miles from their nesting sites. The period of time to the onset of ovulation when comparing the local and wild birds can be referred to as a lag. To demonstrate this lag, Table 6, birds numbered G-42 and G-44 showed total protein values (9.5 g% and 5.8 g%), serum calcium values (38.0 mg% and 28.0 mg%), and A/G ratios (0.44 and 0.55) of reproductively stimulated birds. Even though these birds showed strong reproductive stimulation, the sampling data of April 10, 1968, suggests that the birds (known migrants from the bands they sported) were already two weeks behind the Kellogg local birds (Kellogg local birds laid their first eggs March 27, 1968). To further demonstrate this lag, MacInnes (1968) stated that wild birds of the Upper Hudson Bay arrived in that area to nest approximately May 20. Several factors may play a role in this lag: Food availability, sensitivity to photoperiods, and temperature as well as a possible sensory perception of their breeding grounds (Marshall, 1951; Farner, 1964; and Wolfson, 1959). Unfortunately, only a

few samples were obtained from the wild populations at Kellogg, primarily because of the warm temperatures and lack of experience and knowledge in trapping techniques.

Reproductive Condition of Populations

The populations studied in Michigan had accessible records of their breeding and non-breeding flocks. It was the intent of this study to make use of this data by comparing the records of each flock with each other, in order to obtain information relating to the static, growing, and/or declining nature of the flocks. Also, comparisons were made to examine the compositions of the flocks in relationship to the breeders and non-breeders.

The Kellogg Bird Sanctuary has limited acreage and a large variety of birds using it. In spite of this, it maintains a small but productive breeding flock of Canada geese. Figures 1 and 2 illustrate that the age of the breeders at Kellogg from 1965 through 1968 tends to be from three to seven years old. Craighead and Stockstad (1964) in their work with the Canada goose, stated that the most productive ages of the birds are between the ages of three and ten years, although older birds in captivity have been known to maintain the ability to reproduce. This was demonstrated in the Mason breeding records (Figure 6) where the majority of breeders are over ten years of age.

Analysis of the non-breeding records (Figures 3, 4, and 5) demonstrated that the majority of birds that failed

Figure 1. 1965 and 1966 Age Distribution of the Kellogg Breeding Flock.

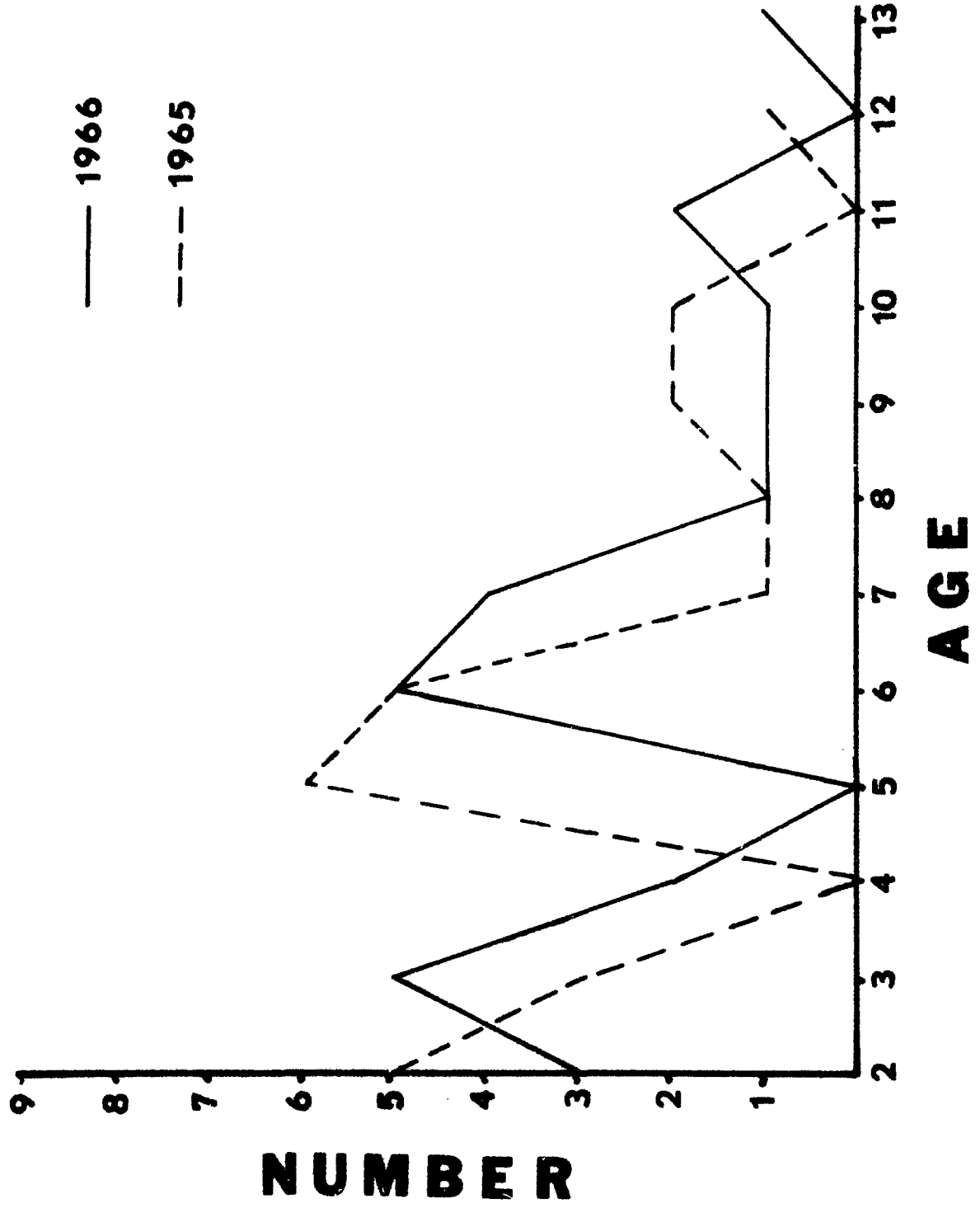


Figure 2. 1967 and 1968 Age Distribution of the Kellogg Breeding Flock.

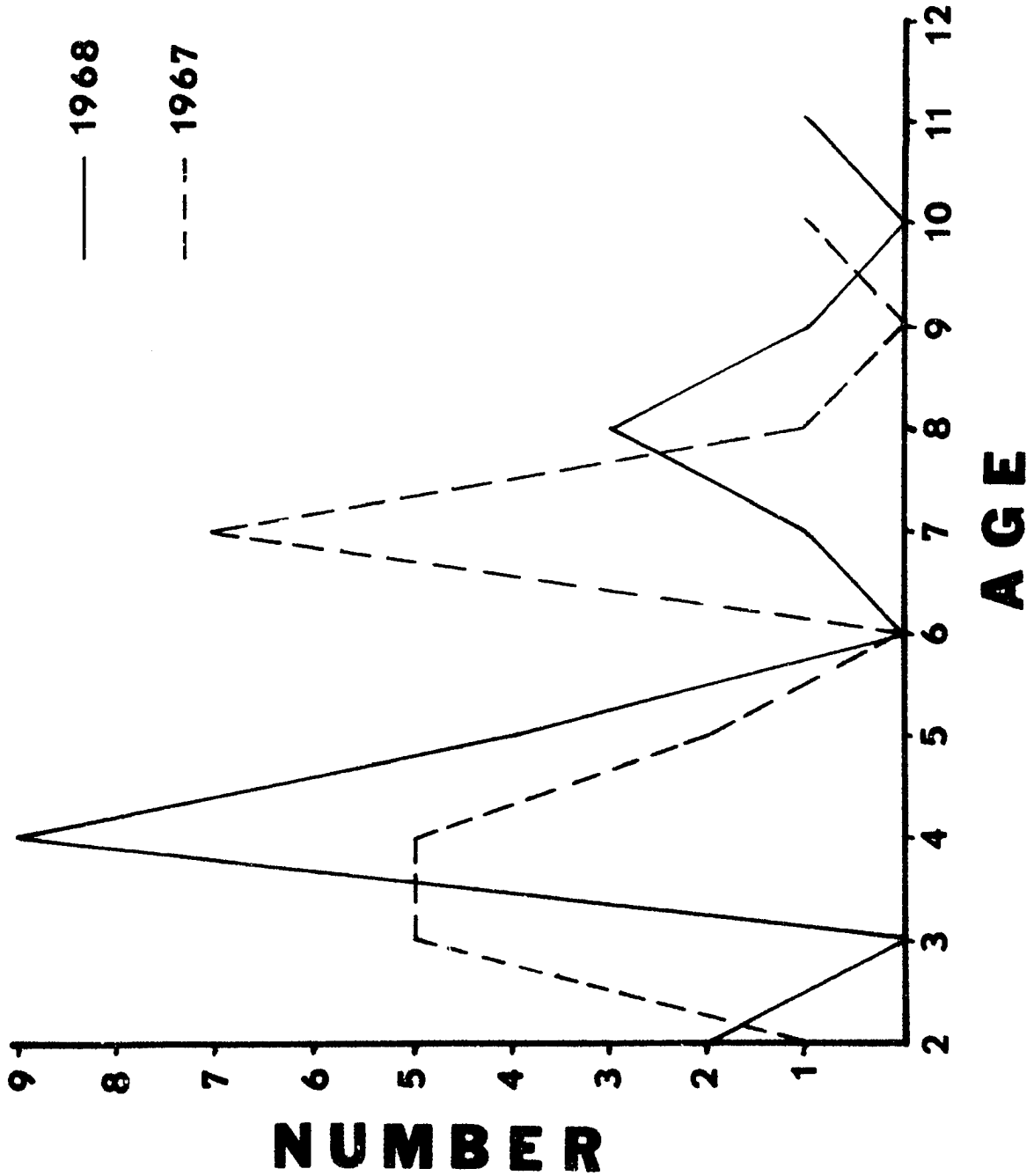


Figure 3. 1965 Age and Sex Distribution from the Records of the Kellogg Non-Breeding Flock.

