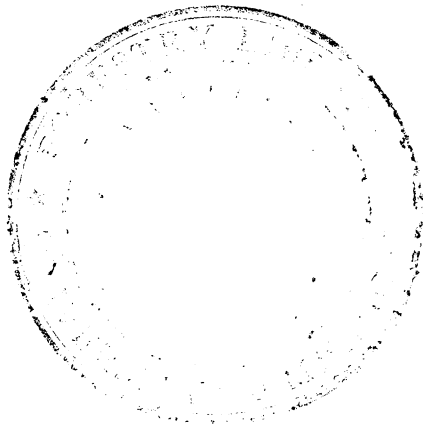


Richards, Elmer V

A winter deer browse study on
shrubby vegetation of the George
Reserve, Michigan. 1949.

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**A Winter Deer Browse Study on Shrubby Vegetation
Of The George Reserve, Michigan**

By Elmer V. Richards

**Submitted in partial fulfillment for
the degree of Master's in Forestry. University
of Michigan, Ann Arbor, Michigan. May, 1949**

Table of Contents

Introduction -----	1
Methods of study -----	3
History of deer herd -----	6
Previous studies -----	7
Vegetation -----	7
Cover types -----	9
Identification of shrub species -----	13
Shrub distribution and habitats -----	14
Upland mixed hardwood shrubs -----	14
Upland grassland shrubs -----	22
Marsh shrubs -----	28
Bog shrubs -----	34
Transitional shrub zones -----	40
Effects of deer browsing on shrubby growth ----	52
Key shrub species -----	57
Need for additional research -----	58
Summary -----	59
Literature cited -----	61
Appendix -----	63

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Other persons who helped me in the research and writing of the paper are hereby gratefully acknowledged.

INTRODUCTION

In the State of Michigan there are two distinct white-tailed deer areas, which can be called the northern and southern. The northern deer range, covering the upper part of the Lower Peninsula and the entire Upper Peninsula, cannot be thought as being similar to the southern deer range, made up of hardwoods and agricultural areas. In the north, the deer range is comprised largely of burned-over or second growth coniferous forests along with areas of northern hardwoods. Heavy snows drive the deer into cedar swamps where they "yard" up. Food conditions in these northern swamps are critical. In the northern deer range of Michigan the principal problem of management is the regulation of the numbers of deer to the available food supply.

In the hardwood country of lower Michigan deer have been steadily increased due to the spreading of the northern deer southward and to the restrictions on hunting in the farming areas of southern Michigan. Bow and arrow seasons have been used in the past few years to harvest deer from the more heavily populated southern deer counties; however, the opening of these counties to shotgun hunting and possible rifle hunting is advocated by many. As more orchard and truck-farm owners in southern counties continue to report deer damage, it has become apparent that some management program has to be formulated for Michigan's

southern deer range.

White-tailed deer in the southern range of Michigan, in contrast to the northern areas, are not forced by severe winters to "yard up" in swamps. Due to the lack of deep snow, they use the entire range the year around. To properly manage these southern deer it is important to determine the "carrying capacity" of the range. Some measure of the relation of the food available to the populations of deer using an area has to be made. Therefore a study of the existing food supply is the logical place to begin to formulate a sound management program for these southern Michigan deer.

This study, dealing with the effects of white-tailed deer browsing on shrubby vegetation, was carried out on the Edwin S. George Reserve of the University of Michigan. The study was made during the months of January through May, 1949.

The George Reserve, which is surrounded by a deer proof fence, is typical of what might be called the southern deer range in Michigan. Through this study it is hoped that some of the following questions will be answered:

- 1) What shrubs within the George Reserve constitute the principal browse species?
- 2) To what degree do deer use the various shrubs for food?

- 3) In what manner can this degree of utilization be measured?
- 4) Do "key species" exist in the George Reserve that reflect in their degree of use the density of deer on the area?
- 5) Can these "key species" be applied to similar areas in southern Michigan hardwood deer country?

METHODS OF STUDY

At the beginning of this study, an intensive survey of past literature was made to determine possible methods of measuring deer browsing.

Dean (1938) listed the following methods for measuring deer food preference:

1. Stalking
2. Observation from tree platforms
3. Tracking in snow
4. Stomach analysis
5. Temporary sample plots
6. Permanent sample plots

Schilling (1938), in a study of the management of white-tailed deer on the Pisgah National Forest, used four methods in recording deer food habits:

1. Extensive field observations
2. Quadrat analysis

3. Sampling milacre plots along definite compass lines
4. Comparisons of plant succession inside deer-proof enclosures with the plant succession immediately outside.

Aldous and Smith (1938) used 120 milacre plots at an interval of 5 chains in studying the food habits on Minnesota deer. Julander (1937) used a series of permanent sample plots in a wildlife forage study.

Temporary sample plots were used in this study to measure deer browse. These plots, a milacre in size (6'6" x 6'6"), were taken along straight lines paced through the various types on the reserve. The plots were taken at random distances varying from one to five chains. All distances were paced and no set compass line was followed.

The procedure used in locating these milacre plots was to lay off the boundaries with a stick measured for that purpose. When the outline of the plot was ascertained, the author stood in the center of the plot and recorded the data on mimeographed forms, using a separate form for each plot. (See Appendix).

METHOD OF MEASURING BROWSE

Woody vegetation grows annually from terminal and lateral buds. As the growing season continues, these buds open and elongate into twigs which bear the leaves.

Thus, every woody plant grows an additional length

of woody twig each year. These twigs of the year are easily discernable in winter due to their appearance. Usually they appear very tender and have a more recent appearance that can not mistake them for older growth. Often these new twigs are colored more brightly or may bear tiny hairs such as the new growth of Hazelnut (*Corylus americana*).

When a plot was located, the author examined each shrub on the plot taking at random a branch and by counting the number of new twigs (in tens or multiples of ten), recorded the number that showed deer browsing. This number was recorded on the data sheet for the plot, under the percentage of browse column, by the use of a dot. Additional branches were examined from all sides of the shrub and the number of browsed twigs recorded. Usually five or six branches were examined on each shrub before an average for the plot could be recorded. All shrub species were examined and recorded on the plot in this way and then the next plot was taken.

Average heights of each species was recorded, along with the percentage of area covered. These estimates were taken ocularly. Additional information was taken at each plot such as location, type, slope and aspect. Browse conditions were noted also in regard to proximity to deer trails and roads. Later in this paper the influence of trails and roads on deer browsing will be covered separately.

HISTORY OF THE GEORGE RESERVE DEER HERD

The entire picture of the presence of the deer herd on the George Reserve must first be reviewed before the nature of the effects of deer browsing on the shrubby growth can properly be appraised.

On the reserve it is possible to study an area of 2 square miles on which the white-tailed deer has been the dominating influence. Although confined within an enclosed area, the George Reserve deer herd is completely wild in every sense of the word. The history of this herd is known from its nucleus of four does and two bucks which were put on the area in 1928 by Colonel Edwin S. George. Eventually these deer increased to number 160 in the fall of 1933, when signs of range depletion were first noted. A high of 188 deer was reached in 1936, with the reserve overpopulated with deer from 1931 to 1938.

Annual deer censuses have been made since 1933. Students from the School of Forestry and Conservation of the University of Michigan generally supplied the manpower for these drives. Regular harvesting of the surplus deer by shooting was begun in 1934 by Lawrence Camburn, the caretaker of the reserve. Removals were designed to reduce the numbers of deer to the desired carrying capacity of 25 deer per section. Records of the deer annually removed are complete, along with records of losses due to accidental death and poaching (O'Roke and Hamerstrom, 1948). Therefore the

yearly populations of deer on this area have been known since 1933.

PREVIOUS STUDIES ON GEORGE RESERVE DEER HERD

Previous studies on the George Reserve deer herd have been concerned with the population and productivity of the herd. Hickie (1937) stated that the deer herd on the George Reserve increased from 6 deer to 160 from 1928. O'Roke and Hamerstrom (1948) investigated herd productivity. Brasch (1947) made a study of the seasonal relations of the white-tails to ecological cover types within the reserve. Pengelly (1948) studied deer browsing on hardwood reproduction. He stated the need for further investigations of the shrubby growth with a view toward determining the requirements and food preferences of the deer. Data was collected during the period from November 1948 to May 1949. Most of the field data was collected during the months of January to May 1949. Therefore this study is not the true picture of the year around browsing of the white-tails and will only reveal the effect of browsing during the winter months of January to May.

THE VEGETATION OF THE GEORGE RESERVE

The original plant cover of the reserve, due to the presence of mature oaks and hickories and the rate at which oak reproduction is invading the upland grassy plateau in

the central portions of the reserve, permits one to believe that in the past most, if not all, of the uplands were covered by a mature sub-climax forest of oaks and hickories characteristic of southern Michigan. Historical data substantiate this, since logging and farming records indicate the character of the forests back to the middle of the 1800's.

The vegetation of the lowlands have undoubtedly undergone changes in plant succession, and it is hoped that data from this study will contribute to our knowledge of some of these changes - both qualitative and quantitative in nature. Plant succession in the lowlands has followed typical hydric successions to the present vegetational cover found today. There is a question of whether the establishment of deer on the area has influenced or at least held in check plant succession in certain areas, such as oak, hickory and elm.

Within the reserve two main upland types are found. These are the grassy, old fields and pastures, and oak-hickory woodlands. Of these, the grassy areas are the more extensive and they occupy the more gradual slopes and a large flat plateau area in the center of the reserve. Early settlers cleared these lands of woods for agricultural development, but most field cultivation gave way in 1900 to cattle grazing. This was due to the increased erosion and gullying of the land as a result of crop farming. Since 1927, there has been neither cultivation or grazing on the reserve.

At present the upland grassy flats, old fields and pastures, some as large as 125 acres, are being invaded by hardwood reproduction such as white oak, red oak and various hickories, but deer browsing has deformed and dwarfed these species on every part of the area.

The lowlands are composed of a multitude of types - ranging from grass-sedge; grass-sedge-shrub to pure cattail marshes. Also found are isolated buttonbush swamps, two leatherleaf bogs, a large tamarack swamp and a dense pot-hole of red maple, yellow birch and elm. It is within these areas that an intensive study of deer browsing was made.

In general, the George Reserve contains adequate samples of all vegetative types characteristic of the southern hardwood counties of Michigan. One notable exception is the absence of the beech - hard maple climax forest. Along the nearby Huron River this type of forest is often found, while in the reserve only one mature beech tree was located. No record of beech reproduction was observed, which is probably due to the lack of suitable seed trees and not the influence of deer browsing.

