THE UNIVERSITY OF MANITOBA

THE EFFECTS OF DOMESTIC SEWAGE ON A CAPTIVE FLOCK OF GIANT CANADA GEESE

(Branta Canadensis Maxima)

by

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MASTER OF ARTS

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This thesis is dedicated to Ryan and Andrea.

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ABSTRACT

Sewage settlement complexes are usually characterized by the relatively inefficient utilization of large tracts of land. By inefficient is meant only partial yearly use due to seasonal conditions with no additional agricultural or recreational uses. The feasibility of using these areas to raise livestock was proposed and giant Canada geese (Branta canadensis maxima)were chosen as the test subjects. Six measurements and four morphological observations were also made on each bird. The data were compared to norms established through a study of data on maxima reported in the literature. An objective system for classifying giant Canada geese was developed and applied to a captive flock of geese. One bird was culled from the flock. Six will be held for a probationary period of one year, at the end of which time they will be reassessed. Forty-seven birds met the standards established and were classifed as giant Canada geese.

Forty-one experimental birds were placed at the West End Water Pollution Control Centre, located at Charleswood, Manitoba, in the spring of 1976. Ten birds were placed at a control site at the Glenlea Agricultural Research Station, Glenlea, Manitoba. Pre-site placement weights were obtained from all birds. Two geese were also sacrificed and necropsies performed to determine the general health of the flock before site placement. The flock was again weighed in the fall of 1976, when it was returned to the University of Manitoba Campus for the winter, and again in the spring of 1977. The results indicated a significant weight loss in the experimental group while the weight of the control group remained the same during the same period. A comparison of the spring

1976 weights with the weights obtained in the spring of 1977 indicated a statistically significant weight gain for both groups over the course of the full year. Non-predator mortality over the length of the experiment was almost non-existent and was not attributed to the effects of the study site. An inspection by a government veterinarian indicated that the flock appeared in good physical health. A comparison of mature to immature birds ruled out the maturation factor as a critical variable affecting the weight change.

The difference in diet between the experimental and control groups was suspected to be the critical variable involved in the weight differential. The vegetation at both sites was predominantly the same, however, the major difference between the two sites involved food supplements added at the control site. Recommendations for altering the environment at the sewage lagoon to make it a more viable habitat for geese were made.

CHAPTER I

INTRODUCTION

There is a great deal of confusion in the literature about the exact conformation standards of the giant Canada goose (*Branta canadensis maxima*). For example, Godfrey (1966) says, "Subspecies of this goose are at present imperfectly understood" (p. 49). Hanson (1965) credits William B. Mershon with the original classic account of the giant Canada goose. Hanson (1965) also notes that on February 24, 1922, R.P. Holland initiated correspondence with Mershon regarding the existence of a big goose. He stated in that letter that he had a considerable 'pile' of data on the bird but nothing conclusive enough to convince ornithologists that a distinct species existed. Holland and Mershon persisted in their joint efforts until Mershon's death in 1939. It was not until Jean Delacour (1951) described the new subspecies as *Branta canadensis maxima* that the subspecies was accepted by the scientific community. Delacour's (1951) description was based on the data collected previously by James Moffitt (Hanson, 1965).

Hanson (1965) cites considerable evidence for the extinction of the maxima from 1930 (Phillips & Lincoln, 1930) to 1961 (Boldt, 1961). It is very interesting to note that during this period of apparent extinction the maxima was taxonomically classified by Delacour (1951) and rediscovered by Hanson in 1960 (Hanson, 1965). Both events were recorded on the basis of secondary data collected by James Moffitt who was killed in World War II. This procedure leaves some doubt concerning the reliability and validity of the measurements concerning the giant Canada goose. The purpose of this research is to validate some of the parameters of the giant Canada goose and to assess what effects placement at a sewage lagoon may have on this bird. The rationale for the latter decision is given on pages 12 and 13.

The literature, as mentioned previously, has been vague in some areas of identifying a giant Canada goose and has raised some questions concerning the exact characteristics of maxima. The recognized authority in this area is Harold Hanson who notes (Hanson, 1965) many significant differences among populations with respect to such measurements as weight, color, and length of middle toe.

Hanson (1965) has noted that the Rochester flock, a flock wintering in Rochester, Minnesota, and summering in Manitoba, is in fact descended from southern Manitoba maxima. Since this flock is one of the largest known flocks of maxima (Hanson, 1965) and is under constant observation, it is felt that the measurements taken from these birds would be an excellent reference point for unclassified flocks of unknown subspecies of Canada geese. Data taken from the Rochester flock and other data reported in the literature will be compared to a flock maintained by the Avian Behavior Laboratory and conformation standards determined for the latter.

If the captive flock of geese maintained by the Avian Behavior Laboratory is to be used as an example of giant Canada geese, then we must be confident that the birds reported as maxima are, in fact, similar to the majority of maxima reported in the literature. If the flock is to become a breeding flock for future research, only birds which exhibit the certain characteristics should be maintained and allowed to propagate. It is not the intent of this study to determine the parameters of all maxima or to establish norms against which all other flocks should be compared. It is hoped, however, that these discrepancies will cause other investigators to be more cautious in labelling their geese.

The giant Canada goose was chosen as the species around which to base a long term research program because it is a species which at one time was thought to be extinct (Hanson, 1965) and which has now regained a prominent status as North America's largest game bird (Hanson, 1965). Its northern range also seems to include Manitoba with its unique climatic conditions. If this bird is hardy enough, other artificial means may be found to maintain it in the far north where native peoples could use the additional source of meat, feathers, and revenue associated with the propagation and sale of these birds.

Classification of the Giant Canada Goose

Taxonomy

Taxonomically, the giant Canada goose was described by Delcour (1951) as belonging to the family, *anatidae*; genus, *Branta*; species, *canadensis*; and subspecies *maxima*. The physical characteristics which describe this bird follow. Although behavioral differences between subspecies have been reported by Hanson (1965), the *maxima* is not taxonomically differentiated by behavioral characteristics.

Physical Characteristics

Hanson (1965) has put together an impressive collection of data and has described in some detail the identifying characteristics of the subspecies *maxima*. "Most of the races of Canada geese are readily distinguishable, but as a group they exhibit a series of clines or gradations in weight, size and body proportions" (Hanson, 1965, p. 13). Unless otherwise referenced, the following descriptions and conformation statistics are his. These parameters have been used to classify the giant Canada goose.

Weight. The trait which has received the most attention has been the weight of the *maxima*. Hanson (1965) cites many "record" size geese from 16 to 24 pounds, but adds some confusion when he states that there is a considerable disparity between the weights of various populations of *maxima*. He also notes, however, that the average weights for *maxima* are higher than for other subspecies. This observation emphasizes the fact that weight alone cannot be used to classify an independent flock of geese into a subspecies. Table 1 (found in the Results section) gives the average weights for several flocks from several sources. The weights range from 3100 to 7484 grams.

Hanson (1965) alludes to deviations from the mean in weight and measurements for many populations of *maxima*. There are also sex and age differences which further confuse the identification of smaller isolated flocks on the basis of weight.

Johnsgard (1968) cites the average weight of a *maxima* at 10 pounds, which is the minimum allowable for a female by the International Wild Waterfowl Association (Dill & Lee, 1970). Wallace (1955) places the average weight at 13.4 pounds. The Manitoba Department of Mines, Resources, and Environmental Management (Notes 1 and 2) states the range of weight to be between 10 and 18 pounds.

The measurements on the Avian Behavior Laboratory flock, (Appendix A) which were collected in the fall of 1975, show that many of our birds fell below the minimum specified by Dill and Lee (1970) but are similar with the data collected by others as indicated in Table 1 of the Results section.

Body proportions. From a distance, the most notable physical characteristic of the _maxima_ is its long neck which, in proportion to its body length, exceeds that of all other races or subspecies of Canada geese.

Wing span and body length. A wing span of 70" is average, with the record being 88 inches (Hanson, 1965). The body length of this record bird, in comparison, was 48" and its weight was 24 pounds.

Wing length. The wing length is measured as the length of the folded wing from the anterior edge of the wrist joint to the tip of the longest primary. The wing is pressed flat and the curved edge is straightened before the measurement is taken. Differences in wing length between various populations of _maxima_ are much less than are the differences in body weight (Hanson, 1965).

Tail length. This is a useful measurement in identifying subspecies only in immature birds where the differences are significant. Only the very largest adult _maxima_ can be identified in this way, however, and this measurement will not be used.

The bill. The bill is very important in differentiating between and identifying the subspecies of Canada geese. The bill of the _maxima_ is spatulate and relatively untapered. The horny palate of the _maxima_ is relatively smooth, with few protuberances. (Other races are characterized by a troughlike, narrow, horny palate, and the protuberances are arranged in rows and are fairly sharp to the touch.)

The nail at the tip of the bill is rounder and more bulbous than other species and it tends to cup around the lower mandible to a greater extent.

In the *maxima*, the lamallae, or sieve-like structure on the edge of the bill, are course with the lateral termini prominently exposed along the entire edge of the upper mandible.

Hanson (1965) notes, "The massiveness of the bill of *maxima* is one of the most consistent and salient characters of the race" (p. 31). For this reason three measurements are taken of the culmen or bill. For a detailed description of this procedure, see page 18. The placement of the calipers on either side of the upper mandible at the mid-point of the nares, or nostrils is the measurement known as the widest culmen. Culmen width varied in the flocks sampled from 22.3 mm to 26.8 mm and culmen length ranged from 51 mm to 72 mm.

Scutellation of the tarsis and feet. The scutellation or scale pattern of the tarsi, or legs, and feet of the *maxima* are very distinctive in comparison to the legs of other subspecies (Hanson, 1965). Hanson describes the difference as follows: "In essence, the skin of the tarsi of *B.c. interior, moffitti* and *canadensis* is suggestive of a smooth-skinned colubrial snake; in *maxima* the scutes are more plaque-like, their central portions are depressed, and the grooves between the scutes are deeper and more pronounced" (p. 23). The scutes are large scales on the legs and feet.

Length of middle toe. The foot of the *maxima* (as indicated by measurements of the middle toe) is the longest of the subspecies of *canadensis*. Some differences exist between populations.

Coloration. Delacour's (1951) original description of the *maxima* is as follows:

> Differs from B.c. canadensis in its larger size and more elongate shape, and in its paler, more even plumage, less conspicuously barred above; the under parts more uniform, the base of the hind neck not whiter than the rest, a white ring at the base of the neck often present (p. 5)

Hanson (1965), however, cites several descriptions and sources which confuse this characteristic. The International Wild Waterfowl Association (Dill & Lee, 1970) clarifies some of this confusion by quantifying the coloration through comparison to a color chart obtainable from Munsell Color Co., Baltimore, Maryland. The acceptable range in this chart is from color #1 to color #5.

