THE WHITE-TAILED DEER IN WISCONSIN

Dahlberg & Guettinger

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FOREWORD

Throughout most of Wisconsin's conservation history we had a very simple objective concerning the white-tailed deer: produce more deer. In this effort we succeeded remarkably well.

Beginning about 1930 our satisfaction was marred by disturbing events. We had warnings that our range was deteriorating. We began to find deer that died of starvation in winter. Range conditions grew worse while deer numbers increased steadily through the 1930's and 1940's.

In the years of 1949 through 1951 we reduced the deer population in many accessible areas through liberal hunting regulations. The reduction was by no means statewide, however.

Where reduction was accomplished, we have seen the range temporarily improved, and we have seen the herd grow again. Where reduction was needed but did not occur, we still have too many deer for the current browse supply. We are now faced with the chance that the problems of extensive overpopulation will repeat themselves.

Not too long ago we were virtual beginners in deer management. The public and game men alike were limited by lack of demonstrated facts on deer, their requirements, and the best means of managing them.

But for years Wisconsin game personnel have been accumulating knowledge of deer. They have conducted intensive research, they have scanned the lessons of history and experience, they have drawn on the extensive contributions of other states. Today, although we still don't know all the answers, good deer management can be a reality.

The gist of the information that has been gathered over the years is assembled within the covers of this book. We commend it to you for your careful consideration.

Time is running out if we are to maintain and to harvest, year after year, as many deer as our potential will permit. Let us not be bound by the ideas of the past, nor repeat the errors that were made, but let us get on with the best management we now can devise.

L. P. Voigt, *Director*
Wisconsin Conservation Department

ACKNOWLEDGMENTS

Throughout the life of the Deer Project many persons have contributed helpful assistance. We, as authors, would like to name them all, but because we have not been associated with the project during its full existence, many persons who deserve acknowledgment may have been overlooked. However, we do not wish to imply that their efforts are any less appreciated.

The project is indebted first to the Wisconsin Conservation Commission, who authorized the study, and to the U. S. Fish and Wildlife Service who sponsored the project through the Federal Aid in Wildlife Restoration Act. The late Aldo Leopold must be given special credit for his initial influence, continued interest, and professional advice.

William S. Feeney initiated the Deer Project in 1940 and was project leader from 1940 through 1947. The senior author wishes to express thanks to Mr. Feeney for much valuable field experience, training, and especially for the new avenues of thought that many hours of association brought forth.

Many personnel in the Wisconsin Conservation Department have extended assistance in various ways. We wish especially to thank former director Ernest Swift, whose keen interest in deer problems provided much of the push necessary to keep the project moving, and whose personal consultation and advice was much appreciated. We are also indebted to Cyril Kabat for his supervision and many valuable suggestions. Others in the department who have provided supervision and advice are I. O. Buss, Ralph Conway, C. L. Fitzsimmons, W. F. Grimmer, W. E. Scott, W. C. Tmax, and F. R. Zimmerman. The department deer committee, composed of IJ. T. J. Cramer (chairman), Allen Hanson, Ragnar Romnes, and William S. Feeney, was in charge of the 1944-45 and 1945-46 winter range surveys. Dr. G. B. Rossbach and B. P. Stollberg made the analyses of deer stomach contents cited in Chapter VI. Personnel of the law enforcement and forest protection divisions have assisted in the field surveys and in many other ways. Game management division personnel have conducted most of the field surveys since 1950.

Members of the big game study committees of the Wisconsin Conservation Congress have contributed considerable personal time in an effort to bring the findings of the Deer Project to the public. This has been particularly true regarding range surveys.

We have received valuable advice and pertinent suggestions from persons outside the conservation department. They include I. H. Bartlett of the Michigan Department of Conservation, Dr. W. H. Marshall of the University of Minnesota, L. W. Krefting of the U. S. Fish and Wildlife Service, and Drs. J. J. Hickey and R. A. McCabe of the University of Wisconsin.

We have had much help in preparing this report. The contributions of the following people are gratefully acknowledged: Betty J. Peterson and Emma Herrman for the many hours devoted to compiling statistics and typing manuscript; Otis S. Bersing for many data on deer feeding, deer damage, and hunting records used in this report; Donald R. Thompson and Charles W. Lemke for statistical analyses of data; Clifford E. Germain for compiling information on deer yard reports and deer feeding experiments; O. C. Grant for statistics on deer killed by automobiles; Alan W. Ebi for drawing maps and graphs; and Mrs. Janet Hochstetter and Lois Doran for typing rough and final drafts. For critical readings of the manuscript of this report we are indebted to I. H. Bartlett, Ruth L. Hine, Cyril Kabat, J. R. Smith, and N. H. Hoveland.

We wish to thank The Lindoo Studio, Ladysmith, Wisconsin, for permission to use some of their historical photographs. All other photographs in this report are by the Wisconsin Conservation Department.

To those persons deserving of mention here whom we have not named, we offer our humble apologies. Without their help and the help of all the others, the Deer Project could not have functioned as successfully as it has.

Edited by James B. Hale

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PERSPECTIVE

In principle the management of white-tailed deer in Wisconsin is relatively simple. It involves recognition of a basic problem common to many animals, including deer and domestic livestock, in many countries. Whenever an animal species eats more food than is produced on its range, there is an inevitable end – its population will decrease. If steps involving plant and animal manipulation are not taken to improve the range, the affected animal population will decrease in proportion to the deterioration of its habitat. Management, then, is the means by which these steps toward improvement are taken.

Historical evidence points up the fact that wildlife populations prior to the advent of human influence fluctuated violently. A species would increase until it reached a point in abundance where more of its food was consumed than produced. Then it would decrease until its numbers were so low that its range would start to recover. However, this was not always the case, because some types of ranges became permanently damaged and the species would either exist at very low levels or disappear entirely.

Superimposed on the simple relation of browsing or grazing animals and their food supply were predators, which at times kept a population in check so that it would not damage its range during relatively short intervals of time. Disease and intolerance were also important limiting factors.

In more recent times, human influence changed this fairly simple relation to the complicated process involving man-made changes that either sped up the process of range deterioration, changed it favorably, or accidentally or intentionally controlled conditions. At the same time predators were reduced. Thus one beneficial controlling factor was eliminated, since predators frequently weeded out the undesirable and surplus animals. Disease and intolerance still operate as population limiting factors under man-made habitat changes.

In Wisconsin today there is virtually no land that has not been recently changed by man and which will not continue to be affected by his activities. Natural deer herd controls, therefore, are gone. Today, man uses the original ranges of wild animals primarily for producing other crops. He must give additional careful attention to the management of deer and their habitat requirements on these areas if he is to have deer in good numbers.

Probably the most understandable example of how to manage a population of animals has been demonstrated to the world by cattle growers. Throughout the world cattlemen have found themselves in the predicament

It became apparent that the ranges had to be improved through objective approaches. Agricultural colleges and far-sighted laymen developed methods of improving pastures. But before the range or pasture could be improved the cattle had to be removed or reduced to permit the pasture improvement practices to succeed. Unfortunately many ranges and pastures were worn out beyond limits of practical repair, and the world suffered for it thereafter.

Although deer are browsing animals there is little difference between their management problems and the management of cattle. For cattlemen to manage their herds they had to obtain information on the condition of the range or pasture; what species of plants were eaten and their nutritional value; how much food was produced with varying numbers of grazing cattle; what plant species would replace the grasses if they were overgrazed; the number of cattle present in any one herd and how many were cows, yearlings, bulls, calves, etc.; and finally how many head of cattle the ranchers or farmers needed to carry to meet their economic conditions. With such information they were ready to manage their herds.

Comparable information is needed for deer management in Wisconsin. The desire of the conservation department to learn more about deer and deer range, coupled with the intense interest in deer matters of hunters, legislators, naturalists, farmers, and others, led to the establishment in 1940 of a Deer Research Project under the Federal Aid in Wildlife Restoration Act. The function of the project has been to obtain the information described previously for cattle which is also needed for deer herd management.

Much of the information obtained has already been used in Wisconsin. Through the liberal statewide hunting seasons of 1949, 1950 and 1951, deer damage to agricultural crops was brought under control. Range conditions in west central Wisconsin, a very important area to deer, improved spectacularly and some areas in the northern primary forest range improved.

Unfortunately, however, time is running out for the employment of general and simple herd management practices. It is apparent that the young forest that followed the logging days and which produced such favorable conditions for deer is growing up. The study of the relation of plants to the environment in which they grow (plant ecology) has shown that the plant communities in any area go through a natural development known as plant succession. Some stages of plant succession are favorable to deer, others are not. Man can change the pattern of natural plant succession and so can deer. Intensive logging changed Wisconsin's deer range greatly. Prior to the year 1800, deer were largely concentrated in the prairie-oak-maple areas of southern Wisconsin. The mature forest of the north was only secondary range. The ax and plow removed the features of the southern areas that attracted and held deer.

The ax and saw improved the northern range. Under favorable habitat conditions following logging and fire, the deer population increased phenomenally, destroying much of its own range by speeding up the development of unfavorable stages of plant succession. Further complicating the picture is the difficulty encountered in managing large areas of deer range when these areas must be used to produce materials for humans.

Although present land-use and natural plant succession will prevent a spectacular statewide increase of Wisconsin's deer herd, much can be done to maintain a herd as large as possible under today's conditions. The approach is clear: We must keep the herd in balance with its range.

This can be done in the same way cattlemen manage their herds — through systematic harvest. In parts of Europe today, deer are systematically harvested even to the degree where the actual number of does, bucks and fawns are counted and certain individual deer are designated for harvest. European range is much more limited than ours in Wisconsin, and although the same principles of herd management prevail, the intensity of applying certain practices in Europe and Wisconsin obviously would vary. Some western states are now employing these practices. A few eastern states prevented the development of herds that were too large for their ranges by setting "any-deer" types of hunting seasons annually.

Wisconsin, a "buck-hunting" state for many years, took a forward step in deer management when it initiated the liberal seasons of 1949-1951, and reduced its deer herd. Now in 1956, after four buck seasons, deer are again on the increase. The need for systematic and selective harvesting is also growing.

At present we have most of the information required to manage Wisconsin's present deer herd to maintain it at its optimum level considering the current stage of forest development. It will take special regulations and a public willing to accept them before the necessary management practices so clearly defined for us can be adopted. Mistakes have been made in the past by both the public and the professional conservationists. The mistakes can be attributed to lack of specific information. There is no further excuse for continuing to make the same mistakes.

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The Deer Project has functioned continuously for more than 14 years and has studied many aspects of deer ecology. Despite this, there has never been a formal and comprehensive publication of results. Many short papers have been published on an aspect or two of the project's work, but the complete story of the project's findings has never reached print. The objective of this report, then, is to summarize the work of the Deer Project for the calendar years 1941 through 1954.

The report is written in four parts. The first is a brief review of Wisconsin history affecting deer. We believe that a historical perspective is necessary to properly consider present-day deer problems. Part II con-

cerns the deer themselves. Food habits, movements, weights, productivity factors, a life equation and other topics are discussed. Part III presents the problems of deer range. Range studies have been perhaps the most important endeavors of the Deer Project. Part IV concerns deer management problems, including hunters, hunting regulations and habitat management.

Our writing task was complicated by several factors. Foremost among them was the great volume of data with which we worked. Fourteen years of studies piled up a tremendous amount of data that we had to pick over, sort out, and summarize. This was not easy to do; during the life of the project there have been several changes in supervisors, in project leadership, in direction of study emphasis, and in project personnel. Such changes do not simplify analyses and interpretations of data.

We are certain that this report will not satisfy everybody. To some it will be too technical, to others, not technical enough; some will want more details, and others will not wade through what details we are presenting to reach the basic principles. We could not treat each subject in the detail that proper scientific writing prescribes; we were not able to make the effort such a task requires, and we doubt that funds would be available to publish the many pages of material that would result. On the other hand, we have not presented this material in purely popular form because we believe that good popular writing must be preceded by technical writing of the same material.

The net result of this dilemma has been that we have tried to write this report to emphasize the fundamental and historical facts about the behavior and management of Wisconsin deer and deer hunters. We have tried to include enough data to substantiate our conclusions, but we have also tried not to load the text with too many unimportant statistics. We hope that the readers will agree with our viewpoint that this report has its main value as a reference for facts about why Wisconsin has had deer problems, and what has been and can be done about them. We hope further that this report will help game managers, hunters and other interested citizens to gain a better understanding of the history and future of Wisconsin's deer herd.

Burton L. Dahlberg
Ralph C. Guettinger

Part I — A REVIEW OF WISCONSIN HISTORY AFFECTING THE WHITE-TAILED DEER

Chapter I

The Original Environment

The Primeval Forests

When Jean Nicolet, a Frenchman, landed on the shores of Green Bay in the summer of 1634 he found a land of forest wilderness inhabited by a few thousand Indians and a wide variety of wildlife. Bounded on the north by Lake Superior, on the east by Lake Michigan, and on the west by the Mississippi river, this area that is now known as Wisconsin contained some of the finest forests in the United States. It has been estimated that Wisconsin's forests covered 30 million acres of the 35 million acres comprising the total area of the state, and that they scaled more than 200 billion board feet of timber (Wis. State Planning Board, 1945).

A mixed hardwood and evergreen forest covered the major portion of northern Wisconsin. Hardwoods were mainly hard maple, yellow birch, basswood, American elm, rock elm and red oak. Beech was limited to the eastern part of the state. Hemlock was the principal conifer associated with the hardwoods. Scattered areas of white pine, balsam fir and white spruce were common. Interspersed with this mixed hardwood and evergreen forest were lowland or swamp areas characterized by white cedar, black spruce, tamarack, balsam, black ash and elm.

The sandy soils in parts of central and northern Wisconsin supported white pine, Norway pine, jack pine and dwarf oak. The major timber species of the southern forest were oak, hickory, hard maple, basswood, black walnut and white ash. There were also extensive prairie openings covered with thick grasses and interspersed with hardwood islands.

The density and distribution of the original forest was dependent upon the interaction of soil, climate and topography. So too were the animal species inhabiting the area closely associated not only with soil, climate and topography, but with the vegetative cover as well. The biologist can reconstruct with a fair degree of accuracy the original distribution of game based on a knowledge of habitat requirements and an account of the original vegetation for certain areas. We know, for example, with considerable

certainty that had Jean Nicolet proceeded directly to northern Wisconsin in 1634 he would not have found any buffalo, wild turkey, prairie chicken, or quail. The known habitat requirements for these species and our knowledge of the vegetation and climate found there indicates they could not have existed in that region.

The original distribution and density of the white-tailed deer (*Odocoileus virginianus*) in Wisconsin was likewise related directly to its original habitat. The extensive virgin forest that covered the major portion of the state was composed for the most part of big timber. The forest floor under these tall trees was relatively bare of vegetation because the heavy canopy of leaves prevented much sunlight from reaching the ground. Thus northern habitat was considerably smaller than it is today, being limited to the edges of swamps, marshes and scattered areas where natural catastrophies such as wind or fire had opened up the forest.

Original deer numbers cannot be estimated except in relative degrees of density based on present-day knowledge of maximum and minimum density for similar habitat. We can only speculate on the probable density of deer for the various areas of the state.

Figure 1 shows probable deer densities prior to 1800 based on known maximum and minimum present-day populations for similar habitat. Leopold (1931, p. 194) mentioned a deer drive conducted in Medina County, Ohio in December of 1808 in which 300 deer were taken on 25 square miles or 12 deer per square mile. He commented that "probably by no means all the deer on the area were bagged, so that a population considerably higher than 12 per square mile is indicated". He also cites a record that ". . . in 1820 Noah Major, one of the first settlers in Morgan County, Indiana, estimated that there were 20,000 deer in the county. This reduces to 53 deer per square mile on the basis of the present area – an astonishing density". Leopold concluded by suggesting that ". . . the central part of the region (north central states) was the qualitative center of the original deer range". This area would include southern Wisconsin.

The general dividing line between the northern deer range in the hardwood-evergreen forest and the southern deer range in the oak-maple forest interspersed with prairie openings is based on the distribution of native vegetation determined by the Wisconsin Geological and Natural History Survey (Wis. State Planning Board, 1945). The probable deer density of 20 to 50 deer per square mile for the southern portion of Wisconsin is not unreasonable. It must be remembered that deer were not the only big game species inhabiting this range prior to 1800, for elk and buffalo were also present. In the light of present day high deer densities (Martin and Krefting [1953] reported that on the Necedah National Wildlife Refuge there was a deer kill of 53 animals per square mile in 1946), the maximum estimate of 50 deer per square mile for the southern area does not seem extravagant.

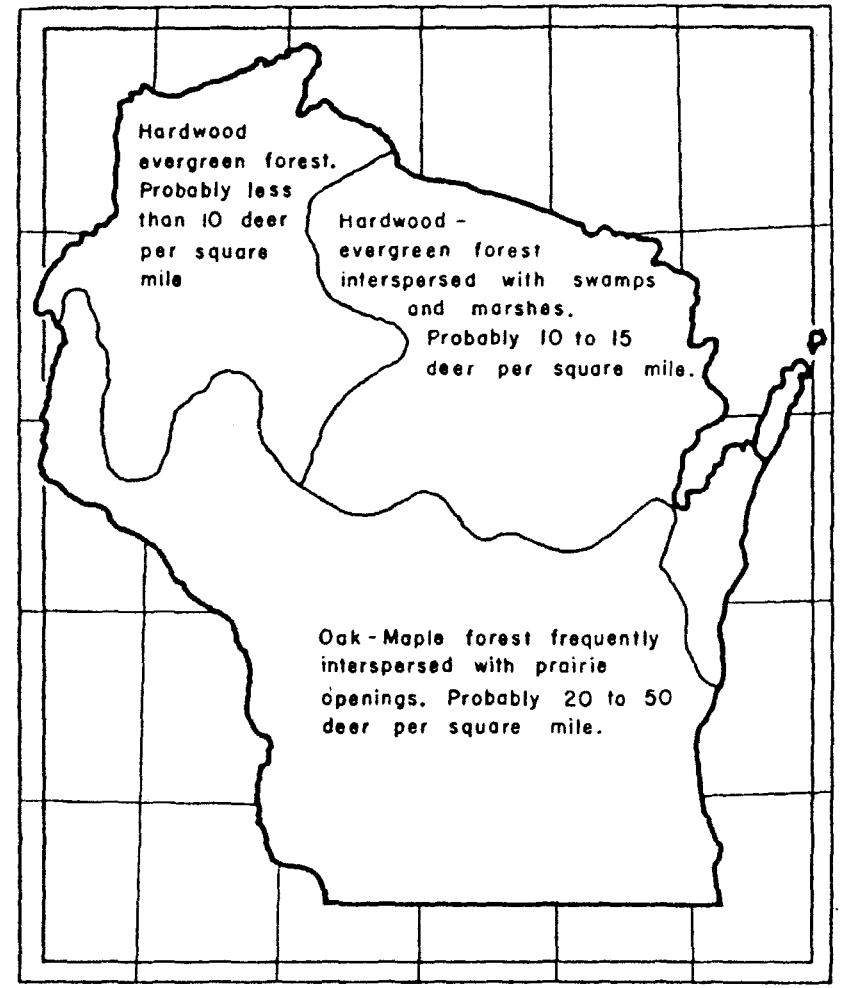


Figure 1. Probable deer densities prior to 1800.

The eastern portion of the northern area contained more favorable habitat for deer than the western portion of the north. A considerably higher acreage of swamp type interspersed with ridges of timber provided a greater area of "edge" that was suitable habitat for deer. However, this northeastern area was far less desirable range than the southern area. A probable density of 10 to 15 deer per square mile is indicated.

The northwestern portion of the state probably had the fewest deer per square mile. A minimum of "edge" in the original habitat [illegible]

to conclude that here the density of deer was probably less than 10 per square mile.

These estimates can be challenged on the basis of local exceptions, but for the general areas indicated they offer a probable picture of the status of deer in the original habitat.

Early historical records indicate that deer were not abundant in the north prior to the advent of logging, fire and settlement. I. A. Lapham (1846) mentioned that "the Indians in the North where game is scarce and agriculture has not been introduced, live almost exclusively upon fish". Shiras (1921) reported that in 1870 only a few deer were found along the south shore of Lake Superior.

The southern portion of the state with its prairie openings and hardwood islands provided deer with adequate habitat. The edge of the prairie openings provided a suitable environment for low-growing woody vegetation. The hardwood islands provided both cover and food. Oak ridges produced mast for fall fattening and winter food. Sizeable deer populations existed.

In contrast to the reports of deer scarcity in the north, Theodore Rodolf (1900, p. 347) wrote as follows about the status of game in 1834 in the southern part of the state: "The country was full of game; prairie chicken, partridges, quail, ducks, geese and deer were abundant. One evening while hunting somewhere below where the village of Darlington, Lafayette County is now situated, I counted more than 50 deer in a herd, but could not get within shooting distance".

Although the northern forest of majestic pines, hardwoods and hemlocks supported a limited deer population prior to 1800, other wildlife found adequate habitat in the virgin forest. The woodland caribou, though never common, was found here, as were moose, marten, fisher and wolverine. These species have long since vanished with the wilderness that supported them.

The Indians and the Fur Traders

Indians, a people of the wilderness, were the only human inhabitants of Wisconsin prior to the coming of the white man. Various tribes were located throughout the state, but the total population apparently never numbered more than 10,000 (Swift, 1946). Before the disturbing influence of the white man it is doubtful if the Indian had more than a very local effect upon wildlife and probably no significant effect upon the native vegetation, except in the south and west where Indian fires helped to maintain prairie openings.

The Indians had a remarkable knowledge of the land on which they lived and of the living things that grew there. They were entirely dependent upon the products of the forest for their livelihood. Fruiting shrubs and trees, mushrooms, herbs and wild game provided them with food, clothing and shelter.

The early explorers found northern Wisconsin to be mostly a land of big trees with few openings and little understory, like this area on the Menominee Indian Reservation in 1940.

Although the Indian had lived as part of the wilderness for many centuries, it did not take long after their association with the fur traders to change this relationship. The Indian was by nature a trader and his great resource of fur was a prize that made many trading companies wealthy and powerful. Armed with the capable tools of the white man

and imbued with his lust for exploitation, the Indian eagerly aided in the destruction of his empire.

The never-ending search for new trade routes and the quest for fur brought the first white man to Wisconsin. For nearly two hundred years after Nicolet in 1634, French and British explorers and fur traders maintained trading posts and trade routes, often in the face of wars with the Indians. The area was under French jurisdiction until 1763 when the British defeated the French at Quebec and began a 20-year rule over the Northwest Territory that ended in 1783.

By 1815, American fur companies had established themselves in Wisconsin. U. S. troops, whose mission it was to protect trade routes, were garrisoned at Green Bay and Prairie du Chien. The insurance against Indian attacks provided by the army encouraged rapid development and expansion of the fur trade and subsequent settlement.

In 1836 Wisconsin was established as a territory and in 1848 the territory became a state. By this time the fur trade was beginning a noticeable decline and considerable pioneer settlement had taken place.

The fur resource provided the incentive for the first exploration and settlement in Wisconsin, but it was an era that left its mark on the wildlife of the area. The white trader, in partnership with the Indian, took a serious toll of all commercially marketable wildlife, especially the furbearers. An ever-increasing demand for deer to provide food and clothing, a shrinkage of the original high-density environment in southern Wisconsin due to settlement and no significant environmental changes favorable to deer in the virgin forest area, must have resulted in a gradual decline in deer populations, especially during the latter part of the period from 1634 to 1836.

During this era rapidly growing cities in the south and southeastern part of the state began to require more and more wood products for development. This expanding market for timber, coupled with improvements in railroad transportation, set the stage for exploitation of the great and seemingly inexhaustible Wisconsin forests.

Chapter II

The Logging and Settlement Era

Forest Exploitation

As the fur trade began to fall off at about the turn of the 19th century, settlers turned to agriculture, hewing farms out of the forest that furnished lumber and fuel for their homes and farms. At the same time, shipyards in the lower Great Lakes ports began using timber from Wisconsin forests for the construction of ships to ply the Great Lakes. River steamers negotiating the mighty Mississippi took aboard quantities of select oak from southwestern Wisconsin to supply fuel for their boilers. Growing communities required ever-increasing amounts of building materials and fuel.

The supply seemed limitless, but soon the easily available forests adjacent to the rivers began to diminish and railroads were pushed into the hinterlands to bring out timber. Wood-burning locomotives found ample supplies of fuel for their boilers, ties to support rails and timbers to bridge rivers. In 1821 the first saw mill on the Wisconsin river was built below where the city of Wisconsin Rapids now stands (Wis. State Planning Board, 1945). By 1836, saw mills were humming as far north as Chippewa Falls on the Chippewa river. Rivers provided cheap transportation for uncut logs as well as sawed timber. Both were floated down stream from the north to points of settlement.

The fine stands of oak in southern Wisconsin were the first to go. Then the mighty white pine became the prize of the lumberman. After the Civil War, the demand for forest products throughout the country increased many fold and the real assault began. By 1870, Wisconsin saw mills were turning out a billion board feet annually. Improvements in saw mills speeded up production to such an extent that by 1889, 3½ billion board feet of lumber were produced and Wisconsin became a world leader in lumber production (Wis. State Planning Board, 1945).

By the late 1890's the pioneering era was over, for almost every township in Wisconsin had been logged for some species of timber. But the exploitation was not yet complete. The northern hardwoods, hemlock, spruce, balsam and cedar remained to be cut. The peak year for lumber production in Wisconsin was 1899. A gradual decline followed (Table 1). By 1920 most of the virgin stands of hardwoods and hemlock had been felled and between 1920 and 1939 the remaining isolated blocks echoed the sounds of axe and saw.

This era of forest exploitation had a profound effect upon many aspects of Wisconsin's wildlife. The tremendous changes wrought by the total destruction of the virgin forest completely changed the original environ-

A lumber camp crew near Fifield in Price county, 1891. This crew was cutting pine that scaled 4 logs to a thousand board feet.

TABLE 1
Wisconsin Lumber Production

Year	Thousands of Board Feet of		
	Softwood	*Hardwood*	*Total*
1899	2,842,912	519,031	3,389,166
1904	2,285,658	337,499	2,623,157
1909	1,999,398	625,640	2,625,038
1914	864,360	526,641	1,391,001
1919	594,125	522,213	1,116,338
1924	453,183	563,323	1,016,506
1929	354,098	488,716	842,814
1934	185,872	233,290	419,162
1939	141,843	194,954	336,797

Data from Wisconsin State Planning Board (1945). Includes only lumber production of mills cutting more than 50,000 board feet annually.

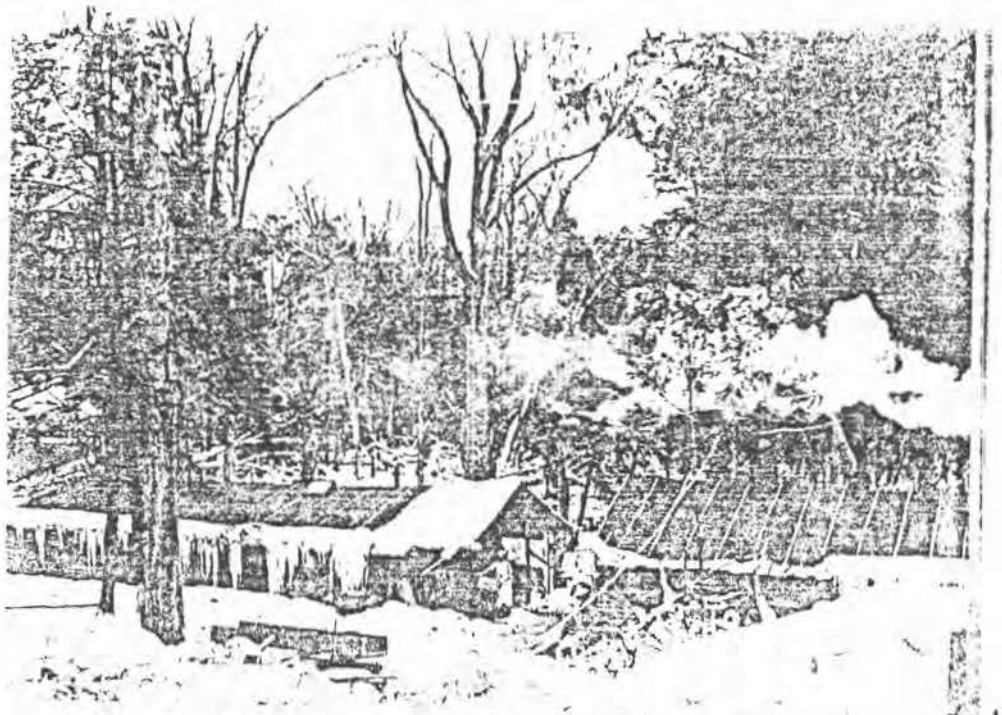
ment. The second most important factor following the felling of this vast forest was the uncontrolled fires that followed the loggers. Slash piled deep on the forest floor provided fuel for the fires that swept through the slashings. Another phase of Wisconsin's "development" was in full swing long before the last pine crashed to earth.

Forest Fires

Fires began to menace the wilderness long before Wisconsin became a state in 1848. However, it was not until forest exploitation had gutted many square miles of virgin wilderness that we saw the tragic holocausts that began with the Peshtigo fire in 1871 and continued well into the 1900's.

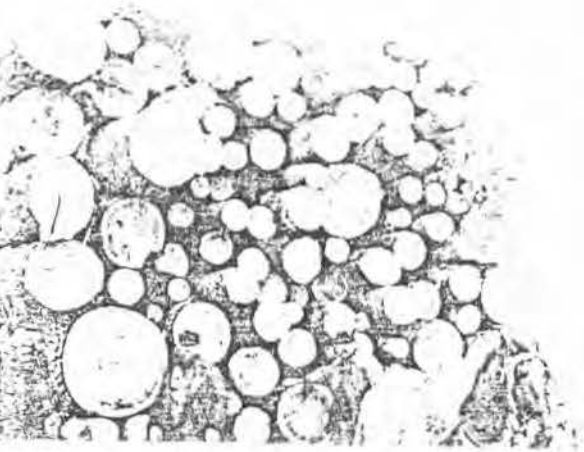
It is not difficult to perceive the permanent and far-reaching effect this "burning of an empire" had on forests and wildlife. The uncontrolled fires that swept over Wisconsin from 1870 to 1936 caused much deep-seated damage. We not only lost many million board feet of merchantable timber, but the yield of subsequent forests was greatly reduced (Parkins and Whitaker, 1939). The watershed protection given by the forests was lost, and as a consequence we suffer increased surface runoff, accompanied by accelerated soil erosion and the countless local problems this implies.

A log jam on the Flambeau river near Ladysmith, 1906.
(Photo by Lindoo Studio.)



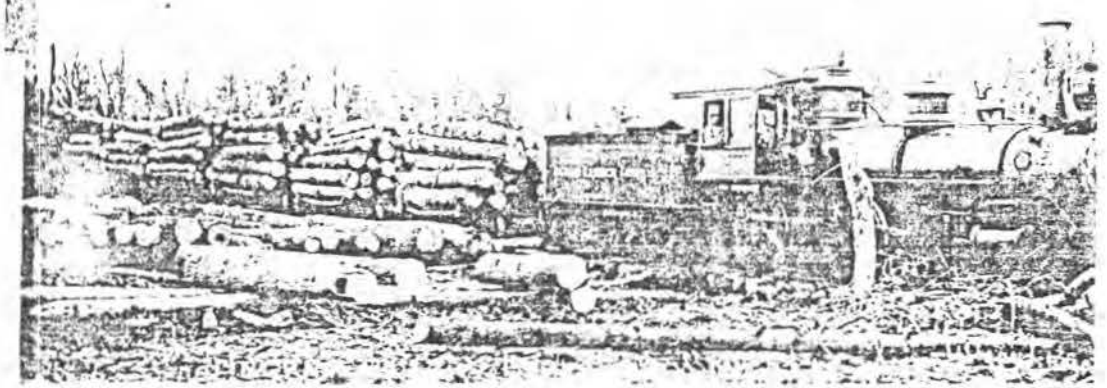
Mitchell's lumber camp on the Thornapple river in Rusk county, 1901.
(Photo by Lindoo Studio.)

A record load of logs hauled by the Ingram Lumber Company of Ingram, 1906.
(Photo by Lindoo Studio.)



The regrettable factor about forest fire damage is that most of the destruction was preventable, and that man is primarily responsible for the fact that it wasn't prevented. When the first brave conservation-minded persons suggested methods of controlling fires, they were met with an avalanche of criticism. A certain group of short-sighted people thought that the slash must be burned over to open up the country for agriculture. Men still live today who have burned off many thousands of acres of cut-over land to "improve" it for agriculture. Land sharks followed the loggers with a box of stick matches, burning the slash and selling the "cleared" land.

Public ignorance and apathy made it impossible to obtain any great degree of success in preventing forest fires until recent years. By the time the public was educated to the seriousness of the forest fire, most of the state had been burned over one or more times. The writers have never found a virgin white pine stump in Wisconsin, the only reminder of the great pine days, that hasn't been burned black by one or more fires.



Logging train of the Ingram Lumber Company of Ingram, about 1905.
(Photo by Lindoo Studio.)

Settlement

The early settlements that sprang up on the routes of the fur traders were located along rivers or streams. They were largely self-sufficient. The forest provided them with timber for shelter and much of their food; crops were produced on small clearings. Most of these pioneer settlers were only part-time farmers.

The prairie soils of southern Wisconsin were the first to be turned under by the plow. Wheat became the first important agricultural crop. In 1850 more than one-half of Wisconsin farm income was from wheat (McNall and Roth, 1945). As lumbering advanced northward, the settlers

Slash such as this left after a logging job in Iron county provides immediate but short-lived deer browse. It is also an extreme fire hazard.

TABLE 2
Number of Farms in Wisconsin

Year	*No. of Farms*	*Acreage*
1850	20,177	2,976,658
1860	69,270	7,893,587
1870	102,904	11,715,321
1880	134,322	15,353,118
1890	140,409	16,787,988
1900	169,795	19,862,727
1910	177,127	21,060,056
1920	189,295	22,148,223
1930	181,767	21,874,155
1940	186,735	22,876,494
1950	168,561	23,221,095

Data from Ebling *et al.* (1948).

emigrated in the same direction. Many settlers worked the lumber camps during the winter months and farmed during the summer.

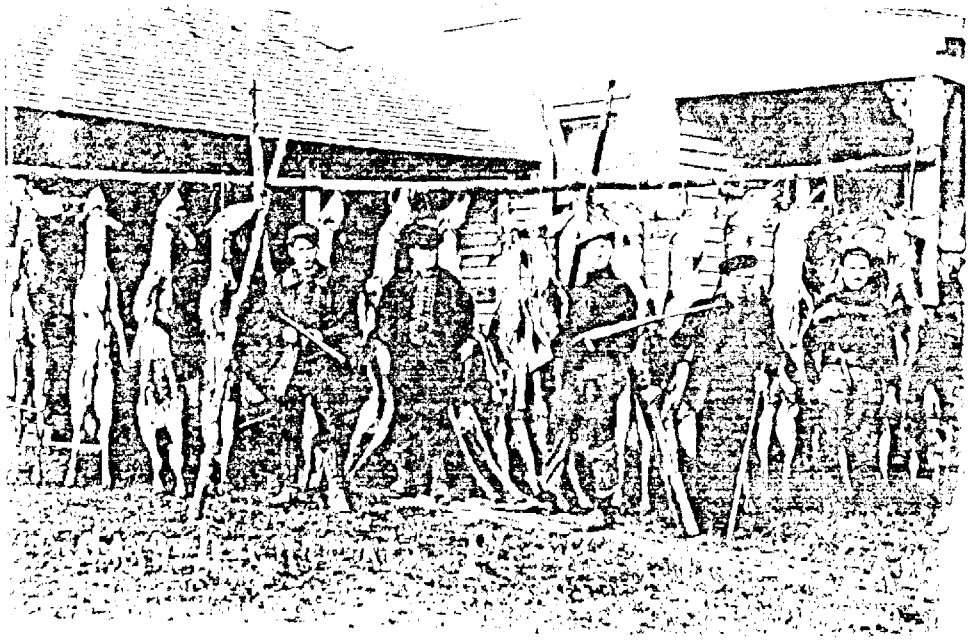
At the close of the Civil War, settlers rushed to Wisconsin to homestead a parcel of land. This expansion of agriculture (Table 2) changed wildlife habitat even more than logging and fire. The early settler lived to a great extent off the land; deer, waterfowl and game birds provided him with food. Many persons living today who settled on the cutover will tell you that their families were raised on venison. The settler turned to the woods for what economic values he could find. The value of wild game, animals, birds and fish was of prime importance to the economy of this era of settlement. Organized market hunters employing every method thinkable for taking game waged a serious war on Wisconsin wildlife. Wild game supplied by market hunters was shipped to cities like Chicago, Milwaukee, Cleveland, and Cincinnati. Tons of venison, hundreds of thousands of passenger pigeons, ducks, geese, quail and grouse reached the city market via the market hunter.

As game was depleted by this terrible onslaught, the settler turned more and more to the crops he raised for his food and income.

As early as 1851 it became evident that game laws were necessary to prevent complete destruction of game species. It was about this time that hunting for sport began to be a popular pastime.

After the first world war the last big settlement rush opened up the remaining wild country. There was hardly a township in Wisconsin without one or more farms.

An early settler in the cutover north: Whitford's farm on the Flambeau river near Ladysmith about 1904. (Photo by Lindoo Studio.)



"A four days hunt at Turkey Roost Camp, eleven miles from Ladysmith, Nov. 15, '09." Deer began to increase in the north after 1900. (Photo by Lindoo Studio.)

Vanishing Game

The environmental changes brought about by logging, fires and settlement coupled with the harsh war waged by the market hunters considerably altered Wisconsin's wildlife picture. Animals requiring a "wild" habitat disappeared with its destruction (Table 3).

As some game species retreated or disappeared in the advance of farm development and lumbering, other species showed gains. The prairie grouse moved north into new openings created by logging and settlement. Sharp-tailed grouse populations became fabulous on the cutover.

Sometime between 1850 and 1900 an expanding deer habitat resulted in an early population peak (Schorger, 1953). A combination of market hunting and uncontrolled forest fires resulted in a population decline after 1900 that probably reached a low around 1910. By 1915 the beginnings of law enforcement, predator control, forest fire protection, limited hunting seasons and bag limits resulted in the slow regrowth of the deer population. By 1930, the population regrowth began to affect agriculture and the first signs of over-browsed range began to appear.

Figures 2 through 6 show population changes and the expanding range of deer in Wisconsin. The graphs in Figure 2 depict the general trend only; localized population increases and decreases may not conform

to the trends shown here. Figure 2 is based on historical accounts of deer density and dispersion, market hunting records, and the history of environmental factors (forest exploitation, forest fires, and settlement).

TABLE 3
Wisconsin Wildlife Chronology

Species	*Reported Original Status*	*Status in 1954*
Cougar	Not common, but found throughout state	None. Last reported killed in Douglas county, 1908.
Lynx	Common throughout state	Few if any remain. Last reported killed near Spring Green, 1915, and Iron county, 1954.
Marten	Fairly common throughout state	None. Last reported killed in Douglas county, 1925.
Fisher	Fairly common throughout state	None. Last reported killed in Barnett county, 1932.
Wolverine	Not common, but found throughout state	None. Last reported killed in Iron county, 1932.
Elk	Fairly common throughout state	None. Last reported killed in Buffalo county, 1868.
Moose	Not common, but found in northern forests	None. Last record not determined.
Woodland Caribou	Not common, but found in northern forests	None. Last reported killed in Ashland county, 1840.
Buffalo	Common in southwest	None. Last reported killed in Trempealeau county, 1832.
Sandhill Crane	Fairly common	A few still nest in state. A fairly common migrant.
Spruce Grouse	Common in northern forests	Rare. A few still remain in the north and may be increasing.
Wild Turkey	Common in southern part of state	None. Last killed in Grant county, 1872.
Passenger Pigeon	Abundant	None. Last killed at Babcock, Wood county, 1899.

Compiled from Leopold (1940), Scott (1939) and unpublished records of the Wisconsin Conservation Department.

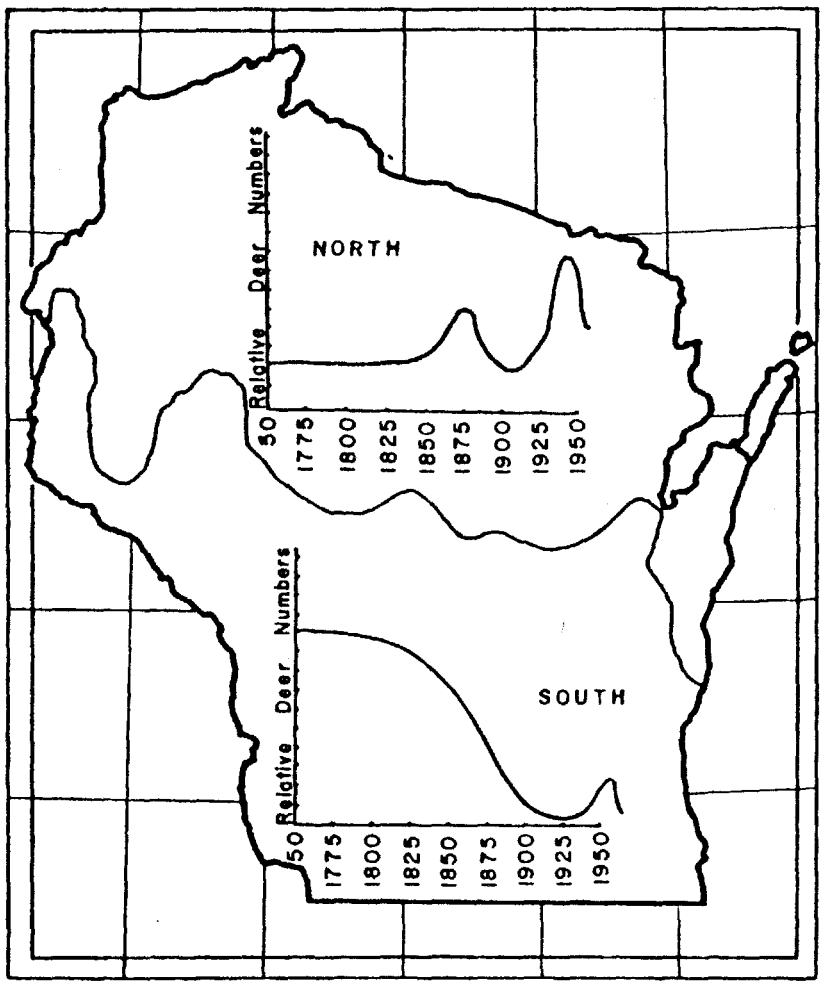


Figure 2. Deer population changes, 1750 to 1950.

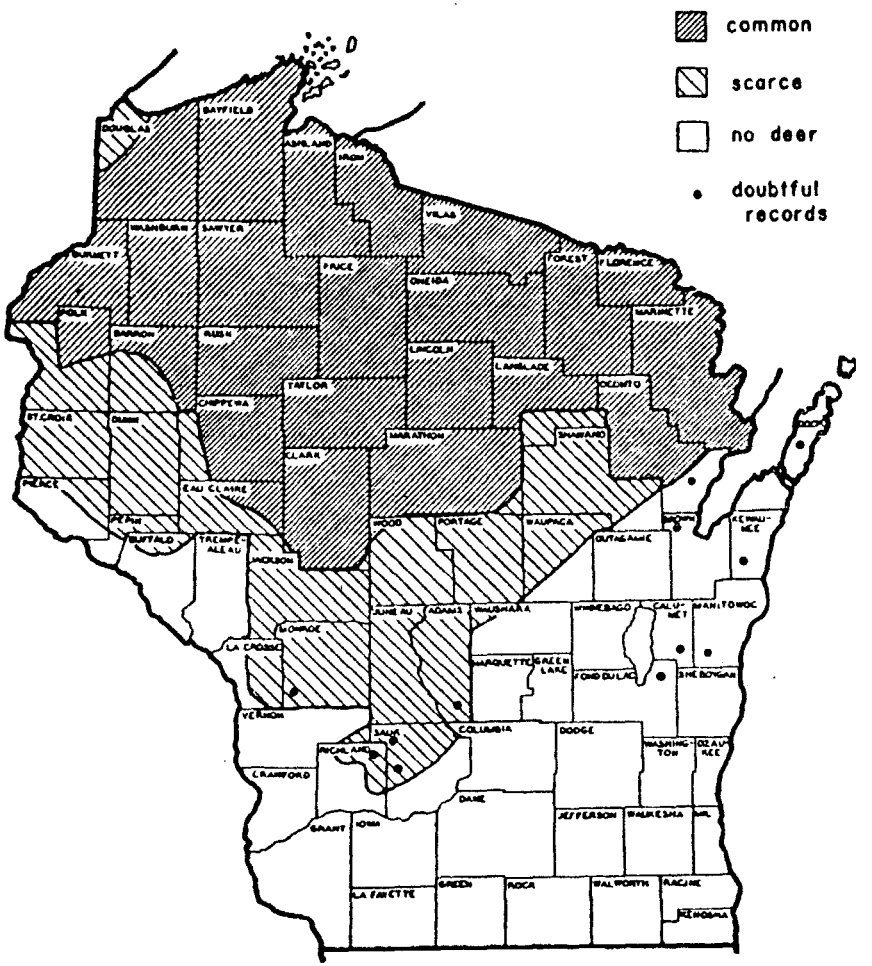


Figure 3. Wisconsin deer range about 1912 (after Cory, 1912).

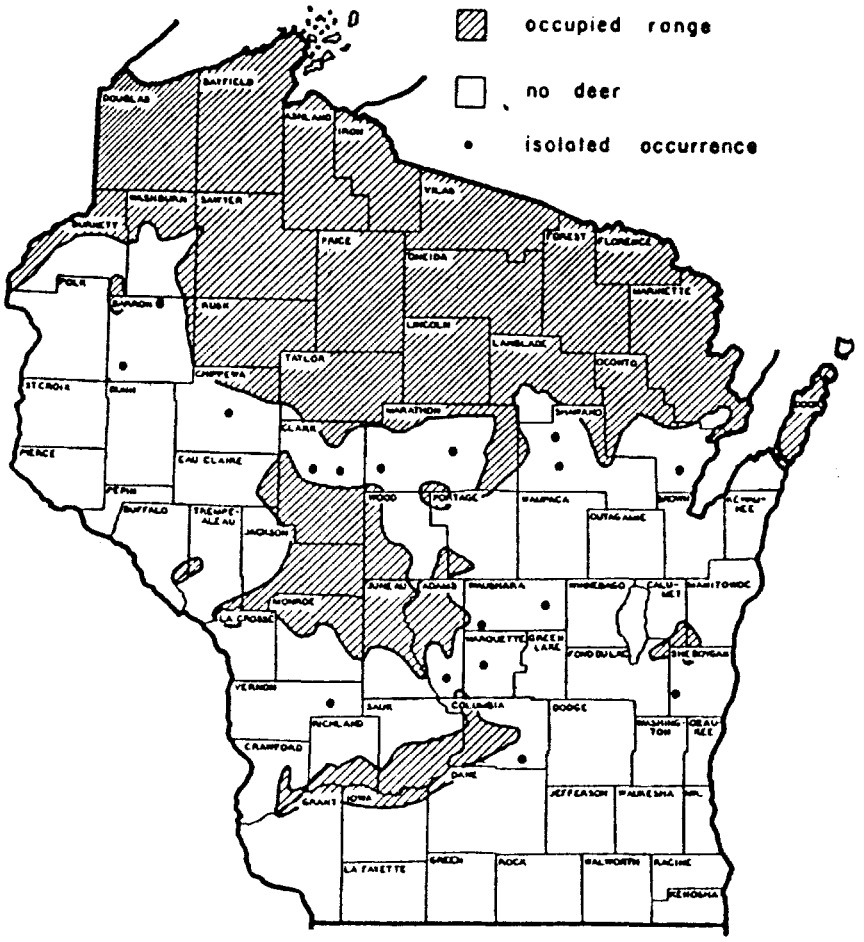


Figure 4. Wisconsin deer range about 1929 (after Leopold, 1931).

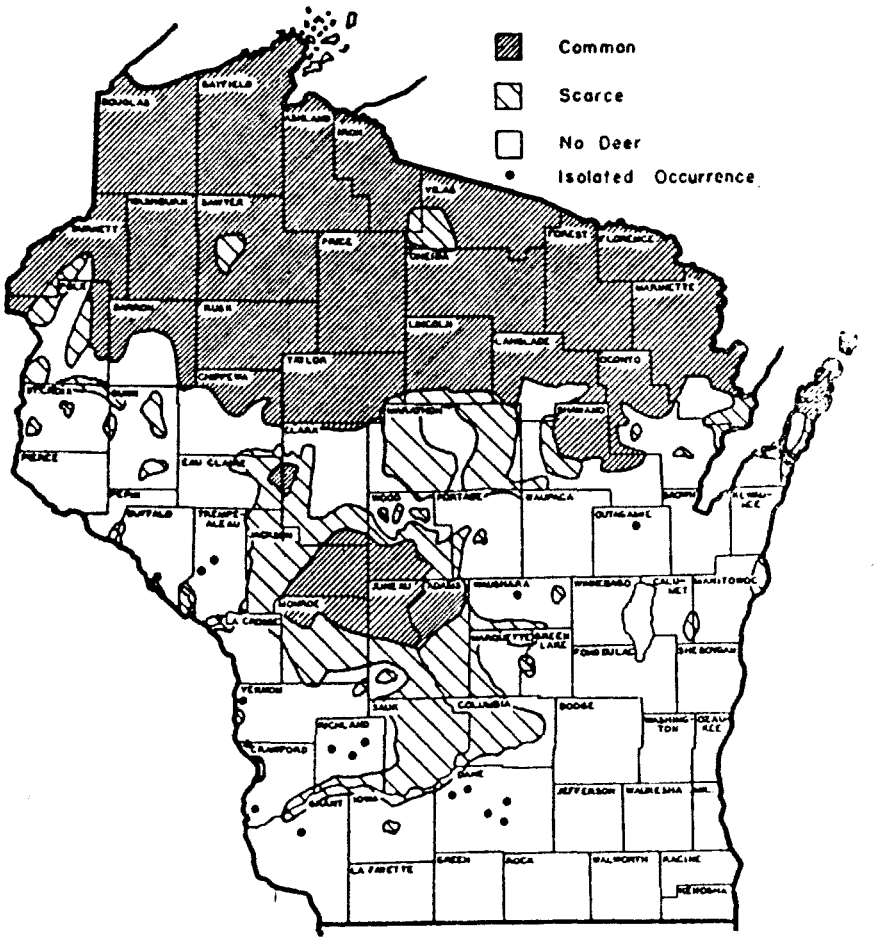


Figure 5. Wisconsin deer range about 1938 (after Scott, 1938).

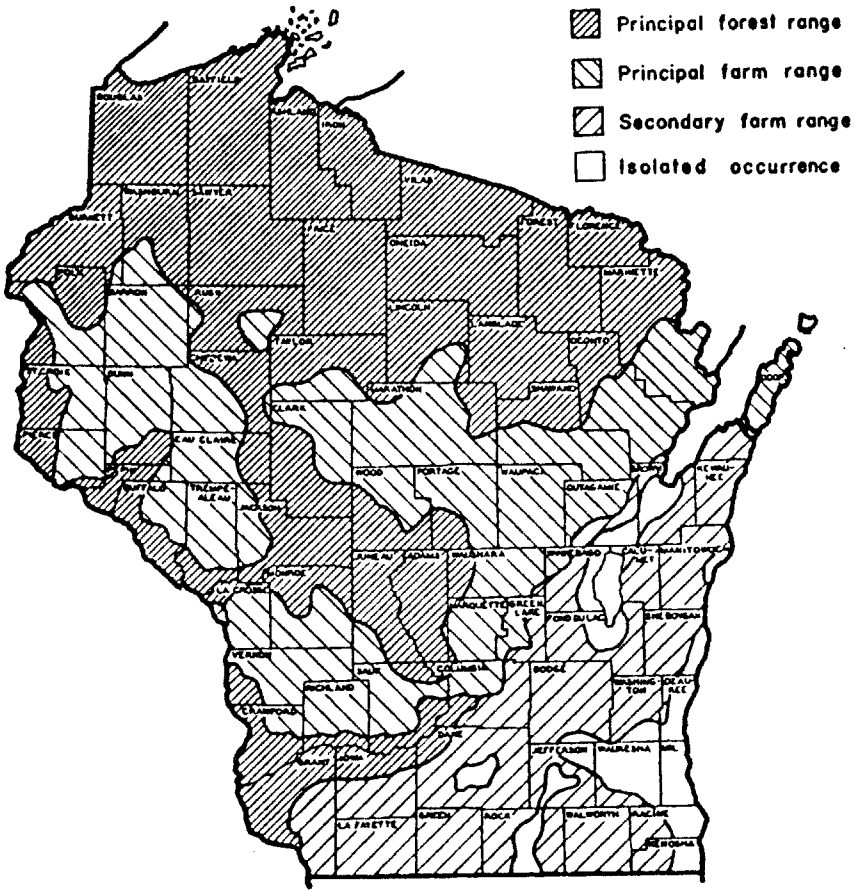


Figure 6. Wisconsin deer range in 1954.

Chapter III

The Development of Conservation

About the middle of the 1800's the idea of conserving wildlife began to grow and provoked legislative action. In 1851 a law was passed prohibiting the taking of deer from February through June. This marked the first legislative action that was concerned with deer.

In these years our conservation philosophy began to grow. From the first uneasy awareness of the social and economic bankruptcy we were headed for if we didn't save our natural resources came the better-defined, though not always lived-by, philosophy of today. The growth of the conservation idea was not simple and straightforward. It grew with painful slowness, often becoming side-tracked in the confusion of public ignorance or stopped altogether by prospects of material gain. In this chapter we briefly review some of the events that transpired during this period of transition and their relationship to the white-tailed deer. A more detailed chronology of these events is given in Appendix A.

Law Enforcement

In 1887 the legislature created the first conservation law enforcement by providing for four game wardens. This action came thirty-six years after the first law regulating the taking of game was passed. Four years later, in 1891, the office of the State Fish and Game Warden was created. He was given authority to appoint one or more deputies in each county.

Modern fish and game laws are based on the doctrines that the ownership of wildlife rests in the state and that the state shall assume the responsibility of regulating seasons, methods of capture, and bag limits for each species. For more than a century in Wisconsin prior to the creation of the office of game warden, the premise that man had the right to take fish and game without restriction was followed. Imagine the gigantic and seemingly impossible task confronting the early game warden faced with a century-old habit and man's philosophy that wild things were his for the taking.

Early conservation laws were not based on the biological needs of wildlife but were primarily social or political in nature. Rather than promulgating the *development* of a wildlife resource, they merely regulated the taking of remaining populations. As the conservation idea grew, it became increasingly apparent that legal force alone could not perpetuate many wildlife species. The need for public education and cooperation in the conservation program was evident from the beginnings of the conservation movement.

Gradually, through education, experience, and observation, a consciousness of the conservation idea developed in the public mind. However, market hunting began to diminish only after the supply of game had dwindled to the point where marketing it was no longer a profitable venture. The Lacey Act, a federal law enacted in 1900, prohibited the interstate shipment of game birds and animals and was the final blow to the market hunter.

Hunting for sport, which began about 1850, became increasingly popular. By the turn of the century many persons were making vacation trips into northern Wisconsin to fish and hunt. This new concept of hunting for sport was a much needed "shot in the arm" for the conservation idea. Game laws became an accepted part of hunting and fishing, although several decades passed before enforcement of these laws became a factor in game populations.

The realization of the need to regulate the taking of game and the establishment of seasons, bag limits and restricted methods of harvesting, coupled with the change from hunting for food or profit to hunting for sport, resulted in profound changes in our public philosophy toward wild-

Fires in the cutover left by the loggers were common in northern and central Wisconsin.

Lookout towers are now scattered across Wisconsin forests, symbols of the battle to keep fire out of the woods.

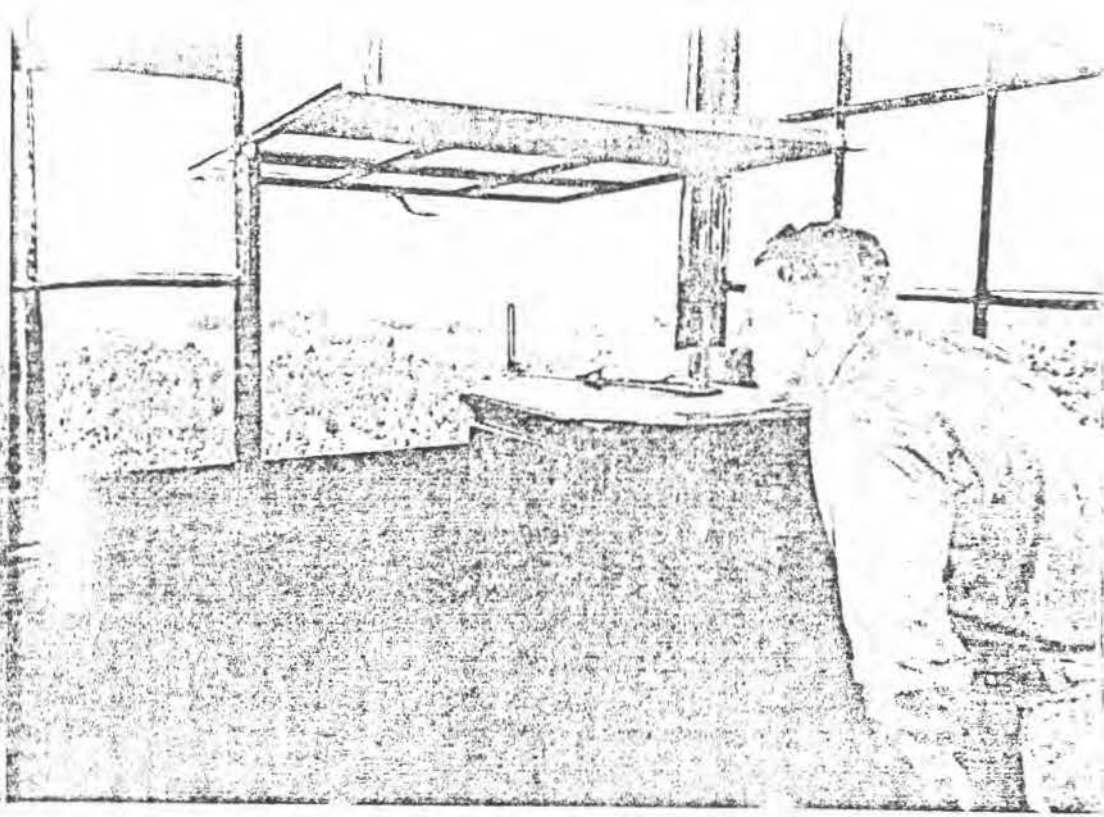
life. The enforcement of the new laws necessitated the beginnings of conservation education to attain public cooperation and support for the conservation idea. Thus the game warden had to be more than an officer of the law; he had to be a teacher of conservation.

Forest Protection

In 1867 a committee to investigate forestry conditions was created by the legislature under Chapter 36, Laws of 1867. I. A. Lapham, chairman of this committee, published a report that same year. Although little was accomplished by the report, it did mark the first official interest in Wisconsin forestry problems.

Timber agents appointed in 1869 were primarily interested in preventing timber thefts on state lands. The 50,000-acre tract in Lincoln county set aside by legislative act as a timber reserve in 1878 and known as "The State Park" was later sold by the legislature to lumber companies. In 1899 all deputy fish and game wardens were declared fire wardens as an additional duty. This action marks the first official effort in forest protection. By 1905 a state forester had been employed, but lack of public support resulted in no real advancement in protection, management or reforestation.

At one time or another forest fires, like this blaze in jack pine, ravaged most of northern and central Wisconsin.



A towerman lines up a fire location.

The "cutover" provided fuel for countless uncontrolled conflagrations between 1850 and 1936. Millions of charred acres took the place of the magnificent pine, hemlock and hardwoods. History will long remember the tragic Peshtigo fire of 1871 in which 1,100 people lost their lives, but will soon forget the countless other fires. Fires still burned brightly during the early twenties, but toward the end of the decade public support began to manifest itself in the form of a favorable vote on a constitutional amendment that authorized special legislation for the taxing of forests. The Forest Crop Law was subsequently enacted in 1927. Favorable legislation also provided for a county forest progam, and an enabling act increased the total allowable acreage of National Forest lands.

The idea of forest management, forest protection, forest restoration and recreational values of the forest had stewed for almost 60 years after I. A. Lapham's first report on forestry conditions before public support backed a full scale program. The 1926-28 Biennial Report of the conservation commission indicates that $40,352.45 were expended for fire protection. (That same biennial report showed a total disbursement of $60,684.00 for bounty payments). The forest protection field force in 1928 consisted of

11 rangers, 24 seasonal men, 371 emergency fire wardens, and look-out men as needed. An 8.6 million-acre area was included in forest protection districts. The 1931-32 Biennial Report of the conservation commission indicated that 13.6 million acres were under forest protection. Systems for the detection of fires and improved methods of suppression had been evolved. The 1931-32 biennium showed a total expenditure for all forestry activities of $996,072.32.

Despite the phenomenal growth of forest protection, reforestation and forest management in the late 1920's and early 1930's, it still took time to change the ways of a people brought up on wanton destruction to recognize that "everybody loses when timber burns". Gradual control of forest fires resulted in the regrowth of thousands of acres of denuded land. Repeated fires in some areas had so severely damaged the soil that they may not produce trees in this century. Fire damage in other areas had limited the productive capacity of the soil so that only inferior tree species could survive. By and large, the despoiled countryside gradually changed from charred stumps and fireweed to brush and trees.

The growing forest provided a favorable environment for deer. A seemingly unlimited food supply, coupled with better law enforcement, a

reduction in numbers of wolves and other predators, an extensive refuge system, and hunting of bucks only in even-numbered years provided the stage setting for a phenomenal upsurge in the deer population that started a whole new era of conservation problems.

The One-Buck Law and the Refuge System

The one-buck law first established in Wisconsin in 1915 was designed primarily to prevent extermination of the deer and to permit their populations to increase. Events of recent years will attest that the buck law was successful in building up deer populations. History has proved that, all other things being favorable, the buck law will permit deer populations to increase.

The refuge idea began in 1891 and grew by leaps and bounds during the late 1920's and early 1930's. By 1932 there were 59 small-game wildlife refuges comprising 62,291 acres. Twelve big-game wildlife refuges comprising 235,137 acres and 11,562 acres in 14 state parks combined to make a total of 298,990 acres of wildlife refuge. These acreages were gradually increased to almost 500,000 by the late 1930's. Unfortunately for the deer the majority of the big game refuges became death traps. Increasing deer populations soon depleted natural food supplies. It is interesting to note that one such area, the Brule Refuge in Douglas county, was the first site of state-sponsored artificial deer feeding in Wisconsin. Despite artificial feed this refuge experienced years of outright deer starvation, yet the "refuge" status of this area continued until 1950.

Both the one-buck law and the refuge system were favorable factors in the deer population increases that followed their inception. Nevertheless, by the time the deer population peak of the late 1940's was reached, refuges had long since outlived their usefulness as continuing management measures.

Summer Resort Industry

Despite the destruction by logging and fire, the "cutover" country provided a place where those with a love of the outdoors could get away from it all. Old logging camps and stopping places furnished lodging for sportsmen and the logging roads made the back country accessible to the hunter and fisherman. Shortly after the turn of the century, new camps were replacing the old and increasing numbers of sportsmen were availing themselves of the opportunity to hunt and fish. The crude logging camps and hunting shacks soon gave way to more luxurious quarters. Women and children began accompanying the men folks on these outings. Thus the summer resort industry was born.

Comfortable camps blossomed out all over the north wherever a blue lake or a winding water course provided the esthetic fundamentals. It

Lakeside resorts have grown into a major Wisconsin industry.

was quite natural that these new visitors to the wilderness should take the white-tailed deer to their hearts. In the early days venison was a staple food provided by the resort; later it became evident that some of the city folks considered the sight of a deer as part of their vacation and many resort proprietors recognized the value of live deer. Resort people began using deer as a lure in their advertising and the esthetic value of deer became an economic factor. It was natural that a unified front to "Save the Deer" should become a part of this mushrooming industry.

The Beginning of the Deer Controversy

As the conservation idea struggled forward through the various phases of public thinking, we find certain groups promoting their own particular philosophy for their own, sometimes selfish, reasons.

The white-tailed deer, more than any other wildlife species in Wisconsin, has been caught in a web-like conspiracy of divergent interests. The sportsman, the vacation naturalist, the resort owner, the poacher, the forester, the farmer and the politician have all had their say. The prevalent idea seemed to be that deer populations are a biological entity unfettered by the requirements of other earthly creatures. Few people realized what Wallace Grange (1949, p. 140) cited as a law of biological surplus that

treats the matter of game populations: "Since game abundance on any one tract of land in the natural course of events (without intentional or accidental management) is temporary, and since the abundance cannot be maintained, the surplus during abundance periods should be harvested by man if possible. In other words (and this needs to be repeated again and again) it is *impossible to stockpile game*".

Few people recognized the biological requirements of the species concerned. Few people recognized the ever-changing status of the environment. The tragedy of the mule deer in the Kaibab National Forest in Arizona was widely publicized and much criticized by a skeptical public nurtured on a conservation policy that taught too much conserving and too little wise resource use (Mann and Locke, 1931). By the middle '30's a few brave people began to suggest that something was wrong at home. Winter deer range in localized areas was being utilized beyond the capacity to sustain deer. Damage to agricultural crops became serious enough to prompt legislative action to provide for payment of damages and the construction of deer-proof fences. Artificial feeding of deer was begun in an effort to prevent outright starvation.

Agricultural crop damage continued to increase and larger allotments for damage payments were necessary. Deer that had died during the winter were found in ever-increasing numbers despite a greater effort to feed them artificially. How and why these deer had died provided substance for many an argument throughout the length and breadth of the state.

The cautious suggestion that deer populations must be reduced to prevent destruction of their range brought down a storm of criticism that prompted "public-spirited" groups to organize "Save the Deer" clubs in the spirit of conservation. It is of interest to note that the majority of the "Save the Deer" clubs originated in resort areas where vacationers fished, drowsed in the sun, took walks in the second-growth woods and especially valued a fleeting look at a wary whitetail. *"How could there be too many deer?"*

In 1937 the United States Congress, recognizing the value of wildlife resources, passed the Federal Aid in Wildlife Restoration Act (50 Statutes 817). This law, more commonly known as the Pitman-Robertson Act, authorized the expenditure of the annual revenues from the excise tax on sporting arms and ammunition, contributed largely by the hunter, for the purchase and development of lands, restoration of natural environment and for surveys and investigations dealing with wildlife problems. The act provided that the tax revenues could be used by the states to defray 75 per cent of the cost of these activities if the state provided 25 per cent. Other requirements for state participation were aimed at preventing misuse of these monies.

In 1940 a Federal Aid Project (W-4-R) known as the "Deer Management Research Project" was authorized to study Wisconsin's deer problems.

The perspective written for the original project document is as follows: "Wisconsin, having one of the major white-tailed deer ranges in the United States, is in need of much additional accurate information regarding these deer herds in order to properly manage and control them at present and in the future. Practical problems of a local nature such as winter yard conditions, individual herd ranges, local sex ratios, hunting pressure, and comparative populations must be solved by a local study, as research in other states cannot answer these questions. In general, the study will be one of ascertaining the status of local herds in relation to the total state herds. The findings, either positive or negative, will be used to secure the best possible management of these herds."

Through participation in the Federal Aid in Wildlife Restoration Act, Wisconsin embarked on a new era of wildlife conservation ideas where scientific investigation formulates the basis for management recommendations. The remainder of this report deals with the facts disclosed by field investigations of the Deer Project, with an interpretation of these facts, and with management recommendations that field studies have produced.

Part II — THE DEER HERD AND ASSOCIATED SUBJECTS

Chapter IV

Notes on Life History

Many things need to be known before deer management can become a reality. The historical perspective just presented is one important factor. The problems of deer food and cover are another. The relations between deer and the hunter, farmer, and outdoorsman are likewise important. Still another aspect of management concerns the deer themselves. Where do they live? What do they eat? What are their reproductive rates? How much do they move around? What causes them to die? These and other questions must be answered by the deer manager. We do not claim to have all the answers for all the questions, but the Deer Project has compiled a good many data leading to many of the answers. These results are discussed in this and the remaining chapters of Part II.

Our life-history studies were designed mainly to establish breeding and fawning dates, since information was needed on the effect on breeding of hunting seasons coinciding with the rut, and on the incidence and importance to herd size of early and late breeding. Another major effort was to determine food preferences and requirements of Wisconsin deer. Food habit studies are treated in Chapter VI. Life-history observations other than breeding and fawning season data presented in this chapter have been accumulated incidentally to other studies and are included primarily to establish dates for such seasonal changes as antler development, antler loss and pelage changes. They supplement already adequate life-history studies of white-tailed deer, such as can be found in Trippensee (1948) and Seton (1929).

The Breeding Season

The breeding season, usually termed "the rut", takes place in the fall. Conception is followed by a gestation period of about 196 days (Cheatum and Morton, 1946). Breeding in Wisconsin apparently reaches a peak sometime during the period from November 10 to November 29. Thirty-two sets of embryos aged according to the method described by Cheatum and Morton (1946) indicate that 62 per cent of breeding does are bred during this period (Table 4).

A second period of breeding following the major period by approximately one month seems to be indicated. The estrus period has been determined by Cheatum and Morton (1946) to be 28 days, with as many as three consecutive heat periods if the doe is not bred. Although our information is limited, it appears that failure to conceive during the first heat period (the hunting season, which usually comes at this time, could disrupt the rut) results in a second period of breeding in December, consequent later fawning, and production of fawns that are younger and hence less developed by the time they must withstand their first winter.