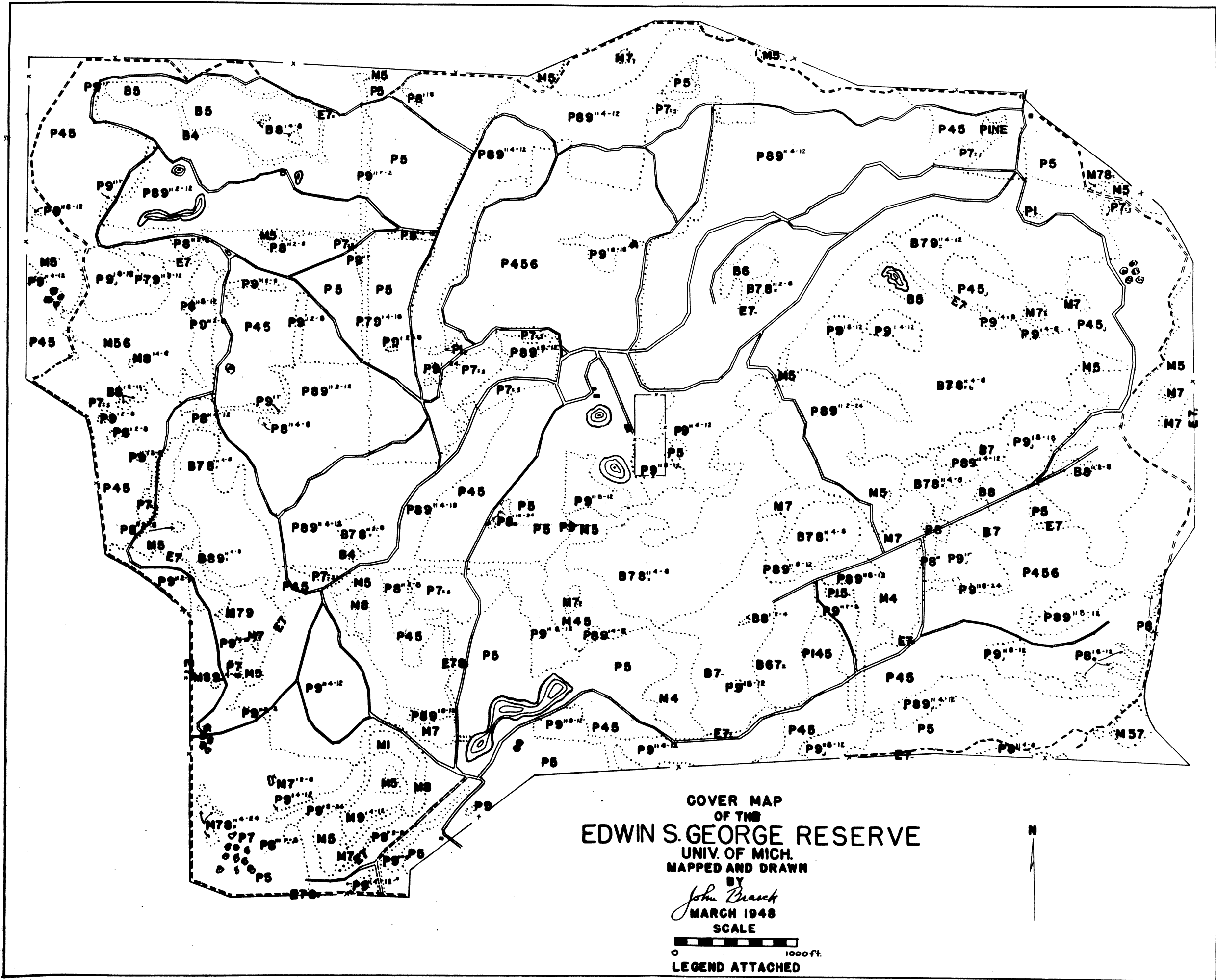
COVER TYPES WITHIN THE RESERVE

The following cover map drawn by John Brasch in 1948 was used for this study. A legend explaining the cover symbols follows the cover map (Map 1). (See Graham, 1945).

Cover types in the George Reserve comprise the following percentages of the total area.

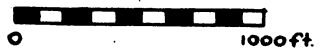
<u>Type</u>	<u>% of Total Area</u>	<u>Acres</u>
Woodland	34.6	438.72
Grassland	39.7	503.39
Marsh (M and MS)	10.0	126.80
Bog Swamps	13.5	171.18
Brush	1.7	21.56
Open water	.5	6.34
	<hr/>	<hr/>
Totals for Reserve	100.0	1267.99

These figures were determined by the use of a Polar Planimeter and Weight-Apportionment methods. (See Tody - 1949).



COVER MAP
OF THE
EDWIN S. GEORGE RESERVE
UNIV. OF MICH.

MAPPED AND DRAWN
BY
John Beach
MARCH 1948
SCALE



LEGEND ATTACHED



Lowland Types - Terrestrial Origin			Lowland Types - Aquatic Origin			Marshes		Transition Types	
Porous Soils P	Nonporous Soils A	Rock Outcrops R	Seepage BS	Stagnant B	Seepage MS	Stagnant M	Floodplain F	Transition Belts E	
1 Bare Soil	Bare Soil	Bare Rock	Saturated Soil or Water	Water	Saturated Soil or Water	Water	Bare Soil	Same as Corresponding Water or Dry land Type.	
2		Crustose Lichens		Submerged Vegetation		Same as B2		do.	
3		Foliose Lichens and Moss		Floating Vegetation		Same as B3		do.	
4 Moss and Annuals	Same as P4	Same as P4	Sphagnum Sedge mat	Same as BS4	Emergent Aquatics	Same as MS4	Annuals	do.	
5 Grass and Other Perennials	Same as P5	Same as P5	Sphagnum Sedge and Heath	Same as BS5	Emergents and Sedge-Grass	Same as MS5	Same as A5	do.	
6 Mixed Herbaceous	Same as P6	Same as P6	Predominantly Heaths	Same as BS6	Same as P6	Same as P6	Same as P6	Same as P6	
7 Shrubs	Shrubs	Shrubs	Swamp Shrubs	Same as BS7	Same as BS7	Same as BS7	Same as P7	Same as P7 or BS7	
8 Intolerant Trees	Same as P8	Same as P8	Same as P8	Same as P8	Same as P8	Same as P8	Same as P8	Same as P8	
9 Mid-tolerant Trees	Same as P9	Same as P9	Same as P9	Same as P9	Same as P9	Same as P9	Same as P9	Same as P9	
10 Tolerant Trees	Same as P10	Same as P10	Same as P10	Same as P10	Same as P10	Same as P10	Same as P10	Same as P10	

Physiographic Conditions - Exponential Letters	Disturbance Effects - Sub Letters
o - Outwash d - Dunes k - Kettle Hole l - Calcareous g - Igneous Rock s - Shale m - Glacial Drift b - Loess	d - Drained p - Pastured e - Eroded c - Cropped f - Flooded y - Cutover x - Burned a - Wild Animal Grazing and Browsing b - Blowdown

Physiographic Conditions - Exponential Letters	Disturbance Effects - Sub Letters
"Same as" - Ecological equivalent not necessarily identical species.	d - Drained p - Pastured e - Eroded c - Cropped f - Flooded y - Cutover x - Burned a - Wild Animal Grazing and Browsing b - Blowdown

Physiographic Conditions - Exponential Letters	Disturbance Effects - Sub Letters
o - Outwash d - Dunes k - Kettle Hole l - Calcareous g - Igneous Rock s - Shale m - Glacial Drift b - Loess	d - Drained p - Pastured e - Eroded c - Cropped f - Flooded y - Cutover x - Burned a - Wild Animal Grazing and Browsing b - Blowdown

IDENTIFICATION OF SHRUB SPECIES

Only shrub species and a few tree species are dealt with, of which a complete list appears in the appendix. Shrubs were identified entirely by winter keys, using bud characteristics.* Some larger groupings of shrubs were made, due to the almost impossible task of separating individual species within a genus. Below are listed the larger groupings of related shrubs, which were made to facilitate collection of data.

- Gray Dogwood Group - includes Cornus paniculata,
Cornus Amomum, and others
- Raspberry Group - - - Includes Rubus villosus, R.
occidentalis, and others.
- Ribes Species - - - - Ribes Cynosbati, and others.
- Rose species - - - - Rose palustris, R. setigera,
and others.
- Viburnum species - - Includes Viburnum lentago,
V. acerifolium, and others.
-

* Shrub keys employed in this study were: Muenscher's "Keys to Woody Plants", 1936; Harrington, "The Woody Plants of Iowa in the Winter Condition", 1934; and Deam, "Shrubs of Indiana", 1932; Billington's "Shrubs of Michigan", 1943; and Gray's New Manual of Botany, 1908, was also useful.

SHRUB DISTRIBUTION AND HABITATS

Within the 1268 acres that comprise the George Reserve all ecological vegetative types characteristic of southern Michigan are to be found. Upland grasslands constitute 40% of the total acreage. Mixed hardwoods make up 35% of the area and marsh types 10 percent. Bog types take up 13.0 percent of the reserve.

Due to the complex distribution of vegetative cover in the reserve, it became evident that some grouping of shrub habitats had to be made up. Therefore seven general shrub habitats were made for this study and each are treated separately.

- 1). Upland Mixed Hardwood Shrubs
- 2). Grassland Shrubs
- 3). Marsh Shrubs
- 4). Bog Shrubs
- 5). Marsh-Grassland Shrub Ecotone
- 6). Marsh-Woodland Shrub Ecotone
- 7). Bog-Woodland Shrub Ecotone

UPLAND MIXED HARDWOOD SHRUBS

The upland wooded areas of the reserve cover about 440 acres of the total area. In composition, these woods range from pure oak - hickory to more intolerant open red maple - elm and aspen stands. Black, red and white

oaks and various hickory species make up the bulk of the wooded types. Five wooded areas are named on the reserve and milacre plots were taken throughout all of these woods.

Oak-hickory woods in this region of southern Michigan apparently are a stable preclimax type. These woods occupy the steep slopes, which in the reserve have slopes up 50 percent.

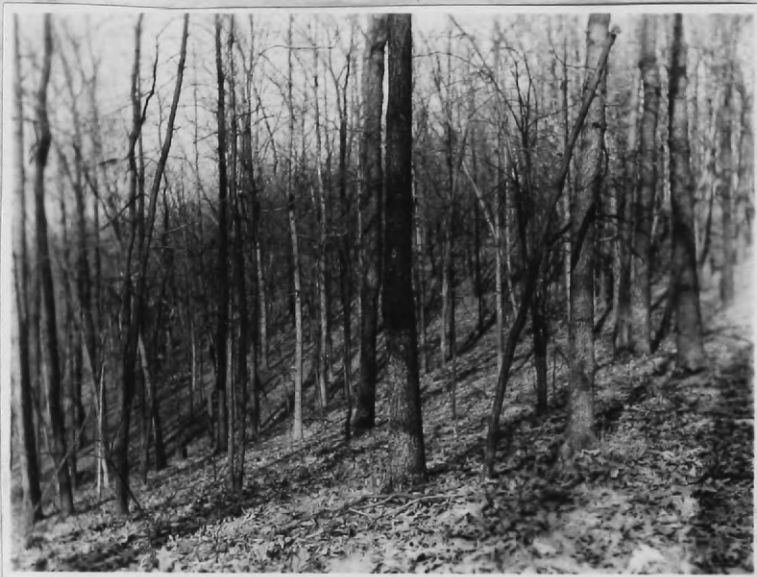


Photo 1. Shows the steep topography in the wooded sections of the George Reserve.