Cheek patches. The white area of the cheek tends to be more extensive in maxima than the other large races giving it a wrap-around appearance. The presence of small, hooklike extensions near the top of the posterior margins of the cheek patch may be regarded as excellent indicators of a maxima population.

White markings. Two white markings frequently occur in maxima: 1) a white spot or bar across the forehead and 2) a pure white neck ring. Both occur infrequently in smaller subspecies of canadensis and do not necessarily occur in all maxima (Dill & Lee, 1970).

Behavioral Classification

In addition to physical differences between subspecies of canadensis, Hanson (1965) notes several behavioral characteristics which differentiate maxima from the other subspecies. Probably the most interesting and important behavioral characteristic from a management or research point of view is the "placid disposition" and "inherent tameness" which has permitted the giant Canada goose to be so readily domesticated (Hanson, 1965). Hanson (1965) also discusses in some detail the tendency of the maxima to remain apart from other races.

Hanson (1965) quotes two sources (Hinde & Tinbergen, 1960; Mayr, 1960) who point out that behavioral traits constitute completely acceptable taxonomic characters.

Tinbergen (1968) describes how three entomologists were independently studying the "same" species of wasp. Two of the ethologists were studying the behavior of the wasp. When they compared their observations they noted peculiar but consistent differences. The third gentleman was studying the morphology of the insect and found minute morphological differences which divided the "species" into two groups. Upon further study it was found that the morphologically different groups corresponded consistently to the two groups which differed behaviorally. Further observation indicated that the two groups did not, when given the opportunity, inter breed. On the basis of behavioral traits, one species was conclusively determined to be two distinct subspecies.

Canada geese in captivity. Hanson (1965) rediscovered the maxima in private flocks and cites numerous examples of captive flocks of giant Canada geese, as do Dill and Lee (1970). There can be no doubt that this subspecies can be raised successfully in captivity as proven by the numerous articles and books about captive geese (Brakhage, 1965; Collias & Jahn, 1959; Dill & Lee, 1970; Klopman, 1962, 1967, 1968; Kossack, 1950; Lee, 1970; Van Wormer, 1968; Ward & Batt, 1973; Weigand, Pollok, & Petrider, 1968).

Hanson (1965), however, mentions that some morphological differences, specifically weight gain, may occur in captive flocks. Pinioned birds may also demonstrate underdeveloped pectoral muscles. This factor must be taken into consideration when comparing specifications of wild birds with measurements of birds propagated and raised in captivity.

Sewage lagoons as propagation and maintenance sites. Manitoba was once a better habitat for migrating flocks due to its abundance of lakes, rivers and numerous pot-holes. Recently many marshes and pot-holes have been drained and the land reclaimed for agricultural purposes (Robel, 1962). The loss of these areas for feeding and breeding has forced many species into alternate areas which may not optimally meet their natural requirements. This may result in the loss of a distinct species through adaptive evolution or, in the extreme, to extinction of the species.

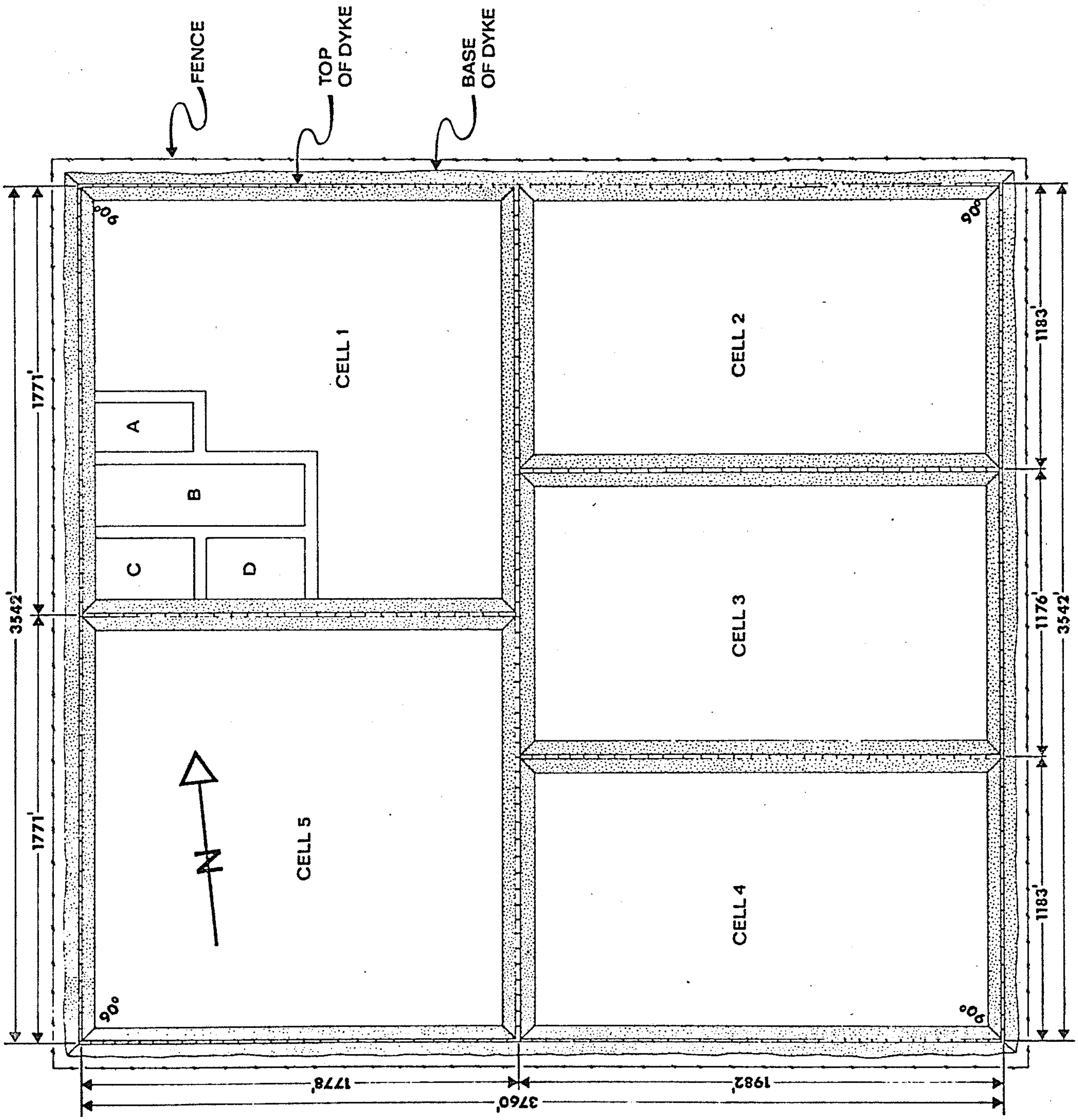
Sewage lagoons are characteristically areas close to communities and are, perhaps, inefficiently used. Raw sewage composed largely of human excreta is pumped in, allowed to settle, and then pumped into subsequent cells where microbiological growth purifies the pollution before being reintroduced to the environment (Lance, 1971). Industrial and chemical wastes are prohibited.

The particular sewage treatment plant of interest in this research is located in Charleswood, Manitoba, and is known as the West End Water Pollution Control Center. The complex is diagrammed in Figure 1.

The continuous cycling characteristic of this type of system has been described by Lance (1971) and may be summarized, with respect to the Charleswood Sewage Lagoon, as follows:

Step 1: The raw sewage is pumped into Cell #1 where it settles for a short time before being pumped into cell #2, which is also, in effect, raw sewage.

Step. 2: The sewage, now partially settled, is pumped into cell #3 where


FENCE
TOP OF DYKE
BASE OF DYKE
CELL 1
CELL 2
CELL 3
CELL 4
CELL 5
A
B
C
D
N
90°
90°
90°
90°
1771'
1771'
3542'
1183'
1176'
1183'
3542'
1778'
1982'
3760'

induced eutrophication (dissolution of nutrients) occurs (Penning, Note 1). Increased blue-green algae growth indicates high levels of nitrates (Gruener & Shuval, 1969).

Step 3: The sewage is pumped to cell #4 where it continues to settle, the algae is removed, and microbiological growth increases (Penning, Note 1).

Step 4: The sewage is pumped into cell #5 where the settling is completed along with the microbiological action.

Step 5: The effluent is pumped into the Assinboine River.

It has been observed by several authors (Dodge & Low, 1972; Dornbush & Anderson, 1964; Glue & Bodenham, 1974; Lance, 1971), that large numbers of avifauna frequent sewage treatment areas. Waterfowl in particular are probably attracted from the air by the large areas of relatively calm, protected water.

Glue and Bodenham (1974) sighted and documented 31 species of birds at a sewage farm in Buckinghamshire, England, many of which nested there. Dodge and Low (1972) have reported waterfowl nesting, resting, and feeding on sewage treatment lagoons while Dodge (cited in Lance, 1971) has reported very little, if any, difference in breeding success between waterfowl nesting in "natural" sites and waterfowl nesting at sewage treatment complexes. Dornbush and Anderson (1964) report doubling reproduction success by species nesting in sewage lagoons as opposed to their natural nesting conspecifics. Perhaps this is due to the relatively stable water levels and relative safety from hunting and predation. Shapiro and Kibbins (Note 5) recorded 83 species at the Charleswood Sewage Lagoons over a four month observation period during the summer of

1975. A maximum of 31 different species were sighted on one day.

Lance (1971) suggests the possible usage of sewage treatment centers for the propagation and maintenance of waterfowl and even livestock. Little research has been undertaken in this direction, however. One exception is Kibbins and Shapiro (Notes 6, 7, 8). They have reported on the successful maintenance and limited propagation of a flock of pinioned giant Canada geese at a sewage lagoon but they did not study the possible effects of the pollution on the flock. No apparent difficulties were reported. Tenhave and Shapiro (Note 9) have studied the effects of sewage on the development of mallard ducklings (*Anas platyrhynchos platyrhynchos*) and found them to be minimal.

The fact that sewage lagoons attract large numbers of avifauna cannot be questioned. Whether or not the pollution has any effect, either positive or negative on these birds or higher forms in the food chain, has yet to be conclusively determined.