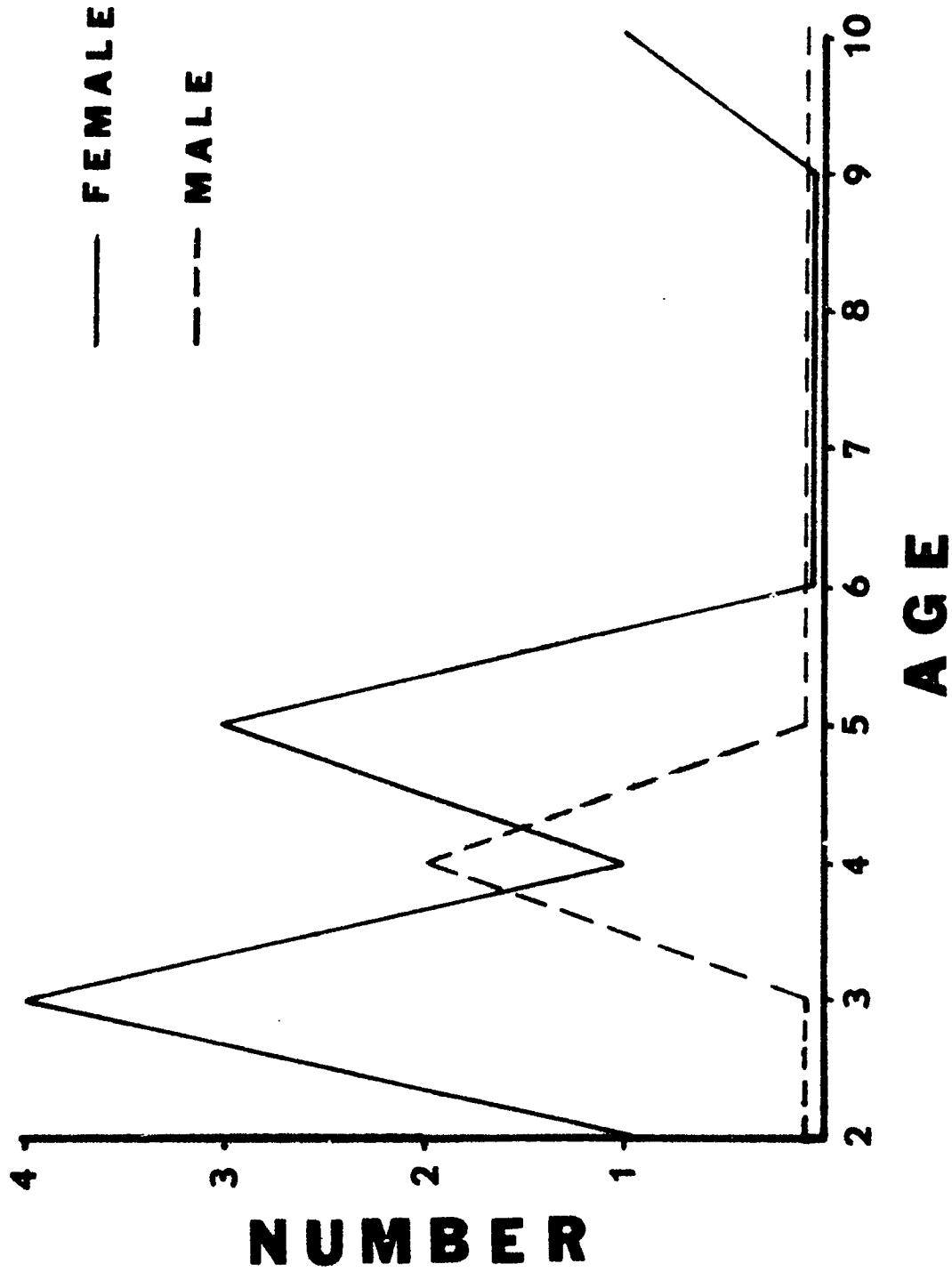


Figure 4. 1966 Age and Sex Distribution from the Records of the Kellogg Non-Breeding Flock.