Near Buck Hollow in the northeast woods is a small dense stand of yellow birch, red maple and elm. Along the more open moist sites aspen has become established, but is gradually giving way to the more tolerant and faster growing shrubs and trees. Sassafras is present on the reserve and forms isolated

stands of trees 4 to 8 inches in diameter. Since sassafras is a highly prized food of the deer, all reproduction is absent or dead from repeated deer browsing. Ironwood, blue beech, occur very infrequently on the reserve.

Black cherry is found to be very abundant throughout the entire wooded area of the reserve. Cherry reproduction is present in all sizes and age classes in the reserve, due to the relative unpalatability of this species as a deer food. Studies were made on the growth of black cherry inside and outside the reserve. Little change in growth conditions was found in any case. (See Chart 2).

Witch-hazel and hazelnut were found to be the most common of the tall shrub stratum on the reserve. Low blueberry and various raspberries comprised the most abundant low stratum shrubs in the wooded areas of the reserve.

Juneberry is abundant in isolated patches along the western slopes of the west and southwest woods. This species was found in abundance bordering many woods roads, especially near shrub ecotone types. In some areas trees over twenty feet tall are found, but most of this species is made up of tall clumps 6 feet and over or isolated single stem shrubs under three feet. Juneberry is browsed heavily and is a staple deer food on the reserve.

Tables 1, 2, 3, show the abundance, frequency of the percentage of occurrence and degree of deer browsing on

upland hardwood shrubs. Comparison between wooded types inside the reserve (based on 106 milacre plots) and on wooded types (based on 56 milacre plots) outside the reserve are made on tables 2 and 3. The wooded areas outside the reserve were of two types. Pastured woods located to the northwest and south of the reserve were studied and 32 milacre plots taken. On unpastured woods west of the reserve 24 plots were made. The unpastured wooded area studied is now state-owned hunting land and has been unpastured for about the same period as the reserve has been in operation. The pastured woods studied is currently being used as cattle pasture and serves as a good comparison for the effects of cattle versus deer browsing.

Low blueberry, which is relatively unbrowsed by white-tails, has a higher percentage of occurrence and appears more abundantly inside the reserve where it is released from competition from the more heavily browsed shrub species. This species is a very poor winter browse food for deer on the reserve, but undoubtedly is utilized during the summer and fall when the deer have removed most of the preferred browse material.

It was found that black cherry had about 20 percent of its annual twig growth browsed by the deer herd; however, little difference in abundance of this species could be found inside and on unpastured areas outside the reserve. On pastured woodlots outside the reserve black cherry

appeared more abundant, probably due to a release effect.

Witch-hazel has a greater frequency of occurrence and appears more abundantly inside the George Reserve than without. This difference is reflected in the almost negligible deer browse observed on this species in comparison with other available browse. Deer just do not relish this species as a food.

The gray dogwood group, which is browsed to the greatest degree by the deer herd, is definitely held in check on the reserve. Its growth is affected and cut to about one half inside the reserve. (See Photo 6). It appears to be a highly preferred food in all areas on the reserve and occurs more frequently and abundantly outside the reserve. Cattle seem to slightly affect its abundance according to the data collected.

Buckthorn appears to be a very prized food. Occurring in only two isolated spots on the reserve and occupying less than one-percent of the total area covered by the milacre plots, this shrub was browsed to such an extent that 46 percent of its annual twig production showed deer browsing.

WINTER SHRUB BROWSE STUDY

TABLE 1

Average Percentage of Twigs Showing Deer Browse on Upland
Hardwood Shrubs

<u>Species</u>	<u>Percentage*</u>
Gray dogwood group	56.0
Viburnum species	56.0
Huckleberry	52.0
Wild rose	50.0
Crataegus species	46.0
Buckthorn	46.0
Aspen	40.0
Sassafras	37.0
Low juniper	37.0
Hazelnut	33.0
Red osier dogwood	30.0
Juneberry	28.0
High bush blueberry	25.0
Black cherry	23.0
Wild currant	19.0
Raspberry group	10.0
Wild grape	10.0
Witch-hazel	8.0
Low bush blueberry	2.0

* Based on 106 milacre plots.

WINTER SHRUB BROWSE STUDY

TABLE 2

Frequency of Shrub Occurrence in Upland Hardwoods

Species	Inside Reserve (106 plots)	Outside in Pastured Woods (32 plots)	Outside in Unpastured Woods (24 plots)
Lowbush blueberry	32.0	6.0	12.0
Black cherry	21.0	47.0	42.0
Raspberry group	19.0	34.0	20.0
Hazelnut	12.0	9.0	37.0
Low juniper	13.0	19.0	4.0
Witch-hazel	15.0	9.0	8.0
Wild currant	10.0	12.0	8.0
Sassafras	10.0	3.0	16.0
Wild rose	8.0	6.0	33.0
Juneberry	14.0	15.0	8.0
Aspen	4.0	6.0	8.0
Crataegus sp.	3.0	6.0	12.0
Viburnum sp.	3.0	3.0	8.0
Red osier dogwood	0.94	3.0	4.0
Huckleberry	4.0	- -	- -
Buckthorn	2.0	- -	- -
High bush blueberry	2.0	- -	- -
Wild grape	0.94	- -	- -
Elderberry	- -	3.0	- -
Prickley Ash	- -	3.0	- -

WINTER SHRUB BROWSE STUDY

TABLE 3

Shrub Abundance in Upland Hardwoods in
Percentage of Area Covered by Shrub Crowns.

Species	Inside George Reserve (106 plots)	Outside Pastured Woodlots (32 plots)	Outside Unpastured Woodlots (24 plots)
Low bush blueberry	17.0	2.0	5.0
Black cherry	12.0	24.0	13.0
Witch-hazel	10.0	6.0	6.0
Juneberry	8.0	5.0	3.0
Raspberry group	7.0	12.0	5.0
Low juniper	6.0	9.0	- -
Hazelnut	6.0	3.0	18.0
Wild currant	6.0	7.0	9.0
Gray dogwoods	5.0	12.0	11.0
Sassafras	4.0	1.0	9.0
Huckleberry	3.0	- -	- -
Viburnum group	3.0	2.0	3.0
Aspen	3.0	3.0	6.0
Wild rose	2.0	4.0	8.0
Crataegus sp.	1.0	2.0	6.0
High bush blueberry	1.0	- -	- -
Buckthorn	0.95	- -	- -
Wild grape	0.32	1.0	1.0
Elderberry	0.32	1.0	- -
Red osier dogwood	0.32	1.0	2.0

UPLAND GRASSLAND SHRUBS

Occupying approximately 500 acres within the George Reserve, grassy areas cover most of the flat upland and some of the more gentle slopes. These large expanses of grass and scattered shrubs are considered as one association.

Composed largely of Canada blue grass, various sedges, mullen, panic grass, goldenrod, milkwood, pearly everlasting and evening-primrose, along with various mosses and lichens, this area has no great shrubby growth. Scattered over the flat grasslands are low juniper, red cedar, red osier dogwood, crataegus species and wild rose. Dewberry occurs in great patches on the very dry, sandy areas. Smooth sumac grows in dense stands on the margins of grassland and woods, and also in the gullies and draws that lead across the flat grassland from the adjacent marshes and woods. These draws are used very heavily by deer as travel lanes and runways and deer browsing on smooth sumac is severe in such locations.

Browsing was noted on all shrub species, but most was old browse injury, probably caused the previous summer. Little fresh browse was noted during the months of January through May when this data was collected. This can probably be explained by the fact that deer on the George Reserve remain in the sheltered kettle-holes and in the swamps during most of the winter and use the flat, open, grasslands very little until later in the spring. My observations of deer activity while collecting my data would substantiate this. It was only until late in March that I began to see any



Photo 2. Upland Grassland type showing red cedar and low juniper. (Note browse line on tall red cedar).



Photo 3. Upland grassland type showing typical flat, open prairie. (Note smooth sumac at left of top of road).

great deer concentrations on the grassy uplands, but as warmer weather progressed the deer began to utilize the early shoots of grass and other vegetation.

Smooth sumac showed the most severe browsing; however this was concentrated in and along the gullies that were used as runways. In patches of sumac located away from any gully or draw, winter deer browsing was absent or very slight. The deer herd during the warm summer evenings feed over this entire grassy area. The scattered red cedar, *crataegus* and red osier dogwood show that they are nibbled at continually until all new twig growth has been taken. Dwarfed and stunted *crataegus* species were examined and aged by counting rings. These trees 2 to 3 feet tall and up to an inch in diameter were found to be 9 to 18 years old.

Fifteen milacre plots were taken over the grassy uplands and shrub abundance, percentage of utilization, and occurrence was measured. Tables 4, 5, and 6 show the effect of the George Reserve deer herd during the winter months only and cannot serve to indicate the complete picture of the year-around utilization of these shrubs by deer. Photos 2 and 3 show a portion of the upland grassland type within the reserve and visible browse line on red cedar. No comparison was made on grassy uplands outside the reserve, as the author thought it unimportant considering the infrequent occurrence of shrub species.

WINTER DEER BROWSE STUDY

TABLE 4

Average Percentage of Twigs Showing Deer
Browsing on Grassland Types

<u>Species</u>	<u>Percentage*</u>
Red cedar	30.0
Smooth sumac	6.0
Rose sp.	5.0
Crataegus sp.	1.0
Red osier dogwood	1.0
Low juniper	1.0

* Based on 15 milacre plots taken within George Reserve.

WINTER DEER SHRUB BROWSE STUDY

TABLE 5

Frequency of Shrub Occurrence in Grassland Types

(Based on 15 milacre plots taken within reserve)

<u>Species</u>	<u>Percent</u>
Smooth sumac	66.0
Raspberry group	25.0
Rose sp.	8.0
Low juniper	7.0
Red cedar	7.0
Red osier dogwood	7.0
Crataegus species	7.0

SHRUB BROWSE STUDY

UPLAND GRASSLAND SHRUBS - TABLE 6

Abundance in Percentage of Total Area Covered
By Shrub Crowns

<u>Specie</u>	<u>Percentage*</u>
Smooth sumac	59.0
Raspberry group	24.0
Rose sp.	7.0
Red osier dogwood	4.0
Crataegus sp.	2.0
Red cedar	2.0
Low juniper	2.0

* Based on 15 milacre plots within George Reserve

MARSH SHRUB TYPE

Marsh areas and marsh-seepage areas occupy about ten percent of the total acreage of the George Reserve. Extensive marshes occur on the eastern and southwestern edges of the reserve. To the south and west of the Big Tamarack Swamp are marshy areas of about thirty acres. Toward the north and northwest are scattered smaller marsh areas. Of interest is the Fishhook Marsh located in the southwest corner of the reserve. This marsh in the shape of a fishhook covers approximately 25 acres and is bordered by extensive shrubby growth.