Effects of the study site. The significance of testing the effects of a sewage lagoon as a study site for Canada geese is two-fold. First, sewage lagoons are characterisized by the fact that they utilize large tracts of valuable land near many communities. This land, in a temperate climate, can only be used for half the year due to freezing temperatures the other half of the year. If additional use can be made of these areas, then the utilization of this land becomes more feasible. Second, the Charleswood Sewage Lagoon is the largest and most easily accessible area available to the Avian Behavior Laboratory in which to raise its flock in the Winnipeg area. Confidence must be maintained in the viability of this habitat, however. If development of the geese is retarded at this location and/or disease evident, then an alternate site must be found in which to maintain and propagate this flock. If, on the other hand, there are no detrimental effects found, then sewage lagoons may be a viable alternate habitat for Canada geese and this would increase the probability that the same may eventually be said for many different kinds of livestock and wildlife. This alternative would be especially important for waterfowl because their natural habitat is constantly being altered and destroyed by human intervention (Robel, 1962).

CHAPTER II

METHOD

Subjects

The Avian Behavior Laboratory flock consists of 53 Canada geese, most of which are suspected to be of the subspecies B.c. maxima. The birds range in age from 14 years of age to 1 year of age. They come from four sources:

1. The original stock was brought from Bowling Green State University, Bowling Green, Ohio, by Dr. L. James Shapiro.
2. Donations from the Assiniboine Park Zoo.
3. A propagation program using the present flock.
4. Birds hatched in the Avian Behavior Laboratory from eggs obtained from the Wascana Waterfowl Park in Regina, Saskatchewan.

All the birds were pinioned. The flock was over-wintered on the University of Manitoba Campus where they had access to clean water and commercial food. See Kibbins and Shapiro (Note 8) for a detailed description of the winter maintenance facilities and food requirements of these subjects. All the birds were leg banded and neck collared for identification purposes.

The birds were randomly assigned to an experimental or control group. The experimental group, consisting of 41 geese, was placed at the sewage lagoons on April 17, 1976. The control group consisted of 10 birds which were placed at Glenlea on the same date. In addition, two birds were sacrificed and necropsied on May 7, 1976.

On April 17, 1976 twenty percent of the subjects from each group were chosen at random and blood samples obtained from them. The blood samples were not analyzed.

Study Sites

The West End Water Pollution Control Center located at Charleswood, Manitoba, was the experimental site. This area services the west end of the city of Winnipeg and consists of a fenced-in area covering approximately one square mile. Within this area are five settlement cells and four experimental ponds (see Figure 1). The pollution ranges from raw sewage in cells 1, 2, and 1A, to relatively pure effluent in cell 5.

An irrigation pumping station located at the Glenlea Agricultural Research Station in Glenlea, Manitoba, was the control site. This site encloses an area of 380 feet by 170 feet, which includes a water area of approximately 115 feet by 365 feet. The water is pumped into the site from the Red River. Although the Red River is not known as the cleanest river in Manitoba, it is not raw sewage either. It is presumed that the water in the dugout at Glenlea is much cleaner than the water at the sewage lagoon. No water analysis was done because of the inordinately high financial costs involved.

Apparatus

Weighing and measuring the geese. A hanging spring scale capable of recording up to 20 pounds and a large weighing cone were used to weigh each bird while the measurements were obtained with vernier calipers.

Bleeding the geese. A 70% solution of alcohol and water was rubbed on a vein to distend it. The 5 cc blood samples were obtained with a 5 cc syringe and a 20 gauge 1½ inch needle. Each sample was immediately transferred to a 10 ml blood vial and the serum extracted using a standard 5 3/4 inch pipette. It was stored in a freezer in 3 ml antigen tubes. Six inch wooden applicators were used to rim the clot if it was necessary to do so.

Transportation and capture. The geese were transported by truck and transport boxes to the two study sites. Fifty foot long by five feet high nylon nets were used to herd the flock into capture areas and hand nets were used where necessary

Procedure

Thirty-seven birds were selected by a process of restricted randomization and placed at the experimental site at the sewage lagoon. Ten more birds were selected for the control site at Glenlea. Two birds (the two smallest) were sacrificed and necropsied by provincial veterinarians.

Weighing and measuring the geese. All the birds were individually weighed in the spring of 1976 using a hanging spring scale and weighing cone with the weight being verified by two observers. The weights were also taken in the fall when all the birds were returned to the over-wintering site on the University of Manitoba Campus.

Each bird was picked up by one person in such a way that the wings were secured with the thumbs of both hands and the feet with the little fingers of both hands. The bird was then lowered head first into the weighing cone where it was restrained by light pressure of a hand on the back until it stopped struggling. The weight was then read by two observers who immediately compared the results. If necessary, the bird was weighed again until inter-observer reliability was assured. The measurements were recorded on a data sheet illustrated in Figure 2.

CANADA GOOSE DATA SHEET

AVIAN BEHAVIOR LABORATORY

Collar # ________ Gosling band # ________

Leg band # ________ Year hatched ________

Culman I ________ White Ring -
Yes Trace No

Culmen II ________

Culmen width ________ White on forehead -
Yes Trace No

Total tarsus ________

Tarsus length ________ Nail of mandible -
Normal Abnormal

Tarsus width ________

R. middle toe ________ Hook on cheek patch -
Yes Trace No

10th primary ________

Weight ________ Abnormalities ________________

Breast Color ________

Scutellation ________________

Parentage:	Band no.	Source of stock	Group no.
Father	________	________________	________
Mother	________	________________	________

Meets minimum standards - Yes No

Disposition: ____

____

- -

Minimum standards:	Males	Females
Culmen	62 mm.	58 mm.
Tarsus length	100 mm.	93 mm.
Weight - 18 months or older	14 lbs.	12 lbs.
6 to 18 months	13 lbs.	11 lbs.
Breast color	1 to 3	1 to 4

Pre- and post-study weights of the geese in the experimental and control groups were compared to see if there were any significant differences in weight changes.

The following measurements were taken on each bird using vernier calipers. These results were also verified by two observers. These measurements are diagrammed in Figure 3.

1. Culmen 1. This measurement is the length of the upper mandible, or bill, from the point where the feathered or unfeathered integument of the forehead contacts the horny portion of the mandible.

2. Culmen 2. Culmen 2 is defined as the length of the upper mandible from the maximum lateral extent of mandible, i.e., where the feathered skin meets the upper point, to the tip of the bill.

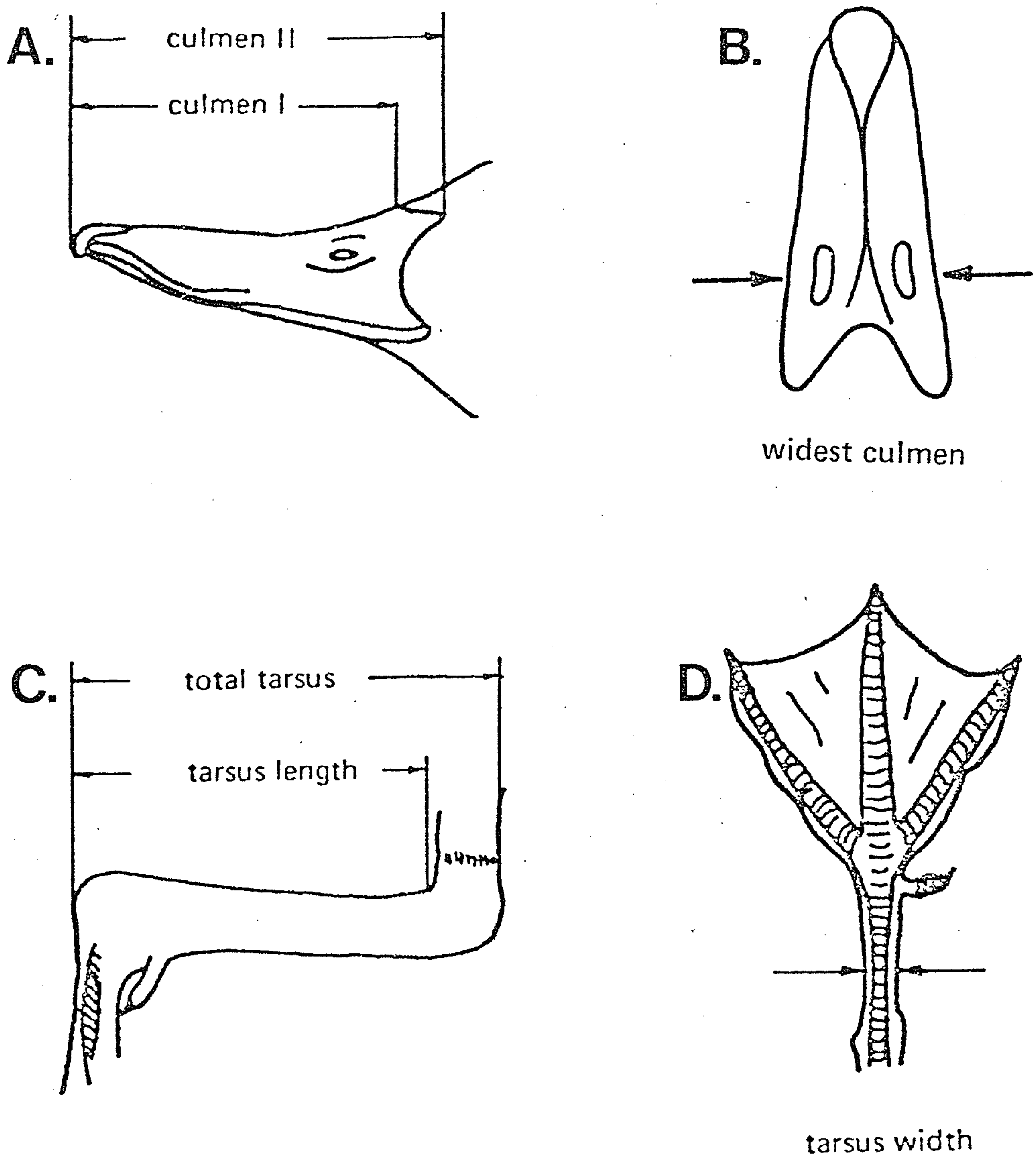
3. Widest culmen. The width of the upper mandible at the widest mid-point of the nares, or nostrils, is defined as the widest culmen.

4. Total tarsus. The total tarsus is the length of the leg from the most anterior medial condyle of the tarsus, or long leg bone, where it articulates with the mid-toe to the exterior portion of the skin covering and including the condyles of the tibia (when this bone is nearly at right angles to the tarsus).

5. Tarsus length. This measurement is defined as the length of the tarsus from the most anterior medial condyle of the tarsus, where it articulates with the mid-toe, to the round lateral edge of the articular surface where the tarsus (tarsus-meta tarsus) articulates with the exterior lateral condyle of the tibia.

6. Tarsus width. The tarsus width is measured midway between the ends of the bone, taken with the caliper at a right angle to the

CANADA GOOSE MEASUREMENTS



foot.