TABLE 4

Breeding Date of 32 Wisconsin Does

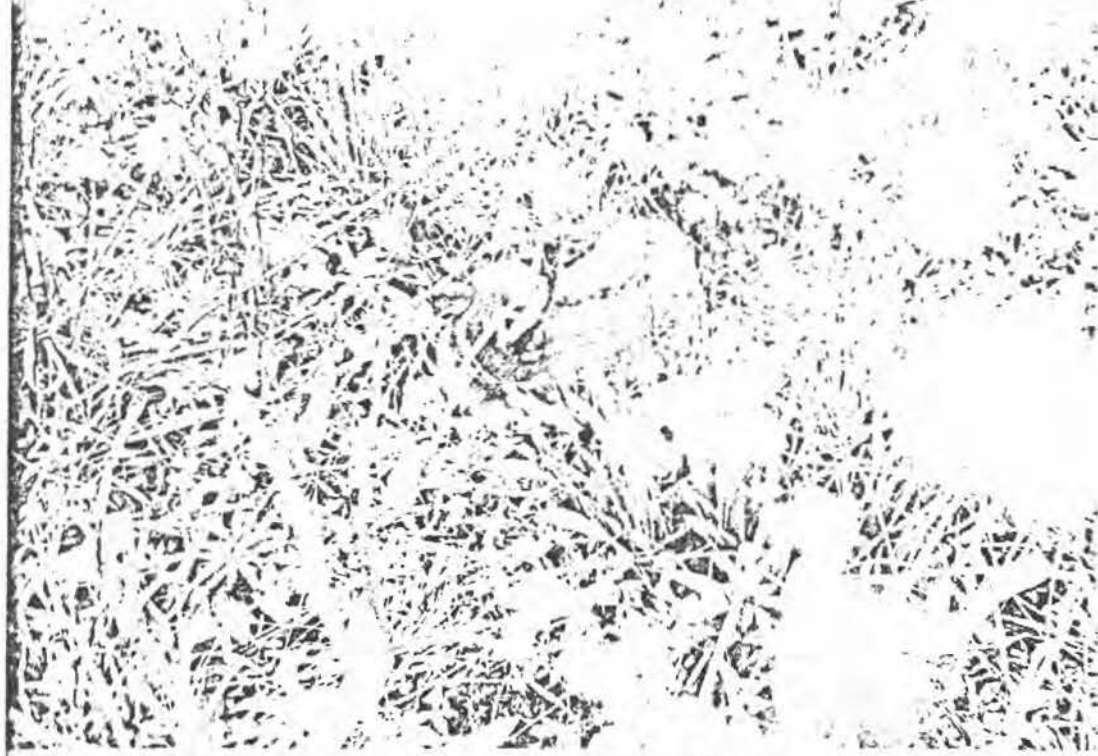
Period	*Central Area*	*Northern Area*	*Total*	*Per Cent*
Before October 1	1	--	1	3
October 1-10	--	--	--	--
October 11-20	--	--	--	--
October 21-30	1	--	1	3
October 31-Nov. 9	2	2	4	12
November 10-19	4	8	12	37
November 20-29	3	5	8	25
November 30-Dec. 9	--	1	1	3
December 10-19	1*	1	2	6
December 20-29	--	2	2	6
December 30-Jan. 8	--	1*	1	3
Totals	12	20	32	

* Yearlings

Our data indicate that the breeding season in central and southern Wisconsin may precede the season for the northern part of the state. Because our information is limited in this regard, we cannot draw any definite conclusions at this time. The speculation that central and southern Wisconsin deer do experience an earlier breeding season is partially substantiated by comparison of the ages of fawns aged by tooth development criteria (Severinghaus, 1949) during the 1950 and 1951 hunting seasons. Table 5 shows that there are proportionately more fawns born before June 5 and fewer fawns born after June 5 in the central area than in the northern areas. (See Figure 7 for map of areas used in analyzing these and subsequent data.)

The differences between areas indicating later fawns in the north are highly significant statistically. This seems to conflict with the popular belief that the rut is earlier in the north than it is in the central area.

One unusual record of a late-born doe fawn from Douglas county was made during the 1949 hunting season. This animal, killed November 20, weighed 30 pounds and its age calculated by tooth development indicated



Most Wisconsin fawns are born in May and June. Their spotted coats are a good example of protective coloration.

TABLE 5

Age of Fawns Shot During the 1950 and 1951 Hunting Season

Age on Nov. 18:	*6 Months and Over*		*5½-6 Months*		*Less Than 5½ Months*		
Approximate Time of Birth:	*Before May 20*		*May 20-June 5*		*After June 5*		*Total Fawns*
	No.	*Per Cent*	*No.*	*Per Cent*	*No.*	*Per Cent*	
CENTRAL							
1950	57	27	54	25	102	48	213
1951	83	32	63	24	112	43	258
Total	140	30	117	25	214	45	471
NORTHERN							
1950	111	26	77	18	239	56	427
1951	257	29	117	13	510	58	884
Total	368	28	194	15	749	57	1,311

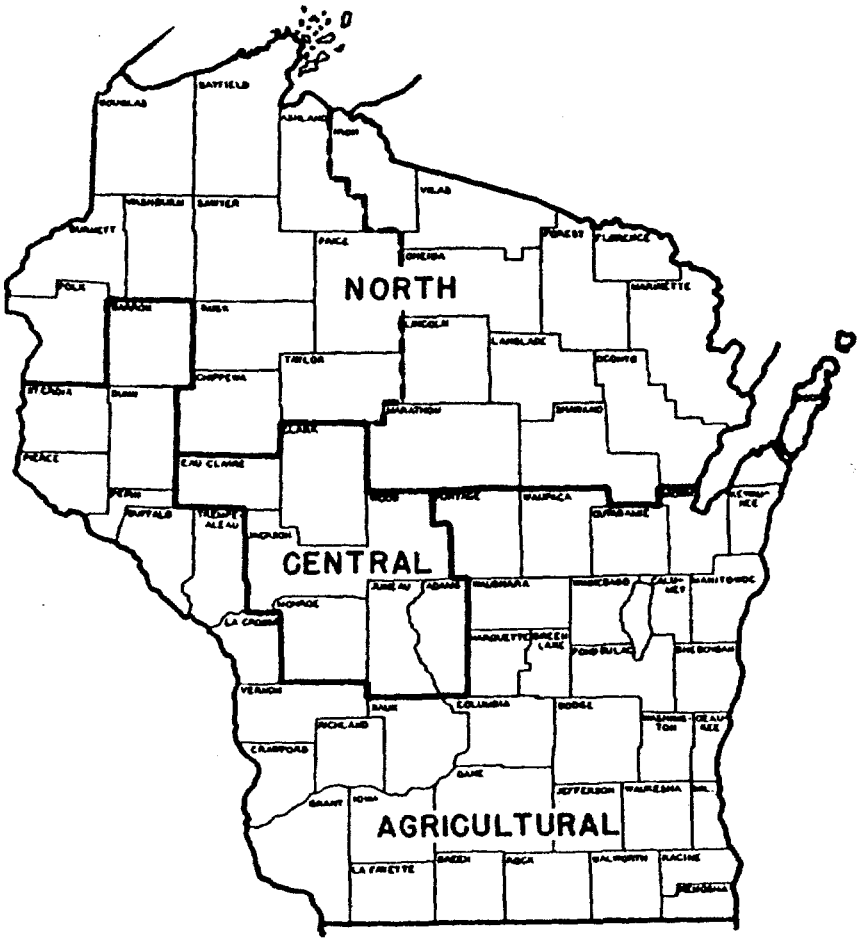


Figure 7. Areas used in treating all data in this report. The dotted line separates the northwest and northeast sections of the northern area.

that it must have been born around August 20. In contrast to this record, an embryo taken from a doe killed on November 20, 1950 by a deer hunter in Dunn county showed a 78-day development (see Appendix B for criterion), indicating that it would have been born around March 18. These extremes show a five-month spread in fawning dates.

We are of the opinion that additional information relative to the breeding season deserves future emphasis since it is entirely possible that late breeding (hence later fawning and weaker fawns going into the winter period) may be an important factor in herd mortality. If it is found that late breeding is affecting a significant percentage of breeding does, this undesirable factor may be partially eliminated by scheduling the hunting season to follow, rather than coincide with, the period of major breeding activity.

Pelage

White-tailed deer undergo two complete pelage changes annually (Burt, 1946). The "gray" winter coat is shed during May and early June, mainly from May 15 to June 15. The winter pelage is replaced by the "red" summer coat which is shed between September 1 and September 25 (Figure 8). Fawns are born with summer pelage that is marked on the side and back with white spots. These characteristic markings are retained until the fall pelage change.

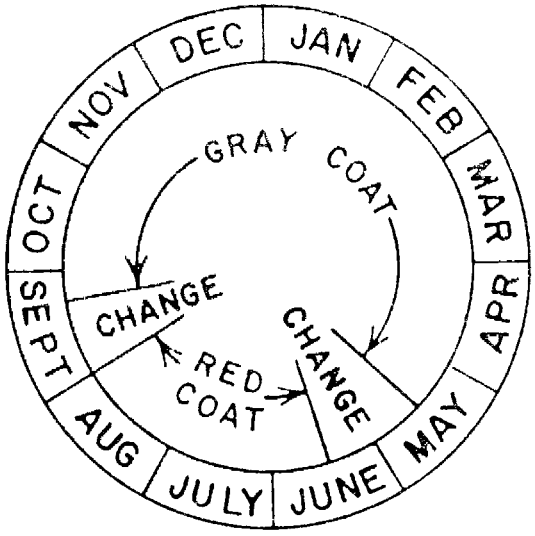
Albinism is not uncommon in white-tailed deer (Burt, 1946; Shiras, 1936). In Wisconsin, pure and partially albino deer are reported quite regularly. A group of three albino deer was photographed by Staber Reese, Wisconsin Conservation Department photographer, near Boulder Junction in Vilas county in 1950.

Burt (1946) reports that there are no records of melanism in Michigan deer. There has been one sight report of melanism in Wisconsin deer, a doe from Vilas county in 1948 (Anonymous, 1948).

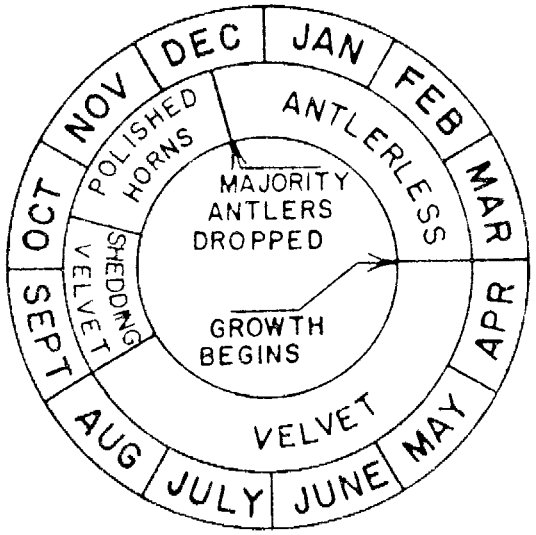
Antlers

The antlers of male deer are grown and shed annually. Antler development begins about April 1 and by the latter part of August is normally complete (Figure 8). The velvet, a skin abundantly supplied with blood vessels, covers growing antlers. When development is completed in late summer the velvet dries up and peels off. It is during this period that buck-rubbings are noted on trees and shrubs. When the velvet has been completely rubbed off, usually by mid-October, the horns are said to be "polished".

Antler point counts made from 1940 through 1950 on 3,892 Wisconsin forked-horn bucks show an average of 7 points per buck. Antler development of 1,531 bucks aged by tooth criteria in the 1950 and 1951 deer hunting seasons is shown in Table 6.



Pelage Change



Antler Development

Figure 8. Pelage and antler phenology for Wisconsin deer.

Albino deer are reported regularly in Wisconsin. This group of 3 was photographed near Boulder Junction, Vilas county, in March, 1950.

shown that the best antler development is found on the best range and that point counts cannot be used as reliable criteria of age. Table 6 substantiates this finding for individual deer, although a trend toward a greater number of points can be correlated with age.

Table 7 gives average antler beam diameters of bucks aged during the 1950 and 1951 seasons. Significant differences in antler points and beam diameters exist between adjacent age classes up to 5½ years in 1950 and between all classes in 1951. Beam diameters differ significantly in the 2½-year and 3½-year groups between the central and the northern areas, but there are no differences between the northwest and northeast areas. These differences point up variations in antler development between areas of good and poor deer range. The central area, which at the time of these checks had the state's highest deer densities and poorest soil types, showed the smallest beam diameters and poorest racks. With the available data, however, these differences between areas can only be called significant in the 2½-year and 3½-year age classes, and are reliable criteria only for large samples and not for individual deer.

TABLE 6
Percentage Frequency of Antler-Point Classes of 1,531 Bucks Shot During the 1950 and 1951 Hunting Seasons*

Age Class	Area & Year	No. Deer	Points per Rack 2	3	4	5	6	7	8	9	10	11	12	13	14
1½	*1950*														
	C.	113	71.6	10.6	11.5	1.8	2.7	--	1.8	--	--	--	--	--	--
	N.W.	112	71.5	10.7	14.3	1.8	1.8	--	--	--	--	--	--	--	--
	N.E.	77	76.5	5.2	9.1	1.3	1.3	2.6	3.9	--	--	--	--	--	--
	1951														
	C.	80	66.3	10.0	15.0	2.5	3.8	1.3	--	--	--	1.3	--	--	--
	N.W.	53	60.4	7.5	18.9	5.7	5.7	1.9	--	--	--	--	--	--	--
	N.E.	122	73.0	4.1	12.3	2.5	7.4	--	0.8	--	--	--	--	--	--
2½**	*1950*														
	C.	72	23.6	8.3	11.1	7.0	18.1	7.0	19.5	1.4	2.8	1.4	--	--	--
	N.W.	92	1.1	1.1	15.2	4.4	24.0	14.1	33.7	4.4	2.2	--	--	--	--
	N.E.	82	9.8	1.2	22.0	12.2	17.1	8.5	23.2	3.7	2.4	--	--	--	--
	1951														
	C.	34	14.7	5.9	17.6	8.8	23.5	5.9	17.6	2.9	2.9	--	--	--	--
	N.W.	62	3.2	--	22.6	11.3	24.2	6.5	21.0	3.2	6.5	1.6	--	--	--
	N.E.	84	2.4	4.8	20.2	8.3	25.0	3.6	26.2	3.6	6.0	--	--	--	--
3½**	*1950*														
	C.	74	6.8	4.1	5.4	4.1	16.2	12.2	36.6	9.5	4.1	1.4	--	--	--
	N.W.	56	1.8	--	1.8	5.4	19.6	10.7	42.9	3.6	12.5	1.8	--	--	--
	N.E.	58	--	--	6.9	--	12.1	13.8	41.4	10.3	15.5	--	--	--	--
	1951														
	C.	55	1.8	3.6	5.5	3.6	9.1	7.3	52.7	3.6	10.9	--	1.8	--	--
	N.W.	72	--	1.4	1.4	6.9	11.1	12.5	45.8	6.9	13.9	--	--	--	--
	N.E.	56	--	--	3.6	1.8	8.9	5.4	46.4	10.7	16.1	5.4	--	--	1.8
4½	*1950*														
	C.	12	8.4	--	--	8.4	16.7	16.7	33.4	--	16.7	--	--	--	--
	N.W.	25	--	--	--	--	4.0	4.0	48.0	--	44.0	--	--	--	--
	N.E.	20	--	--	5.0	--	5.0	5.0	60.0	--	20.0	5.0	--	--	--
	1951														
	C.	5	--	--	--	--	20.0	--	40.0	20.0	20.0	--	--	--	--
	N.W.	38	--	--	--	--	5.3	2.6	36.8	18.4	23.7	10.5	--	2.6	--
	N.E.	35	--	--	--	2.9	2.9	8.6	42.9	14.3	25.7	2.9	--	--	--
5½ & Older	*1950*														
	C.	4	--	--	--	--	--	25.0	25.0	25.0	25.0	--	--	--	--
	N.W.	9	--	--	--	--	--	--	44.5	11.1	22.2	22.2	--	--	--
	N.E.	9	--	--	--	--	--	11.1	11.1	44.5	33.3	--	--	--	--
	1951														
	C.	2	--	--	--	--	--	--	100.0	--	--	--	--	--	--
	N.W.	13	--	--	--	--	7.7	--	38.5	7.7	38.5	7.7	--	--	--
	N.E.	6	--	--	--	--	16.7	--	50.0	--	33.3	--	--	--	--

* T-test significant at 99 per cent level for differences between adjacent age groups up to 4½ years in both years. Differences between 4½ and 5½ groups significant at 95 per cent level in both years.
** T-test significant at 99 per cent level for differences between central area and northern areas in 1950, but not in 1951.

It is interesting to note the average beam diameters of Wisconsin bucks are considerably below the average for most regions of New York State. Only the Adirondack region, which is often cited as an example of poor range in New York, has comparable average beam diameters (Severinghaus *et al.*, 1950).

TABLE 7
Average Antler Beam Diameters in Millimeters of 1,039 Bucks Shot During the 1950 and 1951 Hunting Seasons*

Year & Area	1½ Years Mean Diam.	1½ Years No. Deer	2½ Years** Mean Diam.	2½ Years** No. Deer	3½ Years** Mean Diam.	3½ Years** No. Deer	4½ Years Mean Diam.	4½ Years No. Deer	5½ Years Mean Diam.	5½ Years No. Deer	6½ Years Mean Diam.	6½ Years No. Deer
1950												
Central	15.6	49	19.8	41	25.0	32	28.2	4	38.1	12	38.9	3
N.West	14.5	24	23.4	41	29.4	26	29.1	13	34.1	9	40.4	7
N.East	15.0	62	24.9	28	29.1	25	31.7	16	38.3	5	39.1	1
1951												
Central	17.1	31	22.0	28	28.4	21	29.5	6	32.6	12	45.0	1
N.West	16.0	37	24.9	26	29.0	22	32.6	11	35.4	9	36.4	6
N.East	16.8	101	24.8	28	32.3	28	34.5	30	38.1	3	52.0	1

* T-test significant at 99 percent level in both years for differences in average beam diameters between all age classes except 5½ and 6½ in 1950 when areas are combined.
** T-test significant at 99 per cent level for differences between central and northern areas in both years.

Chapter V

Deer Movements

For the past fifteen years, movement studies have been an integral part of game research projects. Where a deer or any other game animal is at a given time, or where he may be expected to go in a day or a season or a year must be known before intelligent management can be undertaken. Establishing refuges or managing habitat, for example, are worthless unless there is evidence that deer will use the refuge or the managed area at the proper times.

Various techniques have been used in studies of deer movements in other states. Hahn and Taylor (1950) placed bells on deer in the Edwards Plateau region of Texas. Leopold *et al.* (1951) used plastic markers and tags in a study of mule deer movements in California. Olson (1938) and Bartlett (1938) have reported on the results of deer ear-tagging studies for Minnesota and Michigan, respectively.

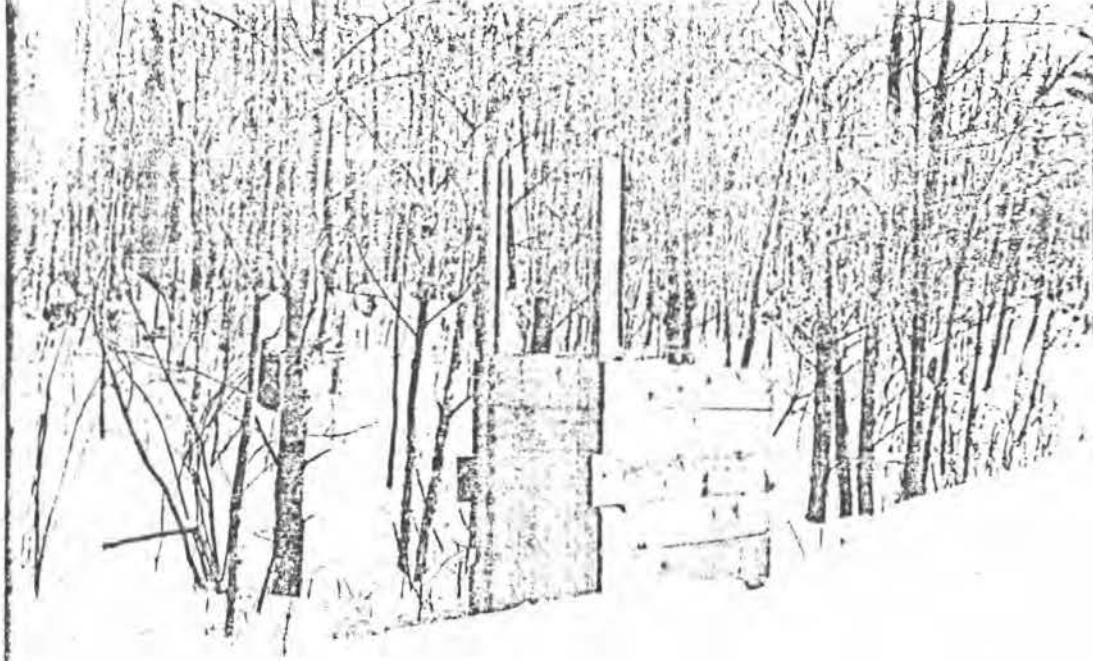
The Wisconsin studies have been of the latter type. The data in this chapter were compiled from returns of deer tagged during the period 1936 to 1951. Prior to the inception of the Deer Project, a few deer had been tagged and transplanted by the Wisconsin Conservation Department from the 1,270-acre enclosure of the DuPont Powder Company at Barksdale in Bayfield county. During the first year of research project activity (1940-41), considerable emphasis was placed on trapping and tagging deer in their winter yards. This activity was aided at that time by the manpower resources of the C.C.C. program.

Since 1947, no trapping and tagging has been done, with the exception of such trapping as was necessary to relieve the critical browse conditions at Barksdale. Deer removed from Barksdale were released in a number of areas.

All efforts through the years have resulted in a total of 898 deer trapped, of which 21 were lost to trapping accidents. The low trap mortality (2 per cent) speaks well for the effectiveness of the Stephenson-type deer trap (U. S. Forest Service, 1940) used in all operations.

Annual Cruising Radius

The major objectives of the trapping and tagging program were to obtain information on deer survival, on movements of transplanted deer compared to movements of deer tagged and released on their presumed normal home range, and on annual cruising radius. We define annual cruising radius as the radius of the area that a deer may range in during a one-year period.



A Stephenson-type deer trap used at the Barksdale powder plant enclosure in Bayfield county, 1936.

Only a small percentage of the deer tags have been recovered. Tag returns from 78 deer have provided usable information on movements. Of these, 35 have been from deer trapped and released on their normal home range. The remaining 43 tags are from deer that were transplanted before release.

Tables 8 and 9 compare the movements of deer released on home range and movements of deer released after transplanting. These deer were trapped and tagged during the normal yarding period, January through March, and recovered by hunters during November hunting seasons. Three exceptions, one train kill, and two car kills, have been included. These animals were killed during May and June and are presumed to have been on summer range. Distances moved are based on map measurements of straight line distances from release to return. Where return descriptions have been located only to the nearest section, an average of the maximum and minimum distances conceivably traveled has been used as a measure of the distance traveled.

It is apparent from Tables 8 and 9 that deer transplanted to new locations move more than deer on their home range. Deer trapped on

TABLE 8
Movement of 78 Tagged Deer from Winter to Summer Range

	Released on Home Range				*Transplanted Before Release*			
Miles Moved	*Bucks*	*Does*	*Total*	*Per Cent*	*Bucks*	*Does*	*Total*	*Per Cent*
0– 1.5	7	8	15	43	5	5	10	23
1.6– 3.0	2	1	3	9	9	1	10	23
3.1– 4.5	5	1	6	17	2	2	4	9
4.6– 6.0	1	2	3	9	1	--	1	2
6.1– 7.5	4	1	5	14	1	2	3	7
7.6– 9.0	--	1	1	3	--	--	--	--
9.1–10.5	1	--	1	3	1	3	4	9
10.6–12.0	--	1	1	3	2	1	3	7
12.1–13.5	--	--	--	--	--	1	1	2
13.6–15.0	--	--	--	--	--	1	1	2
15.1–16.5	--	--	--	--	1	--	1	2
16.6–18.0	--	--	--	--	3	--	3	7
18.1–19.5	--	--	--	--	1	--	1	2
19.6–plus	--	--	--	--	--	1*	1	2
Totals	20	15	35		26	17	43	

* This doe moved 26.5 miles from the release site to where she was shot by a hunter.

TABLE 9
Comparison of Movements of Transplanted Tagged Deer and Deer Tagged on Home Range

	Miles Moved		*Per Cent Recovered Within*				
	Range	*Average*	*1.5 Mi.*	*3 Mi.*	*6 Mi.*	*9 Mi.*	*12 Mi.*
20 Home Range Bucks	0–10.5	3.5	35	45	75	95	100
15 Home Range Does	0–12.0	3.3	53	60	80	93	100
26 Transplanted Bucks	0–19.5	6.2	19	54	65	69	81
17 Transplanted Does	0–26.5	6.8*	29	35	47	59	82

* If the doe that traveled 26.5 miles is excluded, the average distance moved by remaining does is 5.9 miles.

home range moved on the average about 3.5 miles from winter to summer range. Transplanted deer moved an average of about 6 miles.

A 6-mile radius of movement included 75 per cent of the home-range bucks and 67 per cent of the home-range does on which there were returns. Movements over 12 miles were found only among transplanted deer. Thus it seems likely that 6 miles is the average annual cruising radius for deer in a given yard.

White-tailed deer are not generally considered migratory, although a portion of them (Figure 17) use summer ranges that are distinct and separate from their winter range. This annual cycle of movements by deer within their home range is associated with the effects of season on food supplies, need for adequate cover or protection, and breeding requirements. In fall the succulent green plants that have provided food during the summer dry up and deer tend to seek out areas where acorns, wintergreen, new seedings, or hayfields are available. Cold weather and deep snows force deer to seek out areas within their home range that will provide protection from the rigors of winter. When spring comes deer again disperse from their limited wintering areas.

There is some reason to believe that white-tailed deer in the Great Lakes region once were migratory in the strict sense of the word. Shiras (1936, pp. 206-207) reported that prior to the late 1800's "on the south shore of Lake Superior, including all northern Michigan and Wisconsin, there once existed a spring and fall movement of white-tailed deer that possessed all the characteristics of a true migration.

". . . As soon as the depth of snow permitted, thousands of does worked their way north from their wintering ground near Lake Michigan or into Wisconsin, traveling alone into a broad belt a little back from the south shore of Lake Superior, where a few weeks later the fawns were born. The bucks came more leisurely, but by early May the migration was over."

Does, fawns and yearlings began to move south with the arrival of the first fall frosts and cold winds. Thousands of deer left the lake shore area in September, long before the heavy snows.

Shiras believed that the migration was due to the deep snow in the region of Lake Superior. Deer were said to follow many old and deeply-cut trails. "In swamps they were like the caribou trails found in Newfoundland" (p. 207). Deer migrated when winds blew from the northwest, and only in the daytime. Traveling stopped when the wind died or shifted to the south.

Shiras said (p. 207) the migrations ended with the building of wire fences along railroads. This supposedly prevented free movement of the deer and forced them into winter yards where they fell prey to wolves and lawless hunters.

It hardly seems likely that barbed wire fences would stop a movement of deer. Perhaps Shiras was referring to changes in the land that accom-

panied the building of railroads and the construction of fences. As for the fence itself, deer have, at least by the present day, become accustomed to them and except for occasional accidents, manage to get through, under, or over them without difficulty.

Nevertheless, I. H. Bartlett (personal communication) has notes of several early settlers and travelers in the area of the Wisconsin-Michigan border near Lake Vieux Desert which indicate that Shiras was correct in his contention of pre-settlement migration of deer. These references indicate that Indians took advantage of the migration to kill their winter supply of meat. Drift fences, constructed of forest debris, were set in the path of migrating herds to force them through narrow openings where they could be killed easily.

At the present time we have no evidence of such seasonal migration or any evidence of "century-old, deeply-cut" migration trails.

Homing Instinct

Leopold *et al.* (1951, p. 81) in a study of tagged mule deer on the Jawbone Range in California concluded that ". . . every adult deer seems to have a highly specific and localized home range to which it returns each winter. Close observation of the deer arriving on the winter range indicates that each adult animal knows precisely where it is going and leaves the main trail (and the company of other migrating deer) at the most convenient point to reach its own customary winter area." They reported further that "we . . . are inclined to the belief that most Jawbone deer return regularly to habitual home ranges in summer as they do in winter" (p. 81).

Olson (1938, p. 282) says of the Minnesota tagging experiments, "three deer tagged in 1936 were retaken in 1937 in the same yard, indicating that there is a strong tendency to return to the same yard each winter".

We have recorded two cases of transplanted deer returning to areas where originally trapped that would seem to indicate familiarity with home range, or a homing character, or both. In one case, an adult doe trapped at the Barksdale enclosure and released on Madeline Island in Lake Superior at a distance of 13 miles (and 1½ miles from the mainland) was recovered the following spring as a car-kill just outside the main gate of the enclosure. In another case, a deer trapped for use in feeding experiments in Jackson county and released at the site of the experiments six miles from the point of capture was taken by a hunter within one mile of the site where it was originally trapped. In addition to these records, our trapping records for the Camp Rusk area of Rusk county in the winter of 1948-49 showed that out of 25 deer trapped, nine had been tagged and released in the area following prior experiments. Four of the nine had been released in the spring of 1946, one in 1947 and four in 1948, at the site where trapped in1949.

Certainly the latter records indicate that many animals do return to the same yard winter after winter. There is, of course, no data to indicate what happens to the many deer that were not recaptured in the same yard. The same holds true for the possible homing character indicated by the returns of transplanted deer from Jackson county and Madeline Island.

What is the evidence against the existence of a homing character or the often-accepted premise that deer always return to the same yard? The movements of deer transplanted for some distance show no trend toward a uni-directional movement away from the release site. Figure 9 illustrates this point for deer trapped in the Barksdale enclosure and released 103 miles to the southwest at the Crex Meadows Public Hunting Grounds in Burnett county. This would seem to rule out the existence in deer of a "homing instinct" of the type associated with homing pigeons. If deer are able to find home, we believe the results of the Crex Meadows transplant of Barksdale deer indicate that the distance from which deer are able to return or choose to return is limited.

Perhaps a homing character, if it does exist, is related to familiarity with the sights, and more probably the smells and sounds, of the home range. A number of employees of the Barksdale plant told our trappers at the time the deer were being moved to Madeline Island, that "The first time those deer hear the plant whistle, they'll be running back home". There is little evidence, with the exception of the doe already mentioned, to indicate that there was any attempt on the part of the deer transplanted to this island to return. Six tagged deer shot by hunters and one car-kill on the island indicate that the majority of these deer remained close to the release site.

In all likelihood the return of the single doe to the immediate vicinity of the original Barksdale trapping site after being transplanted for a distance of 13 miles is simply a chance happening. Possibly the record of the Jackson county doe can be explained in a similar manner. But how then can we explain the fact that numbers of deer have been recovered in areas where first trapped at one-, two-, three-, and four-year intervals after release? First of all, let us consider the points of evidence which indicate that many deer do not return to the same areas every winter or summer.

Our trapping records show the movement between winters of two deer that did not return to the same yard the winter following tagging. One of these deer was found dead in March, presumably of starvation, at a distance of nine miles from the site of the original tagging in Vilas county. Another was found dead in a farmer's field in Bayfield county, 13 miles from the site of original tagging and release in the Flag yard. This deer was described by Warden Fred Minor as having a swelling on the groin, and may have been run by dogs. Nevertheless it hardly seems likely that the animal could have been run for 13 miles.

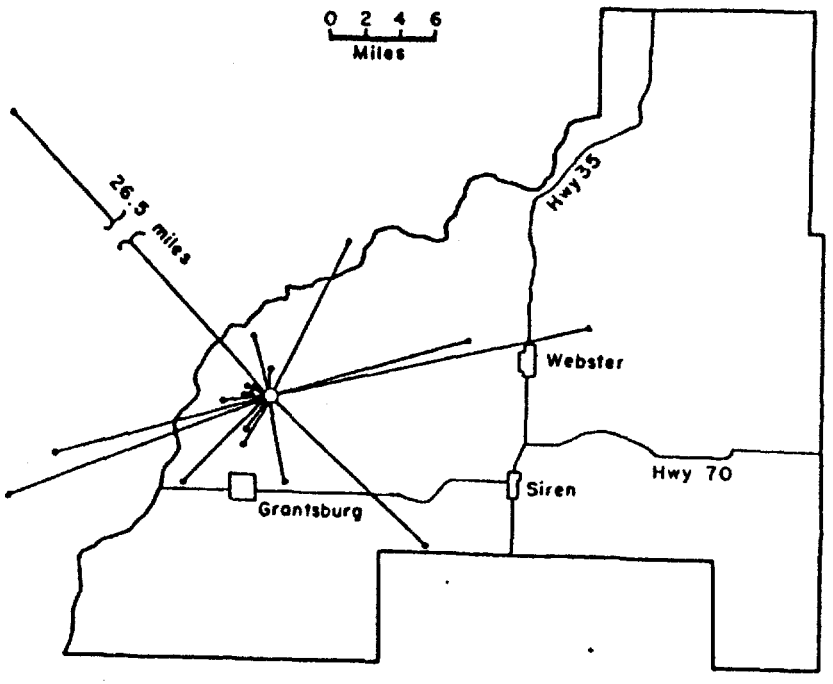


Figure 9. Location of returns from tagged deer transplanted to Crex Meadows Public Hunting Grounds, Burnett county.

During the past 10 to 15 years there have been almost phenomenal increases in deer populations in areas outside the major deer ranges in central and northern Wisconsin. To many interested people the increases in deer numbers in the southern counties have appeared to be nothing short of a large-scale deer "migration" from northern Wisconsin. We do not believe this to be a pronounced migratory movement, particularly in view of the 12-mile maximum movement indicated by home-range tag returns. We do feel that it is the result of short dispersal movements resulting from high populations in the north coupled with high reproductive rates in the new southern range. However, the fact that the deer that have appeared in the southern areas had to come from somewhere and stay is an argument against the claim that deer invariably return to the same yard each winter or the same range each summer.

Leopold *et al.* (1951) indicate that it is the yearling element of the population which accounts for movements and interchange of animals from various mule deer ranges in California. "During the summer the does rear their fawns; the yearlings, being temporarily dispossessed, tend to disperse and wander . . ." (p. 48). While this may be the case, we

have failed to find any conclusive proof, either in our field studies or in the literature, that it is the case in Wisconsin.

It is an established fact in Wisconsin that nothing will move deer like a logging operation. Where these operations are begun before heavy snowfall and conducted in suitable cover, they inevitably attract deer that apparently have previously wintered elsewhere. Artificial feeding, when begun early in the winter before deep snows, seems to have a similar effect. Feeding programs are usually begun late in winter at a time when deer are already yarded, and serve to concentrate deer from the yarding area only. However, some observations of private feeding operations indicate that if feeding is started as early as November, deer will be attracted and held that might otherwise winter somewhere else. We know by observation that these deer are not all yearlings.

Concentrations of deer are possible at all times of the year. Winter concentrations are generally recognized, but there are also concentrations of deer on fields in the spring and fall, and in areas with good mast crops. The idea of prescribed summer and winter ranges is not entirely compatible with the situation in Wisconsin. Although deer may have a definite affinity for certain areas, there would seem to be an almost continuous movement by a portion of the animals in response to changes in food and cover requirements and availability.

Tag returns have indicated that approximately 40 per cent of deer released at trapping sites were recovered on summer range within 1½ miles of their wintering area. Apparently these deer had found their entire yearly food and cover requirements within an area not much more than three miles in diameter. Hamilton (1939, p. 304) makes reference to some deer in New York that had a yearly range with a radius of 200 yards.

It seems likely that some deer develop a familiarity with a relatively small area and develop such an affinity for it that as long as their habitat requirements are met they do not leave it. However, it also seems certain that this affinity is not so strong that they will not leave when habitat conditions deteriorate or when other disturbing influences affect their survival.

If we assume that some deer travel as much as twelve miles from the tagging site (which is indicated by the returns) and return during a successive winter (for which our data offer no proof) we must ascribe to the animal either familiarity with the winter range, summer range and the area between, or we must say he has homing ability (to the extent that he need not rely upon ordinary senses of sight, smell and hearing, but has a "sixth sense"), *or* (and this seems more logical) that in the course of random movements, he is led by features of topography to return in successive years to the same area for winter cover. In other words, if we may suppose a winter yard is located on X creek, a deer may move up the X creek watershed to suitable summer habitat, in which case he probably spends the entire summer moving about somewhere within the confines

When snow is deep, deer concentrate in yards and move about on well-traveled trails. Florence county, 1938.

of the watershed. In fall when snows and cold weather impel the deer to seek yarding cover he moves down-drainage until he finds an area which satisfies his requirements. If the particular yarding area from which he left the previous spring is the nearest area in the watershed satisfying yarding requirements, he will winter on it. Presumably if his summer movement has carried him beyond the confines of his normal summer range he will accept any area meeting his requirements which he may encounter in the search for yarding cover.

The evidence from the Barksdale deer released on Crex Meadows and Madeline Island proves to our satisfaction that a deer has no sixth sense. To ascribe homing to memory or familiarity based on sight, smell or sounds also seems to be an imaginative gesture, implying a facility for memory that must extend over periods of several months.

In our opinion, movements are controlled primarily by habitat requirements. While a deer may become familiar with an area for a short time because of normal sensory contacts, the removal from and return to specific areas separated by distances greater than three miles during various periods of the year is controlled more by the character of the land than by any other factor which could conceivably influence such movement.

Movements During Yarding Periods

How far will a deer move in a day? Again, it would seem that this depends to a large extent upon the adequacy or inadequacies of a particular habitat. Where food, water and desirable cover are found on the same forty acres there is probably little movement out of that forty from one day to the next. However, a deer will move wherever some aspect of habitat becomes deficient, or when he is subjected to violent disturbance. Such movement will be to a degree governed largely by his ability to move at that season, and without regard to daily cruising raidus or home range.

We believe this is demonstrated by the terms "loose" or "partial" yarding which are used elsewhere in this report. Partial yarding accompanies mild winters that have less than normal snowfall. During these winters deer move throughout large portions of the range that are normally abandoned during winters of normal or greater-than-normal snowfall.

Winter yarding appears to be a restriction of movement resulting from the need for protection during deep snows and cold weather. Deep snow and extended periods of cold weather restrict deer movements to the confines of the yarding cover. Conversely, less snow and milder winter weather permits wider ranging from yarding cover. Yarding characteristics are more thoroughly discussed in Chapter XII.

During the winter of 1940-41, a deer tagging operation in the Elk River deer yard in Price county by the U. S. Forest Service, Wisconsin Conservation Department and C.C.C. provided some information on winter movements within a yarding area. A total of 60 deer were trapped during the period January 20 to March 31, 1941. The total number of catches, including repeats, was 291. Traps were distributed in two north-south lines, each ¾ of a mile in length. One line extended north and one south of an east-west road that roughly bisects the yard. Additional traps were distributed at distances of more than one mile from both of these lines.

William W. Barton of the U. S. Forest Service prepared an unpublished report on this project. His summary of winter movements within the yard indicated by repeaters in traps is very brief. In spite of this it is apparent that a majority of the deer taken more than once were trapped no farther than one-fourth mile from the site of the original trapping.

In this particular yard and winter, starvation losses were quite heavy as evidenced by Barton's report that "about 40 deer that died in this period (March 16 to March 31) have been found. Most of these were in the Elk River deer yard." The facts that many of the deer were in critical physical condition and that cedar foliage was being provided as bait at the traps may have tended to cause greater-than-normal restriction of movement. However, we believe that one-quarter mile is probably the extent of the normal daily movement of tightly-yarded deer in winter.

Heavy concentrations of deer in the vicinity of artificial feeding stations tend to support such a view (Kabat, Collias and Guettinger, 1953).

Heavily used deer trail in the Empire yard, Douglas county.

Once the deer have been accustomed to feeding at one of these stations there is little movement away from them. Where water is available, deer will often wander off for a drink after feeding, but the heaviest concentration of deer beds is usually in the area of conifer cover closest to the feeding station. Only rarely do the well-packed trails that mark the vicinity of the station extend beyond a quarter-mile radius from the station. Where feeding is not practiced we presume that when winter food requirements are met on the same forty as are the winter cover requirements, there will be no movement from the forty, barring disturbance by man or predators. However, as mentioned before, we have noted that where normal food requirements are not met, there is a tendency to move greater distances.

Chapter VI

Deer Food Habits

A basic deer management problem concerns natural food supplies. More particularly it concerns food supplies on the winter range, since the amount of available and palatable food in winter is one of the principal factors limiting the size of Wisconsin deer populations. Forage during the spring, summer and fall seasons is generally abundant and seldom a problem.

Deer food habit studies, if they are to be meaningful, must necessarily deal with considerably more than a simple list of what a deer eats. A knowledge of preference or palatability is important to the range manager who must know what deer browse plants to encourage. The quantity of certain foods a deer requires per day must be determined before the number of deer a specific range can sustain in healthy condition can be determined. A knowledge of the tolerance browse species exhibit to various degrees of browsing, the effect of various degrees of browsing on the plant species composition of the range, and the effect of over-utilization of winter browse plants on the deer themselves are also important.

This chapter deals specifically with what a deer eats, what winter foods a deer prefers, and how much food a deer requires per day. A number of methods have been used to determine what a deer eats; 1) watching feeding deer; 2) "snow trailing" or following a fresh deer track observing species browsed by the deer in passing; 3) by controlled feeding experiments; 4) analyzing the stomach contents of deer. Stomach analyses tell the volume of the various browse species eaten as well as what those species are.

Spring, Summer and Fall Foods

Spring and summer foods vary considerably with locality and include a wide variety of species. Table 10 lists some plants eaten by deer in spring and summer. It is by no means a complete list, but it is representative of what a deer eats during this period. No stomach analysis data for Wisconsin are available for this time of the year.

In fall, browse from trees and shrubs begins to make up a greater percentage of a deer's diet as the succulent summer plants dry up. Large quantities of mast are eaten when it is available. However, summer foods still obtainable are readily taken. Table 11 presents a partial list of fall foods based on field observations and examination of stomach contents. A sample of fall food consumption by volume is given in Table 12.

TABLE 10

Partial Check List of Foods Eaten by Deer in Spring and Summer

HARDWOODS

Aspen (*Populus* spp.) leaves and tips, especially sucker shoots
Basswood (*Tilia americana*) leaves and tips
Black cherry (*Prunus serotina*) leaves and tips
Chokecherry (*Prunus virginiana*) leaves and tips
Elm (*Ulmus* spp.) leaves
Mountain ash (*Pyrus americana*) leaves and tips
Oak (*Quercus* spp.) leaves
Pin cherry (*Prunus pennsylvanica*) leaves and tips
Red maple (*Acer rubrum*) leaves and tips
White birch (*Betula papyrifera*) leaves and tips
Willow (*Salix* spp.) leaves and tips

SHRUBS

Bearberry (*Arctostaphylos Uva-ursi*)
Dewberry (*Rubus* sp.)
Elderberry (*Sambucus* spp.) leaves and tips
Hazelnut (*Corylus americana*) leaves and tips
Honeysuckle (*Lonicera* sp.) leaves and tips
Juneberry (*Amelanchier* sp.) leaves and tips
Nannyberry (*Viburnum Lentago*)
Sweet fern (*Comptonia peregrina*)
Wintergreen (*Gaultheria procumbens*)

HERBS

Alfalfa (*Medicago sativa*)
Bracken fern (*Pteridium aquilinum*)
Buckwheat (*Fagopyrum sagittatum*)
Bunchberry (*Cornus canadensis*)
Bur-reed (*Sparganium* sp.)
Clover (*Trifolium* spp.) leaves and tips
Corn (*Zea Mays*) leaves
Cultivated bean (*Phaseolus* spp.) leaves and pods
Cultivated carrot (*Daucus carota*) tops
Cultivated pea (*Pisum sativum*) leaves and pods
Duck potato (*Sagittaria* spp.)
Goldenrod (*Solidago* spp.)
Grass (Graminae)
Milkweed (*Asclepias* spp.)
Pond weed (*Potamogeton* spp.)
Sedge Cyperaceae), especially after spring burns
Smartweed (*Polygonum* spp.)
Soybean (*Glycine Max*) leaves and tips
Sunflower (*Helianthus* spp.) leaves
Vetch (*Vicia* sp.)
Wheat (*Triticum aestivum*)
Wild lettuce (*Lactuca* sp.)
Wild pea (*Lathyrus* sp.)
Wild rice (*Zizania aquatica*)
Wood fern (*Dryopteris* sp.)

TABLE 11

Partial Check List of Foods Eaten by Deer in Fall

CONIFERS

Balsam (*Abies balsamea*)
Hemlock (*Tsuga canadensis*)
Jack Pine (*Pinus Banksiana*)
White cedar (*Thuja occidentalis*)
White pine (*Pinus strobus*)
Yew (*Taxus canadensis*)

HARDWOODS

Aspen (*Populus* spp.)
Basswood (*Tilia americana*)
Beech (*Fagus grandifolia*) mast
Black cherry (*Prunus serotina*)
Chokecherry (*Prunus virginiana*)
Cultivated apple (*Pyrus* spp.) fruit and stems
Mountain ash (*Pyrus americana*)
Oak (*Quercus* spp.) mast and stems
Pin cherry (*Prunus pennsylvanica*)
Red maple (*Acer rubrum*)
Thornapple (*Crataegus* spp.) fruit
Willow (*Salix* spp.)

SHRUBS

Alternate-leaved dogwood (*Cornus alternifolia*)
Bearberry (*Arctostaphylos Uva-ursi*)
Blueberry (*Vaccinium* spp.)
Cranberry (*Vaccinium* spp.)
Holly (*Ilex* sp.)
Juneberry (*Amelanchier* sp.)
Moosewood (*Dirca palustris*)
Mountain maple (*Acer spicatum*)
Red-osier dogwood (*Cornus stolonifera*)
Wild currant (*Ribes* spp.)
Wintergreen (*Gaultheria procumbens*)

HERBS

Alfalfa (*Medicago sativa*)
Aster (*Aster* sp.)
Bracken fern (*Pteridium aquilinum*)
Bunchberry (*Cornus canadensis*)
Clover (*Trifolium* spp.)
Goldenrod (*Solidago* spp.)
Grass (Graminae)
Strawberry (*Fragaria* spp.)
Vetch (*Vicia* sp.)
Wood fern (*Dryopteris* sp.)

TABLE 12

Stomach Contents of 387 Northern Wisconsin Deer from the 1943 Hunting Season*

	Per Cent of Total Volume	*Per Cent Occurrence*
10% or more by Volume or Occurrence:		
Hemlock (*Tsuga canadensis*)	20.3	36.2
White cedar (*Thuja occidentalis*)	15.0	31.0
Balsam (*Abies balsamea*)	11.5	36.0
Aspen (*Populus tremuloides, P. balsamifera*)	10.5	25.1
Jack pine (*Pinus Banksiana*)	6.9	13.2
Alder (*Alnus rugosa, A. crispa*)	5.2	16.5
Wintergreen (*Gaultheria procumbens*)	4.0	10.6
Hazelnut (*Corylus cornuta, C. americana*)	3.3	19.1
Maple (*Acer rubrum, A. saccharum*)	2.0	13.7
Wood fern (*Dryopteris* sp.)	1.7	10.0
5.0% to 9.9% by Volume or Occurrence:		
Birch (*Betula papyrifera, B. lutea, B. pumila*)		
Bracket fungus (*Daedalea* sp., *Lenzites* sp., *Polyporus* sp., *Schizophyllum* sp.)		
Bunchberry (*Cornus canadensis*)		
Grass (Gramineæ, inc. *Poa pratensis, Avena sativa, Oryzopsis asperifolia*)		
Lichen (*Usnea* sp., *Parmelia* sp.)		
White pine (*Pinus Strobus*)		
1.0% to 4.9% by Volume or Occurrence:		
Alternate dogwood (*Cornus alternifolia*)		
Ash (*Fraxinus americana, F. nigra*)		
Bearberry (*Arctostaphylos Uva-ursi*)		
Blue beech (*Carpinus caroliniana*)		
Bog rosemary (*Andromeda glaucophylla*)		
Chokecherry (*Pyrus melanocarpa*)		
Elm (*Ulmus* spp., inc. *U. americana*)		
Labrador tea (*Ledum groenlandicum*)		
Laurel (*Kalmia polifolia*)		
Leatherleaf (*Chamaedaphne calyculata*)		
Mt. holly (*Nemopanthus mucronata*)		
Mt. maple (*Acer spicatum*)		
New Jersey tea (*Ceanothus americanus*)		
Norway pine (*Pinus resinosa*)		
Oak (*Quercus* spp., inc. *Q. rubra, Q. macrocarpa*)		
Red-osier dogwood (*Cornus stolonifera*)		
Rose (*Rosa* sp.)		
Sedge (Cyperaceae, inc. *Carex* spp.)		
Sumac (*Rhus typhina, R. Glabra*)		
Sweet fern (*Comptonia peregrina*)		
Sweet gale (*Myrica Gale*)		
Unidentified Fungi		
Wild cherry (*Prunus* spp., inc. *P. pennsylvanica, P. serotina*)		
Willow (*Salix* spp.)		
Less than 1.0% by Volume or Occurrence:		
Basswood (*Tilia americana*)		
Bedstraw (*Galium* sp.)		
Black spruce (*Picea mariana*)		
Bracken fern (*Pteridium aquilinum*)		
Club moss (*Lycopodium* sp.)		
Corn (*Zea Mays*)		
Cranberry (*Vaccinium Oxycoccos*)		
False buckwheat (*Polygonum cilinode*)		
Goldthread (*Coptis groenlandica*)		
Highbush cranberry (*Viburnum trilobum*)		
Honeysuckle (*Lonicera* sp.)		
Juneberry (*Amelanchier* sp.)		
Lady's thumb (*Polygonum Persicaria*)		
Mayflower (*Maianthemum canadense*)		
Prince's pine (*Chimaphila umbellata*)		
Raspberry & Blackberry (*Rubus* spp.)		
Red-berried elder (*Sambucus pubens*)		
Snowberry (*Gaultheria hispidula*)		
Solomon's seal (*Smilacina trifolia*)		
Strawberry (*Fragaria* sp.)		
Twinflower (*Linnaea borealis*)		
Virgina creeper (*Parthenocissus inserta*)		
White spruce (*Picea glauca*)		
Wild plum (*Prunus americana*)		
Winter-berry (*Ilex verticillata*)		
Yew (*Taxus canadensis*)		

Unidentified material 0.5 per cent by volume.

Winter Foods

Winter feeding habits and requirements of deer have come under close scrutiny because deer concentrations on the limited areas of winter range increase browse pressure on browse species available during this period.

Determination of palatability for winter browse species requires numerous field observations over a considerable period of years. The Deer Project has field records of browse preference and palatability for a twelve-year period.

Regional variations in palatability of certain browse species, possibly related to soil fertility, prohibit the final classification of all species in a specific rank of palatability. As a general rule, palatability ratings for winter browse species listed in Table 13 and Appendix C will follow a preference pattern beginning with Group I and following in sequence through Group IV. For example, species in Group III will not be conspicuously browsed if an abundance of browse is available from species in Group I, except in a circumstance where abundant hardwoods in the higher classifications appear in mixtures with limited amounts of conifers of the lower classifications. In such a case browsing is invariably more conspicuous on the low-palatable conifers, regardless of palatability. This seems to be the result of a dietary requirement or desire for mixtures of hardwood and conifer browse whenever it is possible to obtain such mixtures.

Stomach analysis data for the winter period are given in Tables 14 and 15 to show sample percentages by volume and occurrence of food consumed by deer on poor winter range. Stomach analyses of deer found dead at or near artificial feeding stations show that deer eat available natural foods despite the addition of artificial foods (Table 15).

TABLE 13

Palatability Ratings for 32 Winter Deer Browse Species

GROUP I (1st Choice)	GROUP II (2nd Choice)	GROUP III (3rd Choice)	GROUP IV (Starvation)
Alt. dogwood	Basswood	Aspen	Alder
American yew	Black cherry	Balsam	Black spruce
Hemlock	Blueberry	Black ash	Hardhack
Mountain ash	Jack pine	Hazel	Prickly ash
Red maple	Juneberry	Holly	Tamarack
Sumac	Mountain maple	Norway pine	White spruce
White cedar	White pine	Red oak	
Wintergreen	Yellow birch	*Rubus*	
	Black willow	White birch	

TABLE 14
Stomach Contents of 55 Northern Wisconsin Deer from Starvation Range, January-March, 1943*

Foods	Per Cent of Total Volume	Per Cent Occurrence
Balsam (*Abies balsamea*)	43.1	85
Spruce (*Picea mariana, P. glauca*)	11.9	31
Alder (*Alnus rugosa*)	9.8	25
White cedar (*Thuja occidentalis*)	7.3	45
Hemlock (*Tsuga canadensis*)	7.0	18
Jack pine (*Pinus Banksiana*)	3.8	11
Birch (*Betula* spp.)	1.9	18
Hard maple (*Acer saccharum*)	1.9	4
Aspen (*Populus* spp., mostly *P. tremuloides*)	1.7	11
Ironwood (*Ostrya virginiana*)	1.7	7
Mountain maple (*Acer spicatum*)	1.6	13
Blue beech (*Carpinus caroliniana*)	1.6	2
Hazelnut (*Corylus* spp., including *C. cornuta*)	1.3	18
Willow (*Salix* spp.)	1.2	9
White pine (*Pinus Strobus*)	1.2	5
Red maple (*Acer rubrum*)	0.9	9
Raspberry (*Rubus idaeus*)	0.4	4
Tamarack (*Larix laricina*)	0.3	5
Grass (Graminae)	0.3	5
Oak (*Quercus* sp.)	0.3	4
Lichen (*Parmelia* sp.)	0.2	5
Wild plum (*Prunus* sp.)	0.2	4
Sweet fern (*Comptonia peregrina*)	0.1	2
Holly (*Ilex verticillata*)	T	4
Bracken fern (*Pteridium aquilinum*)	T	2
Fern (Polypodiaceae)	T	2
Unidentified plants	0.3	13

T-Trace.
* Analyses by Dr. G. B. Rossbach.

Deer Feeding Experiments

A Wisconsin statute from 1943 to 1953 provided that 50 cents of each resident hunting license fee ". . . shall be used exclusively for acquisition of deer yards and the provision of winter food for deer." Because thousands of dollars are spent annually in an artificial deer feeding program, it was deemed advisable to determine by experiment the effect of artificial feeding on deer. Studies were designed to answer the following questions: How much food does a deer require per day on various diets? What combinations of natural foods with artificial supplements are satisfactory foods? How much body weight does a deer lose during a normal winter? Will browse put down by a typical northern hardwood logging operation sustain deer satisfactorily in winter?

How much artificial supplement (alfalfa hay, corn or concentrated deer food) is necessary to sustain deer where unlimited balsam browse is available? Will a good quality alfalfa hay alone sustain deer through a winter? Will concentrate alone sustain a deer? How much inedible waste can be expected when feeding a good quality alfalfa or clover hay?

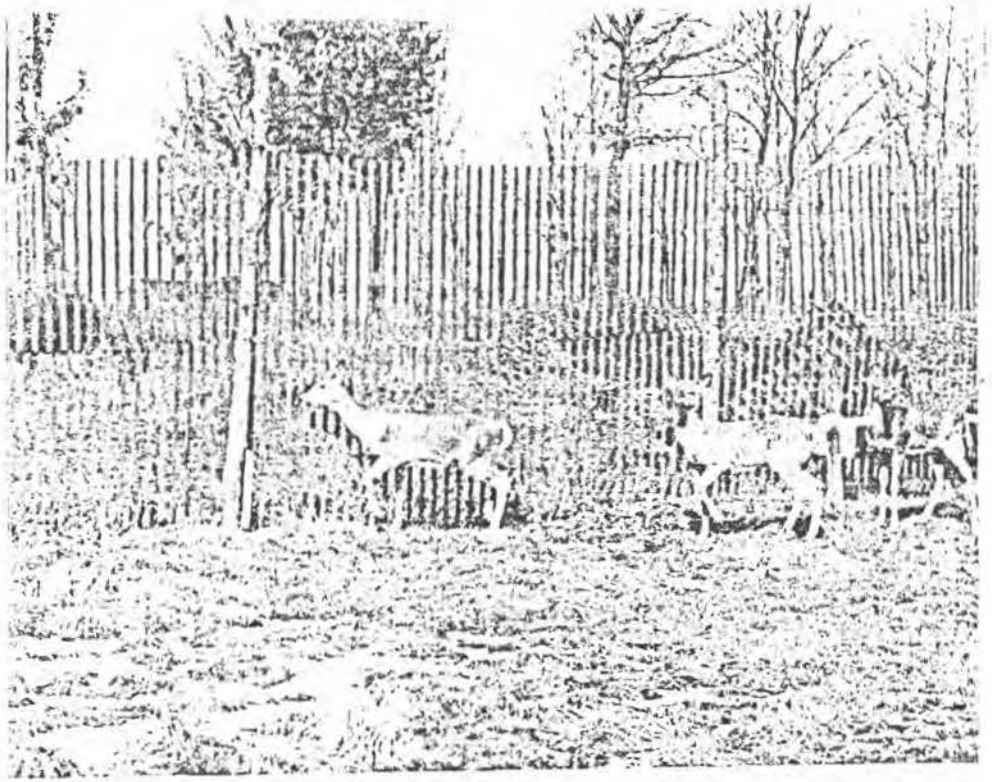
Feeding experiments were conducted in the winters of 1946 through 1949. Because other states (Davenport, 1939; Nichols, 1938) had engaged in extensive pen-controlled deer feeding experiments, it was not planned that the Wisconsin experiment should be elaborate or of a continuing nature. Experimental feeding pens, 66 feet by 165 feet in size, were constructed of double-height snow fencing. Each pen provided an open-end shelter for deer and access gates for personnel. A portable funnel was used to trap deer in the pens for weighing. The snow fence construction of the pens was satisfactory for the period of study, but maintenance costs would have been excessive had the project been continued for another year.

Whenever possible, four wild-trapped deer, usually including two fawns and two yearlings or adults, were placed in each pen. A critical weight based on 80 per cent of the initial weight for yearlings and adults and 85 per cent of the initial weights for fawns was calculated for each deer. These critical weights were chosen because Davenport (1939) and Nichols (1938) found that deer reached a critical physical condition after losing 30 per cent of their normal weight. However, deer used in our experiments were trapped in late December and early January from critical range and had already undergone an unknown weight loss; hence 15 or 20 per cent loss

TABLE 15
Stomach Contents of 17 Deer that Died at or Near Artificial Feeding Stations, 1948*

Foods	Per Cent of Total Volume	Per Cent Occurrence
White pine (*Pinus Strobus*)	17	35
Jack pine (*Pinus Banksiana*)	16	35
Balsam (*Abies balsamea*)	15	47
Alfalfa hay (*Medicago sativa*)	13	35
Spruce (*Picea* sp.)	6	24
Aspen (*Populus tremuloides*)	3	29
Goldenrod (*Solidago* sp.)	2	18
Sweet fern (*Comptonia* sp.)	2	29
Willow (*Salix* sp.)	2	29
Fern (Polypodiaceae)	2	24
Grass (Graminae)	2	29
Alder (*Alnus* sp.)	1	41
Currant (*Ribes* sp.)	1	6
Oak (*Quercus* sp.)	T	18
White cedar (*Thuja occidentalis*)	T	12
Blueberry (*Vaccinium* sp.)	T	12
Wintergreen (*Gaultheria procumbens*)	T	6
Huckleberry (*Gaylussacia* sp.)	T	18
Juneberry (*Amelanchier* sp.)	T	6
Unidentified plants	17	88

T-Trace.
* Analyses by B. P. Stollberg.



Penned deer used in feeding experiments at Camp Rusk, Rusk county, in 1947. The fence is built of double-height snow fencing.

was arbitrarily selected as a critical point. Weight losses beyond these percentages are close to the point of death by starvation. When deer approached the critical weight they were taken off the diet. Deer were weighed at intervals of two weeks, or more often if the condition of the deer appeared to be changing rapidly.

The experimental diets were fed for periods up to a maximum of 80 days. Deer were given food daily. The amounts fed were weighed and recorded on the basis of actual food consumed. Natural browse species were cut no more than two to three days ahead of feeding to prevent their drying out.

Two additional diets including alfalfa meal pellets were tested in a similar manner during 1953 using the facilities and semi-wild deer of the Wisconsin Deer Park at Wisconsin Dells. Mr. Russell Tollaksen, the owner, with the assistance of Otis Bersing and Cyril Kabat of the conservation department, tested the 1953 diets for the Deer Project.

Each diet tested is summarized in the following paragraphs and in Table 16. Food consumption is calculated in pounds of food eaten per

are averages for all deer in each age group expressed in per cent of original weights.

Artificial Diets

Unlimited Alfalfa Hay. Deer on this diet had unlimited amounts of alfalfa hay available at all times. Only the leaves and tender tips were eaten. The leavings from this diet ranged from 30 to 50 per cent of the total weight of food.

A good quality (U. S. Grade No. 1, extra leafy, extra green) alfalfa hay fed in unlimited quantities is a satisfactory diet for deer and will sustain them through an average yarding period.

Alfalfa Hay Leavings. Leavings from the unlimited alfalfa hay diet were fed to force deer to eat as much of the alfalfa as possible to determine what percentage of alfalfa must be considered unusable waste. Deer on this diet could not be forced to eat all of the stems until they were in a starvation condition.

This is an unsatisfactory diet. Deer reached critical weight in less than 80 days. An average of 24 per cent by weight of the original alfalfa remained as unusable waste. When feeding alfalfa hay alone, allowances for this amount of waste should be made in providing for an average of 2.5 pounds per hundredweight per day of usable feed. Actual amounts will vary with the quality of the hay.

Alfalfa Hay and Corn. A diet of 25 per cent shelled corn was fed with 75 per cent alfalfa hay. It proved satisfactory for sustaining deer through an average yarding period. Corn is not subject to weathering and unless covered by snow there is very little wastage.

Alfalfa Hay and Concentrate. The commercial concentrate used in this diet was in a pressed pellet form and was subject to weathering. This diet has been fed extensively in Wisconsin's artificial feeding program. A ratio of about one part of concentrate to three parts of alfalfa hay was fed. It is a satisfactory diet.

Unlimited Alfalfa Meal. This diet consisted of unlimited amounts of commercial dehydrated alfalfa meal pellets. Alfalfa in this form was tested because it is easier to handle and has less wastage than alfalfa hay. This diet provides an adequate emergency winter food supply.

Alfalfa Meal and Concentrate. Unlimited amounts of dehydrated alfalfa meal pellets and commercial concentrate pellets were fed. This is a satisfactory diet. The test deer found concentrate more palatable since 77 per cent of the food they ate was concentrate.

Garver's Concentrate. Straight concentrate pellets were fed. Although deer on this diet showed signs of diarrhea when feeding began, they soon adjusted to the concentrate diet without further distress.

Concentrate alone will carry deer through a normal winter [illegible]

TABLE 16
Summary of Feeding Experiments

	Year	Days Fed	No. Deer Fed		% Weight Change		Food Consumption in Lbs./Hundredweight of Deer
			A&Y*	Fawn	A&Y	Fawn	
ARTIFICIAL DIETS:							
Unlimited Alfalfa Hay	1946	60	2	2	−13	+ 5	2.36
	1947	62	1	2	− 6	− 9	2.33
	1948	80	2	1	− 3	− 5	2.73
Alfalfa Hay Leavings	1947	59	..	3	..	−12	2.19
	1948	80	2	1	−20	−19	2.29
Alfalfa Hay and Corn	1946	59	1	2	− 4	+ 1	2.58
Alfalfa Hay and Concentrate	1949	68	3	1	− 5	+ 3	2.66
Unlimited Alfalfa Meal	1953	61	2	2	− 1	− 1	2.10
Alfalfa Meal and Concentrate	1953	60	2	2	− 7	+ 3	2.20 (Alfalfa 23%)
Garver's Concentrate	1946	61	1	3	− 6	+ 3	2.74
	1949	68	3	1	− 8	0	1.97
Barley Screenings	1946	36	3	...	−15	...	1.68
Whole Barley	1949	28	4	...	−13	...	Not Recorded
Barley & Alfalfa Hay	1949	68	3	1	− 9	0	2.27 (Barley 44 %)
Clover	1946	60	1	2	−19	−10	2.08
MIXED DIETS:							
Balsam 60% & Alfalfa 40%	1946	67	2	1	−13	+ 5	4.38
Unlimited Balsam and Unlimited Alfalfa	1947	62	2	2	−14	− 7	2.28 (Balsam 19%)
Unlimited Balsam and Limited Alfalfa	1948	80	2	1	−12	− 5	3.34 (Balsam 28%)
Balsam and Corn	1946	52	..	3	..	−17	3.11
NATURAL BROWSE DIETS:							
26 Browse Species	1947	47	2	1	−14	−12	Not Recorded
1st-Choice Palatability	1947	42	1	2	− 9	−13	Not Recorded
2nd-Choice Palatability	1947	38	2	1	− 8	− 8	3.40
3rd-Choice Palatability	1947	54	1	2	−18	−15	3.86
Low Palatability	1947	63	2	2	−14	− 9	5.29
	1948	75	2	1	−16	− 7	4.30
Hemlock and Yellow Birch	1946	52	1	2	−20	−12	3.61 (Hemlock 73%)
Hemlock and Hardwoods	1947	55	1	2	−15	−17	3.11 (Hemlock 54%)
Balsam	1946	28	2	1	−13	−15	3.38
Cedar	1947	62	2	2	−12	−17	4.97
Jack Pine 33%, Red Oak 67%	1946	28	2	2	−11	−10	2.84
Jack Pine 50%, Red Oak 50%	1946	28	2	2	−14	−23	2.02
Jack Pine & Red Oak 86%, Alfalfa and Corn 14%	1946	55	2	1	−14	−11	2.76
Jack Pine & Red Oak 79%, Alfalfa and Corn 21%	1946	54	2	2	−10	− 9	3.18

* Adults and yearlings

could easily result in mortality unless it is possible to limit the amount of concentrate. Because of high costs, it is not desirable to feed deer artificially on concentrate alone. As a limited supplement to other foods such as alfalfa, it has merit.

Barley Screenings. Feeding was discontinued after 36 days because deer were approaching the critical weight. An unsatisfactory diet.

Whole Barley. Feeding was discontinued after 28 days because two of the four test deer were near the critical weight. Not a satisfactory diet.

Barley and Alfalfa Hay. The amount of alfalfa hay available to deer on this diet was limited. This is a satisfactory diet. Apparently some roughage, like alfalfa, is needed to make barley satisfactory.

Clover. Unlimited amounts of clover hay were fed. Although the clover used for this diet was not of the best quality, it appears that a high quality clover would be satisfactory. Clover does not seem to be as satisfactory as alfalfa.

Mixed Diets

Balsam 60% and Alfalfa 40%. Balsam and alfalfa hay fed in this ratio was a satisfactory diet. It had the highest consumption rate of any mixed diet.

Balsam was used in these mixed diets because it is the most commonly available conifer on Wisconsin's winter deer range. In many critical areas other browse species have been so depleted by deer that balsam is the only remaining coniferous browse plant.

Unlimited Balsam and Unlimited Alfalfa. Unlimited amounts of alfalfa hay were fed with unlimited amounts of balsam and proved to be a satisfactory diet.

Unlimited Balsam and Limited Alfalfa. Unlimited balsam fed with limited amounts of alfalfa hay was a satisfactory diet. When balsam is the only available natural browse a supplement of at least 1.5 pounds per hundredweight of alfalfa per day would sustain deer through a normal yarding period.

Balsam and Corn. This diet was made up of 83 per cent balsam and 17 per cent corn. It was unsatisfactory, although an increased percentage of corn might make this diet satisfactory.

Natural Browse Diets

26 Browse Species. This diet was designed to approximate a natural browse diet on good winter range. The following species were fed: hemlock, white cedar, red maple, alternate-leaved dogwood, sumac, yellow birch, basswood, juneberry, red-osier dogwood, white pine, mountain maple, honeysuckle, nannyberry, hard maple, white birch, black ash, American elm, quaking aspen (popple), chokecherry, gray dogwood, hazel, Norway

pine, balsam, red oak, highbush cranberry and alder. This diet is satisfactory for short yarding periods in the quantities eaten.

First-Choice Palatability. Cedar was fed in limited amounts. Basswood, alternate-leaved dogwood, willow, red maple and sumac were fed in unlimited quantities. Some minor changes in palatability ratings were made after this and the next three diets were tested, so slight differences exist between these diets and palatability ratings given elsewhere in this report.

This is a satisfactory diet for short yarding periods.

Second-Choice Palatability. Hemlock, mountain maple, hard maple, yellow birch, red-osier dogwood, juneberry and chokecherry were fed in unlimited amounts. This diet is satisfactory for short yarding periods.

Third-Choice Palatability. White birch, white pine, quaking aspen, holly, hazel and red oak were fed in unlimited amounts. A satisfactory diet for short yarding periods.

Low Palatability. In 1947 the following species were fed in unlimited quantities: balsam, elm, black ash, Norway pine, alder and gray dogwood. The same species were fed in 1948, except that gray dogwood was eliminated. This is a satisfactory diet for short yarding periods.

Although deer have a marked preference for certain browse species, it is evident that species classed as low palatables will sustain deer satis-satisfactorily if they are available in quantity and sufficient variety.

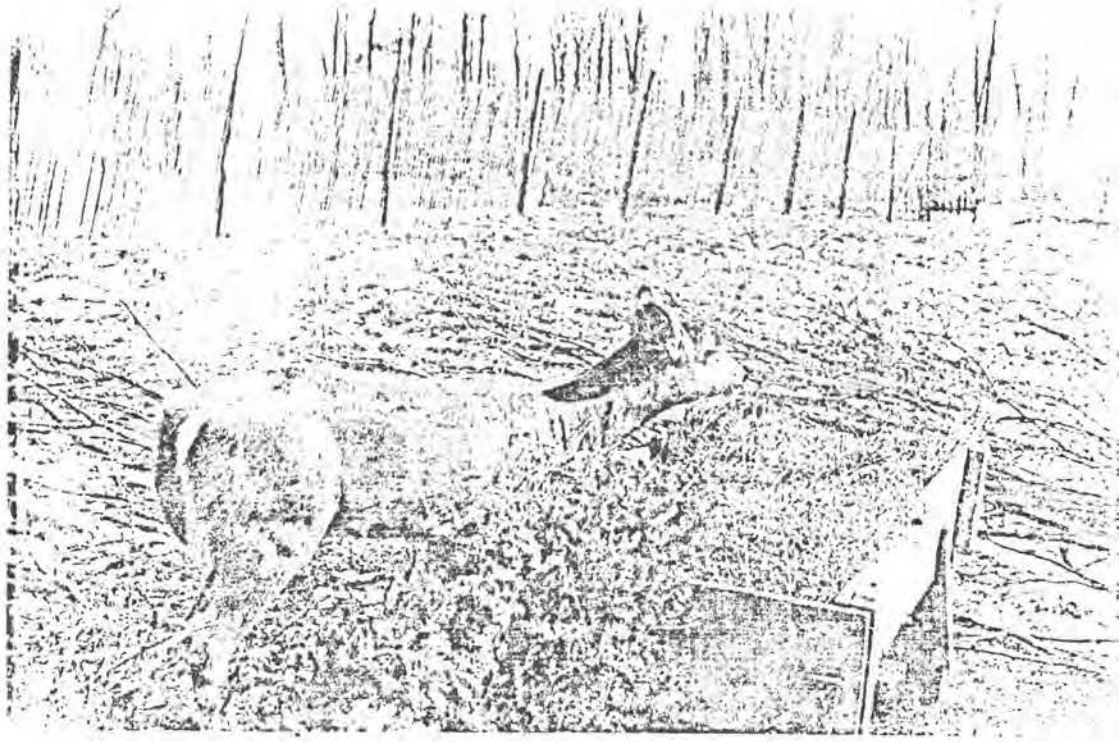
Hemlock and Yellow Birch. Hemlock was progressively limited to force consumption of yellow birch. This diet indicates the preference deer have for hemlock. It is satisfactory for short yarding periods and it approximates food conditions often found at hemlock-hardwood cutting operations.

Hemlock and Hardwoods. Hemlock, basswood, yellow birch, red maple and hard maple were the species fed. This diet also approximates food conditions found at many cutting operations in the north. It is probably satisfactory for short yarding periods.

Balsam. Straight balsam was fed in unlimited quantities. Balsam alone is a starvation food. Test deer had reached or were near their critical weights in only 28 days.

Cedar. Straight white cedar was fed in unlimited amounts. The diet was barely satisfactory for a 60-day yarding period, even though test consumption was high. Apparently cedar when fed alone would not be satisfactory for a 90-day yarding period.