Thirty-two milacre plots were taken throughout all marshy areas in the reserve and fifty-three milacre sample plots were made in three adjacent marsh areas to the south, east and northwest of the reserve. A larger number of plots were taken outside the study area because of the irregular nature and smaller size of the areas examined. In total the plots taken outside the reserve covered an area of about sixty acres.

Nineteen separate genus of shrubs were found associated with marsh habitats within the reserve. Red osier dogwood and willow species made up approximately one-third of the total area covered by marsh shrubs. Seventeen other marsh shrub species covered the remaining area.

Little change in the abundance of red osier dogwood and willow was noted either inside or without the reserve. Browsing on red osier dogwood by deer affected 18 percent

of the annual twig production during the period of this study, whereas in bog types deer browsing affected 47 percent of the annual growth. This difference may be due to the more open character of the marshes on the reserve, which allowed the deer to browse the more favored shrubs to a greater degree. Within the bog areas the fallen tamarack snags and numerous hummocks make the selectivity of deer in choosing their food more difficult by the difference in ease in securing browse. The effect of deer browsing could be seen in the average heights of red osier dogwood within and without the reserve. Inside the reserve this shrub averaged 4.0 feet on 133 milacre plots and outside the average height was 4.5 feet based on 97 milacre plots.

Elderberry was the heaviest browsed marsh shrub in the reserve. Deer feeding had reduced this shrub to mere twigs with only a few remaining buds showing any signs of new growth. On adjacent areas where not subjected to deer browsing, elderberry was found to grow to heights of six and eight feet. It was also found to be slightly more abundant on the outside, but since this shrub is very intolerant, competition for light may have kept elderberry from appearing even more abundant.

The staple deer browse supplied by marshy areas in the reserve appear to be huckleberry, wild rose, aspen, chokeberry, swamp birch, and poison sumac. Also of great browse use to deer in the marshy areas of the reserve are viburnum species, red osier dogwood, and the gray dogwood group.

WISCONSIN DEER HABITAT BROWSE STUDY

Of little or no use to deer as browse food are spirea, buttonbush, low blueberry, raspberries, and shrubby cinquefoil.

Tables 7, 8, and 9 show the utilization of these marsh shrubs by deer, percentage of occurrence and abundance.



Red cedar/Juglans	12.0
Willow sp.	15.0

Photo 4.- Shows marsh in southeast corner of reserve.

View is toward Big Tamarack Swamp in the north.

Spiraea	5.0
Buttonbush	4.0
Low blueberry	3.0
Raspberry group	3.0
Shrubby cinquefoil	0.0

WINTER DEER SHRUB BROWSE STUDY

TABLE 7

Average Percentage of Twigs Showing Deer

Browsing in Marsh Types

(Based on 32 milacre plots within the reserve)

<u>Species</u>	<u>Percentage</u>
Elderberry	90.0
Huckleberry	35.0
Rose sp.	35.0
Aspen	30.0
Chokeberry	30.0
Swamp birch	25.0
Poison sumac	24.0
Viburnum sp.	24.0
Gray dogwood group	23.0
Mountain holly	20.0
Red osier dogwood	18.0
Willow sp.	13.0
Black cherry	10.0
Winterberry	7.0
Spirea	5.0
Buttonbush	4.0
Low blueberry	3.0
Raspberry group	1.0
Shrubby cinquefoil	0.0

WINTER DEER SHRUB BROWSE STUDY

TABLE 8

Frequency of Shrub Occurrence in Marsh Types

<u>Species</u>	<u>Inside Reserve</u> (Based on 32 plots)	<u>Outside Reserve</u> (Based on 53 plots)
Red osier dogwood	34.0	44.0
Willow sp.	28.0	19.0
Poison sumac	19.0	13.0
Buttonbush	16.0	2.0
Swamp birch	13.0	13.0
Gray dogwood group	13.0	8.0
Shrubby cinquefoil	9.0	17.0
Low blueberry	9.0	- -
Winterberry	9.0	8.0
Raspberry group	9.0	8.0
Black cherry	6.0	- -
Aspen	6.0	13.0
Mountain holly	6.0	2.0
Huckleberry	6.0	2.0
Viburnum sp.	6.0	1.0
Rose sp.	6.0	13.0
Spirea	6.0	25.0
Elderberry	6.0	4.0
Chokeberry	3.0	- -

WINTER DEER SHRUB BROWSE STUDY

TABLE 9 * Marsh Shrubs

Shrub Abundance in Percentage of Total Area Covered

By Crowns

<u>Species</u>	Inside Reserve (Based on 32 plots)	Outside Reserve (Based on 53 plots)
Red esier dogwood	22.0	26.0
Willow sp.	10.0	12.0
Buttonbush	8.0	1.0
Poison sumac	6.0	9.0
Gray dogwood group	6.0	6.0
Swamp birch	5.0	10.0
Raspberry group	5.0	2.0
Black cherry	5.0	- -
Chokeberry	4.0	- -
Huckleberry	4.0	1.0
Viburnum sp.	4.0	1.0
Spirea	4.0	10.0
Winterberry	4.0	4.0
Shrubby cinquefoil	3.0	5.0
Low blueberry	3.0	- -
Mountain holly	2.0	1.0
Elderberry	2.0	3.0
Rose sp.	2.0	5.0
Aspen	2.0	7.0

BOG SHRUB TYPES

The most extensive bog area on the George Reserve is the Big Tamarack Swamp. Occurring in the eastern half of the reserve, it covers approximately 150 acres. Made up characteristically of poison sumac, and tamarack, this swamp is filled with standing tamarack snags, which succumbed to the larch sawfly attack shortly after the turn of the century. At the present time, young growth of tamarack, poison sumac, chokeberry, mountain holly, wild rose and various raspberries are growing up among the dead and fallen snags, forming a very uneven vegetative cover. This undergrowth of shrubs is exceedingly variable in content and abundance from one place to another. Hummocks and fallen trees make it difficult to walk across this area unless one follows the numerous deer trails that wind and criss-cross throughout the area. The shrub species most abundant in the Big Tamarack Swamp are poison sumac, red osier dogwood, Michigan holly and wild rose.

Two acid bogs, characterized by thick sphagnum moss and leatherleaf, are found within the George Reserve. The larger, Big Cassandra Bog, lies in the northwestern corner of the reserve. (See Map 3). This bog covers an area of fifteen acres and is covered by a springy mat of sphagnum moss and shrubby growth of leatherleaf, with water standing in the lower depressions throughout the year.

A smaller acid bog of approximately three acres, known as "Buck Hollow", lies in a deep kettle-hole in the northeast

oak-hickory woods. Both of these bogs are very similar, containing standing water throughout the year. Along the shady edge adjacent to the hardwood margins, there is a narrow fringe of bog shrubs, such as high bush blueberry, huckleberry and various dogwoods. These shrubs grow to heights of five and six feet in some instances. Deer activity is heavy in Buck Hollow and around the fringes of Big Cassandra Bog. Herbaceous growth in these acid bogs consists of various mosses, ferns, smartweeds, sedges, and water arum.

Inside the reserve data from 47 milacre plots revealed that swamp birch, red osier dogwood, leatherleaf, poison sumac, spirea and Michigan holly are the most abundant shrubs.

Data from 27 milacre plots taken in a bog area east of the reserve revealed that swamp birch, leatherleaf and red osier occur in relatively the same abundance as within the George Reserve. Poison sumac, which is browsed very heavily inside the reserve, is nearly twice as abundant in the unbrowsed bog type outside. (See Table 12). Within the reserve this shrub often grows to tree heights and out of reach of the deer. Of the available poison sumac examined 48 percent of the annual twig growth showed browsing. Some individual clumps varied in the degree of browsing from less than 10 percent to extreme twig browsing of more than 90 percent. These extreme cases of browsing were usually associated with nearby deer trails or type edges where the deer had good accessibility to the shrubs. Where poison sumac was protected

by jumbles of fallen tamaracks and other brush, little or no browsing was noted.

Swamp birch was the most common bog shrub, occupying 24 percent of the total area by its crowns.

Leatherleaf, spirea and shrubby cinquefoil, although relatively abundant throughout the bog areas in the reserve, were not browsed to any measurable degree. These three shrubs illustrate unsuitable deer foods and even when associated with highly prized deer foods as red osier dogwood, poison sumac and swamp birch, these shrubs were untouched by deer.

Of great palatability to deer are the gray dogwoods, winterberry, and chokeberry. These shrub species occurred in scattered clumps throughout the bog areas in the reserve, and although covering only 4 percent of the total area combined, each showed 40 percent of their annual twig growth browsed.

Tables number 10, 11 and 12 show the position of twenty shrub species that occur within bog types inside the reserve and the degree of utilization of these shrubs for deer food.

WINTER SHRUB BROWSE STUDY

TABLE 10

Average Percentage of Twigs Showing Deer

Browsing on Bog Shrub Types

(Based on 47 milacre plots taken throughout Reserve)

<u>Species</u>	<u>Percentage</u>
Gray dogwoods	50.0
Poison sumac	48.0
Red osier dogwood	47.0
Swamp birch	45.0
Crataegus sp.	40.0
Mountain holly	40.0
Chokeberry	39.0
Wild rose	37.0
Black cherry	35.0
Winterberry	34.0
High bush blueberry	30.0
Raspberry group	25.0
Low blueberry	20.0
Willows	14.0
Hazelnut	10.0
Aspen	10.0
Viburnum sp.	5.0
Shrubby cinquefoil	2.0
Spirea	2.0
Leatherleaf	0.0

WINTER SHRUB BROWSE STUDY

TABLE 11.