The following observations were also made on each bird in the fall when the flock was collected and transported back to the Campus overwintering site:

Color of the breast. The color of the breast of each bird was compared to a color chart obtained from the Munsell Color Co. Inc., 2441 N. Calvert St., Baltimore, Maryland. The color chart is composed of a series of colored chips ranging from white, through different shades of gray, to black. While one person held the bird, another person would hold the color chart up to the breast of the bird about 4 inches below the neck stocking, allowing some feathers to overlap on the chart for easy comparison.

White neck ring. Dill and Lee (1970), and Hanson (1965) describe a white ring on the neck at the base of the black neck stocking as an identifying characteristic of the *maxima*. The data were subjectively recorded as either the presence, absence, or trace of a white neck ring.

Hook on the cheek patch. Subjective data was also recorded on the presence, absence, or trace of a backward hook on the upper posterior of the cheek patch (Dill & Lee, 1970; Hanson , 1965).

White on the forehead. Dill and Lee (1970) and Hanson (1965) also note the common occurrence of white feathering above the eyes of many *maxima*. The data were again recorded subjectively as presence, absence, or trace.

Scutellation. The degree of scutellation was recorded as either positive or negative. Hanson (1965) describes the scutes of the *maxima* as unique to the species and being large, round, and irregular with center depressions and deep grooves.

Bleeding the Geese

Each bird to be bled, on April 17, 1976, was turned upside down, placed on a table with one wing stretched out and held securely by two people. The plumule feathers , or fluffy down, at the base of the wing were removed, exposing the skin. If the artery was not distended it was rubbed with a solution of 70% alcohol and water and tapped lightly. When the artery was distended, the needle was inserted into it and 5 cc of blood was slowly removed. If the artery collapsed, the other wing was used and the procedure was repeated. To stop the bleeding, pressure was applied with a cotton swab soaked in a 70% alcohol solution and the goose released. The blood sample was immediately transferred to a 10 ml blood vial and was allowed to sit at an angle (on a paper plate) for 5-10 minutes. It was then transferred to and stored in a refrigerator overnight. If at least 2 cc of blood serum did not separate, the clot was rimmed using the 6 inch wooden applicator and again allowed to sit (rimming is loosening the clot and allowing it to go back into suspension). If the serum still did not separate, the sample was centrifuged. The serum, which separated and came to the top, was drawn off using the pipette and transferred to a 3 ml antigen tube where it was labelled and stored in a freezer. If any disease, as determined by veterinary inspection, was noted in the geese in the fall, the serum samples would be analyzed to determine whether or not the flock was carrying the disease prior to placement at either site.

Inspection by Veterinarians

The two birds sacrificed were necropsied in the spring of 1976 to ascertain their general physiological condition. A government veterinarian inspected the flock prior to placement at the summer sites and after their return to the overwintering site on campus. It was assumed that the physical condition of the sacrificed birds was indicative of the remainder of the flock.

This generalization may be a gross one but necessary since it is not feasible to sacrifice a large sample of your flock to determine their overall health. It is also not feasible to sacrifice your best breeders or potential breeders for necropsy. Their genes are required for future use.

All the geese which died over the previous four years have been autopsied by provincial verterinarians. The government reports were studied and all causes of death listed and made available to the veterinarians as an indicator of possible problems within the flock. In the event that unhealthy birds were noted, blood samples would be obtained from these birds and these samples would then be compared to the samples of blood obtained prior to the study site placement.

<u>Mortality</u>

The mortality rate of the experimental and control groups was compared as were individual autopsy reports from government veterinarians regarding the cause of death.

CHAPTER III

RESULTS

Conformation Statistics

Based on the data available from the Canadian Wildlife Service from the "Rochester flock" (see Hanson, 1965; Raveling, 1976) and from the literature, six measurements and four observations were chosen to be differentially weighted in order to obtain conformation norms against which birds suspected to be of the subspecies *maxima* could be compared. The six measurements, described in detail in the Method section, are: a) culmen 1 b) culmen 2 c) culmen width d) total tarsus e) tarsus width and f) weight. The observations made were as follows: a) color phase b) white neck ring c) white on forehead and d) hook on cheek patch.

All the available data on these measurements from several different flocks are summarized in Tables 1 to 8. These flocks were classified as *maxima* and it was guardedly assumed that they were all, in fact, *maxima*. The small sample sizes and the lack of adequate descriptive statistics prevented meaningful population inferences from being generated from this collection of data. Nonetheless, on the basis of this data a weighting system was devised and used to assign weighted points to each individual measurement on the birds being studied. This system can be modified in the future as additional data is received and analyzed. In its present form, however, it may be described as indicated in the following paragraphs. The data for the various flocks used in forming this system are all arranged in Tables 1 to 6 and include the

TABLE 1

Weights of Several Populations of Canada Geese

Source	Reference	Sex		Mean	Range
Round Lake	Hanson (1965)	♂	7	6525	4940-7484
		♀	13	5414	4270-6435
South Manitoba	Hanson (1965)	♂	9	4851	4220-5270
		♀	8	3781	3600-4070
Rochester	Hanson (1965)	♂	13	4884	4196-5415
		♀	7	3868	3572-4167
Ohio	Hanson (1965)	♂	8	6132	5216-6804
		♀	5	5387	4536-6350
Manitoba	Raveling (1976)	♂	23	5208	4470-5815
		♀	22	4437	3730-4915
Manitoba	Raveling (1976)	♂	15	4555	4080-5030
		♀	12	3895	3480-4680
Manitoba	Raveling (1976)	♂	18	4802	4270-5660
		♀	15	4067	3550-5270
Manitoba	Hanson (1965)	♂	3	4477	4200-4800
		♀	2	3858	3720-3995
Saskatchewan	Hanson (1965)	♂	1	4780	-
		♀	2	3200	3125-3275
Alberta	Hanson (1965)	♂	1	4610	-
		♀	1	3790	-
South Dakota	Hanson (1965)	♂	13	4104	3685-4905
		♀	9	3453	3289-3799
South Dakota	Hanson (1965)	♂	7	4192	3686-5018
		♀	8	3721	3402-4082
Missouri	Brakhage (1963)	♂	47	4886	-
		♀	61	4193	
Missouri	Hanson (1965)	♂	55	4626	
		♀	74	3830	
Rochester (1975)	CWS Raw Data	♂	15	4305	3620-5150
		♀	15	3754	3100-4540

TABLE I (Continued)

Source	Reference	Sex		Mean	Range
Rochester 1962-67	CWS (Note	♂	129	4650	
		♀	121	3945	
Waterhen 1970-71	CWS	♂	12	4335	4040-5900
	Raw Data	♀	8	3778	3270-4290
	Bellrose	♂	Stated	5725	-
	(1976)	♀	Average	4995	-
Jamestown	Dill & Lee	♂	Minimum	4950	-
	(1970)	♀	Retain	4500	-
Jamestown	Dill & Lee	♂	Minimum	6300	-
	(1970)	♀	Breed	5400	-

Note: All weights in grams.

TABLE 2

Culmen Width

Source	Reference	Sex		Mean	Median	Range
Waterhen 1970-71	CWS Raw Data	♂	12	25.3	23.0	22.3-28.1
		♀	10	22.0	22.0	18.6-24.1
Rochester 1975	CWS Raw Data	♂	15	24.9	24 & 26	23.0-26.0
		♀	16	23.7	24.	22.0-26.0
Rochester	Hanson (1965)	♂	19	24.6	-	23.0-25.7
		♀	10	23.8	-	22.3-25.4
Museum	Hanson (1965)	♂	14	24.0	-	22.9-26.8
		♀	3	23.5	-	22.6-24.5

Note: All measurements in mm.

TABLE 3

Culmen 2 Measurements

Source	Reference	Sex		Mean	Median	Range
Waterhen 1970-71	CWS Raw Data	♂	12	67.0	69.0	58.4-75.6
		♀	10	64.0	64-65-66	57.1-70.0
Rochester 1975	CWS Raw Data	♂	15	70.6	70.0	66.5-76.9
		♀	17	64.8	67.0	60.5-69.0

Note: All measurements in mm.

TABLE 4

Culmen 1 Measurements

Source	Reference	Sex		Mean	Median	Range
Waterhen 1970-1971	CWS Raw Data	♂	12	56.6	56.0	52.0-66.0
		♀	10	54.6	56.0	48.0-61.0
Rochester 1962-1967	CWS (Note	♂	66	59.0	60.0	50.0-68.0
		♀	49	54.0	54.0	48.0-61.0
Rochester 1975	CWS Raw Data	♂	15	58.7	59.0	52.0-62.0
		♀	17	53.7	55.0	49.0-58.0
	Hanson (1965)	♂	8	65.3	-	61-72
		♀	14	59.8	-	55-63
	Hanson (1965)	♂	10	58.3	-	51-62
		♀	6	54.8	-	53-56
	Hanson (1965)	♂	9	59.4	-	54-62
		♀	6	54.0	-	51-56
	Bellrose (1976)	♂	Stated	60.7	-	-
		♀	Average	57.3		51-55
	Hanson (1965)	♂	Stated	56.0	-	-
		♀	Average	55.0	-	-
Jamestown N.D.	Dill & Lee (1970)	♂	Minimum	62.0	-	-
		♀	Breed	58.0	-	-
Jamestown N.D.	Dill & Lee (1970)	♂	Minimum	56.0	-	-
		♀	Retain	52.0	-	-

Note: All measurements in mm.

TABLE 5

Total Tarsus Measurements

Source	Reference	Sex		Mean	Median	Range
Waterhen 1970-71	CWS Raw Data	♂	12	116	115	108-122+
		♀	10	106	-	95-109
Rochester 1962-1967	CWS (Note	♂	58	116	117	106-122+
		♀	43	106	106&109	99-115
Rochester 1975	CWS Raw Data	♂	15	113	113	105-119
		♀	17		103&105	95-113

Note: All measurements in mm.

Table 6

Tarsus Width

Source	Reference	Sex		Mean	Median	Range
Waterhen (1970-71)	CWS Raw Data	♂	12	14.2	-	12.7-17.0
		♀	10	12.8	-	11.0-14.0

Note: All measurements in mm.

TABLE 7

Frequency of Presence of a White Neck Collar

	Avian Behav. Lab. 1976	Waterhen 1970-1971	Rochester 1962-1967	Rochester 1975
Present	6		57	21
Trace	13		41	--
Absent	37		29	11

TABLE 8

Frequency of Presence of White on the Forehead

	Avian Behav. Lab. 1976	Waterhen 1970-1971	Rochester 1962-1967	Rochester 1975
Present	--		--	15
Trace	13		40	--
Absent	43		59	17

means for male and female in each population, the median score for each sex per population and the range for each sex in each population.

