

UTILIZATION, PREFERENCE AND NUTRITIONAL VALUE OF
WINTER-GREEN AGRICULTURAL CROPS FOR GOOSE FOOD

by

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Thesis submitted to the Graduate Faculty of the

Virginia Polytechnic Institute

in candidacy for the degree of

MASTER OF SCIENCE

in

BIOLOGY

Major

WILDLIFE MANAGEMENT

APPROVED:

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June 1957

Blacksburg, Virginia



Canada Goose in Wheat

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ACKNOWLEDGMENTS

The writer is grateful for the cooperation, help and supervision of the many individuals and organizations who made this investigation possible. Thanks are extended to the following persons and organizations: The graduate committee, Dr. A. B. Massey, Chairman, and Drs. J. J. Aulbach, J. S. Lindzey, and H. S. Mosby. Special thanks are due Dr. J. S. Lindzey for his supervision and assistance.

, State Waterfowl Biologist, is hereby thanked for his supervision and assistance on the project.

Appreciation is expressed to , Chief of the Game Division, Virginia Commission of Game and Inland Fisheries, for his assistance and cooperation in the execution of the project.

The support and encouragement of other individuals in the Virginia Commission of Game and Inland Fisheries, particularly , Executive Director, is appreciated.

and , a former manager and present manager respectively at Presquile National Wildlife Refuge, provided generous cooperation and assistance in setting up and maintaining the experimental plots on that refuge.

is thanked for his help in planting the plots and in collecting and preparation of the samples gathered at both locations.

The Department of Biochemistry and Nutrition was most generous in providing laboratory space, equipment, and facilities for the nutritional analysis; one of the department's chemists, , was very helpful in giving instructions and greatly needed assistance in running the analyses.

Dr. C. Y. Kramer of the Statistical Department is thanked for his assistance in the statistical analysis of the data.

To fellow graduate students, , ,
 , , , ,
 and , the writer is indebted for their encouragement and pleasant association.

The assistance of the Virginia Commission of Game and Inland Fisheries and the United States Fish and Wildlife Service in allocating Pittman-Robertson funds to permit carrying out this investigation is gratefully acknowledged.

The writer wishes particularly to recognize the part of the Virginia Cooperative Wildlife Research Unit which made it possible to continue research work toward a M. S. degree while regularly employed.

And to my wife, , I am very grateful for her patience, understanding, and assistance in this investigation and preparation of the manuscript.

INTRODUCTION

General field observations indicate that Canadian geese show a preference for various winter-green forage producing crops along their migration routes and on their wintering grounds. The increased emphasis currently being placed on small refuges indicates the need for a high preference food which will produce the greatest amount of utilizable forage to attract and hold geese in an area. Simultaneously management problems are being created because small refuges tend to concentrate larger numbers of geese in an area than can be fed by the food available on the refuge. This results in increasing the depredations on farm crops in the surrounding area and often gives rise to complaints of crop damage. The need for information that would suggest plants for use in effective management of the geese on refuges and help to indicate the effects of such utilization by the geese resulted in initiation of this investigation. Field study was started July 1, 1955 and continued through March 1957 to determine: (1) the practicability of using winter-green agricultural crops as food for geese; (2) goose food preference for various crops; (3) the nutritional values of the various crops; (4) the degree of utilization of the various crops by geese; (5) the extent of damage or benefit to the various crops by the geese.

The sites of this investigation, Hog Island State Waterfowl Refuge and Presquile National Wildlife Refuge, were particularly appropriate because both refuges are in the early stages of development.

It is believed that the data obtained as a result of this investigation are pertinent to management of waterfowl areas for geese in Virginia coastal areas and in adjoining states with similar habitat conditions.

Scientific names of all plants are taken from Fernald, (1950); Hitchcock (1950); and Preston (1948). Scientific names of birds are from Pough (1951) and scientific names of mammals are from Hamilton (1943).

All photographs were taken by the writer unless otherwise indicated.

REVIEW OF LITERATURE

The most extensive reported investigation, similar to this study, was done by Helm (1951). He found that corn, wheat, soybeans, buckwheat, and Wong barley are the favorite foods of Canada geese in Missouri. He reports Wong barley superior to wheat in preference for fall and spring browse, but found it more susceptible to winter kill. Alfalfa rated poor while red clover and ladino clover were rated as good browse. Fecal analysis placed goose manure slightly higher in plant nutrients than dairy cow manure but lower than chicken manure.

Atkeson, and Givens (1953) list hay crops-alfalfa, crimson, white dutch and ladino clovers, Aldous and Kentucky 31 fescue, redtop, orchard grass and oats as well used by waterfowl. They advise that alfalfa and ladino clover should be mowed to make new green growth available to the geese. Oats planted too early may become too rank and tough for geese to utilize. These same investigators list wheat, oats, rye, barley, and rye grass as non-leguminous cover crops suitable for goose utilization. Leguminous cover crops listed for geese included crimson clover, Austrian peas and button clover (Givens and Atkeson, 1955).

Glazener (1946) in Texas found Canada geese prefer corn. Rice, corn and soughums were found to be the most common foods. Winter graze was utilized to a lesser degree.

Horn (1949) in California found that Canada geese damaged pastures and caused considerable damage to fall-planted grain and pasture in Washington.

Pirmie (1954) reported experimental grazing by captive Canada geese, resulting in no reduction in wheat yields attributable to goose grazing on the dormant plants.

DESCRIPTION OF STUDY AREAS

Hog Island State Waterfowl Refuge is located in Tidewater Virginia on the south side of the James River due east of Jamestown Island, in the eastern corner of Surry County. The refuge includes about 2100 acres of which about 200 acres are crop land, 500 acres are woodland and the rest is marsh and pond areas (Figure 1). "The soils of Hog Island are derived from materials washed from the residual clays of the Piedmont Plateau", (Elrod, 1951). Most of the crop lands are loams or sandy loamy surfaces with fine textured, firm, and moderately heavy subsoils. Most of the soils have good internal drainage but a considerable acreage is subject to flooding, as all crop lands are only from two to six feet above sea level.

The marsh land is primarily salt water or brackish marsh type. The salinity is about 10% of sea strength on the SE side and about 5% on the SW side of the Refuge. Much of the marsh is covered by cord grass (Spartina cynosuroides), with some areas of native millets (Echinochloa walteri and E. crusgalli), smart weeds (Polygonum spp.), cattail (Typha spp.), and sedges (Cyperus spp.). Some small water areas, now controlled by dikes, are producing some good waterfowl food plants.

The woodland is mostly loblolly pine (Pinus taeda) in the lower swampy areas and loblolly pine and mixed oaks (Quercus spp.) in the higher areas. Some bald cypress (Taxodium distichum) is also present in the area. The refuge has a population of approximately 75 to 100 deer (Odocoileus virginianus) which have been a problem in this study because their utilization of forage was frequently concurrent with goose utilization.

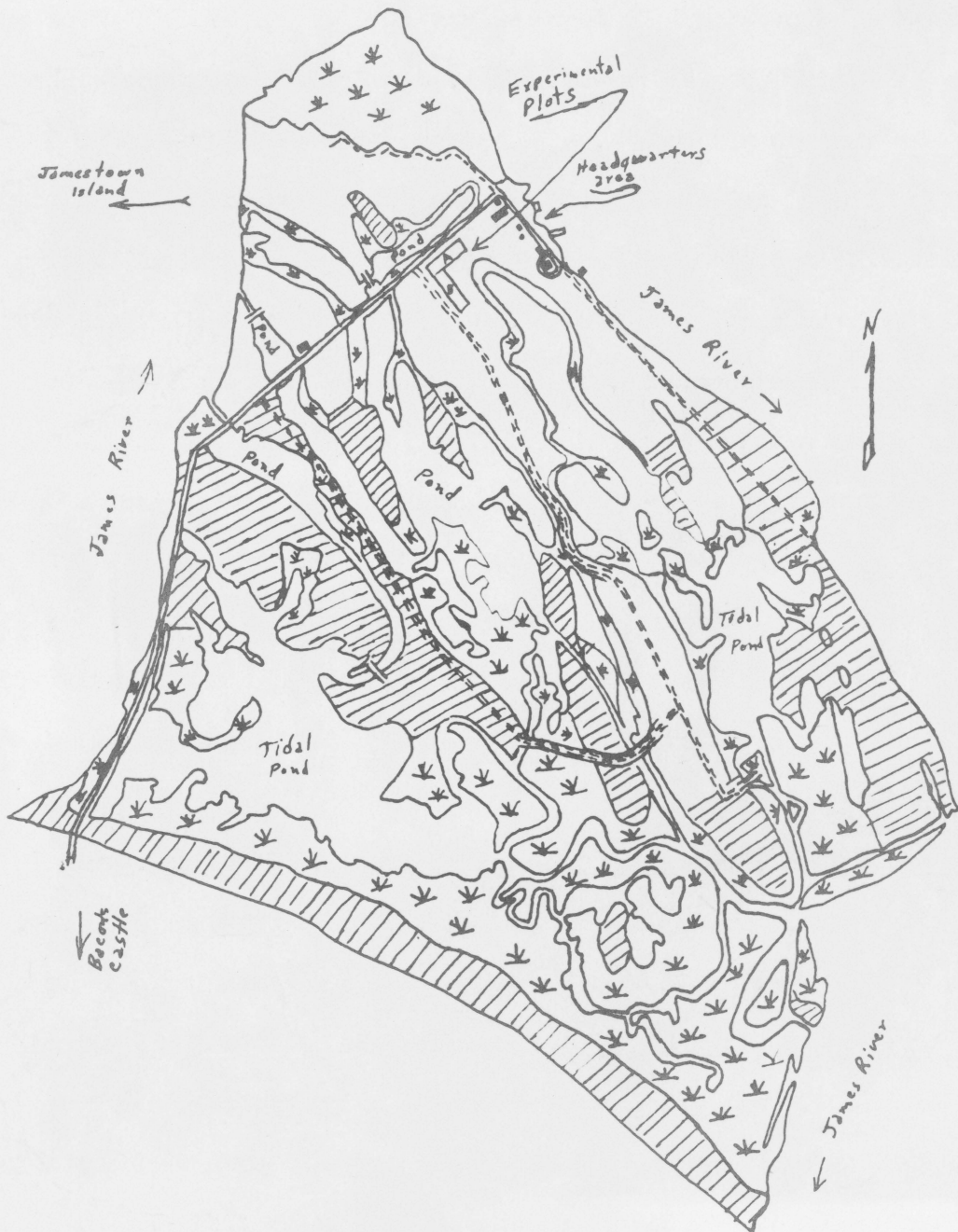


Figure 1. Hog Island State Waterfowl Refuge.
 Scale 1:25,000 (Approximate) 37° 16' N 76° 51' W Jan. 1, 1957



Woodland



Marsh

Fur bearing animals found on the area include red fox (*Tulpes fulva*), raccoon (*Procyon lotor lotor*), muskrat (*Ondatra zibethica*), otter (*Lutra canadensis*), and mink (*Mustela vison*).

The migrant and wintering waterfowl include about 4000-5000 Canada geese (*Branta canadensis*) with an occasional blue goose (*Chen caerulescens*) and snow goose (*Chen hyperborea*); 1500-2500 ducks including mallard (*Anas platyrhynchos platyrhynchos*), black (*Anas rubripes*), green wing teal (*Anas carolinensis*), blue wing teal (*Anas discors*), baldpates (*Marco americana*), pintails (*Anas acuta tzitzihoa*), canvasbacks (*Aythya valisineria*), lesser scaup (*Aythya affinis*), ring-necks (*Aythya collaris*), shovelers (*Spatula clypeata*), ruddies (*Erismatura jamaicensis rubida*), hooded mergansers (*Lophodytes cucullatus*) and coots (*Fulica americana*). A very heavy wintering population of red-wing blackbirds (*Agelaius phoeniceus*), cowbirds (*Molothrus ater ater*), and bobolinks (*Dolichonyx oryzivorus*) are usually present. During the summer very few ducks or geese reside in the refuge. Great blue herons (*Ardea herodias*) are found year round and during the summer many American egrets (*Casmerodius albus*) and a few black crowned night herons (*Nycticorax nycticorax*) and American bitterns (*Bataurus lentiginosus*) are found. The rails, Virginia (*Rallus limicola*), King (*Rallus elegans*), Clapper (*Rallus longirostris*) and Sora (*Porzana carolina*), are found in the refuge.

The surrounding area is primarily farm land on which peanuts, wheat, corn and soybeans are the most common crops.

Hog Island is actually the tip of a peninsula and is formed by a large horseshoe bend in the James River. Lyons Creek about 1.25 miles south of the refuge and Chippokes Creek about 1.75 miles southwest of

the refuge furnish some additional marsh areas for waterfowl. Jamestown Island about 2.5 miles west of Hog Island is surrounded by marsh that also furnishes some waterfowl habitat.

Climatic conditions in 1955 were fairly normal. The summer and fall were rather dry, broken by several storms in August and September which resulted in saturation of the soil and some flooding due to extremely high tides.

The winter of 1955-1956 was normal. During the period the geese were present the temperatures ranged from a high of about 70° to a low of about 10°. In January there was some flooding due to northeasterly storms causing exceptionally high tides.

The spring and summer seasons of 1956 were periods of above average precipitation with extreme tidal flooding occurring April 10. Tides about five feet above normal inundated practically all of the refuge. On September 26 the backlash from tropical storm, Flossy, flooded the refuge again with about 5.5 feet of water. The remainder of 1956 was very wet with high winds and extremes in temperatures. January, February and March 1957 were extremely wet with rain occurring about two out of three days throughout the period. On January 14, 15, and 16 approximately six inches of snow fell and the temperature dropped to about 10°. The snow remained until January 22. During the goose wintering period the temperature varied from an 86° high to a 10° low.

Presquile National Wildlife Refuge, location of the second study area, is situated on an island in the James River, north of Hopewell, in Chesterfield County, Virginia. Agriculture and industry are interspersed in the surrounding area.

The Soil Conservation Service, United States Department of Agriculture, classifies the Presquile National Wildlife refuge in three major land types; 300 acres crop land, 250 acres of marsh land and 779 acres of swamp land (Figures 2). The soils are of mineral origin and exhibit the characteristics of both the piedmont and the coastal plain types. Agricultural operations have been conducted on the area since the late 18th century. The crop land is all located on the SW end of the refuge and is relatively well drained sandy loam. The highest elevation is about 30 feet above sea level with a gradual slope to river level. The marsh land is made up largely of mixed plants of wild rice (Zizania aquatica), smart weed (Polygonum spp.), cattails (Typha spp.), cut grass (Leersia oryzoides), cord grass located around the north and east sides of the island. The swamp land is primarily hardwood composed of predominately ash (Fraxinus sp.) and maple (Acer rubrum), with tupelo gum (Nyssa sylvatica), sweet gum (Liquidambar styraciflua), and some oaks (Quercus spp.), mostly open with very little underbrush.

The river water at Presquile has a very low salinity.

Animal life present on the refuge includes concentration of deer, which have increased from approximately 100 in 1955 to about 250 in 1957.

Fur bearing animals include raccons, foxes and some muskrats.

The migrant and wintering waterfowl include 6000-7000 Canada geese, with 50-100 blue geese and snow geese; 4000-5000 ducks including most of the species found on Hog Island and some wood ducks (Aix sponsa).

The climatic conditions are very similar to those at Hog Island.

Relatively little flooding occurs because the agricultural land is higher.

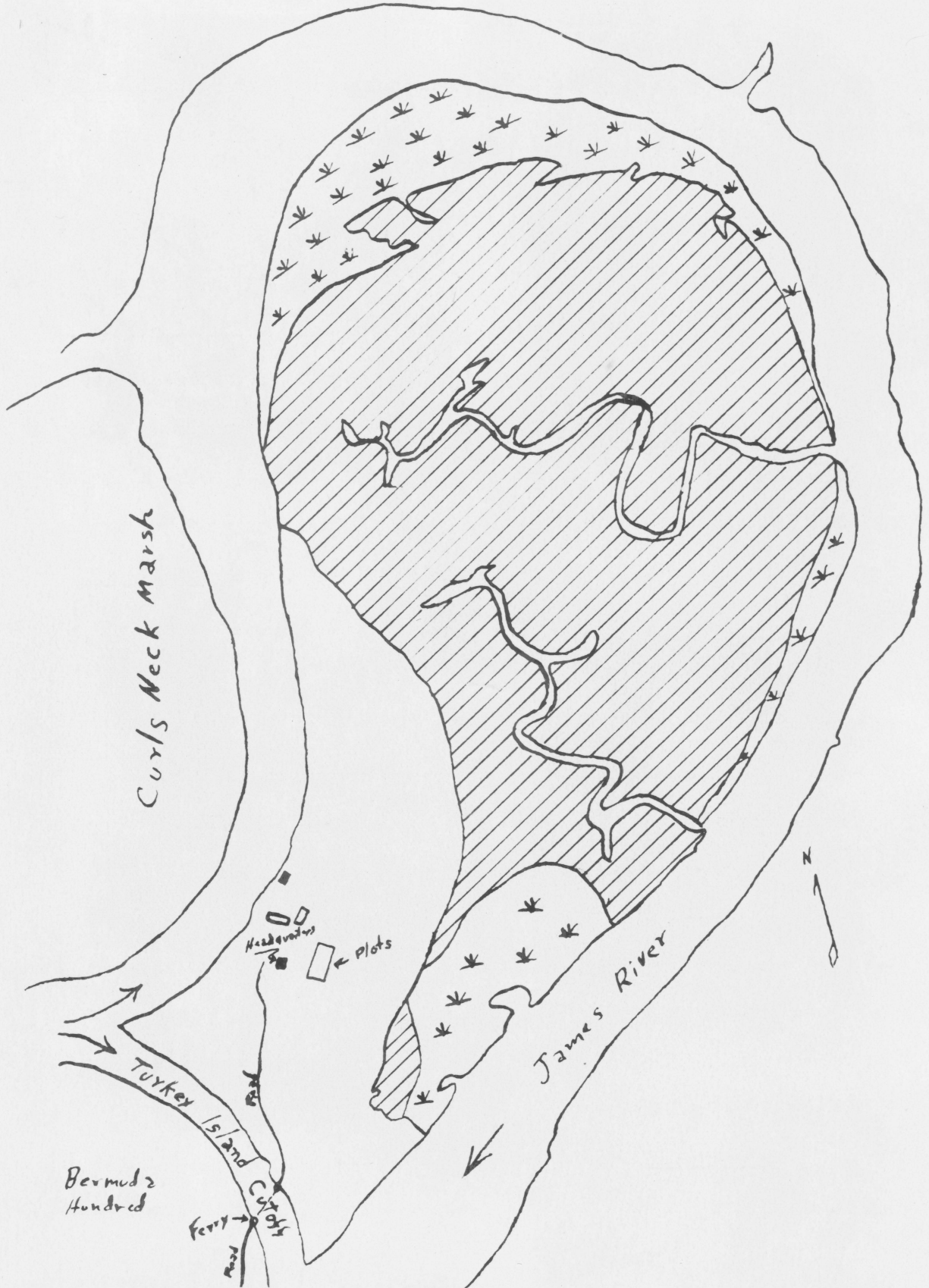


Figure 2. Presqu бере National Wildlife Refuge.
Scale 1:20,000 (Approximate) 37° 22' N 77° 16' W Jan. 1, 1957



Swampy woodland



Marsh

Figure 3, a map of the James River, shows the location of the study areas.