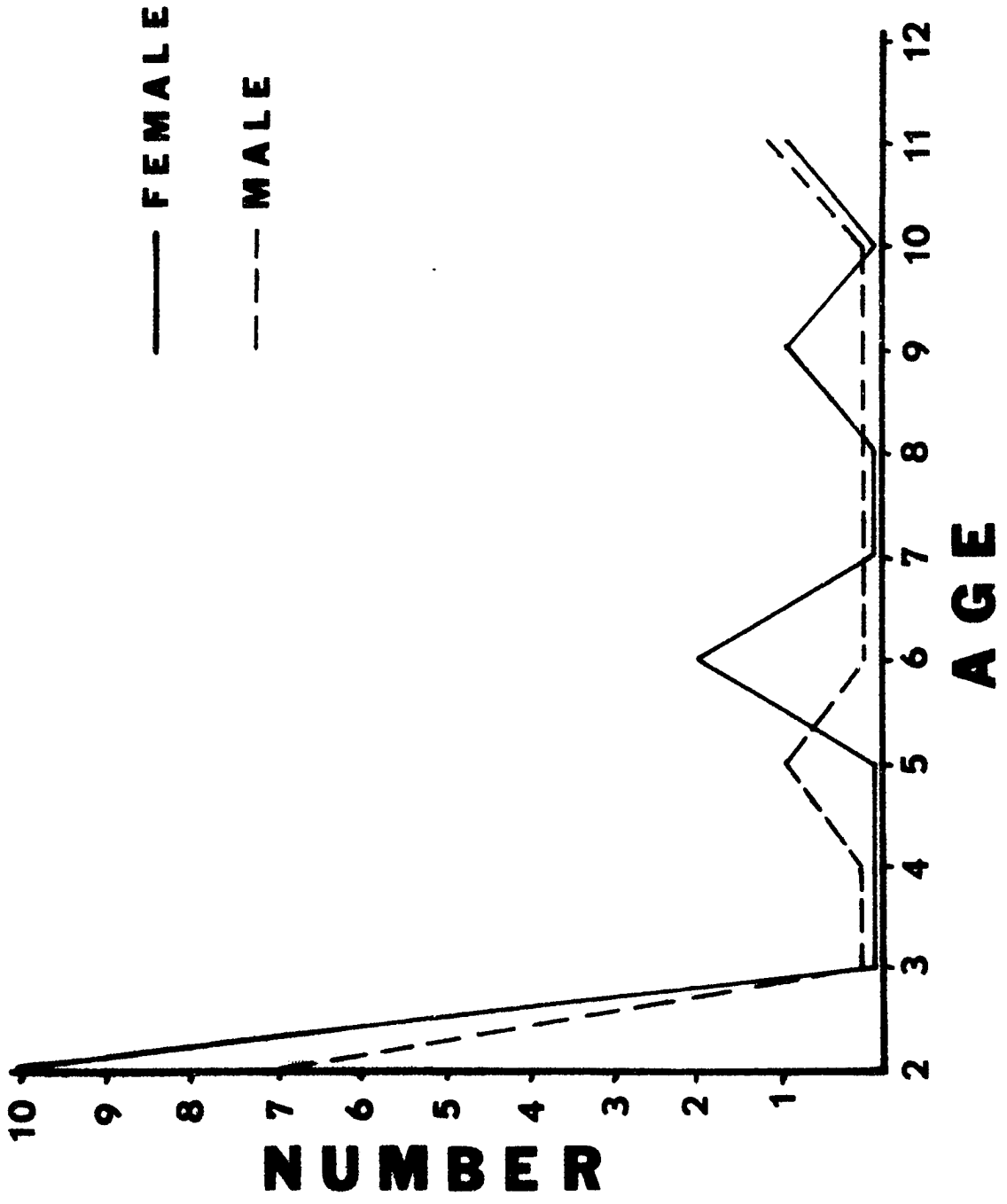
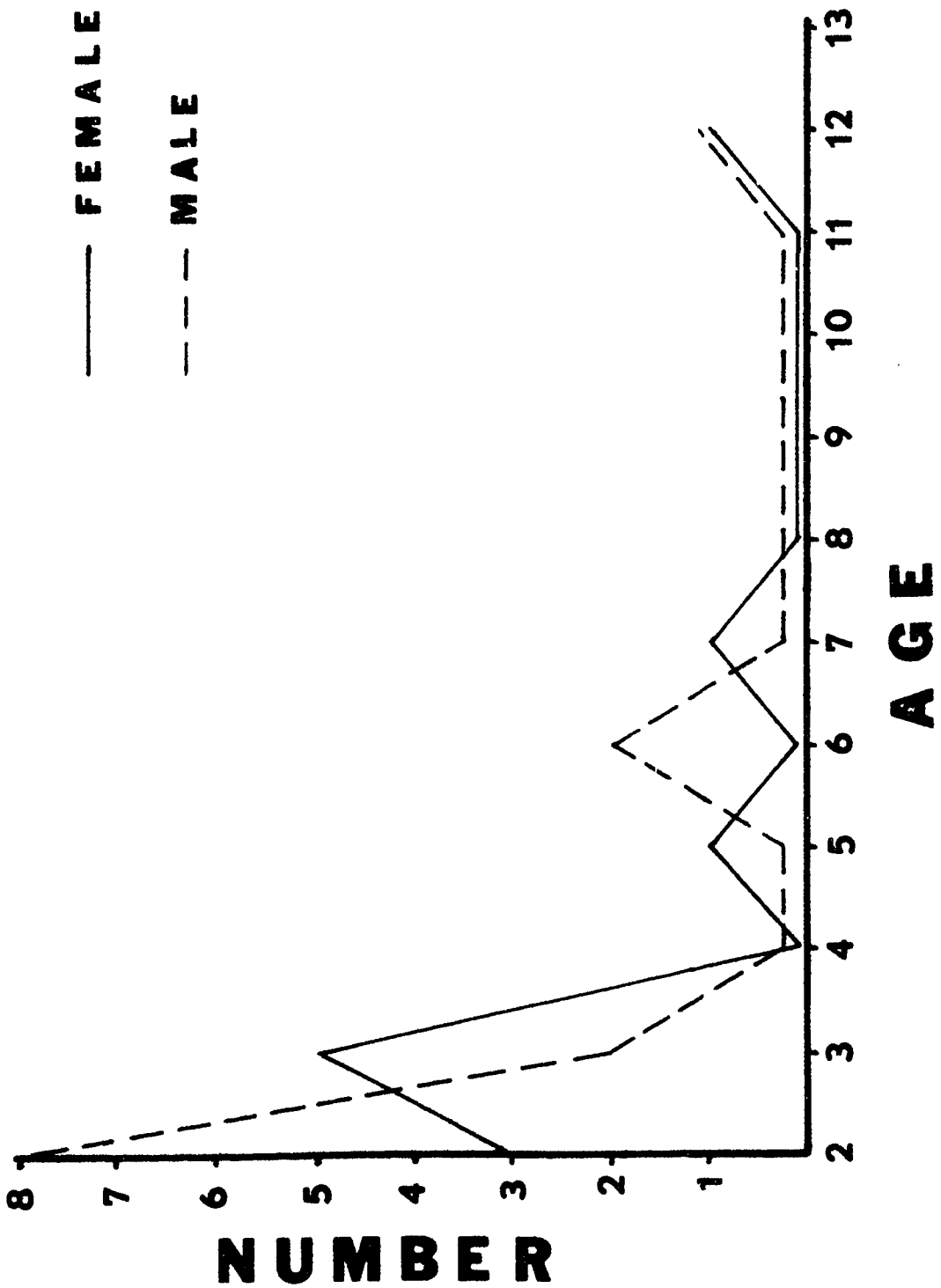


Figure 5. 1967 Age and Sex Distribution from the Records of the Kellogg Non-Breeding Flock.



to breed at Kellogg were two-year-olds, which was in agreement with other investigators studying other populations (Merritt, 1960; Craighead and Stockstad, 1964; Wood, 1964; and Balham, 1950). Older birds that showed reproductive potential but failed to nest, may be subordinate and less aggressive (Johnson, 1967), therefore not being afforded the opportunity to pair and breed. This also showed that there may have been a large turnover in the non-reproductive flock from the year before. The nesting summary (Table 7) shows that nesting pairs at Kellogg since 1965 have maintained constancy at about 30 pairs per year. Those birds who successfully nested were usually about 70%, and hatching success of the birds was normally above 60%. This suggested a high degree of success for breeding Canada geese at Kellogg. The maintenance of these figures was believed to be due to the protection the sanctuary provides. Reproductive potential of the flock was believed to be at saturation due to occupancy of nest sites in all suitable locations on the sanctuary.

The State Conservation Game Farm at Mason, Michigan, maintains a small local flock of Canada geese which breed and raise young. A few years prior to this year, the geese were used to produce more than one clutch of eggs per pair. The eggs were collected after oviposition allowing the female bird to lay another clutch. They were incubated artificially using the goslings for stocking purposes. This policy has now been abandoned and the female geese are allowed to incubate

Table 7. Kellogg Nesting Summary. 1965 through 1968.

Year	Total Eggs	Nesting Pairs	Nest Success	Average Clutch	Gosling Survival	Hatching Success
1965	166	30	93%	5.53	73 %	78.43%
1966	185	33	72%	5.61	57.5%	64.86%
1967	167	30	70%	5.56	81.6%	64.7 %
1968	175	30	70%	6.03	--	71.42%

Figure 6. 1966 through 1968 Age Distribution of the Mason Breeding Flock.