Frequency in percentage of Shrub Occurrence in Bog
Shrub Types

Species	Inside Reserve (Based on 47 plots)	Outside Reserve (Based on 27 plots)
Swamp birch	64.0	52.0
Leatherleaf	36.0	33.0
Red osier dogwood	32.0	33.0
Poison sumac	25.0	29.0
Spirea	23.0	4.0
Wild rose	17.0	11.0
Winterberry	17.0	11.0
Willow	15.0	7.0
Raspberry group	15.0	19.0
Shrubby cinquefoil	10.0	19.0
Viburnum sp.	8.0	11.0
Chokeberry	6.0	11.0
High bush blueberry	6.0	4.0
Low blueberry	6.0	11.0
Black cherry	4.0	11.0
Gray dogwood group	2.0	4.0
Crataegus sp.	2.0	- -
Mountain holly	2.0	- -
Hazelnut	2.0	- -

WINTER SHRUB BROWSE STUDY

TABLE 12

Bog Shrub Types

Shrub Abundance in Percentage of Total Area Covered by Crowns

<u>Species</u>	Inside Reserve (Based on 47 plots)	Outside Reserve (Based on 27 plots)
Swamp birch	24.0	28.0
Leatherleaf	12.0	11.0
Red osier dogwood	10.0	12.0
Poison sumac	7.0	15.0
Spirea	7.0	3.0
Winterberry	7.0	7.0
Willow	6.0	2.0
Raspberry group	4.0	5.0
Wild rose	4.0	3.0
Shrubby cinquefoil	3.0	7.0
High bush blueberry	3.0	1.0
Black cherry	3.0	1.0
Viburnum sp.	2.0	7.0
Chokeberry	2.0	6.0
Low blueberry	2.0	4.0
Gray dogwood group	1.0	1.0
Hazelnut	1.0	2.0
Aspen	1.0	- -
Crataegus sp.	1.0	- -
Mountain holly	1.0	- -

TRANSITIONAL SHRUB ZONE

Shrubby growth on the George Reserve occurs most abundantly and grows to a more luxuriant growth cover along the margins and edges between vegetational types. Shrub ecotones and edges are especially dense along the edges of the higher wooded areas and lower swamps and bogs. Scattered groups of shrubs are also found along the edges of grassland and marsh.

Photo 5 -

View of
Marsh-
Woodland
Shrub
Ecotone



For this study the shrub ecotones found on the reserve were divided into three categories as follows:

1. Marsh - Woodland Shrubs
2. Marsh - Grassland Shrubs
3. Bog - Woodland Shrubs

Each of these shrub habitats on the reserve were studied and milacre sample plots taken. Comparison as to abundance and frequency of occurrence was made between similar areas both in and out of the reserve.

MARSH - WOODLAND SHRUB ECOTONE

In the ecotone between marsh and wooded areas inside the reserve twenty-nine milacre plots were examined. It was revealed that elderberry was browsed the heaviest - having 50 percent of its annual twig growth taken. Gray dogwoods, swamp birch, and red osier dogwood followed in the degree of browse taken by deer. Of little or no use to deer as browse material was low blueberry, shrubby cinquefoil, and spirea. Tables 13, 14 and 15 show comparisons between marsh-woodland shrub ecotones inside and outside the reserve.

It may be apparent that these figures are inadequate and that a larger number of milacre plots are necessary to show the true differences in abundance and percent of occurrence. These figures do show some relationship of marsh - woodland shrub abundance and indicate the relative occurrence of these species.

MARSH - GRASSLAND SHRUB ECOTONES

Shrub species were also examined occurring in the transitional belt between marsh and grassy areas. From eighteen milacre sample plots taken within the reserve, willow was found to occur most frequently. Buttonbush is found in scattered swamps in the northwest edge of the reserve. This shrub characteristically grows in pure stands, usually ringed by viburnum sp., dogwoods, and such intolerant trees as elm and willow. It was found that deer make little use of buttonbush as a browse food and from 18 milacre plots examined, it had a percentage of occurrence of 27 percent, but showed no winter browse injury.

Tables 16, 17 and 18 show the relationship of shrubs found in such a shrub ecotone.

BOG - WOODLAND SHRUB ECOTONE

The transitional zone between bog and woodland vegetation was studied both within and outside the reserve. An extensive bog - woodland shrub ecotone occurs along the western edge of the Big Tamarack Swamp. Smaller areas of similar composition were found along the fringe of Big Cassandra Bog in the northwest corner of the reserve. Huckleberry, low blueberry, winterberry, and poison sumac were the shrubs occurring most frequently. These shrubs were also the most abundant species in this shrub habitat. Table 19 shows the degree of winter browse taken from these bog - woodland shrubs. Gray dogwood had an average of 65 percent of the twigs showing browse. Black cherry, which occurs infrequently in this habitat, had approximately one-half of its annual twig production injured by deer. Poison sumac, occupying 10 percent of the total area of the milacre plots, had an average of 40% of its annual twig affected. Winterberry and chokeberry occurred infrequently within the reserve but showed 28 and 40 percent of their twigs browsed respectively. Raspberry and spirea were found to occupy only a small degree of the total area in plots, but most significant was the almost absence of any deer browsing.

Tables 19, 20 and 21 show the results of milacre sample plots studied within the reserve and on similar areas beyond the deer enclosure.

WINTER SHRUB BROWSE STUDY

TABLE 13

MARSH - WOODLAND SHRUB ECOTONE

Average Percentage of Annual Twigs Showing Deer
Browsing (Based on 29 milacre plots)

<u>Species</u>	<u>Percentage</u>
Elderberry	50.0
Gray dogwood group	40.0
Swamp birch	30.0
Red osier dogwood	27.0
Hazelnut	20.0
Low juniper	20.0
Huckleberry	20.0
Black cherry	20.0
Aspen	10.0
Juneberry	10.0
Willow	10.0
Raspberry group	5.0
Low blueberry	3.0
Shrubby cinquefoil	2.0
Spirea	0.0

WINTER DEER SHRUB BROWSE STUDY

TABLE 14

Frequency of Percentage of Shrub Occurrence in Marsh-woodland
shrub ecotones

Species	Inside Reserve (Based on 29 plots)	Outside Reserve (Based on 12 plots)
Red osier	58.0	41.0
Raspberry group	27.0	33.0
Gray dogwood group	20.0	25.0
Shrubby cinquefoil	17.0	16.0
Hazelnut	14.0	8.0
Willow	14.0	16.0
Low blueberry	10.0	8.0
Aspen	10.0	16.0
Black cherry	7.0	16.0
Low juniper	3.0	8.0
Huckleberry	3.0	- -
Juneberry	3.0	8.0
Spiraea	3.0	8.0
Swamp birch	3.0	16.0
Elderberry	3.0	8.0

WINTER SHRUB BROWSE STUDY

TABLE 15

MARSH - WOODLAND SHRUB ECOTONE

Abundance in Percentage of Total Area Covered by Crowns

Species	Inside Reserve (Based on 29 plots)	Outside Reserve (Based on 12 plots)
Red osier dogwood	44.0	25.0
Raspberry group	12.0	10.0
Gray dogwoods	9.0	14.0
Hazelnut	9.0	5.0
Shrubby cinquefoil	5.0	4.0
Willow species	4.0	10.0
Aspen	3.0	5.0
Low blueberry	3.0	5.0
Huckleberry	2.0	- -
Black cherry	2.0	- -
Spirea	1.0	5.0
Low juniper	1.0	2.0
Elderberry	1.0	- -
Swamp birch	1.0	2.0
Juneberry	1.0	2.0

WINTER SHRUB BROWSE STUDY

TABLE 16

Average Percentage* of Twigs Showing Deer
Browsing in Marsh-Grassland Shrub Ecotones

<u>Species</u>	<u>Percentage</u>
Red osier dogwood	54.0
Gray dogwood group	42.0
Aspen	40.0
Viburnum group	35.0
Wild rose	30.0
Chokeberry	30.0
Hazelnut	20.0
Willow	13.0
Spirea	3.0
Raspberry group	2.0
Buttonbush	0.0

* Based on 18 milaere plots taken inside reserve.

WINTER SHRUB BROWSE STUDY

TABLE 17

MARSH - GRASSLAND SHRUB ECOTONE

Frequency of Shrub Occurrence

Species	Inside Reserve (Based on 18 plots)	Outside Reserve (Based on 12 plots)
Willow	44.0	33.0
Red osier dogwood	27.0	50.0
Gray dogwood group	27.0	33.0
Buttonbush	27.0	33.0
Spirea	17.0	25.0
Viburnum group	11.0	17.0
Wild rose	5.0	8.0
Raspberry group	5.0	17.0
Hazelnut	5.0	17.0
Chokeberry	5.0	8.0
Aspen	5.0	8.0

WINTER SHRUB BROWSE STUDY

TABLE 18

MARSH - GRASSLAND SHRUB ECOTONE

Percentage of Abundance in Total Area Covered by Crowns

Species	Inside Reserve (Based on 18 plots)	Outside Reserve (Based on 12 plots)
Buttonbush	25.0	20.0
Willow	18.0	14.0
Red osier dogwood	14.0	26.0
Gray dogwood group	12.0	12.0
Spirea	18.0	18.0
Chokeberry	7.0	4.0
Viburnum group	5.0	2.0
Hazelnut	3.0	4.0
Raspberry group	2.0	2.0
Wild rose	2.0	2.0

WINTER SHRUB BROWSE STUDY

TABLE 19

BOG - WOODLAND SHRUB ECOTONE

Average Percentage of Annual Twigs Showing Deer Browsing

(Based on 15 milacre plots).

Species	Percentage
Gray dogwood group	65.0
Black cherry	50.0
Poison sumac	40.0
Chokeberry	40.0
Red osier dogwood	35.0
Winterberry	28.0
Wild rose	25.0
Huckleberry	22.0
Willow	20.0
High bush blueberry	15.0
Low blueberry	4.0
Raspberry group	0.0
Spirea	0.0

WINTER SHRUB BROWSE STUDY

TABLE 20

BOG - WOODLAND SHRUB ECOTONE

Frequency of Shrub Occurrence

Species	Inside Reserve (Based on 15 plots)	Outside Reserve (Based on 22 plots)
Huckleberry	53.0	18.0
Low blueberry	47.0	36.0
Winterberry	33.0	14.0
Poison sumac	20.0	32.0
High bush blueberry	20.0	18.0
Wild rose	13.0	9.0
Gray dogwood group	13.0	9.0
Red osier dogwood	13.0	14.0
Willow	7.0	5.0
Raspberry group	7.0	9.0
Black cherry	7.0	- -
Chokeberry	7.0	- -
Spiraea	7.0	5.0

WINTER SHRUB BROWSE STUDY

TABLE 21

BOG - WOODLAND SHRUB ECOTONE

Percentage of Shrub Abundance in Total Area
Covered by Crowns.

Species	Inside Reserve (Based on 15 plots)	Outside Reserve (Based on 22 plots)
Huckleberry	33.0	23.0
Winterberry	16.0	12.0
High bush blueberry	14.0	15.0
Poison sumac	10.0	18.0
Red osier dogwood	7.0	4.0
Low blueberry	5.0	5.0
Wild rose	3.0	2.0
Gray dogwood group	3.0	2.0
Black cherry	2.0	- -
Chokeberry	2.0	- -
Raspberry group	2.0	9.0
Willow	2.0	13.0
Spirea	2.0	2.0

EFFECT OF DEER ON SHRUBBY GROWTH

The nature and effect of the George Reserve deer herd on the shrub growth was studied as another phase of this research. Average heights outside the reserve were compared to the same measurement of shrubs growing inside the fenced preserve.

It became apparent through this study that white-tailed deer browsing effects the growth of several species. The growth of crataegus sp. is shown in Chart 1. Tree heights in feet were measured and plotted against stem diameters, measured in tenths of inches. Tree heights were taken by using a 10 foot pole marked for that purpose. Heights above 10 feet were estimated. Stem diameters were measured at a height of 6 inches above the ground. This was done by using a pair of wooden calipers and the results measured in tenths of inches.

Hawthorne (crataegus sp.) shows a decided difference in rates of growth when affected by continual deer browsing. Black cherry was revealed to be the most abundant reproduction on the wooded slopes and lower shrub borders. An average of 20% of the annual twig production of black cherry showed signs of deer damage. The growth curves from inside and outside the George Reserve showed little difference, and the slight amount of winter browsing actually may have acted as a beneficial pruning effect to the young plants. Aspen was studied and its growth within and outside the reserve plotted graphically. Some reduction in the growth of this

species in the reserve is shown in Chart 3, but this is very slight. In some areas within the reserve aspen was found associated with highly browsed species such as red osier and gray dogwoods. When found in such an association, aspen was browsed very heavily. Photo 8 shows an instance where aspen occurred in a marsh-woodland shrub ecotone and its growth was curtailed by very severe and continued deer feeding. The tree in this picture was $3\frac{1}{2}$ feet tall and growth rings indicated it was 9 years old. The diameter of the stem at a height of 6 inches above the ground was 1.4 inches. Under such conditions white-tails do decidedly affect the growth of aspen.

Of particular interest was the growth of red osier dogwood. Since red osier is a shrub and grows from a rootstock that sends up numerous stolons, it was impossible to accurately age this shrub specie, by counting nodes or growth rings. A method of using shrub heights and the average diameter of individual shrub clumps to construct a growth curve was attempted. When compared to comparable areas outside the reserve, no significant differences in growth habits were noted. Aldous and Smith (1938) in a study of Minnesota deer food habits stated that red osier dogwood reproduces from suckers, but when browsed to a certain degree the annual production of suckers declined. The only indication that red osier dogwood suffers from the browsing of deer on the George Reserve was found in comparing average heights of clumps found inside with those found outside the area of

study. Inside the reserve the average height, based on 133 separate measurements was 4.0 feet, whereas on the outside the average height was 4.5 feet, based on 97 separate measurements.

It became apparent from the examination of individual shrubs that deer browsing is influenced by the accessibility and ease with which the deer can obtain its browse. Deer are definitely influenced by the pattern of runways and roads within the reserve. Browse in general is most severe along deer-tails and runways. This is reflected in the high degree of browse on all shrubs and trees growing along these natural routes of travel.

In the Big Tamarack Swamp many deer paths criss-cross and form well defined ways of travel throughout this type. Poison sumac, a highly prized bog-type shrub, showed great divergence in the degree of use. Where clumps of poison sumac were closely associated with deer tails, browsing was extremely high, ranging from 50 to 100 percent of the total twigs showing deer injury. Conversely, where fallen tamarack snags and logs protected clumps of poison sumac from the influence of deer, the degree of browsing was very slight or completely lacking.

Photo 6 shows an example of the selective nature of deer feeding. Located in a marsh-grassland shrub ecotone, this picture shows a large, dense clump of gray dogwood. Note the height of the clump nearest to the road. Along the road the deer have browsed 40% of the annual twig growth and the average height was 2.5 feet. The same clump of

gray dogwood just 10 feet away from the road showed slight browse or none at all and had grown to heights of six or seven feet. This photo shows very clearly that the greatest degree of deer browsing was concentrated near the road and decreased as the distance from the road increased.



Photo 6.- Deer Browsing on Gray Dogwood (*Cornus paniculata*).

Black cherry was studied for its use by deer in relation to a well defined deer runway. Milacre plots located along and within ten feet of the runway showed an average of 45 percent of the annual twig growth browsed. At right angles and 20 to 30 feet from the same runway the degree of deer browse was less than twenty percent. Various factors have to be considered before such a relationship can be appraised.

In general, the slope of the area was greater as the distance from the runway increased, and this probably affected deer feeding, but the relative amount of food was the same at all distances from the runway.

Witch-hazel was found throughout the wooded areas of the reserve. Deer seemed to avoid this shrub and browse it only slightly. In some areas individual clumps of witch-hazel grew in the open woods with abundant browse material reaching to the ground. The photo below shows a well formed clump of witch-hazel untouched by deer.



Photo 7.- Witch-hazel - an unpalatable deer food on the reserve.

Hazelnut, swamp birch and red osier dogwood also showed severe effects of concentrated deer feeding along runways and trails. However, since these shrubs are extremely important as winter deer browse food, they are continually

taken wherever they occur. No study of the difference in the amount of utilization in relation to routes of travel were made on these species.

KEY SHRUB SPECIES

On any area inhabited by browsing animals, there will be "key species", possibly only one specie, tree or shrub, that will by the degree of its utilization for food reflect the stocking of deer on the area. Perhaps key species are to be found for each season or are year around food.

Julander (1937) determined key species for the Kaibab deer range. He used three methods of study. By studying the utilization of all trees and shrubs on the different seasonal ranges, he was able to determine actual use under existing stocking. Studies were made in regard to the palatability of the plants on properly stocked areas, as well as in take-down deer enclosures. By further studying stomach contents, he was able to get a further index to palatability. Aspen was found to be the key species on the summer range and cliff rose, a native shrub, the key specie on the winter range. The author believes that crataegus sp. and aspen are possible key species on the George Reserve and may be applied to measure the density of deer on similar areas of southern hardwoods in Michigan.

By determining the average height of these species within an area of known deer density and plotting against the stem diameters, a growth curve for that specie can

be had to serve as a yardstick in appraising the density of deer on other similar areas. When deerbrowsing is similar, the resulting height-diameter curve should be the same. Further testing of this method is necessary to evaluate such a measurement of carrying capacity. The author has merely expressed his personal opinion and has no positive data to prove that these species can be successfully employed as "yardsticks" in determining numbers of deer using an area of range.

NEED FOR ADDITIONAL RESEARCH

The short-comings of this paper point to the need for additional research on the vegetative cover on the George Reserve. The data presented in this paper indicate only slightly the true picture of deer browsing on the area. Covering the winter months of January through May 1949, this research presents conclusions drawn from data of that period only. A thorough study of the browsing habits of the deer on the reserve would necessarily have to be carried on throughout an entire year. From such a year-around study the seasonal foods and effects of deer damage to the vegetative cover could be more adequately evaluated. An intensive year-around browse study should employ the use of statistical methods. By such an approach the significance and reliability of data collected could be tested accurately and analyzed mathematically.

The author realizes this paper falls short in not employing statistical analysis of the data. In some cases the number

of milacre plots taken in certain vegetative types are too few. Groupings of shrub types into larger categories may also be too large and further separation into smaller entities probably is advisable. It is hoped any further research on this problem will correct the above shortcomings.

SUMMARY

This study of the winter browse conditions on the George Reserve revealed:

1. In the upland hardwood areas of the reserve, gray dogwoods were utilized to the greatest degree as winter browse.

2. Witch-hazel is browsed very little within the reserve, but it is more abundant within than outside the area.

3. Sassafras is a highly palatable deer food within the reserve, and it is rapidly disappearing from the area. Numerous mature trees and the lack of reproduction reveal that this specie was formerly more abundant.

4. Elderberry is killed by continued deer browsing and is rarely found within the reserve.

5. Hazelnut is browsed to an average of one-third of its annual twig production in the hardwood areas of the George Reserve. This shrub is more abundant outside the reserve where it is not subjected to deer injury.

6. Grassland shrubs are relatively unbrowsed by the deer herd in winter, but as spring approached the degree of use increased, due to the greater range of the deer.

7. The most heavily browsed marsh-type shrubs are elderberry, huckleberry, wild rose, aspen and chokeberry.

8. Shrubby cinquefoil, spirea, low blueberry and buttonbush are relatively unbrowsed by deer in the marsh areas of the reserve.

9. Gray dogwoods, poison sumac, red osier dogwood and swamp birch are highly prized browse foods in the bog areas of the reserve.

10. Leatherleaf, spirea, and shrubby cinquefoil are bog shrubs untouched by white-tailed deer as browse.

11. Shrub ecotones on the George Reserve are characterized by very high and concentrated deer browsing.

12. Deer feeding is most severe along runways and deer trails.

13. Crataegus and aspen are possible key species on the George Reserve and may by their degree of use be used to indicate the relative density of deer in comparable southern hardwood regions in Michigan.

14. Any further study of browse conditions within the George Reserve should have the data tested by statistical analysis.

15. Such a study should be carried on throughout an entire year to indicate the seasonal variations in deer feeding habits.

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APPENDIX

DESCRIPTION OF STUDY AREA

Location - The Edwin S. George Reserve of the University of Michigan is an area of approximately 1268 acres, or two square miles. It is situated in the southwestern part of Livingston County, Michigan. The reserve lies within Range 4 East, (Michigan meridian), Township 1 North (Michigan base line), and covers Section 19 and portions of Sections 25, 29 and 30, of Putnam Township; also portions of Sections 24 and 25 in Unadilla Township. Situated twenty-four miles northwest of Ann Arbor, the reserve is about four miles west of the town of Pinkney, Livingston County, Michigan.

Physiography -

The area in which the George Reserve is located is morainic, hilly and rough, with many kettle-holes, ridges and knobs. To the south of the reserve there is a morainic spur formed by the meeting of the Kalamazoo Moraine and the Mississinana Moraine. The home of Lawrence Camburn, the reserve custodian, is situated on what may be considered this ridge. To the north of the reserve is lowland through which the Pinkney channel of the glacial Huron River flowed in a south and west direction. Of particular interest is a peculiar esker-like formation, extending for one-half mile from the northwest corner of the reserve to the southwest. Geological explanation of this formation is made due to huge blocks of glacial ice filling the kettle-hole and lower lands, between which glacial waters wound their ways. Melt waters deposited tons of glacial debris, eventually building up the esker-like

formation, which appears as a "knife-edge ridge". Scattered throughout the rest of the reserve are hills and lowlands, all of glacial origin.

The lowlands comprise about twenty-five percent of the total area of the reserve and are found below the 900 foot contour. The uplands comprise about seventy-five percent of the total area and lie above the 950 foot contour. These uplands are made up of "a relatively flat high plateau in the north-central part of the area, esker, ridges and hills scattered throughout the area.

SOIL OF THE GEORGE RESERVE

The soils within the reserve are in the Miami-Kewannee soil area. (U. S. D. A. Soil Survey Division 1928). Soils are patchy and irregular in their distributions, ranging in the lowlands from peats to mucks. These soils are classified as acid Greenwood and Rifle peats, and the more neutral and even alkaline Carlise and Kerston mucks.

Mineral soils cover the uplands above the 900 foot contour and include the Bellfontaine sandy loam, Plainfield sandy loam, Coloma loamy sand and infrequent patches of Miami loam.

PAST HISTORY OF GEORGE RESERVE

Prior to 1927, the area now known as the Edwin S. George Reserve was made up of 12 separate farms, with tilled land, pasture, orchards, woodlots and waste swampland. The land was unsuitable for cultivation and the acreage of land in

cultivation steadily decreased from 1900 to 1927, when wide spread erosion took much of the land from use. Gradually grain crops were abandoned and cattle grazing became the primary use of the land. This grazing was so severe that the presence of many Red Cedar (*Juniperus virginiana*) on the uplands stand as an example of the misuse of the land. Some logging took place ever since the white man lived on the area. In 1918 a few large white oaks and hickories were cut for saw timber. Before that logging was restricted to cutting fuel wood and a few small saw logs at various times.

In 1927, Colonel Edwin S. George, a wealthy Detroit industrialist, purchased the land for a country estate. The deer herd was introduced by Colonel George in March 1928. Four does and two buck deer were introduced and from that nucleus of six deer the present fine herd has developed. No additional deer have been stocked on the reserve.

The George Reserve was given to the University Museums of the University of Michigan in 1930 by Colonel George. The administration of the area is the responsibility of the University of Michigan and the area was stipulated to be used as a study area and always left in the natural state.

Fauna of the George Reserve includes numerous song birds, ducks, ruffed grouse, ring-neck pheasants, white-tailed deer, raccoon, skunk, opossum, fox, squirrels, badger, and many smaller mammals. Recently the reserve has been used by the Sandhill Crane (*Grus canadensis*) and due to the rareness of this bird all efforts have been made to encourage the birds to nest on the reserve.

List of Shrub Species Found on
Edwin S. George Reserve, Michigan - 1949

<u>Common Name</u>	<u>Scientific Name</u>
Aspen	<u>Populus tremuloides, Michx.</u>
Bluebeech	<u>Carpinus caroliniana Walt.</u>
Buckthorn	<u>Rhamnus alnifolia L'Her.</u>
Buttonbush	<u>Cephalanthus occidentalis L.</u>
Cherry - (Black)	<u>Prunus serotina Ehrh.</u>
Cherry - (Choke)	<u>Prunus virginiana L.</u>
Chokeberry	<u>Pyrus melanocarpa (Michx).</u>
Crataegus	<u>Crataegus species.</u>
Elderberry	<u>Sambucus canadensis L.</u>
Flowering dogwood	<u>Cornus florida L.</u>
Hazelnut	<u>Corylus americana Walt.; C. rostrata</u>
High-bush blueberry	<u>Vaccinium corymbosum L.</u>
Huckleberry	<u>Gaylussacia baccata (Wang).</u>
Ironwood	<u>Ostrya virginiana (Mill)</u>
Juneberry	<u>Amelanchier canadensis L.</u>
Leatherleaf	<u>Chamaedaphne calyculata Moench.</u>
Low blueberry	<u>Vaccinium canadensis, V. pennsyl- vanicum</u>
Low juniper	<u>Juniperus horizontalis Moench.</u>
Meadow sweet	<u>Spirea salicifolia L.; S. alba.</u>
Michigan holly or winterberry	<u>Ilex verticillata L.</u>
Mountain holly	<u>Nemopanthus mucronata (L.)</u>
Prickley Ash	<u>Zanthoxylum americanum Mill.</u>
Poison sumac	<u>Rhus Vernix L.</u>
Raspberry group	<u>Rubus species.</u>
Red osier dogwood	<u>Cornus stolonifera Michx.</u>
Ribes group	<u>Ribes species.</u>

List of Shrub Species Found on
Edwin S. George Reserve, Michigan - 1949

<u>Common Name</u>	<u>Scientific Name</u>
Rose group	<u>Rosa species.</u>
Sassafras	<u>Sassafras officinales. Nees</u>
Shrubby cinquefoil	<u>Potentilla fruticosa L.</u>
Stag-horn sumac	<u>Rhus typhina L.</u>
Swamp birch	<u>Betula pumila L.</u>
Viburnum group	<u>Viburnum species.</u>
Wild grape	<u>Vitus species.</u>
Willow	<u>Salix species.</u>
Witch-hazel	<u>Hamamelis virginiana L.</u>



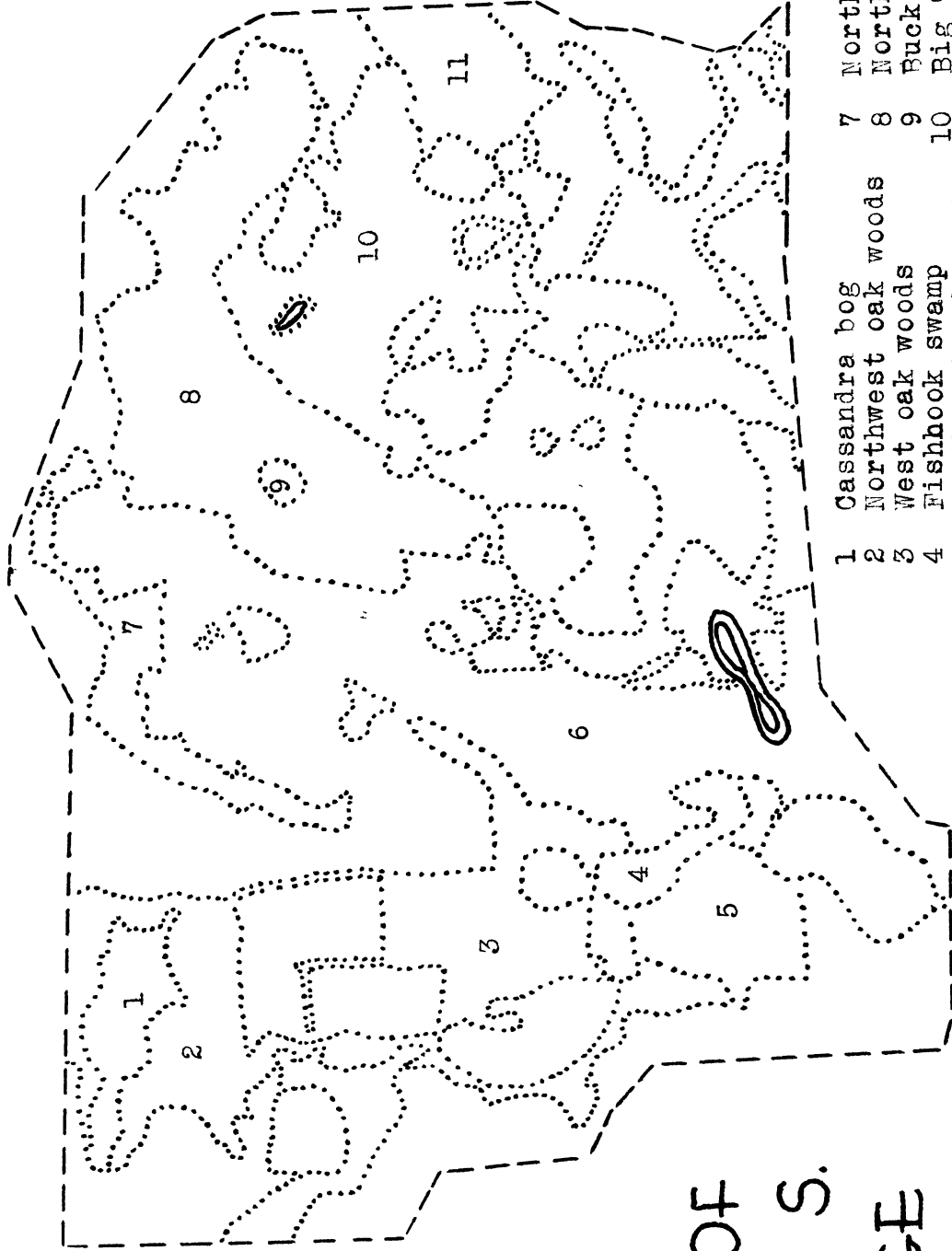
Photo 8. Aspen (Populus tremuloides), showing dwarfed condition due to continued deer browsing.



Photo 9. Low Juniper (Juniperus horizontalis), that shows severe browsing.

RESERVE

MAP OF EDWIN S. GEORGE RESERVE

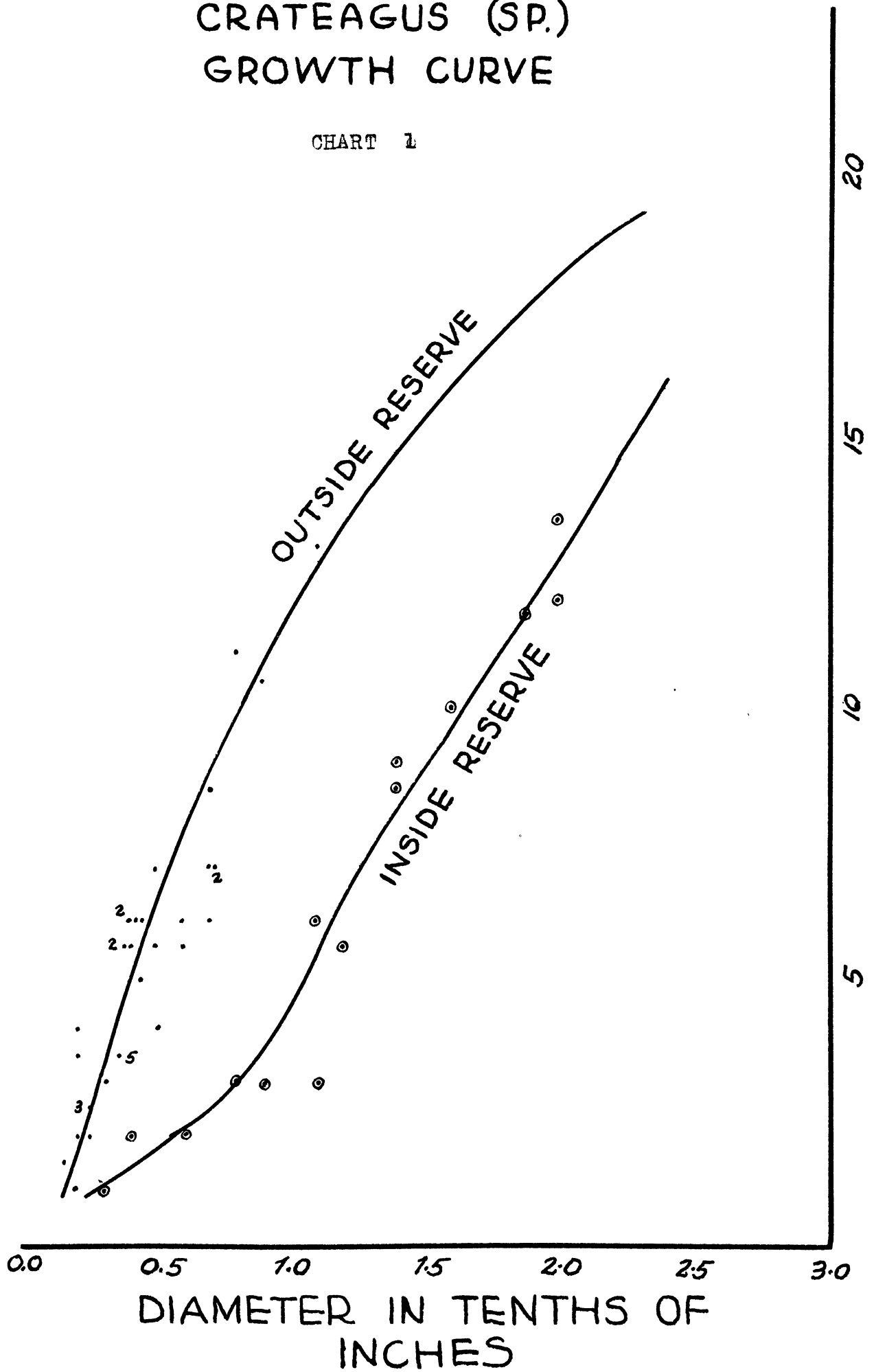


- 1 Cassandra bog
- 2 Northwest oak woods
- 3 West oak woods
- 4 Fishhook swamp
- 5 Southwest oak woods
- 6 Grassy uplands
- 7 North central oak woods
- 8 Northeast oak woods
- 9 Buck Hollow
- 10 Big Tamarack swamp
- 11 Eastern swamp

Drawn by
E.V. RICHARDS
APRIL '49

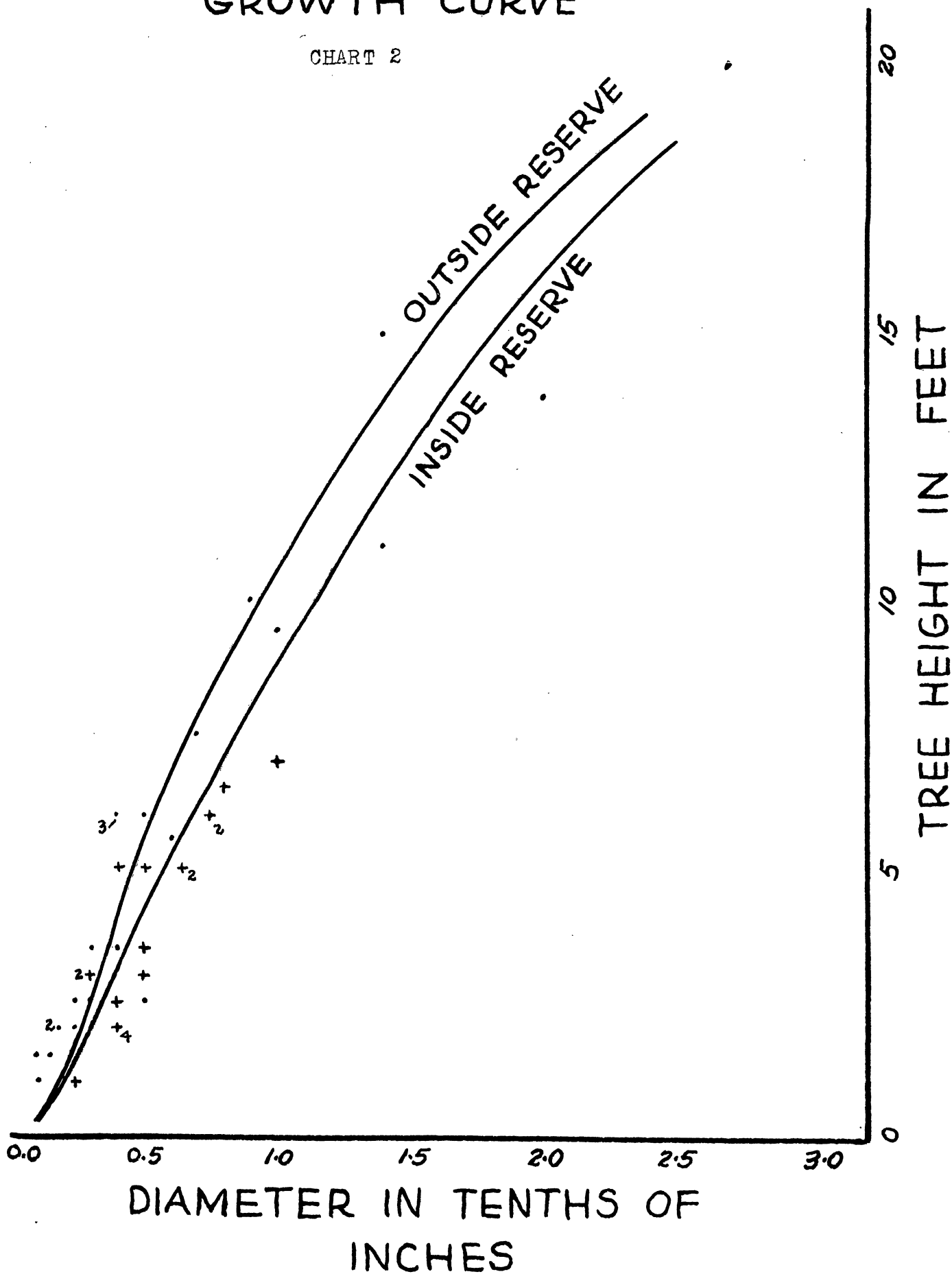
CRATEAGUS (SP.) GROWTH CURVE

CHART 1



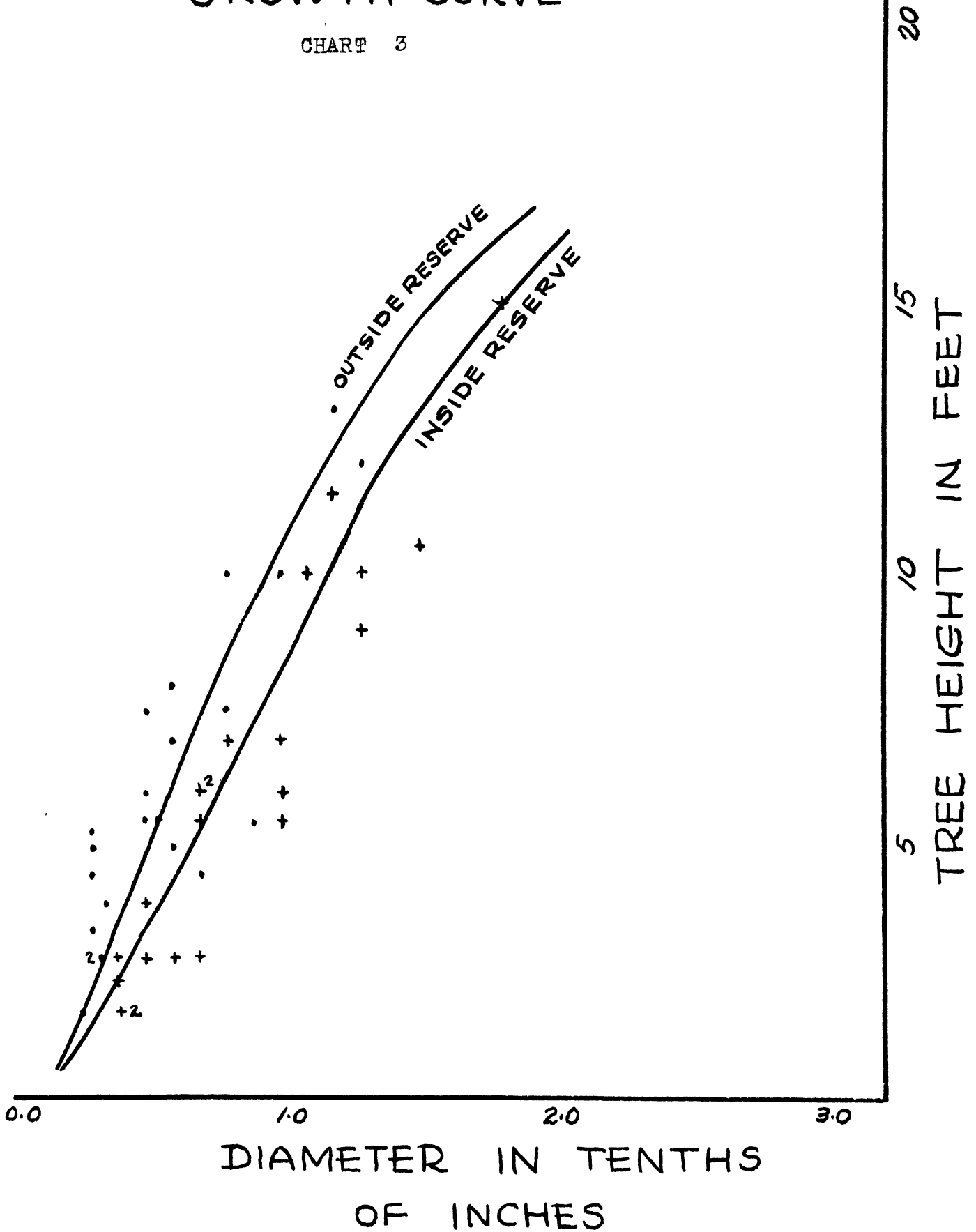
BLACK CHERRY GROWTH CURVE

CHART 2



ASPEN (POPULUS TREMULOIDES) GROWTH CURVE

CHART 3





LEGEND

BOUNDARY FENCE	—————
RAILROAD	—————
ROADS	—————
TRAILS	—————
FRANK HOUSES	—————
FRANK BUILDINGS	—————
SPRINGS	—————
RUNNING WATER AND DIRECTION	—————

EDWIN S. GEORGE RESERVE
 UNIVERSITY MUSEUMS
 UNIVERSITY OF MICHIGAN

ORTHOMETER MEASUREMENTS
 CONTOUR INTERVAL - 5 FEET
 SCALE
 JAN 22, 1933

JOHN BURBANK, ENGINEER
 PAUL F. HITCHCOCK

UNIVERSITY OF MICHIGAN



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