1. The single, lowest, individual measurement per sex, as indicated by the lowest figure in the ranges listed, was allowed to be the lowest acceptable value for each measurement of a bird to be studied. Any measurements under this level were assigned a value of zero points.

2. Individual measurements which fell above the minimum level assigned in 1 above, but below the value of the smallest mean for that measurement listed in the table were assigned a numerical score of "X" points. "X" was decided on the basis of the amount of data available on that measurement, which are summarized in the tables, and the variability of that data.

3. Any individual measurement which falls above the value of the lowest mean listed in the tables, but below the value of the highest figure in the ranges listed, was assigned a score of "Y" points, which must be higher than the value of "X".

4. A measurement lying above the upper limit of the highest range listed would be assigned a value of "Y" -1. This is a built-in factor to discourage a type of "forced evolution" in captive flocks where birds are selectively bred for larger and larger features independent of natural selection.

The assigned values, according to the system of classifying a Canada goose as a maxima, were as follows and are summarized in Table 9.

Culmen width. A relatively large sampling of data was available on this measurement, as summarized in Table 2. Variability was low and this measurement, according to Hanson (1965), is a reliable indicator of

TABLE 9

Conformation Specifications for Giant Canada Geese

CULMEN WIDTH

♂

Under 23 mm - 0 pts
Between 23 & 26 mm=6 pts
Over 26 mm = 5 pts

♀

Under 22 mm = 0 pts
Between 22 & 24 mm=6 pts
Over 26 mm = 5 pts

CULMEN 1

♂

Under 51 mm = 0 pts
Between 51 & 56 mm=2 pts
Between 56 & 72 mm=4 pts
Over 72 mm = 3 pts

♀

Under 48 mm = 0 pts
Between 48 & 52 mm=2 pts
Between 52 & 63 mm=4 pts

CULMEN 2

♂

Under 60 mm = 0 pts
Between 60 & 67 mm=1 pt
Between 67 & 71 mm=2 pts
Over 71 mm = 1 pt

♀

Under 57 mm = 0 pts
Between 57 & 63 mm=1 pt
Between 63 & 67 mm=2 pts
Over 67 mm = 1 pt

TOTAL TARSUS

♂

Under 105 mm = 0 pts
Between 105-113 mm=3 pts
Between 113-122 mm=4 pts
Over 122 mm = 3 pts

♀

Under 95 mm = 0 pts
Between 95-103 mm=3 pts
Between 103-115 mm=4 pts
Over 115 mm = 3 pts

WEIGHT

♂

Under 4050 gms = 0 pts
Between 4050-4500 gms=1 pt
Between 4500-4950 gms=2 pts
Over 4950 gms = 4 pts

♀

Under 3600 gms = 0 pts
Between 3600-4050 gms=1 pt
Over 4050 gms = 4 pts

WHITE NECK RING

Presence = 2
Absence = 0
Trace = 1

WHITE ON FOREHEAD

Presence = 2
Absence = 0
Trace = 1

COLOR PHASE

Light 1 to 3=2
Med. 3 to 5 = 1
Dark 5 & up = 0

HOOK ON CHEEK PATCH

Present = 3
Absent = 0

TARSUS WIDTH

♂

Under 12.7 = 0 pts
Over 12.7 = 1 pt

♀

Under 11.0 = 0 pts
Over 11.0 1 pt

BREEDER: 20+
PROBATION: 17-20
REJECT: 0-17

the subspecies. For this reason, culmen width was weighted the heaviest of all the measurements with a maximum of six points. The ranges and assigned points can be found in Table 9.

Tarsus width. A very limited amount of data was available concerning this measurement and it was obtained from only one sample. The data are summarized in Table 6. Tarsus width, for the present, is weighted very lightly as shown, in Table 9, until more data become available.

Total Tarsus. The range and assigned points of this measurement are described in Table 9. These data were relatively straightforward but were weighted less than culmen width due to greater variability in the data.

Culmen 1. The literature plus the raw data available for analysis enabled a comparison between ten different sources of means for this measurement. The variability associated with this data, however, resulted in slightly less weight being assigned to it than for culmen width.

Culmen 2. This measurement was not obtained as often as the other measurements, hence less data was available for comparison purposes. For this reason culmen 2 measurements are weighted relatively low.

Weight. This measurement is highly variable from population to population, from season to season, and from male to female. Dill and Lee (1970) noted that the minimum requirement for an adult male Canada goose to be retained in their flock is 4950 grams. In a breeder, i.e., a goose which is allowed to nest and propagate, the minimum weight is 6300 grams. Based on these requirements, only one flock of the 17 sampled has a mean weight which meets the minimum for breeder stock and only three of the 17 samples reviewed in this thesis meet the minimum requirements necessary to be retained in the Dill and Lee (1970) flock. The range in the weight data, as indicated in Table 1, is from 3125 grams to 7484 grams. The range in the mean weights of each population is from 4104 grams to 6525 grams. The film "Wild Chorus" (Note 1) comments that the weight of the giant Canada goose is between 10 and 18 pounds. The film "Prairie Giant" (Note 2) states that the weight of this bird extends as high as 18 pounds or 8100 grams. Not one single goose in the data available in Table 1 approaches that size.

Hanson (1965) notes that captive geese tend to be slightly larger in weight than wild birds. This fact could explain the standards set by Dill and Lee (1970).

The considerable variability and the plasticity of this measurement resulted in a relatively low weighted score being assigned to this measurement, even though it is widely quoted as the most significant identifying characteristic of this subspecies (Hanson, 1965).

Scutellation. The scale pattern on the tarsi and webbed feet of the geese could not be conclusively differentiated from other species. Interobserver reliability was very poor. For the purpose of identifying birds as *maxima*, it is suggested that this variable should not be used until more data is available and better methods of discriminating one scale pattern from another are found.

White feathering on the forehead and white neck collar. Dill and Lee (1970) and Hanson (1965) noted that the presence of a white neck ring and the presence of white feathering on the forehead are desirable characteristics but are not required to classify a bird as a maxima. These observations are, therefore, weighted very lightly. They were not common characteristics in the birds sampled.

Cheek patches. Hanson (1965) noted that "the recognition of maxima is virtually certain if the top of the cheek patches....have a small hook or projection extending posteriorly" (p. 41). On this basis, the presence of a hook is weighted rather heavily.

Breast color. Breast color on the maxima is much lighter than other large races (Hanson, 1965; Dill & Lee, 1970). The rating system described by Dill and Lee (1970) was chosen although the Munsell color chart had since been revised. The Munsell Company advised the author that the numbers on the new chart were similar to the old one but had finer distinctions (fractions) between whole numbers. Difficulty in determining breast color arose in matching the breast color to the color chips. Interobserver reliability was highly variable. For this reason, breast color is rated very low.

More information must be obtained and a more efficient method of matching breast color to color chips devised. A suggested method for the future is for a single color chip to be used with a specific value assigned to geese with lighter breasts and no points assigned to geese with darker breast feathers.

Total number of points for maxima status. It was arbitrarily decided that a bird must attain a minimum of 20 points to be permanently retained in the Avian Behavior Laboratory flock. In order to account for a slow maturing bird or a bird who may be temporarily substandard, a probationary range between 17 and 20 points is suggested. A bird in this range would be maintained in the flock for a period of one year during which time it is suggested that it not be allowed to breed or be included in any research. If, at the end of the probationary year the bird is still below breeder status, it will be rejected.

Tables 10 and 11 show all the birds in the flock of the Avian Behavior Laboratory, their measurements, points and status. The weights used in these tables are the weights obtained in the spring of 1977. These weights, it is assumed, are more indicative of a healthy bird in relatively good physical condition than their fall weights, which tend to reflect their study site locations.

On the basis of this system, the results of which are presented in Tables 10 and 11, 47 birds were classified as maxima and retained for breeding and research purposes. Six geese (Nos. 2, 13, 144, 171, 150, 175) will be retained for a probationary period of one year at which time they will be remeasured. One bird (No. 45) was rejected and culled from the flock.

On the basis of the information required to assess each bird, a new data sheet was designed as diagrammed in Figure 4.

Sewage Lagoon Placement

Spring 1976 to fall 1976. The experimental group, consisting of 41 birds, and the control group, consisting of 10 birds, were weighed in the spring of 1976 and the two groups were compared statistically using an independent t-test. A significant difference was found between the two groups and as a result, six experimental birds and one control bird were eliminated from the experiment, resulting in the two groups beginning the experiment with no significant weight differential $t(33) = -1.60$, $p > .05$. Refer to Table 12 for a summary of all statistics.

TABLE 10

Conformation Statistics of Male Geese in Avian Behavior Laboratory Flock, Fall 1976

Bird No.	Culmen 1	Pts	Culmen 2	Pts	Culmen Width	Pts	Total Tarsus	Pts	Tarsus Width	Pts	Weight (Spring 77)	Pts
2	643	4	723	2	277	5	1173	4	107	0	5760	4
3	578	4	659	1	247	6	1117	3	97	0	4815	2
13	600	4	680	2	261	5	1122	3	94	0	4545	2
14	603	4	707	2	255	6	1114	3	94	0	4230	1
23	613	4	705	2	260	6	1139	4	102	0	5040	4
29	591	4	676	2	246	6	1124	3	100	0	4995	4
31	579	4	695	2	249	6	1110	3	94	0	4770	2
33	546	4	714	2	240	6	1124	3	85	0	4725	2
35	603	4	719	2	247	6	1096	4	91	0	5175	4
45	534	2	626	1	226	6	1017	0	98	0	3870	0
130	605	4	727	2	241	6	1224	4	90	0	4995	4
132	633	4	721	2	246	6	1160	4	83	0	5940	4
134	657	4	735	2	234	6	1183	4	92	0	5850	4
135	650	4	718	2	240	6	1235	4	130	1	4995	4
136	650	4	710	2	254	6	1258	4	105	0	6797	4
138	586	4	694	2	248	6	1210	4	140	1	5715	4
139	643	4	726	2	241	6	1232	4	89	0	5400	4
142	686	4	787	2	254	6	1227	4	93	0	5715	4

TABLE 10 (Continued)