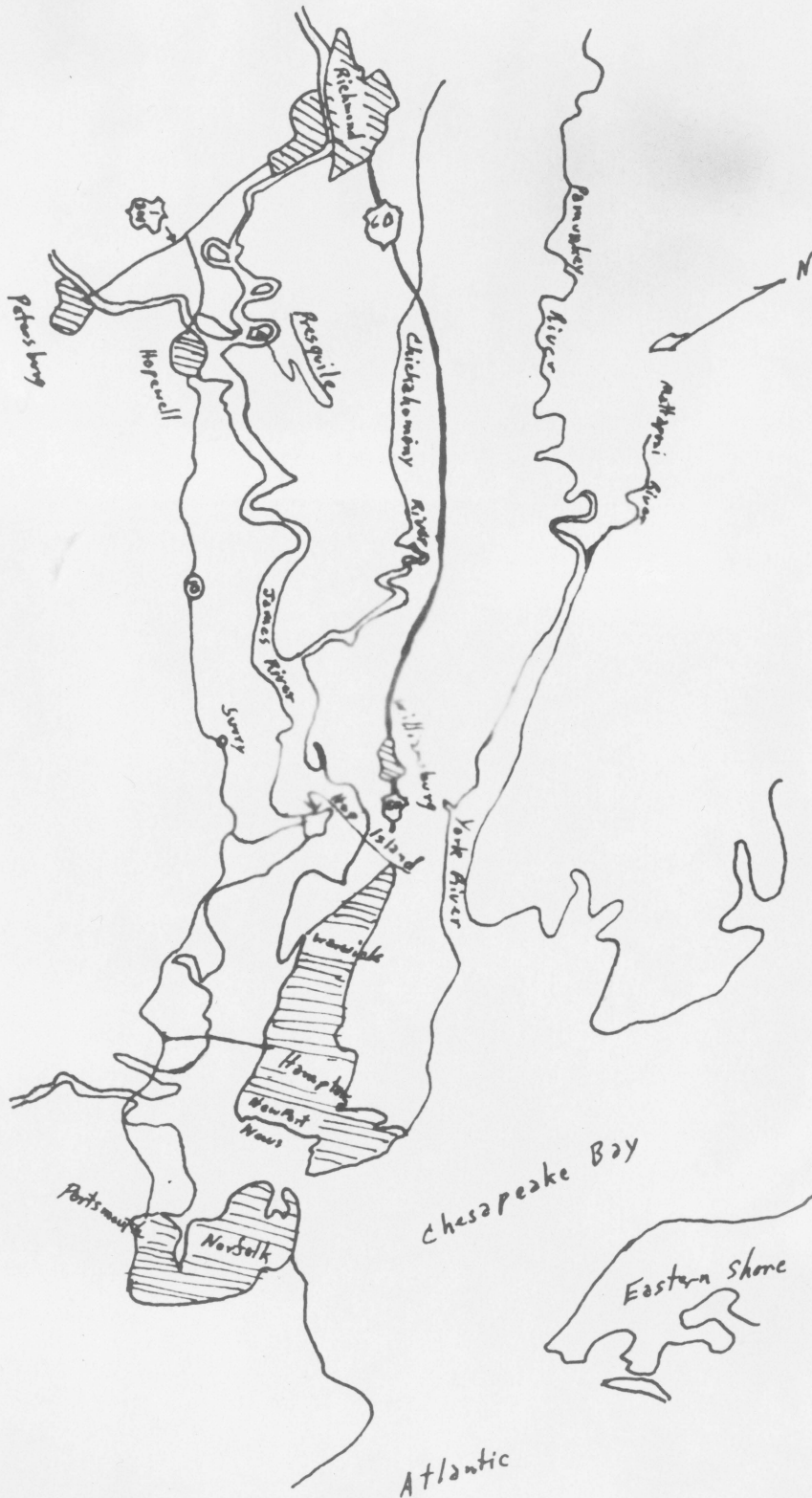


Figure 3. Location of the two study areas.

METHODS AND PROCEDURES

SELECTION OF STUDY AREAS

The Hog Island State Waterfowl Refuge was selected as the principal site of the investigation because of its potential importance to geese and because the writer was resident on the refuge. Canada geese are normally present in the area during the migration period and winter season and the opportunity to manipulate the crops as desired for purposes of the experiment made this area particularly useful for the study.

Presquile National Wildlife Refuge was selected as a secondary area for study because it was located within an hour's drive of Hog Island and Canada geese were present in the area during migration and wintering periods. Through the courtesy and cooperation of the Fish and Wildlife Service it was possible here as at Hog Island to plant and maintain experimental goose food plots.

SELECTION OF PLANT SPECIES FOR STUDY

Alfalfa (Medicago sativa L.), crimson clover (Trifolium incarnatum L.), ladino clover (Trifolium repens L.), Italian rye grass (Lolium multiflorum), Wong barley (Hordeum vulgare L.), oats (Avena sativa L.), rye (Secale cereale L.), and wheat (Triticum aestivum L.) were selected because they had been reported as potential Canada goose winter graze species in the Southeastern United States (Atkeson and Givens, 1955). In addition, these species are considered adapted to the locations of the study. Ladino clover, crimson clover, alfalfa, rye, and wheat are the most commonly grown winter grazing crops for livestock in the region of the study.

EXPERIMENTAL PLOTS

A field was selected at Hog Island which suited the needs of the experiment in size, location, potential use by geese and homogeneous soil conditions. Two sets of eight one-half acre plots, 104.4 feet wide by 208.7 feet long, were laid out. The plots were as nearly homogeneous as possible with regard to soil conditions, exposure, cover and accessibility to water, Figure 4. The species to be planted in each plot was determined by random selection.

At Presquile a field was selected in the same manner as at Hog Island but the limited size of the field permitted establishment of only eight 3/4 acre plots (Figure 5) 70 feet wide by 466.7 feet long. Again they were as nearly homogeneous as possible and the species to be planted in individual plots were chosen by random selection.

Two exclosures of one milacre each were established in each of the plots in both locations to prevent goose and/or deer utilization of the enclosed plants. Each exclosure (Figure 6) was made of 1" x 2" mesh welded wire, 18" high and 6.6' square and covered with the same wire. The corners and top were fastened together with hog rings. Two exclosures were placed in each plot centrally located at points 1/3 and 2/3 of the distance from the ends of the plots.

Exclosures were used to determine the amount of growth in areas not subject to goose and/or deer use to permit comparison with the grazed parts of the same plots. Use of these exclosures permitted visual comparison of the grazed and ungrazed parts of the plots and provided locations where clippings samples could be made to permit comparison of the weight of vegetation from the grazed and ungrazed areas.

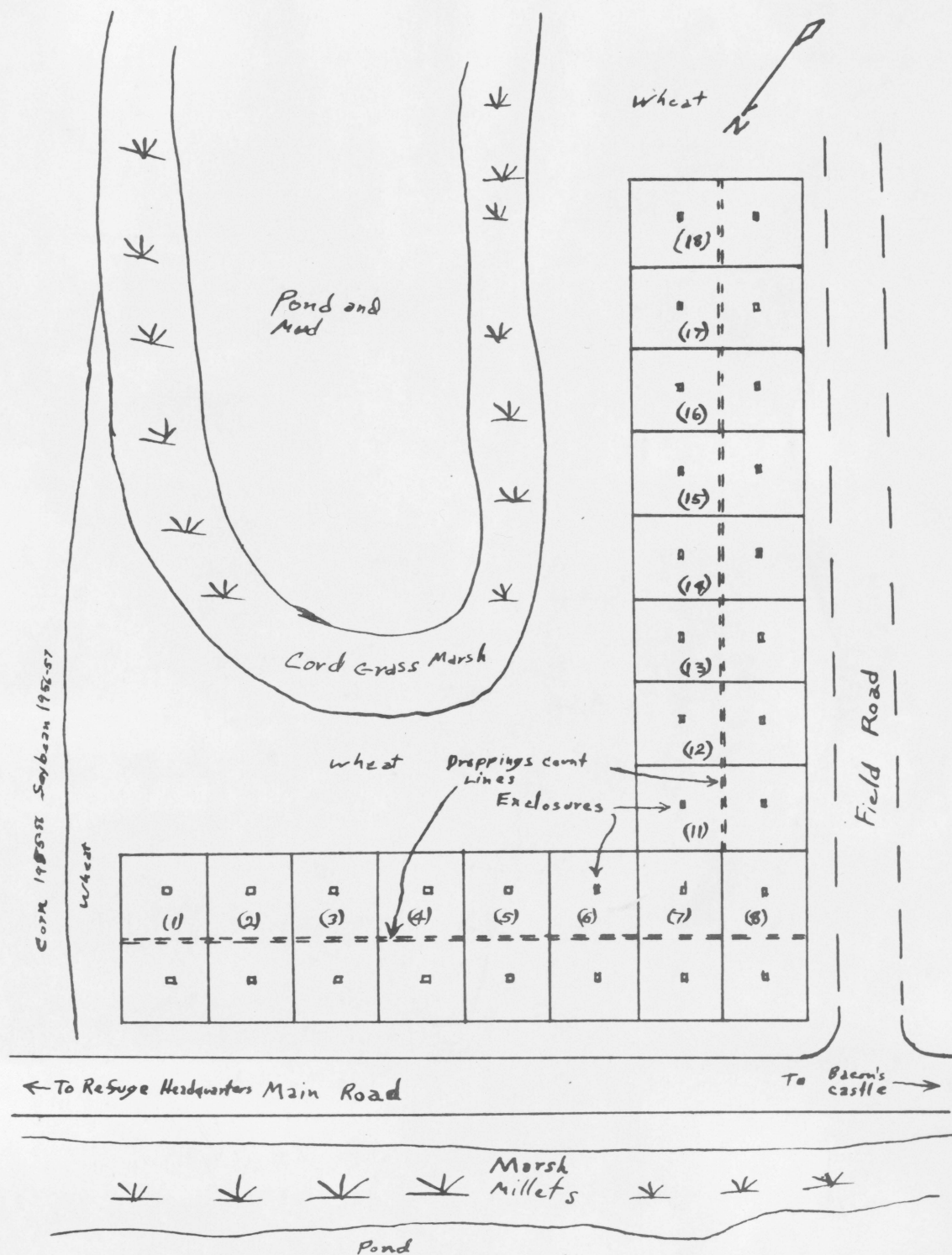


Figure 4. Hog Island plots showing layout, enclosures, dropping count lines and adjoining crops. (1)(16) alfalfa, (5)(15) crimson clover, (3)(11) Ladino clover, (6)(17) Italian rye grass, (7)(12) oats, (4)(14) Wong barley, (2)(13) rye, (8)(18) wheat. Scale one half inch equals one hundred feet.

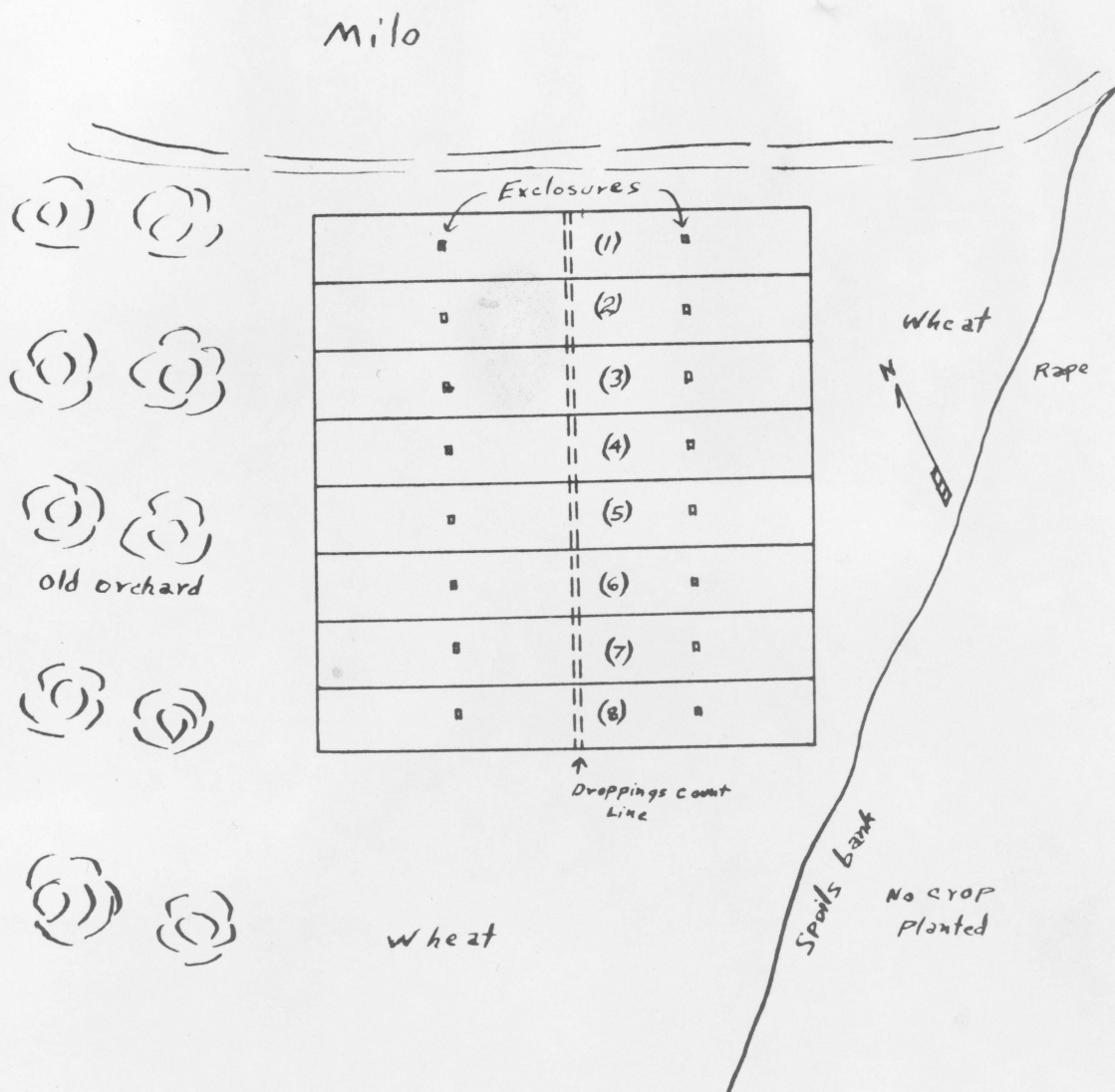


Figure 5. Presquile plots showing layout, exclosures, dropping count lines and adjoining crops. (1) Italian rye grass, (2) oats, (3) Ladino clover, (4) wheat, (5) rye, (6) Wong barley, (7) alfalfa, (8) crimson clover. Scale one half inch equals one hundred feet.