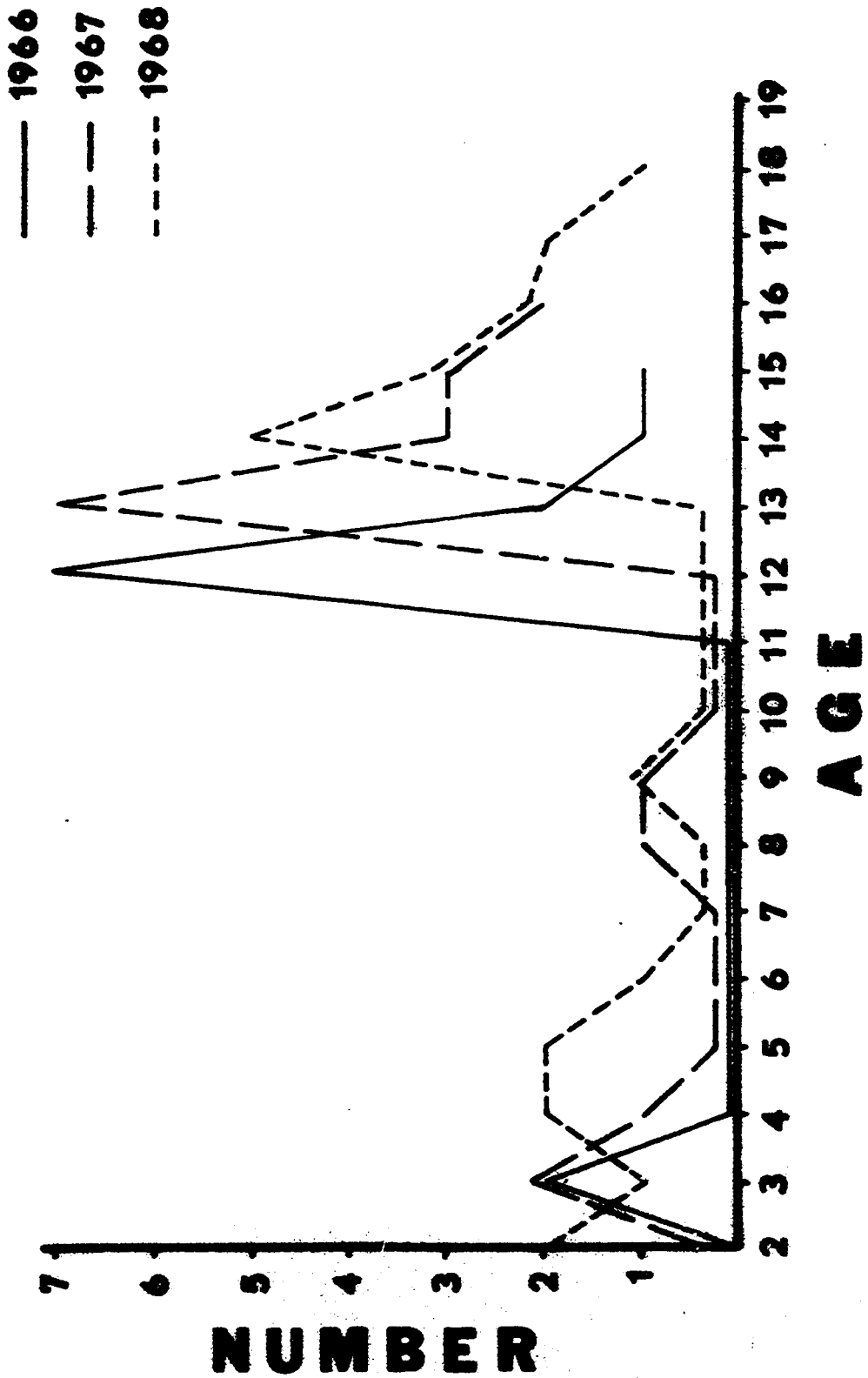
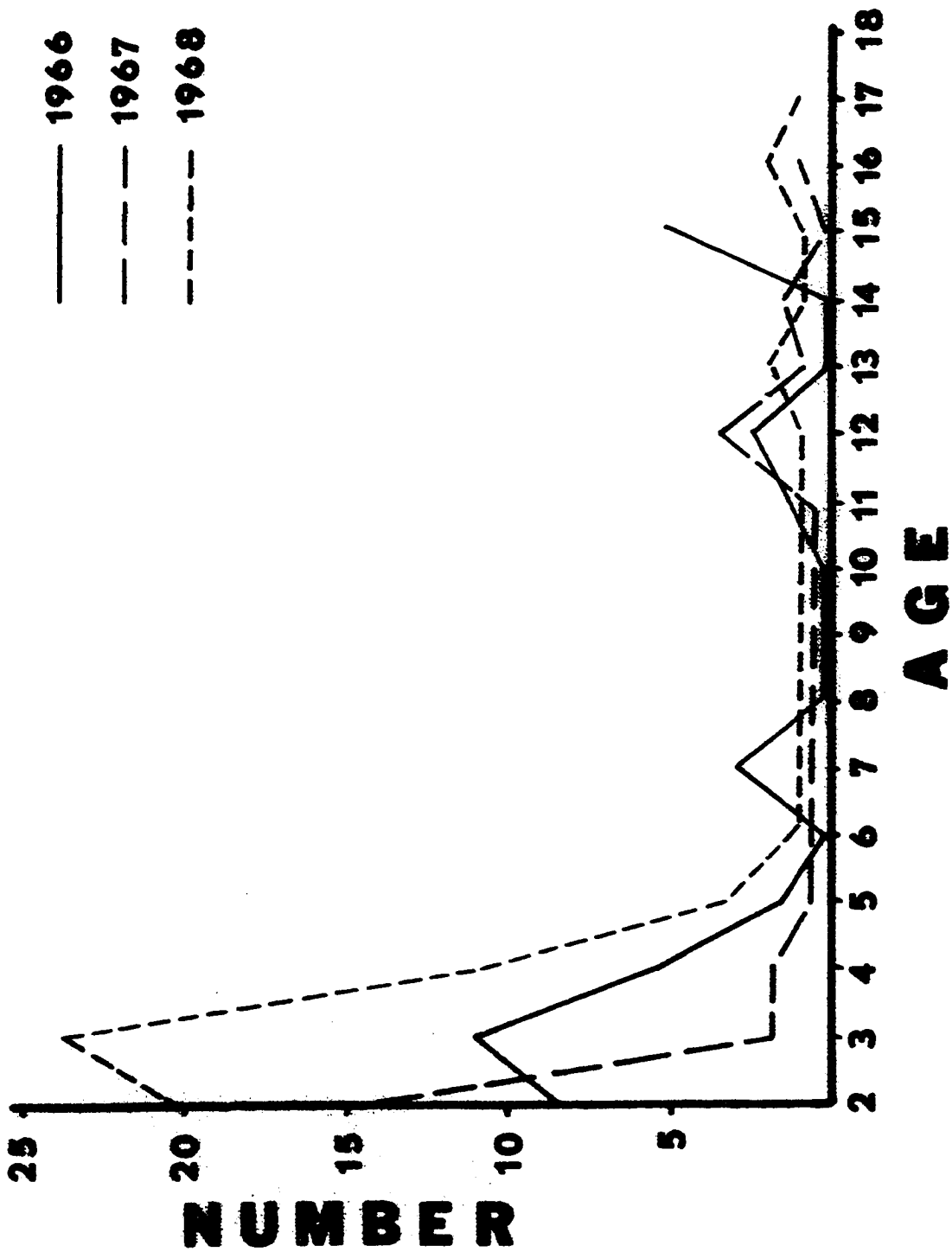


Figure 7. 1966 through 1968 Age Distribution of the Mason Non-Breeding Flock.



their eggs.

Figure 6 illustrates graphically that the majority of the breeders at Mason from 1966 through 1968 were over ten years of age. Again the two-year-olds (Figure 7) were the majority of the non-breeders.

Numbers of nesting pairs at Mason have varied slightly in the past three years. In 1966 there were 13 pairs nesting, while 1967 and 1968, 19 pairs nested successfully.

Seney National Wildlife Refuge is a 95,535 acre refuge composed of four broad habitat types of which 416 acres are cropland, 26,911 acres upland (brush and timber), 60,965 acres marshland, and 7,243 acres open water. Twenty-one pools, in which water levels can be controlled, contain most of the open water acreage. The pools range in size from 27 to over 1,000 acres. They contain numerous islands which are used by the Canada geese for nesting (Sherwood, 1965b).

Due to the vast size of the refuge it was virtually impossible to obtain very much information on the numbers of breeders and non-breeders. Table 8 gives the available information on the Seney flock since 1964. It can be noted in Table 8 that there was a noticeable increase in local birds (those banded in a flightless stage), even though the number of adults and immature birds has seemingly decreased. A major explanation for this apparent decrease was incompleteness of the July trap efforts.

Table 8. Seney National Wildlife Refuge Canada goose age class and sex distribution. 1964 through 1967

Year	Adult		Immature		Sub - Adult		Local	
	Female	Male	Female	Male	Female	Male	Female	Male
1964	141	149	96	36	12	7	14	9
1965	69	63	14	17	-	-	47	45
1966	153	171	55	20	-	-	94	73
1967	68	80	33	35	21	60	149	115

Adult : A bird three years old or older

Immature : A bird banded as the young of the year, but capable of flight

Sub-Adult: A bird between the ages of one and three

Local : A bird banded as a flightless young of the year

Early in the study while trapping at Kellogg with the beach drop-trap a Seney bird (banded at Seney) was captured on two different dates. Table 1, sample G-15 (March 20, 1968) showed a total protein level (6.7 g%), a serum calcium level (21.0 mg%), and an A/G ratio (.53) of a reproductively stimulated bird. Analysis of the second serum sample from the same bird (G-15, Table 1) sampled on March 23, 1968, showed somewhat lower blood parameter levels: total protein was 5.5 g%, the serum calcium level was 21.0 mg%, and the A/G ratio was 1.04. Even though the bird's blood parameter levels were lower at the time of the second sampling the bird remained in a reproductive condition. This slight regression in the blood values does not command much significance, for these values are not static values - they do not reach a point and stop. Instead the values are continuously changing, but remaining in the range of a reproductively stimulated bird. Within a few days after the last sampling, the bird resumed its flight to Seney, where it was known to have nested in the first week of April.

Nesting records at Seney (Tables 9, 10 and 11) were subdivided into various categories, the totals of which were of greatest interest to us. For example, in 1966 (Table 9) total nests found were 239, but only 174 hatched any eggs; the rest were either destroyed or deserted. Total eggs found were 1,115 of which 818 hatched

Table 9. 1966 Canada goose nesting survey on Seney Refuge. April 25, 1966, to June 9, 1966