Jack Pine and Red Oak. All diets containing these two species were used to test types of browse diets found in the central area of the state. In the two diets made up exclusively of jack pine and red oak, jack pine was limited to force consumption of oak. In the first pen, deer were fed a diet approximating a consumption rate of one-third jack pine to two-thirds red oak; this ratio was changed to equal parts of both species in the second pen.



Penned deer feeding on hay and browse offered during feeding experiments at Camp Rusk, Rusk county, in 1947. Only certain types of feeds were given deer in each pen.

Both diets were unsatisfactory, since deer reached or approached their critical weights in relatively short periods. Red oak was indicated to be a better food than jack pine, since deer eating the most red oak lost the least weight, even though the deer preferred jack pine.

Jack Pine, Red Oak, Alfalfa and Corn. Jack pine and red oak in varying quantities were supplemented with alfalfa hay and corn in tests of two pens of deer. In the first pen, alfalfa and corn made up about 15 per cent of the diet; in the second pen, about 20 per cent. Both diets were satisfactory. Alfalfa and corn improved the jack pine and red oak diet in proportion to the amount of the supplement.

Conclusions

It is recognized that wild deer in winter undergo weight losses that are related to the severity of winter weather and condition of the range; however, it was not possible to calculate a "normal" weight loss from these experiments.

It is also recognized that wild-trapped deer which are penned and frequently disturbed by feeding and weighing activities cannot be con-

sidered ideal for feeding experiments. Despite these things, it is possible to arrive at important conclusions.

Several artificial feeds and combinations of artificial feeds will sustain deer through a normal yarding period. A good quality alfalfa hay alone will sustain deer if provided in sufficient quantity. From 3.5 to 5 pounds of average quality alfalfa per hundredweight of deer per day are required to provide 2.5 pounds of usable alfalfa. Twenty-five to fifty per cent of the hay by weight, depending on its quality, must be considered waste.

Alfalfa meal pellets will also provide an adequate emergency winter diet for deer. When fed alone, deer will require an average of about 2 pounds per hundredweight of deer per day. There is little difference in price between hay and pellets. Four pounds of alfalfa hay and two pounds of meal pellets each cost approximately 7.5 cents. However, pellets have an advantage in being easier to handle.

A combination of 75 per cent alfalfa and 25 per cent corn or commercial concentrate provides a satisfactory diet. Concentrate alone will sustain deer if care is taken to prevent deer from gorging themselves for the first week they are on the diet.

Balsam, the principal available conifer on Wisconsin winter deer range, proved entirely unsatisfactory when fed alone. However, a combination of 40 per cent alfalfa hay and 60 per cent balsam was a satisfactory diet.

Palatable, natural browse diets of a few species sustained deer satisfactorily only for short periods. Although deer have marked preferences for certain browse plants, these experiments indicated that a considerable variety of hardwood and evergreen species are necessary to provide a satisfactory natural diet. For example, the straight cedar diet (a first-choice species) was barely adequate for a 60-day period. On the other hand, a diet of hemlock and six second-choice hardwoods was entirely satisfactory. Even the species with the lowest palatability will sustain deer if those species are available in quantity and variety. The conclusion seems inescapable that browse plants of high palatability do not necessarily have a high nutritional value.

It is interesting to note the differences in pounds per day consumption between high- and low-palatability natural browse, and between natural browse and artificial diets. When fed in unlimited amounts, a larger quantity of low-palatables were eaten to provide the same degree of sustenance of lesser quantities of high-palatability species. Natural browse diets require more pounds of browse per day than artificial diets. From 3.5 to 5.5 pounds of natural browse per hundredweight of deer per day is needed, compared to 2.5 pounds of average quality alfalfa hay.

Chapter VII

The Relation of Deer Weights to Range Conditions

There has been considerable speculation by Wisconsin hunters about the smaller size of deer today compared to the size of deer "in the good old days". Two arguments are commonly advanced to explain the reason for supposedly declining deer weights. One theorizes that the shooting of adult bucks leaves only the smaller male deer for breeders. The other says that inbreeding has resulted in a physiological decline in Wisconsin deer. This study does not attempt to prove or disprove either of these theories. Instead, the weight differences of deer from good and poor winter ranges discussed in this chapter seem to offer a more pertinent reason for declining weights.

Classification of deer range based on the status of winter browse has been a major effort of the Deer Project. By 1948, sufficient knowledge of statewide winter range conditions had been obtained to permit the delineation of ranges into areas of "critical" and "non-critical" range. In areas classified as critical, starvation was evident or imminent prior to 1948. All remaining areas were considered non-critical for the purposes of this study. A more detailed discussion of range conditions is presented in Part III of this report.

It was necessary to classify range rather loosely when analyzing deer weights to eliminate the need for a detailed qualification of range status for all the varying degrees of degeneration. For example, much of the range classed as "medium" in Wisconsin range surveys is in precarious balance between the non-critical and critical stages. This range is included as non-critical. Had study been confined to a limited area, it would have been possible to use more detailed range classifications, but on a statewide basis the broad classification was necessary.

More than 8,800 dressed deer weights were compiled for the ten-year period from 1938 through 1947. Only the dressed weights of deer taken in October, November and December are included. Weights were compiled from records of the Deer Project and from conservation wardens' seizure cards. The bulk of the weight data came from the latter source. Seizure cards filed by wardens for confiscated deer show dressed weights, sex, age (usually as buck, doe, or fawn) and the location from which the deer came. Seizure cards provided enough information for a statewide analysis. Adult and yearling weights were grouped for both sexes. To separate adults from yearlings it would be necessary to set up arbitrary weight limits for the yearling class and sufficient information is not available to do this accurately. Weights have been segregated into three areas so that comparisons between the various areas can be made (Table 17). The critical and non-critical range areas are mapped in Figure 10.

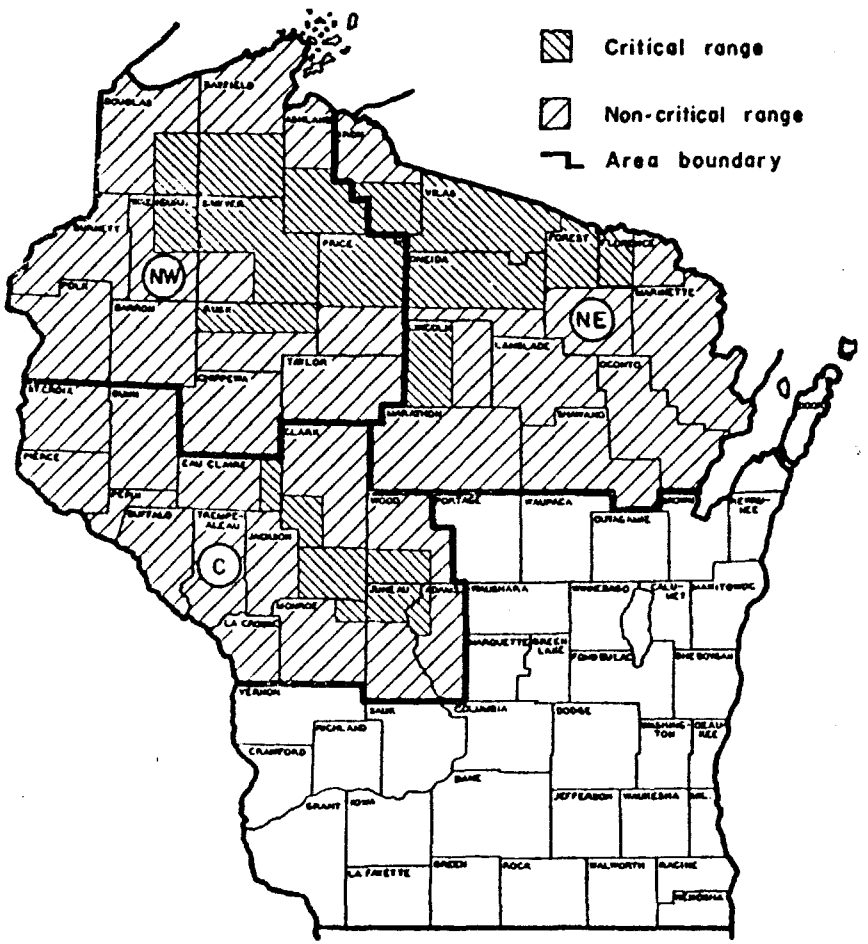


Figure 10. Critical and non-critical deer ranges in 1948.

Table 17 shows that dressed weights of adult and yearling bucks on non-critical range are 11.7 pounds heavier than on critical areas, while dressed weights of adult and yearling does on non-critical areas are 4.6 pounds heavier. These are highly significant statistically. The difference is so great that does from non-critical areas are actually heavier by 3.0 pounds than bucks from critical areas.

Fawns of both sexes combined are 2.4 pounds heavier on non-critical areas. This difference is highly significant statistically.

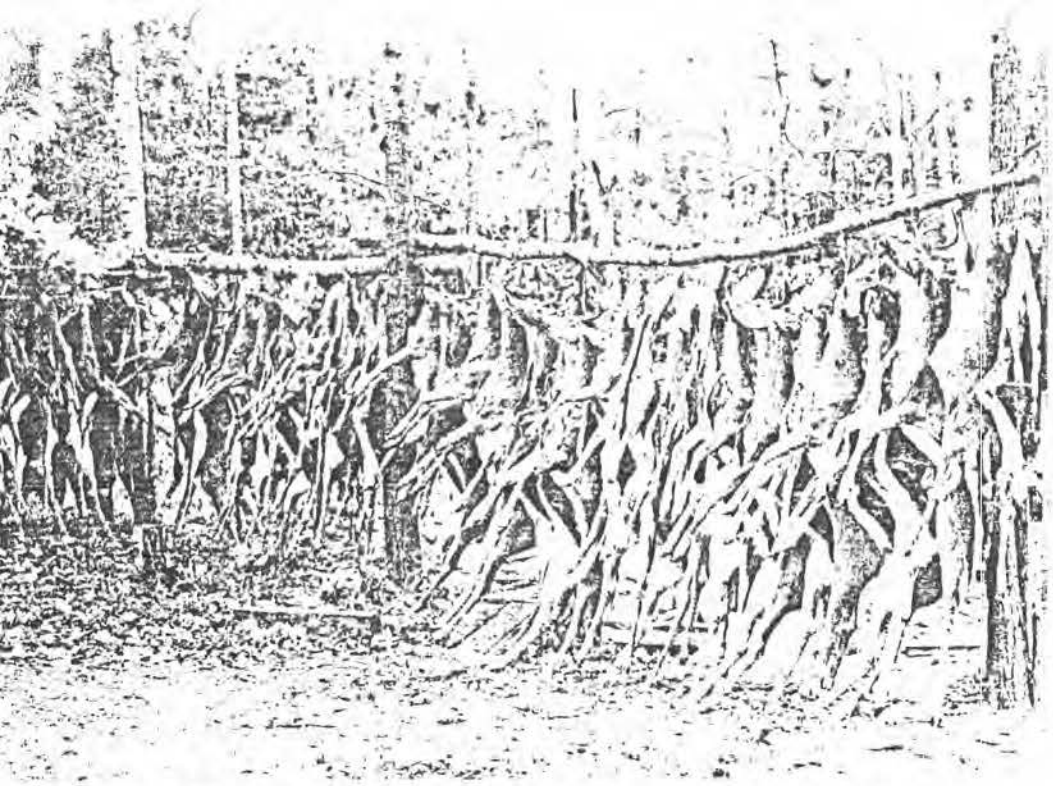
Adult and yearling bucks average 3.6 pounds heavier than adult and yearling does, again a highly significant statistical difference. This difference according to range condition is 1.6 pounds on critical areas and 8.6 pounds on non-critical areas. Buck fawns are 3.4 pounds heavier than doe fawns.

Bucks from the central area are significantly lighter than those from the northern areas.* This is also true of does, the difference being 6.0 pounds, which is significant at the 99 per cent level of confidence. There is a similar highly significant difference in buck fawns (3.2 pounds). The difference for doe fawns is 2.0 pounds, a significant difference.

TABLE 17
Dressed Deer Weights from Non-Critical (Good) and Critical (Poor) Ranges

		Good Range		*Poor Range*	
Area	*Deer Sex & Age*	*No. Deer*	*Ave. Weight*	*No. Deer*	*Ave. Weight*
Northwest	Bucks*	330	113.1	620	102.4
	Does*	417	101.4	529	97.9
	Buck Fawns	146	60.9	163	56.2
	Doe Fawns	152	57.1	176	54.7
Northeast	Bucks	572	111.5	899	101.8
	Does	595	103.8	789	99.7
	Buck Fawns	217	59.3	276	57.7
	Doe Fawns	186	54.8	235	53.1
Central	Bucks	150	100.8	805	97.7
	Does	191	96.8	833	94.2
	Buck Fawns	48	52.5	210	55.8
	Doe Fawns	45	54.0	226	52.6
State Total	Bucks	1,052	110.5	2,324	98.8
	Does	1,203	101.9	2,151	97.2
	Buck Fawns	411	59.9	649	56.7
	Doe Fawns	383	55.7	637	53.4
Chambers Island	Bucks	- - -	- - -	82**	112
	Does	- - -	- - -	108	88
	Buck Fawns	- - -	- - -	27	41
	Doe Fawns	- - -	- - -	33	42

* "Bucks" and "Does" in all areas include both adult and yearling weights.
** Includes a high proportion of adult bucks, whereas bucks from the other 3 areas were mostly yearlings.



Part of the deer removed from Chambers Island by a special hunt in October, 1945. These deer averaged much smaller in size than mainland deer because of poor range conditions on the island.

The weight differences found between all areas of good and poor range lead us to conclude that range conditions as indicated by available winter food have a direct relationship to the physiological condition of the deer herd. In general, areas with poorest winter food will produce the smallest deer.

Figure 11 compares statewide weights with weights of Chambers Island deer. Chambers Island has an area of about 3,000 acres and lies four miles off the shores of Door county in Green Bay. The island has long been overbrowsed by the deer herd occupying it and in 1945 it represented an extreme stage of range degeneration in Wisconsin. A state-conducted hunt on the island in October of 1945 enabled us to obtain dressed weights for the 250 deer removed during the hunt. The weights obtained at that time are equal to or lower than those found elsewhere in the state. They indicate that continued degeneration of Wisconsin deer range will result in continued physical degeneration of the deer herd.

The literature on similar studies in other states is limited. Schunke and Buss (1941) showed a progressive decrease in the weight of 108 Wisconsin bucks taken during the period 1936 to 1940. Buss and Buss

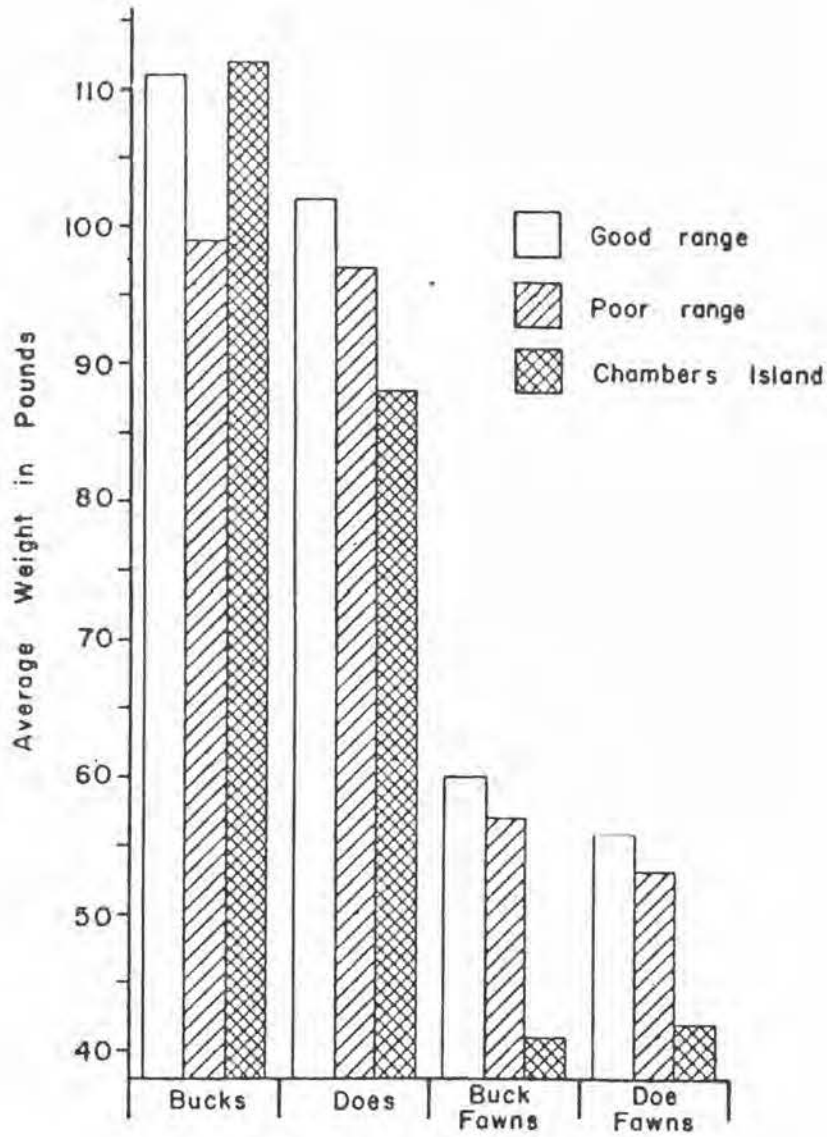


Figure 11. Average dressed deer weights from good range, poor range, and Chambers Island. Chambers Island bucks are mostly adult bucks; other areas are mostly yearlings.

(1947) mention that in a series of 81 hunting-season weights the average yearly weight of bucks shot after 1937 showed a seven-year decline from 173 to 137 pounds. They concluded that the decrease was associated with increasing population density. Martin and Krefting (1953) found significantly lower adult deer weights on poor range than on good range among a sample of 1,311 weights from central Wisconsin in the years 1945 to 1947.

Johnson (1937) states that the average weight of bucks killed on one area in Pennsylvania was 127 pounds, while on a second tract having two and one-half times more deer the average weight was 92 pounds. Sanders (1941) reports that the average weight of white-tailed deer killed on shooting preserves in the Edwards Plateau region of Texas decreased as the number of deer increased. There appears to be adequate evidence to support the contention that deer weights decline as population density increases.

Our study of deer weights in relation to range conditions further indicates that deer weights and deer density are closely associated. As a corollary it may be said that deer density is reflected in range conditions. As population densities increase, range conditions degenerate in proportion to the increase in the deer herd. This is true at least for the types of range in Wisconsin during the period of this study. The number of deer weights from critical range invariably outnumber the number of weights from range classed as non-critical (Table 17). Generally speaking, this is indicative of the relative deer numbers on the two types of range.

Range degeneration from 1938 to 1947 increased in degree and expanded in extent; however, available winter food on the major portion of the range classed as critical in 1948 had begun to decline by 1938. Although the relative degree of range degeneration changed during the study period, the differences between critical range and other areas remained fairly constant. If it were possible to reconstruct the status of the range for each year between 1938 and 1947 it would be possible to show progressive annual weight decreases as browse conditions in critical areas grew worse.

Chapter VIII

Natality Factors

According to Leopold (1933) the rate of increase of a game species is theoretically dependent on the maximum and minimum breeding age; on the number of young per year; on the number of over-age adults; and on the sex and age composition and mating habits of the population. These population properties, called natality factors, determine the breeding potential, or unimpeded rate of increase. The actual rate of increase, or productivity, of a population is controlled by mortality factors that modify the breeding potential. Some mortality factors, such as hunting, predation, or starvation, kill directly. In addition, the adequacy or inadequacy of food, water supply and coverts, will favor or impede population increases depending on their status.

In this chapter and the next, characteristics that determine productivity of white-tailed deer in Wisconsin will be discussed. In Chapter X, these discussions are brought together to create a "life equation" that shows how various factors affecting productivity have influenced Wisconsin deer populations.

Breeding Age

It has been generally assumed in the past that there exist within deer populations considerable numbers of senescent and presumably unproductive animals. Recent findings, however, do not bear out this assumption. The growing evidence from fawning records of captive, known-age animals is that a white-tailed doe may bear fawns annually until she dies of old age.

Palmer (1951) cited records for a doe in Maine that was producing fawns at an age of 15 years. We have a similar record of a Wisconsin doe that lived to be 19½ years old and bore fawns through her 18th year (Popov, 1950)

Supposedly over-age adult bucks that fail to develop normal antlers are called "muley" by Wisconsin hunters. Yet there is no proof that failure to develop normal antlers is any way related to the potency of a buck. There is also little reason to believe that age and sub-normal antler development are related. One buck known from our tagging records to be at least 13 years old when taken had a well-formed 14-point rack.

Records of deer ages taken during the 1950 to 1954 hunting seasons indicate that under current Wisconsin conditions only a small percentage of the herd at any given time is over seven years old (Table 27). The percentage is so low that for all practical purposes, and regardless of whether senescence is or is not a factor at eight, nine or ten years, it is

safe to assume that a majority of deer in the herd one year old or older are capable of breeding.

Past assumptions about minimum breeding age have also been modified by evidence collected in recent years. The minimum breeding age of whitetails is often given as one and one-half years, but there are indications that breeding prior to that age may not be unusual. Cheatum and Morton (1946), for example, reported that up to 30 per cent of the doe fawns may be bred before reaching one year of age in some regions of New York state.

In our study we have found only four fawns carrying embryos in Wisconsin. In addition, our observations of winter deer losses have failed to reveal any pregnancies in fawns. In the winter of 1949-50, 59 doe fawns, the majority of them dead from starvation, were checked for evidence of pregnancy without finding a single gravid fawn. These, of course, were probably not representative of fawns surviving that winter but they indicated that fawn pregnancies may be unusual.

Although we would like more information, nothing yet has been found to indicate that many doe fawns bear young in Wisconsin.

Number of Young Per Year

A doe may bear a single fawn, twins, or triplets. Quadruplets have been reported occasionally elsewhere (Trippensee, 1948), but we have no records of quadruple births in Wisconsin. If they do occur, they are probably rare.

The prevailing opinion among hunters is that the first offspring of a doe, usually born when she is two years of age, will be a single fawn. Each year thereafter she is supposed to bear twins or sometimes triplets. That this is not necessarily the case has been demonstrated by Cheatum and Morton (1946) in New York. They reported some twinning in does dropping their first fawns at one year of age. We have Wisconsin records of ten gravid 2-year-old does that were found dead. Presumably these does were carrying their first fawns. Seven of the does carried single fawns, two carried twins, and one carried triplets. The latter was a Jackson county doe killed by dogs at approximately 20 months of age. Comparable records of 33 does more than two years old showed that 13 (39 per cent) carried single fawns, 19 (58 per cent) carried twins, and one (3 per cent) carried triplets.

While these figures are interesting, they are not as useful for determining productivity as is the average number of fawns per doe. Table 18 shows the ratio of singles to twins and triplets derived from analysis of wardens' seizure cards, reports from pathological examinations at the State Game Farm, and Deer Project field notes for the period 1939 to 1951. An average of 1.6 fawns per breeding doe is indicated by these data.

In Table 18 and the records just cited we do not know how extensive an effort was made to list those instances in which does were examined and found to be without fawns during the period of pregnancy. Consequently we must rely on data collected by the Deer Project from 1949 through 1951 for information on the ratio of bearing to non-bearing adult does. Forty-one of a total of 46 does that were two years old or older at fawning time and were examined by project personnel during this period, were bearing fawns. These data indicate that approximately 89 per cent of does two years old or older at fawning time would be productive. If the productive does average 1.6 fawns per doe (Table 18), the average production per doe that is two years or older at fawning time would be:

1.6 x per cent of productive does (.89) = 1.42 fawns per doe.

During the 1950 hunting season, age determination of does shot by hunters revealed that 27 per cent of the 1,124 does 1½ year old or older were yearlings (16-20 months old). During the 1951 season, similar records for 970 does showed that 23 per cent were yearlings. When the two years' data are averaged, yearling does make up approximately 25 per cent, or one-fourth, of the total adult and yearling doe population in fall. If this yearling segment of the fall population, which would have to have been bred at 6 to 9 months of age, is not significantly productive in Wisconsin, then the average potential productivity for all does at fawning time can be calculated:

Total does (1) x per cent of adult does (.75) = 0.75 (number of does two years and older at fawning time);

0.75 x average fawn production per adult doe (1.42) = 1.06.

This figure (1.06) represents the average number of fawns produced by does in all age classes in the herd.

We might now speculate that for a deer population having an adult sex ratio of one buck to one doe, 106 fawns should be expected for every 200 deer in the herd at fawning time. However, this breeding potential has seldom, if ever, existed in Wisconsin, since it has been modified by varying sex and age compositions.

The Primary Sex Ratio

Conservation wardens' seizure cards, autopsy records and Deer Project field notes since 1949 were examined for information on the sex of unborn fawns. The specimens from which the embryo data were obtained were largely car-killed deer, with dog kills and illegal hunting kills next in importance. Records from does found dead in deer yards on spring dead-deer checks are also included, although they are a relatively minor portion of the whole. It may be argued that records of embryos from such does should not be included. However, there is yet no evidence to indicate that the sex ratio of embryos from old or weakened does is any different from the ratio of fawns from young or thrifty animals.

An average of 160 fawns per year can be expected to be produced by every 100 breeding does in Wisconsin.

TABLE 18

Occurrence of Single, Twin and Triplet Embryos by Area

Area	Number of Does With			Total Does	Total Embryos	Average No. Fawns Per Breeding Doe
	Singles	Twins	Triplets			
Northeast	14	25	3	42	73	1.7
Northwest	29	27	1	57	86	1.5
Central	20	21	1	42	65	1.5
State Total	63	73	5	141	224	1.6

TABLE 19

Deer Primary Sex Ratios

Species	State	No. of Embryos	Per Cent Males	Males Per 100 Females	Source
Whitetail	Wisconsin	168	60	151	This study
Whitetail	Texas	36	58	130	Illige (1951)
Whitetail	W. Virginia	167	49	94	DeGarmo (1952)
Mule	Utah	307	56	126	Robinette & Gashwiler (1950)
Mule	California	64	53	113	Chaffin (1948)

The sex of 168 identified embryos from Wisconsin does shows that 101 (60 per cent) were males, a primary sex ratio of 151 males to 100 females. Table 19 compares the results of this study with similar reports from other states. We cannot explain the differences in primary sex ratios between states.

Of 38 single fetuses examined, 26 (68 per cent) were males; 89 (58 per cent) of 118 twin fetuses were males, and 6 of 12 triplet fetuses were males.

Sex Ratios of Fawns in Summer

Wardens' seizure cards from 1938 through 1952 were searched for records of fawns seized during the months following fawning and prior to the hunting season. The results show that of 341 fawns taken during the months of May through October, 170 (50 per cent) were males, indicating a post-natal sex ratio in fawns of 99 males to 100 females.

It can be argued that these records are indicative of the sex ratio of fawn losses, rather than the ratios of surviving fawns, but there is at present no reason to assume that these records are influenced by differential sex losses. Consequently, they may be accepted as an indication of the summer sex ratio in fawns within the limitations of the statistical reliability of the sample. The differences between the summer sex ratios and the prenatal ratios are statistically significant at the 95 per cent level of confidence. No significant differences were found among ratios between months.

Sex Ratios of Fawns in Fall

A considerable amount of data on sexes of fawns killed during hunting seasons has accumulated. Fall sex ratios that are most comparable to summer ratios are those obtained from illegal kills seized by conservation wardens during buck hunting seasons in the period 1938 to 1948. These records permit an analysis of fawn sex ratios as they are related to range conditions (Table 17).

Of 1,286 fawns taken from poor range, 649 (50 per cent) were males, a ratio of 102 males to 100 females. Of 794 fawns taken from good range, 411 (52 per cent) were males, a ratio of 107 males to 100 females. These ratios are not significantly different and indicate that on the average the same percentage of buck fawns can be expected on good range as on poor range.

On Chambers Island, where range conditions have been poor for many years, more doe fawns than buck fawns have been removed. However, the small sample (41 males and 48 females including weight-study and 1950 hunting-season fawns) does not offer conclusive proof of an excess of females in this area.

In 1946, range conditions on the Necedah National Wildlife Refuge in Juneau county were critical and the Wisconsin Conservation [illegible]

and the U. S. Fish and Wildlife Service jointly conducted a controlled antlerless deer hunt to remove some of the surplus animals. During this season 518 fawns were taken, of which 54 per cent were males.

In 1947 another controlled hunt was conducted on the Necedah Refuge, including most of the area open in 1946, plus additional acreage in the Meadow Valley Unit of the Central Wisconsin Conservation Area in Juneau county where range conditions were similar to Necedah. Of the 642 fawns taken on the total area, 301 (47 per cent) were males, indicating a shift from a preponderance of males in 1946 to a preponderance of females in 1947. The combined kill of 1,160 fawns for two years consisted of 580 deer of each sex, a ratio of 100 males to 100 females. The differences between the sex ratios for 1946 and 1947 is statistically significant at the 98 per cent level of confidence.

During the antlerless and any-deer hunting seasons of 1949 through 1951, the sex and age of 2,400 fawns legally taken were recorded at checking stations. The sex ratios of fawns taken during these years are shown in Table 20. Sexes of fawns taken by bow hunters during the same years (Table 20) show greater variation in the proportion of males, probably because of sample size. When all records of fawns killed in fall are combined, the observations total 6,625. Of this number, 3,451 (52 per cent) were males, indicating that an average fall sex ratio in Wisconsin fawns is 109 males to 100 females.

Sex Ratios of Fawns in Winter

Fawn sex ratios in winter have come from two sources. The first is a record of fawns trapped in winter. These records include 267 fawns taken by Stephenson-type deer traps in winter yards during the months of January, February and March. Of the 267 fawns, 143 (54 per cent) were males, indicating a sex ratio in winter of 115 males to 100 females. A total of 121 of these fawns were removed from the Barksdale enclosure in Bayfield county, which has had a serious problem of over-population since the early 1930's and is not open to hunting. When the 121 Barksdale fawns are considered separately, it is interesting to note that 61 (50 per cent) were males, indicating a ratio of 102 males to 100 females. The sex ratio of the 146 remaining fawns is 128 males to 100 females. These ratios may be distorted by differential trap shyness.

With the exception of the Barksdale sample, the observations of trapped fawns indicate a preponderance of males, with the proportion of males being higher than any hunting-season sample but lower than the proportion of males in the embryo counts.

The second source of winter fawn ratios is the data accumulated from checks of winter mortalities encountered on winter-yard surveys. Of a total of 1,218 fawns found dead, most of which were starved, during the winters of 1940 to 1952, 609 (50 per cent) were males, indicating a ratio

TABLE 20
Fawn Sex Ratios from Wisconsin Hunting Seasons

	Year	No. of Males	No. of Females	Total Deer	Per Cent Males	Males per 100 Females
GUN-HUNTING	1949	172	137	309	56	126
	1950	388	380	768	51	102
	1951	709	614	1,323	54	115
	Total	1,269	1,131	2,400	53	112
BOW-HUNTING*	1948	51	38	89	57	134
	1949	125	75	200	63	167
	1950	73	74	147	50	99
	1951	35	26	61	57	135
	1952	27	16	43	63	169
	1953	68	50	118	58	136
	1954	122	116	238	51	105
	Total	501	395	896	56	127

* Compiled by Otis S. Bersing.

of 100 males to 100 females. These data may be distorted by differential mortality, although we have no reason to support this contention.

Discussion

What determines sex ratios of deer fawns? Does range condition have an effect? Does the ratio of adult bucks to adult does have any influence? Are males more susceptible to mortality than females before they become adults? These are some of the questions for which answers have been sought.

Leopold (1933, p. 106) suggests a relationship between fawn sex ratios and adult ratios. He quotes Crew: "In the case of the (domestic) rabbit it has been shown that the sex ratio is related to the chronological order of the service of the buck; in the first service group there is a preponderance of males, and then an increasing preponderance of females." If such a condition were also true of deer populations it could be that fawn sex ratios are related to adult ratios. Thus an even sex ratio in adults would produce an excess of male fawns, a moderately unbalanced ratio in adults would produce an even sex ratio in fawns, and a great excess of females in the adult segment would produce an excess of female fawns.

It is also possible that on ranges where winter food conditions are poor that the sex ratio will favor female fawns, although the Wisconsin data are not conclusive in this respect. The Chambers Island and Barksdale ratios obtained from the deer weight study (Table 17) are suggestive of a higher proportion or probably even excesses of females on poor range, but the limitations of sample size, or the lack of differences encountered in the larger sample of the deer weight study, rule out a definite conclusion

of a relationship between poor range conditions and the excess of female fawns.

For Wisconsin data from the Necedah Refuge, the indications are exactly opposite. In this case the first removal of 518 fawns in 1946 showed an excess of males by a ratio of 117 males to 100 females. In the succeeding year when herd-range relationships should have been improved, a removal of 642 fawns showed an excess of females by a ratio of 88 males to 100 females.

Gunvalson *et al.* (1952) have reported a similar phenomenon during removal of an excess deer population from St. Croix State Park, Minnesota. In 1945 approximately 76 deer per square mile were taken from 17 sections on the east side of the park and showed a fawn sex ratio of 137 males to 100 females. The following year (1946), removal of approximately 60 deer per square mile from the west one-half of the park showed an excess of female fawns by a ratio of 77 males to 100 females. Most other Minnesota data pointed to a considerable excess of males over females in both adult and fawn segments. The authors concluded that "Males are in excess of females in both fawn and adult classes normally throughout the state" (p. 130).

TABLE 21
Seasonal Changes in Wisconsin Fawn Sex Ratios

Period	*No. of Deer*	*Per Cent Males*	*Males per 100 Females*
In Utero	168	60	151
Summer	341	50	99
Fall	6,625	52	109
Winter	1,485	51	103

There is little indication in the Wisconsin data that any change in sex ratio takes place between birth and the end of the first year of a fawn's life. The only indication of a change is that from fetal observations to summer, fall and winter ratios. Table 21 illustrates this point. A statistically significant decline occurs in the excess of males between the fetal period and summer, but no significant differences in the sex ratio between summer, fall or winter are indicated.

It must then be concluded that (1) any changes in sex ratio that take place as a result of differential losses during the first year of life must occur prior to the time that an age class enters its first hunting season at approximately five to six months after birth; and that (2) on the basis of more than 8,000 observations on fawns the fall and winter sex ratio of whitetail fawns in Wisconsin averages 107 males to 100 females, although subject to yearly variation due to unknown causes.

Sex Ratios of Adults by Direct Observation in Fall

The most important technique for determining the sex and age of adult deer, in terms of effort expended during the course of this study, has been to sample the annual fall population ratio. This tally consists of making direct observations on deer during the period of evening and early morning feeding activity from September to mid-November. Observations are made with the use of spotlight and binoculars to increase the accuracy of sex and age determinations. It is impossible to differentiate between yearlings and older deer by this sampling method, so the deer observed must be classified as bucks, does and fawns. These sex and age ratios are used as an indicator of changes in the sex and age composition of the herd.

The sex ratios of the adult and yearling segment of the herd, (hereafter called "adult") indicated by direct pre-season observation since the beginning of this study in 1940 are shown in Table 22. From 1940 through 1954 the number of bucks observed per 100 does ranged from 31 to 62 and averaged 42. From 1940 to 1951 there was a substantial increase in the number of hunters and the number of deer killed, particularly during the liberal seasons of 1949 and 1950 (Table 50). A marked influence on the adult sex ratios due to the effects of these two hunting seasons was noted; the bucks per hundred does ratio changed from 34 in 1949 to 62 in 1951. From 1952 through 1954, which were years of buck hunting seasons, the proportion of bucks remained at a relatively high level.

Summer and fall "deer census drives" conducted by the C.C.C. in the period 1935 to 1941 are reported by Swift (1946). A total of 23,434 deer observed in these years had an average of 38 bucks per 100 does. Thus the ratio of adult bucks to adult does apparently remained relatively constant through the period of buck hunting seasons.

Sex Ratios of Adults in Fall Hunting Seasons and in Winter

The hunting seasons since 1948 have provided information on the sex of adult deer taken by hunters. Sex ratios of adult deer shot by bow and arrow hunters are given in Table 23. From 1948 (when sex ratios in the bow kill were first recorded) to 1953 the number of males per 100 females ranged from 47 to 87 and averaged 60. In these years bow hunters could take one deer of any age or either sex. Bow seasons usually opened in September and ran through the end of the November gun season, although the gun hunting regulations applied to bow hunters during the open season with guns. However, the major part of the bow kill occurred before the gun season opened and during the time when the pre-season population observations were being made.

During the gun hunting seasons of 1950 and 1951, regulations permitted each hunter to take one deer of any age or sex. In these years, the sex of 3,705 adult deer shot by hunters was recorded (Table 24). These

TABLE 22

Pre-Hunting Season Adult Sex Ratios

Year	No. of Males	No. of Females	Total Deer	Per Cent Males	Males per 100 Females
1940	595	1,515	2,110	28	39
1941	162	353	515	31	46
1944	151	323	474	32	47
1945	94	304	398	24	31
1946	140	390	530	26	36
1949	298	876	1,174	25	34
1950	346	774	1,120	31	45
1951	141	227	368	38	62
1952	178	362	540	33	49
1953	134	370	504	27	36
1954	287	532	819	35	54
Total	2,526	6,026	8,552	30	42

TABLE 23

Bow Hunting Season Adult Sex Ratios*

Year	No. of Males	No. of Females	Total Deer	Per Cent Males	Males per 100 Females
1948	69	117	186	37	59
1949	108	228	336	32	47
1950	82	149	231	35	55
1951	43	79	122	35	54
1952	37	43	80	46	86
1953	109	125	234	47	87
1954	208	285	493	42	73
Total	656	1,026	1,682	39	64

*Compiled by Otis S. Bersing

TABLE 24

Gun Hunting Season Adult Sex Ratios

Year	No. of Males	No. of Females	Total Deer	Per Cent Males	Males per 100 Females
1950	842	1,124	1,966	43	75
1951	769	970	1,739	44	79
Total	1,611	2,094	3,705	43	77

deer were classified as adult by the age criteria described by Severinghaus (1949). The number of males per 100 females was 75 in 1950 and 79 in 1951, an average of 77.

For the winter season our data are limited. Records of 176 adult deer trapped throughout the state during the years 1940 to 1952 in random trapping operations indicated a sex ratio of 34 males per 100 females, or 26 per cent males. In trapping operations at the Barksdale enclosure in Bayfield county, 135 adult deer trapped and removed during the period 1936 to 1952 had a sex ratio of 77 males per 100 females or 43 per cent males. On this area, does tend to outnumber bucks, despite the fact that hunting is not allowed. In the total trapped sample of 311 deer there were 50 males per 100 females or 33 per cent males.

Table 25 summarizes adult sex ratios obtained by four methods. It is apparent that important differences occur between samples in given years, but since sex ratios are closely allied with age ratios of the same populations, these differences will be discussed at the end of the next section.

Fall Herd Composition

The relative proportions of adult and yearling bucks, adult and yearling does, and fawns in the Wisconsin deer herd are important inventories for management. Such information, for example, shows the trends from year to year in gains and losses due to various mortality factors such as hunting, and the success of the breeding season as measured by fawn production.

The Deer Project has used three approaches in determining herd composition in fall. The first has been by direct observation in the months preceding the hunting season, as outlined in a previous section. The results by this method are given in the "Pre-Hunting Season" category of Table 26. The indicated 11-year average herd composition is 18 per cent bucks, 43 per cent does and 39 per cent fawns. The average fawn production during the same period indicated by this method was 89 fawns per 100 does. Expressed in other terms, fawn production equalled 0.89 fawns for each doe, a figure that is less than 1.06 fawns per doe determined as the average fawn production per doe at fawning time. This difference may be a measure of the mortality that occurs between the time fawns are dropped and the following fall.

A second method of determining herd composition has been through an examination of deer shot by hunters. The gun hunting seasons of 1950 and 1951, which permitted the taking of deer of any age and either sex, provided an opportunity to age a large sample of the deer harvest. A total of 7,488 deer were checked during these two hunting seasons (Table 26) with an average composition of 32 per cent bucks, 40 per cent does, and 28 per cent fawns.

TABLE 25
Adult Sex Ratio Summary

Period	1936	1940	1941	1942	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	Total
PRE-HUNTING																
No. of Deer	---	2,110	515	---	474	398	530	---	---	1,174	1,120	368	540	504	819	8,552
Per Cent of Males	---	28	31	---	32	24	26	---	---	25	31	38	33	27	35	30
Males:100 Females	---	39	46	---	47	31	36	---	---	34	45	62	49	36	54	42
BOW HUNTING																
No. of Deer	---	---	---	---	---	---	---	---	186	336	231	122	80	234	493	1,682
Per Cent of Males	---	---	---	---	---	---	---	---	37	32	35	35	46	47	42	39
Males:100 Females	---	---	---	---	---	---	---	---	59	47	55	54	86	87	73	64
GUN HUNTING																
No. of Deer	---	---	---	---	---	---	---	---	---	---	1,966	1,739	---	---	---	3,705
Per Cent of Males	---	---	---	---	---	---	---	---	---	---	43	44	---	---	---	43
Males:100 Females	---	---	---	---	---	---	---	---	---	---	75	79	---	---	---	77
WINTER TRAPPING																
No. of Deer	35	7	56	18	---	---	30	64	5	19	29	43	5	---	---	311
Per Cent of Males	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	33
Males:100 Females	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	50

The third index of fall herd composition is the record of deer shot by bow hunters as reported by conservation wardens. These data are likewise given in Table 26. The six-year average for deer killed by bow hunters is 26 per cent bucks, 39 per cent does, and 35 per cent fawns. Indicated average fawn production is 89 fawns per 100 does.

It is apparent that important differences have occurred in the ratios compiled by the various methods in any one year. Highly significant statistical differences exist between the pre-hunting and gun-hunting ratios in 1950 and 1951. In these years the pre-hunting and bow-hunting ratios are not significantly different. However, the difference between the pre-hunting and bow-hunting ratios in 1949, 1952, 1953, and 1954 are highly significant.

TABLE 26
Wisconsin Deer Herd Composition

Year	Season	Bucks* No.	Bucks* %	Does* No.	Does* %	Fawns No.	Fawns %	Total Deer	Fawns per 100 Does
1940	Pre-Hunting	595	17	1,515	43	1,440	40	3,550	95
1941	Pre-Hunting	162	22	353	48	223	30	738	63
1944	Pre-Hunting	151	21	323	44	267	35	741	83
1945	Pre-Hunting	94	14	304	45	272	41	670	89
1946	Pre-Hunting	140	16	390	44	364	40	894	93
1948	Bow-Hunting	69	25	117	43	89	32	275	76
1949	Pre-Hunting	298	16	876	46	731	38	1,905	83
	Bow-Hunting	108	20	228	43	200	37	536	88
1950	Pre-Hunting	346	20	774	44	637	36	1,757	82
	Bow-Hunting	82	22	149	39	147	39	378	99
	Gun-Hunting**	842	31	1,124	41	768	28	2,734	68
1951	Pre-Hunting	141	24	227	39	219	37	587	92
	Bow-Hunting	43	23	79	43	61	33	183	77
	Gun-Hunting**	1,553	33	1,878	39	1,323	28	4,754	70
1952	Pre-Hunting	178	21	362	42	316	37	856	87
	Bow-Hunting	37	30	43	35	43	35	123	100
1953	Pre-Hunting	134	15	370	43	364	42	868	98
	Bow-Hunting	109	31	125	35	118	34	352	94
1954	Pre-Hunting	287	21	532	38	575	41	1,394	108
	Bow-Hunting	208	28	285	39	238	33	731	84

* Includes adults and yearlings. No data taken in missing years. From 1940 through 1949 approximately 33 per cent of bucks were spikes; in 1950 through 1954, per cent of spikes was 20.
** Percent of spikes among bucks: 1950, 31; 1951, 26.

What are the reasons for these differences? In comparing pre-hunting and gun-hunting ratios we believe that several factors exist which tend to distort the observations in opposite directions. The pre-hunting ratio tends to favor does and fawns. Bucks, during the early fall when the direct observations are being made, are approaching the rutting period. At this time they tend to segregate to some extent and are more furtive than at other seasons; thus they are less often seen than antlerless deer. A second reason is due to the nature of the observation method. Of necessity, the pre-hunting tallies are made at night or at twilight when deer are feeding in openings. Under such poor light conditions, even though a spotlight and binoculars are employed by the observer, the small antlers of spike bucks are difficult to identify positively. Spike bucks, which make up the yearling portion of the adult and yearling segments classed together as bucks in the ratios, therefore tend to be under-represented. For these reasons we believe that antlered bucks do not appear in the pre-hunting ratios in their true proportions.

At the other extreme, the gun-hunting ratios of 1950-51 tend to favor antlered bucks, and to a lesser extent the larger antlerless deer. This results in a distorted proportion of bucks killed by hunters. The hunting season usually coincides with the rut; bucks are, therefore, less wary and more active at this season, making them more vulnerable to the hunters' guns. Coupled with the behavior of the bucks is a degree of selection for larger deer, particularly forked-horn bucks, by a sizeable number of hunters. This is particularly true of opening weekend, when a large share of the total season kill takes place.

The net result of this hunting season behavior of both deer and hunter is the take of a disproportionate percentage of bucks during the liberal hunting seasons. This and the favoring of does and fawns in pre-hunting ratios account, at least in part, for the discrepancies between the pre-hunting and gun kill ratios of 1950 and 1951.

The difference between herd composition ratios compiled by bow-hunting and the pre-hunting and gun-hunting methods is a more difficult problem. It would be logical to assume that the pre-hunting and bow-hunting ratios should be the same, since the bow hunting season has usually been open from late September through the November gun season, thus covering most of the period during which pre-hunting observations are made. However, this assumption held true only for 1950 and 1951. The differences seem due, at least in part, to the scope of the bow kill. Each year a major part of the bow kill is made in about six central and northeastern counties; Vilas and Juneau are two counties in particular. The bow-hunting sample is small to begin with and covers relatively small areas of the state compared to the pre-hunting and hunting-season ratios, which cover all the major deer counties. We therefore place less confidence in the accuracy of statewide herd composition indicated by the bow kill than by the other two methods.

Useful data are obtained annually at checking stations by examining deer killed by hunters. Here a game manager is aging a buck by tooth-wear criteria during the 1953 hunting season.

It is our opinion that some error exists in both the pre-hunting and gun-hunting herd composition ratios. Since the pre-hunting ratios favor antlerless deer and the hunting ratios favor antlered bucks, the true population ratio probably falls somewhere between the two. Thus, the pre-hunting ratios in years without any-deer hunting seasons must be considered as minimum percentages for bucks and maximum for does and fawns. Whatever errors exist in either sampling method should remain fairly constant from year to year, since neither the method nor the behavior of the deer are subject to much change. The only exception would be in years where weather results in an early rut, in which case pre-hunting observations would be closer to absolute accuracy since they would cover part of the rut when bucks are less wary and more active.

Hunting Season Age Ratios

Since the 1949 hunting season 9,884 deer shot by hunters have been aged by tooth development and wear criteria developed by Severinghaus (1949). The ages of these deer are summarized in Table 27.

TABLE 27
Statewide Hunting Season Age Ratios

Age*	1949 Male	1949 Female	1949 Total	1950 Male	1950 Female	1950 Total	1951 Male	1951 Female	1951 Total	1952 Male	1953 Female	1954 Male
Fawn												
Number	71	80	151	388	380	768	709	614	1323	--	--	--
Per Cent	70	34	45	32	25	28	48	39	43	--	--	--
1½ Years												
Number	29	34	63	324	300	624	266	222	488	136	389	806
Per Cent	--	22	34	38	27	32	34	23	28	21	38	39
2½ Years												
Number	2	19	21	257	342	599	185	230	415	126	244	565
Per Cent	--	12	11	31	30	30	24	24	24	19	24	27
3½ Years												
Number	--	31	31	187	276	463	198	260	458	199	229	403
Per Cent	--	20	17	22	25	24	26	27	26	30	23	19
4½ Years												
Number	--	31	31	49	104	153	92	121	213	119	97	147
Per Cent	--	20	17	6	9	8	12	12	12	18	10	7
5½ Years												
Number	--	20	20	18	48	66	14	61	75	47	33	74
Per Cent	--	13	11	2	4	3	2	6	4	7	3	4
6½ Years												
Number	--	14	14	5	21	26	7	23	30	22	8	51
Per Cent	--	9	7	0.6	2	1	1	2	2	3	1	2
7½ Years												
Number	--	4	4	--	16	16	6	36	42	8	8	21
Per Cent	--	3	2	--	1	0.8	0.8	4	2	1	1	1
8½ Years												
Number	--	1	1	1	9	10	1	13	14	--	4	6
Per Cent	--	0.6	0.5	0.1	0.8	0.5	0.8	1	0.8	--	0.4	0.3
9½ Years												
Number	--	--	--	--	3	3	--	3	3	2	1	3
Per Cent	--	--	--	--	0.3	0.2	--	0.3	0.2	0.3	0.1	0.1
10+ Years												
Number	--	1	1	1	5	6	--	1	1	2	--	1
Per Cent	--	0.6	0.5	0.1	0.4	0.3	--	0.1	0.1	0.3	--	0.1
Total Deer	102	235	337	1230	1540	2734	1478	1584	3062	661	1013	2077

* The per cent of fawns is per cent of total deer in each year's sample; the per cent of age classes 1½ years old and older are per cent of all deer from the 1½ year age class through 10 years.

The anterless hunting season of 1949 followed 20 years of bucks-only hunting, with the exception of the 1943 split season when antlerless deer could be shot after a buck season. Despite protection, the age distribution of does shot in 1949 shows that deer older than 5½ years were very few. Similar age distributions were found for bucks in the period 1950 to 1954. It is obvious that at no time since deer ages were first recorded in 1949 have older deer contributed much to the kill. A striking example of similar age composition was found in Indiana when that state had its first deer hunting season in 58 years. In this previously unshot population only 10 per cent of the adult and yearling bucks and does were more than 5½ years old (Allen, 1952).

Although individual deer may live as long as 20 years, we believe that causes other than legal hunting are removing deer from the population at a rate that permits only a small portion of the herd to reach an age of 6 years or more. In other words, there is no evidence to show that older deer are present but are not shot because they are "smarter" than young animals and successfully elude hunters. Even in areas of extremely heavy hunting pressure, where the proportion of older deer might be expected to be larger, the age ratios of deer shot by hunters are the same as in lightly hunted areas.

Deer are continually exposed to a wide variety of potential mortality factors other than legal hunting; what these factors are and how they affect the various age groups are discussed in the next two chapters. A more complete analysis of hunting-season age ratios is pending; more intensive study of this subject is necessary before interpretations can be properly made with confidence.

Chapter IX

Mortality Factors

Throughout the year, the natality factors that tend to increase the herd are weighed against the mortality factors that tend to decrease the herd. Those factors that directly reduce the numbers of animals existing in a population include hunting, predation, starvation, diseases and parasites, and accidents (Leopold, 1933). When the combined effect of these factors is equal to the increase factors, the herd remains stable. It follows that increases or decreases in the herd depend on the degree to which one set of factors outweighs the other.

One of the objectives of management is to maintain stable deer populations at the highest level possible. This "highest" level is not necessarily the greatest in terms of absolute numbers of deer, but it is always the largest number of deer that the existing range can support in a healthy condition. It is also an objective of management to legally harvest the proportion of the annual increases in the herd that must be removed to maintain a healthy and productive herd as well as a healthy and productive range.

In this chapter is presented what knowledge is presently available on the effect of the various mortality factors upon the herd and some suggestions for increasing the return to the legal hunter.

Hunting

Included in this factor are (1) the legal deer taken home during a hunting season, (2) the cripples and illegal kills left in the woods after a hunting season, and (3) the deer taken by illegal hunting out of season.

It is generally conceded by most authorities that legal hunting under any type of buck law has very little effect on a deer population. Under a forked-horn buck law, such as existed in Wisconsin during most years of our study, the effect is usually considered insignificant. In a population that has a buck-to-doe ratio of about one buck to three does, the aggregate of all bucks would make up less than 20 per cent and forked-horn bucks less than 15 per cent of the total herd. Even if two-thirds of the forked-horn bucks would be removed annually from this population the effect of legal hunting would be the removal of less than 10 per cent of the fall population each year. When compared with the expected potential increase in total herd size of at least 30 per cent each year, it is evident that legal hunting for forked-horn bucks could not by itself stabilize or reduce a deer population.

What percentage of the total available forked-horns are taken by hunters each year? This is one of the questions that deer tagging experiments have sought to answer. In Table 28 is shown the frequency of returns from 196 bucks that were legal in the first season following tagging and from 117 bucks released as fawns, the majority of which would not have been legal under the forked-horn buck law until the second season following tagging.

The total return of 49 deer is 16 per cent of the 313 tagged bucks. Of the 49 returns recorded over periods ranging up to 13 years after

TABLE 28

Returns of Bucks Tagged in Winter and Shot by Hunters

Winter of Tagging	*Number Tagged*	*Season of Return after Tagging*								*Total Return*
		1st	*2nd*	*3rd*	*4th*	*5th*	*7th*	*8th*	*13th*	
ADULTS										
1935-36	16	1	---	---	---	---	---	---	---	1
1938-39	34	2	---	---	---	---	---	---	1	3
1940-41	87	12	4	1	1	---	1	1	---	20
1941-42	1	---	---	---	---	---	---	---	---	0
1945-46	12	1	1	---	---	---	---	---	---	2
1946-47	13	3	---	---	---	---	---	---	---	3
1947-48	2	1	---	---	---	---	---	---	---	1
1949-50	17	5	1	---	---	---	---	---	---	6
1950-51	14	2	---	---	---	---	---	---	---	2
Total	196	27	6	1	1	---	1	1	1	38
% of Returns		71	16							
FAWNS*										
1935-36	4	---	---	---	---	---	---	---	---	0
1938-39	22	---	---	---	---	---	---	---	---	0
1939-40	1	---	---	---	---	---	---	---	---	0
1940-41	21	---	1	---	---	---	1	---	---	2
1941-42	15	1	2	---	---	---	---	---	---	3
1945-46	20	---	1	---	---	1	---	---	---	2
1946-47	32	1	2	1	---	---	---	---	---	4
1947-48	2	---	---	---	---	---	---	---	---	0
Total	117	2	6	1	---	1	1	---	---	11
% of Returns		18	55							
TOTAL RETURNS										
Number		29	12	2	1	1	2	1	1	49**
Per Cent		59	24	4	2	2	4	2	2	

* Since only a portion of bucks developed forked antlers at 12 months of age, the bulk of these deer would not have been legal until the second season following tagging. Therefore, both first and second season returns for fawns (8 deer total) must be lumped with first season returns of older bucks (27 deer) to give the maximum removal figure (35 deer). If this is done the resulting percentage (71 percent) represents the maximum removal indicated by these returns. For further discussion see text.

** The total return of 49 deer is 16 per cent of the 313 tagged bucks.

tagging 71 per cent occurred in the first hunting season after tagging in which these deer were legal. Since a number of deer released prior to 1951 may still be alive, and since undoubtedly a number of tagged deer have been bagged but not reported, the 16 per cent total return represents a minimum recovery. The high percentage (71 per cent) of the total returns during the first legal season following tagging is a maximum removal of forked-horn bucks, since any further tag returns in subsequent years would tend to reduce the first-year return percentagewise. The true percentage of forked-horn bucks removed from the population each year falls somewhere between the extremes of 16 and 71 per cent. The legal hunting kill probably accounts for the greater proportion of such removals.

Table 29 shows special-area tagging studies that indicate a minimum return of 27 per cent for all deer during any-deer hunting seasons. This figure falls within the range of removal percentages for bucks only.

Illegal Kill and Crippling Loss during Hunting Season

It is an unfortunate fact that a large part of the losses from a deer herd that is hunted under a buck law results from the kill or crippling of deer that are not legal game during such a season. A number of studies of these losses have been made.

Leopold (1931) cites the records of F. C. Kilp, whose tree planting crews found the carcasses of eight does on 300 acres covered by planting operations following the 1928 deer season. The indicated illegal kill ratio was 500 illegal deer killed for every 100 legal bucks taken home. Leopold also cites a rougher survey made by the Rev. B. F. Schoenfeld of Park Falls, who, through personal interview of hunters and assumption, concluded that not over 10 illegal does per 100 legal bucks killed had been left in the woods in the area covered by his survey.

Sanders (1939) concluded from sample cruises on the Chequamegon National Forest in 1937 that there were 68 wounded or dead, legal and illegal bucks, does and fawns left in the woods for each 100 legal bucks removed from the forest. In 1938 similar cruises indicated the loss to be 60 illegal deer per 100 legal bucks.

Grange (1948) estimated the illegal kill on the Wood County Public Hunting Grounds and surrounding area in 1941 to be 67 illegals per 100 legal forked-horn bucks, or one illegal kill for 175 acres.

Almost all other evidence collected in Wisconsin since 1941 indicates that these estimates (with the exception of Kilp's data) are, if anything, conservative (Table 30). In 1941 the Deer Project conducted a check of crippling losses and illegal kill in Burnett county, with the cooperation of the Civilian Conservation Corps from Camp Riverside. On a total area of 2,060 acres, a minimum of 10 illegal kills was found. In addition, three adult buck carcasses were found which were apparently crippling losses. The indicated legal kill on this area, based on a count of all entrails not positively identified as illegal kills, was 10 deer. The check indicated an illegal kill equal to the legal kill, plus an additional crippling loss of legal bucks equal to one-third of the legal kill. The indicated illegal kill of a deer per 206 acres is slightly above the average legal kill for Burnett county of one buck per 270 acres.

In 1947, coverage of 2,959 acres of observed area on a survey of deer damage to forest reproduction in the central forest area turned up a total of 39 deer identified as "hunter kills" left in the woods following the 1946 hunting season (DeBoer, 1947). The indicated loss was 130 illegal deer for every 100 legal bucks taken (Table 30).

In the spring of 1948, two separate dead-deer surveys totaling 1,246 acres in the Town of Knapp, Jackson county, indicated losses by illegal hunting of 338 deer per 100 legal bucks taken during the 1947 hunting season (Table 30). This evidence can be challenged on the basis that it represents an unusual situation. The town of Knapp was for many years a refuge, and its opening to hunting in 1947 resulted in a tremendous influx of hunters, with a very heavy legal kill, and, as should be evident, a very

TABLE 29

Returns of Deer Tagged in Winter and Recovered in Years of Any-Deer Seasons

Area & Winter of Release	*Sex & Age Class*	*Number Tagged*	*Season and Number Returned*				
			*Pre-1950**	*1950 Hunting*	*Pre-1951**	*1951 Hunting*	*Total Returns*
Chambers Id.	Ad. Buck	8	--	3	--	--	3
1946-47†	Buck Fawn	3	--	1	--	--	1
	Ad. Doe	20	1**	3	--	1	5
	Doe Fawn	4	--	3	--	--	3
	Total	35	1	10	--	1	12
Crex Meadows	Ad. Buck	17	1	5	--	1	7
P.H.G.	Buck Fawn	14	1	3	--	1	5
1949-50	Ad. Doe	12	--	--	--	1	1
	Doe Fawn	15	--	1	--	4	5
	Total	58	2	9	--	7	18
Madeline Is.	Ad. Buck	14	--	--	1	2	3
& Bayfield	Buck Fawn	17	--	--	2	1	3
County	Ad. Doe	29	--	--	2	4	6
1950-51	Doe Fawn	19	--	--	3	1	4
	Total	79	--	--	8	8	16
3-AREA TOTAL		172	3	19	8	16	46
Per cent of Return							27

† No hunting season until 1950.
* Includes car kills and starvation losses.
** This deer found dead in the Peshtigo Refuge, Marinette county. It apparently had moved off the island and across Green Bay.

heavy illegal kill. However, when compared with an average legal kill in Jackson county of slightly more than one buck per 100 acres, the illegal kill of one deer per 28 acres indicates an illegal kill several times greater than the legal take.

Since 1948, sample areas have been checked using a dead-deer drive system such as was used in the 1948 surveys in Jackson county. The results are shown in Table 30. During 1948 and 1952 these losses were largely illegal kills. During 1949 they included some illegal kills, but since only forked-horns were illegal, most of the loss was deer crippled or killed and not recovered. During 1950 and 1951, the entire loss must be classified as crippling loss since any deer was legal game. The central checks were made on the same areas each winter, while the northern area checks were made in conjunction with winter-yard checks and did not include the same yards each winter. The illegal kill losses are apparently somewhat less in northern areas than they are in the central area.

Some indication of the number of deer crippled by hunters that survive at least until the middle of the following winter was found by Kabat, Collias and Guettinger (1953). Their observations at artificial feeding stations in the Flag yard, Bayfield county, in February, 1952, showed that 15 (2 per cent) of 730 deer observed had crippled legs or obvious body scars, presumably due to hunting. These were deer of all ages and both sexes, since the preceding hunting season (1951) was for any one deer.

TABLE 30

Summary of Illegal Kill Checks

Following Season of	*Area*	*Observed Acreage*	*Observed Hunting Losses**		*Estimated Legal Kill†*		*Losses/100 Legal Deer*
			No.	*Acres/Deer*	*No.*	*Acres/Deer*	
1941	Burnett Co.	2,060	13	158	10	206	130
1946	Central Area	2,959	39	76	30	100	130
1947	Jackson Co.	1,246	44	28	13	96	338
1948	Central Area	2,997	40	75	22	135	182
Buck-Season Total		9,262	136	68	75	123	181
1949	Central Area	2,781	43	65	107	26	40
1949	Northern Area	2,490	36	69			
1950	Central Area	240	4	60	6	39	75
1950	Northern Area	2,124	35	61			
1951	Central Area	1,574	3	525	43	37	7
1951	Northern Area	784	4	196			
1952	Northern Area	808	7	115			
1953	Jackson Co.	864	2	432			
1953	Northern Area	336	5	67			

* 1941, 1948, 1949, 1952, and 1953 include illegal kills and crippling losses. 1946 and 1947 include illegal kills only. 1950 and 1951 include crippling losses only since these were any-deer seasons.

† Based on an average kill per acre of deer range for the entire county or groups of counties.

Their conclusions were as follows (pp. 29-30): "This estimate of deer surviving hunting season crippling does not include those deer surviving body wounds which left no visible external evidence of injury. Mortality from crippling during an antlerless deer season in areas of heavy deer concentration based on field checks (by Guettinger in 1949) has been estimated at 17 to 22 per cent of the legal kill . . . . If approximately two per cent of the deer seen in February are cripples, it appears that most deer that are crippled during the hunting season die within one to two months thereafter."

In summary, it appears that crippling and illegal kill losses during hunting seasons are roughly proportional to the size of the deer herd being hunted, although our samples of losses are not extensive. During buck seasons before 1949, when deer populations were high, the observed loss of cripples and illegal kills exceeded the legal kill at a rate of 181 to 100 legal bucks. This is a loss of one deer per 68 acres.

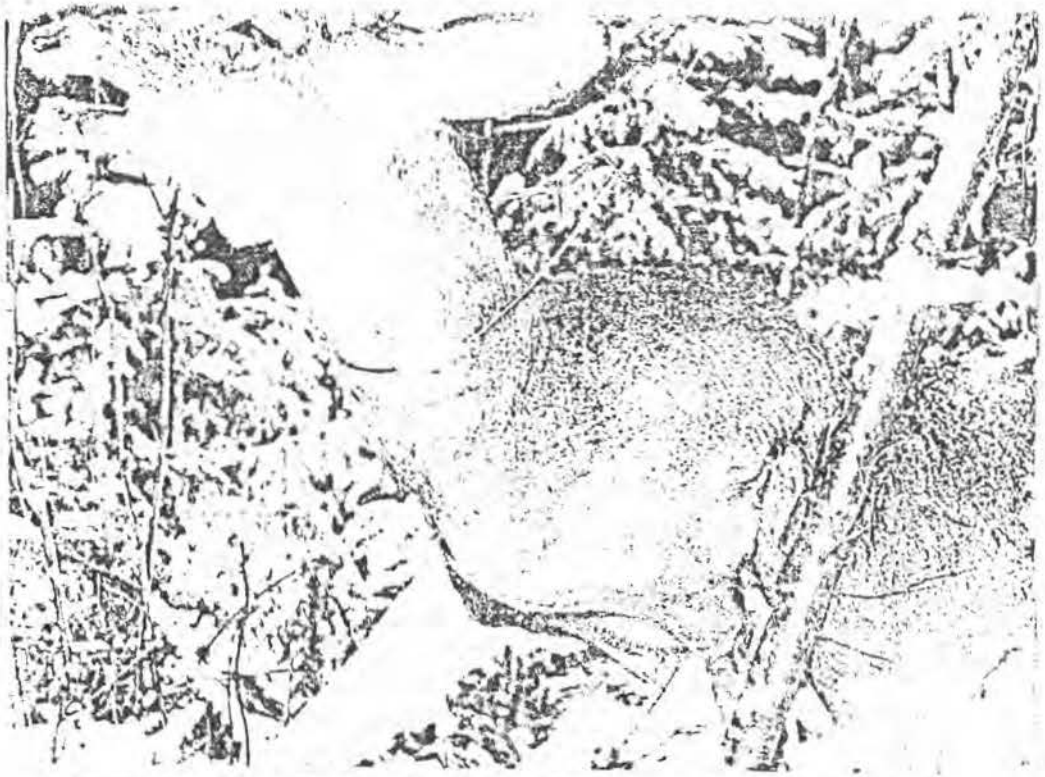
A similar loss of one deer per 67 acres was observed following the 1949 antlerless hunting season. Both illegal kills and crippling losses are included here. In 1950, when all deer were legal, all hunting losses were assumed to be cripples, since there were no illegal deer. Losses were observed to be one deer per 61 acres. By the fall of 1951, when a second any-deer season was held, a reduction of deer numbers in some parts of the central and northern areas had taken place. Hunting losses declined to one deer per 337 acres. Again, these losses were assumed to be entirely crippling losses, since all deer were legal game.

With a return to forked-bucks-only hunting in 1952 and 1953, losses were somewhat larger but not nearly as large as in the pre-1949 buck seasons. The two-season average was one deer lost per 143 acres, and included illegally-killed antlerless deer as well as cripples. In these years fewer deer were available to hunters than in any of the other recent seasons.

As a general trend, losses to crippling and illegal killing have been higher during years of buck seasons than in liberal seasons, but this does not seem to be a hard and fast rule. An additional consideration is how the number of hunters in the field influences hunting-season losses. The greatest numbers of hunters were found in the 1949 and 1950 liberal seasons when losses were highest. It seems logical to assume that with more deer and more hunters the illegal kills and cripples would increase. Although the mechanics of the interaction between deer and hunters that results in illegal kills and crippling losses are obscure, it has been our experience that such losses will never be eliminated. The "look before you shoot" idea has been widely publicized for years by the conservation department and others, but results have not been particularly satisfactory.

Illegal Hunting Outside of Hunting Season

There can be only speculation about the total losses that result from "outlaw" hunting outside of the regular hunting season. Almost anyone



Snaring is a type of poaching that is difficult to detect. This snared buck was found in 1940.

who has any contact with deer in Wisconsin has heard of illegal hunting of one type or another. A good share of the stories are pure bunk, but there is no denying that many are not.

Perhaps the most important type of illegal hunting, though not by any means the most well known, is the occasional deer taken by a rural landholder to supplement his meat supply. This drain on the population is difficult to detect, almost impossible to stop, and impossible to evaluate. Yet speculation indicates that it may in total be more important than the shining or other illegal hunting by transients operating one night here and another there. Nevertheless, the "shiners" who advertise their activities by use of spotlights and the occasional shooting of livestock occupy the limelight of illegal hunting.

There seems to be a direct relationship between deer density and the incidence of illegal hunting. During the early growth of a deer population, public feeling against poaching runs high and few are willing to admit they kill deer out of season. Probably very few people do. Once a herd becomes well established, however, it is a different matter. Getting a deer is easier, of course, and as public sentiment concerning deer "pro-

tection" relaxes, illegal hunting increases. We suspect that the annual out-of-season kill by individuals for private use, by "thrill-seekers", and by those who kill deer for resale is considerably larger than most people are willing to admit.

It is an unfortunate fact that the unavoidable emphasis on "too many deer" that accompanied the fight for herd management in recent years resulted in an increased tolerance of poaching. It should be emphasized that it *was not, is not,* and *never should be* the policy of the conservation department or the sportsmen of the state to allow the poacher to harvest game surpluses. Every hunter should have an equal opportunity to participate in such harvest. To assure himself that he will have that opportunity he should report immediately to his local conservation warden any evidence of poaching that he obtains. Until such time as there is less public apathy toward the illegal hunter, the drain on Wisconsin's deer herd by out-of-season hunting will be an important decimating factor.

Predation

Before the coming of the white man there were a number of predators in Wisconsin capable of exercising control over deer populations. Two of these, the cougar *(Felis concolor)* and wolverine *(Gulo luscus)* have been extirpated from the state. A third species, the lynx *(Lynx canadensis)*, is practically gone, as there have been only a very few widely scattered records of its occurrence in recent years. Another species, the timber wolf, exists only as a remnant population and probably cannot be considered as a serious decimating factor for deer except in small, local areas. In addition to the wolf, a number of other species currently found in Wisconsin are actual or potential deer predators. These include the coyote, bobcat, black bear, foxes (both red and gray), domestic and feral dogs, and possibly the raven and crow. However, their cumulative effect on Wisconsin deer can hardly be called great, as the number of deer killed by predators compared to other known causes in the period 1940 to 1952 was very small (Table 31).

The relative abundance of some of these predators can be indicated roughly by two methods summarized in Tables 32 and 33. Table 32 gives the results of one method for the winters of 1945 and 1954, a count of predator tracks in snow made by deer-yard cruisers. Tracks were tallied (in order of abundance) for fox, coyote, dog, bobcat and timber wolf. The only indicated significant change in the abundance of these predators between the two years was an apparent increase of foxes in the northern area.

The predator harvest by hunting and trapping since 1940 is shown in Table 33. Because of variations in hunting and trapping pressure due to season dates, bounty prices, fur values and so on, the year-to-year trends in number of animals taken are probably not important. Wolves are tallied with coyotes, and bobcat with lynx, because positive species identification

TABLE 31

Sex, Age, and Cause of Death of 2,845 Deer Examined During the Winters of 1940 to 1952

Cause of Death	Fawns				Adults				Age Unknown				Total Deer	
	Buck	Doe	Sex?	Total	Buck	Doe	Sex?	Total	Buck	Doe	Sex?	Total	No.	% of Losses
Starvation														
Number	609	609	217	1435	73	119	10	202	16	20	193	229	1866	66
Percent				88				12						
Illegal Kill & Crippling														
Number	38	45	6	89	73	116	1	190	--	--	20	20	299	11
Per cent				30				70						
Predation														
Number	13	5	6	24	8	21	2	31	1	2	23	26	81	3
Per cent				44				56						
Old Age														
Number	--	--	--	--	13	57	2	72	--	--	--	--	72	3
Per cent				--	19	81								
Accidents														
Number	4	3	2	9	5	18	--	23	1	--	--	1	33	1
Per cent				28				72						
Disease or Parasites														
Number	1	3	1	5	1	3	--	4	--	--	--	--	9	0.3
Per cent				56				44						
Unknown														
Number	31	41	52	124	34	54	12	100	--	4	257	261	485	17
Per cent				55				45						
Total Deer													2,845	

TABLE 32

Winter Predator Track Summary, 1945 and 1954

Area and Year	Miles Traveled Afoot	Tracks Observed									
		Timber Wolf		Coyote		Bobcat		Fox		Dog**	
		No.	T/100M*	No.	T/100M*	No.	T/100M*	No.	T/100M*	No.	T/100M*
NORTH											
1945	3013	112	4	2287	76	242	8	1274	42	102	3
1954	701	6	1	356	51	19	3	487	69	--	--
CENTRAL											
1945	2060	0	--	88	7	2	--	456	22	174	13
1954	69	0	--	5	7	0	--	15	22	--	--
TOTAL											
1945	5073	112	2	2375	47	244	5	1730	34	256	5
1954	770	6	1	361	47	19	2	502	65	--	--

* Tracks observed per 100 miles of walking.
** Not recorded in 1954.

is not always possible when bounties are paid. However, these tallies consist almost entirely of coyotes and bobcats, since the lynx is even more rare than the timber wolf in Wisconsin. As with track counts, these harvest figures indicate that the most common predators are foxes, coyotes, and bobcats, in that order. The black bear kill is likewise low. Of added interest in Table 33 is the fact that the major Wisconsin deer range coincides with the area of greatest harvest for all the predators listed except foxes.