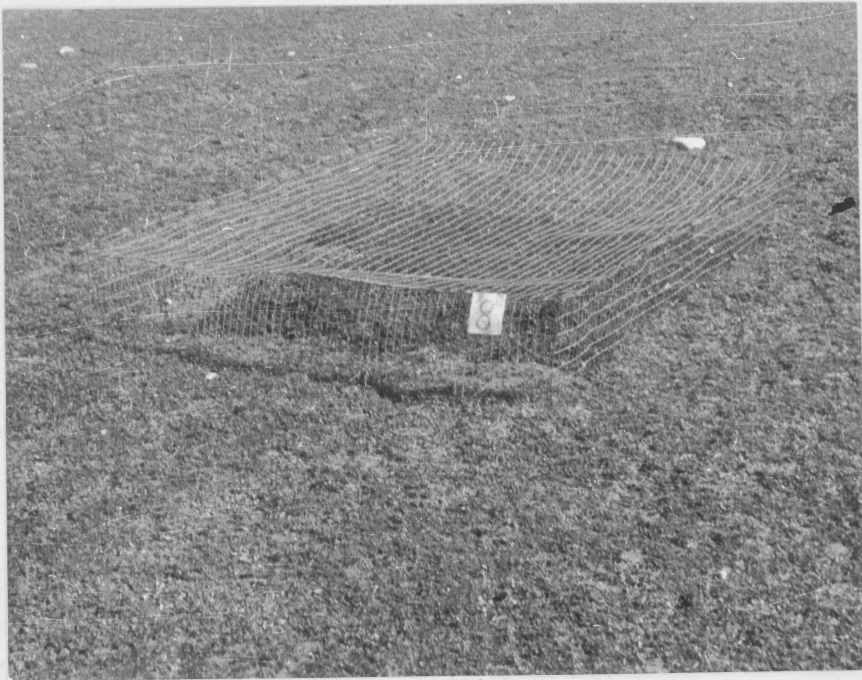


Figure 6. Exclosure in use on crimson clover

AGRICULTURAL ACTIVITIES

In 1955 the fields selected were plowed, fertilized, and prepared for planting. Plots at Hog Island were planted in early October and at Presquile in late September.

To speed up the planting operation which had been delayed due to inclement weather in both locations, the soil was prepared and 400 pounds of 2-12-12 fertilizer spread on the entire field before the plots were laid out. Seed for each crop was planted in an amount equal to or slightly higher than that recommended for farm crops. Table 1 shows the amount of seed and fertilizer used per acre.

Table 1. Amount of seed and fertilizer used per acre

Crop	Seed	Fertilizer
Alfalfa	50 lbs.	400 lbs.
Crimson Clover	50 lbs.	400 lbs.
Ladino Clover	5 lbs.	400 lbs.
Wong barley	2 bu.	400 lbs.
Oats	2 bu.	400 lbs.
Rye	2 bu.	400 lbs.
Wheat	2 bu.	400 lbs.
Italian rye grass	50 lbs.	400 lbs.

After the geese had migrated north in the spring of 1956 the plots at Hog Island were allowed to stand until the cereal grains had matured to permit determination of the amount of grain produced in the grazed and ungrazed areas. After yield samples had been taken all sixteen plots were mowed and the hay removed. All plots were mowed throughout the summer.

At Presquile all plots with the exception of ladino clover were plowed under. The ladino clover was mowed at intervals throughout the summer to maintain forage conditions considered desirable for geese.

Originally it was planned to maintain all of alfalfa and ladino clover plots to study the use by geese during their second year. However, at Presquille the stand of alfalfa was so poor that it was plowed under along with the annual crop plots. The alfalfa and ladino clover plots at Hog Island were retained for second year observation.

The twelve remaining plots (all except the ladino clover and alfalfa) at Hog Island refuge were plowed and planted in late September, 1956. Each plot was planted to the same crop it contained the previous year. The remaining four alfalfa and ladino clover plots were mowed at intervals so that they would be at a suitable height and condition for goose utilization. All sixteen plots were again fertilized, however, 5-10-10 was used for the second year because of its greater availability. Fertilizer used followed quite closely recommendations of the county agricultural agent.

At Presquille, all plots with the exception of ladino clover were plowed and planted in early October 1956. The ladino clover plot was mowed as at Hog Island.

An electric fence was installed around the experimental plots at Hog Island by December 22, 1956, in an attempt to discourage the utilization of the plots by deer. A 14 gauge, smooth galvanized wire, four strand fence was used with three strands on the post and one on an outrigger. This fence was used until clippings were discontinued on February 5 with reasonable success.

At Presquille a 9 foot deer proof fence was started in the fall of 1956 but was not completed until after collection of data for this investigation was completed.

SAMPLING, COLLECTING AND OBSERVING

Three techniques were used to establish indications of preference for the crops being tested including the clipping and weighing of samples of the grazed and of the ungrazed areas, the counting of goose droppings and deer pellets groups in the individual plots, and the recording of actual observed use of the individual plots.

Clippings: Clipping of the vegetation in the grazed areas of the plots and in the ungrazed exclosures was undertaken to permit measurement of the amount of growth of the individual species under study and to detect differences in the amount of forage available following grazing as compared to the amount which was being produced in the ungrazed control exclosures. Samples were taken with grass shears (Figures 7 and 8) within a square foot sampling frame made of welded rod. All samples were clipped as nearly at the same height, (ground level) as possible. In the exclosures, because of the limited area available and need for undisturbed vegetation at each clipping, it was necessary to systematically place the sampling frame in spots that had hitherto been unclipped. In the grazed or experimental portion of each plot samples were taken where the sampling frame landed when it was tossed into the plot. It was of course necessary to resample if the frame landed where a previous clipping had been made. Two samples including one square foot each were taken in each plot each time clippings were made. Samples were taken at two week intervals when few geese were observed using the plots and weekly when goose utilization appeared heavy.

All vegetation clipped from the plots was placed in marked paper sacks bearing the plot number and other data. The clippings were then



Figure 7. Investigator placing sampling frame in place for clipping sample of crimson clover Feb. 6, 1957. Photo taken by John Walther



Figure 8. Investigator clipping sample Feb. 6, 1957. Photo taken by John Walther

thoroughly air dried, extraneous material removed and weighed. The technique used was the same both years of the investigation. These weights are recorded in Appendix Tables 1, 2, 3, and 4.

After the crops had matured at Hog Island in 1956, clippings were made of two square feet from undisturbed, ungrazed areas and two square feet from the grazed areas of each plot. These clippings were thoroughly air dried and weighed. After weighing all cereal grains were threshed and the grain weighed to determine whether or not grazing by geese and by deer had damaged the crops. The weights of clippings and grains are shown in Appendix Table 5.

Droppings counts: On February 23 at Hog Island two strips were laid out, and on February 29 at Presquile one strip was laid out, by driving a motor vehicle across each plot to delimit a sampling area for counting goose and deer droppings. At Hog Island a Willys jeep was used and all of the area inside the tracks gave a counting strip totalling 936 square feet to each plot. At Presquile a pickup truck was used and the area inside the tracks gave a count line of 420 square feet. All droppings were counted and the deer droppings were cleared from the lines. On March 12 the lines were checked for deer droppings since all goose usage had ceased. No goose droppings were observed. All counts were converted to droppings per acre as shown in Appendix Tables 6 and 7.

As a further technique in appraising goose use of the various food plants it was decided to regularly record the number of geese and deer droppings occurring on the individual plots during the second year of the study. At the time the second clippings were made at each refuge a strip was laid out by driving a motor vehicle across the approximate center of

each plot as shown in Figures 4 and 5 to delimit a sampling area for counting and removing goose and deer droppings. At Hog Island, a Willys jeep was used and all of the area inside the tracks gave a count line of 468 square feet in each plot. At Presquille a pickup truck was used and the area inside the tracks gave a count line of 420 square feet. All droppings were counted and cleared from the lines at the time of their establishment. Each time clippings were taken thereafter, the droppings were counted and cleared from the line. All counts were converted to droppings per acre as shown in Appendix Tables 8 and 9. For the purposes of this study the term droppings as used in reference to deer droppings indicates a pellet group. Goose droppings were recorded as individual droppings.

From time to time crippled geese were captured at the Hog Island refuge. On January 7, 1957 a pen 12' x 12' was made of 1" x 2" welded wire, four feet high. This was placed in a field of wheat on the refuge which had not been utilized by geese at that date. Two crippled Canada geese were placed in the pen to observe the use of wheat and to check the number of droppings per goose per day. One of these geese died the second day and a third was soon captured, but it also died after two days in captivity. A fourth goose was secured on February 2 and two geese were kept under observation until February 15.

Each day all droppings inside the pen were counted and removed or the pen was moved to a new location. A record was kept (Appendix Table 10) from January 10 to February 15 on one or two geese for a total of 54 goose days. The number of droppings counted were divided by the number of goose days to get an average of 92.2 droppings per goose per day.

Because of the small numbers of geese used and the close confinement of these geese this is not believed to be an accurate estimate of goose day usage but merely an indication of the amount that may be produced in one day. Under different environmental conditions it is believed that the number of droppings may vary considerably.

The two penned geese grazed and trampled practically all green wheat which was nine to twelve inches high inside the pen (144 square feet) in three days time. In Figure 9 the pen with two geese inside has just been moved after remaining in place for three days. In the foreground of the picture the pen had remained in one place two days. The rule shown in Figure 10 shows that about six of the ten inches of green wheat was utilized in one day.

Sight Observations: Sight observations of geese and deer were made as often as possible at Hog Island during the second year of the investigation. Although it was often possible to record numbers of geese in a plot or an area, it was not practical because of other duties to record goose minutes by plots as an indication of use. Geese were most often observed in early morning. Appendix Table 11 gives the results of these observations by plot. Deer were generally observed in late afternoon and at night. Because the deer usually moved very quickly whenever automobiles were stopped, it was usually impossible to tell which plot the deer were using. The results of deer observation are shown in Appendix Table 12, indicating numbers seen inside the plots and total number seen on the refuge.

It was realized that the use of sight observations had serious limitations because consistent, long period, and night observations was



Figure 9. Two geese in 12' x 12' pen in wheat. The foreground shows three (in front of pen) and two days use.



Figure 10. One days use by two geese in 11 1/4 square foot pen

frequently impossible. However, it was considered that data obtained in this fashion would supplement other indications of use. Data obtained during the first year of the study were so fragmentary they were discarded. Weekly estimates of the total population of geese present in each refuge area were recorded for the two years this investigation was in progress. The results of these censuses are shown in Appendix Table 13.

ANALYSIS OF DATA

The study, despite efforts to provide checks and balances which would make definite conclusions possible, proved difficult to appraise because of the many factors affecting the results and because of inconsistencies in the data. Since much more data were available for the second year of the study, more importance could be attached to the indicated trends. It was decided, therefore, to depend chiefly on the information obtained during the second year and use data collected the first year as a further check. The information obtained from the second years clippings was analysed statistically and the results compared with other data indicating preference. In addition, factors which are deemed important in affecting the demonstration of preference by the geese are pointed out.

Statistical: A statistical analysis of variance was run on the nine clippings made in 1956-1957 on the two replicate sets of plots at Hog Island to determine the degree of reliance that could be placed on the recorded differences in the weights of clippings from individual plots. The result of this analysis to a five percent level of confidence is shown in Table 2. The New Multiple Range test by Duncan was used. It was found that there were significant differences in the total yields (weights of ungrazed crops) except between ladino clover and rye. In the total utilization (difference between ungrazed and grazed weights) there was a significant difference in all crops except between ladino clover and Italian rye grass and Italian rye grass and alfalfa.

As there was no period between collecting dates during the second year observations in which deer were excluded completely, therefore,

Table 2. Analysis of variance. Results of the new multiple range test on nine sets of clip-pings taken from "A" and "B" plots on Hog Island Refuge November 27, 1956 to February 6, 1957 using significant ranges to 5 percent level. Differences that are not significant are joined by a solid line

Control or total yield of crop on two square feet in grams						
Wheat	Crimson clover	Alfalfa	Ladino clover	Rye	Wong barley	Italian rye grass
	238.00	258.15	284.10	287.80	314.00	365.95
	226.15					403.70
Utilization or difference between grazed and ungrazed crop*						
Oats	Wheat	Rye	Ladino clover	Italian rye grass	Alfalfa	Wong barley
	15.25	62.45	75.40	77.40	81.35	90.30
	-46.80					96.90

* Utilization includes both goose and deer use

goose and deer usage could not be separated, and the droppings count data were not statistically analysed. Data collected at Presquille were not replicated and, therefore, were not analysed statistically. Because of heavy deer pressure it was not used as a replicate of the Hog Island plots.

Nutritional: A proximate nutritional analysis was run on a composite sample from the 1956-1957 clippings of each plot to determine the percentage of the various nutrients present in the eight crops and to permit determination of any correlation between nutrients available and preference of geese. This analysis was run as instructed by the biochemistry department of VPI and included the determination of nitrogen (protein), ether extract (crude fat), ash, and nitrogen-free extract (N.F.E.). As the samples had been previously dried the moisture content was not determined. The results of this nutritional study are shown in Appendix Table 14.

General: Soil samples were taken from each plot on Hog Island by the Surry County Agricultural Agent in February 1956. The samples were tested by the Agronomy Department, VPI, Blacksburg, Virginia, for plant nutrients present. All plots were found to be reasonably high in plant nutrients and 400 to 800 pounds of 2-12-12 or 5-10-10 fertilizer was recommended.

DETERMINATION OF COSTS

In determination of costs the cost of seed, fertilizer, plowing, planting and mowing were considered. A summary of the total costs per acre for the use of each species for the two year period of the investigation at Hog Island is shown in Table 3. These costs are itemized in Table 15 of the Appendix. The perennial alfalfa and ladino clover were mowed at intervals comparable to regular mowing in standard farming practices. All other crops were planted the second year.

Cost of preparation of the seed bed and planting were similar for most crops. The fertilizer used for all plots was of the same analysis, and applied at the same rate each year. Therefore, this cost was the same for all crops.

On the basis of these costs for a two year period, ladino clover is the least expensive and crimson clover the most expensive. Alfalfa was second most expensive. Although, it did not require planting the second year, the cost of seed for one planting was much higher than other crops. The cereal grains and Italian rye grass were very similar in cost of seed and in total cost.

Table 3. Total cost per acre to plant and maintain plots at Hog Island Refuge for two years 1955-1957

CROP	COST
Alfalfa	\$ 82.62
Ladino clover	56.12
Crimson clover	91.63
Wong barley	71.08
Oats	69.68
Rye	73.38
Wheat	74.68
Italian rye grass	73.38

RESULTS

FORAGE AND GRAIN PRODUCED

Forage: The production of forage plants highly attractive to geese and of usefulness in refuge management dictates the need for a species that is not only highly palatable but will also provide large quantities of readily available forage and maintain itself under heavy grazing pressure. In order to determine the amount of forage that a species would produce, two exclosures were placed in each plot to prevent grazing of control areas. Clipping weights of the ungrazed (inside the exclosure) dried samples shown in Table 1, 2, 3, and 4 of the Appendix are the dry forage produced by that plot up to the time of clipping since no grazing occurred and these plants were free to grow at their maximum rate.

There are variations of yield in different location, which may be attributable to a number of factors such as the weather (a wet or dry growing season), flooding from extremely high tidal water, and good or poor stands.

The difference in the growing season between the two years, the first year normal with some rain and flooding and the second year abnormally wet with extensive flooding, influenced the forage production of some crops.

In order to compare yields for all plots for both years, summary tables 4 through 11 were made showing total yields in grams for each plot of each crop, for eight clippings dates covering approximately the same period, late November through early February for both years.

Alfalfa (Table 4) showed comparable yields at Hog Island and Presquile in 1955-1956. The yield on both Hog Island plots, however,

Table 4. Summary of clippings data for alfalfa for two years, 1955-1956 and 1956-1957

	Combined wts. of eight clippings in grams*			
	Hog Island		Presquile	Totals
	"A"	"B"		
	<u>1955-1956</u>			
Ungrazed**	37.91	41.37	55.48	134.76
Grazed	21.65	15.25	37.98	74.88
Difference	16.26	26.12	17.50	59.88
	<u>1956-1957</u>			
Ungrazed**	107.35	127.35	30.15	264.85
Grazed	94.20	59.80	24.75	178.75
Difference	13.15	67.55	5.40	86.10

* One square foot clippings

** Exclosures

Table 5. Summary of clippings data for crimson clover for two years, 1955-1956 and 1956-1957

	Combined wts. of eight clippings in grams*			
	Hog Island		Presquile	Totals
	"A"	"B"		
	<u>1955-1956</u>			
Ungrazed**	44.73	63.89	68.42	177.04
Grazed	23.42	19.51	75.30	118.23
Difference	21.31	44.38	-6.88	58.81
	<u>1956-1957</u>			
Ungrazed**	123.10	92.35	55.85	271.30
Grazed	63.55	48.70	47.00	159.25
Difference	59.55	43.65	8.85	112.05

* One square foot clippings

** Exclosures

was much better the second year because it was second year growth. At Presquile the alfalfa had to be replanted because the first year stand died out. If the alfalfa had been planted earlier before the geese arrived the forage yield would probably have been higher for the first year in all cases.

Crimson clover (Table 5) yields were comparable for the 1955-1956 season but varied widely for 1956-1957. At Hog Island in September shortly after the plants broke through the surface plot "A" sustained less flooding than did plot "B". Also plot "A" was perhaps a little better drained than plot "B". Although 1956-1957 was a much wetter year both Hog Island plots produced higher yields than in 1955-1956. Presquile plots produced less the second year but both years stand appeared rather poor perhaps due in part to late planting.

Ladino clover (Table 6) which made a very poor yield in 1955-1956 had a good stand and in the second year of growth produced a much better yield. The first year might have been better had planting been earlier.

Italian rye grass (Table 7) produced good yields both years. At Hog Island the forage produced was greater the second year while at Presquile the best yield was in 1955-1956. Of the Hog Island plots it appeared that the "B" plot was in a lower more poorly drained location and was subjected to more flooding than was plot "A".

Wong barley (Table 8) gave comparable yields the first year with an increase on all plots the second year indicating that a wet season increased production of forage in this crop. The two plots at Hog Island were homogeneous in moisture conditions.

Rye (Table 9) was a heavy producer both years. Both Hog Island

Table 6. Summary of clipping data for ladino clover for two years, 1955-1956 and 1956-1957

	Combined wts. of eight clippings in grams*			
	<u>Hog Island</u>		<u>Presquile</u>	<u>Totals</u>
	"A"	"B"		
	<u>1955-1956</u>			
Ungrazed**	18.14	21.03	50.21	89.38
Grazed	18.31	11.32	40.46	70.09
Difference	-0.17	9.71	9.75	19.29
	<u>1956-1957</u>			
Ungrazed**	133.65	128.70	120.75	383.10
Grazed	103.40	90.45	80.40	274.25
Difference	30.25	38.25	40.35	108.85

* One square foot clippings

** Exclosures

Table 7. Summary of clippings data for Italian rye grass for two years, 1955-1956 and 1956-1957

	Combined wts. of eight clippings in grams*			
	<u>Hog Island</u>		<u>Presquile</u>	<u>Totals</u>
	"A"	"B"		
	<u>1955-1956</u>			
Ungrazed**	84.38	51.99	265.93	402.30
Grazed	54.23	14.67	202.02	270.92
Difference	30.15	37.32	63.91	131.38
	<u>1956-1957</u>			
Ungrazed**	206.80	123.85	178.05	508.70
Grazed	197.45	64.95	86.30	348.70
Difference	9.35	58.90	91.75	160.00

* One square foot clippings

** Exclosures

Table 8. Summary of clippings data for Wong barley for two years, 1955-1956 and 1956-1957

	Combined wts. of eight clippings in grams*			
	<u>Hog Island</u>		<u>Presquile</u>	<u>Totals</u>
	"A"	"B"		
	<u>1955-1956</u>			
Ungrazed**	69.87	79.05	76.58	225.50
Grazed	41.55	31.72	74.52	147.79
Difference	28.32	47.33	2.06	77.71
	<u>1956-1957</u>			
Ungrazed**	131.55	139.90	93.95	365.40
Grazed	117.50	99.75	97.05	314.30
Difference	14.05	40.15	-3.10	51.10

* One square foot clippings

** Exclosures

Table 9. Summary of clippings data for rye for two years, 1955-1956 and 1956-1957

	Combined wts. of eight clippings in grams*			
	<u>Hog Island</u>		<u>Presquile</u>	<u>Totals</u>
	"A"	"B"		
	<u>1955-1956</u>			
Ungrazed**	126.10	90.24	220.02	436.36
Grazed	92.29	32.80	164.23	289.32
Difference	33.81	57.44	55.79	147.04
	<u>1956-1957</u>			
Ungrazed**	143.65	183.60	148.50	475.75
Grazed	143.95	64.80	96.85	305.55
Difference	-0.30	118.80	51.65	170.15

* One square foot clippings

** Exclosures

plots increased production the second year with a slight increase for "A" and doubled production in "B". However, forage yield was very much reduced at Presquile the second year.

Oats (Table 10) yielded a large amount of forage each year. Hog Island yields increased the second year while Presquile yield dropped. The "A" plot for 1956-1957 produced more forage outside the control enclosure than inside. Since this plot was utilized very little by geese during the wintering season this difference may be the result of mechanical location of the enclosure in an area with a poor stand.

Wheat (Table 11) showed widely varying yields for the three plots, but comparable yields for the two years. The forage increased slightly for Hog Island and decreased slightly for Presquile. The poorest yields were on Hog Island "B" which was in a lower, more poorly drained area than plot "A". Although the "B" plot was subject to severe flooding in September of 1956, it produced a comparable yield to the previous year.

When the crops are arranged in order of yield from maximum to minimum (Table 12) it can be seen that Italian rye grass, rye and oats produced the greatest quantity of forage per square foot for both years. Oats and rye ranked high in rating of each plot both years, while Italian rye grass varied from the highest to medium low. Wheat which ranked at the top in the "A" plots for 1955-1956 varied widely and was lowest ranked for "B" in 1956-1957. Ladino clover which ranked last for all plots in 1955-1956 increased to about average for 1956-1957 in second year growth. Alfalfa which was second from the lowest in 1955-1956 dropped to the lowest in 1956-1957 except for plot "B" in which it showed a good increase. Wong barley rated about average for both years while crimson clover

Table 10. Summary of clippings data for oats for two years, 1955-1956 and 1956-1957

	Combined wts. of eight clippings in grams*			
	<u>Hog Island</u>		<u>Presquile</u>	<u>Totals</u>
	"A"	"B"		
	<u>1955-1956</u>			
Ungrazed**	105.32	74.26	170.46	350.04
Grazed	56.77	42.25	142.84	241.86
Difference	48.55	32.01	27.62	108.18
	<u>1956-1957</u>			
Ungrazed**	177.00	184.20	126.95	488.15
Grazed	214.20	179.80	89.30	483.30
Difference	-37.20	4.40	37.65	4.85

* One square foot clippings

** Exclosures

Table 11. Summary of clippings data for wheat for two years, 1955-1956 and 1956-1957

	Combined wts. of eight clippings in grams*			
	<u>Hog Island</u>		<u>Presquile</u>	<u>Totals</u>
	"A"	"B"		
	<u>1955-1956</u>			
Ungrazed**	133.48	52.04	163.05	348.57
Grazed	76.86	29.57	159.23	265.66
Difference	56.62	22.47	3.72	82.81
	<u>1956-1957</u>			
Ungrazed**	145.70	58.10	132.15	335.95
Grazed	147.80	47.30	92.20	287.30
Difference	-2.10	10.80	39.95	48.65

* One square foot clippings

** Exclosures

Table 12. Crops listed in declining order by weight of forage yielded in control plots in eight clippings* 1955-1956 and 1956-1957

Hog Island "A"	Hog Island "B"	Presquille	Grand totals
<u>1955-1956</u>			
Wheat	Rye	Italian rye grass	Rye
Rye	Wong barley	Rye	Italian rye grass
Oats	Oats	Oats	Oats
Italian rye grass	Crimson clover	Wheat	Wheat
Wong barley	Wheat	Wong barley	Wong barley
Crimson clover	Italian rye grass	Crimson clover	Crimson clover
Alfalfa	Alfalfa	Alfalfa	Alfalfa
Ladino clover	Ladino clover	Ladino clover	Ladino clover
<u>1956-1957</u>			
Italian rye grass	Oats	Italian rye grass	Italian rye grass
Oats	Rye	Rye	Oats
Wheat	Wong barley	Wheat	Rye
Rye	Ladino clover	Oats	Ladino clover
Ladino clover	Alfalfa	Ladino clover	Wong barley
Wong barley	Italian rye grass	Wong barley	Wheat
Crimson clover	Crimson clover	Crimson clover	Crimson clover
Alfalfa	Wheat	Alfalfa	Alfalfa

* Clippings were made between November 27 - February 6. Yield is ungrazed clipping weight.

dropped from average to low the second year.

Grain Produced: In 1956 all of the plots at Hog Island were allowed to stand until the crop was mature. Clippings were made of two square foot samples inside the exclosures in locations which had not been previously clipped and outside of the exclosures at random. These clippings were dried and weighed in the same manner as the earlier clippings. In addition, the small grain was threshed and the threshed grain weighed. These results are shown in Appendix Table 5. The weights obtained from these clippings indicate very strongly that heavy grazing by both geese and deer did not damage the small grain crops. Sight observations indicated that the alfalfa and the clovers were utilized heavily by deer until these clippings were made, Figure 11. This is apparent in the weights shown in Appendix Table 5 for these crops. There was no apparent difference in ripening or maturing of the crops with the exception of barley (Figure 12) and oats. In both the barley and the oats plots it was observed that the grain inside the exclosures matured about one week before that outside the exclosures in the utilized area. The small grains all produced a higher yield in the grazed areas. These results were obtained from only one years experiment and may be more variable than these data indicate. The wheat harvested on the refuge in 1956 produced yields of from 20-28 bushels per acre. This is considered to be an average to high yield for Surry County. The increased yields in the grazed areas of the experimental plots are believed to be due in part to the fertility of the droppings left by geese and deer. Stooling of the plants was observed in some cereal grains-wheat (Figure 13) and barley (Figure 14). This increased the number of stalks bearing grain from each



Figure 11. Deer utilization on ladino clover at harvest time May 29, 1956. The enclosure was trampled and all clover grazed except underneath the sides of the enclosure held up by stakes.



Figure 12. Difference in ripening of ungrazed and grazed Wong barley May 29, 1956. Ungrazed on left had ripened and most of grain fallen.



Figure 13. Wheat showing stooling of plants March 11, 1957



Figure 14. Wong barley showing stooling of plants March 11, 1957

plant and resulted in more heads of grain per square foot.

UTILIZATION OF CROPS BY GEESE AND DEER

Direct Observation: The utilization of the plots by geese and deer at Hog Island was observed with some difficulty because of the small size of the plots, the flatness of the land and the location of the plots in relation to the observation point (road). It was generally only possible to estimate the number of geese in each plot. The estimated numbers of geese observed in the 1956-1957 season are shown in Appendix Table 11. The geese were first observed in the plots of the "B" set. This set of plots as shown in Figure 4 was farthest from the main road and was, in the opinion of the writer, in a preferred location for geese. The plots with shorter plants appeared to be utilized first. Alfalfa, crimson clover, and Italian rye grass were all very short when first utilized and continued use kept these plots grazed very close until the geese left the area. The geese gradually moved into other plots until all "B" plots had been utilized. Then they moved around the edge of the small marsh to the SE in the wheat, which bordered the experimental plots into the middle plots of "A" series. Alfalfa, rye, oats and wheat of "A" series were perhaps in a low preference location because geese were not observed in these plots until very late in the season. The rye, oats and wheat were in good growing locations and probably became too tall and tough to be desirable for geese. After a heavy snow, about five inches on January 14-16, geese were observed using the alfalfa and rye (Figure 15) very heavily before the snow melted. Also, about 150 coots were observed in the crimson clover for the first time (Figure 16). After the snow had melted geese were observed in all sixteen plots. The last observed use of the plots by geese occurred on January 31 and shortly



Figure 15. Canada geese in alfalfa and rye plots with snow on the ground January 18, 1957



Figure 16. Coots in crimson clover with snow on the ground January 18, 1957

afterward practically all geese departed from Hog Island except 200-300 which remained in the area until late February. However, after January 31 none were observed in or near the experimental plots.

Observation of deer use was more difficult than goose use because most observations were necessarily made in the late afternoon or at night. Most often the deer appeared to prefer the leguminous plants. Deer observed were recorded as inside or outside of the plots as shown in Appendix Table 12. It was interesting to note that the deer kept the alfalfa and ladino clover plots grazed rather closely before the arrival of the geese and may have made these crops more desirable for geese. The deer, therefore, obviated the need for mowing. When the geese moved in and grazed the "B" plots very closely the deer apparently could not compete and moved to taller plants of other species.

After the electric fence was installed December 22, 1956, there were fewer deer seen in the plots but the fence had no apparent effect on the geese. Although no record was kept during 1955-1956 the deer usage of the experimental plots was observed to be much heavier than in 1956-1957. The electric fence was an important factor but it was also noted that the deer population was apparently smaller than during the previous year. During the 1955 special three-week bowhunt for deer, October 17 to November 5, twenty-one deer, both sexes, were killed as compared with only five killed in the same period in 1956.

The coots first observed January 18, 1957 in the crimson clover "A" plot continued to use the crimson and also used alfalfa and ladino clover of "A" plots until early April. The coots did not compete very much with the geese because the geese soon moved from the area. Had the coot

invasion commenced earlier, it is believed competition might have developed between the coots and geese for the forage.

At Presquile no record was kept of sight observations during either year. Both years the geese moved into the experimental plots from the milo bordering the Italian rye grass on the NE end (Figure 5) of the field and gradually worked through the remaining plots to the SW. There appears to have been heavier utilization of the plots the second year by both geese and deer. Figures 17 to 24 show the difference in grazed and ungrazed areas of each crop on March 25, 1957 at which time most of the geese had left the area.

Observation of other fields planted to wheat at Hog Island and Presquile indicate that geese prefer the wheat at a very early stage. Fields just planted were utilized as soon as the green shoots broke through the ground. Wheat fields that were planted early made good growth and were in some instances five to six inches high when geese arrived. No utilization was observed in these fields until all younger tender wheat had been closely cropped. All wheat on Hog Island Refuge had received some use the end of January. Even a strip within 200 feet of the writer's home and only fifty feet from two bird dogs, who barked constantly at the geese, was used by about 500 birds. No doubt the dogs would have frightened the geese to flight had they been unchained. A soybean field within fifty feet of the house and a strip of milo between the soybeans and the wheat that also adjoined the dog house were utilized almost within reach of the dog. No milo or soybeans were utilized until they were mowed or knocked down. Shortly after mowing, geese were observed to move into mowed areas. No noticeable preference for either

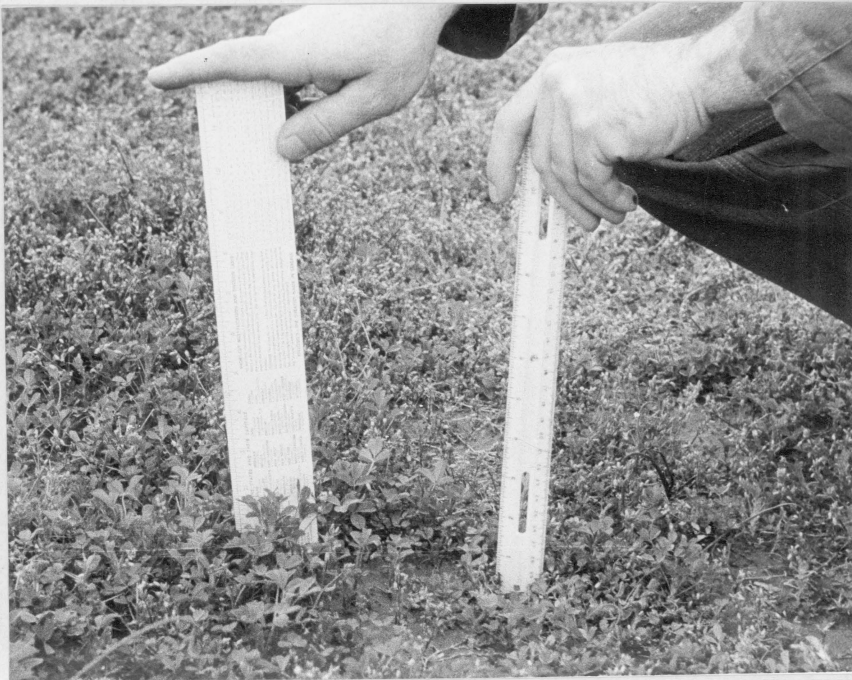


Figure 17. Alfalfa utilization at Presquile March 25, 1957. The wide rule is in ungrazed area.



Figure 18. Crimson clover utilization at Presquile March 25, 1957. The wide rule is in ungrazed area.

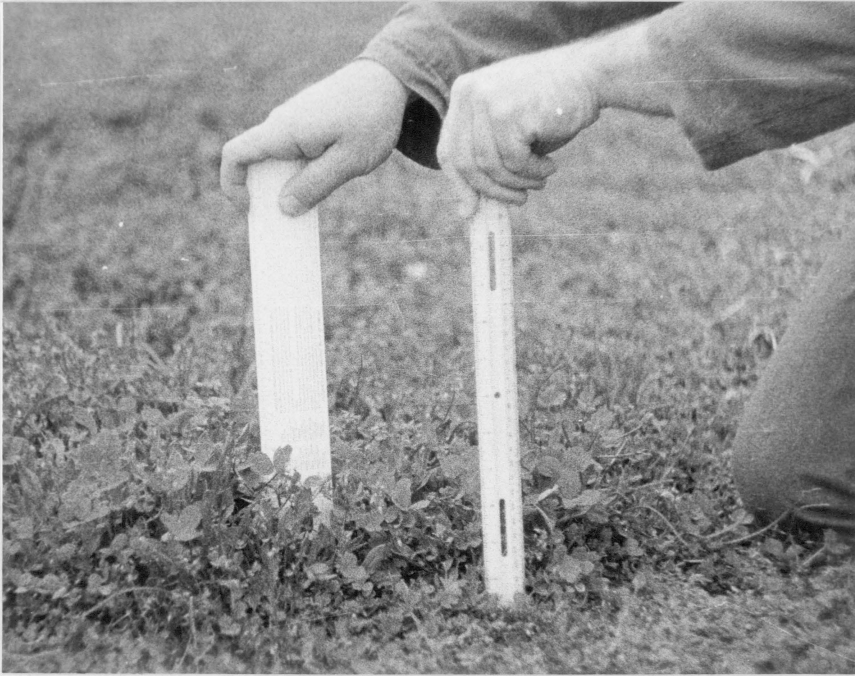


Figure 19. Ladino clover utilization at Presquile March 25, 1957. The wide rule is in ungrazed area.



Figure 20. Italian rye grass utilization at Presquile March 25, 1957. The wide rule is in ungrazed area.



Figure 21. Wong barley utilization at Presquile March 25, 1957. The wide rule is in ungrazed area.



Figure 22. Oats utilization at Presquile March 25, 1957. The wide rule is in ungrazed area.



Figure 23. Rye utilization at Presquile March 25, 1957.
The wide rule is in ungrazed area.



Figure 24. Wheat utilization at Presquile March 25, 1957. The wide rule is in ungrazed area.

crop over the green graze was noted.

With the advent of an extremely wet winter season of 1956-1957 some puddling of the wheat by geese in the high preference fields was observed to the extent that much of the wheat was destroyed. This puddling did not occur during the previous normal year. Extreme flooding and a very wet wintering season coupled with heavy goose use appears to cause damage to the wheat plants. One field on Hog Island, the favorite location of geese, was puddled and trampled until it appeared that very little wheat remained. This field was not subject to severe flooding but did remain wet throughout most of the wintering season. Fields that received extreme flooding plus heavy usage by geese appeared to have a very poor stand of wheat. The first year of the investigation, as mentioned earlier in this report, produced good yields of wheat on all fields harvested. The 1956-1957 yield, not reported herein, is expected to be lower than 1955-1956.

The geese became accustomed to the vehicles regularly used on Hog Island refuge and soon paid very little attention to them, seldom moving out of a field. However, strange automobiles of visitors usually made the geese nervous and often put them to flight. Humans walking about appeared to frighten the geese much more quickly than people in cars or on motorized equipment.

There was a definite preference of location shown for certain fields on Hog Island refuge. The favorite field was one that was clear of all hedge-rows and trees, and which was located on the river shore with easy access to water.

Weather conditions seemed to affect the feeding time. On clear days most feeding occurred during early morning and late afternoon with a long

rest period during midday. Similar findings are reported by Helm (1951) in Missouri. On dark, cloudy, overcast days feeding usually continued later in the morning and started earlier in the afternoon. On clear moonlight nights there was some night feeding. Normally the geese went to the river or large open ponds inside the refuge to rest at night. During the day the rest period most often was spent on open water but sometimes appeared to be spent in a favorite open field.

Droppings counts: The droppings counts are believed by the writer to be the best index of relative use and preference used in this investigation. It is regretted that droppings counts were not started earlier the first year of the project to permit more adequate comparison of the results of the two years investigation.

The droppings counts recorded in Appendix Tables 6 and 7 for February and March, 1956 are considered of only minor importance. These counts, however, indicate that there had been some geese on all Hog Island plots. Italian rye grass received heaviest use by geese but light use by deer. Rye was well utilized by both geese and deer. Oats, rye and wheat were high in preference for deer at the time the counts were made. Oats appear to have been high in preference for deer but low in preference for geese. The Presquile counts indicated that there was very light goose use. Rye, Italian rye grass, wheat and oats were used by deer in that order. It should be noted that all three legumes at both refuges were planted too late in 1955 to produce good forage for geese. However, they received relatively heavy use at HOG Island by geese but very little use by deer. At Presquile no goose or deer droppings were recorded in any of the legume plots.

A more thorough droppings count for 1956-1957 provided a better substantiated technique of appraisal of goose and deer use. Appendix Table 8 clearly shows the early use of geese in the Hog Island "B" plots by the large number of droppings recorded. The "B" plots were without doubt in preferred locations for the geese over the "A" plots. "B" plots, however, continued to receive heavy usage throughout the period that droppings were recorded until January 29 after which no goose use was recorded. The "A" plots received scattered use until January 3, 1957 when heavy use was recorded in barley, ladino and crimson clover. After this date, use increased in adjoining plots until January 22 and 29 when good use was recorded in all plots except oats which received very light use.

The deer use as indicated by droppings counts (pellet groups) was relatively heavy on all plots when the counts were begun but dropped off rapidly in the plots most heavily utilized by geese. The writer believes that the deer were unable to compete for the forage present or found it undesirable, once the geese have cropped it off very close to the ground. The electric fence completed on December 22, 1956, appeared to have greatly reduced deer use for about one month after which there was some increase in the number of deer droppings found.

Appendix Table 9 for Presquile indicates that utilization by geese occurred in two peaks, the first just before December 12, 1956 and the second just before January 9, 1957. Location appears to have influenced utilization. As indicated by droppings counts and by observation, the geese appear to have first moved into the rye grass plots out of the nearby milo. They then gradually worked toward the opposite end of the

field. It is of interest to note that although the oats plot was the second in line it received relatively little use by geese. The ladino clover which was second year growth had been grazed closely by the deer before the geese arrived and continued to receive heavy deer use. Notwithstanding the deer use it also received high goose use as indicated by droppings counts. Barley, alfalfa and crimson clover all received relatively light use. The 1956-1957 total droppings of geese and deer on each crop for all three plots used were found to vary noticeably. Often several variables were involved. In order to compare the three series of plots it was possible to use only eight collecting dates covering a comparable period, November 27, 1956 to February 6, 1957.

The "B" plot of alfalfa at Hog Island showed three times as many goose droppings as either of the other two alfalfa plots which were about equal in total counts, Table 13.

Table 13. Summary of eight droppings counts for alfalfa, November 27, 1956 - February 6, 1957

Animal	Hog Island		Presquile	Totals
	"A"	"B"		
Goose	30,251	102,481	30,441	163,223
Deer	1,954	1,303	312	3,569

Both plots at Hog Island showed much higher deer droppings counts than at Presquile. This may be explained in part by the fact that the alfalfa at Presquile was new growth and was a relative poor stand, whereas, at Hog Island both plots were second year growth and received heavy utilization by deer before geese arrived in the areas. The much

heavier goose use on the "B" plot appears to have made the plot undesirable for deer.

Crimson clover received variable use as indicated by wide variations in numbers of goose droppings (Table 14). Deer droppings occurred in only one plot (Hog Island "A"). The "A" plot was in a slightly higher location than the "B" plot and was, therefore, not subject to the heavy flooding in September 1956 which is believed to have retarded the growth of plot "B". The geese utilized "B" as soon as it started growing and kept it so short that deer did not utilize it. At Presquile the crimson clover produced a very poor stand besides being in what may have been a poor location.

Table 14. Summary of eight droppings counts for crimson clover
November 27, 1956 - February 6, 1957

Animal	No. of droppings per acre		Totals
	Hog Island		
	"A"	"B"	
Goose	117,189	83,211	230,268
Deer	1,303	0	1,303

Ladino clover made a very good showing on all three plots (Table 15) during second year of growth. All ladino was also well used by deer. Before the geese arrived in both areas very little mowing was necessary to keep the clover at a desired height. Presquile had much lighter goose use but much heavier deer use than Hog Island. However, in considering relative preference at Presquile ladino was heavily utilized by geese.

Table 15. Summary of eight droppings counts for ladino clover, November 27, 1956 - February 6, 1957

Animal	Hog Island		No. of droppings per acre Presquile	Totals
	"A"	"B"		
Goose	100,712	149,765	43,314	292,791
Deer	3,164	1,303	9,853	14,320

Italian rye grass, as indicated in Table 16, was one of the best utilized crops by geese but was not too heavily used by deer. The "B" plot was one of the first used by geese in the fall and continued to receive heavy use throughout the season. Plot "A" was not used until very late in the season although it was a good stand. Growth may have been too rank to be desirable by the time geese arrived. The location may also have been less desirable than the "B" plot. At Presquile, Italian rye grass appeared to be in perhaps the most desirable location.

Table 16. Summary of eight droppings counts for Italian rye grass, November 27, 1956 - February 6, 1957

Animal	Hog Island		No. of droppings per acre Presquile	Totals
	"A"	"B"		
Goose	16,847	172,198	63,338	254,383
Deer	1,395	372	1,764	3,531

Wong barley droppings counts results varied widely for both goose and deer use (Table 17). Barley was best utilized in the "B" plot by geese and very little deer use occurred. At Presquile the deer use was high and goose use was much lighter than at Hog Island.

Table 17. Summary of eight droppings counts for Wong barley, November 27, 1956 - February 6, 1957

Animal	Hog Island		No. of droppings per acre Presquile	Totals
	"A"	"B"		
Goose	51,007	81,352	14,623	146,982
Deer	279	93	2,385	2,757

Oats appeared to be well utilized by deer at all three locations, yet, varied widely in amount used by geese (Table 18). Location may have influenced goose use in plot "A" but the Presquile plot was in apparently the second best location. The oats may have become too rank to be desirable on all plots for geese. Deer droppings counts were high on all oats plots indicating it was high in deer preference.

Table 18. Summary of eight droppings counts for oats, November 27, 1956 - February 6, 1957

Animal	Hog Island		No. of droppings per acre Presquile	Totals
	"A"	"B"		
Goose	186	61,897	19,601	81,684
Deer	2,047	2,699	3,832	6,578

Rye was similar to alfalfa in that it had almost three times as much utilization on "B" as on the other two plots. However, Presquile had heavy deer use (Table 19). The small number of deer droppings in "B" indicate that the heavy use by geese may have made the plot undesirable for deer.

Table 19. Summary of eight droppings counts for rye,
November 27, 1956 - February 6, 1957

Animal	No. of droppings per acre		Totals
	Hog Island "A"	Presquile "B"	
Goose	46,540	109,369	191,648
Deer	1,023	279	5,036

Wheat, generally considered one of the best winter graze crops for geese, (Helm 1951) (Atkeson and Givens, 1956) varied widely in its apparent utilization by geese and deer as indicated by droppings counts, Table 20. The "A" plot was in perhaps the poorest location for geese but it was in a good growing location. With no use occurring until late in the season it probably became too tall and tough to make good goose food. However, it was well utilized by geese after most of the other desirable graze had been eaten. The wheat location in plot group "B" was considered excellent. However, due to flooding, it was in a poor growing location. At Presquile wheat was in a medium preference location but ranked high in use.

Table 20. Summary of eight droppings counts for wheat,
November 27, 1956 - February 6, 1957

Animal	No. of droppings per acre		Totals
	Hog Island "A"	Presquile "B"	
Goose	11,534	141,947	216,225
Deer	1,303	93	6,996

The very low deer droppings count for "B" and very high goose droppings count indicates that the heavy goose use probably made the area less desirable for deer.

Weight differentials in clippings: Appendix Tables 1, 2, 3, and 4 show all dry clippings weights taken during this investigation. The ungrazed sample weights were taken inside the exclosures and the grazed sample weights were taken at random in the plot. Also shown are the weight differentials or difference between ungrazed and grazed weights which are considered the forage utilized. This utilization was in most instances both goose and deer utilization.

The forage utilized varied widely and in many instances shows negative results indicating that the weight of the clipping outside was greater than the ungrazed clipping inside the exclosure. From the statistical analysis it was found that these are normal variations which may occur due to difference in density of stand, and variation in fertility of the soil. The influence of goose and deer fertilization on plant growth and the stooling resulting from the grazing may have been responsible for some of the negative results. The experiment, however, was not designed to measure the importance of this influence.

It is assumed that when utilization of the plants was sufficiently intense and continuous a positive difference was recorded. Utilization as indicated by differences in weights, therefore, is not a highly accurate technique because of the varying ability for rapid regrowth in the plants studied.

During 1955-1956 alfalfa plot "A" and Presquile (Table 4) indicated similar utilization while plot "B" indicated much higher use. In 1956-1957 utilization dropped off on the "A" and Presquile plots while the "B" plot increased in utilization. Forage available the second year was greater on both Hog Island "A" and "B" plots but less at Presquile.

However, Presquile was a new stand while both Hog Island plots were second year growth.

Crimson clover (Table 5) utilization varied from a negative figure for Presquile to relatively high utilization in "B" during 1955-1956. In 1956-1957 there was a large increase in forage available in plot "A" and corresponding increase in utilization. Plot "B" showed an increase in total yield of forage but utilization remained about the same. Presquile increased utilization but forage available decreased. The Hog Island plots both appeared to be in favored locations for geese while at Presquile, the location appeared less favorable.

Ladino clover (Table 6) evidenced low utilization on the new stands in 1955-1956 but indicated very good utilization on second year growth in 1956-1957. Yield of forage available was also much higher the second year.

Italian rye grass (Table 7) was a good producer of forage and showed heavy utilization of forage. All plots were well utilized the first year. Plot "A" during the second year was observed to receive very light use by geese until very late in the season.

Wong barley (Table 8) varied widely in utilization both years with consistent drops in utilization on all three plots for the second year in spite of a substantial increase in available forage. The forage may have reached a tough unpalatable stage the second year before the geese started using it.

Rye (Table 8) ranked first in total utilization for both years. Utilization rate for 1955-1956 did not correspond to forage yield. Utilization was observed to be very low on plot "A" in 1956-1957 until

after the January snow while plot "B" received moderate to heavy goose usage throughout the season. Plot "B" appeared to be in a more preferred location than plot "A". The minus result in "A" is believed due to variation in the stand. The second year's result in utilized weight of forage for "B" was the highest total for any crop.

Oats (Table 10) while a very good forage producer, varied greatly in utilization. The greater the amount of forage produced, the less it was utilized. The first year's production showed comparable results for both Hog Island plots while with greater production at Presquile less utilization occurred. In 1956-1957 Hog Island plots produced greater amounts of forage but utilization dropped noticeably. Presquile with a reduction in yield showed an increase in utilization. Hog Island plots had much better growth the second year when the geese arrived and appeared to have become less attractive as forage for geese. The large minus figure in "A" is probably due to a poor stand in the enclosure which was systematically located (Figure 4). Another factor may have been the increased growth due to fertilization from first year goose and deer droppings outside of the enclosure. The goose utilization on "A" plot was very light compared with "B" and both received very light usage compared to other plots. The "B" plot appeared to be the favored location.

Wheat (Table 11) varied in both yield and utilization with very little correlation between the two. Lower yield appears to have resulted in better utilization when each plot is compared for the two years. The Hog Island plot "B" having poorer growth, due to flooding and poor drainage, than "A", had a higher percentage of utilization. Plot "A" in 1956-1957 received very little observed utilization until late in

the wintering season. Location appears to have been poorer for "A".

When the utilization totals (weight differentials) are ranked from maximum to minimum (Table 21) rye and Italian rye grass are the top two for total utilization during both years and are consistently high in the plot totals except for 1956-1957 plot "A" for rye. Oats and wheat which were high the first year changed places with crimson clover and ladino clover the second year and plot rank varied comparably. Alfalfa and Wong barley were in the lower middle ranks for both years while plot ratings varied from medium high to low.

Compared with crop yields (Table 12) the rank of utilization corresponded more nearly with yield rank in 1955-1956 than in 1956-1957. Rye and Italian rye grass ranked high in both yield and utilization for the two years. Ladino clover which was low in both total forage produced and utilization by geese and deer the first year did much better in both classifications as the second year's growth improved in 1956-1957. Alfalfa as second year growth improved some in utilization but remained low in forage produced.

Figures 17 through 24 show utilization as indicated by difference in heights of vegetation inside and outside of the exclosures.

Table 21. Crops ranked according to declining utilization as indicated by total clipping weight differences between grazed and ungrazed (control) areas*

Hog Island "A"	Hog Island "B"	Presquile	Grand totals
<u>1955-1956</u>			
Wheat	Rye	Italian rye grass	Rye
Oats	Wong barley	Rye	Italian rye grass
Rye	Crimson clover	Oats	Oats
Italian rye grass	Italian rye grass	Alfalfa	Wheat
Wong barley	Oats	Ladino clover	Wong barley
Crimson clover	Alfalfa	Wheat	Alfalfa
Alfalfa	Wheat	Wong barley	Crimson clover
Ladino clover	Ladino clover	Crimson clover	Ladino clover
<u>1956-1957</u>			
Crimson clover	Rye	Italian rye grass	Rye
Ladino clover	Alfalfa	Rye	Italian rye grass
Wong barley	Italian rye grass	Ladino clover	Crimson clover
Alfalfa	Crimson clover	Wheat	Ladino clover
Italian rye grass	Wong barley	Oats	Alfalfa
Rye	Ladino clover	Crimson clover	Wong barley
Wheat	Wheat	Alfalfa	Wheat
Oats	Oats	Wong barley	Oats

* Eight clippings were made between November 27 - February 6. Yields equal differences between weights of ungrazed and grazed samples.

PREFERENCE OF GEESE OR DEER AND BOTH

There appear to be several factors which influence geese in their preference for one crop over another. Among these factors are the amount and height of vegetation, its location, weather conditions and human activity. From direct observation it was noted that geese apparently preferred the very short tender plants. When the vegetation became four or five inches high, they would leave it alone until all other forage was exhausted. The "B" plots farthest from the main refuge road were utilized first and most often. Human activity tended to discourage geese from using the "A" plots, especially those plots on the ends. Preference was shown for plots in the wetter locations over those in the higher, dryer areas.

The best index of preference appears to be the droppings count data mentioned earlier. In Table 22 the crops have been ranked in order of total droppings counts. This is relative preference in terms of total droppings for one year only and because of the other factors affecting utilization which have already been noted should not be considered conclusive evidence indicating the positive relative preference of any species of plant. There appears to be a definite preference, however, for certain crops. "B" plots at Hog Island which were most heavily used and the Presquile plots show a similarity in preference by geese. The "A" plots which were not utilized until late in the wintering season show some variation in preference order. Italian rye grass ranked high in preference of geese and medium to low for deer. Ladino clover was high in preference for both geese and deer. Oats ranked low preference in all instances for geese and high for deer. Rye and alfalfa ranked medium in

Table 22. Relative preference of crops as shown by total droppings counts recorded for the plots for 1956-1957*

Hog Island "A"	Hog Island "B"	Presquile	Grand totals
<u>Geese</u>			
Crimson clover	Italian rye grass	Italian rye grass	Ladino clover
Ladino clover	Ladino clover	Wheat	Italian rye grass
Wong barley	Wheat	Ladino clover	Wheat
Rye	Rye	Rye	Crimson clover
Alfalfa	Alfalfa	Alfalfa	Rye
Italian rye grass	Crimson clover	Oats	Alfalfa
Wheat	Wong barley	Wong barley	Wong barley
Oats	Oats	Crimson clover	Oats
<u>Deer</u>			
Ladino clover	Oats	Ladino clover	Ladino clover
Oats	Alfalfa-Ladino clover	Wheat	Wheat
Alfalfa	Italian rye grass	Oats	Oats
Italian rye grass	Rye	Rye	Rye
Crimson clover-Wheat	Wong barley-Wheat	Wong barley	Alfalfa
Rye	Crimson clover	Italian rye grass	Italian rye grass
Wong barley		Alfalfa	Wong barley
		Crimson clover	Crimson clover

* Ranked according to data from Tables 13 - 20

preference for geese and deer. Wheat varied in preference for geese and deer, but averaged medium high for both geese and deer. Large areas of the refuge were planted in wheat and were available and utilized by the geese. The effects of this available wheat in locations other than the plots cannot be determined. Crimson clover varied from one extreme to the other for geese but was low in preference for deer. Wong barley was generally low to medium in preference for both geese and deer.

From the two droppings counts made in February and March 1956 an indication may be seen of relative preference of both geese and deer for the first year at Hog Island only. Both plots of Italian rye grass at Hog Island ranked highest for geese and low for deer. Oats were again low for geese but high in desirability for deer. These two preferences were supported by the results already mentioned, for 1956-1957. Rye which ranked medium for both geese and deer in 1956-1957 was, however, a high preference food in the previous year for both animals. Ladino clover ranked low probably because of poor growth.

EFFECTS ON CROP DUE TO GRAZING OF GEESE AND DEER

The effects of grazing on the crops appears to be for the most part good. As previously mentioned, the yields of cereal grains resulting from the harvest samples taken in 1956 (Appendix Table 5) were greater from the grazed areas. Thus, it would appear that grazing helped each crop for that year. However, the second year with a much wetter wintering season, may produce different results. Unfortunately, this paper cannot report these data because crops have not yet matured. Italian rye grass during 1956 produced more hay in the grazed areas indicating no damage from grazing. The effects of grazing by deer on the clovers and alfalfa, however, were apparent in the low yields at harvest time. This result further indicated a high preference of deer for clover and alfalfa during spring and summer. Grazing during the winter season by geese and deer did not harm the ladino clover and alfalfa at Hog Island insofar as could be determined by direct observation of the individual stands. Each crop was left standing and produced very satisfactory forage for the second year.

From observation on the plots and on other wheat at Hog Island during 1956-1957, it is apparent that the extremely wet weather and flooding, which kept the land wet during the winter season caused puddling by the geese, and has resulted in some damage to the wheat crop.

ECONOMICS

The cost of each crop which was discussed previously and itemized in Table 3 and Appendix Table 15, showed that ladino clover cost less than any other crop. However, ladino clover was very low in forage yield in 1955-1956 and only medium in 1956-1957 (Table 12) and low in 1955-1956 to medium in 1956-1957 in utilization (Table 21). Low preference was indicated for both geese and deer during the first year. However, in 1956-1957 ladino clover was very high in preference for both. If the planting had been earlier in 1955 both years might have been high in preference.

The most expensive crop planted was crimson clover. On the basis of yield produced, utilization and determined preference it appears economically impractical to plant crimson clover for goose use on either refuge.

Alfalfa was the second most expensive crop and if it had been necessary to plant the second year, would have been far more expensive than crimson clover. It was also a poor forage producer and ranked only medium in preference and utilization.

Italian rye grass and the cereal grains were comparable in cost. Rye grass, rye and oats were the highest forage producers and also highest in utilization in 1955-1956. Rye and rye grass were highest in utilization in 1956-1957 while oats dropped to the lowest in utilization. Preference for Italian rye grass by geese and minor use by deer as shown in 1956-1957 make it a desirable crop for refuge management where deer are a problem.

High deer preference for oats and low preference by geese make it economically a poor choice.

Rye a high producer was equally well liked by geese and deer and might be a good winter-green plant choice where deer are not a problem.

Wheat which was medium to low in yield and utilization was low in preference in 1956-1957 and seems a rather poor choice for the locations of this investigation. The presence of large areas of wheat on the Hog Island Refuge other than in the plots may have had some effect on the wheat utilization.

From the farmers view point geese do not appear to damage any of these eight crops (Appendix Table 5) during a normal goose wintering season in this area. However, during a very wet season great concentrations of geese may cause puddling of the fields and damage may result.

Observation indicates that all the crops appear to be able to withstand some flooding. The wet season occurring during 1956-1957 produced increased amounts of forage in practically all crops.

SUMMARY AND DISCUSSION

The purposes of this investigation which was conducted from July 1956 through March 1957 were to determine: (1) the practicability of using winter-green agricultural crops as food for geese, (2) goose food preference for the various crops, (3) the nutritional values of the various crops, (4) the degree of utilization of the various crops by geese, (5) insofar as practicable the extent of damage to the various crops by geese.

Eight crops, alfalfa, crimson clover, ladino clover, Italian rye grass, Wong barley, oats, rye and wheat were planted. Two one-half acre plots at Hog Island and one three-quarter acre plot at Presquile of each crop were used. Clippings were taken of each grazed and ungrazed area in each plot and were dried and weighed to determine weight differential or utilization. Italian rye grass, rye and oats were highest in both yields and utilization the first year. Rye and Italian rye grass were highest the second year in both yield and utilization. Ladino clover improved in both yield and utilization with the second years growth. Rank of all crops in weight of vegetation produced and in utilization are shown in Tables 21 and 22 in declining order.

A statistical analysis of the clippings weight data showed that the sampling was valid and that there were significant differences at a five percent level of confidence in the amounts of forage produced and in the amounts utilized. It was impractical because of the combined use of deer and geese on most plots to separate goose and deer use and demonstrate a preference by statistical methods for either animal. It was necessary to make more general assumptions in interpreting the importance of a crop to geese or deer individually. The droppings counts were helpful in this

respect.

The nutritional analysis showed similar percentage of nutrients in most species. No correlation between available nutrients and preference was apparent.

Droppings count lines run regularly the second year gave the best index of preference by geese and/or deer. Ladino clover and wheat by this technique was high in preference for both geese and deer. Crimson clover was medium preference for geese but low for deer. Oats was high for deer but low for geese.

Economically Ladino clover was the least expensive, and showed high preference by both geese and deer for second year growth. Crimson clover and alfalfa were both very high in cost and were only medium to low in yield and in ratings by pellet counts and utilization. Italian rye grass and all cereal grains were all lower in cost. The determined high preference rating for geese plus low cost figures indicate Italian rye grass probably is the most economical goose grazing species. In addition it has a low deer preference rating.

The effects of grazing by 5000 to 7000 geese left no apparent damage but appeared to increase the crop yields in a normal season. Abnormally wet winter seasons, severe flooding and the same goose pressure might damage crops.

Deer if not too numerous in relation to available food apparently do not damage crops for goose utilization but may, as observed on ladino clover and alfalfa, help by keeping the plants at a height preferred by geese.

Heavy goose usage, however, may leave the forage so short that deer find it undesirable.

Location was a factor in the demonstrated preference of geese for a given plot. A definite preference was shown for open spaces with nearby access to water and no nearby hedge-rows or trees.

Observation of two captive Canada geese indicated that they will completely consume wheat about 4.5 to 5 inches tall (Figure 10) in a 114 sq. ft. pen in one day. Droppings counts from these two geese averaged 92.2 droppings per goose per day for 54 goose days. This figure may vary widely for wild birds because of varying food conditions.

CONCLUSIONS AND RECOMMENDATIONS

Present data are insufficient to permit final recommendations as to the best winter-green crop for geese of the eight crops studied. Italian rye grass appears, however, to have very good possibilities because of its good production of forage, its utilization and apparent high preference by geese coupled with a low preference by deer. It is also a relatively inexpensive field crop. Ladino clover is good as a second year crop for both geese and deer besides being economical to plant and maintain, but should be planted early to permit satisfactory first year utilization. Oats, on the refuges on which this investigation was conducted, appears a poor choice because of its high preference by deer and low goose preference.

There is a need for additional investigation to permit the accumulation of more conclusive data. Presently reported results reflect limitations which might be overcome with additional investigation.

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APPENDIX

Appendix Table 1. Hog Island clipping weights 1955-1956

Crop	Plot	Clipping wts. in grams per sq. ft.		Diff.	Clipping wts. in grams per sq. ft.		Diff.
		Ungrazed	Grazed		Ungrazed	Grazed	
A Plots							
		Dec. 8, 1955			Dec. 15, 1955		
Alfalfa	1	2.84	2.78	0.06	1.75	1.28	0.47
Rye	2	8.50	8.30	0.20	8.44	2.06	6.38
Ladino clover	3	0.44	0.36	0.08	0.72	0.20	0.52
Wong Barley	4	6.56	8.93	-2.37	4.78	2.73	2.05
Crimson clover	5	2.40	2.78	-0.38	2.11	1.40	0.71
Italian rye grass	6	5.61	5.00	0.61	5.32	3.46	1.86
Oats	7	7.34	6.05	0.29	9.22	6.20	3.02
Wheat	8	11.02	9.25	1.77	16.02	6.60	9.42
B Plots							
Ladino clover	11	0.30	0.13	0.17	0.41	0.13	0.28
Oats	12	3.20	3.70	-0.50	6.89	4.12	2.77
Rye	13	5.00	2.76	2.24	4.38	2.58	1.80
Wong barley	14	3.70	4.19	-0.49	5.93	4.49	1.44
Crimson Clover	15	2.11	2.20	-0.09	2.60	1.31	1.29
Alfalfa	16	1.31	0.88	0.43	1.08	0.70	0.38
Italian rye grass	17	1.08	3.18	-2.10	2.88	0.45	2.43
Wheat	18	2.28	2.57	-0.29	2.98	1.95	1.03

Appendix Table 1. Hog Island clipping weights 1955-1956 (continued)

Crop	Plot	Clipping wts. in grams per sq. ft.		Diff.	Clipping wts. in grams per sq. ft.		Diff.
		Ungrazed	Grazed		Ungrazed	Grazed	
"A" Plots							
Alfalfa	1	2.74	2.74	0.00	5.60	4.11	1.49
Rye	2	10.59	7.34	3.25	14.38	5.80	8.58
Ladino clover	3	1.86	3.20	-1.34	3.65	4.08	-0.43
Wong barley	4	9.16	2.59	6.57	10.52	3.85	6.67
Crimson clover	5	5.50	1.78	3.72	6.22	2.97	3.25
Italian rye grass	6	6.36	1.64	4.72	16.59	8.82	7.77
Oats	7	13.11	6.39	6.72	16.90	5.05	11.85
Wheat	8	15.51	11.04	4.47	15.78	7.80	7.98
"B" Plots							
Ladino clover	11	0.70	1.78	-1.08	1.92	1.00	0.92
Oats	12	10.30	6.47	3.83	3.20	6.20	-3.00
Rye	13	6.21	4.23	1.98	11.10	3.70	7.40
Wong barley	14	8.48	1.89	6.59	6.90	3.30	3.60
Crimson clover	15	9.20	1.82	7.38	8.58	1.80	6.78
Alfalfa	16	5.07	0.90	4.17	5.07	1.00	4.07
Italian rye grass	17	8.33	1.11	7.22	8.00	1.90	6.10
Wheat	18	4.03	3.28	0.75	3.30	2.50	0.80

Appendix Table 1. Hog Island clipping weights 1955-1956 (continued)

Crop	Plot	Clipping wts. in grams per sq. ft.			Clipping wts. in grams per sq. ft.		
		Ungrazed	Grazed	Diff.	Ungrazed	Grazed	Diff.
"A" Plots							
Alfalfa	1	2.90	1.01	1.89	7.68	5.00	2.68
Rye	2	17.95	5.73	12.22	18.10	11.10	7.00
Ladino clover	3	1.85	3.56	-1.71	5.72	1.91	3.81
Wong barley	4	5.50	2.50	3.00	11.01	7.40	3.61
Crimson clover	5	3.90	1.00	2.90	8.79	5.15	3.64
Italian rye grass	6	8.42	3.11	5.31	15.00	10.40	4.60
Oats	7	11.70	3.50	8.20	15.35	8.12	7.23
Wheat	8	16.70	5.49	11.21	23.09	12.03	11.06
"B" Plots							
Ladino clover	11	0.40	0.75	-0.35	2.29	1.13	1.16
Oats	12	11.55	4.25	7.30	6.52	5.30	1.22
Rye	13	9.50	2.88	6.62	11.24	3.81	7.43
Wong barley	14	9.12	1.70	7.42	14.23	3.55	10.68
Crimson clover	15	10.80	0.85	9.95	13.60	2.70	10.90
Alfalfa	16	5.49	0.65	4.84	7.00	1.62	5.38
Italian rye grass	17	8.50	0.80	7.70	6.00	3.19	2.81
Wheat	18	5.80	2.05	3.75	7.06	5.90	1.16

Appendix Table 1. Hog Island clipping weights 1955-1956 (continued)

Crop	Plot	Clipping wts. in grams per sq. ft.		Diff.	Clipping wts. in grams per sq. ft.		Diff.
		Ungrazed	Grazed		Ungrazed	Grazed	
<u>"A" Plots</u>							
Alfalfa	1	2.98	2.48	0.50	11.42	2.25	9.17
Rye	2	24.19	12.76	11.43	23.95	9.20	14.75
Ladino clover	3	0.70	2.60	-1.90	3.20	2.40	0.80
Wong barley	4	11.84	7.25	4.59	10.50	6.30	4.20
Crimson clover	5	6.60	2.64	3.96	9.21	5.70	3.51
Italian rye grass	6	16.26	11.28	4.98	10.82	10.52	0.30
Oats	7	16.00	7.66	8.34	15.70	13.80	1.90
Wheat	8	27.71	16.20	11.51	7.65	8.45	-0.80
<u>"B" Plots</u>							
Ladino clover	11	2.90	1.30	1.60	12.11	5.10	7.01
Oats	12	17.75	7.89	9.86	14.85	4.32	10.53
Rye	13	11.51	4.23	7.28	31.30	8.61	22.69
Wong barley	14	16.05	5.45	10.60	14.64	7.15	7.49
Crimson clover	15	9.80	2.80	7.00	7.20	6.03	1.17
Alfalfa	16	6.30	2.00	4.30	10.05	7.50	2.55
Italian rye grass	17	9.82	3.54	6.28	7.38	2.50	4.88
Wheat	18	11.70	4.85	6.85	14.89	7.47	7.42

Appendix Table 1. Hog Island clipping weights 1955-1956 (continued)

Crop	Plot	Clipping wts. in grams per sq. ft.			Clipping wts. in grams per sq. ft.		
		Ungrazed	Grazed	Diff.	Ungrazed	Grazed	Diff.
<u>Feb. 10, 1956</u>							
"A" Plots							
Alfalfa	1	7.90	6.10	1.80	2.96	2.32	0.64
Rye	2	29.05	9.21	19.84	29.05	9.10	19.95
Ladino clover	3	4.90	2.05	2.85	1.11	1.85	-0.74
Wong barley	4	14.85	7.73	7.12	10.85	7.40	3.45
Crimson clover	5	7.87	3.56	4.31	7.72	3.45	4.27
Italian rye grass	6	21.40	8.25	13.15	27.22	8.11	19.11
Oats	7	19.50	5.95	13.55	19.80	5.81	13.99
Wheat	8	27.75	10.47	17.28	27.30	6.62	20.68
<u>Feb. 23, 1956</u>							
"B" Plots							
Ladino clover	11	6.52	7.17	-0.65	3.71	4.33	-0.62
Oats	12	16.25	4.81	11.44	15.94	5.70	10.24
Rye	13	21.50	4.55	16.95	17.28	4.51	12.77
Wong barley	14	17.85	9.70	8.15	13.55	9.80	3.75
Crimson clover	15	10.75	7.85	2.90	6.80	2.00	4.80
Alfalfa	16	7.20	6.05	1.15	7.40	2.20	5.20
Italian rye grass	17	9.50	3.25	6.25	5.75	3.25	2.50
Wheat	18	10.25	4.56	5.69	6.24	4.58	1.66

Appendix Table 1. Hog Island clipping weights 1955-1956 (continued)

Crop	Plot	Clipping wts. in grams per sq. ft.			Diff.
		Ungrazed	Grazed		
"A" Plots					
		<u>Mar. 12, 1956</u>			
Alfalfa	1	7.46	6.46	1.00	
Rye	2	39.30	17.30	22.00	
Ladino clover	3	2.10	2.10	0.00	
Wong barley	4	27.65	9.30	18.35	
Crimson clover	5	9.56	8.22	1.34	
Italian rye grass	6	30.78	5.61	25.17	
Oats	7	32.32	10.20	22.12	
Wheat	8	51.00	15.11	35.89	
"B" Plots					
Ladino clover	11	4.10	6.81	-2.71	
Oats	12	30.90	10.10	20.80	
Rye	13	24.61	9.30	15.31	
Wong barley	14	28.09	6.01	22.08	
Crimson clover	15	22.97	11.50	11.47	
Alfalfa	16	13.90	6.60	7.30	
Italian rye grass	17	4.71	8.82	-4.11	
Wheat	18	11.10	3.00	8.10	

Appendix Table 2. Presquile clipping weights 1955-1956

Crop	Plot	Clipping wts. in grams per sq. ft.			Clipping wts. in grams per sq. ft.		
		Ungrazed	Grazed	Diff.	Ungrazed	Grazed	Diff.
		<u>Dec. 22, 1955</u>			<u>Dec. 28, 1955</u>		
Italian rye grass	1	18.50	19.77	-1.27	23.80	12.54	11.26
Oats	2	6.78	10.17	-3.39	11.75	8.98	2.77
Ladino clover	3	6.25	5.50	0.75	2.89	4.46	-1.57
Wheat	4	19.59	12.11	7.48	15.18	14.56	0.62
Rye	5	13.42	13.98	-0.56	15.30	11.70	3.60
Wong barley	6	4.15	4.50	-0.35	8.32	5.82	2.50
Alfalfa	7	5.77	3.42	2.35	6.80	4.89	1.91
Crimson clover	8	6.41	4.06	2.35	7.77	8.57	-0.80
		<u>Jan. 4, 1956</u>			<u>Jan. 12, 1956</u>		
Italian rye grass	1	27.57	23.10	4.47	30.50	17.57	12.93
Oats	2	14.32	8.70	5.62	24.45	13.39	11.06
Ladino clover	3	4.30	5.48	-1.18	5.40	2.83	2.57
Wheat	4	16.20	16.12	0.08	18.91	13.50	5.41
Rye	5	20.99	16.00	4.99	24.60	12.40	12.20
Wong barley	6	8.95	12.62	-3.67	8.20	4.25	3.95
Alfalfa	7	6.38	3.80	2.58	10.00	2.10	7.90
Crimson clover	8	12.80	5.89	6.91	8.95	8.51	0.44

Appendix Table 2. Presquille clipping weights 1955-1956 (continued)

Crop	Plot	Clipping wts. in grams per sq. ft.			Clipping wts. in grams per sq. ft.		
		Ungrazed	Grazed	Diff.	Ungrazed	Grazed	Diff.
		<u>Jan. 18, 1956</u>			<u>Jan. 25, 1956</u>		
Italian rye grass	1	32.70	25.49	7.21	35.75	36.70	-0.95
Oats	2	20.83	16.17	4.66	15.00	24.50	-9.50
Ladino clover	3	8.15	4.67	3.48	10.30	3.40	6.90
Wheat	4	16.89	26.57	-9.68	21.38	20.60	0.78
Rye	5	29.71	30.05	-0.34	29.68	27.70	1.98
Wong barley	6	5.10	12.60	-7.50	16.55	9.57	6.98
Alfalfa	7	5.70	10.85	-5.15	5.10	5.42	-0.32
Crimson clover	8	10.29	17.61	-7.32	11.60	11.40	0.20
		<u>Feb. 1, 1956</u>			<u>Feb. 8, 1956</u>		
Italian rye grass	1	44.87	32.55	12.32	52.24	34.30	17.94
Oats	2	33.95	28.98	4.97	43.38	31.95	11.43
Ladino clover	3	8.21	3.05	5.16	4.71	11.07	-6.36
Wheat	4	20.19	32.97	-12.78	34.71	22.80	11.91
Rye	5	33.00	28.20	4.80	53.32	24.20	29.12
Wong barley	6	13.50	13.59	-0.09	11.81	11.57	0.24
Alfalfa	7	12.30	3.05	9.25	3.43	4.45	-1.02
Crimson clover	8	6.71	9.70	-2.99	3.89	9.56	-5.67

Appendix Table 2. Presquille clipping weights 1955-1956 (continued)

Crop	Plot	Clipping wts. in grams per sq. ft.			Clipping wts. in grams per sq. ft.		
		Ungrazed	Grazed	Diff.	Ungrazed	Grazed	Diff.
		<u>Feb. 16, 1956</u>			<u>Feb. 22, 1956</u>		
Italian rye grass	1	46.26	13.65	32.61	40.10	20.51	19.59
Oats	2	15.38	23.30	-7.92	16.65	20.00	-3.35
Ladino clover	3	9.03	8.30	0.73	3.05	7.50	-4.45
Wheat	4	29.55	30.00	-0.45	42.60	24.85	17.75
Rye	5	34.21	15.49	18.72	50.50	30.00	20.50
Wong barley	6	13.12	10.59	2.55	13.85	21.89	-8.04
Alfalfa	7	5.72	5.81	-0.09	3.30	4.10	-0.80
Crimson clover	8	3.51	10.00	-6.49	4.50	12.77	-8.27
		<u>Feb. 29, 1956</u>			<u>Mar. 14, 1956</u>		
Italian rye grass	1	45.02	31.40	13.62	60.22	30.20	29.92
Oats	2	32.20	20.39	11.82	35.30	35.30	0.00
Ladino clover	3	11.30	3.25	8.05	10.60	14.20	-3.60
Wheat	4	45.27	25.76	19.51	59.22	48.63	10.59
Rye	5	46.85	28.76	18.09	72.36	29.50	42.86
Wong barley	6	21.62	3.20	18.42	17.67	25.52	-7.85
Alfalfa	7	2.20	5.50	-3.30	1.49	1.80	-0.31
Crimson clover	8	11.34	5.00	6.34	12.60	15.60	-3.00

Appendix Table 2. Presquile clipping weights 1955-1956 (continued)

Crop	Plot	Clipping wts. in grams per sq. ft.		
		Ungrazed	Grazed	Diff.
		<u>Mar. 28, 1956</u>		
Italian rye grass	1	48.37	24.06	24.31
Oats	2	66.89	17.15	49.74
Ladino clover	3	14.70	18.77	-4.07
Wheat	4	53.00	41.99	11.01
Rye	5	80.26	26.60	53.66
Wong barley	6	51.92	33.80	18.12
Alfalfa	7	10.70	13.50	-2.80
Crimson clover	8	12.01	21.85	-9.84

Appendix Table 3. Hog Island clipping weights 1956-1957

Crop	Plot	Clipping wts. in grams per sq. ft.		Diff.	Clipping wts. in grams per sq. ft.		Diff.
		Ungrazed	Grazed		Ungrazed	Grazed	
"A" Plots		Nov. 13, 1956			Nov. 27, 1956		
Alfalfa	1	13.15	13.75	-0.60	15.70	8.40	7.30
Rye	2	17.25	10.45	6.80	12.55	14.70	-2.15
Ladino clover	3	14.90	22.40	-7.50	16.25	19.85	-3.60
Wong barley	4	10.05	11.05	-1.00	7.80	12.30	-4.50
Crimson clover	5	6.05	6.55	-0.50	11.80	10.65	1.15
Italian rye grass	6	12.55	11.20	1.35	28.75	19.80	8.95
Oats	7	19.00	19.50	-0.50	19.40	15.90	3.50
Wheat	8	10.75	12.20	-1.45	10.15	14.20	-4.05
"B" Plots							
Ladino clover	11	20.65	25.70	-5.05	18.30	18.30	0.00
Oats	12	14.60	10.85	3.75	26.35	14.80	1.55
Rye	13	5.95	5.90	0.05	7.70	8.25	-0.55
Wong barley	14	9.30	11.05	-1.75	14.95	9.95	5.00
Crimson clover	15	5.40	3.20	2.20	4.40	0.55	3.85
Alfalfa	16	9.00	3.75	5.25	24.70	5.40	19.30
Italian rye grass	17	8.50	8.50	0.00	7.60	7.55	0.05
Wheat	18	1.40	4.25	-2.85	2.30	4.00	-1.70

Appendix Table 3. Hog Island clipping weights 1956-1957 (continued)

Crop	Plot	Clipping wts. in grams per sq. ft.			Clipping wts. in grams per sq. ft.		
		Ungrazed	Grazed	Diff.	Ungrazed	Grazed	Diff.
"A" Plots							
Alfalfa	1	19.40	13.80	5.60	15.55	13.90	1.65
Rye	2	19.40	23.05	-3.65	16.55	20.80	-4.25
Ladino clover	3	24.00	20.70	3.30	21.65	13.00	8.65
Wong barley	4	19.30	21.75	-2.45	11.85	20.15	-8.30
Crimson clover	5	15.00	3.95	11.05	14.50	13.80	0.70
Italian rye grass	6	22.90	16.30	6.60	19.00	27.90	-8.90
Oats	7	24.30	24.15	0.15	19.05	32.50	-13.45
Wheat	8	20.80	22.25	-1.45	14.50	23.90	-9.40
"B" Plots							
Ladino clover	11	20.95	19.95	1.00	9.05	10.50	-1.45
Oats	12	29.05	21.40	7.65	17.65	23.50	-5.85
Rye	13	21.10	9.55	11.55	14.45	12.45	2.00
Wong barley	14	32.50	20.70	11.80	17.15	15.75	1.40
Crimson clover	15	12.40	2.45	9.95	14.60	5.80	8.80
Alfalfa	16	22.30	5.75	16.55	18.50	8.50	10.00
Italian rye grass	17	12.10	7.80	4.30	17.20	11.15	6.05
Wheat	18	3.00	6.85	-3.85	17.30	10.05	7.25

Appendix Table 3. Hog Island clipping weights 1956-1957 (continued)

Crop	Plot	Clipping wts. in grams per sq. ft.			Clipping wts. in grams per sq. ft.		
		Ungrazed	Grazed	Diff.	Ungrazed	Grazed	Diff.
"A" Plots							
Alfalfa	1	10.00	7.35	-2.65	9.20	8.50	0.70
Rye	2	20.90	17.25	3.65	15.85	16.30	-0.45
Ladino clover	3	16.80	11.80	5.00	11.05	12.05	-1.00
Wong barley	4	11.90	10.40	1.50	29.00	20.40	8.60
Crimson clover	5	21.50	8.75	12.75	17.10	5.90	11.20
Italian rye grass	6	33.00	33.55	-0.55	27.85	23.40	4.45
Oats	7	19.75	39.65	-19.90	24.60	25.25	-0.65
Wheat	8	21.30	24.40	-3.10	20.80	20.00	0.80
"B" Plots							
Ladino clover	11	18.85	8.15	10.70	15.70	5.20	10.50
Oats	12	21.45	25.30	-3.85	23.70	28.00	-4.30
Rye	13	19.00	14.35	4.65	15.80	5.60	10.20
Wong barley	14	17.30	15.50	1.80	18.40	11.60	6.80
Crimson clover	15	16.70	21.80	-5.10	12.00	4.30	7.70
Alfalfa	16	17.10	16.55	0.55	10.10	5.90	4.20
Italian rye grass	17	17.20	13.10	4.10	15.00	5.70	9.30
Wheat	18	5.70	5.80	-0.10	9.90	6.30	3.60

Appendix Table 3. Hog Island clipping weights 1956-1957 (continued)

Crop	Plot	Clipping wts. in grams per sq. ft.			Clipping wts. in grams per sq. ft.		
		Ungrazed	Grazed	Diff.	Ungrazed	Grazed	Diff.
"A" Plots							
Alfalfa	1	8.70	13.10	-4.40	18.60	18.25	0.35
Rye	2	19.25	18.35	0.90	27.00	24.00	3.00
Ladino clover	3	13.75	4.00	9.75	14.15	11.40	2.75
Wong barley	4	17.90	12.10	5.80	20.55	13.10	7.45
Crimson clover	5	15.80	6.60	9.20	15.80	9.40	6.40
Italian rye grass	6	27.50	32.80	-5.30	28.25	24.05	4.20
Oats	7	25.75	23.95	1.80	21.05	28.20	-7.15
Wheat	8	19.85	9.55	10.30	23.90	21.70	2.20
"B" Plots							
Ladino clover	11	20.15	5.00	15.15	16.00	16.50	-0.50
Oats	12	20.90	18.25	2.65	22.00	23.35	-1.35
Rye	13	16.45	4.80	11.65	14.00	5.35	8.65
Wong barley	14	13.30	10.00	3.30	14.40	8.05	6.35
Crimson clover	15	8.70	7.70	1.00	12.20	3.80	8.40
Alfalfa	16	9.20	5.00	4.20	12.30	5.50	6.80
Italian rye grass	17	23.95	10.10	13.85	18.40	5.20	13.20
Wheat	18	8.00	9.10	-1.10	6.40	1.80	4.60

Appendix Table 3. Hog Island clipping weights 1956-1957 (continued)

Crop	Plot	Clipping wts. in grams per sq. ft.			Clipping wts. in grams per sq. ft.		
		Ungrazed	Grazed	Diff.	Ungrazed	Grazed	Diff.
"A" Plots							
Alfalfa	1	10.20	10.90	-0.70	12.70	11.30	1.40
Rye	2	12.15	8.50	3.65	13.55	11.70	1.85
Ladino clover	3	16.00	10.60	5.40	13.40	10.25	3.15
Wong barley	4	13.25	7.30	5.95	26.15	9.50	18.65
Crimson clover	5	11.60	4.80	6.80	13.05	18.25	-5.20
Italian rye grass	6	19.55	20.55	-1.00	15.00	16.00	-1.00
Oats	7	23.10	21.60	-1.50	17.85	23.75	-5.90
Wheat	8	14.40	11.80	2.60	13.70	9.00	4.70
"B" Plots							
Ladino clover	11	9.70	6.85	2.85	8.35	3.10	5.25
Oats	12	23.10	25.20	-2.10	24.60	22.70	1.90
Rye	13	10.30	4.45	5.85	11.80	6.90	4.90
Wong barley	14	11.90	8.20	3.70	16.40	9.00	7.40
Crimson clover	15	11.35	2.30	9.05	9.50	10.30	-0.80
Alfalfa	16	13.15	7.10	6.05	10.75	6.20	4.55
Italian rye grass	17	12.40	6.35	6.05	20.30	8.15	12.15
Wheat	18	5.50	3.40	2.10	8.65	6.80	1.85

Appendix Table 4. Presquile clipping weights 1956-1957

Crop	Plot	Clipping wts. in grams per sq. ft.			Clipping wts. in grams per sq. ft.		
		Ungrazed	Grazed	Diff.	Ungrazed	Grazed	Diff.
		<u>Nov. 28, 1956</u>			<u>Dec. 12, 1956</u>		
Italian rye grass	1	9.10	11.10	-2.00	16.60	21.30	-4.70
Oats	2	11.15	11.30	-0.15	19.55	16.95	2.60
Ladino clover	3	9.20	4.40	4.80	21.05	20.20	0.85
Wheat	4	9.85	10.20	-0.35	11.50	15.80	-4.30
Rye	5	17.20	12.70	4.50	18.30	16.80	1.50
Wong barley	6	7.00	8.30	-1.30	10.75	16.70	-5.95
Alfalfa	7	0.15	0.15	0.00	3.80	2.30	1.50
Crimson clover	8	1.30	3.15	-1.85	4.75	3.20	1.55
		<u>Dec. 27, 1956</u>			<u>Jan. 2, 1957</u>		
Italian rye grass	1	30.95	7.40	23.55	22.30	13.40	8.90
Oats	2	7.15	8.05	-0.90	16.55	23.40	-6.85
Ladino clover	3	12.70	9.90	2.80	8.70	4.15	4.55
Wheat	4	10.45	12.05	-1.60	21.55	21.90	-0.35
Rye	5	21.45	13.45	8.00	10.20	10.20	0.00
Wong barley	6	14.45	16.60	-2.15	12.95	9.50	3.45
Alfalfa	7	5.70	5.50	0.20	5.20	4.45	0.75
Crimson clover	8	11.90	8.20	3.70	5.25	2.15	3.10

Appendix Table 4. Presquile clipping weights 1956-1957 (continued)

Crop	Plot	Clipping wts. in grams per sq. ft.			Clipping wts. in grams per sq. ft.		
		Ungrazed	Grazed	Diff.	Ungrazed	Grazed	Diff.
		<u>Jan. 9, 1957</u>			<u>Jan. 23, 1957</u>		
Italian rye grass	1	25.20	12.60	12.60	27.00	10.80	16.20
Oats	2	18.20	11.25	6.95	14.30	11.80	2.50
Ladino clover	3	18.30	16.45	1.85	23.60	12.90	10.70
Wheat	4	20.55	7.50	13.05	20.40	7.65	12.75
Rye	5	19.80	18.15	1.65	27.40	12.10	15.30
Wong barley	6	21.80	8.25	13.55	13.00	17.90	-4.90
Alfalfa	7	4.90	3.75	1.15	4.10	2.20	1.90
Crimson clover	8	11.00	10.00	1.00	2.45	5.50	-3.05
		<u>Jan. 30, 1957</u>			<u>Feb. 6, 1957</u>		
Italian rye grass	1	22.35	4.80	17.55	24.55	4.90	19.65
Oats	2	22.05	10.70	11.35	18.00	7.15	10.85
Ladino clover	3	14.90	8.50	6.40	12.30	3.90	8.40
Wheat	4	26.20	7.70	18.50	11.65	9.40	2.25
Rye	5	15.65	6.80	8.85	18.50	6.65	11.85
Wong barley	6	7.10	11.20	-4.10	6.90	8.60	-1.70
Alfalfa	7	3.30	2.30	1.00	3.00	4.10	-1.10
Crimson clover	8	5.70	10.30	-4.60	13.50	4.50	9.00

Appendix Table 5. Yield in forage and grain on two square feet sample clippings taken in grazed and ungrazed (control) areas at time of harvest of crop June 8, 1956 at Hog Island

Crop	Plot	Dry wt. of clipping (grams)		Wt. of threshed grain (grams)	
		Ungrazed	Grazed	Ungrazed	Grazed
"A" Plots					
Alfalfa	1	916	700	216	
Rye	2	440	586	-146	36.80
Ladino clover	3	371	193	178	
Wong barley	4	300	443	-143	18.50
Crimson clover	5	284	198	86	94.00
Italian rye grass	6	450	484	- 34	
Oats	7	680	605	75	207.85
Wheat	8	358	312	46	66.00
					-128.75
					-3.90
"B" Plots					
Ladino clover	11	171	119	52	
Oats	12	171	420	-249	61.10
Rye	13	244	540	-296	26.70
Wong barley	14	192	384	-192	24.70
Crimson clover	15	230	181	49	88.00
Alfalfa	16	324	221	103	64.20
Italian rye grass	17	195	320	-275	136.50
Wheat	18	157	145	12	29.60
					-3.71

Appendix Table 6. Hog Island goose and deer droppings counts 1956

Crop	Plot	Droppings per acre		Droppings per acre	
		Goose	Deer*	Goose	Deer*
		<u>Feb. 23, 1956</u>		<u>Mar. 12, 1956</u>	
A Plots					
Alfalfa	1	1255	0	0	0
Rye	2	2930	3880	0	1488
Ladino clover	3	1350	0	0	0
Wong barley	4	1955	0	0	186
Crimson clover	5	1860	0	0	0
Italian rye grass	6	4650	1395	0	651
Oats	7	465	975	0	930
Wheat	8	930	2046	0	1815
B Plots					
Ladino clover	11	512	0	0	0
Oats	12	372	1068	0	1215
Rye	13	1163	232	0	697
Wong barley	14	1908	0	0	326
Crimson clover	15	2000	0	0	0
Alfalfa	16	3580	0	0	0
Italian rye grass	17	5480	0	0	0
Wheat	18	1535	0	0	0

* Pellet group

Appendix Table 7. Presquile goose and deer droppings counts 1956

Crop	Plot	Droppings per acre		Droppings per acre	
		Goose	Deer*	Goose	Deer*
		<u>Feb. 29, 1956</u>		<u>Mar. 14, 1956</u>	
Italian rye grass	1	0	830	0	104
Oats	2	104	204	0	208
Ladino clover	3	0	0	0	0
Wheat	4	208	204	0	519
Rye	5	0	1659	0	1141
Wong barley	6	104	0	0	0
Alfalfa	7	0	0	0	0
Crimson clover	8	0	0	0	0

* Pellet group

Appendix Table 8. Hog Island goose and deer droppings counts 1956-1957

Crop	Plot	Droppings per acre		Droppings per acre	
		Goose	Deer*	Goose	Deer*
		Nov. 27, 1956		Dec. 11, 1956	
"A" Plots					
Alfalfa	1	0	93	0	558
Rye	2	0	279	0	372
Ladino clover	3	0	558	0	1768
Wong barley	4	0	0	372	186
Crimson clover	5	0	0	2234	838
Italian rye grass	6	0	465	0	93
Oats	7	0	186	0	0
Wheat	8	0	0	0	186
"B" Plots					
Ladino clover	11	0	279	16382	652
Oats	12	0	279	20850	2420
Rye	13	16941	0	23456	279
Barley	14	10425	93	17499	0
Crimson clover	15	30809	0	16754	0
Alfalfa	16	38256	558	18058	652
Italian rye grass	17	43375	279	48402	93
Wheat	18	48309	93	34067	0

* Pellet group

Appendix Table 8. Hog Island goose and deer droppings counts 1956-1957 (continued)

Crop	Plot	Dec. 18, 1956		Dec. 27, 1956	
		Droppings per acre Goose	Droppings per acre Deer*	Droppings per acre Goose	Droppings per acre Deer*
"A" Plots					
Alfalfa	1	0	0	0	279
Rye	2	0	0	0	93
Ladino clover	3	0	93	18244	652
Wong barley	4	0	0	279	93
Crimson clover	5	0	93	652	93
Italian rye grass	6	0	0	0	93
Oats	7	0	0	0	0
Wheat	8	0	0	0	0
"B" Plots					
Ladino clover	11	372	93	838	279
Oats	12	0	0	186	0
Rye	13	4468	0	2792	0
Wong barley	14	9122	0	4282	0
Crimson clover	15	5212	0	652	0
Alfalfa	16	4282	0	2606	0
Italian rye grass	17	6516	0	12845	0
Wheat	18	8470	0	15917	0

Appendix Table 8. Hog Island goose and deer droppings counts 1956-1957 (continued)

Crop	Plot	Droppings per acre		Droppings per acre	
		Goose	Deer*	Goose	Deer*
A Plots					
		<u>Jan. 3, 1957</u>		<u>Jan. 8, 1957</u>	
Alfalfa	1	0	0	0	0
Rye	2	0	0	0	0
Ladino clover	3	42900	0	7074	93
Wong barley	4	11449	0	12007	0
Crimson clover	5	77908	186	13869	0
Italian rye grass	6	186	0	0	93
Oats	7	0	0	0	0
Wheat	8	0	0	0	0
B Plots					
Ladino clover	11	87774	0	15544	0
Oats	12	9866	0	18802	0
Rye	13	42724	0	1396	0
Wong barley	14	23177	0	1210	0
Crimson clover	15	16754	0	279	0
Alfalfa	16	23828	93	2792	0
Italian rye grass	17	43189	0	7167	0
Wheat	18	21688	0	2327	0

Appendix Table 8. Hog Island goose and deer droppings counts 1956-1957 (continued)

Crop	Plot	Droppings per acre		Droppings per acre	
		Goose	Deer*	Goose	Deer*
"A" Plots					
		<u>Jan. 22, 1957</u>		<u>Jan. 22, 1957</u>	
Alfalfa	1	25504	279	4747	745
Rye	2	43468	279	3072	0
Ladino clover	3	7353	0	25132	0
Wong barley	4	17127	0	9773	0
Crimson clover	5	3072	93	19454	0
Italian rye grass	6	186	558	16475	93
Oats	7	0	1489	186	372
Wheat	8	9393	745	2141	372
"B" Plots					
Ladino clover	11	7074	0	21781	0
Oats	12	6981	0	5212	0
Rye	13	10611	0	6981	0
Wong barley	14	8191	0	7446	0
Crimson clover	15	9866	0	2885	0
Alfalfa	16	10239	0	2420	0
Italian rye grass	17	7819	0	2885	0
Wheat	18	8656	0	2513	0

Appendix Table 8. Hog Island goose and deer droppings counts 1956-1957 (continued)

Crop	Plot	Droppings per acre	
		Goose	Deer*
"A" Plots			
		<u>Feb. 5, 1957</u>	
Alfalfa	1	0	0
Rye	2	0	186
Ladino clover	3	0	279
Wong barley	4	0	0
Crimson clover	5	0	0
Italian rye grass	6	0	0
Oats	7	0	372
Wheat	8	0	186
"B" Plots			
Ladino clover	11	0	0
Oats	12	0	0
Rye	13	0	0
Wong barley	14	0	0
Crimson clover	15	0	0
Alfalfa	16	0	0
Italian rye grass	17	0	0
Wheat	18	0	0

Appendix Table 9. Presquille goose and deer droppings counts 1956-1957

Crop	Plot	Droppings per acre		Droppings per acre	
		Goose	Deer*	Goose	Deer*
		<u>Dec. 12, 1956</u>		<u>Dec. 27, 1956</u>	
Italian rye grass	1	27898	0	1556	415
Oats	2	4978	207	0	415
Ladino clover	3	17631	2282	1452	4252
Wheat	4	15349	726	4148	1763
Rye	5	2489	519	0	1245
Wong barley	6	1452	0	0	311
Alfalfa	7	415	104	0	0
Crimson clover	8	0	0	0	0
		<u>Jan. 2, 1957</u>		<u>Jan. 9, 1957</u>	
Italian rye grass	1	0	415	35365	519
Oats	2	0	104	14416	830
Ladino clover	3	1659	207	21572	2800
Wheat	4	0	726	39410	2385
Rye	5	0	104	32254	1452
Wong barley	6	0	207	12445	1452
Alfalfa	7	0	104	29972	104
Crimson clover	8	0	0	29868	0

* Pellet group

Appendix Table 9. Presquile goose and deer droppings counts 1956-1957 (continued)

Crop	Plot	Droppings per acre		Droppings per acre	
		Goose	Deer*	Goose	Deer*
		<u>Jan. 23, 1957</u>		<u>Jan. 30, 1957</u>	
Italian rye grass	1	519	0	0	415
Oats	2	207	1037	0	830
Ladino clover	3	0	104	0	104
Wheat	4	3422	0	415	0
Rye	5	726	0	0	207
Wong barley	6	519	104	207	207
Alfalfa	7	104	0	0	0
Crimson clover	8	0	0	0	0
		<u>Feb. 6, 1957</u>			
Italian rye grass	1	0	0	0	0
Oats	2	0	415	0	0
Ladino clover	3	0	104	0	0
Wheat	4	0	0	0	0
Rye	5	0	207	0	0
Wong barley	6	0	104	0	0
Alfalfa	7	0	0	0	0
Crimson clover	8	0	0	0	0

Appendix Table 10. Goose droppings per day of captive wild
Canada geese 1957

Date	No. geese	Total Droppings
Jan. 10	2	58
11	1	74
12	1	83
13	2	134
14	2	156
15	1	60
16	1	96
17	1	103
18	1	85
19	1	53
20	1	42
21	1	65
22	1	93
23	1	87
24	1	79
25	1	81
26	1	61
27	1	95
28	1	80
29	1	118
30	1	165
31	1	97
Feb. 1	1	106
2	2	165
3	2	156
4	2	178
5	2	307
6	2	243
7	2	237
8	2	210
9	2	200
10	2	174
11	2	245
12	2	187
13	2	174
14	2	234
15	2	198
Total	54	4979
Average droppings per day per goose		92.2

Appendix Table 11. Estimated number of geese observed in plots on Hog Island 1956-1957

Crop	Plot	Date								
		Nov. 16	Nov. 17	Nov. 24	Nov. 25	Nov. 27	Nov. 29	Nov. 30	Dec. 3	
"A" Plots										
Alfalfa	1								46	
Rye	2							9	235	
Ladino clover	3							10	78	
Wong barley	4							15		
Crimson clover	5							100		
Italian rye grass	6									
Oats	7									
Wheat	8									
"B" Plots										
Ladino clover	11							13		
Oats	12			50				100	10	
Rye	13			20				100	75	
Wong barley	14			12				120	12	
Crimson clover	15	100	50	17				45		
Alfalfa	16	100	200	35				10		
Italian rye grass	17	150	250	45	10			67		
Wheat	18	50	200	45	35			93		
		10	100		60			37		
Total in plots		410	800	179	105	246		513	209	359
Total on Refuge		810	1750	1179	1380	1520		1013	2937	2544

Appendix Table 11. Estimated number of geese observed in plots on Hog Island 1956-1957
(continued)

Crop	Plot	Date								
		Dec. 13	Dec. 16	Dec. 18	Dec. 20	Dec. 22	Dec. 26	Dec. 27	Dec. 31	
"A" Plots										
Alfalfa	1									
Rye	2									
Ladino clover	3				20					300
Wong barley	4				30		34			250
Crimson clover	5		86							
Italian rye grass	6		100							
Oats	7		63							
Wheat	8									
"B" Plots										
Ladino clover	11									8
Oats	12							10		
Rye	13							25	21	
Wong barley	14							65		
Crimson clover	15							23		30
Alfalfa	16									
Italian rye grass	17	30								
Wheat	18	72								
Total in plots		103	249	143	50	113	65	550	38	
Total on Refuge		2078	749	3735	2300	3113	2865	2982	4538	

Appendix Table 11. Estimated number of geese observed in plots on Hog Island 1956-1957
(continued)

Crop	Plot	Date										
		Jan. 1	Jan. 4	Jan. 10	Jan. 15	Jan. 18	Jan. 20	Jan. 23	Jan. 25	Jan. 31		
A Plots												
Alfalfa	1			75	25	200	15	25				
Rye	2		50	75	35	100	65	100				
Ladino clover	3		125	15	15	15	37	275				
Wong barley	4	6		125	20	43	54					3
Crimson clover	5	115		95		50	75					26
Italian rye grass	6	137				23	10					30
Oats	7	47				16						
Wheat	8	5				3						
B Plots												
Ladino clover	11			35			1	35				
Oats	12						13	40				10
Rye	13						27	53				11
Wong barley	14						11	6				
Crimson clover	15							23				
Alfalfa	16							36				
Italian rye grass	17							21				
Wheat	18							19				
Total in plots		310	175	420	95	315	304	772				80
Total on Refuge		3636	4735	4004	1305	315	304	2127				1121

Appendix Table 12. Deer observed on Hog Island 1956-1957

Date	Total seen on refuge*	Total seen in plots
Oct. 2	23	7
Oct. 8	21	19
Oct. 16	6	1
Nov. 7	3	0
Nov. 17	11	11
Nov. 22	7	7
Nov. 27	13	3
Dec. 3	17	12
Dec. 11	8	8
Dec. 14	15	0
Dec. 21	19	19
Jan. 1	3	0
Jan. 7	13	1
Jan. 16	3	3
Jan. 27	15	7
Feb. 6	19	3

* Includes those seen on plots

Appendix Table 13. Estimated Refuge populations of Canada geese by week, 1955-1956 and 1956-1957

Week	Hog Island		Presquille	
	1955	1956	1955	1956
Sept.				
	4	27	22	26
Oct.				
	1	130	13	90
	2	150	200	500
	3	200	200	800
	4	360	525	1050
Nov.				
	1	1470	2675	1500
	2	2000	2540	4550
	3	4000	4900	5000
	4	3000	5000	1050
Split week				
			2930	5000
Dec.				
	1	5000	5300	6500
	2	5300	6100	6700
	3	4500	6900	6000
	4	5000	7100	6900

Appendix Table 13. Estimated Refuge populations of Canada geese by week, 1955-1956 and 1956-1957 (continued)

	Week	Hog Island		Presquille	
		1956	1957	1956	1957
Jan.	1	5000	4700	6000	6900
	2	4000	4000	5500	6000
	3	2500	1300	4000	5000
	4	500	2120	3500	3000
Feb.	1	300	1000	3500	1200
	2	35	200	3000	2000
	3	50	300	2000	1200
	4		175	1000	1200
Mar.	1		65	800	975
	2		135	700	1500
	3		82	250	1600
	4		143	600	300

Appendix Table 14. Proximate nutritional analysis of composite plot clipping samples
1956-1957 *

Crop and Plot	% N	% Protein	% Ether Extract	% Crude Fiber	% Ash	% N.F.E.
Alfalfa						
Hog Island "A"	3.87	24.19	2.17	23.25	9.38	37.14
Hog Island "B"	2.74	17.13	2.66	22.46	13.26	41.75
Presquile	1.71	10.69	1.18	6.97	58.06	21.38
Crimson clover						
Hog Island "A"	3.90	24.38	3.41	15.07	19.94	33.30
Hog Island "B"	4.00	25.00	3.72	14.12	15.53	27.63
Presquile	2.76	17.25	2.45	11.46	34.81	31.27
Ladino clover						
Hog Island "A"	4.19	26.19	2.45	20.31	14.32	32.54
Hog Island "B"	3.60	22.50	2.78	20.95	13.43	36.74
Presquile	3.35	20.94	1.91	17.91	18.79	37.10
Italian rye grass						
Hog Island "A"	2.62	16.38	3.84	21.06	13.70	42.40
Hog Island "B"	2.47	15.44	3.87	19.05	12.91	46.26
Presquile	3.96	24.75	5.05	19.12	13.68	33.44

* Moisture of samples was not determined

Appendix Table 14. Proximate nutritional analysis of composite plot clipping samples
1956-1957 * (continued)

Crop and Plot	% N	% Protein	% Ether Extract	% Crude Fiber	% Ash	% N.F.E.
Wong barley						
Hog Island "A"	2.58	16.13	3.75	21.60	14.89	41.05
Hog Island "B"	2.93	17.69	3.61	22.17	17.18	36.52
Presquille	3.07	14.19	3.61	18.75	12.20	43.18
Oats						
Hog Island "A"	2.61	16.31	4.13	23.45	12.78	40.72
Hog Island "B"	2.40	15.00	3.90	21.48	10.50	46.72
Presquille	3.98	24.88	4.53	17.26	10.68	38.67
Rye						
Hog Island "A"	3.11	19.44	4.51	22.62	13.06	37.26
Hog Island "B"	3.24	20.25	4.70	20.04	16.04	35.75
Presquille	4.54	28.38	5.02	17.17	13.20	31.69
Wheat						
Hog Island "A"	2.04	12.75	3.96	27.81	13.96	39.48
Hog Island "B"	2.56	16.00	3.56	23.36	24.65	29.87
Presquille	3.47	21.69	3.70	19.68	10.62	40.84

* Moisture of samples was not determined

Appendix Table 15. Per acre costs of planting and maintenance of crops at Hog Island

Crop	Year	Seed	Fertilizer 400 lb./ A.	Labor \$0.90/hr.	Equipment \$1.25/hr.	Total
Alfalfa	1955	\$31.00	\$6.20	\$10.35	\$14.38	\$62.93
Ladino Clover	1955	3.75	6.20	10.35	13.13*	36.43
Crimson clover	1955	11.50	6.20	10.35	13.13*	44.18
Wong barley	1955	3.70	6.20	10.35	14.38	34.63
Oats	1955	2.70	6.20	10.35	14.38	33.63
Rye	1955	3.80	6.20	10.35	14.38	34.73
Wheat	1955	5.30	6.20	10.35	14.38	36.23
Italian rye grass	1955	4.50	6.20	10.35	14.38	35.43
Alfalfa	1956	**	7.65	5.04***	7.00	19.69
Ladino clover	1956	**	7.65	5.04***	7.00	19.69
Crimson clover	1956	16.50	7.65	10.80	12.50*	47.45
Wong barley	1956	3.00	7.65	10.80	15.00	36.45
Oats	1956	2.60	7.65	10.80	15.00	36.05
Rye	1956	5.20	7.65	10.80	15.00	38.65
Wheat	1956	5.00	7.65	10.80	15.00	38.45
Italian rye grass	1956	4.50	7.65	10.80	15.00	37.95

* Hand seeders were used to plant

** Not reseeded second year

*** Includes cost of mowing plots to keep plants in tender green stage preferred by geese.