Bird No.	Color Phase	Pts	White Forehead	Pts	White Collar	Pts	Hook	Pts	Total Points	Status
2	7.75	0	A	0	A	0	A	0	19	Pr
3	8.0	0	T	1	T	1	P	3	21	B
13	8.0	0	A	0	A	0	P	3	19	Pr
14	8.0	0	A	0	T	1	P	3	20	B
23	7.75	0	A	0	A	0	P	3	23	B
29	8.25	0	T	1	P	2	P	3	25	B
31	7.75	0	A	0	T	1	P	3	21	B
33	7.75	0	T	1	T	1	P	3	22	B
35	6.75	0	A	0	A	0	P	3	23	B
45	7.5	0	T	1	T	1	A	0	11	R
130	8.0	0	A	0	P	2	P	3	25	B
132	8.5	0	A	0	T	1	A	0	21	B
134	7.25	0	A	0	A	0	A	0	20	B
135	8.25	0	A	0	A	0	P	3	24	B
136	7.5	0	A	0	T	1	P	3	24	B
138	8.25	0	A	0	A	0	P	3	24	B
139	8	0	A	0	T	1	P	3	24	B
142	8.00	0	A	0	A	0	A	0	20	B

TABLE 10 (Continued)

Bird No.	Culmen 1	Pts	Culmen 2	Pts	Culmen Width	Pts	Total Tarsus	Pts	Tarsus Width	Pts	Weight (Spring 77)	Pts
144	617	4	700	2	244	6	1208	4	89	0	4725	2
147	564	4	673	2	244	6	1176	4	99	0	5265	4
149	633	4	751	2	256	6	1256	4	99	0	5130	4
151	578	4	675	2	248	6	1179	4	96	0	6570	4
154	586	4	692	2	253	6	1224	4	96	0	4455	1
156	581	4	677	2	247	6	1193	4	89	0	3960	0
161	642	4	735	2	249	6	1184	4	96	0	5130	4
163	622	4	686	2	252	6	1222	4	90	0	5985	4
164	618	4	719	2	248	6	1118	3	94	0	4545	2
165	634	4	746	2	257	6	1220	4	100	0	5265	4
167	558	2	652	1	236	6	1179	4	92	0	5040	4
168	603	4	690	2	259	6	1221	4	100	0	5310	4
171	617	4	717	2	248	6	1126	3	86	0	4725	2

Note: All measurements in mm except weight (grams).

A = Absent; T = Trace; P = Present; B = Breeder; Pr = Probation; R = Reject.

TABLE 10 (Continued)

Bird No.	Color Phase	Pts	White Forehead	Pts	White Collar	Pts	Hook	Pts	Total Points	Status
144	8.5	0	T	1	A	0	A	0	19	Pr
147	7.5	0	A	0	A	0	A	0	20	B
149	7.5	0	A	0	T	1	P	3	24	B
151	8.75	0	A	0	A	0	A	0	20	B
154	7.75	0	A	0	A	0	P	3	20	B
156	6.5	0	T	1	T	1	P	3	21	B
161	8.0	0	A	0	A	0	A	0	20	B
163	7.75	0	A	0	A	0	A	0	20	B
164	8.0	0	A	0	A	0	P	3	20	B
165	8.0	0	A	0	A	0	P	3	23	B
167	8.25	0	T	1	A	0	P	3	21	B
168	7.75	0	A	0	A	0	P	3	23	B
171	8.25	0	A	0	A	0	A	0	17	Pr

TABLE 11

Conformation Statistics of Female Geese in Avian Brhavior Laboratory Flock, Fall 1976

Bird No.	Culmen 1	Pts	Culmen 2	Pts	Culmen Width	Pts	Total Tarsus	Pts	Tarsus Width	Pts	Weight Spring 77	Pts
5	564	4	639	2	227	6	1018	3	87	0	4905	0
9	595	4	660	6	229	6	1074	4	94	0	4770	4
12	571	4	656	2	239	6	1051	4	86	0	4995	4
28	538	4	627	2	118	6	980	3	84	0	4410	4
30	572	4	657	2	231	6	1054	4	81	0	3960	4
32	548	4	632	2	242	5	1022	3	90	0	3870	4
34	588	4	699	1	242	5	1130	4	90	0	5310	4
36	562	4	620	2	231	6	1018	3	82	0	4365	4
37	566	4	674	2	240	6	1041	4	96	0	5130	4
44	570	4	648	2	244	5	1046	4	90	0	5175	4
47	631	3	734	1	270	5	1096	4	89	0	5130	4
133	549	4	610	2	225	6	1116	4	87	0	4500	4
140	597	4	662	2	234	6	1124	4	95	0	4635	4
141	576	4	630	2	249	5	1084	4	91	0	3870	4
145	577	4	666	2	228	6	1027	3	88	0	4950	4

TABLE 11 (Continued)

Bird No.	Color Phase	Pts	White Forehead	Pts	White Collar	Pts	Hook	Pts	Total Points	Status
5	8.25	0	A	0	P	2	P	3	24	B
9	8.0	0	A	0	A	0	P	3	23	B
12	8.0	0	T	1	A	0	P	3	24	B
28	7.25	0	A	0	A	0	P	3	22	B
30	7.0	A	0	0	A	0	P	3	23	B
32	7.75	0	A	0	A	0	P	3	21	B
34	8.25	0	A	0	A	0	P	3	21	B
36	7.5	0	T	1	A	0	P	3	23	B
37	7.0	0	A	0	A	0	P	3	23	B
44	8.25	0	A	0	T	1	P	3	23	B
47	8.25	0	T	1	A	0	P	3	21	B
133	7.75	0	A	0	P	2	A	0	22	B
140	8.0	0	A	0	A	0	P	3	23	B
141	8.25	0	A	0	A	0	P	3	22	B
145	8.25	0	A	0	A	0	P	3	22	B

TABLE 11 (Continued)

Bird No.	Culmen 1	Pts	Culmen 2	Pts	Culmen Width	Pts	Total Tarsus	Pts	Tarsus Width	Pts	Weight Spring 77	Pts
150	575	4	612	2	230	6	995	3	97	0	4455	4
158	594	4	698	1	237	6	1016	3	90	0	4050	4
160	550	4	645	2	238	6	1148	4	94	0	4140	4
169	604	4	706	1	226	6	1110	4	91	0	4680	4
170	584	4	700	1	235	6	1018	3	86	0	4320	4
174	590	4	707	1	235	6	1152	3	90	0	4455	4
175	602	4	721	1	222	6	1068	4	85	0	4365	4
177	643	3	764	1	243	5	1222	3	98	0	5985	4

Note: All measurements in mm except weight (grams)

A = Absent; T = Trace; P = Present; B = Breeder; Pr = Probation

TABLE 11 (Continued)

Bird No.	Color Phase	Pts	White Forehead	Pts	White Collar	Pts	Hook	Pts	Total Points	Status
150	8.0	0	A	0	A	0	A	0	19	Pr
158	8.25	0	A	0	A	0	P	3	21	B
160	7.75	0	A	0	A	0	P	3	23	B
169	8.0	0	A	0	T	1	P	3	23	B
170	9.0	0	A	0	P	2	A	0	20	B
174	8.0	0	T	1	A	0	P	3	22	B
175	8.25	0	A	0	A	0	A	0	19	Pr
177	8.5	0	T	1	A	0	P	3	20	B

Collar #________ **CANADA GOOSE DATA SHEET** Date________

Legband ________ **AVIAN BEHAVIOR LABORATORY** Status: Breeder____

Sex________ Probation____

Rejected____

HISTORY

Source ________ Year Hatched________

Father ________ Gosling band # ________

Mother ________ Incubation ________

VITAL STATISTICS

MEASUREMENTS

	RAW DATA	ASSIGNED POINTS
CULMEN 1	____mm	____
CULMEN 2	____mm	____
CULMEN WIDTH	____mm	____
TOTAL TARSUS	____mm	____
TARSUS WIDTH	____mm	____
WEIGHT	____gms	____

SUBTOTAL MEASUREMENTS ________Pts

SUBTOTAL OBSERVATIONS ________Pts

TOTAL:

____ TO ____ = BREEDER

____ TO ____ = PROBATION

UNDER ______ = REJECT

OBSERVATIONS

		POINTS
COLOR PHASE		
DARK:	______	
MED:	______	
LIGHT:	______	______
WHITE NECK RING		
YES:	______	
TRACE:	______	
NO:	______	______
WHITE FOREHEAD		
YES:	______	
TRACE:	______	
NO:	______	______
HOOK ON CHEEK PATCH		
YES:	______	
NO:	______	______

OTHER MEASUREMENTS

NAIL OF MANDIBLE -

NORMAL - ABNORMAL

SCUTELLATION -

MAXIMA OTHER

TARSUS LENGTH ________

R.MIDDLE TOE ________

70th PRIMARY ________

NOTES ON ABNORMALITIES, DISPOSITION, OR DOMINANCE:

TABLE 12

Group Comparisons of Weight

Group[a]		Mean[b]	Test	df	Result	Level of Sig.
FALL 1976						
Exp. S 76 Control S 76	28 8	4390.7 4615.7	$t_I = -1.60$	33	Not Sig.	p .05
Exp. S 76 Exp. F 76	28 28	4390.7 3915.0	$t_D = 7.09$	27	Sig.	p .001
Control S 76 Control F 76	8 8	4615.7 5130.0	$t_D = -1.62$	7	Not Sig.	p .05
Exp. F 76 Control F 76	28 8	3915.0 5130.0	$t_I = -7.48$	33	Sig.	p .001
SPRING 1977						
Exp. S 77 Control S 77	28 7	4998.0 5349.0	$t_I = -1.41$	33	Not Sig.	p .05
Exp. S 76 Exp. S 77	28 28	4390.7 4998.0	$t_D = -8.60$	27	Sig.	p .001
Control S 76 Control S 77	7 7	4615.7 5348.6	$t_D = -7.16$	6	Sig.	p .001
Exp. F 76 Exp. S 77	28 28	3915.0 4998.0	–	27	Sig.	p .001
Control F 76 Control S 76	7 7	5136.4 5348.6	$t_D = -1.97$	6	Not Sig.	p .05
MATURITY FACTOR						
Mature S 76 Mature S 77	9 9	4475.0 4810.0	$t_D = -3.32$	8	Sig.	p .02
Immature S 76 Immature S 77	19 19	4350.8 5087.4	$t = -9.49$	18	Sig.	p .001

a. Exp. = Experimental; S = Spring; F = Fall; 76 = 1976; 77 = 1977.

b. All weight reported in mm.

Twenty-six of 28 geese remaining in the experimental group in the fall of 1976 lost an average of 475.7 grams per bird during their confinement to the sewage lagoon (April 17, 1976 to October 9, 1976). This represents 11% of the original body weight of these birds. Two birds each gained 45 grams or .01% of their original body weight. The weight differential among these birds ranged from a gain of 45 grams (+.01%) to a loss of 900 grams (-18%). A dependent t-test performed on the pre- and post-study site placement weights indicated that the weight loss was not a chance effect, $\underline{t}(27) = 7.09$, $\underline{p} < .001$.