Timber Wolf (Canis lupus). The timber wolf once ranged throughout Wisconsin. With the advent of settlement, wolf numbers declined until only a very few small packs now live in some of the wilder sections in the north. Wolves are traditional deer predators. The few remaining wolves in Wisconsin continue to make deer their staple food at all seasons. A study of wolf food habits in Iron and Oneida counties from 1946 to 1948 showed that deer remains were present in 97 per cent of 435 scats (Thompson, 1952). Fawn remains occurred in about half of the summer scats. However, deer numbers were not seriously affected by the small number of wolves in these two counties. Thompson's studies showed that deer densities increased from about 10 deer per section in 1935 to 30 deer per section in 1940 on the wolf range as well as on nearby wolf-free range. The timber wolf is a Wisconsin native that has nearly disappeared from the state. Its preservation as a valuable part of Wisconsin's fauna depends on maintenance of large blocks of wilderness habitat. Under present trends of land-use leading to partial settlement and continued human disturbance of the remaining wolf range, the few wolves left will not survive for long.

Coyote (Canis latrans). There is no doubt that coyotes can and do kill deer. However, much coyote predation is simply secondary scavenging on carcasses laid down as a result of starvation or as illegal kills during

TABLE 33
Wisconsin Predator Harvest, 1940-1953

Number of Animals Harvested in Fiscal Year

Species and Area	*1940-41*	*1941-42*	*1942-43*	*1943-44*	*1944-45*	*1945-46*	*1946-47*	*1947-48*	*1948-49*	*1949-50*	*1950-51*	*1951-52*	*1952-53*
Wolf & Coyote Bounties													
North	879	886	854	*	1783	3049	3091	3365	2714	2919	2783	2724	2467
Central	27	34	29	*	54	98	153	184	122	124	56	62	51
Statewide	913	924	885	1125	1936	4134	3317	3650	2902	3135	2877	2846	2664
Bobcat & Lynx Bounties													
North	180	283	190	161	365	1011	557	409	422	467	515	698	728
Central	0	0	6	0	3	14	0	3	3	1	2	4	2
Statewide	180	283	193	173	384	1048	577	427	437	482	525	724	740
Red & Gray Fox Bounties													
North	2035	3351	3302	6305	11312	7306	6109	5225	4887	6330	5399	6811	9349
Central	1170	1017	1084	2545	5205	2408	3045	2710	3005	3053	2727	3139	4148
Statewide	9907	10756	10622	21498	36487	23428	25793	23559	24230	28442	22023	27667	35503
Black Bear Gun Kill													
North	304	**	638	670	483	537	733	659	685	**	1067	1020	657
Central	0	**	3	0	0	13	5	4	0	**	0	0	4
Statewide	314	**	647	684	489	575	790	721	711	**	1276	1094	710

* No bounties paid; total is by hunting rather than trapping.
** Season closed.

A deer killed by coyotes in the Flag yard, Bayfield county, in April, 1941.

hunting seasons. We have heard numerous times the allegation that coyotes often prey upon newborn or young fawns, and that high coyote populations are associated with poor "fawn crops". We have found no evidence to indicate that this is true; nevertheless, it does seem likely that if coyotes exert any substantial influence on a deer population it would be through predation on fawns less than five months old rather than on mature animals. The evaluation of the effectiveness of the coyote as a predator on deer fawns must be determined through food habit studies, since it is a virtual impossibility to obtain significant information from field study on deer ranges during the post-fawning period.

The principal prey species of the coyote in much of northern and central Wisconsin appears to be the snowshoe hare (*Lepus americanus*). The snowshoe and the deer are in direct competition for the browse produced by many forest tree and shrub species during the winter period. Because of the control that the coyote exercises over the snowshoe hare, the presence of coyotes on deer ranges is at least in part beneficial to deer.

Whether or not these beneficial aspects outweigh the detrimental aspects of coyote predation we leave to future investigations. It may be said, however, that through the period of study from 1910 to 1949, when

adequate hunter harvests became a reality, the presence of coyotes on the deer range was probably more beneficial than detrimental. There was then no question of sharing huntable game with a predator since legal hunting was limited to the removal of a relatively small and unproductive segment of the herd. The limiting factor governing the size of the deer herd was the capacity of the range to support deer; this capacity was being lowered through over-browsing by deer, and secondarily through competition between deer and snowshoe hares for the same food supply. If the coyote during this period had any effect on snowshoe populations, it was definitely beneficial, and if coyotes did remove some deer from the herd this might likewise be termed beneficial.

After the herd is brought under control, the merits of the coyote must be weighed simply on the basis of his services in reducing competition from the snowshoe hare and in selective predation on weakened or genetically sub-standard deer, as against the dis-service he does to management in removing healthy animals that might otherwise provide sport for hunters.

Bobcat (Lynx rufus). Much of what has been said of the coyote can be repeated for the bobcat. He can and does kill deer, although such predation may be considered more unusual than usual. He also preys principally on the snowshoe hare. His merits or demerits must be measured on the same basis as those of the coyote.

Black Bear (Ursus americanus). This omnivorous species is an occasional deer predator. Upon leaving hibernation bears often feed on the carcasses of starved deer, and this activity is often presumed by sportsmen to indicate predation by bear on adult deer in the spring. Although an ability to kill cattle and sheep indicates that the bear can be an effective deer predator, the actual incidence of such predation seems to be much less than commonly supposed.

Red Fox (Vulpes fulva) and Gray Fox (Urocyon cinereoargenteus). In 1947 the Deer Project verified a report that semi-wild foxes were killing deer in the Frohm Brothers fur farm enclosure in Lincoln county. Although this incident indicates that foxes are capable of killing deer, it is unlikely that it can be considered more than a rare occurrence. When pressed by deficiencies in normal prey species, it may be assumed that a fox might turn to deer, but foxes can hardly be considered capable of killing large numbers of mature deer. During the fawning season it does seem possible that newly born or very young fawns might be attacked. However, in an examination of the contents of 63 red and gray fox stomachs from southwestern Wisconsin, only one showed evidence of having eaten deer, and this was probably carrion (Richards and Hine, 1953). It is unlikely that fox predation is of any consequence in normal situations.

Golden Eagle (Aquila chrysaetos) and Bald Eagle (Haliaeetus leucocephalus). The golden eagle has been reported as a capable predator of big game in the west. Leopold *et al.* (1951) cited evidence of eagle predation on mule deer *(Odocoileus hemionus)* fawns. Einarsen (1948) reported an incidence of eagle predation on antelope *(Antilocapra americana)* kids. We have no records of golden eagles killing fawns in Wisconsin although they may be capable of doing so.

Raven (Corvus corax) and Crow (Corvus brachyrhynchos). Both the raven and crow are energetic scavengers of deer carcasses and it is surprising that more reports of predation by them are not received.

Einarsen (1948) lists the raven as a predator of antelope kids on the assumption that kids are subject to the same kind of attack (picking out the eyes) by ravens as are lambs on the sheep ranges of the west where the losses are often considerable. Presumably the crow is capable of the same type of activity. However, we have no observations of predation by these birds in Wisconsin and they are listed here mainly because they are apparently capable of attacking deer.

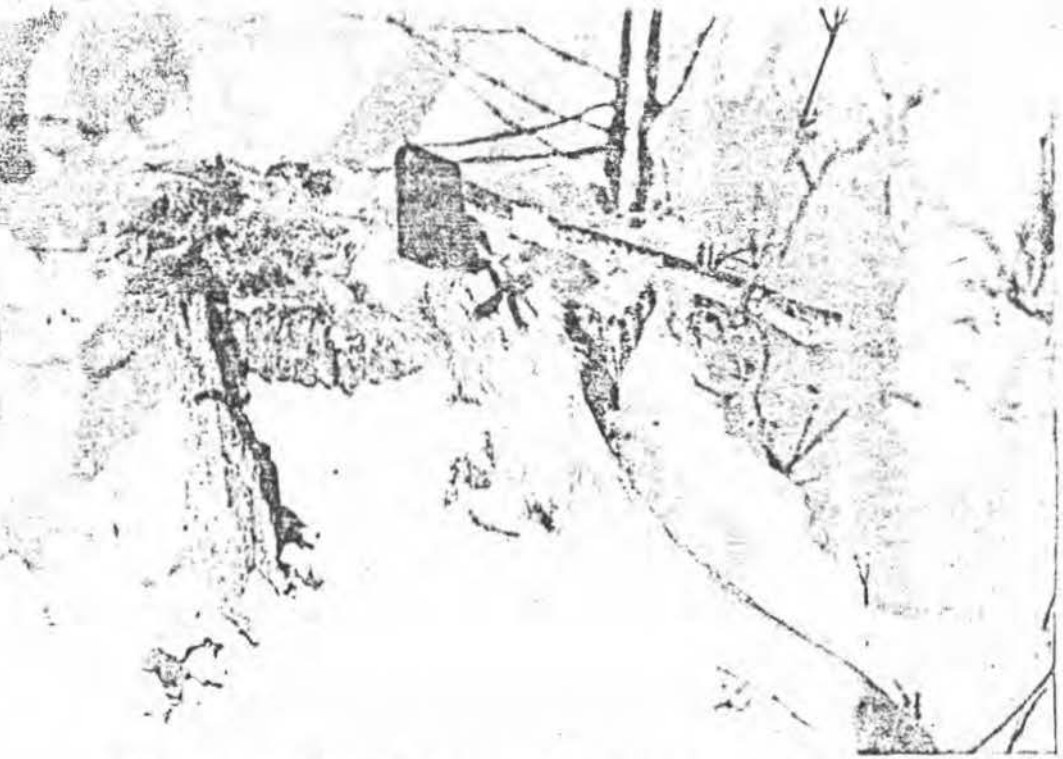
Dogs. Predation by domestic and feral dogs probably accounts for the greatest proportion of annual deer losses to predators in Wisconsin. Dog predation is most common in the late winter period when deer are in poorest condition. Dogs usually attack deer in packs of two or more. Packs of six to twelve dogs have been observed.

Dog predation can be a serious local factor, especially when easily accessible deer herds in the vicinity of farms or settlements are the prey. These deer, because of hunting pressure and poaching, exist in a better relationship with the range than is the case in wilder, less accessible areas. Secondarily, there is no evidence of any "beneficial" predation by dogs on snowshoe hares of the type such as is found in the case of natural predators.

Starvation

Starvation during hard winters in over-browsed areas has resulted in serious losses to Wisconsin's deer herd. Numerically these losses have probably at times exceeded the total of losses from all other factors combined. On a statewide basis, estimates of starvation losses have ranged up to many thousands of deer for the most critical winters. During recent years starved deer have been estimated at 5,000 in the winter of 1947-48, 15,000 to 20,000 in 1949-50, and 7,500 to 10,000 in 1950-51.

The bone test described by Cheatum (1949) has been used as a field criterion for starvation in deer. In brief, this test requires examination of the marrow in the femur, or upper leg bone. If the marrow is almost solid white fat, the deer is not suffering from malnutrition. If the marrow is in a red or yellowish jelly-like state, the deer has reached the point of starvation. There are some arguments againts this procedure. The contention is that certain parasite and disease infestations produce symptoms comparable to those found in starved deer. Wisconsin field and laboratory investigations by qualified veterinarians showed no evidence that starvation was not the factor responsible for death. Although parasites and diseases may



The bone marrow of starved deer has a red, jelly-like appearance such as this marrow split from the leg bone of a deer found dead in a winter yard.

be responsible for deer losses, these agents to date have become important only when deer are subject to a prior stress of malnutrition on an inferior range.

Fawns suffer most on over-browsed range, since what little food is available is beyond the reach of smaller deer. Eighty-eight per cent of losses identified as starvation from 1940 through 1952 were fawns (Table 31). The sex ratio in starved fawns was 100 males to 100 females. The composition of adult starvation losses was 61 males to 100 females.

Very little density data on starvation losses were collected during the first years of Deer Project activity. However, a few records are available as follows. In the Brule River yard of Douglas county during the winter of 1938-39, 32 starved deer were picked up on an area of approximately 10 acres (Swift, 1948). During the spring of 1943 in the Town of Knight, Iron county, Forester O. A. Schmidt reported to the Deer Project that he found seven deer carcasses while marking a 40-acre tract for a timber sale on May 25. He said, "The carcasses were much disintegrated when found because of warm weather and birds and other carrion eaters having been present. All seven deer were found on one forty. There was an abundance of cedar at one time, now mostly browsed off".

On April 25 and 26, 1949, 14 conservation department personnel walking abreast at half-chain (33 feet) intervals on six miles of pre-determined strips in the Flag River deer yard in Bayfield county found a total of nine illegal hunting kills, 44 starved deer and four deer for which cause of death was undetermined (Table 31). The total acreage of observed areas was computed to be 336 acres, since each man covered four acres per mile traversed. This check showed a minimum loss of an illegal kill for each 37 acres; a starved deer for each 8 acres and a total loss of one deer for each 6 acres of the portion of the yard covered. The strips were believed to be representative of approximately 1,740 acres of the yard, which covers five to six square miles. The 1,740 acres represents the core of the artificial feeding area where most of the deer were concentrated. Total loss, if the strips were representative of this area, was in excess of 225 deer.

The herd in this yard has been variously estimated from 500 to 3,000 deer. It is our opinion that in 1949 the actual numbers probably were in excess of 1,500 but not exceeding 2,500. If this is true, approximately 10 per cent of the deer in the yard were lost. Assuming that fawns made up about 35 per cent of the population surviving the hunting season, the herd contained 875 fawns, of which a minimum of about 25 per cent were lost through starvation. This loss occurred despite a feeding program in which

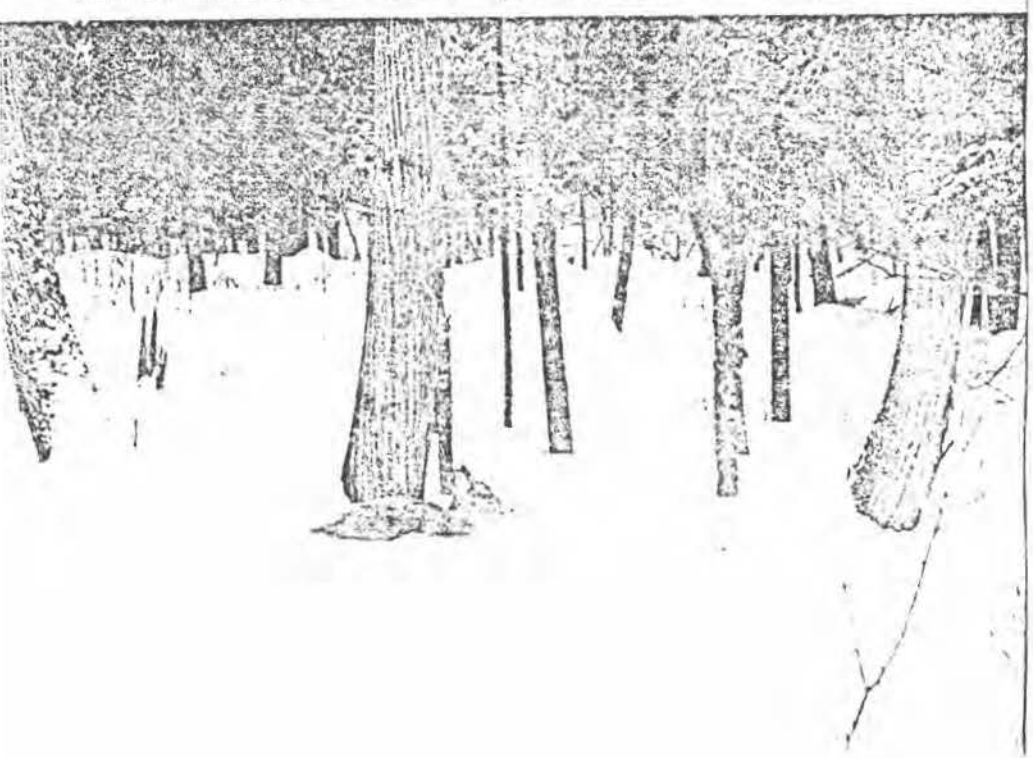
In March, 1949, veterinarians went to the Flag yard, Bayfield county, and examined 33 deer found dead. Starvation caused the death of all 33 deer.

TABLE 34
Flag Yard Dead Deer Checks

Spring of	Acres Observed	Starvation		Other Causes		Total	
		Number	A/DD*	Number	A/DD*	Number	A/DD*
1949	336	44	8	13	26	57	6
1950	232	52	4	10	23	62	4
1951	240	4	60	5	48	9	27
1952	120	0	-	0	-	0	-
1953	222	0	-	3	74	3	74
1954	156	0	-	2	78	2	78

* Acres per dead deer.

A fawn weakened by starvation in the High Lake yard, Vilas county, April 1943.



Starved deer are often not noticed until after the snow goes. This carcass was found in the Flag yard, Bayfield county, in the spring of 1948.

many tons of alfalfa hay and deer concentrate were provided to supplement natural foods.

During the winter of 1949-50 another check in the Flag yard covering 232 acres resulted in the finding of 52 starved deer and 10 other dead deer, a loss of a deer for every four acres from starvation and other losses of a deer for every 23 acres (Table 34). Checks in other northern yards, also in poor condition, showed losses varying from zero (Stone Lake yard, Oneida county) to a deer for each seven acres (Cedar Island yard, Douglas county). Average loss on a total of 2,499 acres checked in northern yards was a starved deer per 23 acres and other losses equaling a deer per 69 acres.

During the winter of 1950-51, which followed two seasons of liberal hunting regulations, starvation losses on 2,124 acres checked in northern Wisconsin declined to one deer for each 47 acres (Table 35). Flag yard starvation was much less in this winter; one starved deer was found for each 60 acres checked (Table 34).

During the period 1951-52 to 1953-54, losses were much reduced over the previous three years due to mild winters and presumably the improvement of browse conditions resulting from herd reduction in parts of the range. Table 35 summarizes the results of these surveys.

How important are starvation losses in terms of their effect on the remaining herd? The answer to this question is qualified by the difficulty of developing any reliable method of censusing animals on their winter range. We might speculate, however, on the basis of what information is available.

We have already estimated that losses in the Flag yard during the winter of 1948-49 equaled a minimum of 10 per cent of the herd and 25 per cent of the fawns using the yard. During the winter of 1949-50 losses were 70 per cent heavier. It seems likely that unless an increase in population occurred despite the previous year's losses, or unless deer were concentrated to a greater extent than they had been the winter before, the 1949-50 losses removed no less than 17 per cent of the herd and 43 per cent of the 1949 fawn crop. If there was any reduction in the herd as a result of starvation during the winter of 1948-49 or the 1949 antlerless hunting season, the 1949-50 starvation loss would then have to be proportionately greater in relation to the total herd and to the fawn segment.

To date, with the exception of the winter of 1942-43, when starvation was extremely heavy, these direct starvation losses have had a relatively limited effect upon the herd on a statewide basis. It is our impression that the antlerless and any-deer seasons of 1949 and 1950 were at least in part responsible for the reduction in starvation losses over what might otherwise have been expected in critical areas. Nevertheless, there is some evidence to indicate that during the severe winters that followed these seasons we lost, in addition to the extra deer removed by them, approximately 15 to 25 per cent of the fawn crop surviving the hunting season in northern Wisconsin. A large segment of the deer shot by hunters in those seasons could very well have been added to the starvation losses under a buck hunting law.

TABLE 35

Dead Deer Check Summary

Spring Of	No. Yards Checked	Acres Observed	Starvation		Other Causes		Total	
			Number	A/DD*	Number	A/DD*	Number	A/DD*
NORTHERN AREA								
1950	15	2,489	111	23	36	69	147	17
1951	12	2,124	45	47	35	61	80	27
1952	9	784	0		4	196	4	196
1953	7	808	4	202	7	115	11	73
1954	3	336	0		5	67	5	67
CENTRAL AREA								
1950	3	2,781	0		43	65	43	65
1951	1	249	0		1	60	1	60
1952	3	1,571	0		3	525	3	525
1954	2	864	0		2	432	2	432

* Acres per dead deer.
In 1953 no checks were run in the Central Area.

Many fawns starved in northern yards during the winters of the 1940's due to a combination of limited natural food supplies and a large deer herd. Flag yard, Bayfield county, March 1943.

Diseases and Parasites

Wisconsin's deer herd has proved to be remarkably free from important losses to diseases and parasites. This conclusion has been reached separately by a number of pathologists working on disease and parasite problems during the period of Deer Project study. As early as 1939, autopsies were made on dead deer in the Brule River yard by qualified veterinarians. Further investigations by Drs. G. R. Hartsough, G. B. Rossbach, T. T. Chaddock, A. M. McDermid, Sr., A. M. McDermid, Jr., and K. G. Flakas, have shown no indications to date that disease and parasite infestations are important considerations in the management of Wisconsin deer. However, this phase of investigation has not had the emphasis it deserves.

There are a number of diseases and parasites that conceivably may be responsible for heavy deer losses in the future. These are discussed in Appendix D. Their relative abundance is shown in Table 36, which records the types of parasites found at the autopsy of deer carcasses between 1938 and 1952. Nose bots, intestinal worms and liver flukes were the most common types. This should not be interpreted as [illegible]

TABLE 36

Deer Parasites found at Autopsy, 1938-1952

	Area				Total	
	North	Central	Agricultural	Unknown	No.	Per Cent
Number of Deer Examined	184	13	22	4	223	43
Negative	71	6	17	3	97	43
Positive Infestation with One or More Species	113	7	5	1	126	57
Nose Bots	54	1	..	..	55	44
Intestinal Worms	35	2	4	..	41	33
Liver Flukes	33	4	..	..	37	29
Lungworms	21	..	..	1	22	17
Lice	6	..	1	..	7	6
Tapeworms	5	..	..	..	5	4
Coccidia	3	..	..	..	3	2
Ticks	..	..	1	..	1	1

TABLE 37

Incidence of Deer Parasites in Northern Area

Parasite and Date of Check	No. Deer Examined	No. Negative		No. Positive		Total Negative	Total Positive	Per Cent Positive
		Fawn	Adult	Fawn	Adult			
Liver Fluke								
April 1943	85	63	5	8	9	68	17	20
Nov. 1943	89	..	..	..	..	31	58	65
March 1949	28	18	0	8	2	18	10	36
April 1950	25	..	..	..	..	25	0	0
Total	227					142	85	37
Lungworms								
April 1943	83	70	13	0	0	83	0	0
April 1950	20	..	..	..	..	5	15	75
Total	103					88	15	15
Nose Bots								
April 1943	78	48	8	17	5	56	22	28
March 1949	28	11	1	15	1	12	16	57
Total	106					68	38	36
Tapeworms								
March 1949	28	23	1	3	1	24	4	14

parasites in the population, since not all parasites were looked for when carcasses were posted, and all deer were sick or found dead from other causes before posting.

The incidence of four types of parasites is shown in Table 37. All the deer examined were picked at random from deer found dead in winter yards, except the November 1943 sample, which were deer shot by hunters. Despite the wide variety and occasional heavy infestation of parasites, both parasites and disease have not been an important factor in deer losses during Deer Project study.

Accidents

Deer meet death in a variety of accidental ways. At least 13 types of fatal accidents have been verified by the Deer Project:

1) Killed by automobiles.
2) Killed by trains.
3) Entangled in fences.
4) Feet caught while reaching for browse.
5) Impaled on branches while running.
6) Falling over cliffs.
7) Falling into wells and silo pits.
8) Mired in muck around swamp edges.
9) Drowned while swimming or after falling through ice.

Bucks occasionally lock horns while fighting during the rutting season and die of exhaustion or starvation.

10) Trapped on ice floes.
11) Struck by lightning.
12) Poisoned by herbicides.
13) Buck fighting.

Other causes have been reported, such as deer jumping through plate glass store windows, but were not verified. There is some indication that deer badgered by flies and other insects are more susceptible to accidents than other deer.

Perhaps the most important cause of accidental death is the automobile, since several hundred deer have been run over annually in recent years (Table 38). As long ago as 1937, at least 192 deer were killed on Wisconsin highways. Automobile deaths are the only accidental ones for which objective records are available. They must be considered minimums, however, since many deer hit by cars escape into the woods and die without being immediately found, or are found but not reported. Although automobile and train kills may be a serious factor locally, it is doubtful that accidents will ever be important mortality factors on a statewide basis.

TABLE 38
Deer Killed by Automobiles, 1951-54*

Area	No. of Deer Killed			
	1951	1952	1953	1954
North	169	145	305	427
Central	81	92	135	183
Agricultural	185	228	350	483
Total	438	465	790	1,093

* Compiled by O. G. Grant.

This deer died after being caught by a foot between two closely growing trees while reaching high for browse. Price county, April, 1943.

Chapter X

A Life Equation for Wisconsin Deer

In Chapters VIII and IX we have discussed the natality factors that tend to increase a deer population and the mortality factors that tend to decrease it. Over the period of a year, the fate of the population is determined by the extent to which one set of factors outweighs the other.

The annual increment of a deer population resulting from the fawn crop may be compared to annual interest on a savings account. Likewise, losses resulting from the various mortality factors are analagous to withdrawals from the savings account. If the number of deer that die (withdrawals) exceed the numbers added to the population by the fawn crop (annual interest payment), the population (savings account) suffers a net loss during the year. If losses do not exceed the fawn crop there is a population gain, and such gains are compounded by ensuing fawn crops.

A deer population existing on good range ordinarily returns a high rate of "interest". Perhaps the classic example of known deer productivity on an area of considerable size was displayed by a stocking of six deer on the 1,200 acre George Reserve in Livingston County, Michigan (O'Roke and Hamerstrom, 1948). This stocking of six deer increased to 160 in six years, an average annual increase of about 60 per cent. Although wild deer populations seldom attain such a high rate of increase, deer are usually considered to be capable of an increase in total numbers of 30 per cent each year under satisfactory range conditions. However, such potentials are rarely achieved, even where the species is granted complete protection.

Slight changes in reproduction, survival, or sex ratio in the adult population can cause rather substantial changes in the rate of increase from year to year. For example, in a herd in which does have an average reproductive potential of one fawn per doe and the sex ratio in adults is balanced, the potential rate of increase would be 50 per cent. In this case, a number of deer equal to one-half the pre-fawning population might be removed each year without decreasing the herd.

If the ratio in the adult class were distorted in favor of females in a ratio of 50 males to 100 females, the rate of increase figured as a percentage of the pre-fawning population would be 67 per cent. If the ratio is further distorted to 35 bucks to 100 does, the rate of increase is 74 per cent.

When there is a change in the reproductive rate of does, changes in the absolute rate of increase are brought about. If we return to the first example and reduce the rate of reproduction to one fawn per two does, the

absolute rate of increase is lowered from 50 per cent to 25 per cent. For herds with ratios of 50 and 35 bucks per 100 does, the rate of increase figured as a percentage of the pre-fawning population would be 33 per cent and 37 per cent, respectively.

Changes in the reproductive rate can be brought about by changes in range conditions. This has been indicated by data from the George Reserve herd (O'Roke and Hamerstrom, 1948) and from New York state, where Morton and Cheatum (1946) have reported differences in the breeding potential of does from various regions of the state that are apparently closely related to range conditions, which in turn are related to population densities. It seems likely that in deer, as in monetary investments, there is an optimum stocking or capital investment, which if exceeded will subject the total investment to the same laws of diminishing returns that govern economic affairs.

The life equation presented here is an attempt to analyze the yearly "investment pattern" of Wisconsin's deer herd to the best of our present knowledge. Some of the factors in the equation cannot be measured, at least with present-day methods of analysis. And, perhaps more important, the wide variation in the importance of the factors between regions in an area as large as the state of Wisconsin limits the accuracy of a single equation as an average picture. Thus the presentation of this equation does not mean it is necessarily correct in every detail, or that it contains all the answers. We suggest that the reader examine it critically, accepting those parts for which he feels there is adequate basis in fact, and appraising the reasonableness of those for which there is not. If the equation does no more than stimulate thought regarding the annual interplay of the various factors, it will have achieved an important purpose. Table 39 gives our interpretation of the average annual life equation of Wisconsin deer during the period 1938 to 1948. In these years the herd was increasing in size and legal hunting was confined to forked-horn bucks, with the exception of 1943 when a short antlerless season followed the usual buck season. In these years also, the average quality of winter range was declining due to the increasing pressure by deer on natural food supplies and to normal maturing of yarding cover. A similar equation for the years since 1948 would be considerably more complicated because of the varying effects of antlerless, any-deer, and forked-horn buck hunting seasons on sex and age ratios. Because of this complexity, we have confined the equation to a period of consecutive buck seasons.

We have begun this equation with a theoretical population of 1,000 deer, including 250 adult and yearling bucks (25 per cent), 420 adult and yearling does (42 per cent), and 330 fawns (33 per cent). These deer are assumed to be present before the hunting season and about November 1. The percentages are intermediate between those found among 31,932 deer observed in the months preceding November hunting seasons in the years

TABLE 39
An Annual Life Equation for Wisconsin Deer, 1938-1948

Season	Type of Gain or Loss	Deer Lost	Fawns		Adults*		Total Deer
			Bucks	Does	Bucks	Does	
PRE-HUNTING POPULATION			171	159	250	420	1,000
Hunting	Legal Kill	75			75		
	Crippling Loss	6			6		
	Illegal Kill	89	15	15	20	39	
	Total	170	15	15	101	39	
POST-HUNTING POPULATION			156	144	149	381	830
Winter	Starvation	46	20	19	2	5	
	Predation, Poaching, etc.	27	6	6	4	11	
	Total	73	26	25	6	16	
PRE-FAWNING POPULATION			130†	119†	143	365	757
Spring	Fawning Season Gains		311	207	130	119	
POST-FAWNING POPULATION			311	207	273	484	1,275
Summer	Weakness, Disease	179	122	33		24	
	Poaching, Accidents, etc.	36	8	5	8	15	
	Total	215	130	38	8	39	
PRE-HUNTING POPULATION			181	169	265	445	1,060
POPULATION GAIN OVER PREVIOUS YEAR							6%

* Includes both adults and yearlings.
†These deer are removed from fawn group and added to the adult group as fawning season gains

1935 through 1949, and among 10,066 deer checked during the any-deer bow hunting seasons of 1948 through 1954 and the any-deer gun hunting seasons of 1950 and 1951. For these samples, the pre-hunting season observations averaged 21 per cent bucks, 54 per cent does, and 25 per cent fawns. The average hunting season ratio was 30 per cent bucks, 40 per cent does, and 30 per cent fawns. The intermediate ratio was chosen because, as discussed in Chapter VIII, the true early fall population ratio seems to fall somewhere between pre-hunting-season and hunting-season ratios due to biases introduced by the varying behavior of antlered bucks during the two periods. The above comments hold true for adult sex ratios as well as buck-doe-fawn ratios.

The sex ratio within the fawn class (52 per cent males) is approximately that found among 2,080 fawns killed [illegible]

factors in the equation are explained in the following paragraphs, which are mainly summaries of information from the previous two chapters.

Legal Kill. Approximately two-thirds of the 1,440 antlered deer seen on pre-hunting population ratio tallies from 1940 through 1949 were forked-horn bucks, the remainder being spike bucks, most of which were probably yearlings. A similar proportion of forked-horn bucks was found during the 1950 hunting season, the first modern season when both forks and spikes were legal game at the same time. In checks made that season, 69 per cent of 815 antlered bucks had forked horns. In the equation, therefore, we have applied the two-thirds proportion to the 250 adult and yearling bucks in the pre-hunting population, with a resulting total of 167 forked-horn bucks that were legal game in a buck season.

What proportion of these 167 bucks would be shot? Forty-nine hunting-season returns of deer tagged in the winters of 1935-36 through 1950-51 indicated that up to 71 per cent of the forked-horn bucks might be shot by hunters in the first year in which the bucks were legal game. This is probably a maximum harvest. At the other extreme, 38 per cent of 842 bucks more than one year old shot during the 1950 hunting season were yearlings, indicating a turnover rate of 38 per cent. Indications in 1950 were that the proportion of yearlings in that year's population had been reduced by starvation losses during the previous winter. Thus 38 per cent is probably a minimum harvest figure. The actual turnover rate in bucks apparently lies somewhere between the extremes of 38 and 71 per cent. For the equation we have estimated a legal harvest of 75 forked-horn bucks (45 per cent of the 167 available legal bucks) and a crippling loss of six forked-horn bucks (three per cent of the available legal bucks) for a total removal of 48 per cent.

Crippling Loss and Illegal Kill are based on dead deer checks made in late winter and early spring following buck hunting seasons from 1941 through 1952. In these years a total of 190 hunter-killed deer were found; this number includes only those deer for which death by gunshot could be determined positively. All the forked-horn bucks were assumed to be cripples that died after hunting was over, since they were legal game when the season was open. The total was made up of 12 crippled forked-horn bucks and 178 illegal does, fawns and spike bucks. This is a ratio of one cripple to approximately 15 illegals.

The question next arises, what is the ratio of *legal* kill to crippling loss? We have somewhat arbitrarily chosen six forked-horn bucks, or eight per cent of the legal kill, to represent crippling loss. This estimate is based on the assumption that the 1:15 ratio between cripples and illegals is accurate. If so, the crippling loss must be more right now [illegible]

a known kill on any specific area. However, it is similar to the crippling loss of 8.75 per cent estimated by Shaw and McLaughlin (1951) in Massachusetts.

With a crippling loss of six bucks and an approximate 1:15 cripple-illegal ratio, we have allowed 89 deer for the total illegal kill. These deer were taken from the sex and age classes on the following basis: Of 165 illegals for which age was recorded, 110 (67 per cent) were adults. Of 108 adult illegals for which sex was recorded, 72 (66 per cent) were does and 36 (34 per cent) were spike bucks. Therefore, the indicated one crippled forked-horn buck to 15 illegal deer can be translated into one cripple for each 3.4 spike bucks, for each 6.5 does and for each 5.1 fawns; or six cripples for each 20 spikes, 39 does and 30 fawns. Illegal fawns were divided evenly between the sexes for want of evidence that a different situation existed.

The indicated illegal kill and crippling loss of 95 deer is equal to 126 hunting losses for 100 legal deer taken. We feel this is a reasonable estimate since the 4-year average buck-season loss on limited check areas shown in Table 30 was 181 cripples and illegals per 100 legal bucks shot.

The hunting season removed 170 deer from the pre-hunting population of 1,000 deer. Less than half the removals were legal hunting kills. By about December 15, which is before winter losses occurred, the post-hunting population consisted of 149 bucks, 381 does and 300 fawns — a total of 830 deer.

Starvation losses are based on checks in northern yards, mainly the Flag yard of Bayfield county, and on dead deer checks made in early spring. These studies showed that from 15 to 25 per cent and as high as 40 per cent of fawns entering winter, depending on severity of the weather, starved before the winter was over. In addition, the studies showed that male and female fawns starved in equal proportions. We have removed 13 per cent (20 males and 19 females) of the 300 fawns in the post-hunting population from the equation as starvation losses in an average year. Adult starvation losses also were found on dead-deer checks at an average rate of one starved adult to 5.6 starved fawns. This ratio has been applied to the equation with the removal of 2 adult bucks and 5 adult does, or a total of seven adult deer to 39 fawns. The adult sex ratio in these losses is the one that was found among starved adults on dead-deer checks.

Predation, Poaching, Etc. Losses to disease, accidents and old age are also included here. The ratio of four fawns to five adults is the same as found on dead-deer checks for non-starvation losses. Unfortunately, however, the true proportion of losses to such miscellaneous causes, particularly to poaching, does not show up on dead-deer checks, so their magnitude cannot at present be measured. We have estimated a total loss of 27 deer to these causes. This figure results in a higher ratio of

starvation to non-starvation losses than were found on dead-deer checks, but this is intended to account for the additional, previously unmeasured mortality.

The stresses of the winter season removed 73 deer from the post-hunting season population of 830. Thus by about April 15 the pre-fawning season population had 143 bucks, 365 does, and 249 fawns of last year — a total of 757 deer.

Fawning Seasons Gains are of two types. The first is a matter of terminology. In the pre-fawning population are 130 buck fawns and 119 doe fawns from the previous summer. But with the coming of the current year's fawn crop, last year's fawns become yearlings and are transferred to the "Adults" columns of the equation (which include yearlings) as additions to the adult segment of the population. This transfer is indicated by daggers in Table 39. The 119 doe fawns are assumed here to produce none of the current year's fawn crop.

The second type of fawning gain is the production of fawns at the rate of 1.42 fawns per adult doe. This rate was derived in the following manner: From 1939 to 1951, records of 141 pregnant does were obtained from warden's seizure records, and Deer Project autopsy and field notes. These does were carrying an average of 1.6 fawns each. Information on non-bearing does is available only from a sample of 46 does that were two years old or older at fawning time and which were collected from 1949 through 1951. Forty-one of these does (89 per cent) were bearing fawns. Thus the average production per doe that is two years old or older at fawning time would be: 1.6 fawns per pregnant doe X 89 per cent productive does = 1.42 fawns per doe. The latter figure (1.42) multiplied by the 365 adult does in the equation yields the year's fawn production of 518 fawns. This is the number of fawns at time of birth and before post-natal mortality has occurred. The sex ratio of 311 male to 207 female fawns (60 per cent males) is that found among 168 embryos examined during the period 1949 through 1951. This is the only available Wisconsin information on this topic.

The number of fawns produced can be confirmed at least in part by another approach. During the 1950 and 1951 hunting seasons, 75 per cent of 2,094 adult and yearling does shot by hunters were adults. If the yearling segment (25 per cent) of the fall population is not significantly productive in Wisconsin, then the average fawn production for all does at fawning time can be calculated by multiplying the average number of fawns per adult doe (1.42) by the per cent of adults among the does in the herd (75 per cent). The resulting total of 1.06 represents the average number of fawns produced by does in all age classes in the herd. In the equation, if the total fawn production of 518 is divided by the total number of adult and yearling does (484; which is derived by adding the 365 adults and 119 yearlings), the result is 1.07 fawns per doe of all ages. This is not different than the known production of 1.06.

The fawning season added 249 yearlings to the adult class and resulted in a new class of 518 fawns. After fawns were born, the post-fawning season population on about July 1 consisted of 273 bucks, 484 does and 518 fawns — a total of 1,275 deer. This is the high point in the year's population.

Summer Losses are almost impossible to measure accurately, but the evidence indicates they are larger than in any other season. The most important losses are among fawns. Despite the fact that an average productivity of 1.06 fawns per doe of all ages is indicated, the pre-hunting season ratios discussed at the beginning of the equation have consistently shown a survival by fawns to fall of approximately 0.8 fawns per doe. It may be that many fawns are born dead or die within a few days of birth; at any rate a considerable mortality takes place in the summer months. We have removed 155 fawns from the post-fawning population due to weakness and disease, which is comparable to 30 per cent of the initial fawn crop.

Poaching, accidents and predators result in additional summer losses to all age and sex classes, although not nearly as large as weakness and disease losses among fawns. Here again are losses that are not measured; our estimate is that 36 deer were removed by these causes, including 8 bucks, 15 does and 13 fawns. These losses are equal to approximately 3 per cent of the bucks and does, and 2.5 per cent of the fawns in the post-fawning population. An additional 24 does are removed by weakness and disease, since we believe that summer losses in the adult population group are weighted to does. This is because the physical stresses of reproduction makes does more vulnerable to environmental factors such as disease, accidents, and predation than at other times of the year.

There seems to be a very definite differential mortality removing a higher percentage of male than female fawns in summer. The primary sex ratio discussed under "Fawning Season Gains" was 60 per cent males. By fall, however, this percentage had declined to 52 per cent males, as indicated by pre-hunting-season population ratios. This reduction is accomplished in the equation by the removal of 130 male and 38 female fawns.

Summary. By November 1, summer losses have removed 8 bucks, 39 does and 168 fawns from the post-fawning population. Thus one year after the equation began we have a pre-hunting season population of 1,060 deer. Included are 265 adult and yearling bucks (25 per cent), 445 adult and yearling does (42 per cent) and 350 fawns (33 per cent). These are the same percentages with which we began, since this equation represents an average annual picture for a 10-year period. There is a net population gain over the previous year of 60 deer, or 6 per cent of the original group of 1,000 deer. The net annual increase of 6 per cent for the period covered by the equation seems small; however, when 6

The history of deer over-populations and accompanying degeneration of winter cover and natural food supplies in Wisconsin indicates that an increase of this magnitude between 1938 and 1948 is entirely within reason.

It is significant to note that legal buck hunting accounts for only a very small part of total deer losses. Of the 458 deer removed each year by all causes, only 75 (16 per cent) were taken as legal game. It is also significant that losses to crippling, illegal hunting season kills, and starvation totalled 141 deer, or 31 per cent of the annual total. These are all losses that management could have greatly reduced by the use of more liberal hunting regulations or some other form of herd reduction. The evidence is therefore strong that during the period covered by the equation the potential human use of deer in Wisconsin was not fully realized.

This life equation emphasizes two important points. It demonstrates the magnitude of deer population mechanisms that are important to game managers, such as the inefficient harvest by hunters during forked-horn buck seasons, or the extent and importance of fawn production to future populations. The equation also shows where there are gaps in our knowledge of deer population behavior and points out the most important research problems for future study. Certainly we know very little about such things as the number of deer taken by poachers, or the causes and size of fawn losses in summer, or how many fawns breed, or the effects of winter starvation stresses on breeding does. These things must be known if this equation is to have maximum accuracy.

Part III — THE DEER RANGE AND ITS PROBLEMS

Chapter XI

The General Environment and Summer Deer Range

The Present-Day Environment

To better understand the environment of Wisconsin deer today, after more than three centuries of dominance by the white man, something must be known about land-use and its relation to habitable deer range.

The total land area of the state comprises about 35 million acres. A well-distributed system of rivers and inland lakes provides an adequate supply of fresh water. The general topography is characterized by rolling hills cut through by broad river valleys. Elevations vary from 581 feet above sea level at Lake Michigan to 1,940 feet at Rib Mountain in Marathon county.

Wisconsin experiences extreme temperature ranges from 50 degrees below zero to 110 degrees above zero. Precipitation, especially during the winter, becomes a factor of considerable importance to deer management. Average monthly temperature, total precipitation and snowfall are given in Figure 12.

Figure 13 shows that the best agricultural areas lie in the southern half of the state. The growing season in Wisconsin varies from 170 days in the south to as low as 80 days in the north (Wis. State Planning Board, 1945). The good soils in the southern part of the state are favorable to such row crops as corn while the more stony or sandy soils of the northern agricultural areas, even though hampered by a short growing season, provide good pasture and hay land. Although different crop producing potentials exist in the northern and southern halves of the state, dairying is the major agricultural pursuit in both regions.

The general distribution of vegetative types throughout the state is shown in Figure 14. A thorough discussion of the important subject of soils and forests is found in Wilde, Wilson, and White (1949). It is recommended for further information on the relationship between soils and deer range.

Generally speaking, land-use in Wisconsin falls into three basic classifications: (1) timber and brush lands; (2) farm crop and pasture lands; and (3) lands occupied by urban and industrial development, roads, and railroads. Timber and brush lands comprise about 16 million acres, including 5 million acres of unpastured farm woodlots (Table 40). It is these lands that make up Wisconsin's deer range and that are the most important areas considered in subsequent discussions of range problems. In 1953, about four of these 16 million acres were in public ownership or control and open to public hunting.

TABLE 40

Wisconsin Forest Acreages in 1950*

Forest Types	*Number of Acres*
Commercial Forests	
Old-growth saw timber	300,000
Second-growth saw timber	1,500,000
Pole timber	2,900,000
Restocking	6,900,000
Poorly stocked and denuded	3,600,000
Total	15,200,000
Non-commercial Forests	600,000
Lands Reserved for Parks	200,000
Total Acreage	16,000,000
Commercial Forest Species	
Hardwoods	6,150,000
Aspen	5,900,000
Spruce and Fir	1,900,000
Northern pine	1,250,000
Total Acreage	15,200,000
Forest Ownership	
Federal Ownership or Management	
National forests	1,422,000
Indian lands	450,000
Other lands	228,000
Total	2,100,000
State, County and Municipal	3,000,000
Private	
Farm woodlots	5,600,000
Other lands (including industrial forests)	5,300,000
Total Acreage	16,200,000

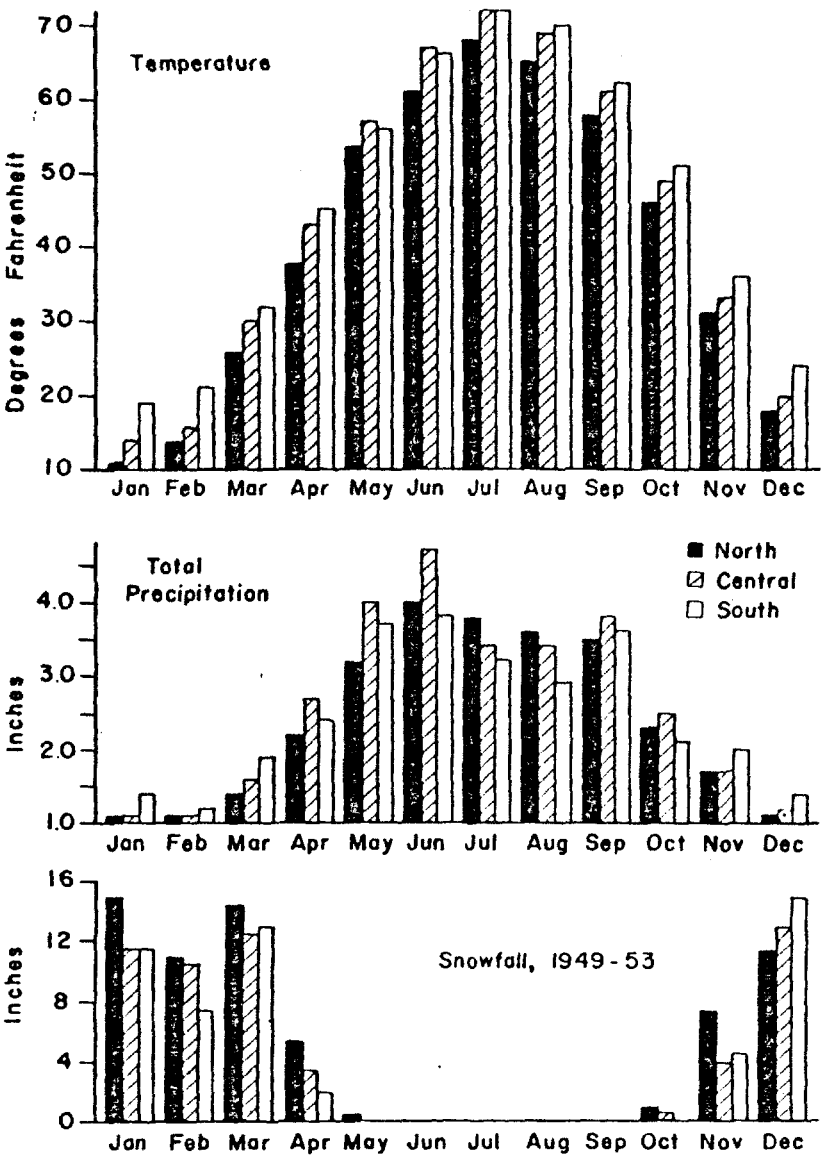


Figure 12. Average monthly temperature, total precipitation and snowfall. Areas are as in Figure 7, except that "South" includes only those counties in the agricultural area south of a line from La Crosse to Sheboygan.

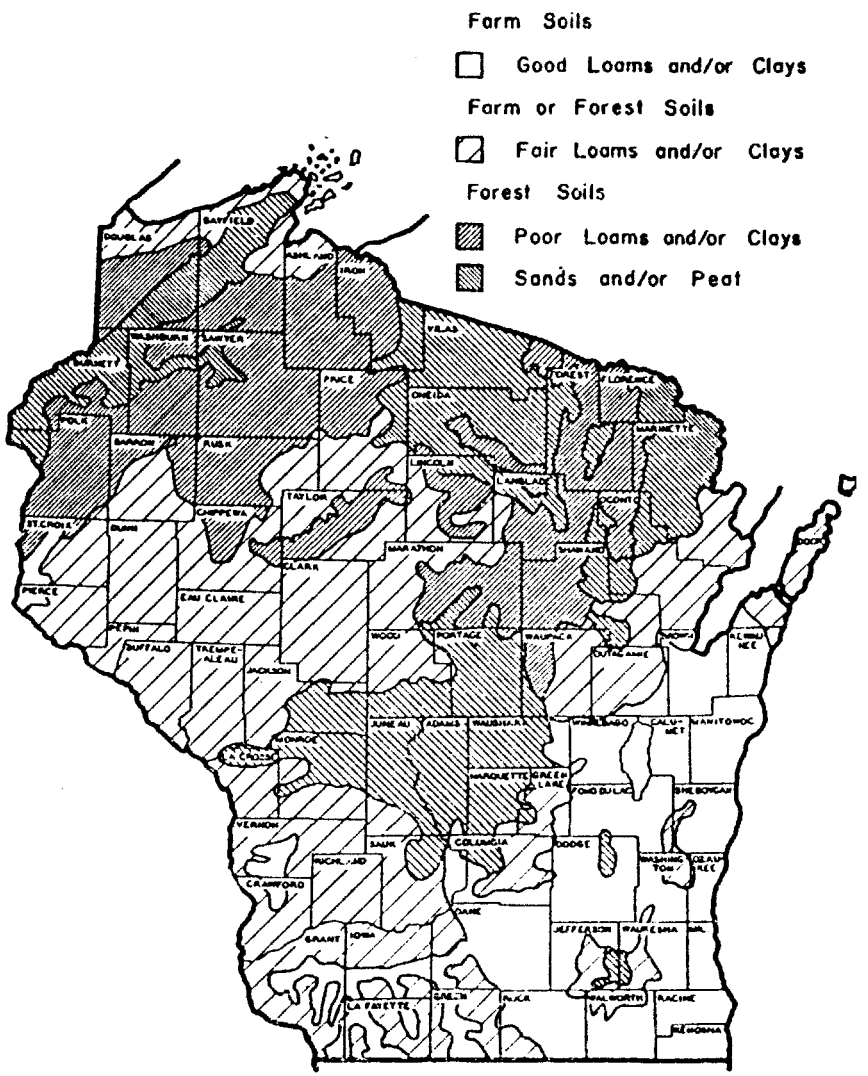


Figure 13. Generalized map of Wisconsin soils (after Muckenhirn and Dahlstrand, 1947).

Farm crop and pasture lands number about 17 million acres, of which ten million are in crops and seven million are in pasture and other uses. Wisconsin ranks as the leading dairy state in the nation. Hay, corn, and oats have the greatest crop acreages, and a wide variety of other grains, vegetables and fruits are grown.

The remaining lands comprise about two million acres. Urban and industrial areas occupy more than one million acres and the remaining acreage is made up of roads, railroads, and other non-forest and non-agricultural lands.

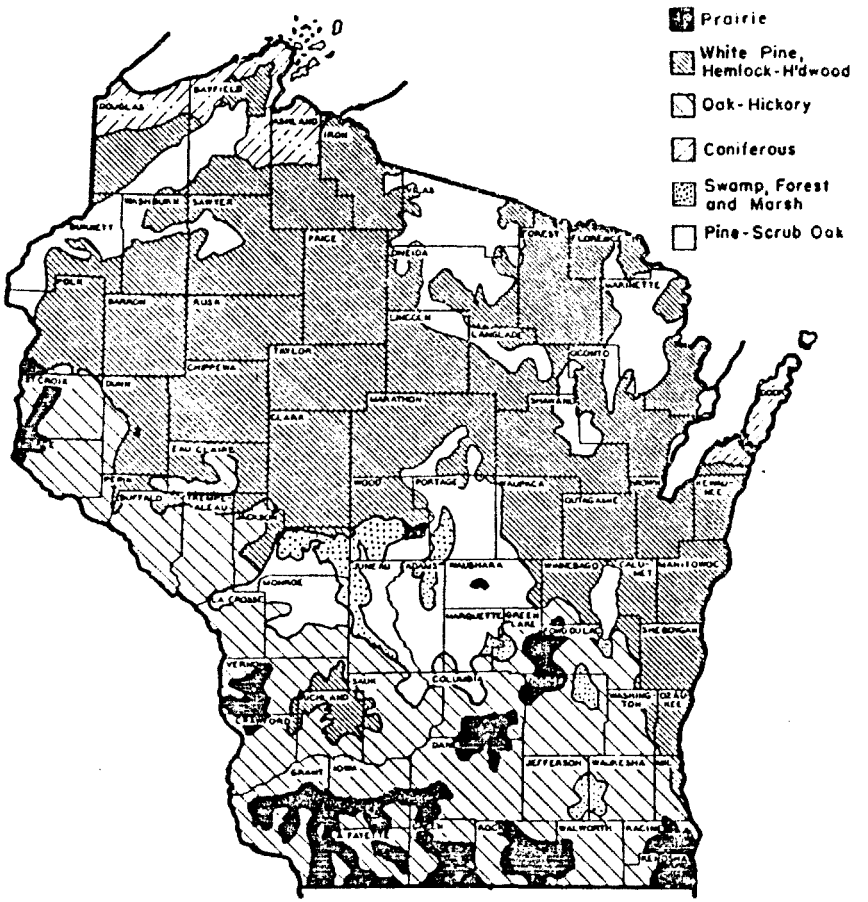


Figure 14. General vegetative types in Wisconsin inferred from soil surveys and present stands (after Wilde, Wilson & White, 1949).

Wisconsin's Summer Deer Range

The density and distribution of deer during the summer in most areas of Wisconsin are largely governed by the number of deer the winter range, rather than the summer range, can support. All of the state's 16 million acres of forest lands and much farm land provide the habitat requirements for deer in the summer months (Figure 6 and Appendix E). In contrast, deer during winter are limited to an estimated 1¾ million acres of range (Figure 16).

All other things being favorable, many times more deer could live on the summer range than have ever been present historically, or will conceivably be present in the future, if it were not for the limited area and limited capacity to support deer on the winter range. Although the quality of summer range varies throughout the state, there are no known problem areas where deer numbers are limited by food deficiencies in summer.

Some idea of minimum densities of deer on summer range is shown by Figure 15, which gives the estimated deer kill per square mile of deer range in the 1950 hunting season. In this year deer of all ages and both sexes were legal game for the first time in many years. It is obvious that deer densities were high on the summer range, since hunters took only a fraction of the total herd.

Agricultural development indirectly limits the deer populations in major farming regions. Fertilized farm crops are apparently more palatable than the best available natural foods, and deer do not hesitate to make use of crops when they are available. In these agricultural areas, the maximum density of deer will be determined by the tolerance of farmers for depredations by deer on their cultivated crops, or by limitations in the ability or desirability of payment by the state for crop damage, rather than by the ability of the habitat to support deer.

Ideal summer deer habitat contains a wide variety of cover types interspersed with openings and supplies of fresh water. An equally wide variety of food plants should exist. Although drouth, floods, defoliating insects, and fire can alter considerably or even destroy areas of summer range, there has been no indication during the course of this study that these factors have so far had more than a very local and temporary effect on the deer population. Historically, fire has been an important ecological factor, and is responsible in large measure for the present composition of Wisconsin's forests. During recent years, however, the control of fire through prevention and improved suppression methods, has practically eliminated this factor as an influence on the environment.

During periods of high insect numbers in the warm months, deer are frequently observed using water areas and woodland openings where breezes act to reduce the insect nuisance. The adequate interspersion of these water areas and openings undoubtedly influences the distribution of deer in summer and should be recognized as a desirable component of the summer range.

Wisconsin deer in summer have few problems concerning food and cover.

The Crop Damage Problem

Deer damage to farm crops is the principal management problem associated with summer deer range. Damage by deer through trampling and browsing agricultural crops, orchards and landscaping has been and continues to be a vexing and costly range problem.

Section 29.585 of the Wisconsin Statutes provides that damage to property caused by deer shall, upon written complaint of the owner or lessee of the land, be investigated by the conservation commission. All claims allowed by the commission are to be paid on a pro rata basis at the end of each fiscal year from the funds provided ($40,000) in section 20.20(19) of the statutes. This law was first enacted in 1931, at which time $12,000 was directed to be taken from deer tag receipts during the years when there was an open deer season. In 1935 the law was amended to permit the state to construct deer-proof fences in cases of recurrent damage. In 1939 bear damage was also included in the provisions of the law. By 1945 claims against the state had increased alarmingly and the annual appropriations were increased to $25,000. In 1949 the funds were further raised to $40,000 to pay for growing damage claims.

Agricultural damage by deer is not confined to row crops. The bark of this apple tree in a Bayfield county orchard was stripped off by deer. May, 1951.

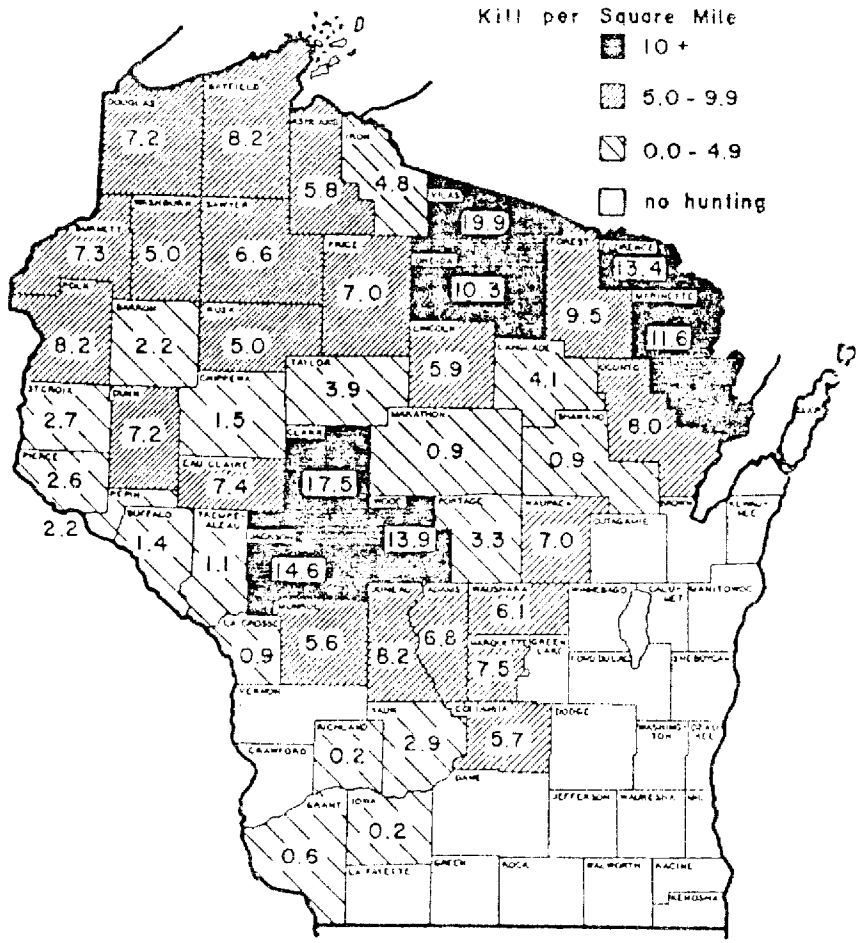


Figure 15. Deer kill per square mile of deer range in the 1950 hunting season.

Monies expended in settlement of deer damage claims have amounted to $411,314.91 for the period 1932 through 1954. Paid claims during these years numbered 5,795. Expenditures for the construction of "deer-proof" fences have amounted to $14,944 for the same period (Table 11). The time and expense of conservation department personnel for investigation and settlement of claims would swell this figure considerably.

Deer food habits in relation to farm crops, orchards, cranberries, flower gardens and landscaping follow a peculiar and unpredictable pattern. Despite the availability of adequate natural foods, deer often persist in browsing crops. Fertilization and irrigation apparently enhance the palata-

bility of farm crops and account in part for the fact that deer find these crops more desirable than natural foods.

Oats, corn, and apples are the crops that have received the greatest damage payments. Table 42 summarizes the items for which deer damage was paid during the 1950-51 fiscal year, a typical example of damage claims in recent years. Table 43 presents a list of crops for which deer damage payments have been made since 1932.

If a deer population is present within or immediately adjacent to agricultural areas, damage to crops is sure to follow. Regardless of the quantity and quality of natural forage available, deer are sure to do a certain amount of browsing on agricultural crops. Many other states have deer damage problems similar to the problem in Wisconsin. Michigan has experienced serious deer damage in the agricultural areas of the southern peninsula, and since 1948 has conducted special deer harvests in areas of high deer damage in an effort to reduce damage. The states of Washington, Utah, and Colorado are paying for increasing damage by deer to orchards and other crops. Several other states permit shooting of deer doing damage.

There is no clear-cut solution to the deer damage problem. It is obvious that herd control through hunting seasons offers the best and cheapest, although by no means complete, solution. It is not implied that deer populations must be totally eliminated from agricultural areas. Deer populations must, however, be carefully controlled to prevent undue interference with legitimate agricultural pursuits. The incidence of deer damage is closely associated with the density of deer populations; however, no specific formula for this relationship in Wisconsin can be written because of the considerable variety of circumstances that are common to different units of range.

There are a number of control methods that have been employed in Wisconsin and in most other states. Some of them have been successful in certain areas and failures in others.

The deer-proof fence, although expensive to construct and maintain, has been the most satisfactory for small areas of recurrent damage on high-value crops (Longhurst *et al.* 1952). Single-wire electric fences provided with shiny metal danglers have been moderately successful when they can be put in operation before damage begins to occur (Hale, 1948). Chemical repellents have not been as generally successful as fences, but certain crops have been satisfactorily protected by repellent applications. There are several commercial deer repellents on the market today that have been tested in Wisconsin (Thompson and Keener, 1951).

There are many other unusual methods for which users claim good success. One back-woods Wisconsin farmer says half-seriously that a well-worn union suit located conspicuously will do the job. Wolf droppings or moth balls placed at intervals around the edge of a field are reportedly

TABLE 41

Deer Damage Payments, 1932-1951*

Fiscal Year	Payments for: Crop Damage	Payments for: Fence Construction	Total Expenditure
1932-33	$ 4,259.70	$ --	$ 4,259.70
1933-34	1,773.85	--	1,773.85
1934-35	5,746.14	--	5,746.14
1935-36	5,040.09	--	5,040.09
1936-37	5,413.24	--	5,413.24
1937-38	6,578.54	381.06	6,959.60
1938-39	6,428.09	1,161.01	7,589.10
1939-40	9,427.67	2,276.79	11,704.46
1940-41	12,405.73	1,840.17	14,245.90
1941-42	11,623.95	545.21	12,169.16
1942-43	19,006.45	--	19,006.45
1943-44	14,690.04	21.04	14,711.08
1944-45	23,725.50	7.40	23,732.90
1945-46	26,329.77	2,217.06	28,546.83
1946-47	25,402.59	2,119.08	27,521.67
1947-48	52,726.16	2,256.59	54,982.75
1948-49	45,839.29	1,605.81	47,445.10
1949-50	39,998.93	500.00	40,498.93
1950-51	37,442.61	--	37,442.61
1951-52	21,378.55	--	21,378.55
1952-53	8,084.57	13.09	8,097.66
1953-54	13,049.14	--	13,049.14
Totals	$396,370.60	$ 14,944.31	$411,314.91

*Compiled by Otis S. Bersing

TABLE 42

Deer Damage Claims, 1950-51 Fiscal Year*

Item	Claims: Number	Claims: Per Cent	Payments: Amount	Payments: Per Cent
Corn	172	41.5	$10,765.37	28.8
Oats	67	16.2	7,398.48	19.8
Garden Vegetables	55	13.2	3,967.28	10.6
Beans	39	9.4	2,095.79	5.6
Hay Crops	31	7.5	3,454.88	9.2
Fruit & Forest Trees	27	6.5	7,009.34	18.7
Buckwheat	14	3.4	1,427.70	3.8
Sugar Beets	4	1.0	1,083.51	2.9
Miscellaneous**	5	1.2	240.26	0.6
Total	414	100.0	$37,442.61	100.0

Isolated agriculture in forested areas will be subject to deer damage as long as deer populations are present. It does not seem logical to control deer populations in such areas at a level that would eliminate crop damage. The best solution for deer damage on isolated agricultural lands within forested areas would seem to be the elimination of the agriculture. Better land-use planning has already and will probably continue to eliminate much agricultural development within extensive areas of deer range where it is desirable to maintain relatively high densities of deer.

Deer herd management on areas where great agricultural development precludes a damage problem if deer populations are permitted to increase should be directed toward minimizing the potential damage problem through adequate deer harvest by hunting. Isolated farms in forested areas should be discouraged, rather than encouraged by the payment of deer damage claims.

TABLE 43

Crops For Which Deer Damage Has Been Paid*

VEGETABLES	GRAIN	FRUIT	HAY AND SEED	MISCELLANEOUS
String Beans	Barley	Cranberries	Alfalfa	Carnation Plants
Beets	Buckwheat	Fruit Trees	Canary Grass	Forest Trees
Broccoli	Corn	Muskmelons	Alsike Clover	Landscaping
Cabbage	Flax	Raspberries	Red Clover	Pansy Seedlings
Carrots	Millet	Strawberries	Clover Seeding	Pasture
Cauliflower	Oats	Watermelons		Straw
Celery	Rye			Sugar Cane
Swiss Chard				
Cucumbers				
Lettuce				
Onions				
Parsley				
Parsnips				
Sweet Potatoes				
White Potatoes				
Pumpkins				
Rutabagas				
Soybeans				
Squash				
Tomatoes				

*Compiled by Otis S. Bersing

Chapter XII

Winter Deer Range

> "Every range is more or less out of balance, in that some particular aspects of food or cover is deficient, and thus prevents the range from supporting the population which the other aspects would be capable of supporting."
>
> Leopold (1933, p. 135)

The Problems of Winter Range

Deer populations in northern latitudes where deer concentrate during the winter are limited by the capacity of winter ranges to support deer. Invariably the relationship between the total deer range and the winter range follows a pattern of limited winter range. In other words, Wisconsin's total deer range is "more or less out of balance", in that the number of deer the winter range can support (carrying capacity) is much lower than the carrying capacity of the summer range.

Wisconsin's winter deer range comprises about 10 per cent of the total deer range. Figure 16 shows the general location of 819 deer yards that comprised the principal known winter range in 1946. Similar percentages of deer range are found in the other lake states. Michigan, for instance, estimated winter deer range to comprise about nine per cent of the total range (Bartlett, 1938). Although winter deer concentrations vary considerably in size from winter to winter, and within the state during any particular winter, the tendency for deer to concentrate on limited portions of the total range during the winter months is the principal factor limiting the size of deer populations. As an example, Figure 17 illustrates variations in area of winter range for Sawyer county.

Why do deer yard or concentrate in the winter months? There have been many reasons suggested to explain it. It has been said that deer yard up so that their numbers will afford them protection from predators and so that by concentrating they are able to keep trails open in the deep snow to facilitate movement. Other explanations simply state that deer are gregarious like sheep and have a natural tendency to band together. Some say it's just age-old habit. Although we cannot rule out any of these explanations, we are of the opinion that the primary reason for deer yarding or concentrating during the winter period is for protection from the rigors of winter weather. The character of the areas where deer choose to yard substantiates this idea. The principal characteristic of a yarding area is its topographic location and cover; lowland or swamp

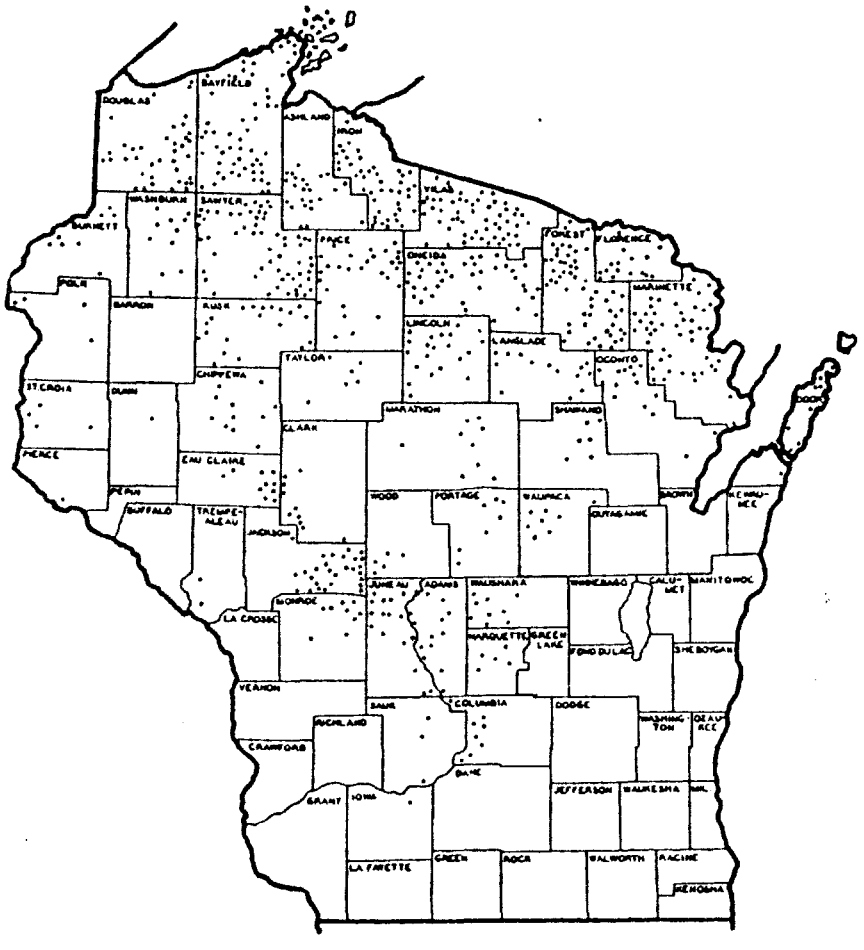


Figure 16. Wisconsin winter deer range. Each dot represents the location (but not area) of a deer yard in the period 1945-1950.

areas are particularly favored, especially if the cover is coniferous. These areas provide shelter from winter winds and to some extent they limit snow depth, depending on the character of the cover present. Adequate food supplies may or may not be present. Deer tend to choose areas where the requirements of cover are most adequately met regardless of the status of food supplies.

The degree of winter concentration varies directly with the intensity of the winter weather. During comparatively mild, snowless winters, deer range freely over a considerable portion of their summer range, foraging

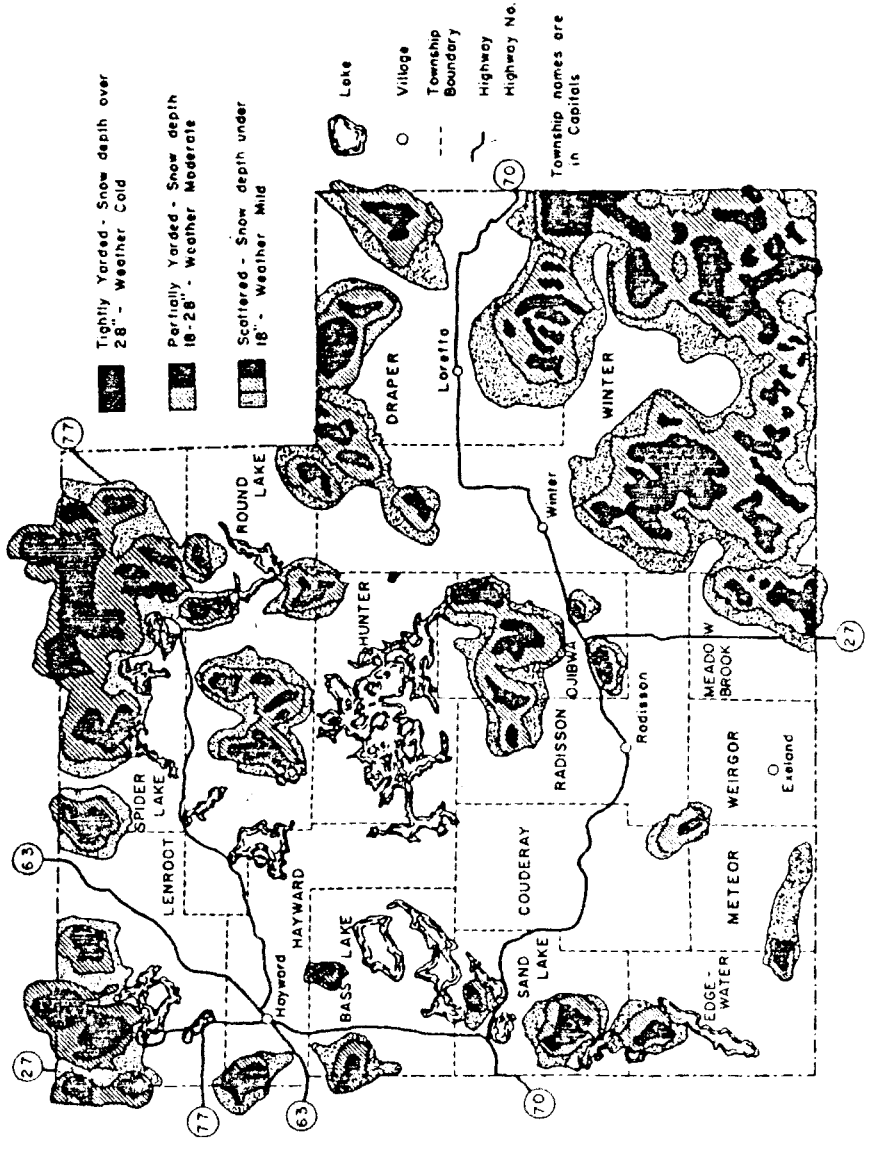


Figure 17. Winter deer range in Sawyer county during the period 1945-50.

for food and bedding down in less protected areas. When temperatures drop and snow depths increase, deer concentrate in the areas that provide the best protection from the elements. Deep snow, which hinders deer movement, causes deer to yard or concentrate despite comparatively mild weather; conversely, cold weather without deep snow causes deer to yard, although to a lesser degree. Minimum temperatures combined with maximum snow depths result in the greatest degree of concentration.

As the degree of yarding varies with the severity of winter weather, so is the length of the yarding period controlled by the weather. During the 1940's and early 1950's the period of yarding has varied from a minimum of 27 days to a maximum of 130 days, the average period being about 90 days. In Wisconsin, deer are usually able to range freely until late in December and frequently until the middle of January. January, February and March are normally accompanied by cold weather and sufficient snowfall to limit deer to the confines of winter range. It is not unusual, especially north of latitude 46 degrees, for the yarding period to extend well into April.

Before discussing winter range conditions one paramount point should be recognized. In winter deer depend on those plants that have grown above the snow level to provide enough tender buds and shoots to supply sufficient feed for the deer concentrated in a yarding area. If deer keep eating all of the browse produced by plants on the winter range year after year, they will eventually reduce the ability of the plants to produce enough food to carry the deer through a winter. Such damage can cause a plant to die, to live but produce only a small number of available buds and shoots (which are the only portions of the plant deer eat), or to produce no available browse because the portion of the plant within reach of deer is no longer able to produce new growth. Thus the purpose of any range survey is to determine the welfare of the plant from the standpoint of deer browse production.

Since an animal species will be affected by what happens to its habitat and since the animal may in turn exert an influence on its habitat, it follows that animal and habitat are biologically inseparable. In other words, winter deer habitat will degenerate if subjected to excessive pressure by more deer than can be fed without damage to the existing natural deer food supplies. As a consequence, the damaged habitat can support fewer deer. If an animal and its habitat are inseparable, it should be possible to tell much about habitat through critical examination of the animal. Cheatum and Severinghaus (1950) have done just that by showing the relationship between fertility of white-tailed deer and the status of range conditions. They said (p. 187) ". . . . The data suggested that measurements of deer fertility may afford a valuable index to trends in status of populations in relation to the general adequacy of the range and that such measurement may be used as a tool in the management of the species." In Chapter VII we have

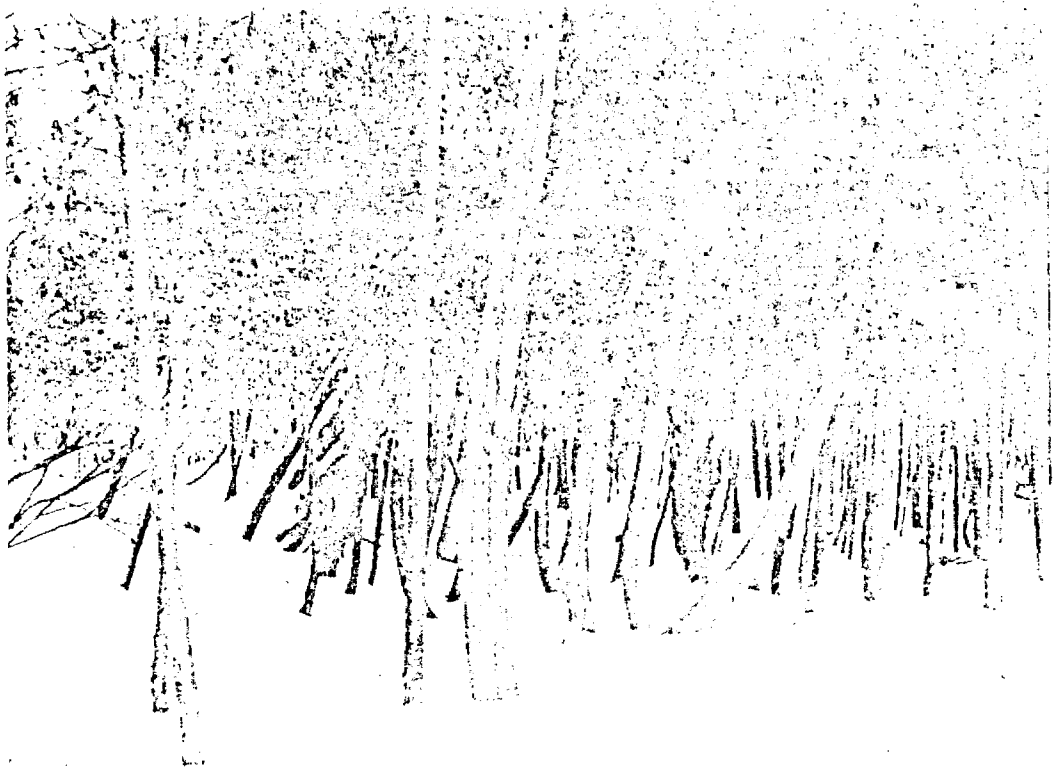
shown the relationship between the weights of deer from range that is classed as poor and range classed as good. There is a measurable difference in the weights of deer from these range classifications which may be used as an index of range status.

Since the major limiting factor in deer populations is the extent to which winter range can support deer, the basic problem of management is to determine the carrying capacity of the winter range through inventory and analysis. Ways and means must then be devised to (1) control deer populations within the limits indicated; (2) increase the carrying capacity, through manipulation of food and cover; (3) increase or extend the range by providing the basic requirements of food and cover.

The most commonly employed method of determining the status of habitat is to survey the range directly using one of several methods. The method used in Wisconsin is discussed in Chapter XIII. Other methods of measurement, such as the one suggested by Cheatum and Severinghaus (1950), are usually used as supporting evidence. There are few states where evidence of over-populated deer ranges have been accepted by the public without long and troublesome debate. In most cases the facts supporting the idea that deer populations must be limited to the capacity of their range have been contested or labeled as pure bunk. This has necessitated the development of many diverse methods for proving that certain limitations have been imposed upon the capacity of the land to produce deer. The fact that limited winter range controls deer populations appears to be a simple problem which should be readily understood and accepted. Unfortunately it is not so simple and certainly not so easily understood, since in all states where this problem has manifested itself there has been a time lag of anywhere from a few years to several decades between the time when recognizable signs of over-population are noted and the execution of corrective action.

It is difficult to analyze the reasons why this cardinal truth is so unpalatable to the general public. Perhaps a long history of too few rather than too many deer overshadowed the impending danger of over-populations. Perhaps a public nurtured on conservation ideas that taught too much saving through limited hunting, predator elimination and laws designed to protect the existing populations, found it impossible to believe that unlimited increases in deer populations were controlled by still other factors. At any rate, the tragedy that befell the mule deer on the Kaibab National Forest in Arizona (Mann and Locke, 1931), where too much predator control and a limited harvest resulted in too many deer for the range to carry and extensive starvation, was not accepted as truth in Wisconsin. The much-reduced capacity of the Kaibab range to carry deer in future years did not worry those who doubted the truth of this disaster. The much-publicized deer problem in Pennsylvania, which pre-dated our problem in Wisconsin by almost a decade, was also rejected. A deaf ear was turned to these and many other warnings.

Good winter range should have plenty of available natural browse, such as this white cedar. Price county, 1938.



As early as 1930, over-browsing was noted in a few northern yards. This white cedar was browsed as high as deer could reach and was photographed in Price county during March, 1938.

The reasons for rejecting the idea that the carrying capacity of the Wisconsin winter range was limited and that over-populations would result in fewer and smaller deer were many and varied. Some people refused to recognize the fact that deer were limited during the winter period to a small portion of their total range. It was even suggested that deer didn't need food during the winter months because they stored up a sufficient layer of fat in the fall to carry them through the winter. By and large the average person was just simply uninformed about the requirements of deer and the status of their habitat. A few selfish persons, who unfortunately made the loudest noise, stubbornly refused to recognize even the most obvious conditions when they were clearly pointed out to them.

Because of criticism and opposition which met the idea that deer populations must be managed in strict conformity with the carrying capacity of their habitat, it was obvious that no short cut to herd management would be found and the long and arduous course would have to be taken. Prior to 1940, when the Deer Project began field investigations of the Wisconsin deer problem, there was ample evidence that something was wrong. Although there were many questions that could not be adequately answered without extensive field study, the basic problem was known.

Evidence of Range Status Before 1940

For more than a decade prior to 1940 there had been increasing evidence that deer concentrations on portions of the winter range were too large for the range to carry on a sustained basis. Dead deer were being found each spring with increasing regularity. Although the question of how and why they died provided substance for many an argument throughout the length and breadth of the state, those persons who knew how and why they died had cause for great concern. Isolated cases of over-browsing and starvation were showing up as early as 1930 (Swift, 1946). In 1934 an extensive artificial feeding program was begun in the Brule river valley in Douglas county in an effort to sustain over-populations of deer on an already over-browsed range. It is interesting to note that this area had been established as a deer "refuge" a few years earlier and the "refuge" status continued until 1951. Swift (1946) reported that following the hard winter of 1935-36, heavy over-browsing accompanied by deer starvation was reported in six northern counties (Figure 15).

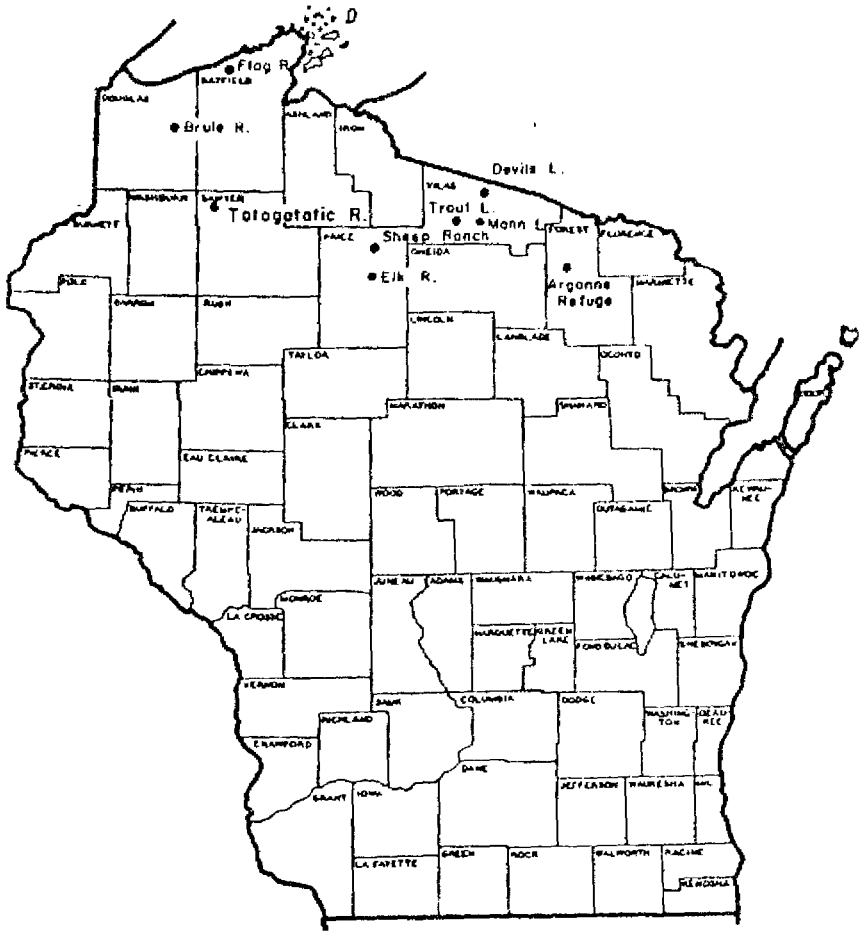


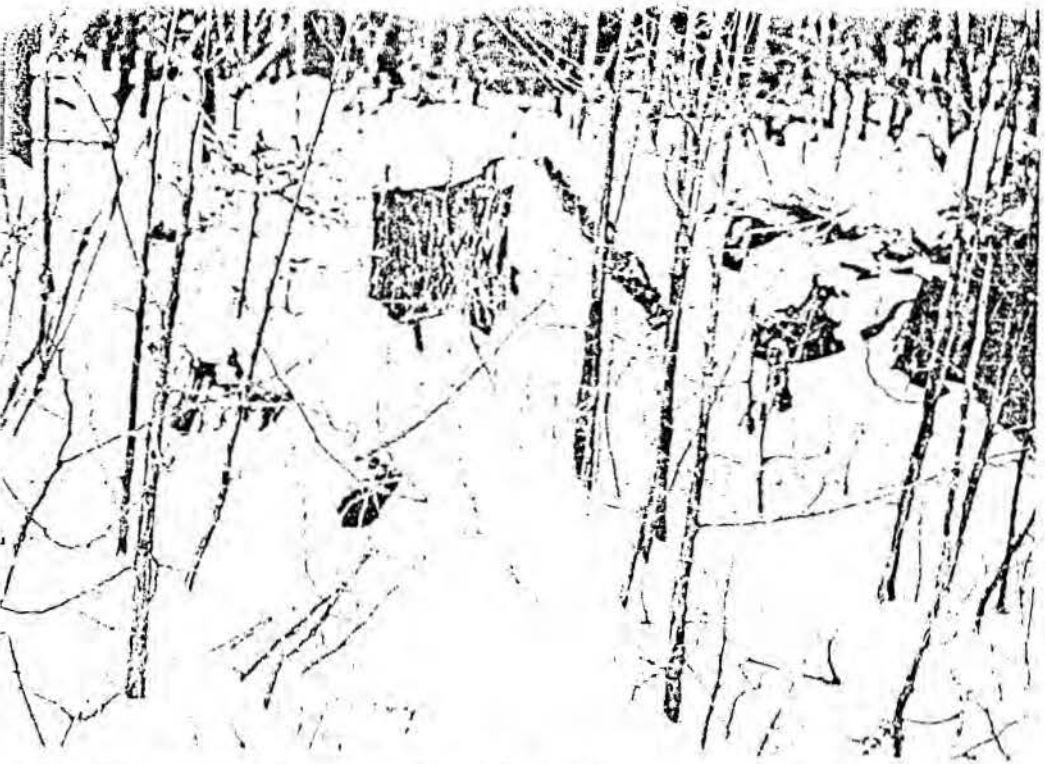
Figure 18. Areas where deer starved in the winter of 1935-36.

In 1936 the U. S. Forest Service made a formal request to the Wisconsin Conservation Commission that 14,000 deer of any age or sex be removed from a 600,000-acre area within the boundaries of the Chequamegon National Forest in Sawyer, Price and Ashland counties. This request was made in recognition of the fact that excessive browsing pressure by deer would ultimately destroy the capacity of this range to support deer, not to mention the damage to a growing forest. The request was rejected because of extreme public objection. The public reaction to the proposal can well be imagined. Only six years before, in 1930, the conservation

department had estimated the state deer population to be 25,000 animals. The refuge idea was just catching on and the idea that deer populations could be limited by the capacity of the range to support them was too revolutionary. "Save the Deer Clubs" were hastily organized throughout the state in answer to this request for herd control.

In 1937 the conservation commission broke with precedent by establishing a deer season in an odd-numbered year, thus marking the first consecutive deer seasons since 1923 and 1924. An already alarmed public found much to criticize as a result of this action. Swift (1946, p. 37) said of this event, "Puzzled and indignant citizens made dire predictions that the deer would soon pass with the buffalo and the passenger pigeon if we are to have seasons every year". Scott (1938, p. 45) summarized the deer situation as follows: "It seems that Wisconsin must be blessed with particularly fine deer yards, or certainly we would have witnessed more serious starvation of deer during this past winter (1937-38). However, in previous severe winters within the last decade, many deer have starved in Wisconsin forests and it is easily possible that with continued increase of our deer, another severe winter will prove deadly." Scott's prediction

Even second-choice browse plants like this red-osier dogwood showed early signs of over-browsing. Argonne Refuge, Forest county, 1937.



These young white cedars were stripped by deer during the winter of 1937-38 near Partridge Lake in Vilas county.

of serious starvation came true the following spring. "The winter of 1938-39 was one of the severest winters for the deer in the locality (Brule river, Douglas county), and heavy snows trapped many deer away from the feeding stations. The fawn crop was hit the hardest, as all browse had been eaten off to such a height that they were unable to reach it. The field personnel estimated that 1,500 deer wintered in the yard. In March of 1939, deer died in the Brule Valley and the public demanded action, regardless of the fact that feeding had been carried on all winter and for years previous" (Swift, 1946, p. 39).

There were warnings from other parts of the state pointing out the existence of a deer browse problem. Hamerstrom and Blake (1939, p. 213-214) reported that in central Wisconsin "Most of the concentration areas had more than enough food. . . . In a few concentration areas, however, there was a food shortage. In 1936-37 two areas were overbrowsed and a browse line was developing in one of them. By the end of the winter, food was scarce in five areas, and in doubtful condition in two. We found no deer dead of starvation, but some were in poor condition by spring. . . . The project area can support its present deer herd.

There is no general critical range deficiency. Many of the concentration areas can winter more deer than they now carry. In a few, however, trouble is beginning to appear. Food supplies on the weak wintering grounds must be increased or winter herds reduced. There have been no losses from starvation as yet. Such losses are more easily prevented than stopped. Now is the time to take action."

It is obvious from these records that Wisconsin's winter deer range had suffered considerable degeneration prior to 1940. Artificial deer feeding had been employed as a means of holding up excessive deer populations for several years. Post-mortem examinations of deer found dead in the winter yards by reliable veterinarians indicated that malnutrition was the primary cause of death (Minor and Hanson, 1939).

There was adequate evidence that serious winter food shortage existed. With this much known, what remained to be done was to gather sufficient factual data on a statewide basis to prove conclusively to a skeptical public that there were very real limitations to the carrying capacity of the winter range and that unless immediate recognition of the need for herd control was achieved, we would stand a real chance of losing our deer population. Although the evidence of over-browsing was confined to limited areas in several northern counties, it should have been sufficient warning that immediate action was imperative. However, the idea that deer populations could out-grow their food supply was at that time flatly rejected by the public.

In 1940 the Deer Project began the laborious task of providing the facts needed for management measures which would recognize the relationship between the deer and its habitat.

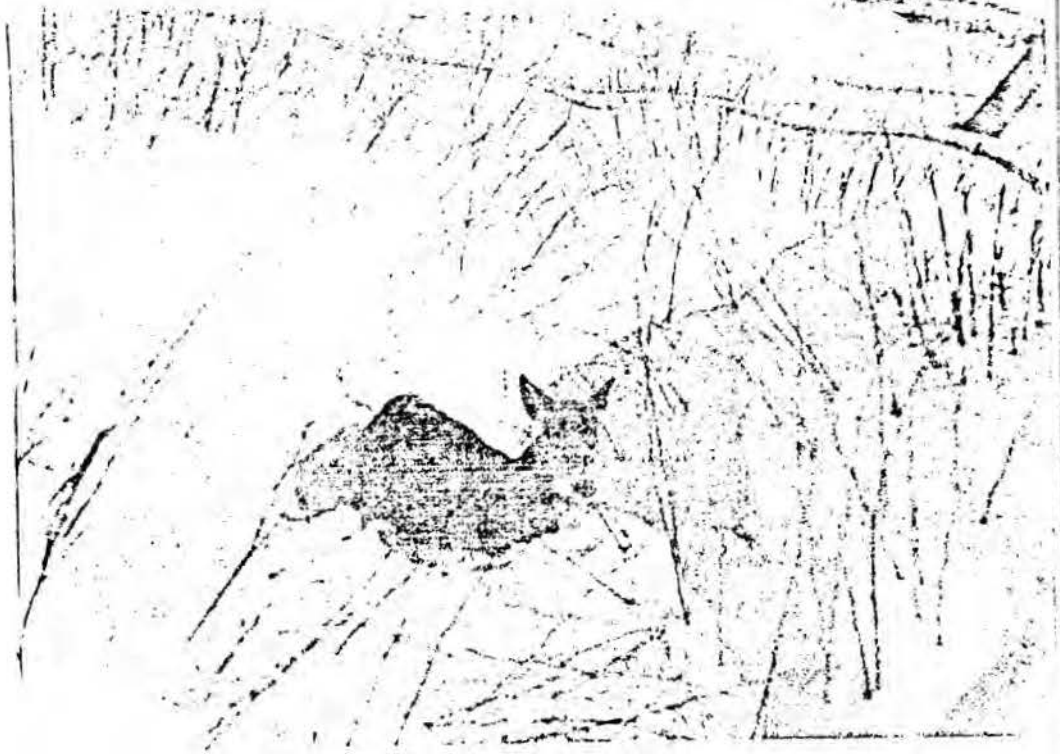
Chapter XIII

Winter Range Condition Surveys

By 1940 an already unsatisfactory condition existed throughout an extensive portion of the state as a result of over-utilization of the winter deer range. Despite repeated warnings, the presentation of volumes of factual data, and actual field examination of the problem, there was no clear-cut public recognition of the seriousness of the situation. It appeared impossible to teach the simple biological lesson that there is a limit to the number of deer the winter deer range can support without suffering serious consequences. Throughout the decade of the 40's, winter deer range conditions degenerated to an unbelievably critical situation. Finally, in 1949 a belated though certainly not complete recognition of the problem resulted in the first of three liberal hunting seasons.

Failure to attain adequate public recognition of the limited capacity of the land to produce deer populations is not peculiar to Wisconsin. It has been and continues to be a common failing throughout the majority of states that have deer. It is particularly difficult to understand the basic reason for not recognizing the biological concept of limitations as they pertain to deer. During the past quarter century great strides have been made in the field of agriculture in teaching the principles of the limited capacity of the land to produce crops and more especially the limitations of grazing or pasture lands to provide adequate pasturage on a sustained basis. The farmer today who does not recognize that he must limit the number of cattle on his farm to the capacity of his pasture is a backward farmer indeed and usually a poor farmer.

Many thousands of words have been written and spoken in an effort to present an understandable explanation of the problem involved. Citizens' committees have been organized to study and report on the problem. Winter tours into the deer yards have been conducted by trained personnel but have failed to attract more than a pitifully small percentage of the people who have out-spoken opinions on the matter. By and large the average person has exhibited complete apathy toward the whole problem and has preferred to let an opinionated minority have their say rather than make any effort to find out what the problem is all about. We clearly recognize that there has been no real public recognition of the problem despite the fact that Wisconsin began in 1949 to liberalize deer seasons in a belated effort to control deer populations to the capacity of the range. Apparently, few people understood that liberal seasons would mean a reduced deer population, despite the fact that herd reduction has been cited as the first step toward a management policy for deer.



A doe weakened by malnutrition in the Jones Lake yard in Vilas county, winter of 1940-41.

Methods of Survey

During the first years of Deer Project activity, the major task concerned locating, mapping and classifying winter deer range. It was soon apparent that extensive rather than intensive range surveys would yield the most valuable information that could be used in deer management in a very short time. Had it been anticipated that the project was to continue for as long as it has, more detailed methods might have been given greater emphasis. Nevertheless, the extensive methods used in Wisconsin have had wide application in many other states, and are still in use in most states for general management purposes.

The range survey methods used by the Deer Project seek two things: (1) The general distribution, composition and availability to deer of deer food plants on the winter range. The results reflect various environmental factors influencing vegetative succession. The degree of browsing by deer prior to the current survey is one of the most important of these factors. (2) The degree of current utilization of various "key" browse species by

deer. The degree of use is an important factor affecting the future trend of range condition. In other words, the cruiser who makes the range surveys is asked to do two things. He must make an appraisal of the amount and quality of deer food available, and determine within broad limits the utilization by current deer populations of the annual production of these plants. He must also relate this utilization to the trend in range conditions.

Feeney (1943, p. 13) pointed out that "when conditions are at their worst — all the trees stripped clean and dead deer lying every few yards along the trails — it does not take much skill to determine that the area is browsed out and that starvation has taken place. On the other hand, it calls for a real expert with a great deal of experience to estimate conditions and prepare a reliable report two or three years before the critical stage is reached. Likewise, it is equally difficult to correctly estimate trends up or down when the evidence is not clearly very bad or very good, or where a change is being initiated."

The Project has attempted to provide its cruisers with enough background knowledge to make an adequate winter range appraisal. This has included practice in the identification of the various tree and shrub species that make up the bulk of the deer's winter browse diet (Appendix F); practice in differentiation between browsing by snowshoe hare and deer; providing lists showing the palatability ratings of the various browse species; and practical field experience in appraising a number of yards prior to the time they assume the responsibility of reporting conditions on their own. It should be obvious that good cruising takes practice and experience.

The actual cruise, which follows the location of the winter yard and on which yard appraisal is based, consists of a random walking cruise of as large a portion of the yard's total area as the cruiser feels is desirable. He notes the distribution, composition, density and availability of the various deer browse plants, the evidence of current and previous browsing pressure and the degree of yarding. When completed, he makes an appraisal report of the yard which consists of: (1) His appraisal of the *present range condition,* classified into the three general categories of "poor", "medium" and "good". A classification of "poor" indicates that the range is probably not capable of supporting its present number of deer and that starvation, if not evident immediately, seems imminent in the very near future. A classification of "medium" indicates that the yard is currently capable of supporting the existing deer population, but that the condition is changing, ordinarily from good range to poor range except where herd management has reversed the usual trend. A yard in "good" condition is one where there is no immediate browse shortage and where no shortage is forseeable for several years, regardless of the trend of range conditions. Such a yard usually includes quantities of first-choice browse species like white cedar, yew, alternate-leaved dogwood, red maple, and sumac, or untouched re-

serves of second and third choice species. (2) His appraisal of *present browse utilization* in relation to the carrying capacity of the yard. The appraisal of carrying capacity is a determination of whether the amount of browse eaten by deer each winter is greater than the annual amount of browse produced, about as much, or less than might be removed without endangering the future food supply. This is distinct from range appraisal in that a yard in any one of the three range condition categories (poor, medium, or good) may fall into any one of the three categories of browsing in relation to carrying capacity.

Relating current browse usage to carrying capacity is more meaningful than simply setting down figures on browse use without regard to the variables that effect a plant's ability to produce browse, such as site differences and variations between seasons and in the tolerance of the species to browsing. For example, a shrub such as red-osier dogwood may be able to thrive despite a 90-per-cent use of its annual growth by deer for a number of years. The same intensity of use on a relatively browse-intolerant species like hemlock or white pine would kill the majority of plants. Similarly, red-osier dogwood on a poor growing site cannot withstand the intensity of browsing that it endures on a good site. Finally,

Not all damage to forest trees and shrubs is caused by deer. These juneberries were girdled by snowshoe hares in Clark county. April, 1948.

heavy summer browsing undoubtedly is more damaging to any plant than the same degree of winter browsing.

In using this method of range analysis we have sacrificed what is often considered desirable detail to fulfill the greater objective of extensive coverage. The reports as submitted are somewhat subject to human error. Variations in the knowledge and experience of individual cruisers sometimes make for different conclusions, especially in those cases where it ". . . is not clearly very bad or very good or where a change is being initiated". However, the information collected has been sufficiently intensive and accurate to formulate sound recommendations for the management of Wisconsin deer during the course of Deer Project activity.

We would like to emphasize that the range appraisal methods we have described are the ones currently in use. They have not always been used in this form, but have been evolved over the years of range cruising experience. However, the differences between the current methods and those of ten or more years ago are not great enough to prohibit comparison of data between any years.

It seems likely that similar surveys will be used for some years in the future. We can, however, foresee the time when harvests, the number of deer an area can support under current conditions, and other management factors will of necessity be more intensively controlled. When that time comes, more intensive range survey methods will have to be used. Such methods must provide statewide information if intensive management is to be successful.

The results of all Deer Project winter range checks are shown in Table 44 and Appendix G and are discussed below. The abbreviations used in these tables are identified as follows:

"Food Conditions" are expressed as "P"-poor, "M"-medium, "G"-good. This category is the appraisal of present natural browse conditions.

"Browsing". This concerns the relation of current browse usage to the sustained carrying capacity of the yard. The column headings are abbreviated in this manner — "Ex"-browsing exceeds sustained carrying capacity, "Eq"-browsing is equal to sustained carrying capacity, "L"-browsing is less than sustained carrying capacity.

"Yarding" is expressed as "T"—deer are typically yarded; *i.e.* almost exclusively confined to the yard itself. There may be some tendency to work the edges of the yard, but at no time is there movement beyond one-quarter mile from the edge of yarding cover. "P"—deer are partially yarded. Most of the deer sign and the heaviest concentration of deer are found in yarding cover, but movement to adjacent upland or hardwood areas not normally used in typical yarding is not greatly restricted. Tracks and trails may be found as much as three-quarters of a mile from the yard although the bulk of the sign is still in yarding cover. "S"—deer are scattered through most of their normal fall range. Deer sign and numbers will be heavier in the yarding cover than it is in adjacent areas.

A symptom of over-browsed range is that hungry deer lose much of their fear of man in the vicinity of artificial feeding stations.

"Deer Concentration". "H"—high, "M"—medium, "L"—low. This is an expression of the relative number of deer in the yard area. It is a rather broad category designed to indicate the density of deer without regard to yarding behavior. Thus an area with density of deer classified as "high" could also fall into any one of the yarding classifications depending on how the "high" number of deer are yarded.

"Logging" and "Feeding" refers to the number of yards in which commercial logging and artificial deer feeding are being done at the time the yard is cruised.

To portray the total effort put into both the range surveys and attempts to present these data to the public, the principal points of the surveys and public relations effort will be presented in chronological order. Range surveys have evolved through three basic periods as follows: (1) Preliminary Surveys, 1941-1944; (2) Inventory Surveys, 1945-1946; (3) Range condition Surveys, 1947-1954.

TABLE 44
Deer Yard Summaries in Per Cent of Yards Checked by Game Division Personnel, 1941-1954

	No. of Counties	No. of Yards Checked	Food Conditions			Browsing Vs. Carrying Capacity			Yarding			Deer Concentration			Logging	Feeding
			P	M	G	Ex	Eq	L	T	P	S	H	M	L		
North																
194 -41	14	80	66	25	9	67	24	9	---	--	---	---	--	---	39	--
1941-42	15	156	41	44	15	74	22	4	---	--	---	---	--	---	42	--
1942-43	16	146	75	21	4	80	14	6	---	--	---	---	--	---	25	--
1943-44	--	147	56	41	3	40	35	25	---	--	---	---	--	---	27	--
1944-45	--	187	50	13	37	61	41	8	---	--	---	---	--	---	28	--
1945-46	--	95	2	11	27	38	47	15	---	--	---	---	--	---	26	--
1946-47	16	119	70	25	5	62	35	3	---	--	---	13	36	51	35	13
1947-48	17	114	78	20	2	---	--	---	---	--	---	---	--	---	--	--
1948-49	20	189	64	25	11	56	29	15	---	--	---	---	--	---	33	20
1949-50	22	189	62	31	7	42	38	20	40	49	11	26	37	37	41	23
1950-51	29	143	69	27	4	62	18	20	48	31	21	27	41	32	45	27
1951-52	20	142	46	44	10	36	30	34	11	71	18	14	44	42	54	5
1952-53	20	143	41	48	11	38	31	31	55	36	9	27	45	28	45	4
1953-54	21	209	58	37	5	36	35	29	8	56	36	24	46	30	41	3
Central																
1947-48	3	8	88	12	0	---	--	---	---	--	---	---	--	---	--	--
1948-49	7	49	55	39	6	53	33	14	---	--	---	---	--	---	8	20
1949-50	7	31	58	32	10	42	52	6	6	81	19	13	52	35	19	35
1950-51	7	38	42	50	8	27	32	41	0	76	24	26	34	40	26	39
1951-52	7	36	3	61	36	3	17	80	8	14	78	3	30	67	39	0
1952-53	7	37	8	51	41	5	5	90	0	54	46	8	38	54	19	0
1953-54	7	34	6	62	32	6	9	91	0	21	79	3	56	41	32	3

Preliminary Surveys, 1940-41 to 1943-44

During the winters of 1940-41 through 1943-44 range surveys were conducted by a small crew of Deer Project cruisers (Table 44). Their purpose was to get general information on the location and types of yards, and on comparative deer numbers. A total of 279 different winter yards were checked by these crews in this period. Although the total extent of winter deer range was not known, these surveys do point up the fact that a critical situation was rapidly developing on a wide-spread area of winter deer range. Feeney (1944, pp. 3-4) summarized the status of the deer and outlined the general condition of the range as follows:

"By those who have given it any study, it is well known that an important deer range problem has existed in Wisconsin for a number of years. Somewhat alarming starvation losses were noted by some Wisconsin Conservation Department officials as far back as 1935 and 1936. Since that time, rather heavy winter losses have been noted in northern Wisconsin from year to year, varying in extent, of course, with the severity of the winter. During the past four years in which the Pittman-Robertson deer project has been conducted, we have had the opportunity of observing unusually varied winters. In 1940-41 the weather was about normal with starvation prominent [Figure 19]. In 1941-42 the winter was comparatively light with very little loss from starvation. 1942-43 was severe, and the starvation losses were tremendous. Last winter, 1943-44, was the mildest in 52 years recorded by the United States weather bureau in Wisconsin. As a consequence of last winter's mildness, starvation was light except for fairly heavy losses in the Flag Yard only.

"Regardless of the mild winter, logging operations, and (artificial) feeding, the deer herds were currently still way over the browse production capacity in 40% of the winter range. In 35% of the areas, the number of deer was about equal to the total current browse production, and in 25% the deer did not eat as much browse as grew last year. This means that not more than ¼ of our winter range has a reasonable chance for early recovery, even if the deer remain scattered and browse as lightly as they did during the past mild winter . . . .

"In making range appraisals, it is neither the deer kill, apparent numerical concentrations nor starvation losses that tell the real story, but examination of the extent of browsing which alone will give a reliable comparison of deer abundance to range carrying capacity.

"There is no known remedy beside starvation for getting a deer population in balance with its range, except to reduce the surplus by taking antlerless deer, with or without the taking of bucks. . . ."

The fact that Feeney and his associates during this period succeeded in bringing this information to the public is attested to by the number of protest meetings, editorial comments, and general expressions of disbelief with

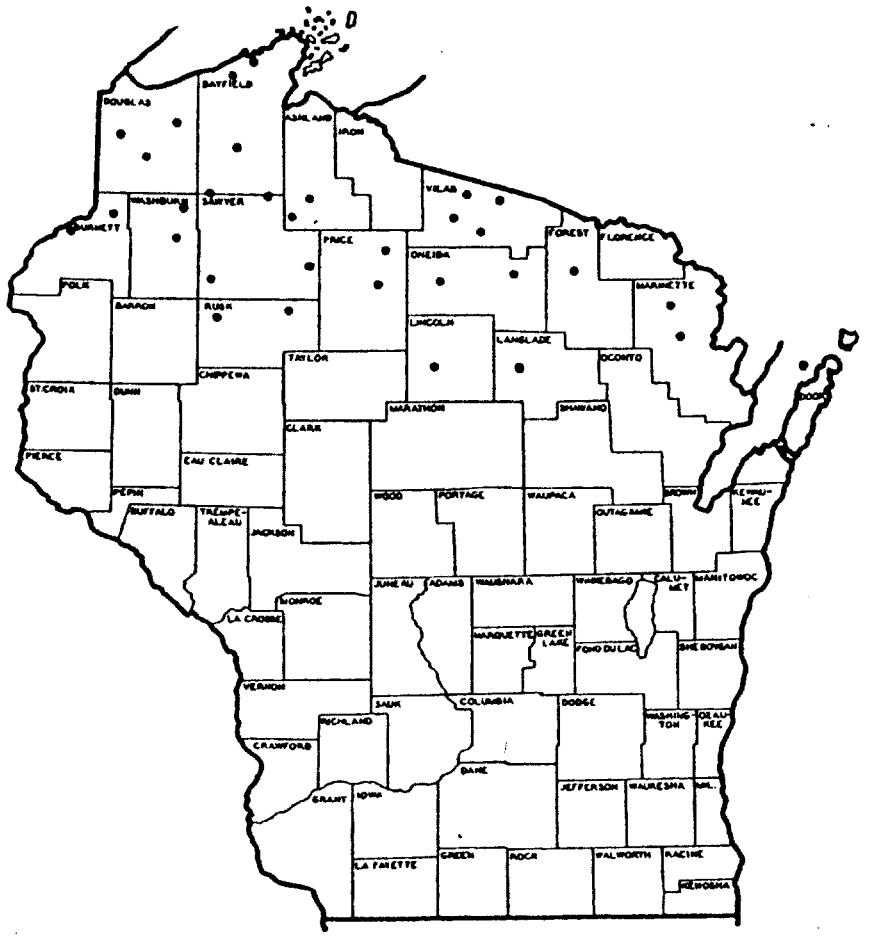


Figure 19. Critical winter range areas in the winter of 1940-41. Each dot represents a deer yard where starved deer were found.

which the reported findings of these surveys were greeted. There can be no doubt that the facts were made available to a large segment of the public and it was apparent that the truths revealed by these surveys were wholly unpalatable to them. In the winter of 1942-43 a "Citizens Deer Committee" was appointed by the Wisconsin Conservation Commission to determine the facts from the layman's point of view. Aldo Leopold acted as chairman of the committee. The commission instructed this committee to study the deer problem and to report on their findings. The Deer Project was called upon to provide information and field guidance for this group.

A majority report was submitted to the commission in June 1943. Swift (1946, pp. 54-55) summarized the observations of this group as follows:

"1. The Wisconsin deer herd has increased beyond its winter food supply and is beginning to starve during hard winters like 1942-43.

"2. The degree of over-population varies; not all localities are in critical condition, but critical spots are increasing.

3. Starvation so far kills mainly fawns. Their stomachs are full of food, but not good food.

"4. The good winter food plants are being eaten out, are unable to reproduce, and are being replaced by plants of inferior value.

"5. Artificial feeding does not relieve the pressure on good food plants.

"6. The herd should be reduced to the carrying capacity of the good winter foods.

"7. The sooner this is done, the more good food plants will be salvaged, and the more deer can be carried in the future.

"8. If the herd is not shot down, it will starve down. Further starvation means further depletion of food plants, and this means a very small herd for decades to come.

"9. Reducing the herd means reducing antlerless deer."

The serious starvation losses in the critical winter of 1942-43 brought home the fact that a serious problem existed, even to skeptical persons who refused to recognize the unmistakable evidence of over-browsing. The report of the Citizens Deer Committee, which substantiated the findings of the Deer Project biologists, together with a recommendation for a more liberalized hunting season from the Wisconsin Conservation Congress prompted the conservation commission to authorize a split hunting season for 1943. Four days of forked-horn buck hunting were followed by a three-day rest period. After the rest period a four-day antlerless deer hunt was permitted. This decision by the commission, which clearly recognized that herd reduction was a necessary prelude to a sound management policy for deer, marked the first time in 25 years that antlerless deer were legal game.

An army of 158,000 hunters took to the woods that season and bagged 66,252 forked-horn bucks and 62,044 antlerless deer. This kill was more than three times the number of deer that had been taken during the most successful buck season and alarmed many people into thinking that the deer population had been slaughtered. An avalanche of criticism descended upon the conservation commission, the conservation department and anyone who dared to view the deer problem in the light of biological and ecological fact.

Inventory Surveys, 1944-45 to 1945-46

The overwhelming criticism of the 1943 "split" season by the general public and by many persons within the conservation department again brought up the perennial question of whether or not the findings of the

Deer-browse line on balsam at the Drummond yard, Bayfield county. April, 1941.

Deer Project were a true picture of the actual conditions. In 1944 the commission instructed the conservation department to conduct an extensive field survey utilizing field personnel from the law enforcement, forest protection, and forestry divisions, as well as project biologists, to survey as much of the total range as possible. A departmental deer committee, representing the Deer Project and each of the divsions employed in the survey, was appointed to compile and analyze the survey reports and to prepare a final report.

More than a hundred conservation wardens, forest rangers, foresters and biologists participated in these surveys. Survey crews were schooled by the Deer Project in winter identification of browse species, methods of survey and other matters pertaining to the survey. Assignments were made on the basis of known winter yarding areas. To determine the complete picture, additional areas were assigned for locating winter yards that had not been recorded to date. Aerial surveys were made in some areas to locate winter yarding areas and to facilitate checking.

The following quotation has been taken from the report filed by the

"From the information gathered in 2,432 man-days of effort covering 8,555 miles on foot including 706 reports for 475 deer yards (winter concentration areas) the following conclusions can be drawn . . . .

"1. The deer herd has shown a general increase since 1943. (No attempt was made to get a numerical estimate of the total deer population of Wisconsin.)

"2. The fawn crop of the past season was normal and sufficient as shown by the number of fawns observed — a little over one-third of the deer seen were last spring's fawns.

"3. The number of predator tracks seen was not unusual, in fact, contrary to anticipations, the tally figured in few-to-many miles per track instead of so many tracks per mile. The number of known instances in this survey where deer had been killed by coyotes or wolves was very few.

"4. The general browsing on the principal food species was excessively heavy in 46% of the yards in northern Wisconsin.

"5. Balsam, a poor food but a good indicator of the trend of browsing shows an increased utilization by deer. This species was conspicuously browsed in 79% of the winter areas.

Balsam is not a preferred deer food, but deer will eat it as a last resort. Flag yard, Bayfield county, March 1941.

"6. The deer herds, irrespective of the light winter and early spring (with only about 27 days of yarding) were browsing in excess of the present carrying capacity in more than one-third of the yards. The deer were browsing less than what the winter ranges could produce in only about one-fourth of the northern areas."

The committee made recommendations for the 1945 season as follows:

"The buck law, which went into effect in 1916 was effective in increasing the deer population. The problem today is a problem of keeping the deer in balance with the carrying capacity of the winter range. This can only be done by cropping the surpluses where they occur. Past history proves that the surplus cannot be kept in check except by some system for taking not only bucks but antlerless deer as well, in over-browsed areas. *AN ATTEMPT TO CARRY MORE DEER THAN THE RANGE CAN SUPPORT WILL RESULT ONLY IN HEAVY STARVATION AND FEWER DEER IN THE END.*"

The 1945 survey not only substantiated conditions reported by project biologists for a small sample of the total range, but indicated that conditions were even worse than Feeney had reported in 1944. Forty-five per cent of the 215 winter yarding areas examined in the north were classified in poor condition as regards natural foods, despite an extremely mild winter and early spring (Table 45). There were only 27 days of yarding. The survey included 49 winter concentration areas in central Wisconsin counties which indicated that a trend toward range degeneration was developing in this area of the state where winter weather was less severe.

A special report of the findings of this survey was prepared by the departmental deer committee and presented to the conservation commission in the spring of 1945. These data were also made available to the public at the conservation congress game hearings that same spring.

During the winter of 1945-46 the extensive survey which had been started in 1945 was continued. An aerial survey was conducted early in winter to locate yarding areas and to determine the boundaries of yards that had not been adequately surveyed in the past. Ground crews checked new areas located from the air. A total of 621 winter yarding areas were checked bringing the total number of known deer yards to 819 in 42 counties. Results of both the 1944-45 and 1945-46 checks are given in Table 45 for the northern and central areas.

Feeney (1946, p. 26) reported on the 1946 survey as follows: "When all factors are considered, our findings show that the conditions on the winter deer range trend to date toward increased deterioration. For the past three winters, largely because of weather conditions, starvation losses have been almost negligible, but a heavy loss in a critical winter is becoming more and more likely. The status or condition of the range is gauged by the carrying capacity of the deer yard areas for deer. This is in turn

TABLE 45

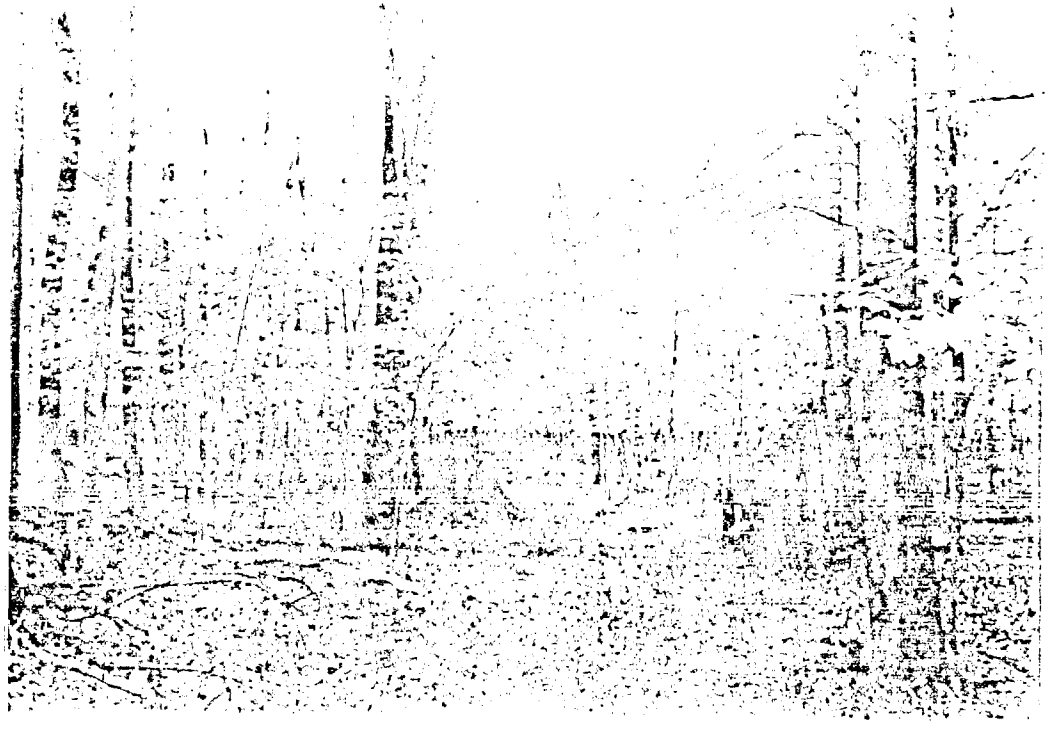
Winter Range Survey Summary, 1944-45 and 1945-46

Yards Checked for General Food Conditions

Area and Winter	*No. Yards*	*Poor*		*Fair*		*Good*		*Total Known Yards*	*Total Yards Checked**
		No.	*%*	*No.*	*%*	*No.*	*%*		
North									
1944-45	215	97	45	73	34	45	21		
1945-46	423	149	36	169	40	105	24		
Central									
1944-45	49	4	8	17	35	28	57		
1945-46	81	33	41	22	27	26	32		
State Total									
1944-45	264	101	38	90	34	73	28	537	475
1945-46	504	182	36	191	38	131	26	819	621

* Not all yards were accurately appraised for general food conditions.

Chambers Island in October, 1945, an example of extreme over-browsing by deer. Note the browse line on the maples and the lack of undergrowth.



based on the degree of browsing on the principal food species, and on natural food conditions in general.

By the spring of 1946 approximately 2,000,000 acres were classified as winter deer range. Although all of the 819 yards known to exist in 42 counties were not examined during any one year, a fairly accurate picture of the statewide winter deer range up to 1946 was obtained by compiling the most recent report for each known yard. Yard status of 19 yards was unknown. Of the remaining 800, 292 (36 per cent) had poor food conditions, 276 (36 per cent) had fair food conditions, and in 232 yards (29 per cent) food conditions were good.

This compilation shows that more than one-third of the total known winter yarding areas were in poor condition insofar as general food conditions were concerned. Relatively mild winters during the last three years of the period had minimized starvation losses. The ever increasing demand for artificial deer feed during the winter months, together with the increase in damage claims filed against the state by persons who had sustained damage by deer to crops, points up the fact of an increasing deer population.

The problem of over-browsing and subsequent range deterioration was no longer limited to the northern deer range. The central Wisconsin area now showed a very definite trend toward widespread over-browsing (Table 44). Nobody had paid any attention to the warning published by Hamerstrom and Blake in 1939 (p. 215) which said, "There have been no losses from starvation yet. Such losses are more easily prevented than stopped; now is the time to take action".

Range Condition Surveys, 1946-47 to 1953-54

The preliminary surveys, (1940-41 to 1943-44) and the inventory surveys (1944-45, 1945-46) provided an account of the over-all status of winter range conditions, and an inventory of the total winter range. It was recognized that an annual accounting of the many factors of habitat that mean prosperity or starvation for the deer was a prerequisite to intelligent management. Because habitat is continuously changing through the influence of temperature, precipitation, browsing, insect infestation, logging, fire, etc., and because habitat directly influences the health and productivity of the deer, an annual survey to determine the current status of range conditions was needed.

In 1947 and 1948 a survey of deer damage to forest reproduction was undertaken by the conservation department to determine the effect of the deer population upon the future forest of the state. With Stanley DeBoer as Chief of Party, this survey was sponsored by the department under the general guidance of a six-man committee made up largely of men interested in forestry.

The survey examined almost 160,000 individual trees between one and eight feet high in more than 11,000 sample plots on managed forest lands,

TABLE 46

Deer Damage to Forest Reproduction, 1947-48*

*Per Cent of Reproduction Browsed***

Species	No. of Sample Plots	No. of Trees Checked	Northwest				Northeast				Central				Indian Reservation			
			None	Light	Heavy	Rabbit	None	Light	Heavy	Rabbit	None	Light	Heavy	Rabbit	None	Light	Heavy	Rabbit
Basswood	986	2627	25	0	75	5	30	0	65	5	None tallied				65	5	25	5
Maple	8838	73227	30	5	60	5	25	0	65	10	15	5	75	5	80	0	15	5
Oak	691	1673	20	5	70	5	40	5	50	5	35	10	50	5	70	5	10	15
Ash	1666	9008	30	5	65	0	40	0	55	5	None tallied				85	0	10	5
White Pine	813	2605	45	10	40	5	45	5	40	10	30	10	60	0	85	0	10	5
Jack Pine	1027	12927	50	10	40	0	50	10	35	5	50	10	40	0	None tallied			
Aspen	2335	19487	55	5	35	5	55	5	30	10	45	5	50	0	75	0	20	5
Birch	1669	6220	40	0	40	20	50	0	20	30	35	10	50	5	80	0	5	15
Cedar	270	2486	30	0	40	30	30	5	25	40	None tallied				90	0	0	10
Hemlock	351	1048	None tallied				40	5	35	20	None tallied				90	0	5	5
Elm	606	5641	60	5	30	5	60	5	25	10	None tallied				95	0	5	0
Balsam Fir	2269	12742	60	10	25	5	80	5	10	5	None tallied				85	5	10	0
Norway Pine	373	1715	90	0	10	0	90	0	5	5	55	15	30	0	100	0	0	0
Spruce	1094	7497	90	0	0	10	90	0	0	10	None tallied				95	0	0	5

* Data from Swift (1948).
** Rounded to the nearest 5.

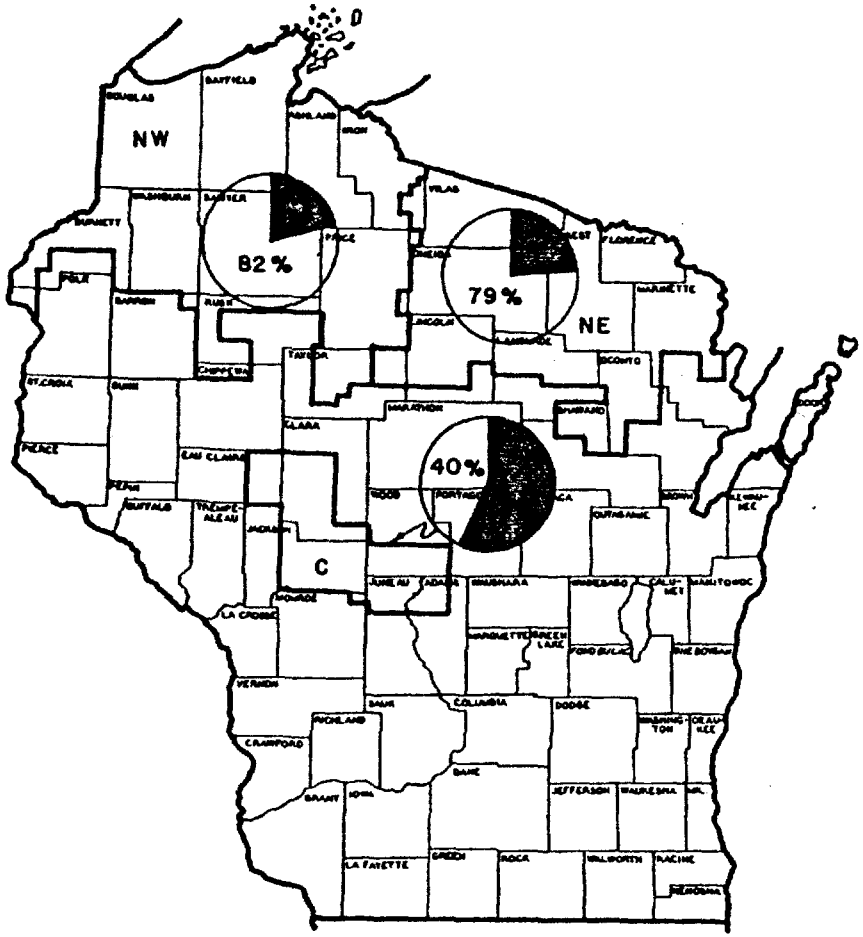


Figure 20. Per cent of desired tree stands found by survey of deer damage to forest reproduction.

irrespective of winter or summer deer range classification (DeBoer, 1947). It is somewhat surprising, therefore, that the survey indicated such a high over-all effect of deer on the total environment (Table 46 and Figure 20). So far as the forest manager is concerned, the deer and snowshoe hare are welcome to anything over 500 stems of tree reproduction per acre. Using 500 stems as a base, browsing by deer had left 82 per cent of the desired stand in the northwest area, 79 per cent in the northeast area, only 40 per cent in the central area, but 147 per cent in Indian reservations where deer numbers were low.

Despite the results of DeBoer's survey, the prospects for an increased harvest of deer, necessary to relieve a serious over-browsing situation, appeared remote at this time. It seemed inevitable that herd reduction, however unpleasant, must soon be recognized as the only alternative to complete range destruction. In anticipation of the time when range surveys might become a meaningful part of management instead of simply recording ever-increasing and ever-expanding degeneration, all of the range analysis data recorded for the six-year period of project existence were compiled and studied preparatory to setting up an annual range condition survey on a representative sample of known winter yards.

"Key" yards to be checked annually were selected first on the basis of conditions as shown by the 1946 summary. Hence 36 per cent of the yards were selected from that group whose general food conditions were classified as *poor;* 35 per cent were from that group classified as *fair;* and 29 per cent were classified as *good.* Next, yards were selected that represented all soil, topographic and cover types. A third criterion was to have key yards well distributed throughout the total range.

A preliminary selection of key yards was checked in the field during the winter of 1946-47 and 1947-48 (Table 44), and after necessary adjustments, a final system of key yards was selected. Figure 21 and Appendix H show the location and distribution of the key yards. Minor changes in number and locations of yards checked are made annually depending on weather, manpower for checks, and changing condition of individual yards. However, the great bulk of key yards checked has remained the same since 1946.

A reorganization of the game management division of the Wisconsin Conservation Department in 1949 shifted the responsibility of the annual winter range survey from the Deer Project to district game managers. Since the winter of 1948-49 the Deer Project has participated only to the extent of organizing the survey and compiling and interpreting data.

The conditions found by district game managers in the key yards of their districts are shown in Table 44.

The winter of 1947-48 was the hardest on deer since 1942-43 and as a consequence many deer died from starvation in the yards. This winter saw the first large-scale losses in the central area. The trend toward increased deterioration of winter range was very severe (Figure 22). Heavier browsing on food species of low palatability was recorded for this year than any year since 1942-43. Costs for artificial feeding and deer damage reached an all-time high.

The Wisconsin Conservation Congress authorized a committee to be known as the "Deer Committee", comprising seven members of the congress representing the state as a whole, to study and report on the deer problem. Their unanimous report presented to the congress in the spring of 1948

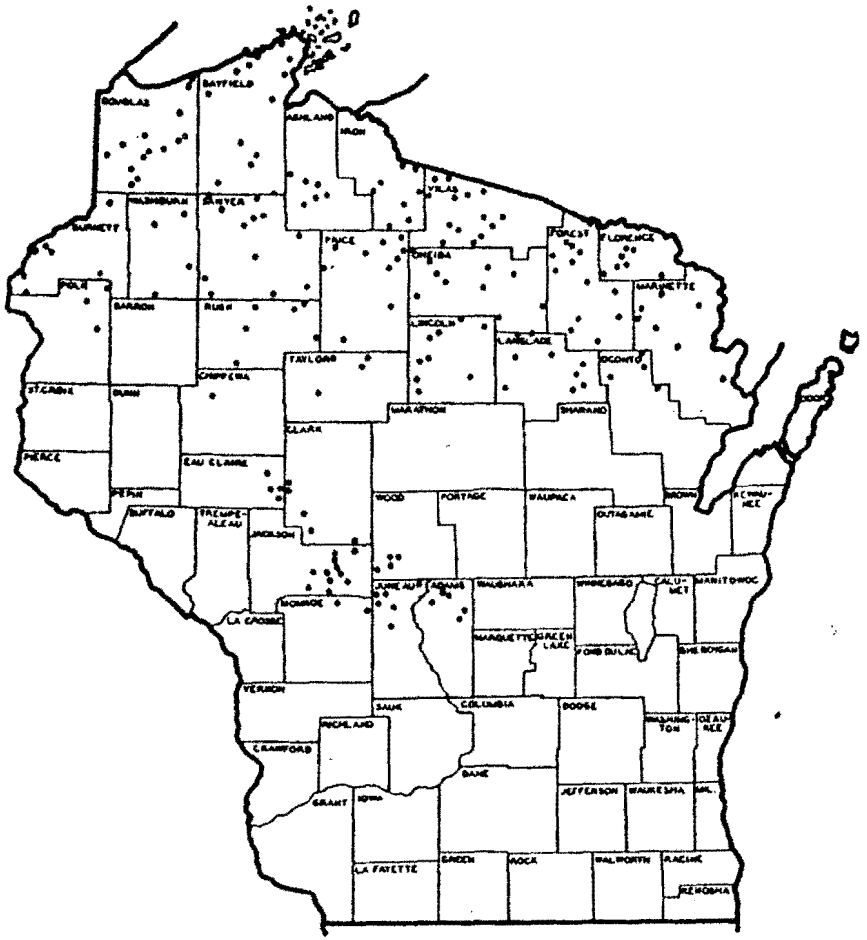


Figure 21. Key deer yards checked in the winter of 1952-53. Each dot represents the location of one yard checked.

recognized the existence of a serious range problem and asked for its solution by an any-deer hunting season.

The congress concurred in the committee's recommendation for a herd control program by recommending a seven-day any-deer season for 1948. This recommendation was subsequently approved by the conservation commission but vetoed by executive order of the governor, and herd reduction was again delayed.

In contrast to the hard winter of 1947-48, the winter of 1948-49 was relatively mild with less-than-normal accumulation of snow. Despite these

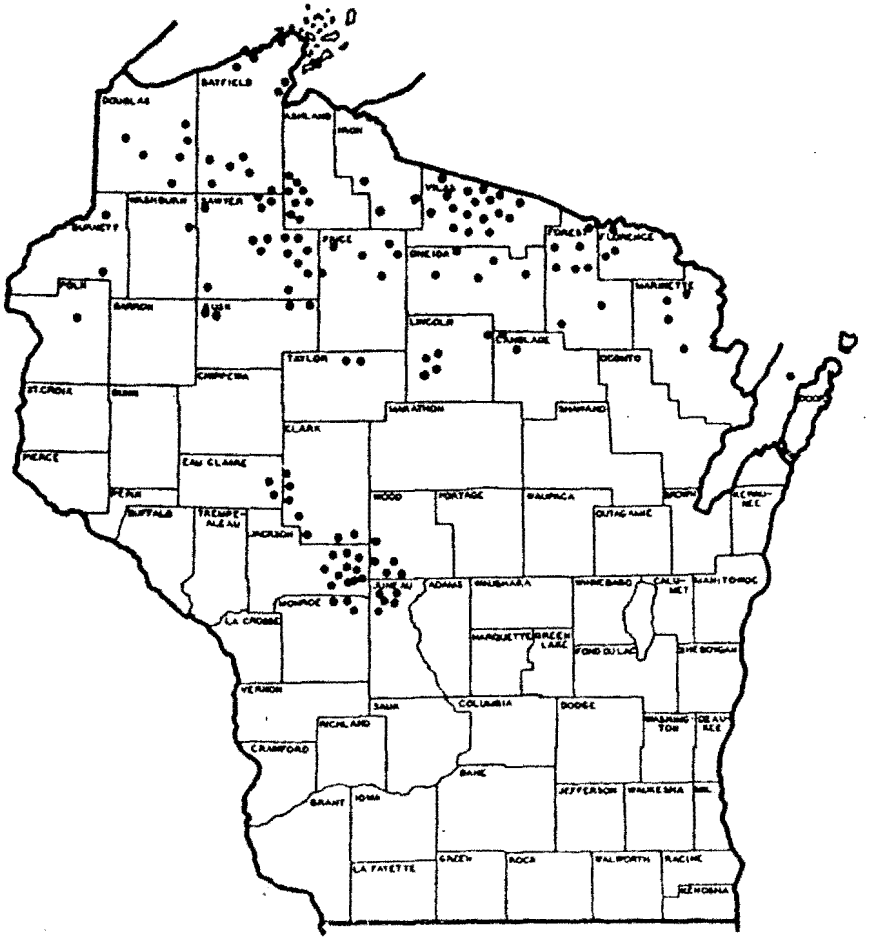


Figure 22. Critical winter range areas in the winter of 1947-48. Each dot represents a deer yard where starved deer were found.

favorable conditions, browsing continued to be excessive in the major portion of the winter yards. Survey reports showed that 64 per cent of the northern yards and 55 per cent of the central yards were in poor condition as regards availability of food in relation to numbers of deer present in the areas.

The conservation congress deer committee, which had become a continuing study group, again recognized the seriousness of winter range conditions and recommended a herd reduction program as the first step toward a deer management program. However, after many hours of heated

debate the conservation congress asked for a nine-day forked-horn buck season for 1949. The conservation commission, however, elected to recognize the committee's recommendation and authorized a five-day antlerless deer season for all counties of the state previously open to hunting. Forked-horn bucks with antlers exceeding a two-inch fork were excluded as a safety measure.

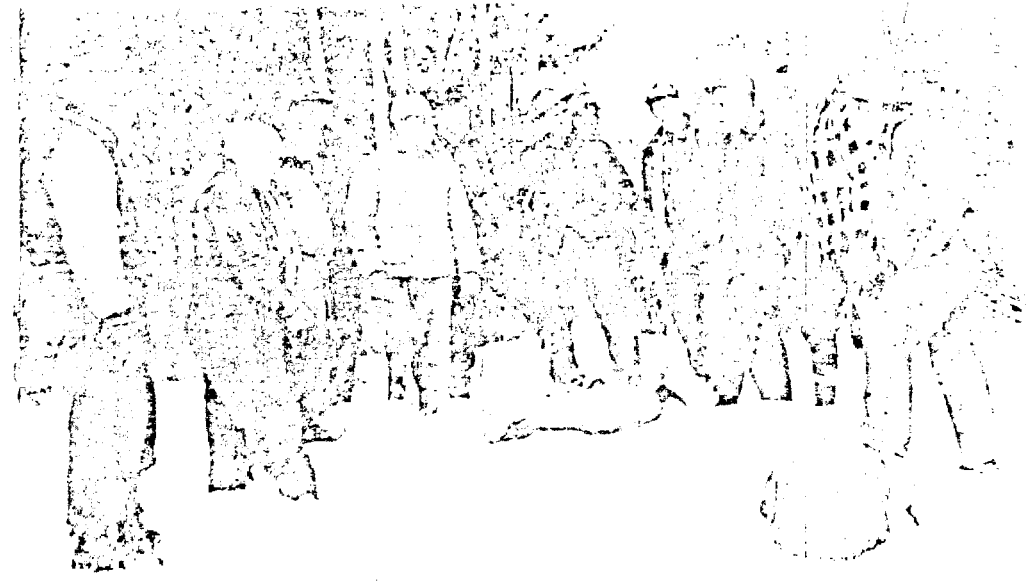
Thus, six years after the liberalized 1943 season, an estimated 159,000 antlerless and spike-horn deer were legally removed from the population. Although the browsing pressure in the heavily hunted area of central Wisconsin was immediately reduced, the effect of this season on the major portion of the winter deer range in the north was negligible.

The winter of 1949-50 was accompanied by normal accumulations of snow and relatively cold weather. Despite the unprecedented harvest of deer during the '49 season and hundreds of tons of blowdown timber in the yards due to a severe fall windstorm, starvation losses were severe. An estimated 15,000 to 20,000 deer were lost in northern Wisconsin. There was no significant change in the status of food conditions in the northern yards (62 per cent poor in 1950 as compared to 64 per cent in 1949).

The deer committee of the conservation congress, although recognizing that a problem of over-browsing still existed, recommended a forked-horn buck season to be followed by controlled hunting on critical areas. (A bill to authorize the conservation commission to conduct controlled hunting was before the state legislature at this time.) The deer committee, recognizing that the controlled hunting bill would probably not receive favorable support in the legislature, had recommended an any-deer season as their second choice. The controlled hunting bill failed to get support in the legislature and the deer committee's second recommendation was accepted and approved by the conservation congress. The conservation commission concurred in this recommendation and a seven-day any-deer season was authorized for 1950. An estimated 168,000 deer were legally removed from the deer population during the 1950 deer season.

Yarding conditions during the winter of 1950-51 in the northern area varied from a completely open condition in December and January to a tightly yarded condition during February and March. Deer remained in the yards until the latter part of April and in some areas they did not leave winter range until early in May. Conditions in the central area were entirely different; the winter there was characterized by open and relatively mild weather. There was little or no starvation loss in the central area. Starvation in the northern yards was not as severe as during the previous winter.

The deer committee again recognized that winter range conditions had not materially improved in the northern portion of the state, although they pointed out that range conditions in central Wisconsin had been considerably improved as a result of a decreased browsing pressure. Their final

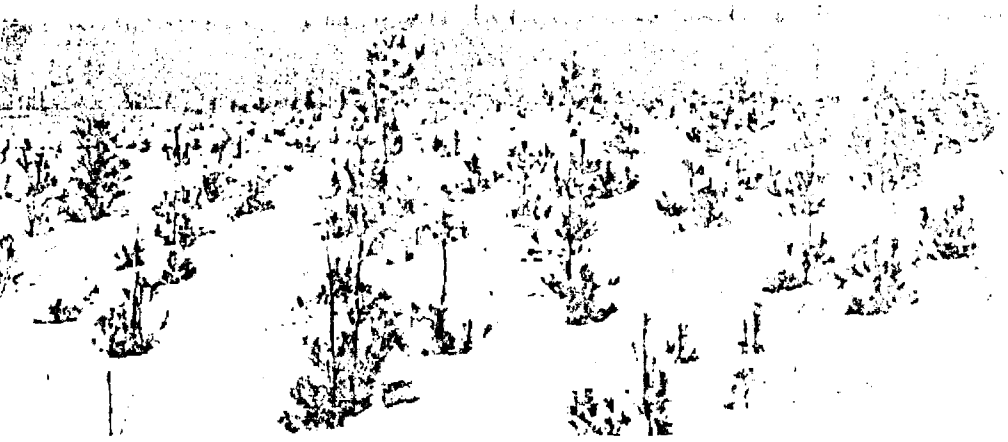


Deer study committees of the Wisconsin Conservation Congress have done much to gain public understanding of Wisconsin's deer problems. This is the 1947-48 committee in the field near White Birch Lake, Vilas county, on their annual tour of deer wintering areas.

recommendation to the conservation congress was for an any-deer season, statewide. The congress approved this recommendation. The conservation commission authorized a seven-day any-deer season for 1951. The deer kill in the 1951 deer season reflects the heavy kill of 1949 and 1950, for the take that year dropped to an estimated 128,000 deer. The more easily accessible areas in the northern part of the state began to show unmistakably that the liberal seasons of the past three years were resulting in a reduced deer population.