Pools	Nests Found	Nests Dest.	Nests Desert.	Nests Hatched	Nests Un-Hatched	Eggs Found	Eggs Dest. No.	Eggs Dest. %	Eggs Desert. No.	Eggs Desert. %	Eggs Not Hatched* No.	Eggs Not Hatched* %	Eggs Hatched No.	Eggs Hatched %
A-1	4	2	0	2	0	17	4	23	0	0	5	30	8	47
B-1	6	2	0	4	0	32	10	32	0	0	3	9	19	59
C-1	9	5	0	4	0	38	20	53	0	0	3	8	15	39
D-1	17	4	0	12	1	86	13	15	3	3	5	6	65	76
E-1	24	6	0	18	0	116	23	20	5	4	7	6	81	70
F-1	13	0	0	13	0	66	11	16	0	0	3	5	52	79
Up.F	3	1	0	2	0	15	5	33	0	0	4	27	6	40
G-1	7	3	0	4	0	31	13	42	0	0	2	7	16	51
H-1	6	0	0	6	0	35	1	3	0	0	1	3	33	94
I-1	15	2	0	13	0	71	0	0	2	3	2	3	67	94
J-1	14	5	2	7	0	40	9	23	3	7	1	2	27	68
Show	1	1	0	0	0	6	6	100	0	0	0	0	0	0
LGP	11	0	0	11	0	63	0	0	2	3	2	3	59	94
UGP	2	0	0	2	0	9	0	0	2	22	1	11	6	67
A-2	17	2	1	14	0	72	9	12	2	3	7	10	54	75
C-2	22	3	1	18	0	109	9	8	2	2	6	6	92	84
M-2	24	10	0	13	1	84	17	0	0	0	4	5	63	75
T-2	7	2	0	5	0	37	8	22	0	0	3	7	26	71
C-3	22	4	2	16	0	113	19	17	6	5	14	13	74	65
Sub Total	224	52	6	164	2	1040	177	17	27	3	73	7	763	73
Est. Missed	15	5	0	10	0	75	13		2		5		55	
Total	239	57	6	174	2	1115	190	17	29	3	78	7	818	73
%		24	2	73	1									

*Includes 7 removed for artificial incubation

Goslings to Flight - 600

Table 10. 1967 Canada goose nesting survey on Seney Refuge. May 5, 1967 to June 12, 1967

Pools	Nests Found	Nests Dest.	Nests Desert.	Nests Hatched	Nests Un-Hatched	Eggs Found	Eggs Dest. No.	Eggs Dest. %	Eggs Desert. No.	Eggs Desert. %	Eggs Not Hatched* No.	Eggs Not Hatched* %	Eggs Hatched No.	Eggs Hatched %
A-1	4	0	0	2	2	22	0	0	0	0	14	64	8	36
B-1	8	0	0	8	0	51	0	0	0	0	6	12	45	88
C-1	5	0	0	4	1	23	0	0	0	0	7	30	16	70
D-1	12	0	1	10	1	64	0	0	4	6	11	17	49	77
E-1	27	2	2	23	0	146	9	6	2	1	10	7	125	86
F-1	15	0	0	14	1	81	0	0	0	0	7	9	74	91
G-1	10	1	0	7	2	58	3	5	0	0	12	21	43	74
H-1	6	0	1	5	0	30	0	0	3	10	0	0	27	90
I-1	12	2	1	8	1	56	9	15	5	10	8	14	34	61
J-1	9	0	1	8	0	46	2	5	5	10	0	0	39	85
UGP	2	0	0	2	0	11	0	0	0	0	2	18	9	82
LGP	10	0	1	9	0	57	0	0	5	9	2	3	50	88
A-2	12	0	0	12	0	70	0	0	2	3	4	6	64	91
C-2	21	4	0	17	0	106	14	13	1	1	2	2	89	84
M-2	17	2	0	15	0	88	6	7	0	0	5	6	77	87
T-2	9	2	0	7	0	40	6	15	0	0	0	0	34	85
C-3	18	2	0	14	2	98	6	6	1	1	12	12	79	81
Show	1	0	0	1	0	5	0	0	0	0	5	100	0	0
Sub Total	198	15	7	166	10	1052	55	5	28	3	107	10	862	82
Est. Missed	15	3	1	10	1	75	5		5		15		50	
Total	213	18	8	176	11	1127	60	5	33	3	122	10	912	82
%	100	9	4	82	5									

*Includes 11 removed for artificial incubation

Goslings to Flight - 675

Table 11. 1968 Canada goose nesting survey on Seney Refuge, April 27, 1968, to June 3, 1968.

Pools	Nests Found	Nests Dest.	Nests Desert.	Nests Hatched	Nests Un-Hatched	Eggs Found	Eggs Dest. No.	Eggs Dest. %	Eggs Desert. No.	Eggs Desert. %	Eggs Not Hatched* No.	Eggs Not Hatched* %	Eggs Hatched No.	Eggs Hatched %
A-1	5		1	4		30			6	20			24	80
B-1	7			7		40							40	100
C-1	6	1		5		32	4	12			5	16	23	72
D-1	10		2	8		61	4	7	6	10	7	21	44	72
E-1	25	2	1	22		135	10	8	6	4	7	5	112	83
F-1	15			15		86			2	2	2	2	82	96
G-1	12			11	1	68					8	12	60	88
H-1	9	1		8		50	4	8			3	6	43	86
I-1	13		1	11	1	64			7	11	4	6	53	83
J-1	7			7		35					4	11	31	89
UGP	2	1		1		11	5	45					6	55
LGP	13			13		77							77	100
A-2	10			10		56							56	100
C-2	16	1		15		89	4	4					85	96
M-2	16	2		14		82	3	4			2	2	77	94
T-2	10			10		53							53	100
C-3	19	2		17		108	10	9			2	2	96	89
Show	1		1			6			6	100				
Sub Total	196	10	6	178	2	1083	44		33		44		962	
Est. Missed	15	2	1			75	10		5				60	
Totals	211	12	7	190	2	1158	54	5	38	3	44	4	1022	88
%	100	6	3	90	1									

*Includes 14 goslings (three broods) sacrificed for Leucocytozoon study

for a 72% hatch. Of the 818 eggs hatched only 600 goslings reached flight stage. The low success of the Seney flock as indicated by the above example was believed due to predators, disease, accidental losses and limitations of the available habitat (Sherwood, 1965b).

South Dakota Birds

Analysis of the blood serum samples obtained at Sand Lake, South Dakota, on March 21, 1968 (Table 12) showed that the majority of the birds were not stimulated reproductively. Only two birds (A-3 and A-26) showed any real reproductive stimulation: total protein was 6.1 g% and 5.1 g%, the serum calcium levels were 15.2 mg% and 13.2 mg% and the A/G ratios were 0.56 and 0.63, respectively. Other birds (A-25, A-17 and A-8) demonstrated high beta globulins (1.08 g%, 1.11 g% and 1.18 g%) and A/G ratios (0.46, 0.61, and 0.40), which may have represented an upswing in these birds' blood parameter levels toward those levels demonstrated in reproductively stimulated birds. Therefore, the population sampled at Sand Lake did show some reproductive stimulation but considerably less than the birds sampled at Kellogg and Mason around the same date of March 21, 1968. Examples of this difference in blood parameter levels can be seen in Tables 1 and 3. Table 1, sample G-13 showed more definite values of a reproductively stimulated bird than the Sand Lake birds cited earlier. The values of G-15 were: total protein 5.5 g%, serum calcium 21 mg%, and an A/G ratio of 1.04.

As was stated previously, by March 21, 1968, the Kellogg and Mason birds showed pronounced reproductive stimulation. The above findings, although not in agreement with those of Kellogg and Mason, were not unexpected, since the Canada geese in the Jamestown area were all migrants. Therefore, as proposed earlier, the birds may be subjected to the same type of lag as the wild birds at Kellogg. For example, sample number G-39 (Table 6) showed similar values to the birds sampled at Sand Lake (Table 12). The values for G-39 were: total protein 6.3 g%, serum calcium 17 mg%, and an A/G ratio of 1.9. These compared in a similar manner to sample number A-13 (Table 12): total protein 4.6 g%, serum calcium 12.1 mg%, and an A/G ratio of 1.7. However, the existence of this lag to the extent to which it is manifested in the onset of peripheral blood changes is unknown at this time because of a lack of earlier (February and March) blood samples from migrant geese.

Table 12. South Dakota Canada goose blood serum analysis values for calcium (mg%), total protein (g%), albumin (g%), gamma, beta, and alpha globulins (g%), and the A/G ratio. March 21, 1968.

Bird No.	Date	T.P.	Calcium	Gamma Glb.	Beta Glb.	Alpha Glb.	Alb.	A/G
I-1	3-21-68	4.3	10.1	.387	.907	1.290	1.700	.658
A-19	"	4.5	9.3	.508	.954	1.503	1.525	.514
A-16	"	3.8	9.1	.269	.342	1.171	3.021	3.830
A-21	"	4.5	10.1	.418	.877	.981	2.214	.972
A-1	"	4.0	9.8	.132	.400	1.108	2.352	1.434
A-25	"	4.4	9.2	.558	1.082	1.364	1.381	.459
A-17	"	4.2	10.3	.260	1.113	1.230	1.583	.608
A-5	"	4.5	10.3	.310	.913	1.471	1.638	.608
A-23	"	4.1	9.8	.414	.766	1.152	1.758	.753
A-13	"	4.6	12.1	.299	.598	.795	2.898	1.712
A-26	"	5.1	13.2	.453	1.361	1.295	1.978	.636
A-11	"	4.6	12.3	.892	.575	1.315	1.251	.449
A-9	"	3.9	9.3	.280	.686	1.205	1.727	.795
A-6	"	3.7	8.7	.240	.688	1.013	1.756	.899
A-8	"	4.4	9.1	.392	1.188	1.566	1.245	.395
A-3	"	6.1	15.2	.646	1.195	2.055	2.189	.561

SUMMARY

Three local flocks of Canada geese were sampled to make use of and expand the reproductive blood parameter levels demonstrated by Johnson (1967) to semi-domesticated non-confined birds. Also demonstrated in the study was a recognition of the differences in reproductive timing that exist between the birds of three Michigan local flocks and free-flying migrants from the South. The blood samples were obtained from birds in three different localities in Michigan. The results obtained from analysis of these samples were then compared to values established by Johnson (1967), in order to demonstrate a relationship among the reproductive potentials of these flocks under field conditions.

Flocks at the Kellogg Bird Sanctuary, Hickory Corners, Michigan, and the State Conservation Game Farm, Mason, Michigan, were sampled thoroughly and demonstrated findings similar to Johnson's (1967). The birds both at Kellogg and Mason first demonstrated blood parameter levels of reproductively stimulated birds in the first week of March. In the second or third week of March the blood parameter levels of the birds were elevated, demonstrating a more enhanced reproductive condition. The first eggs were laid on March 27, 1968, and March 31, 1968, respectively.

At the Seney National Wildlife Refuge, Seney, Michigan, only one-year-old and two-year-old Canada geese were sampled

from a non-breeding segment of the population and, as expected, showed limited signs of reproductive stimulation. The local birds at Seney were believed to have had similar reproductive timing and stimulation experiences as those birds at Kellogg and Mason, for the first egg laid at Seney was on April 1, 1968. Also, a Seney bird was sampled at Kellogg before its arrival at Seney and displayed similar reproductive stimulation to both the Mason and Kellogg birds on that date, adding further evidence to the similarity of the reproductive timing of the three flocks.

As a part of the overall purpose of the study, different trapping methods were used in order to establish techniques applicable for future use. The methods of capture used at Kellogg were of three types: a beach drop-trap, capture by hand with the aid of nets, and a new drug, alpha-chloralose. At Mason a large walk-in trap was used and at Seney a cannon net was employed.

Problems encountered with these traps were many but the two major ones were timing and weather. The major timing factor was the feeding habits of the geese; prior knowledge of these habits was important to facilitate capture. The other factor, weather, was naturally an uncontrollable one. The warm spring possibly caused the birds to become scattered over wide areas, thus making it difficult to capture large numbers of birds.

All of the traps used proved to be applicable and yielded adequate catches of birds. One of the trapping techniques

(capture by hand with nets) showed possible adverse effects on the samples when analyzed, but each of the techniques facilitated handling and rapid release of the captured birds as compared to the use of no trap at all.

The reproductive condition of the three flocks studied was reviewed and brought up to date. Seney, consisting of large acreage, much open water and hundreds of breeding pairs, showed a rather constant production of goslings over the last three years. Kellogg seemed to have reached a saturation of breeding pairs due to limited availability of territories, while at Mason the condition of their flock was in the rebuilding stage.

The Northern Prairie Wildlife Research Station, Jamestown, North Dakota, contributed blood samples of 16 wild Canada geese to the study. These samples were analyzed and compared to the values obtained for the Kellogg and Mason birds. Comparison indicated a noticeable lag similar to that found in the wild birds sampled at Kellogg. Also, the local birds at Kellogg and Mason showed more advanced reproductive stimulation than the Dakota birds.

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APPENDIX A

Table of Raw Data for Canada geese sampled at Kellogg, Mason, Seney, and Sand Lake.

Table 1. Raw data for Canada geese sampled at Kellogg, Mason, Jamestown, and Seney for blood serum analysis values of calcium (mg%), total protein (g%), albumin (g%), gamma, beta, and alpha globulins (g%), and the A/G ratio. February 29, 1968 to May 6, 1968.

Bird No.	Date	Place	T.P.	Calcium	Gamma Glb.	Beta Glb.	Alpha Glb.	Alb.	A/G
G-1	2-29-68	Kellogg	5.0	9.2	1.288	.337	.890	2.485	1.125
G-2	"	"	4.8	11.0	.439	.912	.912	2.535	1.119
G-3	"	"	4.6	14.3	.133	.668	1.043	2.755	1.493
G-4	"	"	4.4	8.0	.600	.900	.966	2.366	.959
G-5	"	"	5.0	14.2	.596	.950	.992	2.562	1.051
G-7	3- 4-68	"	4.5	8.0	1.014	.838	.573	2.073	.855
G-8	"	"	6.0	15.0	2.797	.743	.743	2.133	.500
G-4-90	3- 7-68	Mason	6.4	23.0	.559	1.366	.559	3.914	1.550
G-2	"	"	6.4	13.0	1.295	1.183	.887	3.033	.901
G-14-379	"	"	6.0	15.2	.483	1.189	1.153	2.974	1.053
G-2-1	"	"	5.2	13.2	.578	.794	1.047	2.780	1.149
G-14-71	"	"	6.5	14.5	.910	.943	1.593	3.055	.887
G-2-2	"	"	6.3	13.5	1.089	.848	.788	3.574	1.311
G-13-57	"	"	5.6	12.5	.055	.388	1.331	3.825	2.156
G-2-3	"	"	5.9	12.6	.778	.648	1.167	3.307	1.275
G-3-1	"	"	5.2	14.0	.783	.965	.819	2.635	1.028
G-5	"	"	5.1	10.2	1.020	1.581	.510	1.989	.639
G-2-8	"	"	4.9	10.0	.428	.367	.490	3.614	2.809
G-3-2	"	"	6.8	18.8	.829	.580	.414	4.976	2.727
G-18-35	"	"	6.2	14.0	.663	1.794	.389	3.353	1.178
G-16-32	"	"	4.2	9.8	.309	1.339	.825	1.726	.698
G-3-4	"	"	4.4	10.0	.823	1.199	.823	1.553	.545
G-2-7	"	"	4.5	10.4	.225	.450	.450	3.375	3.000
G-5-93	"	"	5.6	13.0	.795	1.452	.968	2.385	.742
G-4-74	"	"	6.7	18.6	2.802	.904	.729	2.364	.533
G-2-4	"	"	6.2	16.0	1.703	.340	.477	3.679	1.459
G-3-5	"	"	6.0	15.4	1.492	1.370	.974	2.162	.563

Table 1. Continued

Bird No.	Date	Place	T.P.	Calcium	Gamma Glb.	Beta Glb.	Alpha Glb.	Alb.	A/G
G-18-271	3- 7-68	Mason	5.0	11.0	.730	.730	.620	2.920	1.404
G-2-5	"	"	5.8	15.6	.986	.767	.713	3.234	1.311
G-3-3	"	"	5.6	15.2	.545	.842	.743	3.469	1.628
G-2-6	"	"	6.8	17.4	1.511	1.113	.795	3.374	.989
G-3	"	"	5.8	12.6	1.914	.522	.232	3.132	1.174
G-2-9	"	"	5.6	8.0	.377	.692	.629	3.901	2.297
G-5-1	"	"	5.6	8.9	1.304	.652	.681	2.963	1.124
G-16-69	"	"	4.9	8.9	1.033	1.165	.847	1.854	.609
G-15-275	"	"	5.5	12.1	.563	.909	.996	3.031	1.228
G-10	3-14-68	Kellogg	6.9	34.4	.528	3.376	.616	2.202	.620
G-11	"	"	5.5	12.0	.530	1.236	1.259	1.877	.620
G-12	"	"	6.2	15.6	1.913	1.482	.531	2.183	.620
G-13	3-16-68	"	6.8	8.0	4.302	.688	.258	2.150	.410
G-14	"	"	6.7	32.0	.673	2.753	.917	2.355	.542
G-15	3-20-68	"	6.7	21.0	.212	3.580	.531	2.304	.533
G-16	"	"	7.5	39.6	1.184	3.445	.610	2.261	.431
G-17	"	"	5.4	18.2	.974	1.642	.779	2.004	.590
G-18	3-21-68	"	3.9	8.0	.516	.773	.870	1.740	.806
I-1	3-21-68	Jamestown	4.3	10.1	.387	.907	1.290	1.700	.658
A-19	"	"	4.5	9.3	.508	.954	1.503	1.525	.514
A-16	"	"	3.8	9.1	.269	.342	1.171	3.021	3.830
A-21	"	"	4.5	10.1	.418	.877	.981	2.214	.972
A-1	"	"	4.0	9.8	.132	.400	1.108	2.352	1.434
A-25	"	"	4.4	9.2	.558	1.082	1.364	1.381	.459
A-17	"	"	4.2	10.3	.260	1.113	1.230	1.583	.608
A-5	"	"	4.5	10.3	.310	.913	1.471	1.638	.608
A-23	"	"	4.1	9.8	.414	.766	1.152	1.758	.753
A-13	"	"	4.6	12.1	.299	.598	.795	2.898	1.712
A-26	"	"	5.1	13.2	.453	1.361	1.295	1.978	.636
A-11	"	"	4.6	12.3	.892	.575	1.315	1.251	.449

Table 1 Continued

Bird No.	Date	Place	T.P.	Calcium	Gamma Glb.	Beta Glb.	Alpha Glb.	Alb.	A/G
A-9	3-21-68	Jamestown	3.9	9.3	.280	.686	1.205	1.727	.795
A-6	"	"	3.7	8.7	.240	.688	1.013	1.756	.899
A-8	"	"	4.4	9.1	.392	1.188	1.566	1.245	.395
A-3	"	"	6.1	15.2	.646	1.195	2.055	2.189	.561
G-15-1	3-21-68	Mason	6.0	37.4	.849	2.199	.450	2.499	.714
G-16-2	"	"	5.5	18.5	.520	1.367	1.399	2.213	.673
G-2-4	"	"	5.6	20.0	1.112	1.112	1.075	2.298	.697
G-3-4	"	"	4.4	12.3	.341	.726	1.132	2.200	1.000
G-2-10	"	"	4.5	9.4	.317	.662	.926	2.594	1.361
G-4-1	"	"	5.8	11.0	.366	1.233	1.599	2.599	.813
G-15-2	"	"	5.4	23.0	.457	2.057	.371	2.514	.871
G-3-8	"	"	3.8	10.9	.259	1.198	.617	1.624	.746
G-14-2	"	"	6.7	25.0	1.380	2.491	.303	2.356	.168
G-3-5	"	"	4.4	8.0	.554	1.247	.866	1.732	.649
G-3-3	"	"	5.5	17.2	.688	1.194	1.266	2.352	.747
G-2-7	"	"	5.5	19.2	.661	1.269	1.454	2.115	.625
G-3-1	"	"	5.6	9.4	.535	.823	.988	3.252	1.386
G-5-2	"	"	6.3	28.0	.349	2.275	.350	3.908	1.634
G-2-3	"	"	5.6	11.3	.414	.622	.207	4.355	3.500
G-14-1	"	"	5.5	11.3	.312	1.437	.250	3.450	1.750
G-16-1	"	"	4.4	9.4	.330	.275	.660	3.135	2.478
G-3-7	"	"	5.7	19.0	.154	.808	1.271	3.461	1.552
G-2-2	"	"	5.4	12.3	.265	.929	.752	3.452	1.773
G-3-2	"	"	7.8	12.1	.803	1.848	.322	5.225	1.157
G-2-9	"	"	4.5	8.4	.338	.338	.532	3.290	2.720
G-2-6	"	"	6.2	20.6	.463	1.912	.289	3.534	1.326
G-2-5	"	"	4.5	8.0	.365	.608	.304	3.223	2.523
G-3-6	"	"	4.3	9.2	.502	.614	.167	3.015	2.348
G-2-1	"	"	5.7	10.6	.403	.748	.461	4.088	2.536

Table 1. Continued

Bird No.	Date	Place	T.P.	Calcium	Gamma Glb.	Beta Glb.	Alpha Glb.	Alb.	A/G
G-4-2	3-21-68	Mason	8.0	33.4	.408	2.694	.916	4.082	1.042
G-5-2	"	"	5.5	21.0	.567	1.397	.305	3.231	1.423
G-4-3	"	"	4.9	8.6	.374	1.122	.972	2.431	1.161
G-19	3-23-68	Kellogg	4.6	8.0	.357	1.277	.489	2.556	1.250
G-15	"	"	5.5	21.0	.282	.987	1.410	2.491	1.040
G-21	"	"	5.8	15.0	1.588	.759	.414	3.090	1.100
G-22	3-28-68	"	8.5	21.0	2.304	2.780	.079	3.336	.646
G-23	"	"	12.5	37.2	.857	2.400	1.887	7.155	1.433
G-24	"	"	13.0	32.0	11.365	.388	.233	1.011	.084
G-25	"	"	7.0	37.2	.543	2.242	.068	4.145	1.452
G-26	"	"	9.3	30.2	5.483	1.754	.044	2.017	.277
G-27	"	"	14.0	34.0	10.706	.696	.063	2.534	.221
G-28	"	"	12.5	34.0	10.204	.319	.446	1.530	.140
G-29	4- 4-68	"	7.4	28.8	.596	1.850	1.432	3.401	.877
G-30	"	"	7.4	30.8	.489	2.874	.122	3.914	1.123
G-2-4	"	Mason	4.8	10.8	.178	.712	.652	3.259	2.115
G-2-2	"	"	5.3	9.2	.568	1.325	1.041	2.366	.806
G-2-5	"	"	5.1	10.8	.578	1.156	1.224	2.041	.690
G-2-1	"	"	4.7	8.0	.476	1.398	.981	1.844	.644
G-2-7	"	"	4.3	9.0	.209	.626	.543	2.922	2.122
G-2-6	"	"	6.9	15.5	.555	2.359	.347	3.539	1.085
G-2-3	"	"	5.6	8.0	.783	1.958	.783	2.075	.588
G-2-8	"	"	6.5	18.9	.505	1.44	.433	4.117	1.727
G-31	4- 8-68	Kellogg	9.3	38.6	1.221	3.625	1.260	3.192	.523
G-32	"	"	5.9	18.7	.562	1.124	1.461	2.753	.875
G-33	"	"	6.0	17.1	.535	1.352	1.774	2.338	.638
G-34	"	"	6.2	18.4	.594	2.093	1.305	2.118	.519
G-35	"	"	6.3	10.4	1.130	1.301	1.656	2.218	.543
G-36	"	"	6.8	21.0	.743	2.266	1.263	2.526	.591

Table 1. Continued

Bird No.	Date	Place	T.P.	Calcium	Gamma Glb.	Beta Glb.	Alpha Glb.	Alb.	A/G.
G-37	4- 9-68	Kellogg	7.3	28.4	.392	2.583	.112	4.211	1.364
G-37	"	"	6.0	12.0	.361	1.590	.361	3.686	1.594
G-38	"	"	6.5	20.0	.450	1.277	1.540	3.231	.989
G-39	"	"	6.3	17.0	.219	.767	1.150	4.108	1.923
G-41	4-10-68	"	6.1	20.5	.961	1.548	1.712	1.876	.444
G-42	"	"	9.5	38.0	1.420	1.452	3.724	2.903	.440
G-43	"	"	6.0	16.1	.275	1.483	1.483	2.620	.775
G-44	"	"	5.8	28.0	.898	2.245	.599	2.058	.550
G-2-1	4-18-68	Mason	5.0	11.8	.317	.714	.555	3.413	2.150
G-2-2	"	"	3.9	12.1	.213	1.064	.709	1.915	.964
G-2-3	"	"	6.3	11.8	.567	1.021	1.305	3.405	1.176
G-2-4	"	"	6.2	11.6	.391	1.098	.863	3.845	1.633
G-2-5	"	"	6.5	11.6	.229	.919	1.207	4.141	1.756
G-2-6	"	"	5.2	13.9	.121	.967	.725	3.386	1.866
G-2-7	"	"	4.7	12.1	.810	.648	.567	2.431	1.200
322	4-23-68	Seney	5.5	10.0	.980	1.497	1.170	1.851	.507
028	"	"	4.8	8.0	1.635	1.258	.566	1.341	.388
090	"	"	5.5	8.0	.595	1.140	.842	2.923	1.135
480	"	"	5.8	8.0	.999	1.880	.640	2.280	.645
M-1	"	"	6.8	10.0	1.507	2.813	.703	1.775	.353
F-1	"	"	7.0	11.2	1.211	2.019	1.413	2.355	.507
G-45	4-24-68	Kellogg	5.1	13.0	.248	.497	.373	3.980	3.555
G-46	"	"	4.7	12.0	.798	.748	.956	2.204	.883
G-45	4-29-68	Kellogg	5.6	12.0	.236	.589	.766	4.008	2.518
G-46	"	"	5.1	10.8	.749	1.229	1.139	1.980	.634
G-46	4-30-68	"	4.5	11.5	.468	1.193	.936	1.742	.632
G-45	"	"	5.3	10.0	1.101	1.816	.834	1.548	.413
G-45	"	"	4.9	11.9	.319	.745	.532	3.302	2.066
G-46	"	"	4.8	9.8	.508	1.462	.922	1.907	.659

Table 1. Continued

Bird No.	Date	Place	T.P.	Calcium	Gamma Glb.	Beta Glb.	Alpha Glb.	Alb.	A/G
519	5- 6-68	Seney	4.5	-	.673	.986	.449	2.288	1.085
564	"	"	7.0	8.2	1.347	2.144	1.320	1.876	.390
683	"	"	5.6	9.7	1.015	2.306	1.248	.821	.180
468	"	"	4.9	8.0	1.196	1.161	1.054	1.480	.434
493	"	"	5.0	9.0	.734	1.306	.994	1.757	.570
572	"	"	5.5	9.4	1.201	1.472	.853	1.664	.472
322	"	"	4.9	9.1	1.015	1.410	.588	1.683	.558
564	"	"	5.2	8.3	.585	1.755	.925	1.725	.528
525	"	"	7.1	9.0	.994	3.493	.795	.796	.339
172	"	"	6.2	14.6	1.153	1.632	1.443	2.066	.484
566	"	"	5.0	11.4	.825	1.420	1.158	1.585	.466
573	"	"	5.3	10.9	1.129	1.611	.869	1.680	.464
565	"	"	5.1	10.7	1.209	1.505	.541	1.836	.564
562	"	"	5.0	10.0	.865	1.365	.900	1.865	.595
560	"	"	7.1	12.9	.931	3.213	.812	2.030	.409

APPENDIX B

Table of Weather Data

Table of Weather Data Taken at the Kellogg Biological Station.

Date	Temp. (°F.) Max.	Min.	Ave.	Precipitation (inches) Liq.	Solid	Grd.	Remarks
2-29-68	28	14	21	0.02	T	T	Snow melting
3- 4-68	41	21	31	0.00	0	T	
3- 7-68	45	19	32	0.00	0	0	
3-14-68	39	13	26	0.00	0	T	
3-16-68	60	32	46	0.00	0	0	Fog
3-20-68	50	35	42.5	0.00	0	0	
3-21-68	39	30	34.5	0.13	0	T	Snow melting
3-23-68	31	20	25.5	0.30	6.02	6.0	Blowing Snow
3-28-68	69	42	55.5	0.00	0	0	
4- 4-68	60	42	51	0.85	0	0	Rain
4- 7-68	67	32	49.5	0.00	0	0	
4- 8-68	67	44	55.5	0.00	0	0	High winds
4- 9-68	57	40	48.5	0.00	0	0	
4-10-68	57	35	46	0.00	0	0	
4-18-68	61	45	53	0.13	0	0	Rain
4-21-68	63	50	56.5	0.01	0	0	Rain
4-23-68*	42	38	40	0.09	0	T	Rain
4-24-68	62	38	50	0.07	0	T	Snow fell and melted
4-29-68	63	47	55	0.02	0	0	Rain
4-30-68	62	39	50.5	0.00	0	0	
5- 6-68	60	24	42	0.00	0	0	

T = less than 0.5 inches
Liq. = any form of melted precipitation
Solid = any form of solid precipitation
Grd. = precipitation staying on the ground
* = weather taken at the Seney National Wildlife Refuge

APPENDIX C

Tables of Kellogg Breeders and Non-Breeders

Table 1. 1965 and 1966 Age and Sex Distribution of the Kellogg Breeders.

1965	Sex and Number		1966	Sex and Number	
Age	Female	Male	Age	Female	Male
2	1	1	2	2	2
3	5	4	3	0	1
4	5	4	4	9	4
5	1	4	5	3	5
6	0	3	6	0	1
7	7	2	7	0	2
8	1	3	8	3	1
9	0	0	9	1	2
10	1	1	10	0	0
Unknown	4	5	Unknown	6	7
Totals	25	27	Totals	25	25

Table 2. 1967 and 1968 Age and Sex Distribution of the Kellogg Breeders.

1967	Sex and Number		1968	Sex and Number	
Age	Female	Male	Age	Female	Male
2	5	3	2	3	2
3	3	1	3	4	5
4	0	1	4	4	1
5	6	6	5	0	0
6	5	4	6	5	4
7	1	1	7	4	3
8	1	2	8	1	1
9	2	1	9	0	1
10	2	2	10	2	0
11	0	0	11	1	2
12	1	0	12	0	0
13	0	0	13	1	0
Unknown	4	10	Unknown	4	9
Totals	30	31	Totals	29	28

Table 3. 1965 Apparent Kellogg Non-Breeders.

	Actual Breeders		Potential Breeders		Apparent Non-Breeders	
Age	Female	Male	Female	Male	Female	Male
2	1	1	2	1	1	0
3	5	4	9	4	4	0
4	5	4	6	6	1	2
5	1	4	4	4	3	0
6	0	3	0	3	0	0
7	7	2	7	2	0	0
8	1	3	1	3	0	0
9	0	0	0	0	0	0
10	1	1	2	1	1	0
Unknown	4	5	13	16	9	11
Totals	25	27	44	40	19	13

Table 4. 1966 Apparent Kellogg Non-Breeders.

	Actual Breeders		Potential Breeders		Apparent Non-Breeders	
Age	Female	Male	Female	Male	Female	Male
2	2	2	12	9	10	7
3	0	1	0	1	0	0
4	9	4	9	4	0	0
5	3	5	3	6	0	1
6	0	1	2	1	2	0
7	0	2	0	2	0	0
8	3	1	3	1	0	0
9	1	2	2	2	1	0
10	0	0	0	0	0	0
11	1	0	2	1	1	1
Unknown	6	7	7	17	1	10
Totals	25	25	40	44	15	19

Table 5. 1967 Apparent Kellogg Non-Breeders.

	Actual Breeders		Potential Breeders		Apparent Non-Breeders	
Age	Female	Male	Female	Male	Female	Male
2	5	3	8	11	3	8
3	3	1	8	3	5	2
4	0	1	0	1	0	0
5	6	6	7	6	1	0
6	5	4	5	6	0	2
7	1	1	2	1	1	0
8	1	2	1	2	0	0
9	2	1	1	2	1	1
10	2	2	2	2	0	0
11	0	0	0	0	0	0
12	1	0	2	1	1	1
Unknown	4	10	7	22	3	12
Totals	30	31	44	56	14	25

APPENDIX D

Tables of Mason Breeders and Non-Breeders

Table 1. 1966, 1967, and 1968 Age Distribution of the Mason Non-Breeders.

1966

Age	Number
2	8
3	12
4	6
5	1
6	0
7	3
8	0
9	0
10	0
11	1
12	2
13	0
14	0
15	5
Total	38

1967

Age	Number
2	14
3	2
4	2
5	0
6	0
7	0
8	0
9	0
10	0
11	0
12	3
13	0
14	1
15	0
16	1
Total	23

1968

Age	Number
2	21
3	23
4	3
5	2
6	1
7	0
8	0
9	0
10	0
11	0
12	0
13	2
14	1
15	1
16	2
17	1
Total	57*

*Includes 18 newly acquired birds

Table 2. 1966, 1967 and 1968 Age and Sex Distribution.

1966	Sex & Number	
Age	Female	Male
2	0	0
3	2	1
4	0	0
5	0	1
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	7	5
13	2	3
14	1	3
15	1	0
Totals	13	13

1967	Sex & Number	
Age	Female	Male
2	0	0
3	2	0
4	1	2
5	0	2
6	0	0
7	0	0
8	0	2
9	1	0
10	0	0
11	0	0
12	0	0
13	7	5
14	3	4
15	3	4
16	2	0
17	1	0
Totals	19	19

1968	Sex & Number	
Age	Female	Male
2	2	0
3	0	2
4	2	0
5	2	3
6	0	2
7	0	0
8	0	0
9	1	1
10	0	0
11	0	0
12	0	0
13	0	0
14	5	4
15	3	4
16	1	3
17	2	0
18	1	0
Totals	19	19

APPENDIX E

Tables of Seney Nesting Survey

Table 1. 1964 and 1965 Canada Goose Nesting Surveys at Seney.

Subject	1964 Number	1964 Percent	1965 Number	1965 Percent
Nests Destroyed	90	38.0	61	27.0
Nests Deserted	7	3.0	12	5.0
Nests Hatched	138	59.0	152	68.0
Total Nests	235	100.0	225	100.0
Eggs Destroyed	410	37.0	267	25.0
Eggs Unhatched	55	5.0	92	8.0
Eggs Deserted	25	2.0	43	4.0
Eggs Hatched	631	56.0	676	63.0
Total Eggs	1,121	100.0	1,078	100.0
Goslings to Flight	127	20.3	490	72.5

Table 2. 1966 and 1967 Canada Goose Nesting Surveys at Seney.

Subject	1966 Number	1966 Percent	1967 Number	1967 Percent
Nests Destroyed	57	24.0	18	9.0
Nests Deserted	8	3.0	8	4.0
Nests Hatched	174	73.0	176	82.0
Nests Unhatched	-	-	11	5.0
Total Nests	239	100.0	213	100.0
Eggs Destroyed	190	17.0	60	5.0
Eggs Unhatched	78	7.0	122	11.0
Eggs Deserted	29	3.0	33	3.0
Eggs Hatched	818	73.0	912	81.0
Total Eggs	1,115	100.0	1,127	100.0
Goslings to Flight	600	74.4	675	74.0