One of the remaining nine birds in the control group died during the experiment. The necropsy report indicated that its death was due to "factors normally associated with sporadic losses in waterfowl" (see Appendix B, Veterinarian's Report). Of the remaining eight birds, all gained weight over the course of the summer. The gain per bird ranged from +90 grams (.02%) to +945 grams (20%) or an average of 10% gain in weight per bird. A dependent t-test, however, indicated that the difference was not significant, $\underline{t}(7) = -1.62$, $\underline{p} > .05$.

As noted previously, the experiment began with no significant difference existing between the experimental and the control groups. An independent t-test at the end of the experiment revealed that a significant difference had developed between the two groups, $\underline{t}(33) = -7.4$, $\underline{p} < .001$. The average weight differential between the two groups at the end of the experiment was 1215 grams compared to a differential of 270 grams at the beginning of the summer.

Spring 1976 to spring 1977. On March 19, 1977, the weights from all the birds were again obtained. This date was almost one full year from the beginning of the experiment and allowed a comparison of the reduced weights, obtained in the fall of 1976, to be made with the weights of the same birds after five months of near optimal conditions at the overwintering site. The experimental group, interestingly, gained more than the control group over this period of time, resulting in the two groups weighing about the same with no significant difference between them $\underline{t}(33) = -1.41$, $\underline{p} > .05$. Both the control group, $\underline{t}(6) = -7.16$, $\underline{p} <$ .001 and the experimental group $\underline{t}(27) = -8.60$, $\underline{p}$ .001 showed significant gains over the full year from spring 1976, to spring 1977, regardless of where they were located during the course of the summer. The individual data collected is reported in Appendix C.

Mature vs immature birds. One interpretation of the significant weight gain between the spring of 1976 and the spring of 1977 is that the birds gained weight because of maturational factors. To test the hypothesis that the difference in weight between the two groups was attributable to a maturation factor the experimental group was divided into nine mature (three or more summers) birds and 19 immature birds. Both the mature birds, $\underline{t}(8) = -3.32$, $\underline{p} < .02$, and the immature birds, $\underline{t}(18) = -9.49$, $\underline{p} > .001$, showed significant weight gains from the spring of 1976 to the spring of 1977. Therefore, since both groups revealed significant differences, maturation must be ruled out as the critical variable associated with the observed weight differential. Any effect of maturation can be assumed to be minimal.

Mortality

A total of 41 geese were placed at the experimental site at the Charleswood Sewage Lagoon. Of these 41 geese, six were eliminated from the experiment to ensure a non-significant difference between the experimental and control groups at the beginning of the experiment. All six of these birds survived the summer. Seven of the remaining 35 birds were presumably lost to predators or poachers, over the period of confinement. Hence, no bodies were available for necropsies.

Of the ten birds placed at the control site, one was eliminated at the beginning of the experiment to ensure a non-significant difference between the experimental and control groups at the beginning of the experiment. This bird survived the summer. One other bird died and a necropsy performed by a provincial veterinarian indicated that death was the result of Visceral Amyloidosis with termal dehydration and Visceral Gout (see Appendix B). For a further discussion of these diseases, please refer to Dougherty, Rickard, and Scott (1963); Rigdon (1961); and Rigdon, (1967).

Pathological Inspection

Dr. L. Lillie, a government veterinarian, inspected the flock on November 4, 1976, after they were returned to the overwintering site on the University of Manitoba Campus. He found the flock to be in excellent condition with no apparent signs of disease. A copy of his report can be found in Appendix B.

Blood Serum

In view of the low non-predator mortality and relatively good health of the flock in general, as confirmed by Dr. L. Lillie, an analysis of the blood serum was deemed to be unnecessary, again by Dr. Lillie.

CHAPTER IV

DISCUSSION

Conformation Specifications

The conformation specifications reported in Table 9 are based on a very limited sampling of birds that were reported to be of the subspecies maxima. How these authors determined that these birds were, in fact, maxima is not known. The results in Tables 1 to 8 are reported under the assumption that the data reported in the literature were collected from maxima. The possibility exists that some of these birds were of smaller subspecies and therefore the specifications which were calculated from this data will result in the acceptance into the Avian Behavior Laboratory flock of smaller subspecies of Canada geese. For this reason, the specifications in Table 9 are not considered absolute but will be altered as more data are collected and analyzed.

If some birds reported in the literature were not maxima then it can be assumed that the entire flock was not maxima. Hanson (1965) and Bellrose (1976) both indicate that the maxima does not mix with other subspecies and remains mutually exclusive, preferring smaller flocks of conspecifics which are usually made up of one or two family groups. The possibility of mistaking the odd individual bird for a maxima is always present, but the erroneous identification of an entire flock by these experts in the field is very unlikely. Therefore, we are relatively confident that the birds reported in the literature as maxima were, in fact, giant Canada geese.

The absence of descriptive statistics in the literature necessitates an objective analysis of the data and arbitrary assignation of values to particular measurements. These specifications are meant to be used as a relative guideline in choosing birds for the flock of the Avian Behavior Laboratory at the University of Manitoba. As more and more data become available, these specifications will be modified until conformation specifications are obtained that will reliably identify individual members of the subspecies *Branta canadensis maxima*. At the same time, behavioral research should be conducted with these birds with the intention of eventually using behavioral data as taxonomic tools.

Consequences of Sewage Lagoon Placement

The experimental and control groups began the experiment at roughly the same weights, as indicated by the non-significant t-test. The experimental group lost a significant amount of weight while the control group gained slightly although not significantly. The lost weight of the experimental group was regained and a significant increase over the original weight resulted after a winter on a diet of commercial food, fresh greens (lettuce, cabbage, and celery cuttings), and a grain supplement composed mostly of triticale with some barley. The control group also showed a significant increase over the entire year on the same winter diet.

There are several possible explanations for the above results and they will be discussed under the following headings: a) Possible Effects of Raw Sewage b) Maturity of Individual Birds and c) Diet.

Possible effects of raw sewage. The significant difference in weight between the control group and the experimental group suggests that the sewage lagoon exerts a negative effect on the birds placed there.

The primary suspect would appear to be the raw sewage and liquid pollution in various stages of purification.

Kibbins and Shapiro (Note 9) indicated that the flock, in fact, spent very little time in cells 1 and 2, which were composed mostly of raw sewage. The majority of their time was spent around the ponds with the cleanest water. Therefore, they had very little contact with the raw sewage. The low non-predator mortality rate over the period of the experiment is an indication that the effects of this environment are not immediately terminal. Of the seven birds lost over the summer, no carcasses were recovered for necropsy and the probable cause of death was natural predation. Foxes have been observed in the area and direct empirical evidence has been obtained in the past indicating that a number of geese have fallen prey to predators.

The inspection of the flock by Dr. L. Lillie, Chief Veterinary Pathologist of the Department of Agriculture, indicated that the flock appeared normal and in good health after their summer at the sewage lagoon (Appendix B). Dr. Lillie noted that "the live birds appeared entirely normal in appearance and behavior.... . No evidence of clinical disease or other abnormality was seen in the geese."

Until further research is conducted which pinpoints the sewage as the cause of this weight loss, there does not appear to be enough evidence to support the statement that sewage, in any stage of treatment, has positive or negative effects on Canada geese. It can, however, be concluded that something in the environment resulted in the significant loss of weight, all of which was regained when removed from this environment. Maturation and diet are other possible variables which must be considered.

<u>Maturity of individual birds</u>. From spring 1976 to spring 1977 it was observed that both groups gained significant amounts of weight. Two variables which might account for this observation are maturity and diet. Nineteen of 28 experimental birds were immature, i.e., in their second summer. Five of nine control birds were also immature. Hanson (1965) notes that a giant Canada goose does not reach sexual maturity until it is two years old, i.e., in its third summer. It is very possible that the immature birds gained weight over the full year due to the natural growth of their maturing bodies. If maturation was indeed a factor in the observed weight gain, it could be assumed that mature birds would remain relatively constant in weight and not gain significantly from one year to the next. In fact, the mature birds showed identical results, i.e., they gained a statistically significant amount of weight from the spring of 1976 to the spring of 1977. The effects of maturation, therefore, can be assumed to be minimal in this instance, since both mature and immature birds gained significant amounts of weight over the same period.

<u>Diet</u>. The birds were exposed to three different diets over the course of the experiment:

1) <u>Winter of 1975-76</u>. The birds had free access to commercial food supplies in a 1000 pound capacity Pride of the Farm, Model F25B feeder. The diet was not supplemented with fresh greens.

2) <u>Summer of 1976</u>. The experimental group had free access to any and all vegetation growing naturally within the confines of the Charleswood Sewage Lagoon. The land area was approximately 45 acres.

The predominant vegetation is Kentucky blue grass (Poa pratensis) and creeping red fescue (Festoca rubra), (Korven, Note 10).

The control group, located in a compound at the Glenlea Research Station, also had free access to all vegetation within their area. Again, the predominant vegetation is P. pratensis and F. rubra (Truscott, Note 11). In addition, two feeders were available in which cereal seed screenings made up of 80% wheat and 20% small cracked grains were occasionally placed. Although the staff at Glenlea did not keep detailed data, their estimate of the amount of food available for the entire period of confinement was approximately 400 pounds of grain. This amount was shared with a flock of white peking and a flock of mallard ducks and was further reduced by spoilage. The exact amount of grain ingested by the geese cannot be accurately estimated but is assumed to be approximately 10 pounds per bird over the six month period. Behavioral observations indicated that the geese did not eat regularly from the feeders. The supplementary food was provided because it was not thought that the land area available could support the birds present.

3) Winter of 1976-1977. The birds again had free access to commercial food identical to that supplied during the winter of 1975-76. In addition, however, vegetable greens were dropped off daily from the university kitchens. One thousand pounds of mixed grains (triticale and barley) also supplemented the diet over the winter.

The significant loss of weight while confined to the sewage lagoon is important information to be aware of if similar locations are to be considered for areas in which to raise livestock. Although, in this study, disease and mortality can be discounted as serious threats to the geese in this environment, the loss of weight remains serious and without modifying the environment to counteract this problem, the propagation and maintenance of geese cannot be considered a viable alternate use for these areas. Several recommendations follow, based on the results of this study which, after more experimentation, may transform this area into a viable habitat for Canada geese.

Recommendations

One conclusion which can be drawn from this experiment is that under the conditions present at the experimental site used in this thesis, Canada geese lose weight. They should not be maintained in a sewage treatment area without modifying the environment in some way to counteract this phenomenon.