During the winter of 1951-52 near-normal weather conditions prevailed. Winter yard reports showed that herd reduction which had taken place over the past three years had materially reduced browsing pressure in many northern yards. The starvation losses which would have been expected under range conditions comparable to those of three years earlier did not materialize. It seemed that the range balance which had been the objective of the seasons was generally close to reality. However, there remained considerable areas where even in a normal winter it was evident that any immediate increase in the deer population would again reverse the trend.

To many persons, the reduction in numbers of deer in the yards appeared too drastic. The talk of a closed season gained momentum, but combined with this feeling was another, that the past three seasons had proved to be much more palatable than was originally presumed. The congress and the department both recommended a return to a seven-day



Deer heavily browsed this white pine plantation near Tioga in Clark county, February, 1950.

forked-horn buck hunting season and such a season was authorized by the commission. A total estimated kill of 27,630 bucks was made by 227,988 hunters. Hunting success was not as good as in the most recent buck seasons in the mid-1940's and much less than during the preceding three liberal seasons. This resulted in a good deal of grumbling by hunters. However, considering the herd reduction due to the seasons from 1949 to 1951, the 1952 buck kill was in line with pre-season expectations.

Yard surveys in the winter of 1952-53 found increases in deer numbers in most of the major deer counties, heavier deer concentrations in yards due to more severe late-winter weather, but few starvation losses. Despite this, many northern yards were in critical condition. The central range was in excellent shape. The hunting season was again set for seven days with only forked-horn bucks legal, as recommended to the commission by the congress and department. The opening of the season was delayed one week due to dry weather and accompanying forest-fire hazard. Once under way, the kill was light; only 20,178 bucks were estimated to be shot despite an obvious increase in the herd shown by the numbers of all deer reported seen by hunters.

Annual kill estimates cited so far are those determined by a poll of hunting license buyers conducted by Otis S. Bersing of the conservation department. In 1953 hunters were required for the first time to register the deer they shot with the conservation department. A total of 15,880 bucks were registered.

The mild winter of 1953-54 resulted in less yarding than normal and less pressure on the limited natural browse within the yards. Some of the northern yards were still over-browsed. The central range remained in good shape. The congress, department and commission recommended a seven-day forked-horn buck hunting season.

After the liberal hunting seasons of 1949-51 reduced deer numbers in many areas, browsed plants like this small white pine in Washburn county began to make normal growth again.

The 1954 kill was again light, but to all indications better than last year, despite poor hunting conditions due to dry weather on the first three days of the season. A total of 19,877 bucks was registered.

In the summer of 1954 there was little cause for optimism about range conditions. The herd had allowed parts of the northern range and most of the central range to recover from the extremely poor conditions of the late 1940's but enough northern yards were in poor condition so that starvation can be expected in the next normal winter.

An important aspect of the range problem is that much present range, both winter and summer, is growing up. As the forests mature, the shrubs that grow under a young forest and supply much deer food disappear, and the young trees themselves grow out of reach of the deer. The whole present trend is developing toward less favorable deer habitat. The disappearance of natural winter food in a growing number of deer yards can only result in fewer deer in the future.

Although over-browsing has been stressed because it resulted in an immediate loss of deer food, another very real danger to future herds in

northern counties is lack of cover. Losses in future winter cover for deer as a result of heavy browsing during the last decade or more have been very serious.

A balanced winter range should have many coniferous trees of varying size. Then as older conifer cover matures and is cut, its place will be filled by other growing trees in younger age classes. However, much of the northern forest is maturing without the spread of younger age classes ready to take over when the old cover trees topple or are cut.

It is a general rule that buck seasons alone will not keep the deer herd from increasing. Thus in the foreseeable future we will be faced again with a herd that is eating itself out of house and home. In addition it now seems on the basis of three liberal hunting seasons that no single type of statewide hunting season will keep the herd and its winter food supply in balance. Despite our vastly increased knowledge of the mechanics of deer populations and deer range, keeping the herd and its winter food supply in good shape is the major deer problem today as it was when the Deer Project began in 1940.

Chapter XIV

Artificial Deer Feeding

Public reaction to deer starvation is usually characterized by an impulse to provide artificial feed for starving deer rather than to reduce the number of deer to the carrying capacity of the range. The fact of starvation may or may not be recognized as a symptom of range deficiency. In Wisconsin attempts to sustain over-populations of deer by artificial feeding preceded herd control by about 15 years. Starved deer were first found in the early '30's and in the winter of 1934-35 an artificial feeding program was begun. Herd control, reluctantly, and needless to say belatedly, did not become a reality until the early '50's and then only after the major portion of the winter range had been seriously over-browsed.

This chain of events is not peculiar to Wisconsin, for it has taken place in many states during the past quarter century. There are few examples in the record where the previous experience of other states has been used to guide subsequent programs. One notable exception to this general rule has been Michigan's steadfast refusal to initiate artificial deer feeding as a part of their game management program. Bartlett (1938, p. 48) said of feeding attempts by private hunting clubs in Michigan, "Winter feeding has not as yet been successful nor may it ever prove to be a feasible method of holding up declining deer populations." In 1951 the Michigan Department of Conservation reiterated Bartlett's comment. They said, "Artificial feeding has been tried over and over again in a dozen states. Its record is 100 per cent bad. It has never worked because the underlying principles are wrong. It has no part in scientific deer management and should be forgotten once and for all" (Anonymous, 1951, p. 10).

Aldo Leopold (1943, p. 8) had this to say about deer feeding: "Winter feeding of game birds and songbirds carried no known penalties, why not feed deer? The main difference lies in the effect of artificial feeding on the supply of natural foods. *Artificial deer food is not a net addition to natural food and may become a net subtraction.*" The true wisdom of Leopold's words are evidenced by the thousands of acres of seriously, and perhaps irreparably over-browsed winter deer range throughout northern Wisconsin, where many thousands of dollars have been expended during the past fifteen years. The true cost of this ill-advised venture cannot be measured by the account of funds expended alone, but must also include an accounting of the values lost to the natural range because feeding is a "net subtraction" from natural foods.

Swift (1946, p. 39) said, "Browse depletion in the Brule River Valley was evident in the late 20's and rather extensive feeding was commenced

in 1934 and has continued every winter since that time." This was the beginning of a program that was to grow into the largest venture of its kind in the United States.

In considering the matter of artificial deer feeding in the light of recent experience, we are forced to the unhappy conclusion that although feeding appeared to offer a solution to starvation it failed to recognize the true cause of starvation correctly. Consequently, the cure treated only the effect and the underlying illness went undetected.

During the period 1935-1942 the state-sponsored winter deer feeding program was relatively insignificant in scope and effect. The total effort throughout this period was considerably less than the effort for a single year after 1942 (Table 47). The damaging effect of these early years of feeding effort are not measured as a "net subtraction" from natural foods but rather by the precedent it established for justifying a vastly expanded program in subsequent years.

In 1943, although there was little indication that over-populations on winter deer ranges had been accepted as fact, the state legislature passed

Artificial deer feeding by the state first took place in the Brule river valley, Douglas county, during the winter of 1934-35. Here feed is being distributed at a Brule valley feeding station in March of 1938.

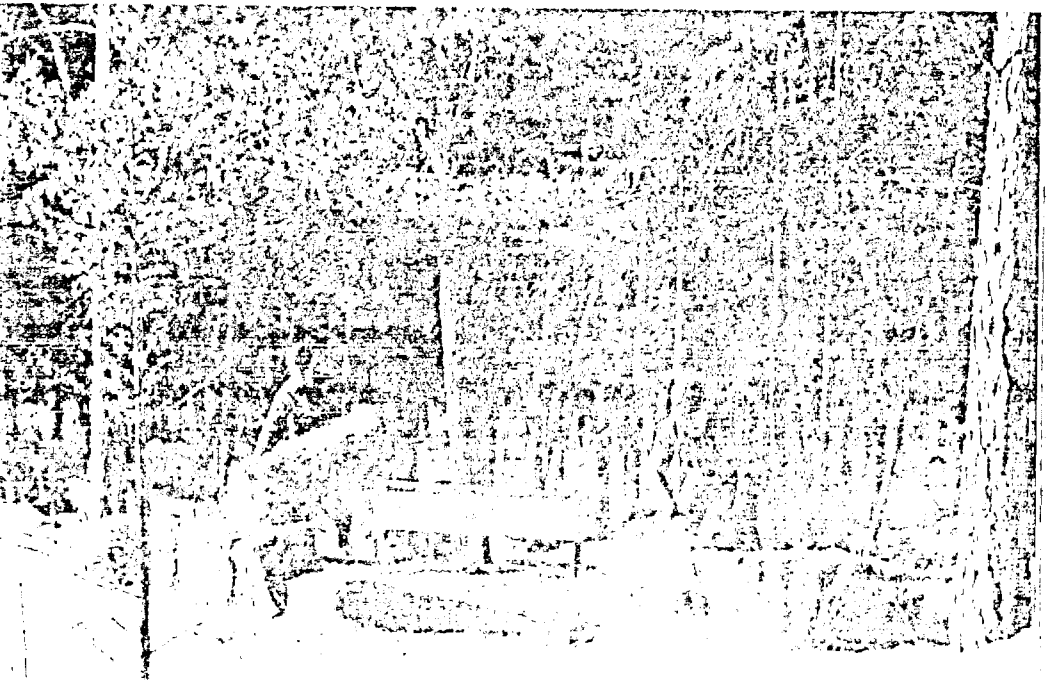


TABLE 47
Winter Deer Feeding Summary

Year	Tons of Feed				Costs		
	Hay	Grain	Concentrate	Total	Feed	Distribution	Total
1935-36	23	--	1	24	$ 377.20	$ 204.54	$ 581.74
1936-37	28	--	3	31	457.50	249.01	706.51
1937-38	39	--	2	41	1,327.50	739.26	2,066.76
1938-39	41	--	2	43	577.15	329.18	906.33
1939-40	13	2	12	27	965.43	549.08	1,514.51
1940-41	20	--	21	41	1,438.67	797.19	2,235.86
1941-42	3	--	7	10	391.56	220.44	611.94
1942-43	25	--	22	47	1,467.48	823.69	2,291.12
Total	192	2	70	264	6,942.38	3,912.39	10,854.77
1943-44	107	38	106	271	8,237.71	9,338.43	17,576.14
1944-45	202	110	173	485	18,149.13	9,405.37	27,554.50
1945-46	377	35	355	767	45,910.38	33,419.96	79,330.34
1946-47	282	--	175	457	15,861.45	18,466.71	34,328.16
1947-48	492	3	491	986	55,094.71	17,843.31	72,938.02
1948-49	521	--	393	914	45,866.43	15,044.33	60,910.76
1949-50	625	--	362	987	43,687.77	21,209.55	64,897.32
1950-51	775	--	356	1,131	50,049.34	44,353.82	94,403.16
1951-52	584	--	170	754	31,481.70	34,795.85	66,227.55
1952-53	133	6	38	177	9,000.01	28,821.10	37,821.11
1953-54	224	--	50	274	12,329.85	10,159.59	22,489.44
Total	4,302	212	2,489	7,203	335,618.48	248,052.52	578,671.00
Grand Total	4,494	214	2,739	7,467	342,560.86	246,964.91	589,525.77

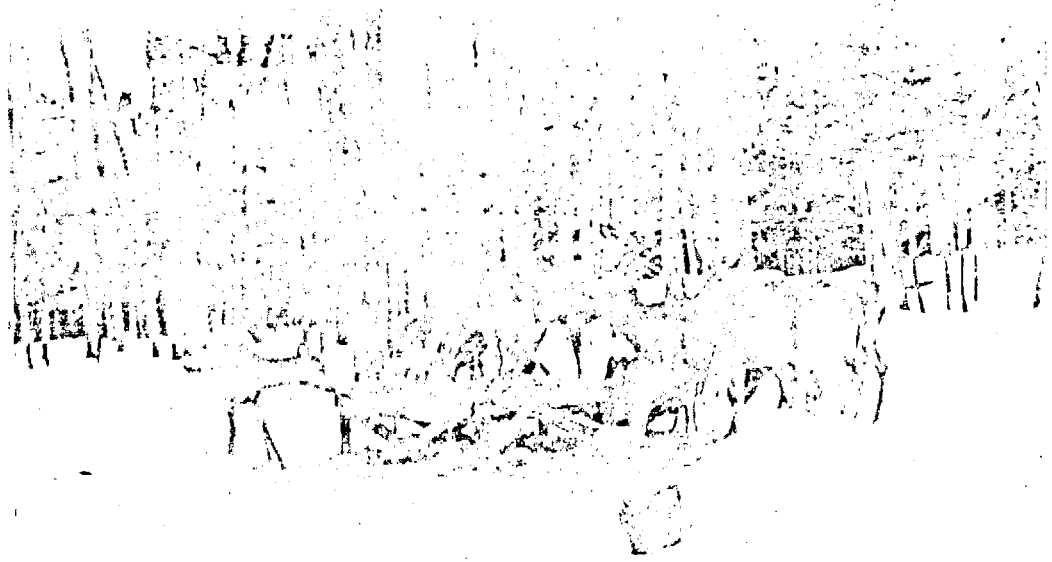
a law that authorized a fifty-cent increase in the deer hunting license fee. This law remained in effect until repealed in 1953. The monies collected under this law were to be used "exclusively for the acquisition of deer yards and the provision of winter food for deer". The enactment of this legislation was preceded by one of the most critical winters for deer the state had ever experienced. Wholesale starvation throughout much of the northern deer range probably influenced legislators' favorable reaction to this bill. It seems inconceivable that this legislation would have received favorable consideration had there been no substantial indication that winter deer range conditions warranted some action. Funds provided by this law were to bolster the limited monies then available to the conservation department for this activity and an expanded program of artificial feeding was envisioned as an adequate solution to the problem of deer starvation.

During the following winter (1943-44) the artificial deer feeding program was expanded tremendously. Almost twice as much money was expended that year to feed deer than had been spent in the total effort during the eight years since the first official deer feeding had been initiated in 1931. The "net subtraction" this expanded program had on natural foods become a serious factor as the program grew, encompassing a considerable area of winter range.

Feeney (1944, p. 2) had this to say about the expanded feeding program: "The two most heavily fed areas were not too satisfactory. In northern Vilas county, a heavy feeding program may have lessened starvation, but it did not remove in the least the browse pressure on natural forage. Consequently, the range gained nothing and the outlook for the coming winter is not good. In northern Bayfield county, heavy feeding did nothing for the range except possibly make natural browsing worse. Neither did it prevent starvation, as this area was the exceptional example of starvation in 1944."

The large-scale feeding program which began in the winter of 1943-44 grew by leaps and bounds, especially after the end of World War II when the sale of hunting licenses began an unprecedented rise and provided more and more money for feeding purposes.

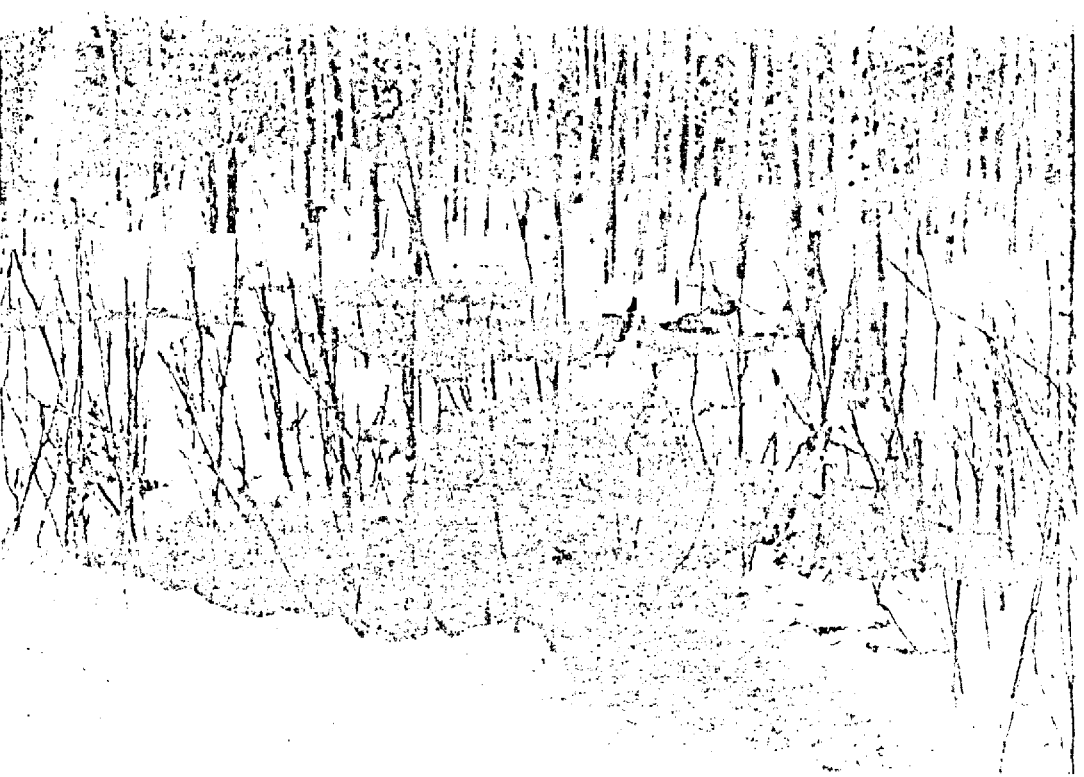
Artificial deer feeding has contributed directly to the critical status of much of Wisconsin's deer range by: (1) Holding excessive deer populations on ranges already over-populated and consequently over-browsed. Range destruction has been far more serious because of artificial feeding than under natural conditions because surplus deer would have perished, thereby relieving the over-population problem to some degree. (2) Offering what appeared to be a solution to the over-population problem. The feeding program seemed to offer a solution to persons who admitted we had a problem but could not recognize herd reduction as the cure. By substituting artificial feeding as a solution, herd control was delayed until the major portion of the winter deer range had been over-browsed.



Deer at a private feeding operation in Vilas county, 1944.

Besides the fact that artificial feeding contributed to the critical status of the range, it sometimes offered little relief from starvation during critical winters. Starvation losses were tragically high in some feeding areas where the greatest efforts or at least the greatest costs were incurred. During the winter of 1947-48 starved deer were commonplace throughout the northern range and serious losses were incurred in several central Wisconsin counties. More money was expended to feed the deer that winter than during any previous year. Table 47 shows a greater amount for the winter of 1945-46, but a considerable portion of that allotment was expended for the purchase of trucks and other equipment necessary in the administration of the program.

Most of the starvation losses occurred during the spring break-up when travel conditions are at their worst, discouraging persons from getting out to check on reported losses. However, the conservation congress deer committee toured many of the feeding areas in the spring of 1948, and made the following recommendations regarding artificial feeding: "That artificial feeding of deer is costly, inefficient and unsound, but that such feeding cannot suddenly be discontinued in some major browsed-out yards in which little natural food is left; nor should feeding be discontinued in emergencies such as sometimes arise when logging operations are abandoned, or in similar situations." It is interesting to note that every deer committee since 1948 has made similar recommendations regarding the artificial feeding program.



Artificial feeding does not lessen browsing pressure on natural food plants. This heavily browsed maple was in the center of an area where hay was being fed. Flag yard, Bayfield county, 1944.

When starved deer are found in areas where feeding operations are being conducted, the inevitable question asked is why, if pen-controlled feeding experiments prove conclusively that deer can be sustained satisfactorily on artificial feed for normal yarding periods, should there be any starvation losses? This has been explained by theorizing that dead deer found at feeding stations have just moved into the feeding area from outside areas and they were either in a starved condition when they arrived, and were unable to assimilate artificial foods, and died after gorging themselves; or that they arrived at the feeding area too late and died before artificial food could help them. This may help to explain some of the mortality found at feeding stations, but it seems unlikely that it explains satisfactorily losses reaching the proportions found in some yards after the spring breakup.

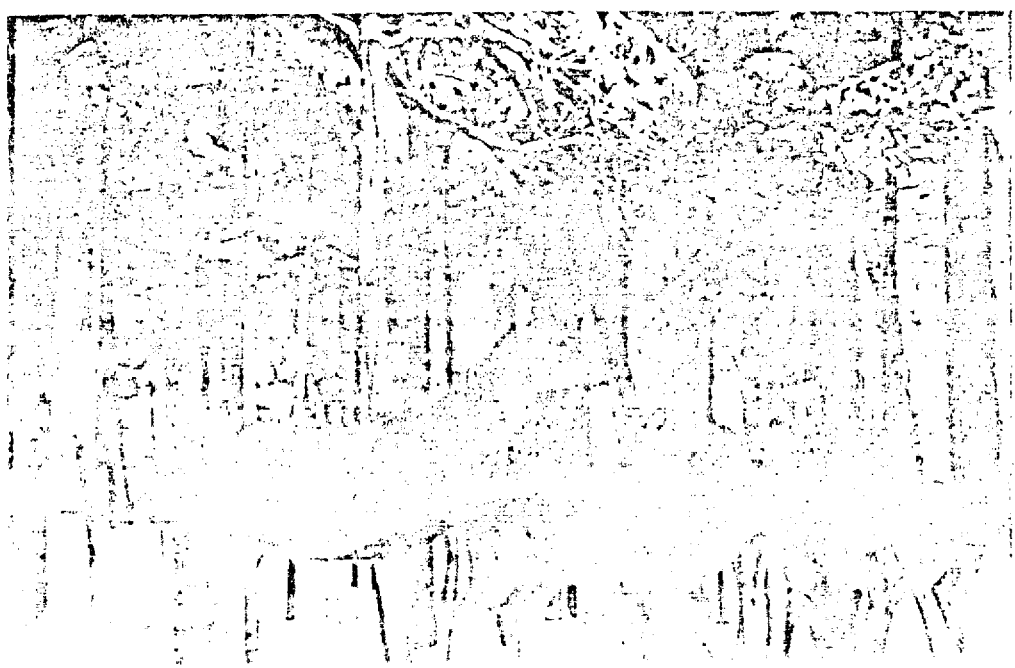
In the spring of 1949, losses through starvation in the Flag River deer yard (Bayfield county) were found to be one starved deer for every 7.64 acres of the area checked. Pathological examination of over 30 of these deer by veterinarians indicated that starvation was the primary cause of death. Over 90 per cent of the deer were fawns born the previous spring.

It is not likely that there would be an influx of that many young deer into the yarding area after snow conditions had become severe enough to cause deer to yard. The answer to starved deer in feeding areas seems to be the result of providing insufficient amounts of food throughout the feeding period, or if sufficient food is provided, the deer that need it most do not receive the benefit of it.

Adult deer, contrary to the cartoon concept of parental deer behavior, exhibit considerable competitive spirit toward fawns for the same food supply. Unless provision can be made for distributing artificial feed so that fawns may feed undisturbed, it is likely that they will receive a short ration. It is also difficult to differentiate between usable and unusable leavings at feeding stations, especially when hay is being fed. Waste at feeding stations runs quite high, and as it accumulates it is difficult to know just how much food should be put out at each feeding.

Feeds used in the Wisconsin feeding program have been good quality alfalfa hay, together with a supplement of concentrated high-protein ground feed in pellet form. Hay usually made up two-thirds of the diet by weight, and concentrate the remaining one-third. Perhaps the most important factor

Older deer will compete with fawns for food at a feeding station. Fawns usually do not eat until the aggressive larger animals will permit it. Vilas county, 1950.



In spring, heavily used artificial feeding sites have all the characteristics of an unkept barnyard. Deer were still feeding here when this picture was taken in the Flag yard, Bayfield county, during the spring of 1947.

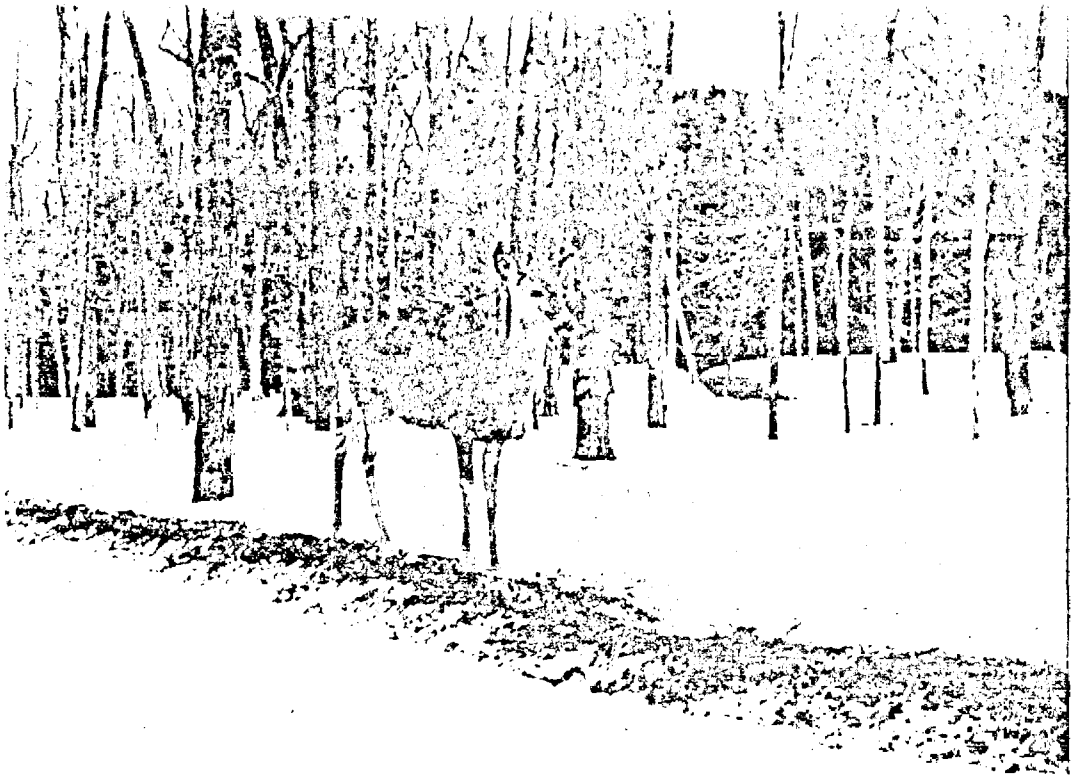
of all is that once a feeding area has been established, feeding operations necessarily must continue until the deer are able to move out of the area freely. If feed supplies run short because the feeding program has been expanded too far, and if the amounts of food put out during the latter part of the period are reduced, the purpose of the entire program is lost and starvation claims many deer despite the fact that feeding is being done.

Simple arithmetic can tell us much about the total effect, in terms of deer fed, of Wisconsin's large-scale deer feeding program. We know from actual feeding experiments with pen-controlled deer that the *minimum* requirement per one hundred pounds of deer per day is two pounds of good quality alfalfa hay. This means two pounds of hay consumed, exclusive of waste. Experiments have shown that in order to provide two pounds of edible hay, it is necessary to supply about four pounds of hay. This, of course, will vary with the quality of the hay. Average alfalfa hay will run about 50 per cent by weight to coarse stems, weeds, etc.; therefore, for every 100 pounds of deer we must provide three to five pounds of hay per day. For the purpose of this calculation, the normal yarding period is about 90 days for northern Wisconsin.

Let us assume that we have a population of just 1,000 deer to feed, and that these deer weigh an average of 100 pounds each. What will it cost to feed these deer a full ration of food for a 90-day yarding period? To feed 1,000 deer for 90 days means that we will have to provide 90,000 deer-days of food. This figure, multiplied by four pounds of feed per day, equals 360,000 pounds or 180 tons of hay. At $38.00 per ton, our food bill amounts to $6,840.00. Distribution costs should not exceed 50 per cent of the feed cost on the average and this amounts to $3,420.00. Food and distribution costs total $10,260.00 — in other words, it cost about $10.00 per head to feed a 100-pound deer a full ration of food for a 90-day period. This does not sound bad at all. A 100-pound deer is certainly worth $10.00. But let us see how many deer could have been fed at a minimum cost of $10.00 per head during the winter of 1947-48 when $73,000.00 was spent on the artificial deer-feeding program. $73,000.00 divided by a cost of $10.00 per head means that only 7,300 deer would have benefited by the feeding program that year, assuming they all required a full ration of food for the entire period.

Or to look at it in another way, what would it have cost the deer hunters of this state if they had paid for feeding only the deer they bagged

Artificial feeding was carried on in the winter of 1949-50 near Boulder Junction in Vilas county.



This doe is standing on a dropping-covered trail leading to a deer feeding station. Her gaunt appearance belies much benefit from artificial feeding. Vilas county, 1943.

during the 1950 deer season? We will assume that the average deer weighed 100 pounds and that the yarding period had been a normal 90 days. An estimated total of 168,000 deer were bagged in 1950, which multiplied by $10.00 per head, amounts to the staggering total of $1,680,000.00. These calculations prove two things: (1) that artificial deer feeding is a very expensive operation, and even large sums of money feed only small numbers of deer; and (2) that if we think we can maintain a shootable deer population on the basis of an artificially-fed herd, we had better examine the costs carefully if deer hunting is to continue to be a sport engaged in by the average man.

Artificial feeding conducted on a strictly emergency basis has merit. Current department policy is attempting to keep the feeding program on this basis, even though it is no longer required by law, and especially since the liberal hunting seasons of 1949-51 accomplished a reduction in herd numbers in most of the central area and in parts of the northern range. There are a number of possible circumstances which must be accepted as man's responsibility, and for this reason deer which may be involved should not be left to shift for themselves. Deer that have been trapped by deep

snow in an area where logging operations have terminated, should be provided with sufficient food to carry them through until they can leave the area. In certain situations where bad snow crust conditions prevent deer from moving about, provision should be made for feed if possible. Usually crust conditions do not develop in deer yards where cover is heavy.

It is difficult to keep a feeding program on a strictly emergency basis. Public interest is always keen regarding state deer-feeding programs, and everybody wants a load or two of feed to scatter around their resort or hunting camp. Fawns found in the spring and early summer are commonly thought to be "lost", and so too any deer located during the winter months need feed.

Wisconsin's considerable experience in artificial feeding of deer in winter should offer other agencies, who have not as yet gone through the cycle of over-population, over-browsing, starvation, artificial feeding and finally herd control, conclusive proof that artificial feeding has little value except in emergency situations. Artificial feeding, when conducted on a statewide basis in an effort to sustain over-populations of deer on a winter range that has already been over-browsed, only results in a continued degeneration of the range, and thereby prolongs the time necessary for recovery. The chain of events leading up to artificial feeding programs inevitably ends sooner or later by recognizing that herd control is a necessary part of deer management; and the time required to repair the damages incurred through the period of feeding will depend upon how long it took to finally learn that there are very real limitations in the capacity of deer ranges to support deer populations; and that artificial feeding offers no solution to the winter food problems of deer populations.

Chapter XV

A Discussion of Deer Range Carrying Capacity

One of the basic principles of land-use, whether it be for farmer or for game manager, concerns the carrying capacity of the land. Carrying capacity for the farmer is the number of cattle he can graze without ruining his pasture, or how many crops he can grow without wearing out his fields. For the game manager concerned with deer on wild-land range, *we define carrying capacity as the number of deer a unit of range can support for a full year without serious damage to the plants that provide deer food and cover or to the deer themselves.* Both farmer and deer will suffer when carrying capacities are exceeded.

It is a common human failing to want to grow more cattle, corn or deer than the land can support. History has shown that this failure usually lasts until the land will grow no more cattle, corn or deer, or until the lesson of limitations has been learned through some irrefutable consequence, such as reduced income.

The farmer learns about his land's limitations quicker than the deer hunter, because the farmer can see the results in his pocketbook. But those interested in deer do not learn as fast because it is particularly difficult to associate the number of deer on large areas of wild land with the status of the land as deer range. The hunter tends to think only of the number of deer he sees and it is unlikely that the actual number of deer on a range unit will ever be known to his satisfaction.

The biologist seldom considers the absolute number of deer present. His main concern is whether or not the deer are eating more available food than should be eaten, thereby causing the habitat to degenerate. Such conditions are relatively easy to determine. To date the average person has generally been unable to accept the biologists' stand that the *condition* of the range and not the *number* of deer should be used to determine the size of Wisconsin's deer herd.

The carrying capacity of any given unit of range at any particular time is specific for that particular range at that particular time. However, the many factors that exert an influence on the carrying capacity make it improbable that any given range will maintain a specific carrying capacity for long. Deer population fluctuations, weather, natural plant successions, fire, insects, and many other factors act to prevent any one set of environmental conditions from becoming static. A trained observer can recognize these changes as they occur, but the layman too often misinterprets them to mean other things and often is not aware of them until the effect of the change becomes noticeable.

No two ranges are exactly alike and browse species vary considerably between areas. There are more than a hundred browse species utilized by deer in Wisconsin. To fully understand the relationship between the deer and its habitat it is necessary to be able to identify these species, and to be able to determine what is too little or too much browsing by deer. It is also necessary to know what plant, if any, is likely to replace another plant being over-browsed, in order to determine what kind of deer food the range will have in the future.

It should be obvious that the layman cannot be expected to learn enough about the biological and ecological aspects of habitat to know precisely what current conditions prevail and what should be done to improve the relationship between the deer and their environment. However, it is imperative that he know enough about this relationship to understand the need for certain management measures proposed by persons whose business it is to know these things.

Two experiments have been conducted in Wisconsin to provide a visual demonstration of carrying capacity and to help the laymen understand the relationship between deer and their habitat. The first used deer exclosures, which are areas that have been fenced to keep deer out so that comparison of tree and shrub growth between the fenced area and the unprotected area can be made. The second used enclosures, which are areas with a known number of deer fenced in on specific units of range. The number of deer-browse days in different enclosures is controlled to show the effect of different degrees of browsing pressure on the range.

Although most of these study areas are located in easily accessible sites, relatively few people have availed themselves of the opportunity to see what a deer can do to its environment. Unfortunately, many who do visit these areas approach them with a negative attitude and they look upon these experiments as fixed situations the biologist has conjured up to try to prove a meaningless point.

Deer Exclosure Studies

Although the principal reason for establishing deer exclosures was to provide a visual demonstration of the effect of browsing on natural habitat, an effort was also made to determine such things as survival rates for different browse species and what other factors exert an influence on forest vegetation. It was desirable also to know what survival could be expected for deer browse species planted during periods of high deer populations. Many people felt that planting would solve the food problem in browsed-out deer yards and were urging a large-scale planting program. Another question to be answered was how important is the competition between the snowshoe hare and deer for the same food supply?

A total of 23 exclosures were constructed by the Deer Project on various cover and soil types throughout the northern and central portions

of the deer range. They were built during a period when wire fencing materials were scarce and snow fencing was used as a substitute. Double-height snow fencing adequately keeps out deer as long as it remains in good repair, but it does not withstand much weathering and begins to deteriorate within a short time. In some instances where this type of fencing was used in open areas, wind damage was considerable. Ten-foot posts either broke off or tipped up when broad expanses of fence were subjected to excessive wind pressure.

Most of the project exclosures were too large (1 acre) resulting in excessive maintenance costs. Large areas were thought to be desirable from the standpoint of visual demonstrations, but this advantage is outweighed by the increased problem of maintenance. Only a few of the 23 original exclosures are still in good shape; the locations of three are given in Table 48.

Generally speaking, the educational value of a deer exclosure is potentially good; however, the time required to grow a tree spectacular enough

TABLE 48
Survival of Deer Browse Plants in Exclosures and Unfenced Plots

*Exclosure Name and Type**	*Stocking*	*Size*	*No. of Plants in* 1946	1948	1951	*Per Cent of Survival in* 1951
Pike Lake						
Deer and Hare Proof	Planted	$\frac{1}{8}$ Acre	189	185	181	96
Deer Proof	Planted	$\frac{1}{4}$ Acre	519	437	370	71
Unfenced	Planted	$\frac{1}{4}$ Acre	244	160	107	44
Swayne Tower						
Deer and Hare Proof	Planted	$\frac{1}{8}$ Acre	36	30	10	28
Deer Proof	Planted	$\frac{1}{4}$ Acre	420	311	141	34
Unfenced	Planted	$\frac{1}{4}$ Acre	266	105	21	8
Cedar Rapids						
Deer and Hare Proof	Planted	$\frac{1}{8}$ Acre	41	10	27	66
Deer Proof	Planted	$\frac{1}{4}$ Acre	210	164	87	41
Unfenced	Planted	$\frac{1}{4}$ Acre	99	50	7	7
Deer and Hare Proof	Natural	100 Sq. Ft.	..	38	21	55
Cedar			..	19	4	
Balsam			..	7	7	
Hemlock			..	12	10	
Deer Proof	Natural	100 Sq. Ft.	..	29	15	52
Cedar			..	18	8	
Balsam			..	7	5	
Hemlock			..	1	2	
Unfenced	Natural	200 Sq. Ft.	..	11	3	27
Cedar			..	6	0	
Balsam			..	4	2	
Hemlock			..	1	1	

* Location of Exclosures:
Pike Lake—SE NW, Sec. 28, T36N, R3E, Price County.
Swayne Tower—NW SE, Sec. 18, T37N, R5W, Sawyer County.
Cedar Rapids—SW NW, Sec. 19, T36N, R4W, Rusk County.

Unbrowsed area inside Elk River deer exclosure, Price county, 1951. Note the quantity of balsam reproduction.

to impress a layman is too long for the type of fencing used in the construction of these exclosures. Smaller exclosures, constructed of heavy-gauge sheep fence, are more satisfactory because of reduced maintenance. The U. S. Forest Service has constructed this type of exclosure in the Chequamegon and Nicolet national forests, and find them very satisfactory.

Additional fencing (one-inch-mesh chicken wire) on 1-acre plots within the exclosures was erected to study the effect of eliminating browsing by snowshoe hares. One-quarter-acre plots outside the fenced areas were staked but not fenced as control study areas.

Survival of browse plants has been studied on three of the 1-acre exclosures. The Pike Lake, Swayne Tower and Cedar Rapids areas held

planted nursery stock such as white cedar, hemlock, white pine and balsam. In addition, 100-square-foot areas at the Cedar Rapids exclosure were fenced to check the survival of natural white cedar, balsam and hemlock reproduction. Table 48 gives the number of trees surviving in 1946, 1948 and 1951 in the exclosures and control areas.

The table clearly shows the effect of browsing by deer and snowshoe hare on forest plantations during periods of maximum deer populations. When deer browsing is eliminated plant survival is materially improved. When both deer and snowshoe hare are controlled, survival is generally good, other factors being favorable. It should be obvious that planting more trees as a solution to the over-browsing problem would have little chance of success unless deer populations are controlled.

Table 48 also shows that natural reproduction suffered about the same mortality as planted stock under excessive browsing pressure by deer. Plants in the exclosure of natural reproduction were considerably smaller (4" to 13" high and 1 to 4 years old) than in the exclosures where plantings were made. On these small plants it was impossible to determine the cause of mortalities. Natural reproduction in the 1, 2, and 3-year old age classes is prolific in areas where suitable growing conditions prevail, but mortality is high in these age classes even when deer and hare browsing has been eliminated. Other mortality factors beside deer and hare browsing account for more than half of the 1- to 4-year age classes during the first five years of growth, according to these survival studies.

It is apparent that the delicate balance between plant survival and the animals that must live off forest vegetation can be greatly upset when populations of one or two species of browsing animals are over-abundant. A careful inspection of these exclosures should afford the layman an opportunity to satisfy in his own mind the relationship between deer and their range.

Deer Enclosure Studies

The primary objective of the enclosure study was to determine the carrying capacity of a typical winter deer yard. These studies were conducted in fenced enclosures. Since deer browsing pressure could be controlled, carrying capacity could be determined in deer-browse days. (A deer-browse day is one day of browsing by one deer.) Other factors to be determined were the tolerance to browsing and survival rates for the several browse species in the enclosure pens, and the rate of recovery for plants subjected to different degrees of browsing pressure after deer were excluded from the pens.

The Ladd creek deer enclosure, where these studies were made is located at the site of the Camp Rusk C.C.C. Camp in the town of Cedar Rapids, Rusk county. Here a four-acre area was divided into four one-acre pens and fenced with double-height snowfencing in the fall of 1945.

Eight permanent, two-mil-acre quadrats were established in each pen to facilitate stem counts. Permanent photographic stations were also set up.

The four-acre area where enclosures were built was, generally speaking, quite typical of many northern Wisconsin deer yards. All conifers which had branches that were in reach of deer had been over-browsed prior to fencing, including such low-palatable species as balsam. Canopy trees included white cedar, hemlock, balsam, yellow birch, black ash, hard maple, soft maple, black cherry, pin cherry and willow. Mountain maple, beaked hazel, honeysuckle, and raspberry made up the principal browse species present when the enclosure experiment began.

Deer were first admitted to Pens I, II and III in January, 1946. Pen IV was used as a control and no deer were admitted. During the four winters of 1946 through 1949, from one to three wild-trapped deer were placed in each pen for varying lengths of time to show how increased browsing pressure affects browse plants. Each year deer were released as soon as they lost 20 per cent of their initial weight on the available forage in the pens.

The total number of deer-browse days in Pen I was 240, in Pen II 369, and 453 in Pen III. Table 49 shows the effect of browsing pressure on the carrying capacity of these pens in terms of reduced deer-browse days. Each year the number of days that deer could be carried in the pens without reaching their critical weight decreased. By 1949 the average number of days the plant food supply in the pens could sustain deer without significant weight loss was only 37 per cent of what it was in 1946. In Pen I the number of deer browse days remained fairly constant, while in Pen III the result of over-utilization is very apparent in the reduced number of days it could support a deer in good condition. By 1949, Pen III could not sustain even one deer for a short period, whereas Pen I could still sustain one deer through a normal yarding period.

TABLE 49
Natural Browse Plant Survival in Enclosure Studies

Deer-Browse Days in*	*Pen Number* I	II	III	IV	*Average Per Cent Decrease, Pens I-III*
1946	75	134	192	0	--
1947	57	122	118	0	74
1948	66	78	93	0	59
1949	42	35	50	0	37
Total	240	369	453	0	
Total Stem Counts in					
1949	78	67	23	269	
1951	186	224	179	197	
Per Cent Gain	238	334	778	—73	

* A deer-browse day is one day of browsing by one deer.

March, 1946. Pen 1 of carrying capacity experiment after 75 deer-browse days.

May, 1949. Pen 1 of carrying capacity experiment after 240 deer-browse days.

From 1949 through 1951 no deer were admitted to these pens. The recovery rates are shown in Table 49 and are based on stem counts made on the established quadrats for all browse species in the two-to-seven-foot height class. Red maple, mountain maple and hazel were the major browse species present. It will be noted that recovery was retarded in proportion to the browsing pressure.

No conifer species have regenerated in these pens. The mountain maple and hazel stems have sprouted from root stock and it is doubtful if they could be completely killed out by browsing. Although Table 49 does not show the effect of over-utilization on the less tolerant browse species, there has been a marked decline in all three pens of those species which do not tolerate heavy browsing pressure. Grasses and raspberry have taken over much of the area in the pens with the greatest browsing pressure. In Pen 1, which was subjected to the least browsing pressure, many of the stems in the two-to-seven-foot size class quickly grew out of reach and shaded out plants on the forest floor.

Controlled browsing experiments such as these show the detrimental effect of over-browsing in terms of a reduced capacity to sustain deer during subsequent years. It should be obvious that over-populations of deer reduce the carrying capacity of a range in proportion to the degree of over-population that exists. If over-populations are permitted to exist for any length of time the consequences should be clearly understandable in terms of reduced deer populations.

Future Carrying Capacity

We recognize that there can be no direct calculation upon which to base the carrying capacity of large units of wild-land range in terms of specific numbers of animals. Because of the fact that no two units of range are precisely the same and because the status of all range is continually changing, a carrying capacity based on specific numbers of animals would be subject to considerable error.

The most reliable criterion upon which to base carrying capacity is a careful analysis of the status of available forage on the range. Trained personnel can determine whether the current deer population is presently browsing excessively, equal to, or less than the annual growth of browse. Numbers of deer are meaningless unless they are associated with specific units of range and definite amounts of forage. In Wisconsin we are dealing with a potential range in excess of 15,000,000 acres. This extensive range has many [illegible]

March, 1946. Pen III of carrying capacity experiment after 192 deer-browse days.

May, 1949. Pen III of carrying capacity experiment after 453 deer-browse days.

A healthy and productive deer herd is the product of a healthy and productive range. In order to determine whether or not the range is healthy and productive it is necessary to carefully analyze all aspects of range, particularly the effect of browsing animals, in terms of forage utilization.

If we were to manage the range to prevent over-browsing of all plants, including such highly palatable species as mountain ash, yew, white cedar and hemlock, we would be able to have only an extremely small herd, many times smaller than that present in 1952. This would be necessary because deer exhibit a very real preference for certain browse species and the more preferred species are utilized first. Deer will not limit their browsing on cedar to just that amount which can be tolerated without damage to the plants and then turn to less palatable species. When deer populations become excessive the highly palatable browse species are eliminated first by over-utilization. Next, as the highly palatable species disappear, deer turn to species that are less palatable, and so on. If populations remain uncontrolled all but the very low palatable or nonpalatable species will be excluded from the habitat.

This is not conjecture. Many areas in Wisconsin have approached this browsed-out state in varying degrees. On Chambers Island in Green Bay, we had an opportunity to view a completely browsed-out habitat, from which even such plants as bracken fern, vetch, and goldenrod had been eliminated prior to the removal of a greater portion of the deer population in 1945. Outright starvation had been common-place on this island for many years. A private artificial deer-feeding program which began shortly after the first World War offered no solution to the problem of over-populations. The fact that deer existed at all on the island is a wonder. We are reminded by this example that both the habitat and the deer are a lot tougher than we sometimes dare to believe.

Few people who viewed browse conditions on Chambers Island rejected the fact that it is seriously over-browsed. There is, however, a difference of opinion about what corrective action should be taken. The most commonly heard suggestion recommended that the deer be fed artificially. We have said before that artificial feeding does not lessen the pressure on natural browse species. If we had proceeded with a program of artificial feeding on the island, we would have arbitrarily established a carrying capacity for deer based on the ability to satisfactorily conduct a feeding program, since all natural food had been eaten. Deer would have become semi-domesticated, much as they have in the deer parks of the British Isles and the population would have been held to a minimum level, because of excessive costs, for esthetic purposes only and not for sport hunting.

We have mentioned two extremes of carrying capacity, one in which we assume that all forest vegetation should remain a part of the forest flora, even highly palatable deer browse species such as mountain ash, yew, cedar and hemlock. On Chambers Island we had the other extreme. Here no concern was shown for any of the natural browse species. Instead we set a carrying capacity limit based on our ability to substitute complete artificialty. There are any number of places between these two extremes where we could theoretically establish a basis for carrying capacity.

As a result of excessive browsing pressure in many areas of northern Wisconsin, range conditions since about 1930 have deteriorated through several levels of carrying capacity, any one of which could have been arbitrarily established as a minimum acceptable for deer range management. Initially, deer wintered under ideal conditions of food and cover. Then, as their numbers grew over the years, deer subsisted on second-choice plants, then on poor foods, then poorer foods, until finally in some areas they subsisted almost entirely on artificial feed. This trend would have been more widespread if herd increases had not been checked by the liberal hunting seasons of 1949 to 1951. When the herd can be brought under control statewide, it remains to establish a rather arbitrary level of carrying capacity for managing northern and central deer ranges.

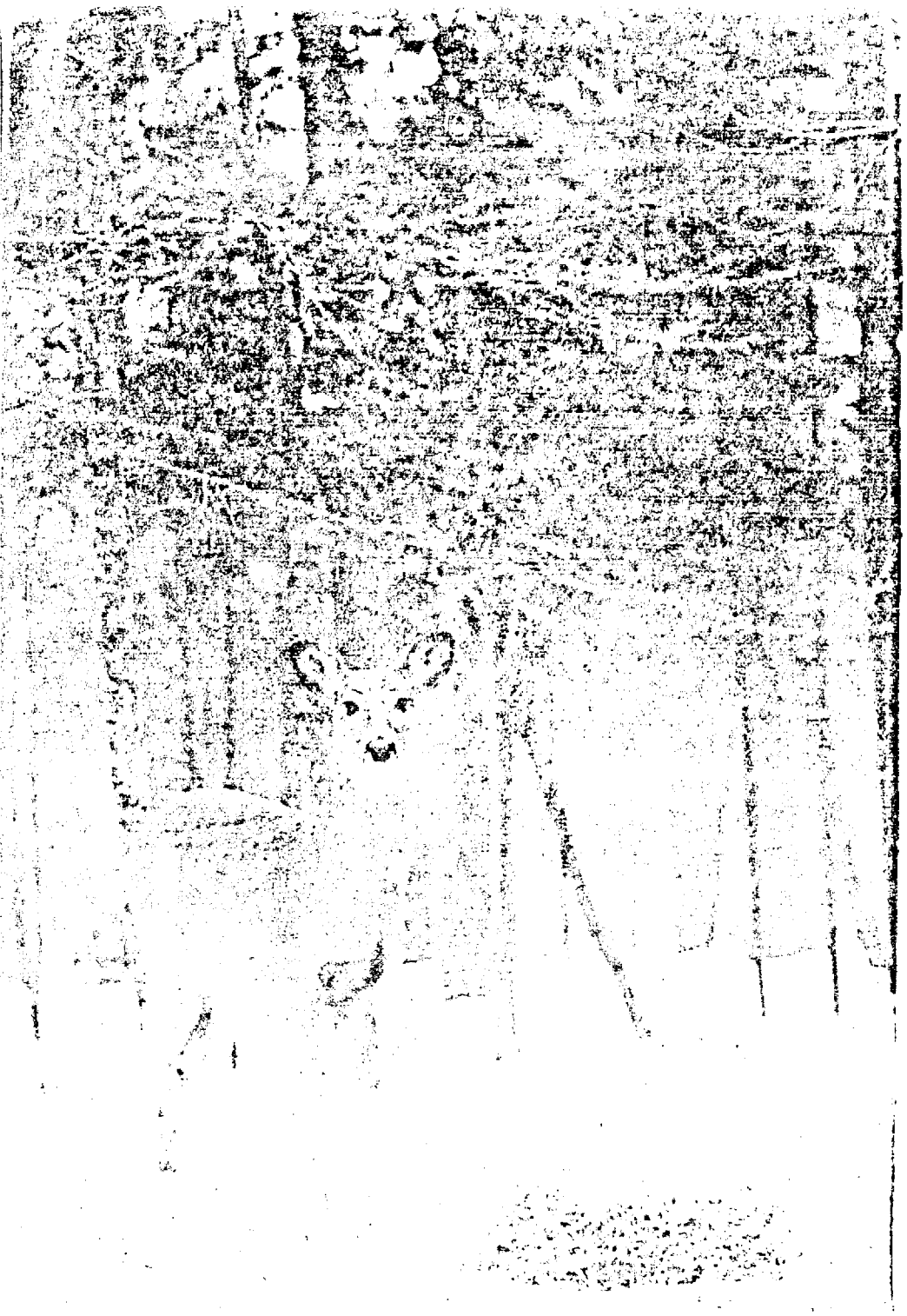
It seems evident that we cannot, without considerably greater herd reductions over a long period of time, hope to bring back highly palatable browse species like cedar, yew, and hemlock where overbrowsing and supression have at present virtually eliminated them. In such places, at least, it would seem that management must be directed mainly toward the second- and third-choice palatability species (such as balsam, red maple, and mountain maple) which can be produced in sufficient volume through more intensive forestry practices.

In areas where winter range degeneration has not proceeded to the most critical level, the plants in the higher order of palatability can and should be included in management efforts. However, it is not necessary from the standpoint of deer management alone to preserve the highly palatable plants that are obviously off-site, are on poor sites, or are of such minor importance in the local flora as to furnish only a small amount of deer food under the best possible conditions.

Management of total plant communities that include small quantities of the highly palatable plants probably should be confined to special study areas. Yew (ground hemlock), for example, formerly was an abundant and preferred deer food over much of northern Wisconsin. Due to overbrowsing it is now confined mainly to relatively small areas bordering Lakes Superior and Michigan. It is still abundant on several of the Apostle Islands in Lake Superior where it is an important deer food. Here yew should be considered as an integral part of deer range management, but

elsewhere in the state there is little possibility of bringing it back as a prominent deer food plant.

Although deer carrying capacity can change due to varying deer numbers and human land-use patterns, and although capacity can be increased through management practices, the need to understand the limitations of carrying capacity remains imperative. If any game management program is to be successful, both managers and the public must understand all aspects of these limitations. We know that to bring back Wisconsin deer range over a large area to a condition that will permit the highly palatable deer food plants to flourish will require that the deer herd be considerably reduced in size below its 1952 level. Without uniform herd reduction in problem areas, there is no choice but to recommend a management program based on maintenance of medium-palatable deer food plants. If management of higher palatables is ever to become a successful reality, more public acceptance than presently exists must be had of the fact that the best range produces the best and usually the most deer.



Part IV — DEER MANAGEMENT PROBLEMS

Chapter XVI

Deer Hunters and the Deer Kill

What Is Successful Hunting?

Many hunters like to talk about deer hunting in the "good old days". To many of them now, the good old days mean the period from 1949-1951, when about half the hunters shot a deer, and the estimated statewide deer kill averaged about 150,000 deer each year. It seems inevitable that years from now those hunters who participated in these hunts will remember them as the years of the "best" hunting they ever experienced.

Nevertheless, since the major objective of these seasons was to reduce an over-large herd, it seems unlikely that management will ever be able to duplicate hunting of a quality (when quality is considered in terms of numbers of animals taken) comparable to those years.

What constitutes good hunting? How is poor hunting defined? Can the success or failure of a deer hunt be measured in terms of numbers of deer brought to bag, success ratio of hunters, numbers of deer seen, or other criteria?

These questions are of utmost importance, since the answers to them will eventually decide the whole future emphasis of management programs. The answers may, in fact, decide how many deer hunters can be allowed to take to the field during future deer seasons.

In Wisconsin, as in many other states, there has been since 1930 a continuous increase in the human population. This increase, coupled with a greater amount of free time per worker, has fostered increases in the numbers of hunters and fishermen, who in turn have begun to create critical problems in game and fish management. Since the whole philosophy of contemporary wildlife management seems to be based on as little interference with nature and with the hunter as possible, the huge armies of hunters and fishermen, made highly mobile by the perfection of the automobile and a fine network of roads, now very often shift from area to area in response to favorable reports of good hunting or good fishing. Without controls, it is almost impossible to predict in advance how many will respond

to such reports. It may be 5 or 5,000, and there is no guarantee that the differences between minimum and maximum expectancies could not be many times greater. Deer hunting is only part of the problem, but it serves to demonstrate what will eventually happen to all hunting in the state.

The number of deer hunters in Wisconsin increased by more than 300 per cent (from less than 100,000 to more than 300,000) in the 14-year period from 1936 to 1951 (Table 50). What may have been good hunting for one hunter in 1936 would probably have been poor hunting for three hunters in 1950. Simply stated, if one hunter in three were successful in 1936, the same kill in 1950 would have meant that only one hunter in nine would have been successful. Where there were only two disappointed hunters for every successful one in 1936, eight would be disappointed and probably disgruntled in 1950.

Yet for a very short period from 1949 to 1951, a combination of circumstances made necessary a harvest of excess deer that temporarily boosted the ratio of success to a far higher rate than any hunter had reason to expect. With the return to buck-hunting seasons in 1952, hunters became disgruntled with what they felt was poor hunting. By 1954, deer were increasing and the number of complaints by hunters was declining. Most hunters seemed to be generally satisfied, although their hunting success remained low.

In examining the question of what constitutes good hunting there are probably only two criteria of importance to a large majority of the present day hunters. They are (1) the ratio of success, and (2) the numbers of deer seen.

The average yearly success of hunters during the forked-horn buck seasons of 1936 through 1948 (excluding 1943) was 26 per cent (Table 50). Only one year since 1944 can be considered above average, and the most recent buck season preceding the liberal seasons (1948) must go on record as the second poorest in the 14-year period from 1936 to 1950. The fallacy of measuring the success of a season only in terms of hunter success should be immediately evident. The year of the largest kill of any of the forked-horn buck seasons (1946) was only slightly better than average in terms of successful hunters. The year of the second largest kill of any of the forked-horn seasons (1947) was below average. It should be evident that there can be no guarantee of a certain percentage of successful hunters during any season in which there is no control over the number of hunters in the field. Yet, there are a good many hunters who will say, "It isn't like it used to be. I can remember when ten of us came up here and went home with five deer. That was good hunting, and that was way back in 1936. It don't even begin to compare with that anymore." Obviously, even if the deer population had doubled in the meantime, a tripling of the hunting pressure would mean a reduced success ratio.

The number of all deer seen is a factor, but not the most important factor, in determining the hunters' opinion of the quality of hunting. In

1950, for example, 2,556 hunters reported seeing an average of 1.6 deer per day (Table 52). In 1951, the average number of deer seen by 4,433 hunters was 0.6 deer per day. The success ratio dropped to 44 per cent from the previous years' 54 per cent and some hunters were dissatisfied. It was felt at this time that since the success ratio had not dropped greatly it was the reduced number of deer seen which was the most important factor in determining hunters' attitudes. The error of this assumption was evident in 1952, when hunters saw about the same numbers of deer throughout the season as they had in 1951, but the success ratio had dropped considerably due to the forked-horn buck restriction. Deer had increased by 1953 so that 7,213 hunters reported seeing 0.9 deer of all ages and sexes per day, or more than they had in the 1951 any-deer season. Hunters, however, were unhappy because of the low kill under a forked-horn buck law. The 1952 and 1953 seasons will probably be remembered as some of the worst on record, despite the fact that the number of deer seen by hunters was comparable to the numbers seen during the 1951 season, which, in total numbers of deer taken by hunters, ranks third in history.

So we expect, at least insofar as the deer hunter of the 1950's is concerned, it is not so much the numbers of deer seen, but the success ratio of hunters who participate in the hunt that determines the hunter's opinion of whether hunting has been good or bad.

Under a forked-horn buck law, it will be extremely difficult to provide good hunting (if good hunting is defined as a success ratio of 25 per cent or more) with 250,00 or more hunters. It also appears that without controls on the number of deer hunters in the field it is going to be impossible to provide *annual* any-deer seasons in Wisconsin that would guarantee a success ratio of 25 per cent or more.

It is perhaps unfortunate that the abnormally high deer populations of the 1940's have fostered such a great increase in deer hunters. It is also somewhat of an abnormality that the new hunters have been initiated with very high success ratios during liberal deer seasons.

There can be little doubt that in the not-too-distant future deer hunters will have to settle for something less than the hunter success which has been enjoyed during the decades of the '30s and '40s if license sales continue to rise. For a time more intensified management programs may provide a larger annual harvest of deer than has been the experience of the past. By this we mean that management can give the hunter a relatively larger portion of the total available and usable annual harvest than he has been taking. It does not seem probable, however, that this can be done without sacrificing some of the freedoms of past hunting seasons. The number of deer hunters in the state for which the conservation department must now provide sport is in the neighborhood of 225,000 to 300,000 and still increasing. With this number of hunters it seems nearly impossible to continue with the present unrestricted choice of hunting areas under general, statewide seasons. Some system of managed hunting will be inevitable.

TABLE 50
Wisconsin Deer Hunting Seasons and Kill*

Year	Season Length In Days	Type of Season and Bag Limit	No. of Hunters	Estimated Total Kill	% Success
Before 1851	365	Any deer, no bag limit	---	---	--
1851-59	215	Any deer, no bag limit	---	---	--
1860-66	153	Any deer, no bag limit	---	---	--
1867-74	168	Any deer, no bag limit	---	---	--
1875-76	91	Any deer, no bag limit	---	---	--
1877-82	107	Any deer, no bag limit	---	---	--
1883-84	45	Any deer, no bag limit	---	---	--
1885-86	61	Any deer, no bag limit	---	---	--
1887-90	41	Any deer, no bag limit	---	---	--
1891-94	30	Any deer, no bag limit	---	---	--
1895-96	20	Any deer, no bag limit	---	---	--
1897	20	Any deer, bag limit 2	---	2,500	--
1898	20	Any deer, bag limit 2	---	2,750	--
1899	20	Any deer, bag limit 2	---	3,000	--
1900	20	Any deer, bag limit 2	---	3,500	--
1901	20	Any deer, bag limit 2	---	4,000	--
1902	20	Any deer, bag limit 2	---	4,000	--
1903	20	Any deer, bag limit 2	---	4,250	--
1904	20	Any deer, bag limit 2	---	4,500	--
1905	20	Any deer, bag limit 2	---	4,250	--
1906	20	Any deer, bag limit 2	---	4,500	--
1907	20	Any deer, bag limit 2	---	4,750	--
1908	20	Any deer, bag limit 2	---	5,000	--
1909	20	Any one deer	---	5,550	--
1910	20	Any one deer	---	5,750	--
1911	20	Any one deer	---	9,750	--
1912	20	Any one deer	---	8,500	--
1913	20	Any one deer	---	9,750	--
1914	20	Any one deer	---	9,850	--
1915	20	One buck	---	5,000	--
1916	20	One buck	---	7,000	--
1917	10	Any one deer	53,593	18,000	34
1918	10	Any one deer, except fawns	50,260	17,000	34
1919	10	Any one deer	70,504	25,152	36
1920	10	One buck, horns not less than 3"	69,479	20,025	29
1921	10	One buck not less than 1 year old	63,848	14,845	23
1922	10	One buck not less than 1 year old	59,436	9,255	16
1923	10	One buck not less than 1 year old	51,140	9,000	18
1924	10	One buck not less than 1 year old	50,212	7,000	14
1925	None				
1926	10	One buck not less than 1 year old	47,330	12,000	25
1927	None				
1928	10	One buck not less than 1 year old	69,049	17,000	25
1929	None				
1930	10	One buck not less than 1 year old	77,284	23,000	30
1931	None				
1932	10	One buck not less than 1 year old	70,245	36,009	51
1933	None				
1934	7	One buck not less than 1 year old	83,938	21,251	25
1935	None				
1936	7	One forked-horn buck	97,735	29,676	30
1937	3	One forked-horn buck	90,906	14,835	16
1938	7	One forked-horn buck	103,721	32,855	32
1939	7	One forked-horn buck	109,630	25,730	23
1940	8	One forked-horn buck	105,198	33,138	32

TABLE 50 (continued)

Year	Season Length In Days	Type of Season and Bag Limit	No. of Hunters	Estimated Total Kill	% Success
1941	9	One forked-horn buck	124,305	40,403	33
1942	9	One forked-horn buck	120,605	45,188	38
1943	4	One forked-horn buck	157,824	66,252	
	4	One antlerless deer		62,044	81
1944	6	One forked-horn buck	127,643	28,537	22
1945	5	One forked-horn buck	133,548	37,527	28
1946	9	One forked-horn buck	201,061	55,276	27
1947	9	One forked-horn buck	222,935	53,520	24
1948	9	One forked-horn buck	248,609	41,954	17
1949	5	One anterless deer or spike buck	286,299	159,112	56
1950	7	Any one deer	312,570	167,911	54
1951	7	Any one deer	296,795	129,475	44
1952	7	One forked-horn buck	238,287	27,504	12
1953	7	One forked-horn buck	234,081	19,823	8
1954	7	One forked-horn buck	237,310	24,698	10

*Data from Otis S. Bersing

TABLE 51
Gunshot Accidents During Deer Hunting Seasons*

Year	Type of Hunting Law	No. of Accidents: Killed	Injured	Total	Accidents Per 100,000 Hunters
1938	Forked-horn buck	11	6	17	16
1939	Forked-horn buck	11	23	34	31
1940	Forked-horn buck	7	13	20	19
1941	Forked-horn buck	8	23	31	25
1942	Forked-horn buck	12	17	29	24
1943	Split: Buck & Antlerless	9	11	20	13
1946	Forked-horn buck	12	36	48	24
1947	Forked-horn buck	5	18	23	10
1948	Forked-horn buck	12	23	35	14
1949	Antlerless & Spikes	7	39	46	16
1950	Any-deer	8	32	40	13
1951	Any-deer	8	38	46	15
1952	Forked-horn buck	9	23	32	13
1953	Forked-horn buck	6	16	22	9
1954	Forked-horn buck	7	19	26	10
	Buck Seasons, 11-year Average				17
	Liberal Seasons, 3-year Average				15

Statistics not available for 1944 and 1945. 1943 is excluded from averages, since accidents that year during the buck and antlerless periods were not separated.

* Data from Otis S. Bersing.

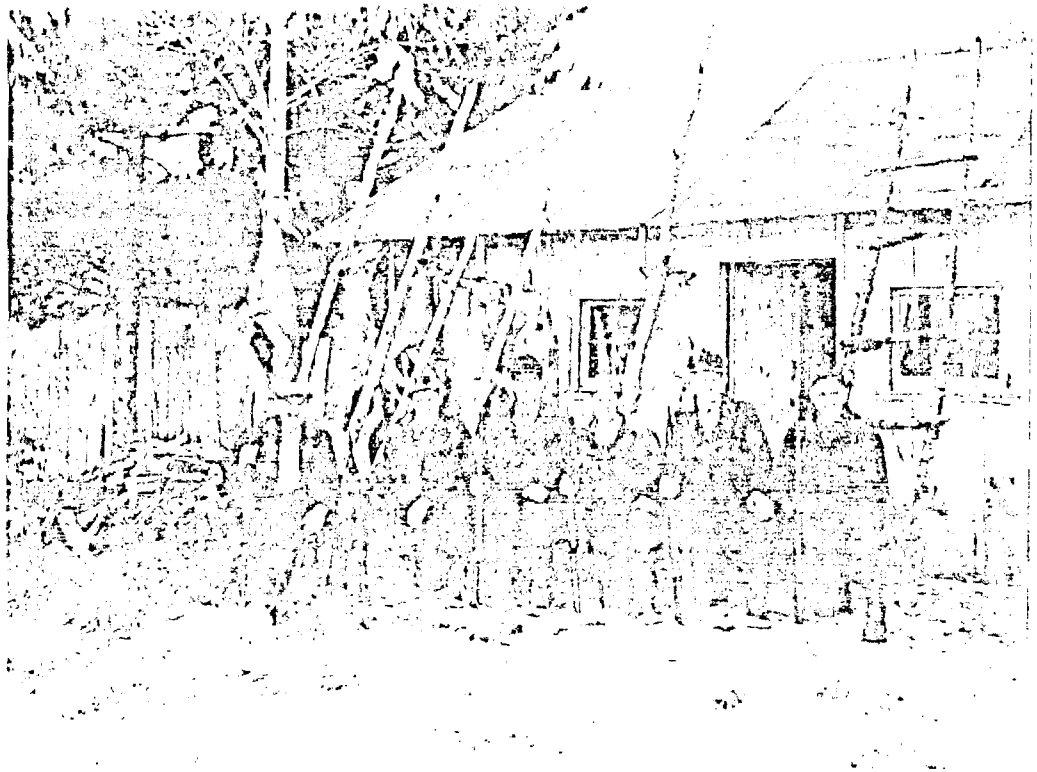
The Changing Attitude Toward Hunting on Private Lands

Each year during the course of Deer Project study, it has become increasingly evident that unrestricted hunting on private land is going to be controlled more and more by the landowner. As the competition for deer hunting areas becomes intensified, the premiums to be paid for deer hunting rights will become greater. There is little doubt that many large private holdings, especially those of wood-using industries, will be devoted to some type of deer farming, at least to the extent that leasing of hunting rights can be called deer farming. Eventually these landholders may find it profitable to practice intensive management for deer, but initially it is expected that they will find a way of paying part of the taxes for their land from the sale of hunting rights for the deer which are naturally a product of their holdings.

Each time that an area of deer hunting ground is closed to public hunting, a shift of hunters from that area to the open public lands creates a greater problem. Eventually that problem will be unsolvable, except through managed hunting.

"Managed hunting", which implies the taking of specific numbers of deer from delineated management areas, has had only limited use in Wisconsin. The any-deer hunts of the Necedah National Wildlife Refuge in 1946 and 1947 are major examples (Martin and Krefting, 1953). Generally speaking, the factor of control necessary in managed hunts has been unpalatable to Wisconsin sportsmen. In a world in which the average citizen finds more and more of his time and perhaps his rights being consumed by controls, he hopes to find at least one form of escape in which he is not controlled. The attempts made to pass controlled hunting legislation during the period from 1948 to 1950 were greeted with opposition by large segments of the hunting public. To a large extent, we believe the opposition was fostered by a failure of the public to understand that the intent of the law was to enable proper reduction of excess deer numbers in certain areas, but was not to trample on the rights of individual hunters. To a lesser extent the opposition was fostered by the philosophies of people who felt that the law would not provide a solution to the immediate problem of herd management which confronted the conservation commission at that time.

In spite of previous objections we believe that a growing number of Wisconsin hunters are beginning to see merit in managed deer harvests, and that eventually, managed hunting will become a reality. In areas where management can control carrying capacities of deer habitat, the hunter must obviously expect to be controlled. Our proposal for the ideal



The happy result of a successful hunt. November, 1950.

Hunters' Manners and Morals

To those who do not hunt, and perhaps to some of those that do, deer seasons must appear to be an orgy of destruction. Radios and newspapers emphasize hunters' deaths, and they are tragically heavy, especially when heart attacks and auto accidents are included in the total. There are always scattered reports of theft, vandalism, disregard for property and livestock, and humans being shot for deer. On the other hand, hunters seem to be growing more safety-conscious; the trend since 1940 has been toward a gradual decrease in the rate of hunting accidents each year (Table 51).

Although the element of danger in deer hunting is greatly overexaggerated it still behooves conservation departments and individuals to make every effort to reduce fatalities due to gunfire. Investigations under the auspices of the National Rifle Association and the National Safety Council in cooperation with conservation departments and sportsmen groups should reduce the tragic loss of human life. Managed hunting, wherein specific numbers of hunters will hunt within delimited management areas to remove a predetermined number of deer, should result in a more orderly

TABLE 52

Field Check Summary for Hunting Pressure, Daily Success and Sight Records

Day of Season	Per Cent of 1st Day Hunting Pressure*						Number of Deer Seen per Hunter per Day						Daily Per Cent of Successful Hunters					
	1949	1950	1951	1952	1953	1954	1949	1950	1951	1952	1953	1954	1949	1950	1951	1952	1953	1954
Saturday	100	100	100	100	100	100	1.0	2.2	1.0	1.1	1.3	1.2	46	46	20	5.7	5.5	5.1
Sunday	119	69	66	92	98	85	0.9	1.7	0.6	0.5	0.9	0.8	20	20	11	2.6	2.6	2.1
Monday	63	20	46	56	61	49	0.8	1.0	0.4	0.3	0.6	0.6	15	16	7	1.6	1.8	1.6
Tuesday	73	20	50	38	42	34	0.9	1.4	0.4	0.5	0.6	0.5	24	15	8	1.6	1.7	2.7
Wednesday	58	16	22	21	36	34	**	0.9	0.4	0.2	0.6	0.5	15	13	7	1.3	1.3	1.8
Thursday	..	7	25	38	31	48	..	0.6	0.2	0.4	0.7	0.5	..	8	7	1.8	1.3	2.4
Friday	..	4	..	20	31	35	..	0.5	0.2	0.3	0.5	0.5	..	19	5	1.3	0.3	1.7
Season Total							..	1.6	0.6	0.6	0.9	0.8						
No. Hunters Checked							..	2556	4433	6616	7213	9072	5995	3244	4433	9140	7213	9072

* 1951 is for NW and NE areas only; other years are statewide.
** Data not taken; complete season totals not available.

Most hunters agree that the quality of deer hunting has degenerated in recent years. The sport of hunting, of course, takes all the blame for the vandalism, killings and other unsavory aspects of present day hunting. A hunter obsessed only with providing meat for the frying pan, or any kind of deer to attest to his hunting skill, is not a sport hunter at all. The joy of hunting should come from the pursuit, rather than the reduction of the prey to something for the frying pan.

Fortunately, there is evidence of a growing desire among hunters for deer hunting of better quality; this is a trend we hope will increase. For example, the desire of a large number of hunters for more enjoyment from the sport of deer hunting is attested to by the ever-increasing army of bow and arrow hunters, who know when they embark upon a hunting expedition that their chances of bringing home a deer are very slim. The quality of hunting will not be saved from further degeneration by regulations or legal action, but by a desire on the part of the hunter himself to raise the standards of his conduct.

Chapter XVII

Hunting Regulations

It is frequently suggested that we ought to be able to establish some kind of uniform deer season, set for specified days each year and for hunting a certain type of deer. There can be no argument that such regulations would eliminate some of the confusion to which the average hunter is subjected by yearly changes in the dates and types of hunting seasons. He would be better able to plan his yearly deer hunting trip. The choice of such a season entails a number of important considerations, some of which assume greater or lesser importance from one year to the next.

The setting of deer seasons poses many problems of a widely varied nature. Wisconsin's north-south dimension of 310 miles covers a considerable difference in seasonal periods within the state. The deer range itself varies from highly agricultural areas to relatively inaccessible forested areas. The distribution of human populations varies considerably, resulting in excessive hunting pressure in some areas and not enough hunting in others. These things, plus the fact that no two Wisconsin citizens have precisely the same concept of what deer management should be, confound the problem to one of many complications.

Because Wisconsin's deer range is so widely varied and because the problems of management are always changing, it does not seem probable that we can long resist the need to recognize specific management needs for specific units of range. In one area we may need to reduce deer populations to eliminate over-browsing. In another area we may want to increase deer populations to fully utilize available food. Obviously a standard statewide season cannot accomplish both of these objectives.

Interest in deer in Wisconsin by many different groups of people with widely divergent ideas indicates that not everyone will be satisfied with any one season. Some people would have deer populations maintained at the highest level possible while others with completely different interests will want deer virtually eliminated. Somewhere in between these extremes we must seek to manage deer within the biological and ecological limitations of habitat and consistent with other land-use programs.

Management for deer must be aimed at producing the following benefits:

(1) The presence of both the deer and deer habitat. (Habitat management can actually increase the capacity to carry deer.)

(2) The continuation of a recreational resource in the face of human population increases.

(3) A greater sustained yield of deer.

(4) Animals of higher quality.

(5) The greatest over-all sustained yield from a multiple-use standpoint for each acre of land.

It is our feeling that hunting seasons designed to meet specific needs in delimited areas where a total management plan for deer has been prepared will find a more sympathetic public than our present statewide season. The establishment of management units throughout the principal deer range will be the first step toward this end. If the sportsmen and others interested in deer could be shown a typical management unit and told exactly what is proposed for that unit regarding the harvest of deer and the management of habitat, there would be considerably less concern for the need for adequate hunter control.

Several western states such as Colorado and Utah have adopted a system of management units delineated by natural boundaries and roads where different types of seasons are conducted on a permit basis. For example, in 1954 Colorado had 14 different deer seasons in 93 management units which ran in size from several thousand acres to several thousand square miles. The period of hunting ran from October 1 to December 31. Setting hunting seasons for management units rather than for the entire state is a satisfactory technique elsewhere; there is no reason why it could not be adopted in Wisconsin.

Length of Season

The longest season which Wisconsin has enjoyed since 1932 is nine days (Table 50). The 1937 season ran only three days, while the 1949 season was set for five days. There are many people who dislike the idea of permitting 300,000 hunters in the woods at the same time. They argue that a longer season, say 30 days, would reduce the pressure on opening weekend and allow the season to assume the more leisurely aspect of a sporting hunt than does the present scramble for the best stand on opening day.

In recent years, most hunters have considered only the opening two days of the season important. More than 90 per cent of the total hunters are out on opening day (Bersing, 1954). By Monday, only about 30 per cent are still hunting (Table 52). About 75 per cent of the total season kill is usually taken on the first two days of the season. Hunters have come to depend upon the "panicking" of deer by the large concentrations of hunters to move the deer to stands. Densities of 20 to 30 hunters per square mile are not unusual.

This concentration of hunters detracts greatly from the sporting quality of the hunting season. Seeing many other hunters around him, the hunter often decides that he must take long shots, or shots in which identity is not positive; in short, he must try too hard to get a deer on Saturday and Sunday, feeling that if he does not get one his chances will

be reduced greatly by Monday. We suspect that this feeling of desperation is largely responsible for many of the mistaken-identity hunting accidents, and for much of the illegal kill of does and fawns that occurs during buck seasons.

It appears to us that mere extension of the season would not necessarily result in fewer accidents or a lower illegal kill. In all probability most of the hunters would still be out on opening day or opening weekend, regardless of the length of the season. The opening weekend hunter checks during the period of Deer Project study substantiate this. The feeling that opening weekend is *The Deer Season* has become so strongly imbedded in the hunting public that for some years at least, extending the season would have relatively little effect upon the hunter concentrations which the advocates of a longer season hope to eliminate.

As a guarantee that a longer season would accomplish the purpose for which it is recommended, consideration might be given to a three-week season, with separate licenses for each week of the season. Such licenses could be issued to license depots in proportion to the total licenses sold by such depots during the previous year. The total license allotment would consist of three series of licenses, one for each week of the three-week season. They would be issued on a first come, first served basis. If the total hunters during the season numbered 300,000, this would guarantee that no more than 100,000 hunters were out during any week of the season. We expect that this reduction of hunting pressure would bring about a return of a more sporting hunt.

Short of this type of modification we expect that length of season is a relatively unimportant factor in management. The season may be four, five, seven or nine days, without having a material effect on the numbers of deer taken, or on the sporting quality of the hunt, simply because all of the hunters are going to be out on opening weekend, and most of them will be out of the woods after the third or fourth day of season.

Time of Season

November is the traditional month for the deer hunting season in Wisconsin, as in many other states. Only occasionally has deer hunting extended into December. With very short seasons, the dates have usually included the Thanksgiving day holiday to make at least two days of hunting opportunity available to hunters who do not take time off from their jobs to hunt deer.

If the season is to be a long one such as previously suggested, there seems little hope that it can be set so that it will not interfere with the rutting season. If it is to be a short season, then a beginning date after the 20th of November should miss the major portion of the rutting activity.

While the data are not completely conclusive, breeding dates of does (Table 4) suggest that interference in the rut by the hunting season may

be responsible for some late breeding. This is an undesirable happening that should be avoided as often as possible. When the peak of the rut and the hunting season coincide, it always makes for better hunting, since bucks are especially active during this period. Nevertheless the effect upon the next year's fawn crop is a much more important consideration. The hunting season should be scheduled to provide the least interference with the rutting season and to follow it if possible.

Types of Seasons

There is, in current management practices throughout the United States, a wide diversity in the liberality of deer hunting season regulations. The state of Maine has, in parts of its deer range, a 45-day season for any deer. The Wisconsin regulations, which have more or less restricted hunting to forked-horn bucks for a relatively short period of seven or nine days, have probably been the most restrictive of any hunting seasons in the country. Even in some of the more highly industrialized areas such as Ohio and Indiana, deer hunting, when it has been allowed, has been under an any-deer regulation. In the other lake states, Minnesota has traditionally hunted under the alternatives of "an any-deer season or none". Michigan has traditionally hunted under the buck law, with a legal buck described as one with an antler exceeding three inches in length. It is small wonder, therefore, that hunters sometimes wonder whether current practices in hunting regulations make sense, when states so similar in character and with roughly comparable ranges and hunting pressures prescribe such widely different types of hunting regulations.

While it is true that no single regulation can be the best to fit all situations, the decision as to the type of regulation that is best for the state often rests as much with the hunters' expressed preference for a type of season as it does with any overwhelming management consideration.

There are three basic types of season regulations. Of these, the buck law in one form or another is probably the most popular, the general open season on any deer follows next, with the "antlerless" season as a sort of special measure in certain cases.

The Buck Law

When herd increases are desired, the buck law provides a form of regulation under which the herd can tolerate hunting without reducing its potential production. Theoretically at least, hunting under the buck law is similar to disposing of excess bulls in a herd of dairy cattle. They contribute nothing to the future production of the herd and subsequently, unless required for breeding purposes, are disposed of to provide greater space and fodder for producing cows.

There are several types of "buck-law" regulations. These are: one buck not less than one year old; one buck with an antler not less than two inches,

Many hunters will hunt only bucks, even though antlerless deer may be legal game. November, 1950.

three inches or five inches long; or one buck with a forked antler, and this *is sometimes qualified by measuring the fork.* The *major difference* between the types of buck-law regulations as far as management is concerned is that the more restrictive the law, the more bucks of breeding age will be *carried over from one season to another.*

Also there are arguments which contend that the wastage loss of deer under the spike-buck law is greater than it is under the forked-buck law; *i.e.*, the hunter is more liable to shoot at a doe or a fawn hoping that it will turn out to have a spike horn than if he is required to produce a deer with a forked horn before he can call it legal. The perennial argument continues that looking for a forked horn prompts many of the trigger-happy hunters to hold off shooting when they might otherwise have killed a fellow hunter. The evidence, if it shows any trend at all, indicates that the any-deer regulation, in which the only requirement for legality is that the animal be a deer, has the best safety record (Table 52).

The indications are too, that the buck law, at least in Wisconsin, is a very wasteful type of harvest regulation. As has been pointed out in Chapter IX, there is evidence which indicates that the total kill during a forked-horn buck season is approximately twice as great as the legal kill.

In other words, at least one doe, fawn or spike buck, is left as waste after the season for each legal buck taken home. This aspect detracts greatly from an otherwise very useful hunting regulation.

Even with this amount of waste, the buck law has in the past permitted the increase of the herd on a statewide basis, and it *seems* logical to expect that it would foster comparable increases in the future, although not as great as the increases of the past 20 years. However, the increases on a year-to-year basis are relatively small when compared to the increases that would accompany complete closure of the season, simply because illegal deer are being killed irrespective of the law.

The Any-Deer Law

The any-deer law has been gaining increasing popularity in recent years. This is largely because many states have hunted deer under the buck law to a point where some type of season that would remove a larger segment of the population became a necessity. In at least 30 states, either local or general deer problems have developed as a result of increases in deer herds. Since the buck law under strict observance does not remove productive animals from the population, the only cure for these problems of over-populations has been to remove some antlerless deer from the herds. Many states have chosen the any-deer season, both with and without control of hunter numbers, as the method of reduction. Others, such as Pennsylvania and Michigan, rely upon short antlerless (does and fawns only) seasons tacked on the end of traditional buck seasons.

The any-deer season has at least one advantage. It eliminates the wastage of illegal deer that occurs during buck seasons, although crippling losses in Wisconsin's 1949 and 1950 seasons in the central area were high. This waste has become so distasteful to many people that they would rather not hunt at all than allow it to occur. This feeling is exemplified by an editorial comment in the *Ladysmith News* of Ladysmith, Wisconsin, dated Friday, November 28, 1952: "The success or failure of the present deer season will not depend upon the number of forked-horn bucks that are killed. It will depend upon how many does and fawns are killed and left to rot in the woods. The exact number may never be known, but if the estimate is high, then Wisconsin ought never to have another buck season. In years when the deer population will not stand an any-deer kill, there should be no season at all."

The any-deer season, in spite of the fact that it may not be an annual affair, will in the long run provide the most venison for the frying pan and the least waste of the resource than any other type of season. It is, in other words, the most practical regulation for harvesting a crop. It has, however, one esthetic disadvantage. It is not a sporting hunt in the sense that the buck season is a sporting hunt. Although the arguments will rage for years, most veteran hunters will agree that it is somewhat less difficult to kill a doe or fawn than it is to kill a buck, regardless of their compara-

The Ideal Hunting Season

If the manners and morals of hunters were to undergo a drastic change in a relatively short time, the ideal season for Wisconsin would be a season on forked-horn bucks, with additional permits to take antlerless deer on management areas according to local range conditions. Under such a system, it seems conceivable that the state could again provide annual seasons with "good hunting" for future hunters. The emphasis of the hunt would have to be upon getting a trophy buck. The hunter would have to train himself to shoot at nothing but a trophy buck. Where range considerations necessitate removing some of the breeding stock, permits, specific to area, in addition to the trophy hunting could be allowed for antlerless deer.

The removal of even 60 or 70 per cent of the forked-horn bucks in the population can be sustained without future decreases in the availability of bucks or of the total deer population. There is then no reason why Wisconsin hunters should not enjoy annual hunting seasons, except that the removal of bucks from the herd is usually accompanied by the wastage loss of antlerless deer, which is undesirable and may in some cases be so great as to defeat the entire purpose of the restrictions on the type of deer taken.

The decision rests ultimately with the hunters. If they count the sport of hunting more important than a high success ratio, if they refrain from killing and wasting antlerless deer except under permit when the removal of antlerless deer is a necessity in herd management, then they will continue to have annual deer seasons. If the waste of antlerless deer which has accompanied buck seasons in the past continues to be a part of them in the future, then there is no doubt that we must adopt the alternative of an any-deer season or none. We must also choose this alternative if hunters insist on very high success ratios when a season is declared. When we must provide a success ratio of 35 to 50 per cent, hunting seasons may be rather few and far between, especially with the 300,000 or more hunters who may be expected to turn out for any-deer seasons.

Restrictions by Refuges, Closed Areas and Firearms

Although in theory the hunting of forked-horn bucks should be restrictive enough in itself to eliminate the need for other restrictions, it seldom works in practice. Any-deer hunting regulations can be used only with the consideration that it is always possible that unpredictably heavy hunter concentrations may greatly reduce deer in some areas without further protection. During the period of low populations from 1920 to 1936, the increases in deer populations in Wisconsin were fostered by restriction of legal game to bucks only, alternate open and closed seasons, and refuges.

During the period from 1949 to 1951, when harvests under the any-deer law were necessary to reduce the herd, temporary refuges known as closed areas were set up to guarantee that adquate breeding stocks would be maintained under the heaviest conceivable hunting pressure and harvest.

The primary reason for the use of closed areas on a temporary basis was to prevent these areas from becoming fixtures in the local management practice. The use of refuges during the '30's, although probably responsible for a large part of the increases in deer populations during that period, had created serious local range problems merely because the refuges had become so firmly established as a necessary part of having deer that the commission could only remove them by acting in the face of an adverse reaction from the hunting public.

In addition to refuges and closed areas, Wisconsin has also attempted to control the kill during any-deer seasons with restrictions on the types of firearms used. When the herd is below or near carrying capacity, and when there is no assurance that hunting under the buck law is going to be confined to the harvest of bucks only, it may be necessary and desirable to add further restrictions in the form of closed areas, refuges, or on the types of firearms to guarantee the continuing existence of an adequate breeding stock.

Refuges. A refuge is an area closed to hunting, primarily so that its excess population may flow out and restock the surrounding areas open to hunting. Refuges are necessary when hunting pressure is great enough to remove a larger than desirable portion of the total population during the open seasons, or a larger than desirable portion of the segment of the population open to hunting, such as cock pheasants or buck deer. The need for deer refuges will vary greatly with the terrain and cover, hunting pressure, deer densities, and the type of hunting regulations. When an area is relatively inaccessible and the cover is hard to hunt, hunting pressure is usually low and there is little to be gained by establishing refuges in it or near it, since the area already serves as a natural "refuge".

Leopold (1933, p. 197) maintained that "The size of a refuge suitable for a given species should, for instance, not be smaller than the unit range for that species, unless it is intended as a rest ground only. The distance apart must not be greater than twice its annual mobility, *i.e.*, the outflow from two adjacent refuges should meet annually at a point theoretically half way between them."

In Wisconsin, the provisions of deer refuges larger than the unit range of the species (usually of township size) has created serious range problems. The large township-size refuge areas were the first to show signs of range distress. It was simply a case of insufficient mobility of the species under protection. Although some movement from the refuge areas to surrounding range was evident, a large portion of the breeding stock in the refuge refused to move, even after winter range conditions had become

critical inside. If the size of the refuges had been reduced prior to this time, or if some method of removing the excess produced on the refuge and not moving out of it had been evolved, the refuges could have continued to provide a desirable function in deer management. As it turned out, however, the only solution to the problem which was tried was complete removal of the refuges. During the first years of open seasons, astonishingly high kills occurred on some of these areas.

If the Wisconsin experience is any criterion, the major function of a deer refuge should be to provide sanctuary or rest ground during the season for a relatively limited number of breeding animals, which after the season will disperse to a number of separate wintering areas. In practice, the fact that deer exhibit little social intolerance and that their movements must be more restricted than generally theorized, probably makes a refuge of township size impractical. A long, relatively narrow refuge for deer would be more desirable.

Closed Areas. Closed areas have been used in Wisconsin for the last four seasons as temporary refuges. To a large extent they have been shifted from area to area from one season to the next. Their major purpose has been to provide temporary sanctuary during the liberal seasons for a number of deer believed to be sufficient to maintain adequate breeding stock under any eventuality.

Firearms. The shotgun with slug is generally believed to be a less effective long-range weapon for deer hunting than the high-powered rifle which is the conventional armament of most deer hunters. In some highly agricultural areas, farmers have objected to the use of rifles because of human safety hazards. Hunters have objected to the use of rifles in farming areas, believing that a rifle season would effectively eliminate deer from a relatively limited environment. Nevertheless, some type of hunting because of deer damage to crops probably is justified. Bow and arrow hunting is much too restrictive to cope with the increase potential of the herds. In these areas, a season on deer with a shotgun and slug has met with favor.

Chapter XVIII

Habitat Management Techniques

The principal argument for deer herd control has been the need to limit browsing pressure to the carrying capacity of the range. Deer populations in excess of the carrying capacity result in degeneration of the range, lower carrying capacity, and smaller deer populations. It should be obvious that proper control of deer populations is imperative if deer management is to be successful.

Man-induced manipulations of habitat, designed to enhance the production of food and cover, cannot be successful if attempted without prior herd control. In Chapter XV we have shown the futility of planting deer-browse species on areas where deer populations are excessive. Other types of management such as cutting, bulldozing and controlled burning are just as ineffectual as planting when practiced without prior herd control.

In Michigan, after 20 years of extensive deer habitat management, it was concluded that there is no future in planting and cutting programs until winter herd size is controlled (Anonymous, 1951).

Longhurst *et al.* (1952, p. 97) in discussing habitat improvement programs in California said, "Among the possible methods of improving deer habitat, *proper stocking* is by far the most efficient from the standpoint of economy of application and results to be obtained. Proper stocking means keeping deer numbers in balance with current range capacities". Recent experience in Wisconsin following the liberal hunting seasons of 1949 through 1951 has shown that proper stocking is an efficient and effective method of initiating habitat improvement. Although ideal herd control methods are not yet available to game administrators in Wisconsin, the liberal seasons did reduce the deer herd to near the carrying capacity of the range in the central area, with the result that natural regeneration of browse species was conspicuous (DeBoer, 1953).

The first and most important step in habitat improvement is adequate deer herd control. This point needs to be stressed again and again, for habitat improvement programs in areas where deer populations are excessive is a waste of the hunter's money. Usually when habitat deficiencies are finally recognized, over-populations of deer are not associated with the problem and habitat improvement programs receive considerable impetus. Such programs, initiated without prior deer herd control, are doomed to almost certain failure.

Although there are certain areas in Wisconsin where deer have been reduced to the carrying capacity of the range, we are by no means ready to launch a large-scale habitat management program for the simple reason that there are many areas remaining today where we do not have adequate deer herd control. Public reaction to the partial herd reduction by the

past liberal deer seasons indicates that we are in no position to begin expensive improvement programs, because the public demand is to build up the deer herd to the highest possible level despitethe fact that the browsing pressure has not been relieved in many of the winter yards.

Habitat improvement, especially on over-browsed ranges, is not something that can be done in a year or two. Deer herd control must necessarily be permanent if any habitat improvement program is to have a chance of success. We must recognize that unless we can achieve the necessary support for adequate deer herd control on a continuing basis, we have no business spending money on habitat improvement.

There are, of course, many considerations that must be taken into account in the matter of habitat improvement for deer. There is the question of land ownership; other land management practices such as forestry; and economics, which will, in the end, determine what and how much management is possible.

The Wisconsin landscape has undergone many changes during the last 200 years. The axe, the plow and fire have reached into almost every section of land in the state, causing profound ecological changes. These changes are continuing from day to day and year to year. Although they do not concern the tremendous areas which were affected during the periods of forest exploitation, forest fires, and settlement, they are still an active part of the ecology of the land. We have not reached a static state nor is it likely that we ever will.

These man-induced changes brought about incidental to, or coincident with, our all consuming effort for the "better life" are accompanied by natural changes that are not easily perceived and certainly not readily understood. The phenomenon of plant successions following logging, fire or the plow and accompanied by successions of animal life which invades, thrives and finally fades away in this changing landscape is a part of the science we call ecology. The game manager, if he is to successfully initiate and conduct a habitat improvement program for deer, must have an intimate knowledge of the succession patterns of both plants and animals on the various soil types, cover types and topographic sites with which he will be concerned. Because there are an infinite number of factors and combinations of factors that exert an influence on the pattern of successions, there is no definite rule which can be set forth to serve as an infallible guide for the game manager to follow. Because there is much that is not known about plant successions, the game manager will have to experiment where field observations are not sufficient for him to ascertain succession patterns.

The first problem confronting management is to determine where there are deficiencies of range that could be improved by management. An annual survey of winter range conditions has been inaugurated, which, if continued, will provide the necessary information relative to the location of areas where range deficiencies exist.

One year's growth of sprouts from management cutting of maple in the winter of 1950-51 at the Chief River yard, Sawyer county. March, 1952.

The second problem is what land ownerships are involved and what changes in land-use concepts will have to be initiated before management can be carried out. The major portion of winter deer range is located on lands that are either privately owned or dedicated primarily for forestry purposes, such as state forests, county forests or federal forests. State-owned lands that have been purchased with sportsmen's money for game management purposes and which fall into the category of winter deer range comprise less than one per cent of the total winter deer range. It is obvious that if we hope to improve the status of winter deer range in Wisconsin we will have to initiate some form of management on lands that have been dedicated primarily to other purposes.

There are people who would like to see deer populations maintained at the highest possible level regardless of the consequences to other interests. They would have us burn off the young forests as an attempt to bring back a succession stage which is most favorable to the deer. There are others, who, having completely different interests, would like to see the deer virtually eliminated so that no interference with other interests would be possible. These are obviously the extremes of thought in this matter. Fortunately, most people are reasonable enough to recognize that neither extreme is compatible with our way of life and that a compromise somewhere between must be reached. Since the basic principle of habitat management involves the initiation of new plant successions and since this in turn can be effected only if existing conditions are changed, it is plain that present land-use policies will have to be modified to include a provision for game habitat management.

It must be recognized that the forestry effort in Wisconsin has an important bearing on the economy of many northern counties. Management for deer, although deer are also important economically, cannot be so extensive as to jeopardize the economic stability of the forestry program. It is extremely doubtful that this could ever happen because of the high cost of habitat management and because the winter deer range occupies a small percentage of the total forest land of this state. Game habitat improvement programs will be criticized, however, by persons who fail to recognize more than a single purpose for forest lands. Fortunately, the forest lands of this state are diversified and extensive enough so that we can have both forests and game without one seriously endangering the economic stability of the other. In fact, it is probable that the improved status of both interests can be achieved.

The principal habitat management problem involves the winter deer range, which has been estimated to comprise about 1,500,000 acres of the total forested deer range. The problem of habitat management in the central Wisconsin area is not as acute as in the northern portion of the state, because the character of yarding or winter concentrations of deer in this area is not as confining as in the northern area. Adequate deer herd control alone in the central area will probably be sufficient as far as management is concerned to maintain suitable deer habitat conditions. Additional management on submarginal and non-forest lands designed to produce maximum forage species will, of course, enhance the status of deer in this area.

Thinning hardwoods to encourage browse production. Ashland county, February, 1953.

Habitat improvement in the central region can be initiated on areas located a considerable distance from present winter deer concentrations and when favorable forage is developed, deer can move into these improved areas. In the northern portion of the state habitat improvement must necessarily be confined to the yarding areas proper and to the immediately adjacent areas surrounding them. Deep snow normally present during the winter period in the northern area limits the movement of deer, thereby making it impractical to initiate habitat improvement on areas located some distance from the winter yards.

There are many ways that could be devised to administer a deer habitat improvement program on public forest lands. The following proposal is not intended to be the only way to handle this matter and it is presented here only for the purpose of initiating thought on the matter. The first

step to be accomplished is an inventory of the winter deer range and classification of this range according to the status of the current browse condition and deer population. The second step is to determine where habitat improvement is necessary and what is necessary to accomplish the desired improvement. The third step must necessarily involve the administrator of the lands concerned. Normally, the best approach is to work out the detail of steps one and two for a specific unit of land. Winter deer yard locations should be plotted on maps and the areas where habitat management is desirable should be clearly defined. The type of habitat management proposed should be clearly defined for each yarding area within the unit. Acreages to be treated should be carefully calculated so the forest administrator will be able to determine what effect this work will have on his program.

Field investigation and actual experimental work showing the various types of habitat improvement programs should follow in order that there will be no misunderstanding as to what is involved. Upon completion of this step, the administrator of the forest lands and the game manager should prepare an agreement which carefully outlines the entire program and which states the policy that will prevail for any contingency which may

Management cutting of black ash in Flag yard, Bayfield county, January, 1953.

occur. Initiation of the actual management program should be accomplished by representatives of both parties and both parties should be responsible for frequent inspection of the work. Usually, habitat improvement for game also involves advantages to the forest. If the forester and the game manager work in close cooperation, both the forest and the game will benefit.

Habitat management for game involves new concepts of land-use and it is characteritsic that new ideas will almost certainly provoke misunderstandings. Every effort should be made to prevent disagreements which can be avoided if plans are well made and adequate discussion on all points of the program has involved all parties concerned. Planning should be consummated by a specific written statement of policy in order that both parties will be adequately protected. This may seem a little ridiculous, but we cannot be too prudent if we wish to avoid unnecessary delays and unreasonable restrictions that are sure to occur if there are many disagreements or misunderstandings attached to the evolution of this type of work.

During these days of high wages and short working hours the cost of cutting operations to provide browse for deer comes very high. Costs vary considerably between areas, between crews, and between different types of cutting operations. Thinning cuttings and clear cutting of non-commercial browse species costs anywhere from $5.00 per acre to $30.00 per acre. It is obvious that a browse improvement program must necessarily count heavily on management practices already in effect on forest lands to carry a considerable part of the program.

Commercial logging operations are going on every winter, putting down tons of palatable browse for immediate use by deer, but more important they create openings where a new succession of browse plants will grow and produce available browse over a period of years. Unfortunately, these operations do not always occur where there is an immediate need for food. Often the periphery of a deer yard is logged completely, providing a short-lived abundance of browse followed by a long period of slim pickings as the new forest grows up and out of reach.

Wherever possible, it is desirable to work out a cutting plan for areas surrounding deer yards which will eventually result in as wide a variety of different age classes, plant patterns and densities as possible. Close cooperation between forest administration and game management is necessary, but there is no reason why such planning is not possible. Usually such operations involve a number of small timber sales. Frequently the operator on a small-scale operation cannot see his way clear to construct logging roads into the cutting site. Here game management should be able to assist in road construction, since logging roads will be used over a long period of years for the benefit of game in the area. For a relatively small outlay on road construction, game management will receive a high return in the status of habitat improvement. Figure 23 illustrates this type of

small-scale cutting operation that can, if conducted over a period of years on areas in and surrounding deer yards, materially improve the status of the yard at a minimum cost to game management.

Slight modifications of timber sale contracts on public forest lands designed to benefit game crops may be possible: (1) Contracts may specify cutting periods to assure a continuing food supply during a particular winter. (2) Contracts may specify slash treatment to assure complete use by deer. (3) On some areas, certain species such as aspen may be cut on a shorter rotation to provide available browse during a gap between other sales, thereby making browse available over a longer period. Current economic conditions and the relative value of the species to be cut will determine what modifications in contracts are possible.

There are many areas within public forest boundaries where cultural cutting operations would materially improve the value of the forest and also the status of food and cover for game. Because of the high cost of such operations and the low return from the sale of products salvaged, the forester cannot undertake such operations alone. For the same reason the game manager cannot undertake such operations but the forester and the game manager together can evolve a joint program that will benefit both interests. If areas to be treated are carefully selected to assure the greatest return to both interested parties and if the areas contain some marketable products which can be sold to offset the cost of the operation, game management should be able to subsidize the program in the amount of the difference between the cost of the operation and the returns from the sale of the products removed. If each operation is carefully planned, game management would receive a relatively high return in improved game habitat for a small expenditure of game funds.

Unfortunately, much of Wisconsin's winter deer range has been subjected to excessive browsing by a deer herd that has not been controlled within the carrying capacity of the range. The result has been that many winter yarding areas have undergone a serious degeneration. In some cases it may not be possible to rehabilitate these areas to the point where they will again attain the cover and variety of browse species necessary to make them productive yarding areas. In all cases where range degeneration has resulted from over-populations of deer, the cost of habitat improvement will be high. This is one of the penalties that we must pay for rejecting the idea that winter deer habitat has a limited capacity to sustain deer.

In most winter yards where range degeneration has taken place, the more palatable forage species have been replaced by less palatable species. To permit the regeneration of the palatable browse species in these yards, it will be necessary to control deer populations in far stricter conformity with the carrying capacity of the habitat than anything we have known in the past. After deer herd control has become a reality it will still be necessary to initiate [illegible] measures to assure adequate

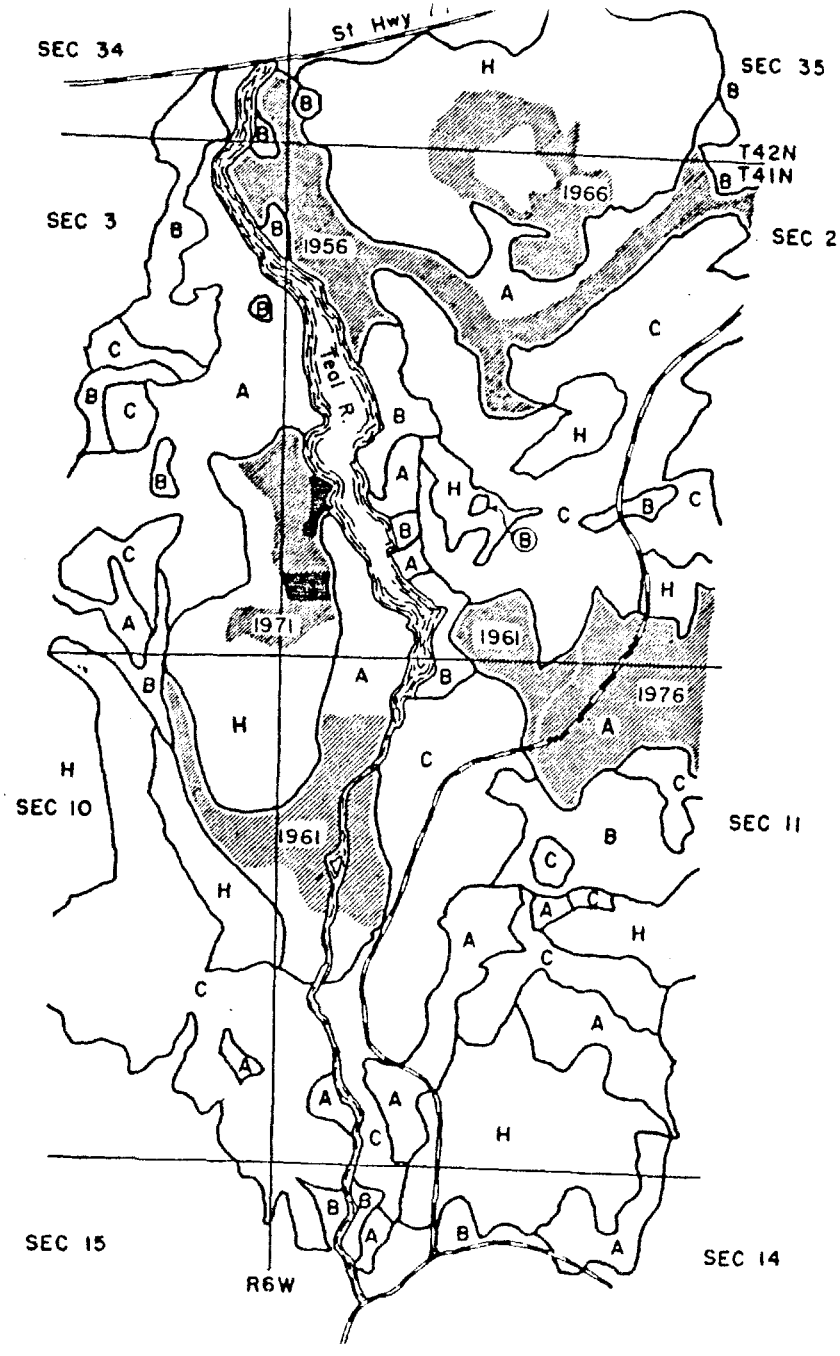
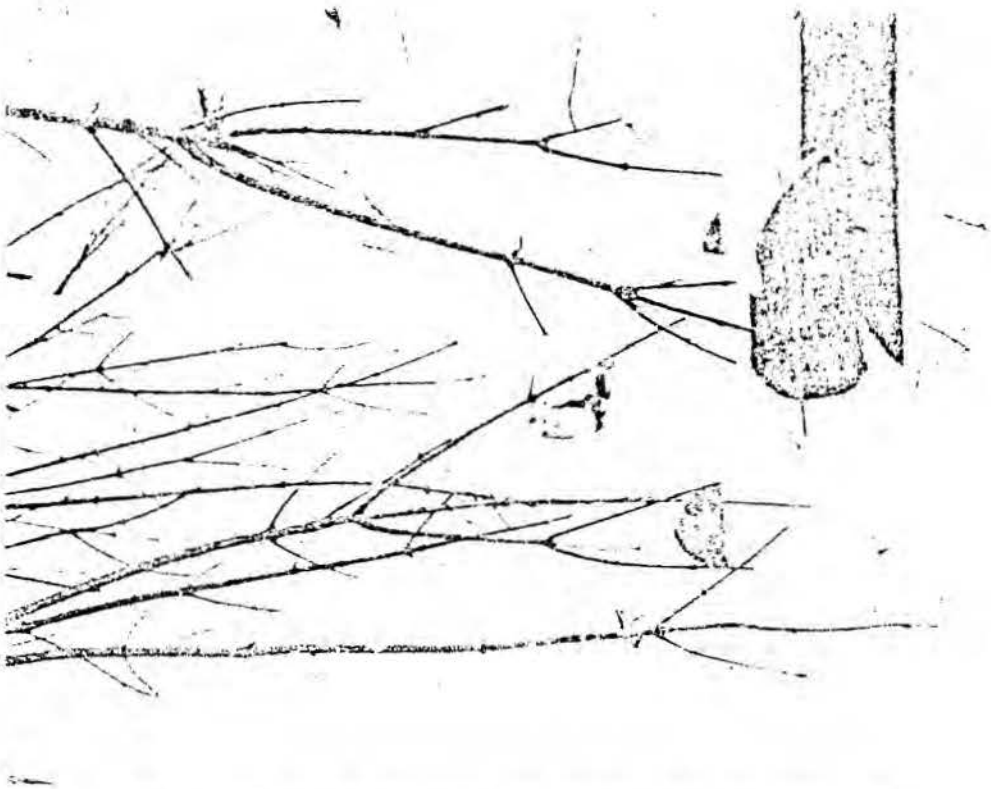


Figure 23. Timber cutting plan for improving winter deer habitat in the Teal River deer yard, Sawyer county. Crosshatching indicates areas and dates of proposed timber sales; solid black is hemlock to be reserved for cover in cutting areas. Cover type symbols: A — aspen, B — [illegible]



Heavy use of red maple thinnings by deer in Price Creek yard, Price county, January, 1953.

Deer management cutting in Lynch Creek yard, Bayfield county, March, 1953.

recovery. Unpalatable species or low-palatable species that have replaced the palatable ones will have to be removed to make room for new growth of palatable species. Depending upon the character of the site and the species involved, the methods by which this can be achieved will vary. Bulldozing or brush racking may work on one area. Rotary tilling may be possible on another. Hand brushing and controlled burning may be the only methods for other areas. If the cost of application is not too high the use of herbicides may be desirable. In some areas it may be necessary to furrow and plant desirable forage and cover species. We cannot at present predict with complete accuracy what will happen to the plant succession on a given site when these various methods are tried. It is possible to make "educated guesses" but further work is necessary before a practical, working knowledge of plant ecology under all site conditions is at hand.

It is obvious that where these types of management are necessary to rehabilitate winter deer range, the cost will be high. Because of the high cost an extensive program of this nature should not be initiated until some assurance that adequate herd control measures will be available to

game administrators and that public reaction to the use of such control measures will be favorable.

The matter of emergency food shortages resulting from climatic conditions or man-made situations also involves the matter of cooperation between the forester and the game manager. Emergency food shortages should not be a recurring problem on any specific area. If it is a recurring problem, then the principle of limitations and carrying capacity of the range are not being adhered to. Emergency artificial feeding measures will not improve the matter. However, if emergency food shortages develop under an adequate herd management program, they can be handled by emergency cutting for browse if the specific situation permits or by providing artificial foods. Browse cuttings on non-commercial species such as mountain maple, hazel, willow, cherry and others if these species are present but unavailable to the deer, will relieve emergency situations.

Usually the game manager can enlist the help of interested rod and gun club members for such emergency work. In other cases where commercially important species are involved, it may be possible to arrange a thinning cutting which will provide food during the emergency. In areas where no cutting is possible or where natural browse will only partially relieve the

situation, then provision should be made to supply these deer with artificial foods. If it is apparent that a similar emergency will develop during the following winter period, action should be taken to harvest these deer because emergency browse cutting or feeding is expensive at best. Unless the situation can be improved or eliminated, there is no point in attempting to maintain deer populations on areas where emergency conditions are likely to prevail.

It must be recognized that forest management practices will be the principal tool available to game managers in game habitat improvement programs. The economic importance of deer as a recurring crop must be recognized by forest administrators so that a habitat improvement program to enhance the production of deer on managed forest lands will receive favorable support. Close cooperation between game management and forest management should result in benefits to both the forest and game. Game management can justifiably subsidize certain forest management practices which the forester cannot inaugurate himself because of economic limitations and the result will be a high return to game management for a relatively small investment. If game managment can succeed in providing adequate deer herd control (and by adequate we mean specific control on relatively small units of range), then there are great possibilities in the field of habitat improvement. Without deer herd control habitat management has little, if any, chance of success.

Chapter XIX

The Outlook for Wisconsin Deer

In the preceding chapters of this report we have attempted to chronicle certain broad environmental and philosophical changes related to the white-tailed deer. From the primeval forests of the last century through the era of logging and settlement to the beginnings of a deer controversy, many changes both favorable and unfavorable influenced the status of the white-tail. We can anticipate that many changes will take place in the future. We hesitate to predict what course these future changes may take. Nevertheless, a few needs and possiblities seem more certain than others and in this chapter we will briefly explain them.

Although much of the specific management necessary to maintain Wisconsin's deer herd in balance with its range is clearly outlined, there is a continued need for research, especially on habitat manipulation. The research conducted on Wisconsin deer and their range from 1940-1954 was designed to obtain basic information on preferred browse plants, food requirements, range condition, reproduction rates, factors affecting hunting and hunter success, and the development of techniques facilitating the collection of this information.

Research effort in the future must be two-fold. In the first place, since conditions are not static, but will continue to change constantly, studies similar to those already conducted in the past will have to be repeated with varying levels of intensity. We must keep up-to-date on what is currently happening to the deer herd and its range.

Secondly, the information obtained previously serves as a stepping stone to experimental range manipulation. The main winter food of deer when the ground is well covered with snow consists of young succulent growing parts of trees and shrubs (browse). Thus the size of the deer herd in any area where deer concentrate in winter will depend on the amount of available and palatable browse. New research projects are being initiated to develop methods for increasing deer browse production in our present forest stands. Development and integration of habitat improvement practices compatible with forest management, which will benefit deer and other forest game and simultaneously improve tree growth, are also being studied.

Perhaps the most important single factor confronting the future of the white-tailed deer and deer hunting is the probable increase in human populations. Human population increases mean greater utilization of lands for the production of basic human needs — food, shelter and clothing. Human population increases must necessarily be accompanied by greater control over human activities.

If we gauge our future growth during the next century by what has happened during the past century, it shouldn't be too difficult to anticipate, for example, some of the changes that will take place in the sport of hunting. We can be fairly certain that as each necessary change evolves there will be a lament from sportsmen, "Hunting ain't what it used to be", followed by a tale of the "Good Old Days". The "Good Old Days" may indeed be old or they may be days of more recent vintage, depending upon the individual, the vicissitudes of memory, and the character of the experiences encountered. For many Wisconsin hunters the "Good Old Days" will probably be the years 1949-50-51 when an abnormally high hunter success ratio was enjoyed during the liberal seasons of those years.

These seasons marked the end of an era in which factors tending to be favorable to deer population increases were present. There can be little doubt that Wisconsin has passed a peak in deer populations on the major portion of the range. The ecological period in the development of a new forest which was favorable to deer population increases is now past or rapidly passing. Coupled with these ecological changes is the fact of long over-utilization of browse species on much of the northern winter range which seriously threatens the future capacity of these areas to support deer. Future over-utilization if it comes, can only contribute to an already tremendous handicap in range management. If the present lack of understanding of habitat–animal relationships is any criterion, we may well anticipate that over-utilization of browse will continue to be a major problem for at least 25 years.

Regardless of game and forest management favorable to deer which may be anticipated, the trend in deer numbers for the next two and possibly three decades will be down. If at the end of that period the trend of agricultural development has not taken over much of the area now considered deer range, logging operations on forest lands should be of sufficient magnitude to create conditions favorable to deer population increases. However, we do not anticipate that these increases will result in a population "high" similar to the "high" of the late 1930's and early 1940's.

If it is possible through more adequate deer herd management than we have known in the past to adequately harvest population surpluses when and where they occur in the future, it may be possible to realize a greater yield of legal deer than during the period when the Wisconsin deer population was at its highest level. Such harvest would necessarily have to be based on sound biological reasoning and carefully controlled to assure that a proper stocking of aminals in relationship to specific units of range was maintained.

Barring some unforseen cataclysm, we do not anticipate that the white-tailed deer stands in danger of extermination in Wisconsin during the next century. The whitetail is a very adaptable animal, capable of living in close proximity to human habitation and surviving under very adverse conditions. We can anticipate that deer will excite much comment in the future from casual nature lovers, hunters, farmers and many others. Interest in deer has in the past encompassed a variety of people with widely divergent interests. We can speculate that selfishness will motivate some of the people in the future just as it has in the past. Although we do not think the deer will come to the brink of extermination, there will be many indignant protests from interested persons that such and such should or should not be done to "save the deer".

Even though the protests regarding deer management will probably be as loud in the future as they have been in the past, and will seem to represent the majority of public opinion, it will probably continue to be a fact that only a very small minority is actively interested. We base this statement on the interest shown in Wisconsin during the last two decades in the annual county fish and game hearings. These are public hearings conducted by the Wisconsin Conservation Commission for the purpose of giving the public an opportunity to express their opinions in the matter of fish and game management and to elect delegates to the Wisconsin Conservation Congress. The record of attendance at these hearings is an interesting commentary on the indifference the public has for problems in wildlife management. Many thousands of people avail themselves of the opportunity to hunt and fish, but few people take the time once a year to attend public hearings conducted for the sole purpose of giving them an opportunity to be heard. For example, the population of Wisconsin in 1950 was 3,434,575 according to the United States census records. In 1949, 284,573 resident hunting licenses were sold. Thus about nine per cent of the total population were deer hunters. Of these 284,573 persons who hunted deer in 1949, only 4,170 or 1.5 per cent of the license holders were interested enough to attend their annual county fish and game hearings in 1950. For the seven-year period from 1948 to 1954, an average of only 1.8 per cent of the licensed resident hunters went to county game hearings each year (Table 53).

TABLE 53
Deer Hunters at County Fish and Game Hearings

Year of Hearing	*Attendance*		*Resident Deer Licenses Sold Last Year*	*Per Cent of Deer Hunters at Hearings*
	Total	*Deer Hunters of Last Year*		
1948	13,488	8,850	221,672	4.0
1949	7,632	5,087	247,046	2.1
1950	6,545	4,170	284,573	1.5
1951	4,573	3,184	309,455	1.0
1952	5,067	3,168	294,045	1.1
1953	7,112	4,251	237,045	1.8
1954	7,449	4,393	232,914	1.9
7-yr. Total	51,866	33,103	1,826,750	1.8

We must conclude that the average person has very little genuine interest in the deer problem, despite the fact that almost every adult person in the state seems to have some sort of an opinion on the matter. We hope this means that most hunters are content with the conservation department's policies, since any governmental program that is satisfactory seldom draws loud public comment in its behalf.

This is not a problem peculiar to game management. The same lack of interest plagues all conservation problems. The inadequacy of conservation philosophy is both a universal and a timeless problem. Throughout the recorded history of mankind there has never been a real understanding of the problems of natural resource management.

We have tried to point out that this is true for the white-tailed deer as well as for other Wisconsin resources. Until such time as there is general public understanding and appreciation of the delicate inter-relationships of deer and their habitat, the future of Wisconsin deer will be subject to the whims of misinformed public opinion despite the best effort of public conservation agencies. However, we have high hopes that Wisconsin sportsmen will come to the support of deer management practices that will give them the largest possible return, even though they are practices that may mean curtailment of unrestricted hunting or periodic any-deer hunting seasons.

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APPENDIX A

A Chronology of Laws and Events Related to Wisconsin Deer and Deer Range

Compiled from Leopold (1940) and records of the Wisconsin Conservation Department.

1851—First Wisconsin game law. Prohibited taking of deer from February 1 to July 1.

1866—Legislature created a committee to investigate forestry conditions.

1867—I. A. Lapham and committee report on "Distastrous Effects of Destruction of Forests".

1869—State Timber Agents appointed to prevent timber thefts on state lands.

1869—Use of set-guns prohibited by legislature.

1870—Wisconsin produced more than one billion board feet of lumber.

1871—Peshtigo Fire; 1,100 human lives lost, 1,280,000 acres burned.

1873—First state association for preservation of game.

1876—Hunting deer with dogs prohibited.

1878—A tract of 50,000 acres in northern Wisconsin was set aside as timber reserve by legislature and called "The State Park". (Legislature later sold area to a lumber company.)

1887—First game wardens. Law provided four wardens to cover the entire state.

1891—Office of state fish and game warden created with authority to hire one or more deputies in each county.

1891—First game refuges established by legislature.

1895—Organized colonization of northern cutover lands began.

1897—First hunting license required; resident $1.00, non-resident $30.00.

1897—First bag limit on deer: 2 deer.

1897—Killing deer on ice or in water prohibited.

1899—All deputy fish and game wardens declared to be deputy forest fire wardens in the first attempt to control forest fires.

1899—Beginning of state park system. Interstate Park Commission appointed for St. Croix River park in Polk county.

1900—Federal legislation (Lacey Act) prohibited interstate sale of game birds and animals.

1903—Sale of protected game prohibited.

1903—First deer tag required.

1903—State department of forestry created and empowered to purchase lands for forestry purposes.

1908—Worst fire year; 1,435 fires burned 1,209,432 acres.

1908—Last Wisconsin cougar killed in Douglas county.

1910—Game refuge idea spreading; established individually by the legislature.
1911—First state forestry nursery started at Trout Lake.
1911—Construction began of fire lanes, towers, and phone lines for forest protection.
1913—First state game farm started at Trout Lake.
1915—State forest program invalidated by state supreme court.
1915—All conservation activities of various boards and commissions combined into one commission.
1915—First "one-buck" law passed by legislature.
1917—Conservation commission given regulatory powers.
1922—Last known wolverine trapped in Sawyer county.
1925—Deer hunting season closed all year for first time; open seasons established every even-numbered year.
1927—Present commission-director plan established for conservation department.
1927—National forest authorized for Wisconsin.
1927—Forest Crop Law established, with provision that lands entered under this law be open to public hunting.
1930—Extensive peat fires in central Wisconsin.
1931—Game kill reports required of all hunters by law.
1932—Last known fisher died in Burnett county.
1933—Civilian Conservation Corps established.
1933—Conservation commission given power to set all open seasons and bag limits for game.
1934—Wisconsin Conservation Congress organized, with county delegates elected in public meetings to recommend game and fish seasons to conservation commission.
1934—First bow and arrow hunting season authorized for deer, in Sauk and Columbia counties.
1934—Artificial feeding began in several northern yards.
1937—First consecutive deer hunting season since 1923 and 1924.
1937—First "Save the Deer" clubs and public criticism of deer management policies.
1938—Federal aid for wildlife restoration became available under Pittman-Robertson Act.
1940—Deer Management Research Project begins investigations.
1940—State takes 95-year lease on Central Wisconsin Conservation Area.
1943—"Split" deer season; 66,252 bucks and 62,044 antlerless deer killed.
1946—First controlled hunting in Wisconsin at Necedah National Wildlife Refuge; 36 deer killed per square mile.
1946—Marked increase in hunting pressure following World War II.
1948—Severe deer starvation in many winter yards.
1949—First of three consecutive liberal hunting seasons; 159,112 deer killed in antlerless hunt.

1950—First any-deer hunting season since 1919; 167,911 deer killed, an all-time high since kills were first estimated.
1951—Second any-deer hunting season; herd reduction accomplished in most of central area and parts of north.
1951—Separate big-game license required for deer hunters.
1952—Return to one-buck law.
1953—Legislature repeals statute requiring artificial deer feeding.
1953—Compulsory registration of deer killed by hunters.

APPENDIX B

How to Age Deer

Fetal Aging by Length

The ages of fetuses may be estimated by determining the straight-line length in millimeters between the crown and rump, or forehead and rump, whichever measurement is the longest. The length-age correlations given below have been compiled from Armstrong (1950) and Cheatum and Morton (1946).

Length in mm.	*Age in Days*	*Length in mm.*	*Age in Days*	*Length in mm.*	*Age in Days*	*Length in mm.*	*Age in Days*
20	40	140	83	260	118	380	154
30	45	150	86	270	121	390	157
40	50	160	88	280	124	400	161
50	54	170	91	290	127	410	165
60	58	180	94	300	130	420	170
70	61	190	97	310	133	130	174
80	65	200	100	320	136	440	179
90	68	210	103	330	139	450	185
100	72	220	106	340	142	460	192
110	75	230	109	350	145	470	203
120	78	240	112	360	148	480	214
130	81	250	115	370	151		

Aging by Tooth Development and Wear

The criteria listed below permit the aging of deer by characteristics of the teeth of the lower jaw. They apply primarily to deer taken during November hunting seasons. These characteristics are abridged from the complete descriptions given by Severinghaus (1949).

Fawns

Less than 5 months — Milk incisors all firmly in place.
More than 5 but less than 6 months — Pincers in stage of eruption.
More than 6 months — Both adult pincers fully erupted.

Yearling

1 year and 5 months or less — All milk teeth firmly in place. Third pre-molar has 3 cusps.
1 year and 6 months — Milk pre-molars loose or shed with permanent pre-molars partially erupted.
1 year and 7 months or more — Permanent pre-molars fully erupted; they are white in contrast to pigmented older teeth. Third permanent pre-molar has 2 cusps.

2½ Years

The lingual crests of the first molar are sharp, with the enamel well above the narrow dentine of the crest. Crests are fully as sharp as those of the 2nd and 3rd molar. Wear on the posterior cusp of the 3rd molar is slight and the gum line is not retracted sufficiently to expose the full height of this cusp in many cases.

3½ Years

The lingual crests of the first molar are blunt and the dentine of the crests is as wide or wider than the enamel. The posterior cusp of the 3rd molar is flattened by wear, forming a definite concavity of the occlusal surface.

4½ Years

The lingual crests of the first molar are almost worn away. The posterior cusp of the 3rd molar is worn at the edge of the cusp so that the occlusal surface slopes laterally downward.

5½ Years

No lingual crests on first and 2nd molar, although rounded edges may appear like crests. An imaginary line drawn from lingual to buccal edges of first and 2nd molars would generally touch the enamel on either side of the infundibulum. Dentine of the lingual crests of all molars is broader than the enamel.

6½ Years

Wear is moderate on first pre-molar, heavy on 2nd and 3rd pre-molars. Infundibulum appears as fine line or chevron on first molar or may be absent. On 3rd pre-molar infundibulum may appear as small triangular hole.

7½ Years

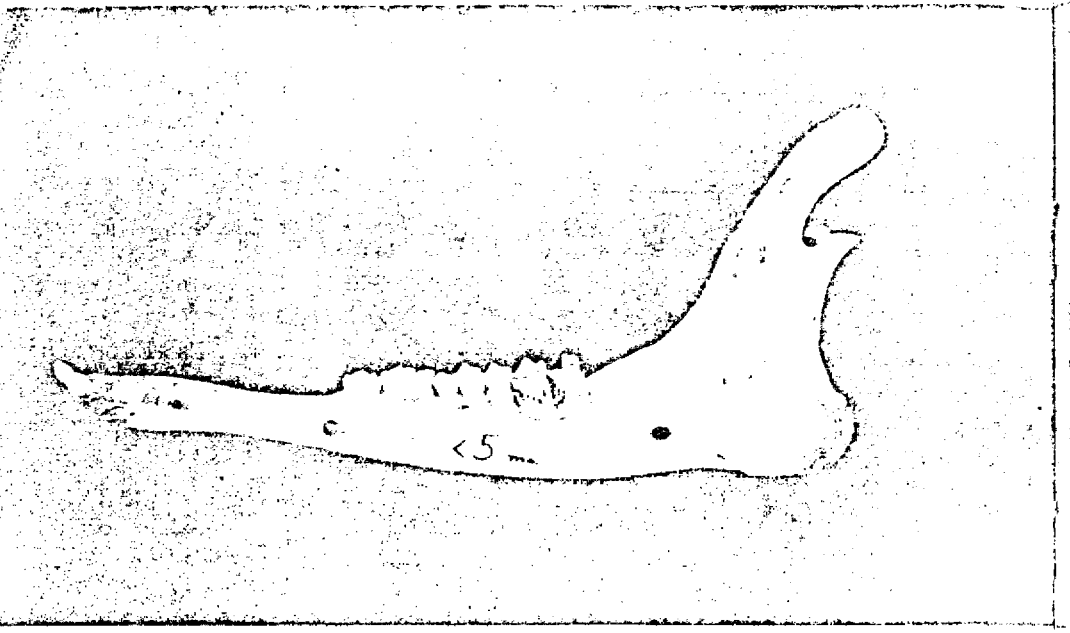
First molar worn down within 2 or 3 mm. of gum line on buccal side and 4 or 5 mm. on lingual side. Second molar almost smooth and 3rd molar worn down until lingual crests are completely gone. Infundibulum almost gone from the 3rd pre-molar, worn out of first molar, but may remain as a fine line or chevron in the 2nd molar and is present to some depth in the 3rd molar.

8½ years

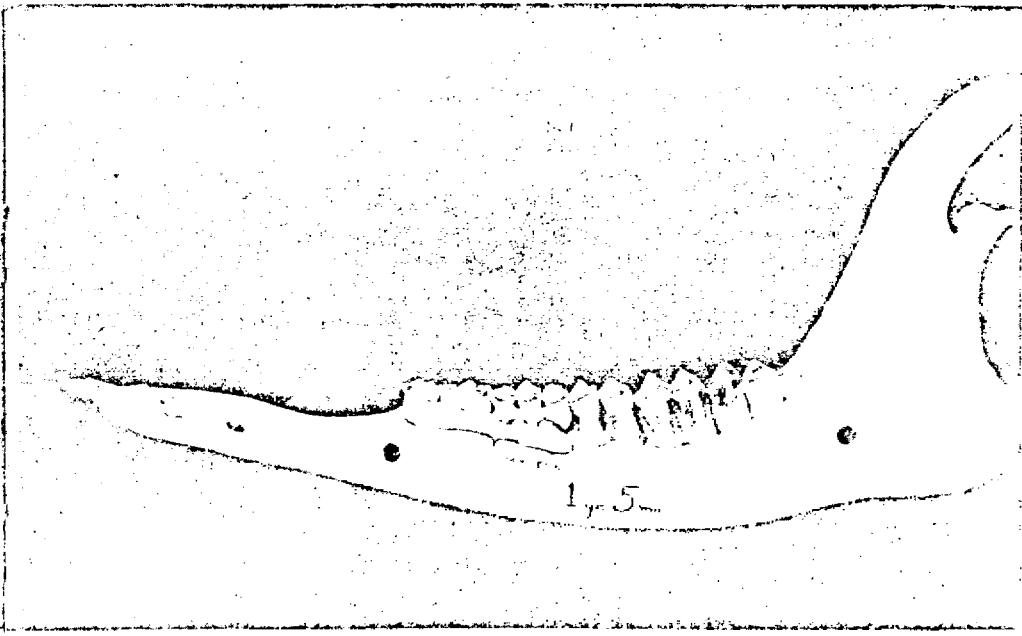
All molars and pre-molars reduced to height of 2 or 3 mm. on buccal side and 4 or 5 mm. on lingual side. Infundibulum absent from 3rd pre-molar and all molar teeth. Dentine joined in cusps of all teeth.

10½ Years

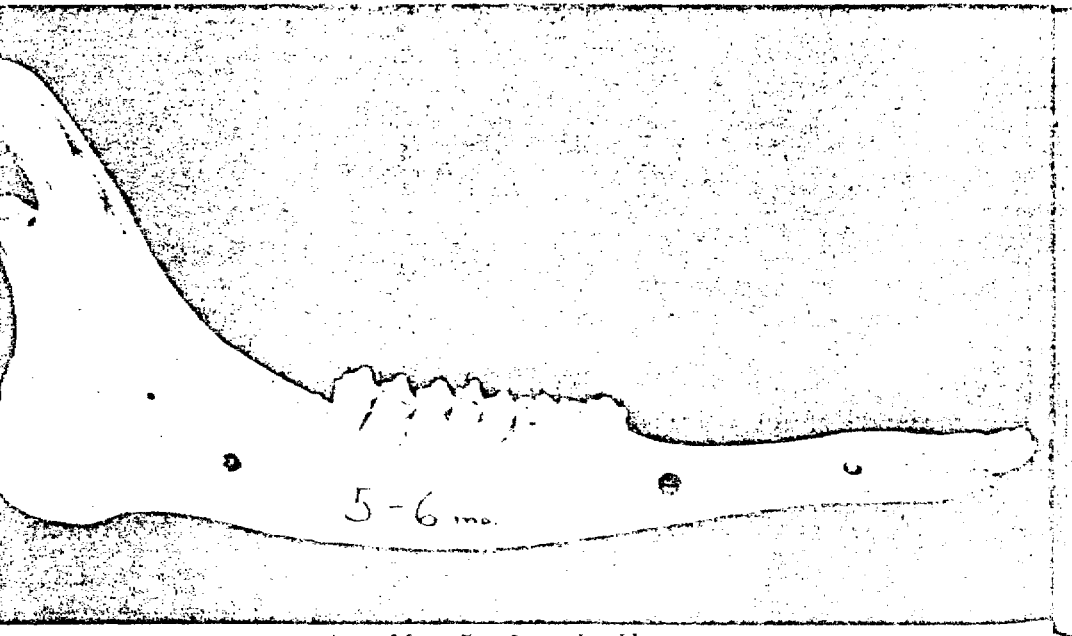
Wear more extreme than preceding. Pulp cavity may be exposed in some teeth.



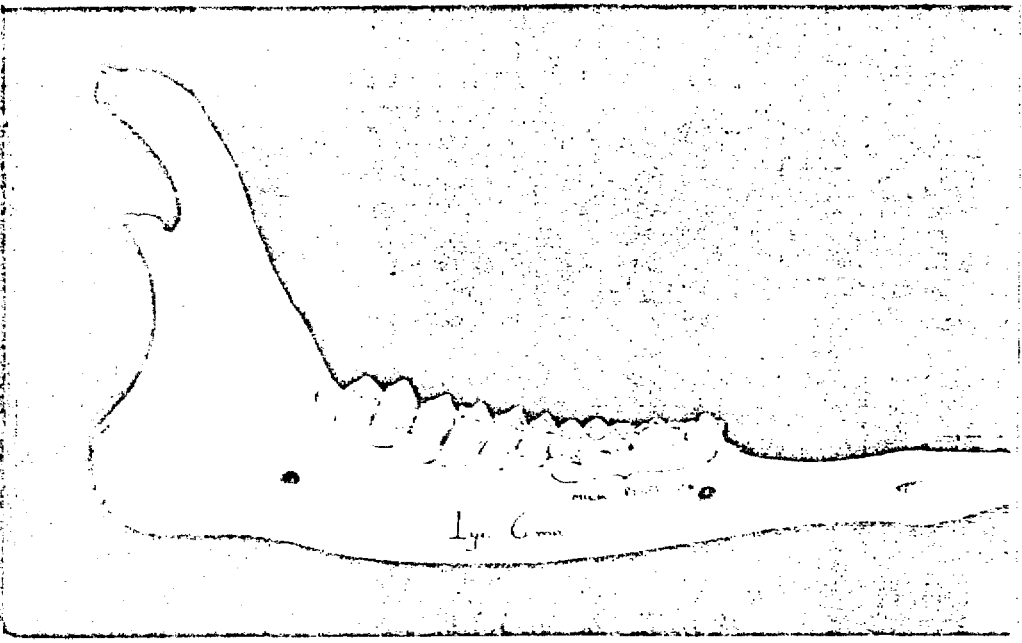
Jaw of fawn less than 5 months old.



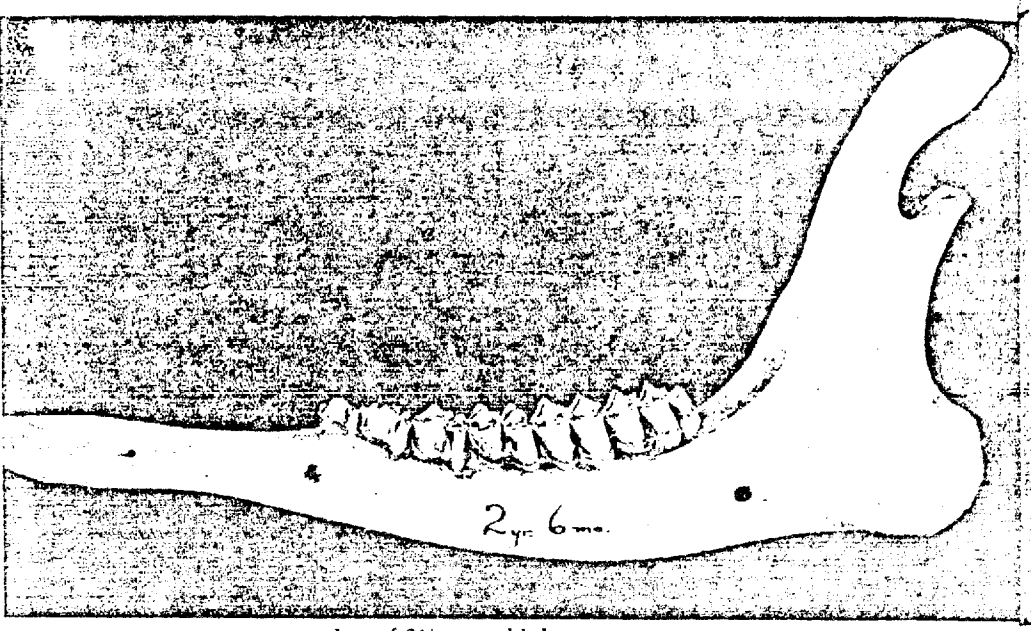
Jaw of deer 1 year and 5 months old.



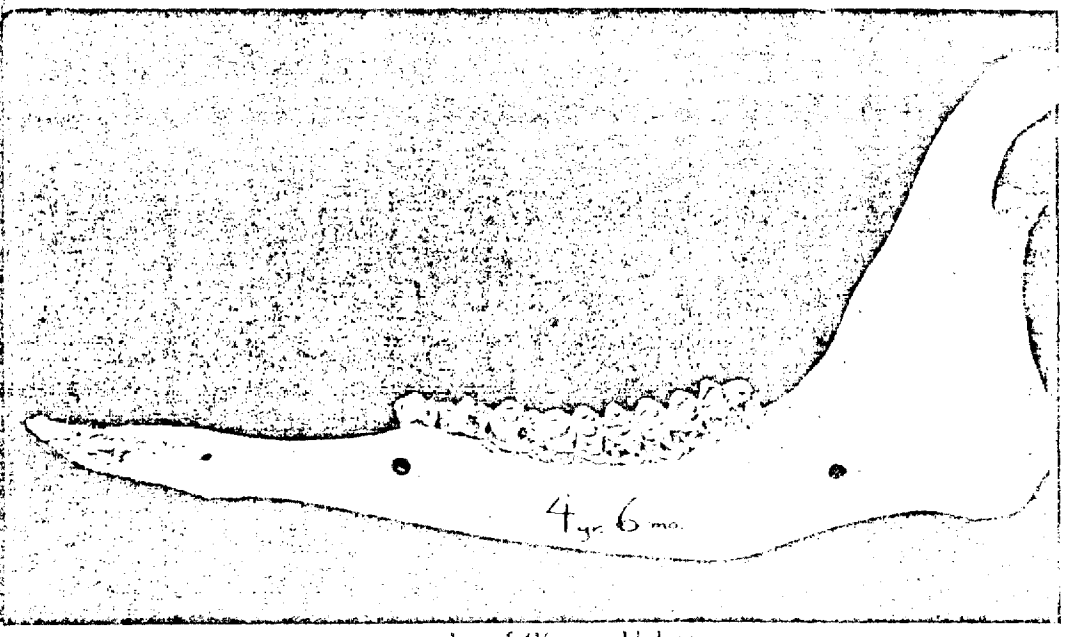
Jaw of fawn 5 to 6 months old.



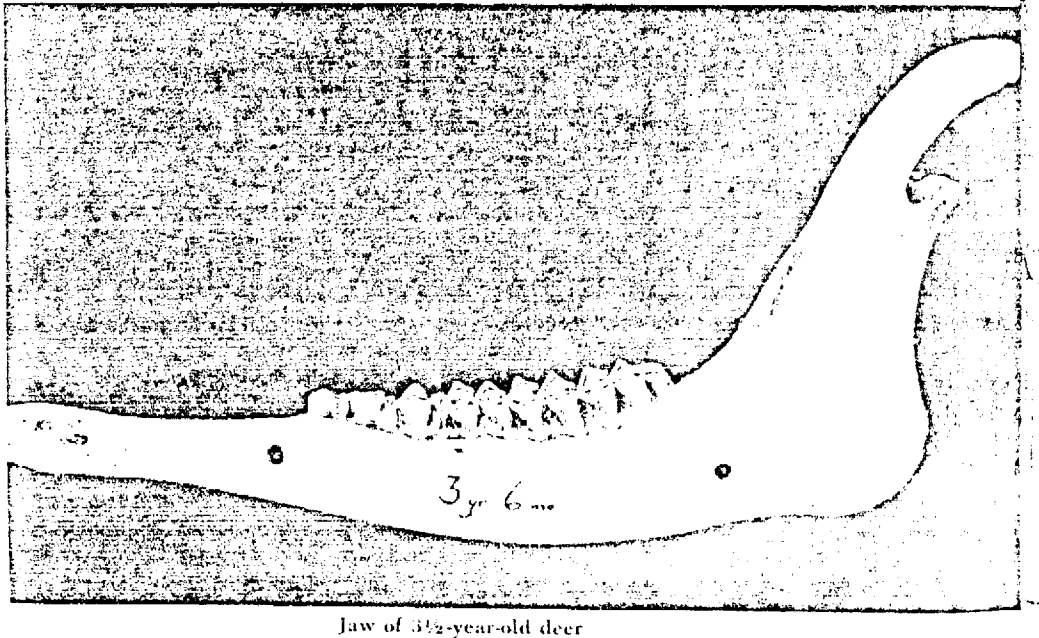
Jaw of deer 1 year and 6 months old.



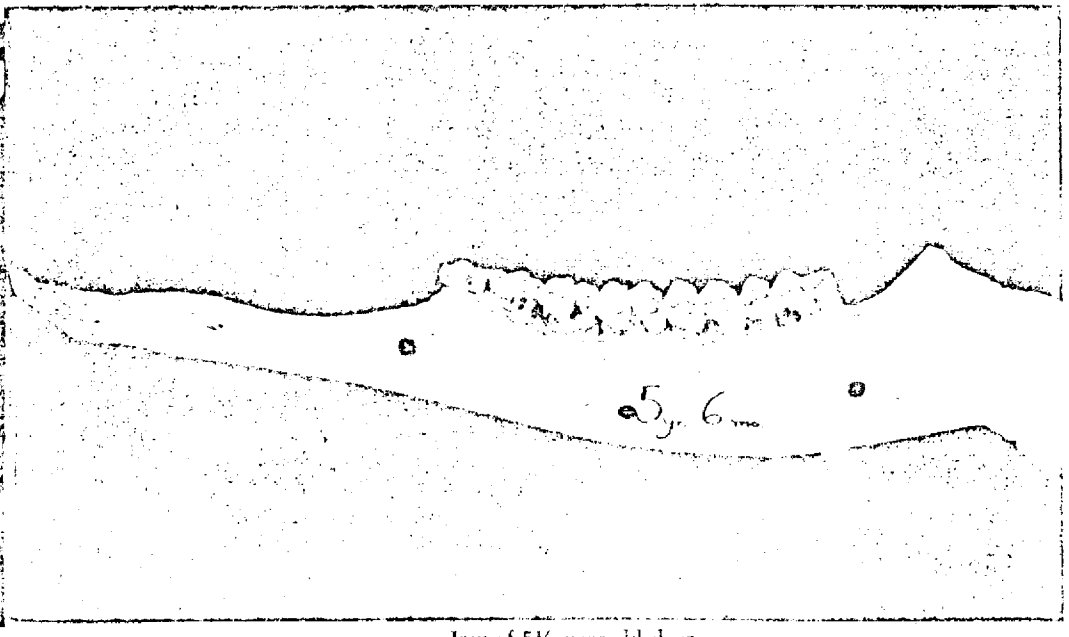
Jaw of 2½-year-old deer.



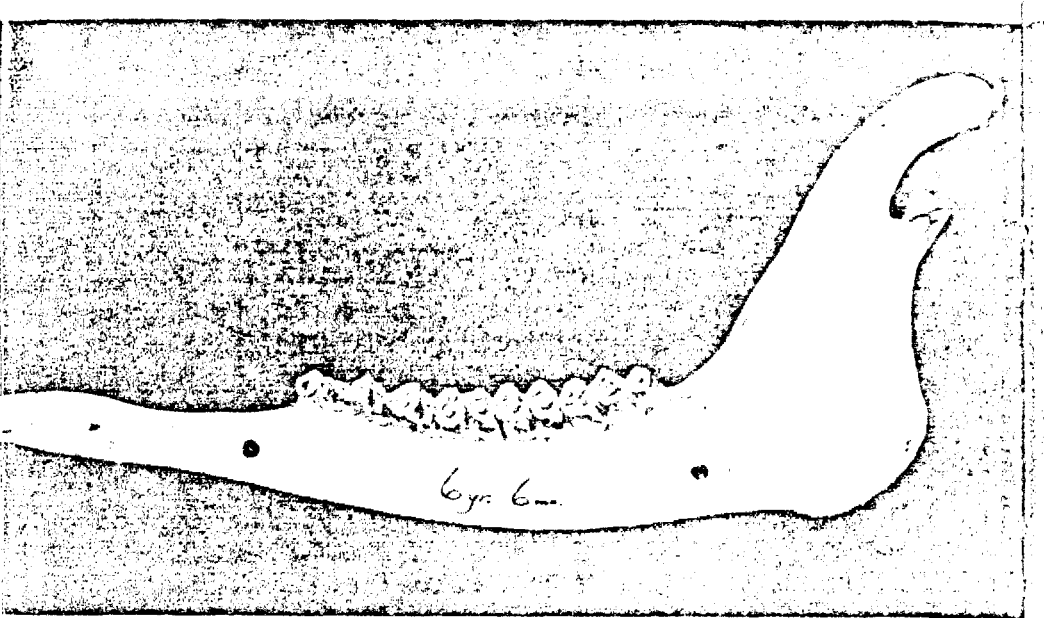
Jaw of 4½-year-old deer.



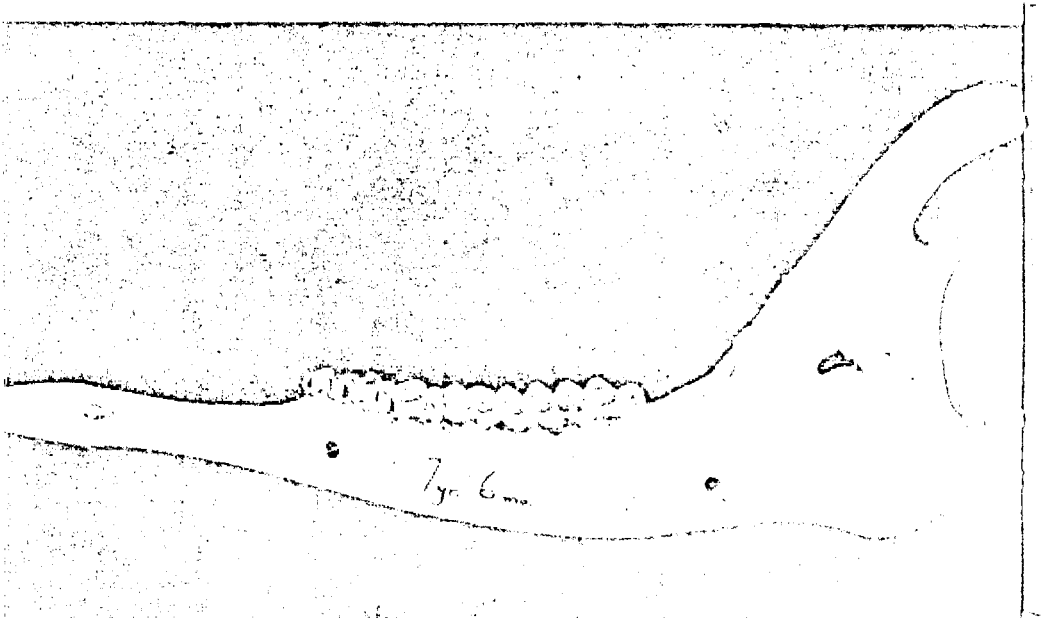
Jaw of 3½-year-old deer



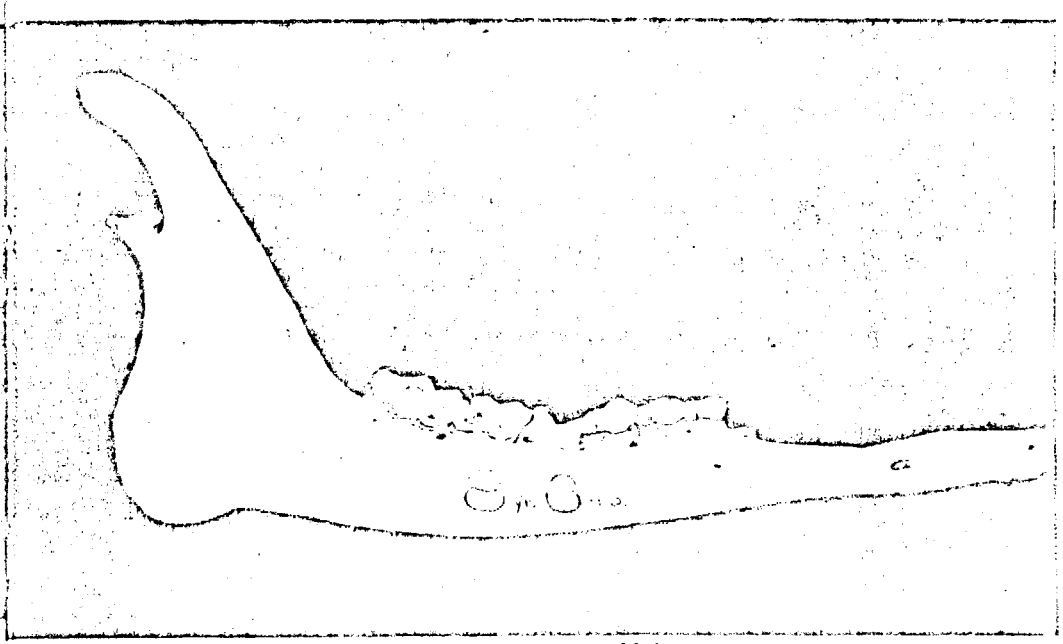
Jaw of 5½-year-old deer.



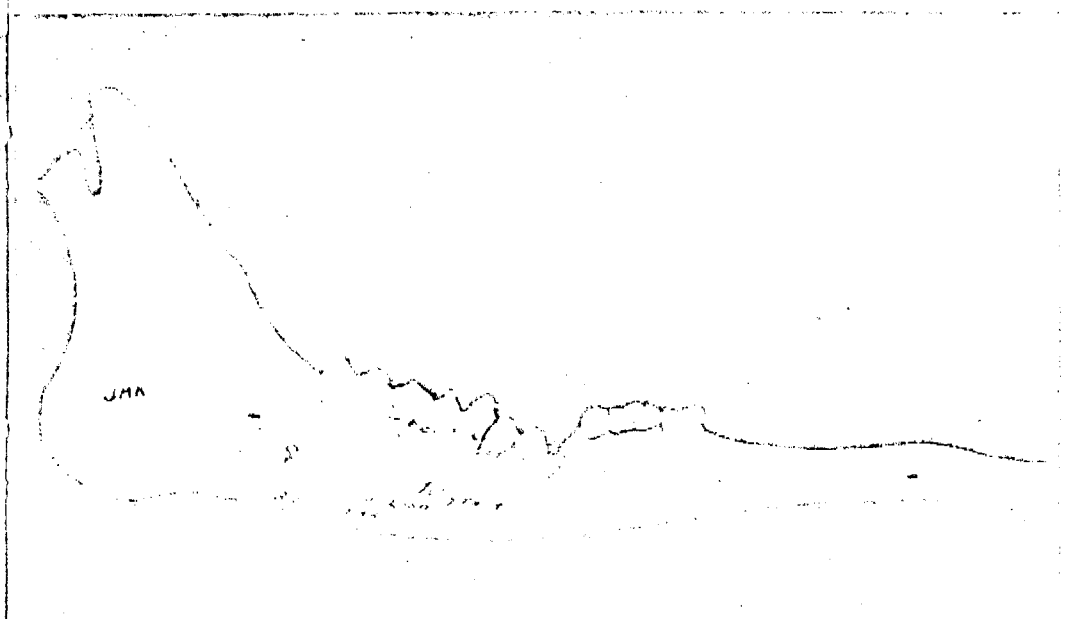
Jaw of 6½-year-old deer.



Jaw of 7½-year-old deer.



Jaw of 8½-year-old deer.



Jaw of deer 10 years old or older.

APPENDIX C

Check List of 110 Trees and Shrubs Browsed by Deer in Wisconsin

Common Name	Scientific Name*	Browse Preference Rating**	Grows in North	Grows in Central & South
CONIFEROUS TREES				
1. Yew (Gd. Hemlock)	Taxus Canadensis	I	x	
2. White cedar	Thuja occidentalis	I	x	
3. Hemlock	Tsuga canadensis	I	x	
4. White pine	Pinus Strobus	II	x	x
5. Jack pine	Pinus Banksiana	II	x	x
6. Norway pine	Pinus resinosa	III	x	x
7. Balsam fir	Abies balsamea	III	x	x
8. White spruce	Picea glauca	IV	x	
9. Black spruce	Picea mariana	IV	x	x
10. Tamarack	Larix laricina	IV	x	x
HARDWOOD TREES				
1. Mountain ash	Pyrus americana	I	x	
2. Red maple	Acer rubrum	I	x	x
3. Black willow	Salix nigra	II	x	x
4. Yellow birch	Betula lutea	II	x	
5. Black cherry	Prunus serotina	II	x	x
6. Pin cherry	Prunus pennsylvanica	II	x	x
7. Basswood	Tilia americana	II	x	x
8. Jack oak	Quercus ellipsoidalis	II-III	x	x
9. Black ash	Fraxinus nigra	II-III	x	x
10. Balsam poplar	Populus balsamifera	III	x	
11. Large-toothed aspen	Populus grandidentata	III	x	x
12. Quaking aspen (Popple)	Populus tremuloides	III	x	x
13. Bitternut hickory	Carya cordiformis	III	x	x
14. Blue beech	Carpinus caroliniana	III	x	x
15. White birch	Betula papyrifera	III	x	x
16. River birch	Betula nigra	III		x
17. Beech	Fagus grandifolia	III		(SE)
18. Red oak	Quercus rubra	III	x	x
19. Black oak	Quercus velutina	III		x
20. White oak	Quercus alba	III		x
21. Bur oak	Quercus macrocarpa	III	x	x
22. Swamp white oak	Quercus bicolor	III		x
23. American elm	Ulmus americana	III	x	x
24. Rock elm	Ulmus Thomasi	III	x	x
25. Wild crab	Pyrus angustifolia	III	x	x
26. Choke cherry	Prunus virginiana	III	x	x
27. Hard maple	Acer saccharum	III	x	x
28. Soft maple	Acer saccharinum	III	x	x
29. White ash	Fraxinus americana	III	x	x
30. Ironwood	Ostrya virginiana	III-IV	x	x
31. Slippery elm	Ulmus rubra	IV	x	x
32. Box elder	Acer Negundo	IV	x	x
33. Butternut	Juglans cinerea	?	x	x
34. Black walnut	Juglans nigra	?		x
35. Shagbark hickory	Carya ovata	?		x
36. Hackberry	Celtis occidentalis	?		x
37. Red mulberry	Morus rubra	?		x
38. Thornapple	Crataegus spp.	?	x	x
39. Red ash	Fraxinus pennsylvanica	?		x
SHRUBS				
1. Staghorn sumac	Rhus typhina	I	x	x
2. Alternate-leaved dogwood	Cornus alternifolia	I	x	x
3. Wintergreen	Gaultheria procumbens	I	x	x
4. Wild cranberry	Vaccinium Oxycoccos	I	x	x
5. Sweet fern	Comptonia peregrina	II	x	x
6. Swamp black currant	Ribes lacustre	II	x	x
7. Wild black currant	Ribes americana	II	x	x
8. Dewberry	Rubus flagellaris	II	x	x
9. Juneberry	Amelanchier canadensis	II	x	x
10. Smooth sumac	Rhus glabra	II	x	x
11. Winter-berry	Ilex verticillata	II		

Common Name	Scientific Name*	Browse Preference Rating**	Grows in North	Grows in Central & South
12. Mountain maple	Acer spicatum	II	x	x
13. Moosewood	Dirca palustris	II	x	
14. Red-osier dogwood	Cornus stolonifera	II	x	x
15. Blueberry	Vaccinium angustifolium	II	x	x
16. Blueberry	Vaccinium myrtilloides	II	x	x
17. High-bush blueberry	Vaccinium corymbosum	II	x	x
18. Fly honeysuckle	Lonicera canadensis	II	x	x
19. Red-berried elder	Sambucus pubens	II	x	x
20. Nannyberry	Viburnum lentago	II	x	x
21. Bog willow	Salix pedicellaris	III	x	x
22. Prairie willow	Salix humilis	III	x	x
23. Hazelnut	Corylus americana	III	x	x
24. Beaked hazelnut	Corylus cornuta	III	x	x
25. Bog birch	Betula pumila	III	x	x
26. Thimbleberry	Rubus parviflorus	III	x	
27. Wild red raspberry	Rubus idaeus	III	x	x
28. Blackberry	Rubus alleghenionsis	III	x	x
29. Prickly wildrose	Rosa acicularis	III	x	x
30. Prairie wildrose	Rosa arkansana	III	x	x
31. Mountain holly	Nemopanthus mucronata	III	x	
32. New Jersey tea	Ceanothus americanus	III	x	x
33. Buffalo-berry	Sheperdia argentea	III	x	
34. Gray dogwood	Cornus racemosa	III	x	x
35. Labrador tea	Ledum groenlandicum	III	x	x
36. Bog rosemary	Andromeda glaucophylla	III	x	
37. Leatherleaf	Chamaedaphne calyculata	III	x	x
38. Bearberry	Arctostaphylus Uva-ursi	III	x	
39. Huckleberry	Gaylussacia baccata	III		x
40. Buttonbush	Cephalanthus occidentalis	III		x
41. Bush honeysuckle	Diervilla Lonicera	III	x	x
42. Common elder	Sambucus canadensis	III	x	x
43. Highbush cranberry	Viburnum trilobum	III	x	x
44. Witch hazel	Hamamelis virginiana	III-IV	x	
45. Ninebark	Physocarpus opulifolius	III-IV	x	x
46. Tag alder	Alnus rugosa	IV	x	x
47. Meadow-sweet	Spiraea alba	IV	x	x
48. Hardhack	Spiraea tomentosa	IV	x	x
49. Prickly ash	Xanthoxylum americanum	IV	x	x
50. Shining willow	Salix lucida	?	x	x
51. Sandbar willow	Salix interior	?		x
52. Mountain alder	Alnus crispa	?	x	x
53. Swamp red currant	Ribes triste	?	x	
54. Prickly gooseberry	Ribes cynosbati	?	x	x
55. Northern gooseberry	Ribes oxyacanthoides	?	x	
56. Chokeberry	Pyrus melanocarpa	?	x	x
57. Wild plum	Prunus americana	?	x	x
58. Laurel	Kalmia polifolia	?	x	
59. Snowberry	Symphoricarpus albus	?	x	
60. Arrow-wood	Viburnum acerifolium	?		x
61. Trailing arbutus	Epigaea repens	?	x	x

* Plant nomenclature is that of Fernald (1950).

** Browse preference ratings: I—1st choice; II—2nd choice; III—3rd choice; IV—4th choice (usually eaten only under starvation conditions).

APPENDIX D

Diseases and Parasites of Wisconsin Deer

This listing describes briefly those deer diseases and parasites that have been positively identified in Wisconsin. None of them have ever caused serious losses in the state. This list is not necessarily complete; it represents only the findings at autopsy of sick or dead deer submitted to department pathologists. A specific study of the Wisconsin herd in this regard has never been carried out.

A. Virus Diseases

Papilloma and Fibroma. Deer with warts or skin tumors occur regularly in Wisconsin. They have been recorded from Sawyer, Oneida, Vilas and Marquette counties. Warts are believed to be caused by a filterable virus. They are non-malignant and do not harm the meat or man, although deer with heavy growth may be in poor physical condition due to obstruction of breathing, vision, or eating.

B. Bacterial Diseases

Hemorrhagic Septicemia ("Shipping Fever"). This is a generalized bacterial infection found mainly in livestock, and caused by organisms of the genus *Pasteurella.* Four cases have been identified in deer from Sawyer, Douglas and Wood counties. Serious deer mortalities in the western states have been caused by this disease.

C. Protozoan Parasites

Eimeria zurnii. This is a member of the Coccidia, which are very small tissue parasites of many animals. Coccidiosis produces severe lesions of the intestinal tract and liver. It is of minor clinical importance in man, but it may be a serious disease in lower animals, particularly cattle. *E. zurnii* has been identified in two deer from Bayfield county, one in 1938 and one in 1943.

D. Parasitic Worms

Stomach Worms. Three genera and species of roundworms of the digestive system have been recorded in Wisconsin deer: *Haemonchus contortus* (sheep wireworm), *Ostertagia ostertagia,* and *Nematodirus* sp. All of them have similar habits and are considered together. Their incidence seems to be quite common. These worms are blood suckers. They are found in the stomach or intestines and when present in numbers can cause serious anemia and digestive irregularities. They infect domestic livestock, as well as such wild forms as deer, moose, antelope and other ruminants, and can cause serious losses to wild populations. *Haemonchus* has been found in Bayfield, Taylor, Vilas, Dunn, and Columbia counties.

Ostertagia has been recorded from Vilas, Oneida, and Marinette counties, and *Nematodirus* has been found in Price, Taylor, Florence, Iron and Vilas counties.

Lungworms. Lungworms are small, whitish worms that are found in the trachea and air spaces in the lungs. Heavy infections can cause severe damage to the lungs and may result in death from pneumonia. Two species have been found in Wisconsin: *Dictyocaulus viviparus* (cattle lungworm) and *Protostrongilus rufescens.* Lungworms affect domestic livestock and have caused serious losses in deer of some of the western states. Wisconsin records are uncommon but regular. Infected deer have been found in Langlade, Marinette and Vilas counties, and in several counties of the northwest area.

Tapeworms. These are flat, ribbon-like worms that live in the deer's small intestine. They may reach a length of several feet. Severe infestations may cause deer to be in general poor condition. The worms are also found in sheep and cattle. Three species have been found in Wisconsin: *Moniezia expansa* is a very large form that can grow to be 10 feet in length; *Thysanosoma actinoides* is a similar form but not as large. The third species is of the genus *Taenia;* its immature or larval forms are called bladder worms and appear as small wattery bladders or cysts embedded in muscles or attached to mesenteries, lungs or liver. Tapeworms in Wisconsin deer are of regular occurrence and have been recorded from Bayfield, Oneida, Price and Vilas counties. Only one case of *Thysanosoma* has been found; a buck fawn from Bayfield county in 1941.

Liver Flukes. The only species of liver fluke we have recorded in Wisconsin is *Fascioloides magna.* It is a common parasite of deer, having been found in many northern and central counties. It does not seem to cause particular harm to the deer, except in very heavy infestations, but it is the cause of "liver rot" that results in serious losses of domestic livestock, particularly sheep. Deer livers containing flukes show yellowish white spots or cysts about the size of a quarter located just beneath the surface. The adult worm is a soft, fleshy flatworm measuring about three inches long and one inch wide, though varying in size. The flukes and cysts are harmless to man and they do not affect the meat of the deer as food.

E. Arthropod Parasites

Nasal Flies. Wisconsin deer seem to be commonly afflicted with grubs in the nasal passages and throat. These grubs are the larvae of nasal flies. They have been found in many counties, particularly in the north. We have found up to 52 grubs in a single deer. The adult flies lay eggs in or about the deer's nose and facial hair. The larvae hatch and migrate into the nasal passages. They are coughed or sneezed out after development, then pupate in the ground and transform into adults. Two species have been identified in Wisconsin deer. *Oestrus ovis* (sheep botfly) is the commonest of the two. *Cephenomyia trompe* has been found only twice, in Marinette and Wood counties.

Lice, Ticks and Mites. Ticks and lice seem to be fairly common parasites of Wisconsin deer, but no identifications of species have been made. Only one instance of identified mite infestation is in our records. In 1953 a deer from the northwest area was found with a severe case of ear mange caused by a mite of the genus *Ottodectes.*

F. Fungus Infections

Trychophyton sp. A deer in Douglas county was found to have a scaly skin condition due to this fungus species. The specimen was taken in 1951.

Lumpy Jaw. Several cases of this disease, characterized by the formation of tumors on the jaw, have been found among deer in over-browsed winter yards in the northern part of the state. It is caused by a fungus of the genus *Actinomyces.*

G. Miscellaneous Pathology

Several abnormal conditions not directly associated with other diseases or parasites have been found in Wisconsin. Two cases of urinary calculi have been found, one each in Iron and Wood counties. Abscessed molars were found in five deer. An adult buck with a cleft palate was found in Columbia county in 1941. Eight cases of congenitally blind fawns have been recorded since 1939. Six of them were from the central area and were affiicted with opaque corneas in both eyes. Another fawn found in Bayfield county in 1943 lacked any semblance of eyeballs. A fawn from Marquette county in 1952 had aniridia (absence of the iris), aphakia (absence of the lens), and tumors on the cornea. The disorders of all eight of these animals are believed to be the result of hereditary deficiencies.

APPENDIX E

Acreage of Wisconsin Deer Range by County, with Hunting Kills per Unit Area

Area and County	Acres of Deer Range	Square Miles of Deer Range	Hunting Kill per Square Mile of Range: 1947 Buck	1960 Any-Deer	1963 Buck
NORTH					
Ashland	575,338	899	1.8	5.8	0.7
Bayfield	845,544	1,321	2.5	8.2	0.6
Burnett	407,559	637	2.2	7.3	0.5
Chippewa	247,993	387	0.8	1.5	0.2
Douglas	696,132	1,088	2.7	7.2	0.7
Florence	284,837	445	3.2	13.4	1.1
Forest	575,231	899	3.2	9.5	1.0
Iron	450,676	704	1.2	4.8	0.3
Langlade	402,667	629	2.1	4.1	0.7
Lincoln	417,033	652	2.4	5.9	1.2
Marathon	418,044	653	0.4	0.9	0.2
Marinette	676,832	1,058	3.0	11.6	1.1
Oconto	455,990	712	2.3	8.0	0.7
Oneida	651,991	1,019	2.6	10.3	1.1
Polk	245,913	384	2.7	8.2	0.9
Price	660,189	1,032	1.6	7.0	1.2
Rusk	366,562	573	1.8	5.0	0.6
Sawyer	731,646	1,143	1.7	6.6	0.6
Shawano	427,805	668	0.3	0.9	0.3
Taylor	380,548	595	1.7	3.9	0.7
Vilas	534,198	835	3.6	19.9	1.8
Washburn	405,358	633	1.6	5.0	0.5
Area Total	10,858,086	16,966			
CENTRAL					
Adams	272,650	426	2.7	6.8	0.6
Clark	309,563	484	5.1	17.5	1.5
Eau Claire	160,093	250	2.2	7.4	2.5
Jackson	389,656	609	4.8	14.6	2.4
Juneau	283,730	443	4.9	8.2	1.3
Monroe	256,977	402	3.3	5.6	1.3
Wood	191,645	299	4.5	13.9	1.1
Area Total	1,864,314	2,913			
AGRICULTURAL					
Barron	159,426	249	1.2	2.2	0.1
Brown	42,668	67	C	C	C
Buffalo	198,536	310	2.2	1.4	0.7
Calumet	19,393	30	C	C	C
Columbia	88,431	138	3.5	5.7	1.2
Crawford	175,245	273	0.8	C	0.1
Dane	88,428	138	C	C	0.1
Dodge	55,987	87	C	C	0.2

Area and County	Acres of Deer Range	Square Miles of Deer Range	Hunting Kill per Square Mile of Range: 1947 Buck	1960 Any-Deer	1953 Buck
Door	111,763	175	C	C	0.2
Dunn	165,282	258	2.7	7.2	0.3
Fond du Lac	34,848	54	C	C	C
Grant	133,921	209	C	0.6	0.4
Green	38,206	60	C	C	C
Green Lake	25,765	40	C	C	0.5
Iowa	96,265	150	0.9	0.2	0.1
Jefferson	48,529	76	C	C	C
Kenosha	22,263	35	C	C	C
Kewaunee	29,428	46	C	C	C
LaCrosse	124,362	194	2.6	0.9	0.4
Lafayette	26,876	42	C	C	C
Manitowoc	69,008	108	C	C	C
Marquette	94,957	148	2.2	7.5	0.9
Milwaukee	6,939	11	C	C	C
Outagamie	73,688	115	C	C	0.5
Ozaukee	17,539	27	C	C	C
Pepin	59,537	93	2.0	2.2	0.4
Pierce	91,657	143	C	2.6	0.4
Portage	163,275	255	1.5	3.3	1.0
Racine	49,680	78	C	C	C
Richland	116,319	182	0.1	0.2	0.1
Rock	37,499	59	C	C	C
Sauk	174,082	272	1.1	2.9	0.3
Sheboygan	40,315	63	C	C	C
St. Croix	86,434	135	C	2.7	0.3
Trempealeau	120,773	189	1.9	1.1	0.4
Vernon	161,062	252	C	C	0.1
Walworth	48,136	75	C	C	C
Washington	45,345	71	C	C	C
Waukesha	49,277	77	C	C	C
Waupaca	154,442	241	C	7.0	1.5
Waushara	127,171	199	2.7	6.1	1.0
Winnebago	37,415	58	C	C	C
Area Total	3,510,172	5,482			
State Total	16,232,572	25,361			

C—County closed to hunting.

APPENDIX F

Browse Identification Key

I. CONIFEROUS TREES

Species	Bark	Needles	Twigs	Branches	Odor	Miscellaneous
Ground Hemlock (Yew)		Flat, sharp-pointed				Shrubby form.
Cedar		Over-lapping scales				
Hemlock	Rough	Stripe on under side, flat, round-tipped				
White Pine		5 needles				
Jack Pine	Dark	2 short				
Norway Pine	Reddish scale	2 long				
Balsam	Smooth with blisters	2 stripes beneath, flat, round-tipped				
Tamarack		None in winter	Yellowish			Small, rounded, brown buds on twigs.
White Spruce	Light & rough	Prickly, four-sided	Yellowish, smooth		Unpleasant scent	
Black Spruce	Dark & scaly	Four-sided, pointed	Fine hairs	Drooping	Pungent	

Species	Form: Tree	Form: Shrub	Leaves: Alt.	Leaves: Opp.	Stem	Twig	Buds	Taste	Miscellaneous
II. OTHER TREES AND SHRUBS									
Alt. Dogwood		x	x		Dark reddish brown	Dark red	Medium size, dk. reddish-brown, short, on stalks		Yellow growth on dead twigs.
Mt. Ash	x		x		Dark colored		Dark red, large, long, close to twig		Conspicuous joints between current and previous growth.
Red Dogwood		x		x	Bright red, raised grey specks, uniform color	Bright red	Hairy, grey, small, sharp		
Red Maple	x			x	Uniform reddish grey	Reddish	Reddish, med. size, rather short, blunt		
Sumac		x	x		Thick, pithy, very large brown pith	Staghorn, hairy; Scarlet-smooth	Staghorn-feathery		
Wild Black Current		x	x		Dark	Conspicuous ridges, lt. grey	Tan		
Mt. Maple		x		x	Red & grey-mottled to greyish below	Red	Small, thin, bright red		
Willow		x	x		Smooth, yellow, red or grey	Yellowish or reddish tipped, sometimes dusky	Single bud scale close to twig.	Bitter	

Species	Form: Tree	Form: Shrub	Leaves: Alt.	Leaves: Opp.	Stem	Twig	Buds	Taste	Miscellaneous
Elder		x		x	Soft, pithy, light grey		Large & Plump		Pith, large, brown or white.
Honeysuckle		x		x	Light greyish brown	Light greyish brown, slender	Small		
Leatherwood		x	x		Grey, very tough & fibrous bark, thick at base and tapering	Grey and tough	Short, round, very hairy, grey, from basal cup.		
Basswood	x		x		Smooth, lt. grey on upper branches, bark deeply furrowed	Light grey or reddish	Large & plump, reddish, smooth		
Hard Maple	x		x		Light brownish grey	Light yellowish brown	Med. size, greyish brown, compact		
Juneberry	Shrub-like	Sometimes a tree	x		Reddish or greyish brown	Reddish or greyish brown	Long, sharp, curved towards stem	Almond.	Almond odor.
Choke cherry	Shrub-like		x		Greyish		Conical, pointed, greyish	Very bitter	
Black Cherry	x		x		Dark		Heart-shaped, smooth, yellowish	Very Bitter	
Pin Cherry	x		x		Dark		Small, reddish, granular, terminal buds clustered, blunt.	Very bitter	Reddish brown specks on bark.

Species	Form: Tree	Form: Shrub	Leaves: Alt.	Leaves: Opp.	Stem	Twig	Buds	Taste	Miscellaneous
Sweet Fern		x		x	Brownish	Brownish			Sweet, strong odor.
Bur Oak	x		x		Rough, scaly	Rough, corky, ridged on long twigs	Stubby, grouped at terminal, red-brown, hairy.	Tannin	Leaf deeply lobed and rounded.
Red Oak	x		x		Smooth, dark grey	Smooth, greyish brown	Small, grouped at terminal, light brown, smooth		Leaf sharply pointed deeply lobed.
Yellow Birch	x		x				Lateral buds ¼" long, conical, acute, brown	Winter-green flavor	
Hazel		x	x		Greyish-brown	Yellowish-grey speckled	Yellowish, med. size, blunt		Catkins.
Highbush Cranberry		x		x	Greyish-brown, smooth	Thick	Large, reddish		Red berries.
Nemopanthus Holly		x	x		Dark, smooth	Reddish tipped & silvery grey below	Small & stubby, single, reddish		
Ilex Holly (Winterberry)		x	x		Dark, smooth	Reddish tipped & silvery grey below	Double and Small		
White Birch	x		x		Prominent grey specks	Reddish-brown	Lower buds on stalks		Bark white on old stems.
Black Ash	x			x	Light grey	Thick, blunt, flattish	Thick, blunt, brown to black		Enlarged at nodes.

Species	Form: Tree	Form: Shrub	Leaves: Alt.	Leaves: Opp.	Stem	Twig	Buds	Taste	Miscellaneous
Quaking Aspen (Popple)	x		x		Smooth, light	Brownish	Brown, shiny, pointed	Very unpleasantly bitter	
Large-toothed Aspen	x		x		Smooth, light	Greyish, not shiny	Dusty looking		
Blue Beech	x		x		Smooth slate to bluish-grey	Slender	Small, close to twig, narrow, ovoid, acute		Ridged stem on larger trees
Ironwood	x		x		Rough	Slender	Buds curve out, yellowish, ovoid, acute		Rough bark, ridged on larger trees.
Alder		x	x		Dark grey	Hairy, orange lenticels	Dark purplish, club-shaped on long stalks		Catkin.
American Elm	x		x			Smooth, red-brown to ash-grey	Ovoid, sharp, smooth, brownish		

This list is not all-inclusive.

APPENDIX G*

Annual Winter Deer Yard Checks by County

Area & County	No. Yards	Food Conditions P	M	G	Browsing EX.	EQ.	L	Yarding T	P	S	Deer Concentration H	M	L	Logging	Feeding
Winter of 1940-1941															
NORTH															
Ashland	1	--	1	--	1	--	--							--	
Bayfield	6	5	1	--	5	--	1							3	
Burnett	3	1	2	--	3	--	--							1	
Douglas	14	9	4	1	10	3	1							--	
Florence	10	6	1	3	6	1	3							7	
Forest	7	4	2	1	5	2	--							3	
Iron	8	6	2	--	3	5	--							5	
Langlade	2	1	1	--	1	--	1							2	
Marinette	3	2	1	--	2	1	--							--	
Price	3	2	--	1	2	--	1							1	
Rusk	7	6	--	1	4	3	--							4	
Sawyer	8	5	3	--	6	2	--							4	
Vilas	7	5	2	--	5	2	--							--	
Washburn	1	1	--	--	1	--	--							1	
Total	80	53	20	7	54	19	7							31	
CENTRAL															
No yards checked															
Winter of 1941-42															
NORTH															
Total for 15 counties	158	64	69	23	116	34	6							65	
CENTRAL															
No yards checked															
Winter of 1942-43															
NORTH															
Total for 16 counties	146	110	30	6	117	21	8							36	
CENTRAL															
No yards checked															
Winter of 1943-44															
NORTH															
Total for 16 counties	147	82	60	5	59	52	36							40	
CENTRAL															
No yards checked															
Winter of 1944-45															
NORTH															
Total for 16 counties	187	94	24	69	114	58	15							52	
CENTRAL															
No yards checked															
Winter of 1945-46															
NORTH															
Total for 16 counties	95	59	10	26	36	45	14							25	
CENTRAL															
No yards checked															

Area & County	No. Yards	Food Conditions P	M	G	Browsing EX.	EQ.	L	Yarding T	P	S	Deer Concentration H	M	L	Logging	Feeding
Winter of 1946-47															
NORTH															
Ashland	8	3	4	1											
Bayfield	10	8	2	--											
Burnett	3	2	--	1											
Douglas	9	8	1	--											
Florence	6	6	--	--											
Forest	15	15	--	--											
Iron	4	--	4	--											
Langlade	4	1	2	1											
Lincoln	13	3	8	2											
Marinette	4	3	1	--											
Oneida	7	6	1	--											
Price	12	10	2	--											
Rusk	3	3	--	--											
Sawyer	3	3	--	--											
Vilas	11	10	1	--											
Washburn	7	2	4	1											
Total	119	83	30	6	74	42	3				16	43	60	42	16
CENTRAL															
No yards checked															
Winter of 1947-48															
NORTH															
Ashland	6	6	--	--											
Bayfield	7	7	--	--											
Burnett	5	3	2	--											
Chippewa	2	--	1	1											
Douglas	5	3	2	--											
Florence	6	5	--	1											
Forest	6	6	--	--											
Iron	10	5	5	--											
Langlade	1	1	--	--											
Lincoln	4	3	1	--											
Oneida	8	7	1	--											
Price	7	7	--	--											
Rusk	13	10	3	--											
Sawyer	10	8	2	--											
Taylor	2	--	2	--											
Vilas	17	17	--	--											
Washburn	5	1	4	--											
Total	114	89	23	2											
CENTRAL															
Clark	2	2	--	--											
Jackson	2	2	--	--											
Juneau	4	3	1	--											
Total	8	7	1	--											
Winter of 1948-49															
NORTH															
Ashland	8	4	4	--	8	--	--							3	4
Bayfield	12	11	1	--	11	1	--							3	1
Burnett	3	2	--	1	2	--	1							1	--
Chippewa	9	--	4	5	--	3	6							3	--
Douglas	14	5	4	5	5	8	1							5	6
Florence	8	6	2	--	--	7	1							4	--
Forest	13	11	2	--	6	6	1							2	1
Iron	10	6	4	--	7	--	3							3	3
Langlade	5	4	1	--	2	3	--							3	2
Lincoln	7	4	2	1	4	3	--							3	--
Marathon	3	--	--	3	--	--	3							1	--
Marinette	8	4	3	1	3	2	3							3	1
Oconto	3	1	1	1	--	1	2							1	--
Oneida	14	11	2	1	13	--	1							3	6
Price	10	7	3	--	5	5	--							5	4
Rusk	20	16	4	--	13	7	--							6	--
Sawyer	20	13	7	--	13	6	1							7	2
Taylor	4	3	1	--	2	--	2							1	--
Vilas	14	12	2	--	12	--	2							3	8
Washburn	4	--	1	3	--	3	1							3	--
Total	189	120	48	21	106	55	28							63	38

Area & County	No. Yards	Food Conditions P	M	G	Browsing EX.	EQ.	L	Yarding T	P	S	Deer Concentration H	M	L	Logging	Feeding
CENTRAL															
Adams	5	2	3	--	1	--	4							1	--
Clark	6	4	2	--	6	--	--							--	2
Eau Claire	7	1	3	3	--	4	3							--	1
Jackson	15	11	4	--	11	4	--							1	3
Juneau	7	2	5	--	2	5	--							1	2
Monroe	4	3	1	--	2	2	--							1	--
Wood	5	4	1	--	4	1	--							--	2
Total	49	27	19	3	26	16	7							4	10
Winter of 1949-50															
NORTH															
Ashland	8	6	2	--	4	4	--	8	--	--	4	2	2	4	4
Bayfield	17	11	5	1	5	6	6	9	6	2	6	5	6	8	3
Burnett	5	4	1	--	4	--	1	3	1	1	2	2	1	1	3
Chippewa	2	--	--	2	--	--	2	--	1	1	--	1	1	1	--
Douglas	15	9	5	1	4	4	7	8	5	2	5	5	5	5	6
Florence	5	3	2	--	--	5	--	--	5	--	--	3	2	--	--
Forest	16	9	7	--	--	16	--	3	11	2	--	9	7	2	--
Iron	12	7	5	--	6	3	3	7	5	--	2	4	6	4	5
Langlade	7	3	3	1	4	2	1	2	5	--	--	4	3	5	2
Lincoln	8	5	2	1	6	2	--	2	6	--	1	4	3	5	1
Marathon	2	--	--	2	--	--	2	--	1	1	--	--	2	1	--
Marinette	12	3	6	3	5	4	3	2	9	1	1	7	4	4	1
Oconto	5	3	1	1	4	1	--	3	2	--	1	2	2	2	--
Oneida	14	12	2	--	12	2	--	6	7	1	6	5	3	8	4
Polk	4	3	1	--	2	1	1	1	2	1	3	--	1	2	--
Price	10	8	2	--	5	1	4	6	3	1	4	1	5	3	6
Rusk	8	3	5	--	1	4	3	2	3	3	4	1	3	2	--
Sawyer	11	10	1	--	7	3	1	5	6	--	4	5	2	8	1
Shawano	2	--	1	1	--	2	--	--	2	--	--	--	2	1	--
Taylor	7	5	2	--	2	4	1	1	6	--	--	4	3	5	--
Vilas	13	11	2	--	7	4	2	4	4	5	4	4	5	3	6
Washburn	6	3	3	--	2	3	1	4	2	--	2	1	3	4	2
Total	189	118	58	13	80	71	38	76	92	21	49	69	71	78	44
CENTRAL															
Adams	1	--	--	1	--	--	1	--	1	--	--	--	1	--	--
Clark	4	3	--	1	3	1	--	--	4	--	1	2	1	--	2
Eau Claire	2	--	2	--	1	1	--	--	2	--	--	2	--	1	1
Jackson	14	9	5	--	6	7	1	--	10	4	1	8	5	5	2
Juneau	5	3	1	1	1	4	--	--	5	--	2	1	2	--	4
Monroe	2	1	1	--	1	1	--	--	1	1	--	2	--	--	--
Wood	3	2	1	--	1	2	--	--	2	1	--	1	2	--	2
Total	31	18	10	3	13	16	2	--	25	6	4	16	11	6	11
Winter of 1950-51															
NORTH															
Ashland	6	4	2	--	6	--	--	6	--	--	4	--	2	2	4
Bayfield	14	9	5	--	5	2	7	9	3	2	5	3	6	6	3
Burnett	3	2	1	--	2	--	1	2	--	1	2	--	1	2	2
Chippewa	1	--	--	1	--	--	1	--	--	1	--	--	1	1	--
Douglas	11	7	4	--	6	1	4	10	1	--	6	3	2	2	4
Florence	6	4	2	--	5	1	--	--	4	2	1	3	2	5	--
Forest	11	7	4	--	10	--	1	1	8	2	--	8	3	4	2
Iron	9	8	1	--	9	--	--	8	1	--	2	6	1	4	3
Langlade	8	4	2	2	4	2	2	4	3	1	4	2	2	4	--
Lincoln	7	5	2	--	2	5	--	4	3	--	1	4	2	3	1
Marinette	5	2	1	2	3	1	1	2	1	2	--	3	2	2	1
Oconto	4	3	1	--	2	1	1	--	1	3	--	1	3	--	--
Oneida	10	7	3	--	9	1	--	4	4	2	3	6	1	7	5
Polk	3	2	1	--	1	2	--	--	1	2	--	3	--	2	--
Price	6	6	--	--	4	--	2	1	3	2	4	--	2	1	4
Rusk	6	4	2	--	3	2	1	--	3	3	--	3	3	2	--
Sawyer	10	8	2	--	4	3	3	3	4	3	1	5	4	7	1
Taylor	4	3	1	--	1	3	--	--	4	--	--	2	2	3	--
Vilas	13	11	2	--	11	--	2	11	--	2	4	5	4	3	7
Washburn	6	3	3	--	2	2	2	3	--	3	1	2	3	4	2
Total	143	99	39	5	89	26	28	68	44	31	38	59	46	64	39

Area & County	No. Yards	Food Conditions P	M	G	Browsing EX.	EQ.	L	Yarding T	P	S	Deer Concentration H	M	L	Logging	Feeding
CENTRAL															
Adams	5	1	3	1	--	2	3	--	4	1	1	--	4	1	--
Clark	6	5	1	--	4	1	1	--	6	--	4	2	--	1	4
Eau Claire	3	1	2	--	2	1	--	--	2	1	1	1	1	--	3
Jackson	11	3	7	1	1	4	6	--	11	--	1	7	3	5	4
Juneau	6	3	3	--	2	1	3	--	2	4	2	1	3	3	1
Monroe	3	1	1	1	--	2	1	--	2	1	--	--	3	--	--
Wood	4	2	2	--	--	--	--	--	2	2	1	2	1	--	3
Total	38	16	19	3	9	11	14	--	29	9	10	13	15	10	15
Winter of 1951-52															
NORTH															
Ashland	6	5	1	--	1	5	--	--	5	1	--	3	3	3	1
Bayfield	15	4	10	1	1	3	11	1	8	6	3	2	10	7	2
Burnett	3	2	1	--	1	1	1	--	--	3	1	1	1	2	--
Chippewa	1	--	--	1	--	--	1	--	--	1	--	--	1	1	--
Douglas	11	5	6	--	4	3	4	4	7	--	6	2	3	8	1
Florence	6	1	5	--	4	2	--	3	2	1	--	4	2	5	--
Forest	11	8	3	--	9	1	1	1	8	2	--	6	5	5	--
Iron	9	2	7	--	5	2	2	1	8	--	--	7	2	4	--
Langlade	8	1	7	--	3	1	4	2	6	--	1	4	3	4	1
Lincoln	7	4	2	1	4	1	2	1	6	--	2	3	2	4	--
Marinette	5	2	1	2	2	--	3	--	3	2	--	1	4	2	--
Oconto	4	--	3	1	1	1	2	--	2	2	--	1	3	1	--
Oneida	16	8	2	--	8	2	--	--	9	1	2	8	--	4	--
Polk	3	2	1	--	--	3	--	--	2	1	--	2	1	2	--
Price	6	3	1	2	2	1	3	1	3	2	1	3	2	2	--
Rusk	6	3	3	--	1	2	3	--	4	2	1	1	4	2	--
Sawyer	9	4	2	3	--	2	7	--	7	2	1	3	5	6	--
Taylor	4	--	3	1	--	2	2	1	3	--	--	1	3	4	--
Vilas	12	10	1	1	5	6	1	1	11	--	1	7	4	8	2
Washburn	6	2	3	1	--	5	1	--	6	--	--	2	4	2	--
Total	142	66	62	14	51	43	48	16	100	26	20	63	59	76	7
CENTRAL															
Adams	5	--	3	2	--	1	4	--	--	5	--	1	4	3	--
Clark	4	--	2	2	--	--	4	--	--	4	--	1	3	--	--
Eau Claire	3	--	1	2	--	1	2	--	--	3	--	1	2	3	--
Jackson	11	--	8	3	--	1	10	--	2	9	--	4	7	5	--
Juneau	6	1	3	2	1	--	5	3	--	3	1	1	4	1	--
Monroe	3	--	2	1	--	2	1	--	1	2	--	1	2	2	--
Wood	4	--	3	1	--	1	3	--	2	2	--	2	2	--	--
Total	36	1	22	13	1	6	29	3	5	28	1	11	24	14	--
Winter of 1952-53															
NORTH															
Ashland	6	2	4	--	3	1	2	6	--	--	2	1	3	3	--
Bayfield	13	5	7	1	5	4	4	9	2	2	5	3	5	3	1
Burnett	3	2	1	--	2	1	--	3	--	--	2	1	--	1	--
Chippewa	1	--	--	1	--	--	1	1	--	--	--	--	1	1	--
Douglas	13	3	9	1	6	2	5	11	2	--	7	5	1	4	2
Florence	6	4	2	--	3	3	--	1	5	--	3	3	--	1	--
Forest	12	6	5	1	6	2	4	7	5	--	1	7	4	6	--
Iron	8	2	6	--	2	4	2	6	1	1	2	3	3	7	--
Langlade	7	--	3	4	--	3	4	2	3	2	--	5	2	6	--
Lincoln	7	2	3	2	1	3	3	--	7	--	1	4	2	2	--
Marinette	8	5	2	1	2	2	4	2	4	2	1	4	3	6	--
Oconto	4	1	1	2	1	--	3	1	2	1	1	--	3	1	--
Oneida	10	7	3	--	5	5	--	7	3	--	2	7	1	3	--
Polk	3	1	2	--	2	1	--	3	--	--	2	1	--	--	--
Price	7	4	2	1	2	2	3	2	2	3	1	2	4	2	--
Rusk	6	2	4	--	1	1	4	2	4	--	1	2	3	1	--
Sawyer	9	4	4	1	5	2	2	6	3	--	5	2	2	5	--
Taylor	4	--	4	--	--	4	--	2	2	--	1	3	--	3	--
Vilas	12	7	4	1	6	4	2	7	3	2	1	6	5	8	3
Washburn	4	2	2	--	2	1	1	1	3	--	1	3	--	--	--
Total	143	59	68	16	54	45	44	79	51	13	39	64	40	65	6

Area & County	No. Yards	Food Conditions P	M	G	Browsing EX.	EQ.	L	Yarding T	P	S	Deer Concentration H	M	L	Logging	Feeding
CENTRAL															
Adams	5	1	3	1	1	1	3	..	5	..	1	2	2	1	..
Clark	5	..	2	3	..	..	5	..	1	4	..	2	3	1	..
Eau Claire	4	..	2	2	1	..	3	..	2	2	1	1	2	2	..
Jackson	11	..	5	6	..	..	11	..	5	6	1	4	6	3	..
Juneau	6	..	3	3	..	..	6	..	2	4	..	1	5	..	..
Monroe	2	..	2	..	..	..	2	..	2	..	..	2	..	..	..
Wood	4	2	2	..	..	1	3	..	3	1	..	2	2	..	..
Total	37	3	19	15	2	2	33	..	20	17	3	14	20	7	..
						Winter of 1953-54									
NORTH															
Ashland	16	14	2	..	11	4	1	7	8	1	2	12	2	3	..
Bayfield	20	16	4	..	9	5	6	1	18	1	8	6	6	12	1
Burnett	8	1	7	..	..	..	8	..	1	7	..	7	1	2	..
Chippewa	1	..	..	1	..	..	1	..	..	1	..	..	1	1	..
Douglas	28	24	4	..	10	10	8	1	22	5	13	7	8	10	..
Florence	7	5	2	..	3	4	..	..	6	1	2	5	..	1	..
Forest	12	5	7	..	7	5	..	..	8	4	2	7	3	4	..
Iron	10	6	4	..	6	2	2	5	3	2	3	6	1	5	1
Langlade	12	5	5	2	5	3	4	..	1	11	3	4	5	5	..
Lincoln	9	1	4	4	..	4	5	..	..	9	..	3	6	5	..
Marathon	2	..	..	2	..	..	2	..	..	2	..	1	1	..	..
Marinette	7	4	3	..	3	4	..	..	4	3	..	5	2	3	..
Oconto	4	2	2	..	1	3	..	..	2	2	1	1	2	..	..
Oneida	10	3	7	..	2	5	3	..	7	3	1	6	3	7	..
Polk	3	1	2	..	..	2	1	..	2	1	..	3	..	..	1
Price	13	9	4	..	4	4	5	..	4	9	4	4	5	8	..
Rusk	7	4	3	..	..	2	5	..	..	7	..	3	4	2	..
Sawyer	14	10	4	..	6	5	3	..	14	..	7	3	4	7	..
Taylor	4	..	4	..	..	1	3	..	..	4	..	1	3	2	..
Vilas	15	9	5	1	6	6	3	3	10	2	4	9	2	8	3
Washburn	7	2	5	..	3	4	..	..	6	1	..	3	4	..	..
Total	209	121	78	10	76	73	60	17	116	76	50	96	63	85	6
CENTRAL															
Adams	6	..	6	..	..	1	5	..	1	5	1	2	3	..	..
Clark	1	..	1	..	..	..	1	..	..	1	..	..	1	1	..
Eau Claire	4	..	1	3	..	..	4	..	..	4	..	2	2	2	..
Jackson	11	..	5	6	..	..	11	..	4	7	..	7	4	5	1
Juneau	7	..	5	2	..	..	7	..	2	5	..	5	2	3	..
Monroe	1	..	1	..	..	..	1	..	..	1	..	1	..	..	..
Wood	4	2	2	..	..	2	2	..	..	4	..	2	2	..	..
Total	34	2	21	11	..	3	31	..	7	27	1	19	14	11	1
AGRICULTURAL															
Door	4	3	..	1	2	..	2	..	..	4	1	1	2	1	..
Fond du Lac	5	..	1	4	..	..	5	..	..	5	..	..	5	3	..
Total	9	3	1	5	2	..	7	..	..	9	1	1	7	4	..

*Abbreviations: P—poor, M—medium, G—good; EX.—exceeds carrying capacity, EQ.—equal to carrying capacity, L—less than carrying capacity; T—tight, P—partial, S—scattered; H—heavy, M—medium, L—light.

APPENDIX H

The 1953 Key List of Winter Deer Yards

Yard No.	Area, County, & Yard Name	Location: Township	Range	Sections
NORTHERN AREA				
	Ashland			
1	Mineral Lake	44N	4W	14-17, 21, 22
8	Moose Hill	42N	3W	5
		43N	3W	29-32
6	Spider Lake	43N	4W	2-4, 9, 10
		44N	4W	34, 35
141	Spilleberg Creek	43N	2W	29-32
142	Brush Creek	43N	3W	9-11
148	Dead End	43N	3W	35
546	N. Madeline Island	51N	2W	28, 33
548	Reservation	51N	2W	33
	Bayfield			
7	Flag	49N	7W	5-8
		49N	8W	1
		50N	7W	30, 31
		50N	8W	25, 36
8	Ole Lake	48N	8W	3, 4, 8-10, 16, 17
10	Grandview	45N	6W	7-10, 14-18
18	Bark River	51N	6W	4
19	Sand Point	51N	5W	1, 11, 12, 14
21	N. Pikes Creek	50N	4W	9, 16
22	Onion River	50N	4W	31
		50N	5W	26
24	W. Barksdale	48N	5W	19
210	Upper Ghost Lake	43N	5W	20, 21, 28, 29
214	Branch of 18 Mile Ck.	45N	6W	29-32
561	Reefer Creek & Iron R.	49N	9W	14-16, 21, 22, 27, 28
575	Pike River	46N	7W	14, 22, 23, 25, 26
593	Siskowitt River	51N	6W	32
	Burnett			
25	Kohler-Peet	40N	18W	13, 14, 19-23, 27-30
26	Clam River	40N	17W	19, 20, 29, 30
162	Hell's Hole	38N	15W	25, 26, 35, 36
163	St. Croix River	42N	14W	17, 19, 20
707	Cowan Creek	38N	19W	6
		38N	20W	1, 12
		37N	19W	31
		37N	20W	36
---	Powell Swamp	37N	20W	2, 3, 10, 11
		38N	20W	34, 35
---	Riegel	39N	19W	1
		40N	18W	31
		40N	19W	25, 35, 36
	Chippewa			
306	Marsh Miller	31N	8W	17, 20, 21, 28, 29
	Douglas			
29	Lyman Lake	46N	13W	9-11, 14, 15
30	Moose River	45N	13W	11-14
31	Moose Lake	45N	12W	5-8, 18
		45N	13W	1, 12, 13
32	Brule Headwaters	45N	11W	7, 8, 17, 18
33	Cedar Island	46N	10W	3, 10, 15
		47N	10W	34
37	Bear Creek	45N	14W	2, 3, 10, 11, 14
38	Chaffey	45N	14W	6, 7, 18
		45N	15W	1, 12, 13
39	Arnold Creek	44N	13W	26, 34, 35
42	Mouth of the Brule	47N	10W	10, 15, 22, 27

Yard No.	Area, County, & Yard Name	Location		
		Township	Range	Sections
43	Bellwood	47N	10W	4-6
		48N	10W	31, 32
164	Buckley Creek	43N	13W	16, 17, 20, 21
166	Crotte Creek	44N	13W	4-8, 17, 18
		44N	14W	12, 13
173	Brule River Group 10	46N	10W	16, 20, 21, 28-30
---	Brule Point	49N	10W	2, 11-14
	Florence			
48	Sand Lake	38N	18E	20, 29
51	Savage Lake Township	39N	16E	2, 3, 7-11, 17, 18
53	Woods Creek	39N	16E	19, 22, 24
54	Patten Lake	39N	16E	13
		39N	17E	18
175	South Popple River	38N	15E	28-33
177	Goodman Lumber Co.	39N	17E	3, 10, 11
		40N	17E	32, 33, 34
619	Morgan Creek	38N	16E	6, 7, 18
	Forest			
57	Camp Scott Refuge	38N	13E	2-4
		39N	13E	32-34
58	Pine River	40N	13E	17, 18
60	Schabadock	35N	16E	7
179	N. Camp Scott Lake	38N	12E	1-4, 9-12
		38N	13E	7, 8
185	Newald	38N	14E	29-32
187	Allen Creek	40N	14E	3, 4, 9, 10
		41N	14E	26, 27, 34
188	Riley Spring	35N	14E	18
		35N	13E	13
219	Zepp Road	39N	13E	1, 2, 11, 12
222	Hay Meadow Creek	40N	12E	32, 33
319	Wildcat Creek	40N	13E	33, 34
323	Hanson	37N	15E	23-26
329	Hemlock Lake	34N	13E	4
		35N	13E	33
331	Range Line	34N	14E	13, 24, 25, 31
	Iron			
65	Mercer Refuge	43N	4E	21-23, 26-28, 33-35
69	McDermott Lake	41N	3E	29-32
77	Randall Lake	41N	4E	17-20
80	Manitowish River	42N	3E	13, 24-26
		42N	4E	18, 19, 30, 31
190	Pleasant Lake Tower	43N	2E	20, 29-31
192	Hewitt Lake	44N	4E	9-11, 14-16
335	Black River	44N	3E	1, 2, 11, 12
337	Ihlenfeldt	43N	2E	11, 14, 15
	Langlade			
86	Ormsby	33N	10E	18-21, 28-33
341	Prairie River	34N	9E	12, 13
		34N	10E	7, 18
342	Elcho	34N	10E	14, 15
346	Hollister	32N	13E	11, 12
347	Nine Mile Creek S.	32N	14E	29-32
348	Elton	31N	13E	1-3, 10, 11
349	Hayes	31N	9E	2, 3, 10, 11
		32N	9E	34-36
659A	Pearson Lake	33N	12E	7
659B	Nine Mile Creek N.	33N	14E	20-22, 29-32
	Lincoln			
350	Hay Creek	35N	5E	11-14
352	Lost Lake	35N	7E	6
353	Hanlson Flowage	35N	8E	9, 10, 15, 16
356	Wilson School	35N	5E	31, 32
359	Rib Lake	33N	4E	23, 25, 26, 35
360	Averill	33N	5E	28, 29
361	Camp 2	32N	7E	15, 16
662	No Name	32N	4E	16, 21
663	Corning	31N	4E	3, 4, 8, 9
	Marinette			
87	Long Swamp	37N	18E	3, 10, 15
366	"G" Lane	36N	17E	8, 9, 16, 17
370	Miscauno Creek	36N	20E	13, 14, 23, 24

Yard No.	Area, County, & Yard Name	Location		
		Township	Range	Sections
373	Porcupine Lake	35N	17E	4, 5
		36N	17E	32, 33
382	Bean's Camp	35N	18E	28, 32, 33
384	Newton Lake	33N	19E	4, 5
393	Begley	31N	22E	14, 15, 22, 23
	Oconto			
397	Thunder River Springs	33N	16E	1
		33N	17E	5-8
398	Wheeler	33N	17E	10, 11, 15, 22
402	Hell's Half Acre	32N	15E	21, 27, 28
406	Peshtigo Brook	31N	18E	2-4, 9-11, 16, 17, 20, 21, 29-31
	Oneida			
90	County Line	36N	11E	25
92	Tomahawk River	38N	5E	10, 11, 14, 15, 22, 23, 27
93	Enterprise Swamp	35N	9E	1-24
226	Rainbow Rapids	38N	8E	4-8
		39N	8E	31, 32
227	Squirrel Lake	39N	4E	24, 25
		39N	5E	19, 30
233	Squaw Lake	39N	4E	7, 8, 17, 19, 20
270	Bear Creek	37N	5E	1, 12
		37N	6E	5, 7, 8
276	S. of Willow Bridge	37N	4E	15, 16, 21, 22
413	McNaughton Swamp	37N	7E	1
		37N	8E	5, 6, 7, 8
416	Sugar Camp	38N	10E	7-9, 17, 18
	Polk			
708	McKenzie Creek	36N	16W	1
		37N	15W	19, 30, 31
		37N	16W	24, 25, 36
709	Rice Beds Creek	35N	15W	29-32
---	Sand Creek	37N	14W	6, 7
		37N	15W	1, 12
	Price			
98	Jump River	36N	2E	13, 14, 23, 24
		36N	3E	17-26
149	Pike Lake Firelane	39N	3E	23
150	Pike Lake	39N	3E	12, 13
152	Cochran Lake	40N	3E	3, 4, 9-11
155	Spur Lake	39N	1E	10, 11, 14, 15
195	Elk River	38N	3E	19, 20, 29, 30
197	Long Lake	38N	2W	5, 6
		39N	2W	29-32
223	Kubis Cuttings	34N	1W	11
263	Little Ck. of Flambeau	39N	2E	4, 5
		40N	2E	32, 33
419	Bass Lake	40N	2W	15
	Rusk			
206	Ladd Creek	36N	4W	2, 11
239	Baker	34N	3W	10, 11, 14, 15, 22, 23
425	Nail Creek	36N	6W	4, 5, 8
426	N. Skinner Creek	36N	3W	3, 4, 9, 10
431	Twin Creek	35N	7W	25, 26, 35, 36
434	Pine Island	33N	7W	11, 14
	Sawyer			
109	Chief River	41N	7W	22, 23, 26, 27
110A	Totogatic Group A	42N	9W	7
110B	Totogatic Group B	42N	9W	2-4, 9-11
112	Hackett Creek	37N	3W	8, 9, 15, 16, 21-23, 27, 28
114	Sisabagama Lake	38N	9W	3-5
		39N	9W	29, 32-34
117	Star Lake	42N	6W	4, 5, 9
118	Ojibwa (Pipestone)	39N	6W	21-23, 27, 28
202	Hay Creek	41N	6W	8, 9, 17-20
243	Boss' Cuttings	37N	5W	20, 21, 28, 29
249	Teal Creek	41N	6W	1, 2, 11, 12
436	Chippewa C.C.C.	40N	4W	3, 4
		41N	4W	33, 34
444	33 Creek	37N	9W	25

Yard No.	Area, County, & Yard Name	Location: Township	Range	Sections
	Taylor			
445	Smith Cuttings	32N	2W	7, 8, 18
446	Silver Creek	33N	1E	5-8, 17-18
447	Mondeaux	33N	1W	23-26
449	Beaver Creek Refuge	31N	3W	11, 13, 14, 23, 24
	Vilas			
124	Between Boulder J. and "B"	42N	7E	2-4
		43N	7E	33
125	Palmer Lake	42N	8E	15-17, 20-22
127	Little Crooked Lake	42N	6E	1, 2, 11, 12
128	Trout River	41N	6E	14, 15, 22, 23, 26, 27
130	Partridge Lake	42N	8E	28-34
262	Star Lake Camp	41N	8E	22
253	Mann Lake	41N	7E	31, 32
256	Mishonagen Swamp	40N	5E	25, 26
		40N	6E	29, 30, 31
257	Lost Lake	40N	8E	9, 16
261	Lake Flora	43N	7E	19, 20, 30, 31
278	Crab Lake	43N	6E	27, 28, 33, 34
283	Prong Lake	40N	7E	23-26
		40N	8E	19, 30
453	South Turtle	43N	5E	17, 20
462	Stormy Lake	41N	9E	12
		41N	10E	6, 7
	Washburn			
135	St. Paul Overhead	42N	11W	25, 36
137	Stance Brook	41N	12W	22-24, 26, 27
451	Slim Creek	38N	10W	9, 10, 15, 16
452	Bear Lake	37N	12W	27, 28, 33, 34
CENTRAL AREA				
	Adams			
468	Spring Branch	20N	6E	3, 4, 9, 10
470	Dyracuse	20N	6E	21-28
471	Big Flats	19N	5E	1, 2, 11, 12
473	Colburn	19N	7E	21, 26-32
474	Preston	18N	6E	1, 2, 10-15
		18N	7E	7, 8, 17, 18
	Clark			
483	N. Fork Eau Claire R.	26N	4W	5-8
		26N	5W	1, 2, 11, 12
484	Knight Pool	26N	4W	17-19
		26N	5W	13-15, 23, 24
487	Hewitt Refuge	24N	3W	7-9, 16-21
489	Arnold Creek	23N	3W	4, 9, 10, 16
591	Washburn-Sherwood	23N	1E	19-21, 28-33
		23N	1W	22, 23, 25-27, 34-36
	Eau Claire			
485	Horse Creek	26N	5W	25, 26, 35, 36
492	Muskrat Creek	26N	6W	1, 2
		27N	6W	25, 26, 35, 36
494	Black Creek	25N	5W	1-3, 10-12
617	Coon Creek Hotel	26N	5W	31, 32
	Jackson			
495	Waterbury	22N	1W	7-9, 16-18
		22N	2W	11-14
496	White Creek	22N	1W	19, 20, 29, 30
		22N	2W	23-26
499	Morrison Creek	21N	1W	6-8
		21N	2W	1, 12
		22N	1W	31
		22N	2W	36
501	North Millston	21N	2W	2-24, 26
504	Knapp	20N	1W	1-4
		21N	1W	19-36
505	Millston	20N	2W	3, 4, 8, 9, 13-17, 21-24
652	City Point	22N	1E	4-9, 17, 18
		22N	1W	1, 12, 13
654	Ball Island	20N	1E	6-8, 17, 18
		20N	1W	13, 22-24, 26
810	Wyman Creek	20N	2W	28, 29, 33, 34
811	Robinson Creek	20N	3W	17-20, 29, 30
		20N	4W	13, 24
812	Levis Creek	21N	3W	8, 9, 16, 17

Yard No.	Area, County, & Yard Name	Location: Township	Range	Sections
	Juneau			
507	Kingston	20N	2E	10, 11, 14, 15, 22, 23, 27
510	Finley	20N	3E	1, 12
		20N	4E	1-12
511	Beaver	20N	2E	7-9, 16-21, 28-33
514	Sprague	19N	3E	8, 9, 16, 17, 20, 21
516	Cutler	19N	2E	15-22, 28, 29, 32, 33
518	Clearfield	18N	2E	24, 25, 36
		18N	3E	19, 20, 29, 30
	Monroe			
524	Camp McCoy	19N	3W	1, 2, 10-14
527	No Name	19N	1E	13, 14, 23, 24
	Wood			
541	Walker	21N	3E	16, 17, 20, 21, 28, 29
542	South Bluff	21N	2E	13-16, 20-28
A	Van Kuren	22N	3E	25, 26, 35, 36
O	Owl Creek	22N	3E	1, 2, 11-13
		22N	4E	6-8, 17, 18

APPENDIX I

Deer Yard Report Form

WISCONSIN CONSERVATION DEPARTMENT

Deer Management Research Project
Box 191, Ladysmith, Wisconsin

Date:_____

DEER YARD REPORT

COUNTY:_____ NAME OF YARD:_____ YARD NUMBER:_____

Sections cruised_____ Township_____ Range_____

Weather past week: Was it generally (cold), (warm), (variable)*. Temp. today____F.

Snow past week:_____inches. Snow depth in yard_____inches. On edge_____

Snow condition: Is it a (walking crust), (breaking crust), (settled), (light)*.

Weather this date: Is it (clear), (hazy), (partly cloudy), (cloudy), (snowing), (sleeting), or (raining)*.

Yarding appears to be (typical), (partial) or (not yarded)*. Density is (high), (medium), or (low).*

Describe yarding condition and density on the basis of deer sign observed, giving number of fresh tracks or trails observed per mile_____

_____

**Logging:_____ (Yes or No) Type & species_____ Extent_____ Use by deer_____ H.M.L.

**Artificial feeding:_____ (Yes or No) State or private_____ Type_____ Use by deer_____ H.M.L.

Predator sign_____ Live deer observed: Ad._____ Fawn_____ ?_____

Is current starvation evident_____ (yes or no) Do you anticipate starvation losses:

Almost certain_____ Likely_____ Unlikely_____

Carrying capacity: Are deer browsing, on a sustained basis:

Excessively_____ Equal to annual growth_____ Less than annual growth_____

What land management measures could be undertaken here to improve range conditions:____

_____

_____

_____

_____ _____

Signature and Title Signature and Title

(Over)

*Underline appropriate adjective.
** Indicate logging or feeding sites on map sheet sketch.

Browse and Browsing:

Species	1. Avail. to deer (A-C-S-N)	2. Abundance of growth (A-C-S-N)	3. Current browsing (H-M-L-N)	4. Previous Browsing (H-M-L-N)	5. Potential Browse production under existing conditions (G-F-P)
Cedar					
Hemlock					
Red Maple					
Alt. Dog.					
Mt. Maple					
Sumac					
Jack Pine					
White Pine					
R. O. Dog.					
B. Ash					
Hard M.					
Aspen					
Juneberry					
Oak					
Willow					
Holly					
Swt. Fern					
Hazel					
Balsam					
N. Pine					
Spruce					
Elm					
Alder					
Beech					
Ironwood					

(A) Abundant (C) Common (S) Scarce (N) None
(H) Heavy (M) Medium (L) Light
(G) Good (Reason) (F) Fair (P) Poor

REMARKS:_____

_____

_____

_____

_____

_____

Rev. 1/52

APPENDIX J

Habitat Management Agreement Between Wisconsin Conservation Department and U. S. Forest Service

The paragraphs quoted below are the significant portions of an agreement between the Wisconsin Conservation Department and Chequamegon National Forest concerning cooperative deer yard management on U. S. Forest Service lands. This material is taken from a memo dated September 9, 1952 to Chequamegon Forest rangers from the forest supervior.

"Deer yards to be considered in management plans have been located . . . on all Districts except the Medford, where management work is not considered necessary at present. Yards will be located there as deemed necessary and the following policy will apply.

"Within the deer yards, . . . and strips 10 chains wide surrounding them, management needs under the P. R. Project for deer browse production will take precedence over timber production needs. This does not mean that no timber sales will be made in these areas. Except for small conifer 'islands' which the Project Leader will designate to be left uncut for deer cover, timber sales may be made as in the rest of our area. We will cooperate with the Project Leader in making small sales in these areas which he deems desirable from the standpoint of deer management, to the extent practicable. Modifications of the Forest slash disposal requirements will be permitted on such sales as recommended by the Project Leader.

"Other management measures planned in these areas will be described . . . and submitted by the Project Leader in triplicate for approval by the District Ranger concerned and the Forest Supervisor prior to initiating the work. Such measures will include:

a. Discing to stimulate reproduction in sparse stands.

b. Thinnings for the purpose of stimulating deer browse production. No conifers will be cut in such thinnings. No thinnings will be made in mature or near mature stands which have sale possibilities within the near future. Thinings in young hardwood stands may be heavier than desirable from a silvicultural standpoint, but well formed dominant and codominant trees of the following species in order of priority will be favored for leaving:

1. Yellow birch
2. Basswood
3. White ash
4. Sugar maple
5. Oak
6. Paper birch
7. Red maple
8. Elm
9. Black ash
10. Aspen

c. Cull trees (those with an estimated sound content of less than 33⅓% of the total scale) may be cut to provide immediate browse, or girdled to create openings for browse production.

"After sufficient information has been gathered from present experimental management work, long range management plans for each permanent deer yard will be prepared.

"Insofar as possible, artificial deer feeding will be eliminated. It must be recognized, however, that emergencies do occur which will require feeding. In such cases feeding will be used to relieve a temporary condition and not used as a regular dole in certain yards."

APPENDIX K

Project Publications

This listing contains titles of publications that are wholly or in major part about activities of the Deer Project. Most of the authors were project employes or supervisors. All titles up to January 1, 1955 are listed.

Anonymous. 1945. Chambers Island. Wis. Conservation Bull. 10(11):3-5.

————————. 1946. Deer feeding. Wis. Cons. Bull. 11(8-9):28-30.

————————. 1948. Chambers Island recheck. Wis. Conservation Bull. 13(5):5-10.

Cramer, H. T. J. 1948. Harvest of deer in Wisconsin. Trans. N. Am. Wildlife Conf. 13:492-508.

Dahlberg, B. L. 1949. Winter deer range conditions, 1949. Wis. Conservation Bull. 14(6):21-24.

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APPENDIX L

Project Personnel

In October, 1940 the Deer Management Research Project, a Pittman-Robertson project (W-4-R), was authorized under the Federal Aid in Wildlife Restoration Act to study Wisconsin's deer problems. Listed below are the personnel who have served with the project. In addition, many other permanent employees of the game management, law enforcement and forest protection divisions of the Wisconsin Conservation Department have assisted with field surveys and other project functions.

Project Leaders

William S. Feeney – Leader 1940-48.

Burton L. Dahlberg – Project Assistant 1941; Assistant Leader 1946-48; Leader 1948-50.

Ralph C. Guettinger – Biologist 1948-49; Assistant Leader 1949-50; Leader 1950-53.

Project Biologists

Ralph C. Hopkins 1941-43; Bernard J. Bradle 1943-47; Felix A. Hartmeister 1943-47; Ralph A. Schmidt 1943-45; Lester M. Berner 1943-44; Bruce P. Stollberg 1945-46; Ralph B. Hovind 1946-47; Frank H. King 1946-47; Clifford H. Bakkom 1946; Harry Stroebe, Jr. 1946; James G. Bell 1947-48; Clifford E. Germain 1949-52; John M. Keener 1949-52.

Project Assistants

George A. Curran 1941, 1945; George Ruegger, Sr. 1941-42; Donald G. Allen 1941; Daniel Q. Thompson 1942, 1946-47; Lee Steven 1942-43; Earl T. Mitchell 1942; Norval R. Barger 1943; Arnold H. Buss 1943; George W. Schubring 1943; Myron E. Witt 1943; Oswald E. Mattson 1944; Eugene A. Nelson 1945; Armin O. Schwengel 1945; Clarence Searles 1945; Samuel F. Spahr 1945; Earl A. Carter 1947; Earl Kennedy 1948-50; Henry Loux 1948-49; Grover Q. Grady 1949; Eugene E. Parfitt 1949; Edward A. Przyczyna 1949; Werner L. Radke 1949; Carl Strozewski 1949; Gordon P. Yohann 1949; Richard W. Mihalek 1950.

Stenographers and Clerks

Beverly J. Hilliker 1944-45; Kathryn M. McIntyre 1945-47; Mrs. Mildred LaForge 1947-49; Donna Mae Eighmy 1949; Emma Herrman 1950; Betty J. Peterson 1950-53.