The veterinary report indicating that the flock was in good physical shape with no gross pathological distress indicates that the effects of the sewage are not particularly serious, although the effects on geese may manifest themselves in other less obvious and presently unknown ways. One very obvious difference between the sites was the presence of a supplementary food source at the control site. The predominant foliage is the same at both locations.

Arthur (1968) lists 14 different types of foliage preferred by Canada geese. Kentucky and creeping red fescue were numbers 12 and 13 in order of preference. Most preferred were the leaves of clovers along with cultivated grains. Bell and Klimstra (1970) noted that geese prefer and thrive on residual corn, small grains and soybeans. Gulden and Johnson (1968) also note that waste corn is the primary winter food of

Canada geese. Addy and Heyland (1968) report that aquatic foliage is forsaken for grains. Korschgen (1955) examined 184 stomachs from Canada geese and determined that grasses made up only 10.2% of the food ingested while wild mullet topped the list with 36%.

These observations of the food habits of wild Canada geese would indicate that the indigenous vegetation at both sites is insufficient to maintain the weight of a flock of 34 giant Canada geese without supplementing their diet. It is very probable that the small amount of grain available to the nine control birds maintained their body weight at a relatively constant level.

If it is not economically feasible to supply additional food to birds placed at the Charleswood Sewage Lagoon, then natural foliage, available to wild geese, should be introduced to the area. Recommended varieties based on preferences of wild birds would be clovers, corn, and cultivated grain.

The fact that the same birds gained a significant amount of weight during the winter of 1976-77 as compared to the weights at the end of the winter of 1975-76 indicated that supplying plant greens and grain, in addition to the commercial food, increases the probability of a heavier flock. The weight gain was significant for all age groups and maturation can be ruled out as an alternative explanation for the weight gain from spring to spring.

Assuming that the effects of the sewage on the geese are minimal, this author feels that further experimentation is warranted wherein food supplements are introduced to the environment. If the weight lost by the flock can be minimized over the summer months, then this author feels justified in raising giant Canada geese for research purposes and other species of geese in these otherwise poorly utilized areas.

In addition, it is suggested that the classification system developed in this thesis be used to evaluate flocks suspected to be of the subspecies *maxima*. In this case, this data must be published to be of maximum advantage in modifying this system.

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APPENDICES

APPENDIX A: WEIGHTS OF AVIAN BEHAVIOR LABORATORY FLOCK

APPENDIX A: WEIGHTS OF AVIAN BEHAVIOR LABORATORY FLOCK

Bird Collar	Nov. 10, 1974	March 15, 1975	Oct. 11, 1975	April 17, 1976
1	10.20	10.40	7.40	11.80
2	13.20	12.20	10.50	12.50
3	7.75	9.10	8.20	9.40
7	9.75	10.20	8.40	9.70
8	10.15	10.50		
9	9.60	9.70	8.60	9.90
11	10.75	11.00		
13	10.40	9.10	8.50	9.50
14	8.90	9.30	8.00	9.00
16	11.00	10.60		
17	10.20	9.50		
19	9.85	9.40		
23	12.40	10.90	9.90	11.00
24	9.75	9.30		
26	11.90	10.70		
27	9.40	9.00		
41	8.90	9.10		
42	10.05			
43	11.00	9.90	8.70	11.00
44	9.80	9.50	7.10	9.60
45	8.95	8.20	7.20	8.90
54	11.40	10.10		
$\bar{X}$	10.24	9.89	8.41	10.21
	1.24	0.90	1.05	1.19
N	22	21	11	11

Note: All weights in pounds.

APPENDIX B: LETTERS FROM DR. L. LILLIE

Province of Manitoba
Department of Agriculture
Marketing and Production Division
Veterinary Services Branch

Agricultural Services Complex
Veterinary Laboratory
University of Manitoba
Winnipeg, Manitoba
R3T 2N2

1977 03 18

TO WHOM IT MAY CONCERN:

This will verify that two (2) Canada Geese (*Branta canadensis*, numbers 130 and 132) were submitted live to the Veterinary Diagnostic Laboratory, Veterinary Services Branch, Manitoba Department of Agriculture, 1976 05 07 (our accession #WA-3390-76).

The live birds appeared entirely normal in appearance and behaviour. Necropsy examination revealed no abnormal findings and indicated both birds were in good health.

Tissues and fluids from these two birds were submitted to routine bacteriologic, parasitologic, serologic and histologic screening procedures.

One small focus of chronic granulomatous, peribronchiolar pneumonia was found in bird number 132. This lesion was associated with numerous particles of mineral and plant debris and was due to accidental inhalation of a small amount of plant and sand material. This lesion was regarded as an incidental finding. All other laboratory screening procedures yielded negative results.

In my opinion, the two birds submitted were normal and healthy and suffered from no disease process.

Yours truly,

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TO WHOM IT MAY CONCERNL

This will certify that on November 4, 1976, I conducted a visual examination of a flock of captive wild waterfowl located at the Experimental Fur Farm compound on the University of Manitoba campus. The flock consisted of approximately 80 Mallard Ducks (Anas platy-shynchos) and 60 Canada Geese (Branta canadensis).

The Birds were free to wander within the perimeter fence of the compound and free access was allowed into and out of two adjacent interconnected buildings located within the compound. One large automatic feeder was located within the compound outside of the buildings. At the time of the examination, this feeder was empty. One open water tank with an inclined board access was located within the buildings. The inner buildings were heated, lighted and ventilated and bedded with straw and hay. In general, the ducks remained indoors and the geese remained outdoors.

No evidence of clinical disease or other abnormality was seen in the geese. One dead duck was found in the building adjacent to the water tank. A second duck was observed to be lame, separated from the flock and in obvious difficulty.

A review of dead birds submitted from this flock from September 1, 1976, to the present time revealed a total of seven submissions comprised of 2 geese and 28 ducks as followed:

WA-6682-76	September 16, 1976		Canada Goose
WA-8282-76	November 2, 1976		Mallard Duck
WA-8509-76	November 4, 1976	2	Mallard Ducks
WA-8680-76	November 8, 1976		Mallard Duck
WA-8824-76	November 12, 1976	23	Mallard Ducks
WA-8829-76	November 16, 1976		Mallard Duck
WA-0491-77	January 19, 1976		Canada Goose

.... 2

It can be shown that, with the exception of the period of November 2, 1976, to November 16, 1976, mortalities in this flock have been low. All birds were subject to routine necropsy, bacteriologic, parasitologic and histologic examinations. Laboratory examination of birds dying in this period all indicated that death was primarily due to a combination of dehydration and inanition. In no case was evidence found which indicated a serious contagious disease. In only one bird was evidence of an infectious disease found (WA-8509-76 - number 2 - Staphylococcal hepatitis). In one bird evidence of nutritional muscular dystrophy (presumably Vitamin E/Selenium deficiency) was found.

In my opinion the period of high mortality in the Mallard Duck segment of the flock was primarily due to maladaptation of these birds to their winter quarters and to an insufficient number of feeders. (As indicated above, only one large feeder was being used. This was located outside and the ducks seemed reluctant to venture outside). Advice on the correction of this problem was relayed to the attending veterinarian, Dr. F.L. Webster. After this time, no further mortalities occurred in the Mallard Ducks.

Goose number 146 (accession #WA-0491-77) was found to have Visceral Amyloidosis with termal dehydration and Visceral Gout. Accession #WA-6682-76 (number not recorded) died of Gizzard Impaction and Inanition. Both of these deaths were due to factors normally associated with sporadic losses in waterfowl. In neither case was there any evidence of a serious infectious disease.

Yours truly,

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APPENDIX C: INDIVIDUAL WEIGHTS OF EXPERIMENTAL AND CONTROL GROUPS

APPENDIX C: Individual Weights of the Experimental Group

Bird No.	Weight Spring 1976	Weight Fall 1976	Weight Spring 1977
2	5625	4905	5760
3	4230	3690	4815
9	4455	3915	4770
12	4365	3690	4995
13	4175	3735	4545
14	4050	3690	4230
44	4320	3870	5175
45	4005	3375	3870
47	4950	4140	5130
135	4455	4185	4995
138	4815	4320	5715
139	4635	4230	5400
144	3960	4005	4725
145	4050	3825	4950
147	4050	3780	5265
150	4050	3330	4455
151	4950	4050	6570
154	3960	3735	4455
161	4590	4050	5130
163	4995	4455	5985
164	4095	4140	4545
165	4500	4365	5265
167	4275	3555	5040
169	3825	3600	4680
170	4275	3375	4320
171	4230	3825	4725
174	3870	3555	4455
177	5085	4365	5985

Note: All weights in grams.

APPENDIX C: Individual Weights of the Control Group

Bird No.	Weight Spring 1976	Weight Fall 1976	Weight Spring 1977
130	4680	4905	4995
132	4725	5490	5940
133	3735	4005	4500
134	4995	5445	5850
142	5040	5445	5715
146	5040	5130	DIED
149	4455	5040	5130
168	4680	5625	5310

Note: All weights in grams.

APPENDIX D: CANADA GOOSE DATA SHEET - AVIAN BEHAVIOR LABORATORY

Collar #__________ | CANADA GOOSE DATA SHEET | Date__________

Legband __________ | AVIAN BEHAVIOR LABORATORY | Status: Breeder____

Sex____________

Probation____

Rejected____

HISTORY

Source __________

Father __________

Mother __________

Year Hatched__________

Gosling band # __________

Incubation __________

VITAL STATISTICS

MEASUREMENTS

	RAW DATA	ASSIGNED POINTS
CULMEN 1	_____mm	_____
CULMEN 2	_____mm	_____
CULMEN WIDTH	_____mm	_____
TOTAL TARSUS	_____mm	_____
TARSUS WIDTH	_____mm	_____
WEIGHT	_____gms	_____

SUBTOTAL MEASUREMENTS ________Pts

SUBTOTAL OBSERVATIONS ________Pts

TOTAL:

_____ TO _____ = BREEDER

_____ TO _____ = PROBATION

UNDER _______ = REJECT

OBSERVATIONS

		POINTS
COLOR PHASE		
DARK:	_____	
MED:	_____	
LIGHT:	_____	_____
WHITE NECK RING		
YES:	_____	
TRACE:	_____	
NO:	_____	_____
WHITE FOREHEAD		
YES:	_____	
TRACE:	_____	
NO:	_____	_____
HOOK ON CHEEK PATCH		
YES:	_____	
NO:	_____	_____

OTHER MEASUREMENTS

NAIL OF MANDIBLE -

NORMAL - ABNORMAL

SCUTELLATION -

MAXIMA OTHER

TARSUS LENGTH __________

R.MIDDLE TOE __________

70th PRIMARY __________

NOTES ON ABNORMALITIES, DISPOSITION, OR DOMINANCE: