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RESOURCE MANAGEMENT REPORT

(Formerly Fish and Wildlife Management Report)

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(These Reports are for Intra-Departmental Information
and Not for Publication)

DEPARTMENT OF LANDS AND FORESTS

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RESOURCE MANAGEMENT REPORT

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A REVIEW OF THE METHODS IN DEER YARD MANAGEMENT

November 1961

by
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Abstract

The purpose of this review is to present the approach, principles of deer yard management, and the techniques that have been used in dealing with deer yard management problems. The review is largely an expansion of the section on techniques of deer yard management from Gill's (1956) paper, but includes results from publications that have appeared in the meantime.

Introduction

There has been a demand in Ontario during recent years for deer yard management aimed at preventing deer starvation during years of severe snow conditions. The purpose of this review is to present to the game manager the approach and techniques that have been used in relation to deer yard management. The present review is largely an expansion of the section on techniques of deer yard management from Gill's (1956) paper, but includes results from publications that have appeared in the meantime. Other papers worth reading in addition to the above are Gill (1957) and Nelson (1951).

Evaluation of Deer Yards

The first problem the game manager should be concerned with in managing deer yards for food production is the type of food that should be encouraged in the yarding area. It is usually impractical to select the food to be grown in a yard, but it is possible to rate a yard as to its suitability as a wintering area for deer.

Deer yard browse surveys might be used to determine what species are most desirable in the yards, however, it may be very difficult to rate the nutritional value and palatability of the various species of plants fed upon by means of a browse survey. Pearce (1937) states that continuous choice of a plant species does not necessarily indicate "preference" in its strictest sense. Most investigators assume that a species reflects the true "preference" when consistently chosen. Caution should be exercised in determining preference by means of browse surveys since numerous factors tend to obscure the true preference or palatability as revealed by browse surveys. Some of the factors involved are (from Pearce, 1937):

1. Disappearance of the less hardy but highly preferred species after a few years of relatively light browsing.
2. The acceptance of species not particularly preferred due to concentrated populations or winter isolation.

3. Unexplained variation in deer tastes for the same browse species on different ranges.

4. When there is a scarcity of staple species those less preferred are sometimes eaten readily.

5. The habit of deer in sampling nearly everything of an edible nature.

6. The individual tastes of certain deer.

7. The age and rate of growth of browse species results in differences in palatability. Sprout growth is chosen rather than normal woody growth. The preference for sprouts over top material is noticeable on areas where logging has occurred for more than one winter and where sprout growth and newly cut tops are available simultaneously.

Deer tend to select browse having the highest nutritional value (Gill, 1956). Nevertheless, it appears evident from the above that palatability and nutritional ratings arrived at from browse surveys may be misleading.

In spite of the difficulties involved in determining the suitability of browse species, Gill (1956) states the present knowledge of deer food preferences permits the use of certain browse species as indicators of yard condition. For example, "A browse line on cedar and none on balsam fir shows an early stage of overbrowsing. A new browse line on balsam plus an old one on cedar indicates there is trouble. Fawns commonly starve when balsam or other poor foods begin to show a browse line" (from Swift, 1946). Maine biologists rely on the appearance of red maple and balsam fir in appraising food conditions in a yard (Gill, 1956). Balsam fir and red maple tend to be resistant to browsing (Gill 1956, p. 18). In addition, feeding tests have shown that balsam fir and red maple are low quality foods (Banasiak 1961; Dahlberg, Burton and Guettinger 1956; Davenport 1939).

Stoeckeler, Keener and Strothmann (1958) present some preliminary data for determining browse which would result from timber cuttings. This information can be used in conjunction with stand tables to determine the amount of browse which would result from a cutting operation.

General Considerations Prior to Planning

Jenkins (1955) noted in Michigan that deer used cuttings as far as a mile from swamps during the winter. Consequently, they plan deer yard cuttings to include that much area surrounding the designated yards (Gill, 1956). In Northern Maine, deer generally do not wander more than 1/4 mile from sheltering cover to feeding areas. On the other hand, trails up to a mile in length have been noted between bedding sites and logging operations (Banasiak, 1961).

Hardwoods are more valuable food suppliers than softwoods, cedar being an exception, since hardwoods tend to reproduce more abundantly through sprouting and are more resistant to browsing.

Many hardwood cutting operations can be adapted rather easily to provide maximum benefits for game. The total area where deer can be appreciably helped by hardwood cutting is small. Deer yards comprise less than 15 per cent of the total range and are largely in softwood growth with hardwoods abundant only around the edges. Consequently, only a small proportion of the total range is involved (Gill, 1957).

It has been shown in the Lake States that large areas of potential hardwood winter range can not be used by deer due to a lack of coniferous cover (Aldous, 1949). If islands of coniferous cover are left while clear-cutting in extensive conifer stands, deer will use the food produced in the cut-over more effectively; otherwise they tend to use only the edges of the cut-over (Marston, 1942).

Laramie and Dole (1957) suggest a general approach to the problem of deer yard management. It appears the greatest length of edge between softwood cover and hardwood food per unit area of cover, when combined with light cuttings in the heaviest cover, is desirable. Cutting in large groups of 5 to 19 acres, leaving about 1/3 of the volume, helps break up the even aged aspect of a stand. The reservation of uncut strips at least 150 feet in width along water courses in deer yarding areas appears to be most compatible with timber operations; these strips are heavily used by deer, however, it does not pay to extend the cover strips beyond the original yarding area. Cover strips are more effective if they can be left connecting larger compartments of cover or if they protrude from a larger segment of the yarding area.

Gill (1946) recommends that uncut strips 150 to 200 feet wide of mature conifers be reserved along water courses or pond margins in areas where deep snow conditions are experienced as in New Hampshire. The peripherel stands to the cover strips which are composed of mixed growth of hardwoods should be cut every 15 to 20 years to provide a sustained browse supply.

One point should be kept in mind where over-browsed yards exist; that is, no silvicultural treatment can be effective either as a forestry or wildlife measure if such large deer concentrations are present that growth of food is prevented (Latham, 1943).

Principles in the Design of Deer Yard Management Plans which are Coordinated with Timber Management

Deer yard management plans should take into consideration the requirements for deer, the cutting plans of timber operators, deer populations, and hunting pressure (Gill, 1956).

Requirements for Deer

Yard management plans should be designed so food and cover are managed as separate units. The problem then is to intersperse the food and cover units. The reason for separating food and cover into separate units is, the management approach for food differs from that for cover. Cutting may damage cover values but nearly always increases browse production. The purpose of management for food is to provide more browse in present or potential yards by light cuttings within the thickest portions of the stand. The purpose of cover

management is to provide continuous strips of softwoods on at least one side of every major stream and most tributaries. Where cover rather than food is the problem in mixed stands, softwoods should be encouraged (Gill, 1956).

Cutting Plans

Yard planning should precede cutting operations and should take into account the operators intentions in regard to the time of cutting, cutting practices, road layout, etc. In some circumstances it may be possible to plan the layout of access roads to facilitate the movement of deer through the yards and provide access for hunters into deer populations without seriously conflicting with the plans of the operators (Gill, 1956).

Deer Population

Gill (1956) suggests that high food production on areas of low deer population is not warranted since the food is wasted. On the other hand, high deer populations may severely damage tree reproduction after small or light cuts. In North Carolina cleaning, salvage or improvement cuts which removed no more than 40% of the original crown canopy area left small openings of 1/4 acre or less scattered throughout the stand. In this case no desirable tree reproduction resulted since the few deer in the watershed were successfully browsing the reproduction to the ground.

Hunting Pressure

There is no justification to promote high deer populations where they are not going to be harvested (Gill, 1956).

Management in Hardwood Stands

The best time of year to cut is from November through to March. Cutting at this time results in greater and more vigorous sprout growth than at any other time of the year. Cutting in late August through to October is a second choice; sprout production is high in following years and the nutritional quality of the tops is better than at any other season. Cutting during April and May is a third choice; sprout production is still good and fresh tops are made available at a time when deer are in the poorest condition. Cutting is not recommended during June, July or early August since sprout production is poor and the nutritional quality of tops is inferior from cuttings made at this time.

Cutting should be done where browse is scarce or heavily used, or where the presence of more deer is desirable. Cuttings as far as a mile from a yard will be used during the winter (Gill, 1957).

Plans should be made for repeated operations in or near deer yards using small clear-cuts or larger selective cuts. Large clear-cuts including most or all of the yard periphery should be avoided. Sustained browse production requires frequent cutting every 5 to 15 years in some part of a yard (Gill, 1957). Under Wisconsin conditions, it was found that following clear-cutting of old growth the area changed from poor range to good and back again to poor range in ten years (Anon., 1948).

Gill (1957) presents a number of points to consider in selecting trees to be cut.

1. The best sprout growth comes from stumps of the smaller but dominant trees.

2. Sprout production decreases radically with increasing diameter in the case of trees 8 inches to 10 inches DBH. Sprout production is negligible in trees above 16 inches DBH.

3. Sprouting ability decreases rapidly with decreasing dominance in the stand, i.e. from dominant to overtopped or suppressed.

4. Competition from trees left standing can be ignored since it has little effect on stump sprouting.

Trees should be cut so that stump faces are low, smooth, flat, and at an angle to the horizontal. This gives better drainage from stump faces, and limits rot in stumps and sprouts.

Trees should be felled so tops are scattered rather than piled since slash piled on stumps inhibits sprouting and limits browsing on sprouts that do form. Where sprouts need protection from overbrowsing, slash can be piled on some stumps. Slash depth over the stumps should not be over two feet in depth.

Red maple sprouts vigorously. This is followed by the birches, and then hard maple. Beech sprouting may be excessive; if so, cutting should be done to limit sprouting in beech.

Management of Cedar Swamps

Gill (1956) says cedar stands in and near yards should probably be treated the same as the slower growing hardwoods. Where deer populations are moderate to high a fairly large proportion of the stand should be cut, otherwise cedar reproduction may be destroyed by overbrowsing.

Ecology of White Cedar

During the initial stages in the development of deer yard management plans, a considerable amount of attention is usually given to white cedar. Nelson (1951) studied the reproduction characteristics of northern white cedar. Some of the main points of this paper are reviewed here.

Effect of Light

Full sunlight inhibits cedar reproduction; partial and dark shade produces better results. Partial shade produces the most vigorous and rapid germination. Light did not appear to be a critical factor in the field, although observations indicated light was beneficial in increasing the growth of reproduction.

Effects of Temperature

Laboratory tests showed no germination below 18°C and growth was less vigorous at low temperatures. In the field, germination was later on the swamp floor than on rotten logs; temperatures on the swamp floor were also lower than on rotten logs. Late spring frosts were found to kill seedlings.

Effects of Acidity

Laboratory tests showed there was a significant decrease in germination below pH 4.0, although adequate germination was found throughout the normal range of pH values existing in cedar stands. Most forest seeds show a wide range of tolerance to pH and germinate well within the limits of acidity usually found in nature (Baldwin, 1942).

Drainage

Along stream courses there was a definite drop in reproduction within 50 feet of the stream. Beyond this distance reproduction was higher.

Soil Moisture

Moisture appeared to be a relatively important factor. Hardwood litter did not promote germination due to low moisture content. The germination on the swamp floor and decaying logs was higher, however, the moisture content was also higher.

Germinating Media

Germination tests were run with four kinds of germinating media: Organic swamp floor material which consisted of the top inch of organic swamp soil of Rifle peat; logs in various stages of decay, hardwood litter consisting of alder leaves and some red maple litter, and the A_1 horizon of a Trenary fine sandy loam. There were no significant differences between the germinating media tested. Field observations showed logs in various stages of decay presented the best germinating media. Seedlings growing on decayed logs had better developed root systems than those growing on the swamp floor. Germination was later on the swamp floor than on logs, but the temperature on the swamp floor was also lower.

Season of Seed Germination

Seed germination took place mainly during June and the first week of July.

Effective Seeding Distance

It is suggested the best seeding distance is within 40 to 50 feet of seed trees. About 150 feet is the maximum distance when aided by prevailing winds.

Effects of Silvicultural Practices

Bowman (1944) mentions the severity of cutting and site quality influence the character of the resulting stand. Barring fire, almost all productive swamps will reproduce well after cutting. Partial cuts result in better fir and cedar regeneration than clear-cuts, but fir tends to come in more vigorously than cedar (Zasada, 1952).

Nelson (1951) mentions briefly the results of experimental cuttings carried on in Michigan at Bob's Lake and the Cusino Experiment Station. 10 to 14 years after cutting, it appeared the heaviest clear-cuts had favoured alder invasion. Seedling reproduction of cedar increased as the intensity of cutting decreased. Ten to 14 years after cutting there was a good proportion of reproduction in the one to two year old classes. On the other hand, cuts that are too light will hinder regeneration (Skilling, 1959).

Slash had an adverse effect on reproduction. Zasada (1952) found that for most species, soils, and cutting methods there was a consistent trend toward better stocking of reproduction on areas with light to moderate amounts of slash than on those free of or covered with heavy amounts of slash. On the Cusino cuttings (Nelson, 1951) slash piles definitely limited reproduction. Lopping and scattering the slash seemed to inhibit alder invasion to some extent. Bowman (1944) stated that undisposed of coniferous slash remains an obstacle to reproduction for 15 to 20 years after cutting.

Plantings

Results from past attempts in Michigan (Nelson, 1951) and Minnesota (Aldous, 1949) to establish cedar plantations indicate this method of establishing cedar stands is unsatisfactory.

Techniques

Ehrhart (1936) felt that cuttings for food production on winter range were of great importance to deer in the northern parts of their range. Krefting (1941) found red-osier dogwood produced the largest amount of browse on a weight basis while honeysuckle produced the least. On the other hand, mountain maple was the most important species treated in Minnesota since it was the most abundant food available to deer in their winter yards. Ground line and snow line cuttings on mountain maple greatly increased the browse produced by this species, most of which remained available five years after treatment. Neither trembling aspen nor paper birch were recommended for cutting. Deer did not utilize their sprout growth to any extent during the winter, their growth rate was too rapid, and the results obtained did not justify the cost of treatment.

Clear-cutting

Clear-cuttings produce the greatest amount of food per unit area for deer. In Pennsylvania clear-cuts in oak stands produced 45 times as much woody browse as uncut stands and thinned stands produced 14 times as much browse (English and Bramble 1949; Harney 1948). Gill (1956) and Bryan (1950) state the effectiveness

of clear-cuts depends on the size of the area cut and the density of the deer population. Small deer herds use only the edges of large clear-cut areas. On the other hand, large deer herds eat all the new growth on small clearings as soon as it starts, thus creating a non-producing forest.

Thinnings

Thinnings can increase browse production (Cook 1939, Gould 1937, and Trippensee 1948). Morton and Sedam (1938) found it was necessary to remove at least 50 per cent of the crown cover in order to ensure the growth of an adequate under-story. Bryan (1950) in North Carolina found that clear-cuts for browse production produced too much food for deer and very little desirable timber reproduction was expected to become established. On the other hand, cleaning, salvage or improvement cuts which removed no more than 40 per cent of the original crown canopy area left small openings of 1/4 acre or less scattered throughout the stand. No desirable tree reproduction resulted in the latter case since the few deer on the watershed were successfully browsing it to the ground.

Weedings (cleanings)

Hosley and Ziebarth (1935) state the cutting back of undesirable stems provides an abundance of new sprout material for deer food. This, in turn, tends to keep deer from browsing the larger crop trees. Krefting (1941) describes the sprouting characteristics of a number of trees and shrubs based on work done in Minnesota. The following is the information he provides:

Aspen-	Sprouts profusely, grows rapidly, and usually grows out of reach of deer in three years.
Paper birch-	Sprouts vigorously the first season but produces less browse than aspen.
Red-osier dogwood-	Sprouts vigorously and, except for aspen, produces the greatest weight and length of any species studied.
Mountain maple-	This is the best adapted species for cutting back for deer food production. This species usually develops sprouts tall enough to provide food during deep snow and should remain within the reach of deer for at least four years.
Red maple-	Morton and Sedam (1938) report this species spouts vigorously and repeatedly, and abundant deer populations usually keep it down.

Neither yellow birch nor hard maple are considered to sprout well following cutting.

Release Cuttings

Release cuttings made around small conifers allow conifers to grow and provide shelter for deer, and at the same time allow deer to utilize the adjacent hardwood stands (Severinghaus, 1950).

Non-commercial Operations

Gill (1956) suggests that non-commercial operations may be used as an emergency measure for local use during exceptionally severe winters. This approach is likely to be expensive and only small yards could be treated. Cutting and bending or bulldozing down trees and saplings of no commercial value provides browse from tree tops and permits the stumps to send out new shoots within the reach of deer (De Boer, 1952). Mountain maple and red-osier dogwood respond well to cutting and bending. The treatment of paper birch and trembling aspen is not recommended for the following reasons: Deer do not utilize their sprout growth to any great extent during the winter, the rate of sprout growth is too rapid, and the results obtained do not justify the cost of treatment (Krefting 1941).

Use of Logging Slash

Logging slash has been used to protect sprouts and seedlings from heavy deer browsing on overpopulated deer ranges in Pennsylvania (Morton and Sedam 1938). Slash depth should be no more than two feet since slash can hinder all types of tree regeneration (Thornton 1957, and Gill 1957). Grisez (1960) mentions the use of tree toppings in Pennsylvania to protect regeneration and sprouting from deer browsing. Tops should be felled in two's and three's but not on top of each other.

Use of Bulldozer

A bulldozer is a useful instrument for treating deer yards. When properly used, it can usually do the job at less cost than cutting. Costs range from $3.00 to $75.00 per acre, the average being about $20.00 per acre (Gill 1956). Krefting (1953) and Swift (1953) mention that TD-9 bulldozers pulling cut-a-way disks have been used to break up stands of mountain maple and poor quality aspen stands. Gill (1956) mentions this would seldom be practical in yards but might be done on neighbouring eskers or similar types of topography as found in Minnesota and Wisconsin.

Food areas in the vicinity of deer yards can often be made available to deer during the winter by breaking a trail between the yard and the food area with a bulldozer.

Forbes and Harney (1952) present the following recommendations for the use of a bulldozer:

1. A large bulldozer equipped with a hydraulic lift blade should be used. The machine should also be equipped with a power winch and protective devices for the operator and machine.

2. Bulldozing is most effective when done in the spring. The best results are obtained when the work is done after the first frost has

left the ground but before the trees have their complete foliage. If the job can not be done at this time, a second choice is the fall after a prolonged rain.

3. The terrain should be reasonably free of obstacles which might damage the machine. Steep hill sides and swampy ground should be avoided.

4. The site selected for treatment should have a relatively large proportion of good sprouting species. Areas in beech, birch, maple or northern hardwood transition forest types are the best sites.

5. For the quickest job and one entirely satisfactory, trees should be felled in one direction and overrun by the bulldozer after being felled. It does not pay to avoid overruning the trees after they have been felled since insufficient increased benefits are realized.

Plantings

The establishment of cedar stands for food or cover is probably not advisable due to the failures of previous attempts (Nelson 1951; Aldous 1949). On the other hand, belts of deciduous trees through coniferous plantations and strips of conifers through hardwood monotypes would be desirable. The re-establishment of dense coniferous cover, 10 acres in size, in extensive hardwood stands adjacent to traditional deer yards is essential (Gill 1956).

Chemical Herbicides

2,4-D had been used to kill overgrown stems of mountain maple. It is used in the ester form at the rate of 12 pounds of acid equivalent per 100 gallons of oil. The chemical is applied during the early budswelling stage and a DBH height. The resulting browse from spraying is readily used, but spray operations are no cheaper than cutting operations (Krefting, Hansen and Stenlund, 1956). At present the value of 2,4-D is still under study (Krefting, Hansen and Hunt, 1960). A mixture of 2,4-D and 2,4,5-T can be used where a mixture of plant species is to be treated (Carlson 1952). Ammate is a general purpose brush killer and is non selective, however, it is expensive and corrosive to spray equipment. None of the above chemicals are toxic to wildlife if properly applied (Gill 1956).

Controlled Burning

The main use of controlled burning to date has been to keep areas in an open condition, exclude hardwood species (Gill 1956) and increase the protein content of browse regrowth (DeWitt and Derby 1955). Most benefits from burning can be obtained from other practices such as cutting, bulldozing, disking or spraying.

Controlling Damage by Deer

Shick (1955) outlines briefly the methods used to prevent damage to agricultural crops by deer. Many of these are likely to be impractical for forestry purposes except in special cases such as small plantations and nurseries. Fencing has given the best results in the case of orchards and crop-land. Two repellents, "Good-rite Z.I.P." and Diamon "L" Brand Deer Repellent, have been used for agricultural crops but have not been completely successful.

McNeel and Kennedy (1959) used plastic sleeves to protect the terminal buds of plantation pine from deer browsing. The sleeves were applied in the fall to protect the buds during the winter. Light weight plastic, 1/2,000 of an inch thick, known as number 2 was used; $1.00 worth covered approximately 480 trees. 150 to 200 trees spaced 8 feet apart could be covered in an hour.

In Conclusion

The approach and techniques described in this review have been developed through research and experience in management. Many of the techniques presented may not be applicable in every case. It is therefore up to the game manager to select the methods or modifications of them which are best suited to the conditions he has to operate under.

References

Anonymous. 1948. Environment and deer. Wisconsin Conservation Bull. 13(3): 7.

Baldwin, H. I. 1942. Forest tree seed. Chronica Botanica Co., Waltham, Mass.

Banasiak, C. F. 1961. Deer in Maine. Game Div. Bull. No. 6, Dept. of Inland Fisheries and Game, Augusta, Maine.

Bowman, A. B. 1944. Growth and occurrence of spruce and fir on pulpwood lands in Northern Michigan. Mich. Agric. Expt. Sta. Tech. Bull. 188.

Cook, D. B. 1939. Thinning for browse. Journal of Wildlife Management 3(3): 201-202.

Dahlberg, B. L., and R. C. Guettinger. 1956. The white-tailed deer in Wisconsin. Wisconsin Conservation Department, Tech. Wildl. Bull. 14.

Davenport, L. A. 1939. Results of deer feeding experiments at Cusino, Michigan. Trans. 4th North American Wildlife Conf: 268-274.

De Boer, S. G. 1952. Feed 'em - with an axe! Wisconsin Conservation Bull. 17(3): 3-11.

De Witt, J. B. and J. V. Derby, Jr. 1955. Changes in nutritive value of browse plants following forest fires. Journ. of Wildl. Mgt., 19(1): 65-70.

Ehrhart, E. O. 1936. Forest management and deer requirements on the Allegheny National Forest. Journ. of Forestry, 34(5): 472-474.

English, P. F. and W. C. Bramble. 1949. Kill 'em? - Starve 'em? - Feed 'em? Deer eat best forage they can find. Science for the farmer, Penn. State College, School of Agric. Exp. Sta., 61st. Ann. Rept., Bull. 502, Suppl. 3: 7-8.

Forbes, S. E. and J. E. Harney, Jr. 1952. The bulldozer. A tool of wildlife management. Penn. Game Comm., Final Report P-R Proj. 31-R.

Gill, J. D. 1956. Review of deer yardmanagement. Game Div. Bull. No. 5, Dept. Inland Fisheries and Game, Augusta, Maine.

Gill, J. D. 1957. Cutting hardwoods to help deer. Maine Dept. Inland Fisheries and Game, Game Div. leaflet Ser. 1(3): 1-4.

Gould, E. W. 1937. Occurrence of low growing game foods during the old field-white pine-mixed hardwood succession in the Harvard Forest. Master's thesis Harvard Univ.: 1-38.

Grisez, T. J. 1960. Slash helps protect seedlings from deer browsing. Journ. of Forestry 58(5): 385-387.

Harney, J. E., Jr. 1948. The effect of forest cutting practices on deer browse in the chestnut-oak (Quercus montana) type. Master's thesis, Penn. State College: 1-54.

Hosley, N. W. and R. K. Ziebarth. 1935. Some winter relations of the white-tailed deer to the forests in north central Massachusetts. Ecology 16(4): 535-553.

Jenkins, B. C. 1955. Program for improvement and increase of food for deer. Mich. Dept. Cons., Inf. Circ. 90:

Krefting, L. W. 1941. Methods of increasing deer browse. Journal of Wildl. Mgt. 5(1): 95-102.

_______________ 1953. Effect of cutting mountain maple on the production of deer browse. U. Minn., Minn. Forestry Notes No. 21.

Krefting, L. W., H. L. Hansen, and M. H. Stenlund. 1956. Stimulating regrowth of mountain maple for deer browse by herbicides, cutting, and fire. Journal of Wildl. Mgt. 20(4): 434-441.

Krefting, L. W., H. L. Hansen and R. W. Hunt. 1960. Aerial applications of 2,4-D to improve the browse supply for deer. Proceedings, Society of American Foresters: 103-106.

Laramie, H. A., Jr. and Summer A. Dole, Jr. 1957. Experimental deer yard management in New Hampshire. Trans. 22nd. North American Wildlife Conference: 502-520.

Latham, R. M. 1943. Our deer - past, present and future. Penn. Game News 14(9): 4-5, 26-27.

Marston, M. A. 1942. Winter behaviour of deer in Northwestern Maine. Master's thesis, Univ. Maine: 1-53.

McNeel, W., Jr., and J. Kennedy. 1959. Prevention of browsing by deer in a pine plantation. Journal of Wildlife Mgt. 23(4): 450-451.

Morton,J. N. and J. B. Sedam. 1938. Cutting operations to improve wildlife environment on forest areas. Journal of Wildl. Mgt. 2(4): 206-214.

Nelson, J. C. 1951. A reproduction study of northern white cedar. Game Div., Mich. Dept. Cons.

Pearce, John. 1937. The effect of deer browsing on certain western Adirondack forest types. Roosevelt Wildlife Bull. 7(1): 1-61.

Severinghaus, C. W., H. F. Maguire, R. A. Cookingham and J. E. Tanek. 1950. Variations, by age class,in the antler beam diameters of white-tailed deer related to range conditions. Trans. 15th. North American Wildlife Conference: 551-568.

Shick, C. (compiled by) 1955. Controlling damage by deer. Cooperative extension service, Mich. State College, East Lansing, Mich., Game Div., Mich. Cons. Dept., Circ. No. 10.

Skilling, D. D. 1959. Growth of swamp conifers following an improvement cut. U. S. Dept. Agriculture, Forest Service. Lake States Forest Experiment Station, Paper No. 71.

Stoeckeler, J. H., J. M. Keener, and R. O. Strothmann. 1958. Deer browse production from felled trees in the northern hardwood-hemlock forest type. Journal of Forestry 56(6): 416-421.

Swift, E. 1946. A history of Wisconsin deer. Wisc. Conservation Dept., Publ. 323: 1-96.

__________ 1953. Modification of forest practices in the Lake States for wildlife habitat betterment. Journal of Forestry 51(6): 440-443.

Thornton, P. L. 1957. Effects of cutting methods on advance reproduction in two mature mixed coniferous swamps in Upper Michigan. Journal of Forestry 55: 448-451.

Trippensee, R. E. 1948. Wildlife management. McGraw-Hill Book Co., New York, ed. 1.

Zasada, J. A. 1952. Reproduction on cutover swamplands in the Upper Peninsula of Michigan. U. S. Forest Service, Lake States Forest Experiment Sta. Paper No. 27.

AN ECOLOGICAL STUDY OF NORTHERN MICHIGAN DEERYARDS*

by
Louis J. Verme

Abstract

This paper reports the progress of deer yard research at Cusino Research Station in northern Michigan. Studies indicate that the quality of winter shelter, rather than availability of food, is the determining factor in selection of yarding areas by deer. A combination of food producing timber types and shelter producing timber types in close proximity seems preferable to a single timber type providing both food and shelter. An empirical classification of deer yards, ranging from good shelter areas (Type I) to good food areas (Type VI) along with others (Types VII and VIII) is included. Management practices recommended are clear cutting at 15-20 year intervals, use of strip cuttings, and maintenance of cut size at from 40 to 160 acres.

In the Upper Peninsula of Michigan we are often perplexed by the seemingly irrational behavior of deer (Odocoileus virginianus) with respect to selection of winter habitat. For example, there are certain areas of apparently excellent range which are devoid of or sparingly used by deer. In many instances highly preferred white cedar (Thuja occidentalis) is very abundant "down-to-the ground". In contrast, however, there also are numerous situations of surprisingly high deer populations utilizing ranges which are in heavily overbrowsed condition. Less frequently we find yards which support sizable populations of deer in relatively good physical condition overwinter due to a high carrying capacity potential. The question, therefore, is what range components or circumstances are responsible for the differential range use noted.

In conducting this study I was attempting to discover some "common denominators" useful in appraising the ecological factors determining selection of yards by deer in winter. The problem of range analysis is very complex because of the great variety of habitats found within yarding areas. The meaning or nature of the terms deeryards and yarding are poorly understood, largely because they vary with local conditions. The findings of this study are based mainly on (1) detailed habitat analysis on four 160-acre study areas (40 plots in each), (2) range appraisal in 25 randomly selected sites (8 plots in each), (3) ecological observations along 80 miles of perimeter for 35 sections partly or wholly in the yard, and (4) data from 7 weather stations (snow depth and temperatures) dispersed in the area. Because of the preliminary nature of the study, the rather large amount of quantitative data collected was of limited value from the standpoint of statistical analysis, thus the report consists of an empirical ecological study.

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Study Area

The area selected for study is located a few miles east of Shingleton, Michigan, and extends northward for a considerable distance. The approximately 40 square-mile lowland swamp is sub-divided into roughly 4 geographic and locally-named units. From south to north these include the Star Siding, Petrel Grade, Cusino, and White Rat Grade areas. The Cusino area has been investigated intensively in the past (Davenport, 1939; Nelson, 1951; Davenport, *et al.*, 1953 and Switzenberg, *et al.*, 1955). Deer research currently in progress at the Cusino Wildlife Experiment Station, near Shingleton, largely is being conducted at the Petrel Grade and Star Siding areas.

At least six classes of organic soil have been identified in the study area (Veatch, *et al.*, 1929), varying extensively in acreage, distribution, and intergradation. Many types of mineral soil also occur. Organic soils vary extensively in physical and chemical properties, ranging from loamy or granular muck (Carbondale) to fibrous, undecomposed peat (Greenwood), alkaline to highly acid in PH, and from 1 to 10 feet in thickness of deposits. Water tables normally are 0 to 2 feet below the surface; consequently, drainage varies from poor to moderate. Organic soil types are important, because each promotes more or less distinct vegetational communities. In addition, many forest mixtures or ecotones occur, especially where organic and mineral soils intergrade.

The study area lies in the deep snow belt of the Upper Peninsula of Michigan. A total snowfall of about 200 inches is not uncommon. Snow generally covers the ground from mid-November to mid-April; frequently later and/or earlier. Much of the snow falls in December and January, with maximum accumulation of from 2 to 5 feet in February and March.

Mean temperatures are below freezing from November through March. Sub-zero weather is common in mid-winter, with temperatures as low as -40° F recorded inland (away from the maritime influence of Lake Superior to the north). Minimum-maximum temperatures in mid-winter often differ only slightly due to the generally present cloud cover.

Winter winds are mostly from the north and northwest. High winds are common, although not particularly severe, except during occasional blizzards. At such times there is considerable drifting of snow in unsheltered sites.

Under these weather conditions deer are usually tightly yarded from at least January through March, or roughly for a period of 100 days.

Forest types, or plant associations, within the study area vary to a marked degree due to natural edaphic differences and extensive prior logging and/or fire. As a result the land has a very complex ecology. Deeryard habitat essentially consists of sites in swamp conifer timber. Species in high to low abundance are white cedar, balsam fir (*Abies balsamea*), black spruce (*Picea mariana*), and

tamarack (Larix laricina) for softwoods. Swamp hardwoods also occur, frequently in high abundance, intermixed with conifers. In descending order of importance are red maple (Acer rubrum), paper birch (Betula papyrifera), black ash (Fraxinus nigra), and three species of aspen, mainly Populus balsamifera. Deciduous shrubs of many species usually occur in abundance in the understory. However, microsite conditions appear to regulate the distribution and density of these plants. Species of value as browse consist mainly of striped maple (A. spicatum), willow (Salix spp.), and red-osier dogwood (Cornus stolonifera). Speckled alder (Alnus rugosa) is widely distributed and frequently in high abundance; however, it ranks low in nutritive value.

Northern hardwoods generally are found on the uplands surrounding the lowlying sites, and in small "islands" on mineral soil within the swamp proper. These stands also vary, although they commonly consist of densely stocked even-aged pole-sized sugar maple (A. saccharum) mixed with beech (Fagus grandiflora), elm (Ulmus americana), and hemlock (Tsuga canadensis). Many other species also occur, adding significantly to the very heterogeneous environments.

The systematic appraisal of the area was of value in further refining the classification of deeryard habitats into the eight major types (forest associations or successional stages) that are presented in Table 1. I feel that the breakdown of yards into more finite ecological entities is an essential first step in interpreting the interrelationship of food and cover, hence the value of winter range for deer.

Discussion of Findings

Ecological Aspects of "Deerless" Areas: The swamp conifer sites at Star Siding and White Rat Grade are outstanding examples of "deerless" habitats. These areas are located at the extreme south and north extensions, respectively, of the overall swamp. Forest type and habitat conditions are essentially the same for both units, consisting primarily of all-aged, mature stands predominantly stocked in white cedar. Black spruce, and to a lesser extent balsam fir, are important co-dominants, while tamarack and white pine (Pinus strobus) are interspersed throughout. These stands are fully stocked at roughly 180-200 square feet of basal area per acre. Much of the timber, especially white cedar, is large and overmature, ranging from 9 to 15 inches in d.b.h. Height of the main overstory varies according to size classes of trees and species present. Tree crowns normally extend from 30 to 60 feet above ground. However, canopy closure is very irregular due to the all-aged nature of the stand. As a generalization, overstory closure is only 50-75 per cent complete. Based on these gross characteristics, I have classified the habitat as Class III deer range (Table 1).

White cedar browse is available on the seedlings and saplings which occur in clumps in openings or are scattered throughout the stand. Because of incomplete crown closure (and lack of browsing) many of the large trees also have foliage available at ground-line. Logging operations in late fall have failed to intercept deer enroute to other yarding sites. A mid-winter survey in 1929 by Ilo H. Bartlett indicated a low to locally moderate population of deer was

present at White Rat Grade. Only a few deer overwinter at Star Siding; the population has not increased despite the expanded logging activity in the area.

Early in the study I theorized that nutritional deficiencies might be responsible for the non-use of these areas by deer. The winter diet of deer would consist primarily of white cedar. Feeding experiments in Michigan (Davenport, 1939) indicated that when fed alone this species would maintain deer in good physical condition overwinter. However, similar studies in Wisconsin apparently did not confirm this finding (Dahlberg and Guettinger, 1956). I therefore fed penned deer an unlimited ration of white cedar, balsam fir, black spruce, and speckled alder, the primary browse plants available in the study areas, for 100 days during the winter of 1957-58. Adult and juvenile deer alike came through this trial in good to excellent health, where 90-95 per cent of the food consumed consisted of white cedar. This is not surprising, as deer in carrying capacity studies at Star Siding, similar to those referred to by Davenport, et al., 1953, also come through the winter in good physical condition, where the natural diet consists mainly of white cedar. Penned deer tests on the relative preference, hence indirectly the nutritive value, of white cedar from a high-use area (Petrel Grade) and from Star Siding have not indicated differences in palatability or sustenance value between sites.

There are nutritional considerations other than the value of white cedar, however. Both areas tend to have a high stocking in black spruce. In fact, some adjacent sites approach in appearance the true black spruce type, grading beyond to either the open spruce-heath bog or willow-sedge marsh. These conditions are the natural result of changes in drainage and soil type. The White Rat Grade is underlain by Rifle peat (Veatch, et al., 1929), a relatively coarse woody peat, acid in reaction, and containing little mixed organic matter. Adjacent organic soils consist of Spalding and Greenwood peat which consist of coarse, undecomposed woody material, are very low in pH, and have very high water tables. Organic soil at Star Siding consists of Carbondale muck, which is finely granular, neutral, or alkaline in pH, and relatively well-drained. The adjacent sites, however, consist of Tahquamenon peat and Houghton muck; they are usually water-logged and support vegetation largely of sedges (Carex spp.), grasses (Graminae), and clumps of willow, bog birch (Betula pumula), stunted black spruce, etc. In both areas, therefore, the surrounding sites are not suitable for deer in winter. Transition to upland mineral soils is usually abrupt; hence there is little "edge".

As a possible result of these site influences, there is a general lack of variety and high density of deciduous plants nutritionally valuable to deer. The presence of hardwoods, even in low amounts or of poor quality, adds greatly to the sustenance value of an otherwise pure conifer diet (Davenport, 1939; Gill, 1957a). Deciduous shrubs which grow abundantly in the understory of these stands consist mainly of species that prefer acid, poorly drained soils. These include alder, Labrador tea (Ledum groenlandicum), leatherleaf (Chamaedaphne caliculata), blueberry (Vaccinum spp.), cranberry (V. oxycoccus), shrubby cinque-foil (Potentilla fruiticosa), etc. Sphagnum moss (Sphagnum spp.) commonly occurs in dense mats,

probably due to the edaphic conditions and the comparatively high amount of sunlight reaching the forest floor. It is not entirely unlikely that the presence of these plants may serve as indicators of unsuitability of certain swamp conifer sites for deer in winter.

I am inclined to believe, however, that the main reason deer do not utilize these sites is inadequate winter shelter. Shelter requirements for deer are poorly understood. Research at this Station indicates, for example, that suitable protection from wind may be vital if food is in limited supply. Low temperatures also appear to influence deer behavior in winter (Severinghaus, 1953), and very likely also affect physical condition due to higher metabolic demands (Silver, _et al_., 1959). Great snow depth likewise affects deer during yarding (Bartlett, 1941; Severinghaus, 1947; Gill, 1957a; and others), and may contribute greatly to debilitation and death of deer. Snow conditions vary greatly, however, and the effects of different situations on deer have not been adequately studied (Passmore, 1953).

Casual observations of shelter components in the White Rat Grade and Star Siding study areas lead one to believe that adequate protection is provided. Actually, shelter may be deficient or at least below the level which deer ordinarily require and/or seek. According to Severinghaus (1953), protection from rigorous weather probably is provided by densely stocked conifers with completely closed canopies. Canopy closure at both study areas is well below this level. As a result I suspect there is an excessive amount of wind flow near the ground. Also, there is a greater range in temperature compared to densely stocked conifer stands, probably because the relatively open canopy permits greater warming of air during sunshine and a rapid cooling at night, respectively. According to Darling (1937), red deer in Scotland show daily and seasonal movements which are associated with habitats offering the most uniform temperatures. It is not unlikely that white-tailed deer react similarly to fluctuations in temperature in selecting winter yards.

Snow conditions are not ideal under the canopy conditions present at Star Siding and White Rat Grade, at least from a snowshower's viewpoint. A large amount of the snowfall is not intercepted by the tree crowns. Much of the fall accumulates on windfalls and on small saplings. This results in very uneven, generally mounded, snow cover which make travel difficult. Under these conditions deer may have to make longer, circuitous trails to avoid precarious footing or floundering in deep, lightly supported snow. I also expect that the all-aged, unpruned condition of the stands is not attractive to deer because it does not provide adequate protection from the possibility of predation.

Habitat conditions described above may appear to vary only slightly with respect to environments in areas of high deer use. The subtle differences in food and cover conditions may be important to the survival of the herd, however. I feel reasonably certain that these areas fail to provide one or more of the requirements needed or desired by deer. That is, if the habitats were suitable, they would be occupied in time to the full extent of their carrying capacity. I doubt that a strong attachment, or home range tendency, for other adjacent yards explains the low deer populations at Star Siding and White Rat Grade.

Reasons for Continued Deer Use of Overutilized Range: The area around Cusino is a classic example of an excessively large number of deer utilizing a seriously depleted range. Reasons for the high population in this area, at least between 1920 and 1940, are not too clear. Extensive logging of conifer and hardwood timber in and around the swamp undoubtedly contributed greatly to a rapid increase in size of the herd. Dedication as a wildlife refuge between 1933 and 1939, together with bucks-only hunting season regulations in other years, probably compounded the herd-range imbalance which subsequently resulted.

Environmental conditions in the Cusino yard vary extensively; this probably is the key to why the range is able to support the current moderate density of deer in winter. The swamp conifer forest comprising the major portion of the yard is in an early-mature stage. White cedar accounts for roughly 50-75 per cent of the overstory, mainly in trees 5-12 inches d.b.h. Other conifers and swamp hardwoods are mixed to a large degree, although not uniformly distributed.

An outstanding characteristic of the yard is the variable stocking or patchy nature of the overstory timber. It is difficult to determine whether this is due to site factors, to plant succession following logging, or is the result of severe overbrowsing in earlier years. Shelter or resting cover is provided by dense stands of even-aged pole-sized conifers. While these units generally are not extensive in acreage, the closed canopy provides adequate protection from high winds, low temperatures, and deep snows. Interspersed throughout the area are generally small, often interconnecting, understocked sites. These openings probably resulted from earlier commercial logging activities, plus some experimental timber cutting studies (Nelson, 1951). In outward appearance the area resembles forest conditions following application of the group selection system of timber harvest. I have classified this habitat as Class II type range (Table 1).

The total effect of this variable habitat is that barely marginal shelter and food are found on the same unit of range. The provision of food and shelter in this manner is a range compromise (Gill, 1957b), which, I believe, is undesirable from the standpoint of both deer and the forest. Enough food is available to enable deer to survive overwinter in poor physical condition. The same time, however, the habitat continues to deteriorate in value.

Because of the relatively productive Rifle peat soil, there is a dense understory of conifer and hardwood reproduction and many deciduous shrubs. While some browse is produced under the closed canopy of the mature timber, most of the browse is available to deer in very limited amounts, such as that contained on wind-thrown and snow-bent or broken trees and saplings. The death of trees in this manner further reduces canopy closure in the overstory, resulting in a decrease in effective shelter.

Deer subsist mainly on browse from hardwood reproduction and shrubs. Species composition and density vary throughout the area; the greatest variety and abundance occur in and around understocked stands, and in the open sites. Fortunately, many of the species,

particularly those with opposite branching (Gill, 1957a), are highly resistant to browsing. Because of repeated browsing, much of the reproduction is small and clubby. Most of these stems and shrubs are covered by snow during mid-winter. Nevertheless, due to the close proximity of the food to shelter, deer seek out and often dig up the snow-covered browse throughout the winter. As a result nearly all plants are severely mutilated, dying, or recently killed. Heavy browsing occurs on such low nutritional value softwoods as black spruce, tamarack, and balsam fir, and on the many hardwoods such as alder, black ash, high-bush cranberry (Viburnum trilobum), and red-osier dogwood.

It is obvious, however, that the large herd of deer present could not subsist solely on the browse available in the swamp conifer site. Adjacent areas contribute greatly to the maintenance of the deer population. An appreciable amount of browse is available in northern hardwood stands adjacent to or interspersed as "islands" within the swamp proper (Switzenberg, et al., 1955). The amount of food produced and degree of browsing depend upon the nature of the stands and the distance from heavy coniferous cover. Nearly all seedling reproduction, especially sugar maple, is severely mutilated.

Among the most important of the many other habitats available is the mixed swamp conifer-hardwood stand bordering the east edge of the study area. This Class IV range (Table 1) is of value to deer primarily because of its food resources. Shelter is marginal here due to the presence of hardwoods in the overstory. Ordinarily, deer do not use this area in mid-winter unless they are hungry. A much greater use occurs in late winter when the weather is comparatively mild. Fortunately, sleet storms and thaws during this period often result in the formation of thick snow crusts which support and permit deer to move freely and range widely in search of unbrowsed food supplies. In addition to a limited amount of white cedar, the browse of many preferred hardwoods such as red, striped and sugar maple, provide a nutritious diet for deer in an acute stage of starvation.

Other forest types or habitat conditions also are found in the swamp vicinity, including Class V, VII and VIII range (Table 1), plus hemlock-hardwood stands, openings, and willow-alder-tamarack marshes. Use of these environments by deer depends mainly on the severity of the winter and the amount and type of snow on the ground. In some winters deer are not able to range widely from heavy cover, thus they soon exhaust the local supply of browse. I suspect that mortality from malnutrition occurs at that time, although the extent of such losses is unknown.

The environmental conditions described for the Cusino study area are typical of many other Michigan deeryards. Strict herd control measures are necessary before range improvement through timber cuttings can be effective in restoring the range to a high carrying capacity. Even under reduced population levels, however, range which provides food and shelter in small, interspersed, relatively distinct units in close juxtaposition appears to be undesirable from the standpoint of habitat management.

Factors Contributing to High Carrying Capacity of Deeryards: The high deer density found in the Petrel Grade study area appears to result largely from fortuitous circumstances ofrange which is currently of optimum value to deer. (It also seems likely that the historical deer population "irruptions" resulted from similar habitat conditions). The primary characteristic of the Petrel Grade study area is the excellent provision of shelter and browse on separate units of range. Much of the 160-acre study area is valuable mainly as winter cover. The swamp conifer stand is very heavily stocked at about 180-225 square feet of basal area, and consists mainly of even-aged trees 30-50 feet in height and 3-9 inches d.b.h. The tightly closed canopy (75-100 per cent closure) intercepts much of the snowfall. Snow on the ground, therefore, is level and of low depth, and probably has a high density or water content (Weitman and Bay, 1959). Such snow conditions are quite likely conducive to easy travel as compared to difficult movement in deep, fluffy snow (Bartlett, 1941; Severinghaus, 1953; Gill, 1957a). Temperatures are quite uniform and relatively mild, and the flow of wind seemingly is negligible as compared to sites less heavily stocked or in younger timber. Deer usually bed in the most secluded portions of the stand, generally in heavily stocked sites where trees are in self-pruned condition. Since very little browse is produced here, deer must seek food elsewhere. White cedar browse is available in surprisingly plentiful amounts along the eastern portion of the 160-acre study area. Here the white cedar is smaller (3-6 inches), moderately stocked (roughly 150-180 sq. feet of basal area), and not as yet self-pruned. Deer feed extensively on the foliage available throughout the winter, judging from the large number of heavily-used trails. In a sense, deer are eating their way through the jungle-like, young stand. The reason for the difference in size classes between the two adjacent even-aged stands is not known, although it probably is the result of the logging.

On the northeast portion of the study area there is a finger of Class IV forest which connects with other Class I type stands to the east and north. This neck of timber provides a travel lane between the stands which provide optimum shelter. A moderate amount of food, mainly hardwood browse, is produced in this mixed swamp conifer-hardwood type. Other sites adjacent to the study area are quite varied, consisting of openings, marshes, and stands of northern hardwoods and hemlock-hardwoods. Food and/or cover is available here to a small or great degree, although use by deer depends upon the proximity of browse to good shelter, severity of the winter, etc.

The high carrying capacity of the Petrel Grade to a large extent is due to the occurrence of two stands of immature swamp conifer timber which lie between areas of good shelter. I do not know the origin of these environments, although they seem to have resulted from clearcutting and/or fire 20-40 years ago. These areas generally are well-stocked, largely in white cedar saplings 10-20 feet in height. The Class VI habitat (Table 1) on the west border of the 160-acre study area is heavily used by deer in the winter. Deer shuttle across this area on well-packed trails in traveling between areas of Class I cover approximately 1/2-mile apart. Deer also forage extensively in this area whenever the weather is not too severe. As a result, many of the white cedar saplings are beginning

to show a definite browse-line, although much of the tree-top foliage now is beyond reach of deer. In addition, there is a great amount of hardwood browse produced on this comparatively fertile site (Carbondale muck). Of the many species present, the most important for deer are willow, black ash, red maple, paper birch, aspen, cherry (Prunus spp.), juneberry (Amelanchier spp.) and mountain holly (Nemopanthus mucronata), roughly in that order of availability. These species fortunately are resistant to heavy browsing and resprout prolifically, hence they supply a reasonably stable amount of browse.

Compared to the Class VI habitat, the Class VII habitat found along the south and east border of the study area has a lower level of stocking, the saplings are generally smaller, and the stand contains a lower proportion of white cedar. During severe winters, such as in 1958-59, deer activity ends abruptly at the edge of the heavy cover; however, in mild seasons (1959-60) deer intensively search the area for browse. Much of the hardwood reproduction and shrub growth is snow-covered during the mid-winter period, although many thousands of stems per acre are available early and late in the season.

The key to the high carrying capacity of the Petrel Grade area, therefore, seemingly is due to the wide variety of habitats, which primarily provide either food or cover for deer. The large acreage in each even-aged forest type and strategic location (interspersion) with respect to one another results in optimum situations of range utilization. Future management must take into account a sizable reduction in deer population to prevent range overuse in the habitats most vulnerable to overbrowsing (Class VI and VII). Logging operations should aim at retaining the combination of varied, even-aged stands in the large acreages that presently are available (See "Management" below).

Management Implications

Swamp conifer forests of greatest value as deeryards require a combination of varied, dynamic plant communities, in contrast to static climax situations, i.e., all-aged, mature stands. It is generally agreed that browsed-out deeryards should be cut to restore their cycle of usefulness, namely food production, to deer. There is a notable lack of agreement, however, on the method of handling coniferous swamps from the standpoint of deer and/or timber production. Moreover, in deer management we probably have been overly concerned with food resources *per se*, and have largely ignored other (i.e. shelter) considerations.

At the present time, most deeryarding areas are managed primarily for timber, in which the welfare of deer is a secondary consideration, although deer usually benefit in some manner. Primarily because of the complex nature of the swamps, the most effective or silviculturally desirable method of handling the swamp conifer forest type has not been developed or recognized (Thornton, 1957). The most commonly used commercial cutting methods include clearcutting, diameter or stick limit cutting, and selective cutting, roughly in descending order of frequency. There are many silvicultural considerations involved in obtaining adequate reproduction in

swamp conifer stands in relation to the cutting methods mentioned (Zazada, 1952; Thornton, op. cit.). Adequate regeneration, to the forester, means a desirable stocking primarily of pulpwood species, while to the game manager a satisfactory growth of white cedar may be of paramount importance. White cedar reproduction ordinarily is not too difficult to obtain following cutting (Nelson, 1951); however, method of logging influences regeneration through its effect on the amount of slash, rise in water table, and hardwood competition which follow (Zazada, op. cit.; Thornton, op. cit.).

Single tree selective (partial) cutting is recommended for handling the northern white cedar type for timber production in the Upper Peninsula of Michigan (Day, 1944), while Aldous (1941) suggests gradual selective cuttings that will leave 1/8- to 1/4-acre openings 1/4- to 1/2-mile apart in deeryards when commercial logging is not in progress. In this region I do not believe that deer will utilize all-aged swamp conifer stands, such as described for Star Siding and White Rat Grade, because these habitats do not provide adequate protection from harsh weather, ease of travel, and good visibility needed or sought by deer in winter (Gill, 1957b). Furthermore, I suspect that unless only low deer populations occurred, the amount of foliage removed annually on white cedar stems under 7 feet in height probably would exceed the threshold level of 15-20 per cent determined by Aldous (1952).

Based on my appraisal of the herd-range situation in the Cusino study area, the group selection method of harvesting timber also is undesirable. Because of the small size and scattered distribution of cutting areas, overbrowsing on sapling stock growing adjacent to mature stands valuable for shelter seems almost certain to result if moderate to high deer populations are present.

Diameter and stick limit cutting methods are widely used in this region of Michigan. The chief criticism of these systems is that they usually open the canopy of the stand to less than a 50 per cent closure. Hence, deer will commonly vacate these sites because of inadequate shelter. I have noted many examples of unused swamp conifer habitat where cutting of this type resulted in essentially two-storied stands which are unsatisfactory for deer in winter. A second criticism is that due to economic consideration the trees left often consist of cull conifers and most swamp hardwoods. Consequently, these stands may ultimately convert to the mixed conifer-hardwoods type.

In the northern Great Lakes States the U. S. Forest Service currently is recommending a 3-cut shelterwood system for managing swamp conifer stands for timber production. While there are certain silvicultural advantages in the use of this system, I believe the gradual planned reduction in overstory closure would have undesirable effects on deer. If sizable populations occurred, deer probably would tend to concentrate heavily in the untreated strips of early-mature timber. Thus, the adjacent younger vegetation may be seriously damaged by overbrowsing.

In view of the high range carrying capacity noted for the Petrel Grade area, I believe the best system of handling coniferous swamps for deer should aim at producing pure, even-aged stands mainly in white cedar, Watson (1936) states that it is best to grow white cedar in pure, even-aged stands because form, quality, and growth are better than in mixed or uneven-aged stands. Furthermore, as compared with partial cutting, there is less risk of windthrow in the largest trees. (However, in mixed stands he believes it is best to cut the various species, conifers and hardwoods, as they mature). Watson also recommends clearcutting in strips about 75 feet wide and up to 1/4-mile long, leaving uncut strips of at least the same width until reproduction on the cut-over portion is established.

Unfortunately, clearcutting commonly results in heavy slash deposits which may inhibit stand regeneration (Nelson, 1951; Thornton, 1957). Logging in large acreages may favor invasion of hardwood brush or balsam fir if a rise in water table, hence a change in site conditions, occurs (Zazada, 1952). White cedar is exceptionally slow-growing and about 20 years' age is required before seedlings reach a height of 4 feet on Rifle peat soil (Nelson, 1951). After 20-40 years, depending on the site and whether reproduction resulted from seedling or vegetative means, a large amount of browse is available in even-aged stands, (i.e. the Class VI and VII sites at Petrel Grade.) Beyond this period there is a tendency for densely stocked stands to self-prune, whether or not the foliage has been browsed by deer.

Gill (1957b) believes that a series of small clearcuttings at regular 10-year intervals, timed to cover a deeryard within one rotation, would have effects comparable to a 10-year selective cut over the entire yard (with respect to browse production). Clearcutting in this manner would be highly desirable <u>if</u> the management units are between 40 and 160 acres in size. I believe that even-aged stands of less than 40 acres could be overutilized during the early reproduction period if a high deer population exists nearby. Shape of cutting areas also is important, since narrow units (i.e., less than 10 chains wide) will permit deer to wander throughout the area, hence overbrowsing on the even-aged stock ultimately is apt to result. Cuttings that are larger than one-half section (320 acres) are likely to result in underutilization of browse on white cedar saplings near the center of the stand because of the greater distance from good shelter. At the same time saplings along the periphery may be overused if adjacent dense stands of mature timber concentrate high populations of deer.

Management of white cedar deeryards, according to one worker[1], should aim at converting the present types (generally mixed and/or all-aged) into a stand composed of strips or groups of even-aged cedar (through clearcutting). Preferably, these even-aged groups should have an age differential of 15 to 20 years, and the type should contain 5 different age groups. A rotation age of 100 years is recommended, with intermediate cuts beginning at 40 years, if economic, and continuing at 20-year intervals. In white cedar stands less than 60 acres in size, a reproduction cut following the shelter-wood system at about age 90 is recommended, followed by a harvest cut at age 100-110 years.

[1] Anonymous processed report, organization and date not listed.

I agree completely with the program suggested above. Deeryard management in this manner will provide a sustained supply of white cedar browse, since those units 20-40 or 40-60 years in age will be in optimum condition of browse production. Beyond age 60 these stands will become increasingly valuable for shelter. For proper management the yard should be mapped first and an overall shelter. For proper management the yard should be mapped first and an overall cutting plan designed with the objective of creating the 5 even-aged groups. These groups should be properly distributed so that deer will utilize the range to its maximum potential. That is, units in optimum browse production should be within 1/4- to 1/2-mile (roughly the maximum daily cruising radius of deer in mid-winter, Gill, 1957a) of heavy cover. As a general rule, mature, all-aged stands, or the most seriously overbrowsed range, probably should be clearcut first. It is essential, however, that adequate shelter be left for deer, if nearby cover is deficient or absent (Laramie and Dole, 1957).

If economically feasible, densely stocked white cedar stands should be thinned starting at about 40 years in age. On good sites this results in improved growth of white cedar (Roe, 1947; Rudolf, 1949). Such intermediate cuts will provide additional browse from felled trees at a time when even-aged stands are becoming self-pruned. Thinnings should be light enough to improve vigor and growth of final crop trees without sacrificing shelter value by excessively reducing crown closure. Intermediate cuttings also should aim at removing culls of other conifers, and most swamp hardwoods. Hardwoods often resprout vigorously when cut; hence, the browse will provide the variety needed in the winter diet of deer. The final stands will consist largely of the pure white cedar type if the above practices are carried out.

In conclusion, I believe that higher populations of deer can be carried overwinter in good health with the clearcut (even-aged) system of deeryard management described above than is possible under the selection (all-aged) system. If properly conducted the creation of even-aged stands in 5 age classes will benefit deer by providing white cedar browse generally in plentiful sustained amounts, while at the same time the damage to reproduction by overbrowsing will be minimized. In a recent study, Habeck (1960) reported on changes in micro-habitat conditions in white cedar swamps of northern Wisconsin as a result of winter deer activity. Although it is not stated, I suspect many of the stands examined consisted of the mature, all-aged type. However, in the present report I allude to the fact that the winter deer populations are importantly influenced by the nature of the range. In the past this co-action probably has not been sufficiently appreciated in analyzing habitat (Hamerstrom and Blake, 1939; Webb, 1958; Gill, 1957a). Hence, it seems appropriate to review our earlier concept of herd-range relationships, which primarily has consisted of appraising the deleterious effects of deer on the habitat, to include the influence of forest conditions in determining the suitability of swamp conifer stands for deeryards.

Summary

This report deals with an ecological study of a roughly 40 square-mile swamp conifer forest near Shingleton, in the Upper Peninsula of Michigan. We were concerned with refining the term "deeryard",

and investigating the reasons for differential winter range use by deer within the area. The study was difficult because of the complex nature of the vegetation as a result of differences in soil and forest succession. Coniferous swamps in the areas primarily consist of white cedar, with balsam fir, black spruce, tamarack, white pine and hemlock in decreasing order of abundance. Various swamp hardwoods are interspersed throughout.

Winter weather in this region is quite severe, with below freezing mean temperatures and heavy snowfall from mid-November to mid-April. Deer are tightly yarded from at least January through March, a period of about 100 days.

Based on intensive study and general observations, I believe subtle differences in habitat or envirnomental conditions account for differential range use by deer. The Star Siding and White Rat Grade study areas, generally deerless, appear to be deficient in shelter. These habitats largely consist of overmature, all-aged swamp conifer timber. Conifer reproduction generally is plentiful in all size classes. The irregular, comparatively open canopy does not effectively intercept snowfall, resulting in variable, often deeply mounded snow cover. Wind movement and temperature fluctuations may be excessive. Much of the understory vegetation consists of species which thrive in acid bogs. The black spruce bog type is found in or around the study areas.

The Cusino study area is a classic example of deer population, irruptions and range overuse. Moderate populations of deer still yard in this area. The early high range carrying capacity probably was related to extensive timber cuttings in and around the yard. Continued occupancy by deer apparently is due to provision of both shelter and food on the same range. Cover is provided by dense clumps of even-aged conifers, while browse is available in patches of hardwood reproduction interspersed throughout the area. Additional browse and/or shelter is provided by the diverse, often extensive forest types present nearby. The small, adjacent, distinct units of food and cover found in this yard permit deer to seriously overbrowse available vegetation; browse of value to deer is dead, dying or severely mutilated.

The Petrel Grade area is unique in that a population build-up has occurred in recent years. The high carrying capacity of this yard is due to ideal provision of food and cover on separate units of range. Stands in even-aged conifer sapling stock of value for browse are interspersed between areas of mature even-aged timber which provide optimum shelter. Maximum use is made by deer of the various forest types or growth conditions, which are ideal in terms of acreage and distribution.

Eight more or less distinct forest types or plant associations were found and classified in this study; they are important in the ecology of deeryards because of the complex co-actions between deer and range.

With the knowledge gained in this study, I believe the best method of range management, in terms of sustained carrying capacity at a high level, consists of a clearcutting system of timber harvest. Management of swamp conifer forests valuable as deeryards should be directed toward developing even-aged groups having an age differential of 15-20 years. Hence, 5 different age groups are represented in a rotation of about 100 years. Clearcutting should be made in a pattern of alternate strips, with the strips roughly 66 to 75 feet in width, leaving uncut strips until reproduction in the cut-over areas is established.

Each age group probably should not be less than 40 nor more than 160 acres in size, in order to prevent over- and under-utilization of the range, respectively. The different age classes of vegetation should be strategically-located so that deer will make maximum use of all stands whether for food or cover.

Literature Cited

Aldous, S. E. 1941. Deer management suggestions for northern white cedar types. Journ. Wildl. Mgt. 5:90-94.

_______________1952. Deer browse clipping study in the Lake States region. Journ. Wildl. Mgt. 16:401-409.

Bartlett, I. H. 1941. Snow and Game in northern Michigan. Proc. Central Snow Conf. 1:102-105. Proc.

Dahlberg, B. L. and R. C. Guettinger. 1956. The white-tailed deer in Wisconsin. Wis. Cons. Dept. Tech. Wildl. Bull. 14, 282 pp.

Darling, F. F. 1937. A herd of red deer. Oxford Univ. Press, London, 215 pp.

Davenport, L. A. 1939. Results of deer feeding experiments at Cusino, Michigan. Trans. N. A. Wildl. Conf. 4:268-274.

_________________D. F. Switzenberg, R. C. Van Etten and W. D. Burnett. 1953. A study of deeryard carrying capacity by controlled browsing. Trans. N. A. Wildl. Conf. 18:581-596.

Day, M. W. 1944. Forest management for the eastern part of the Upper Peninsula of Michigan. Cir. Bull. 190, Mich. State College, East Lansing, 22 pp.

Gill, J. D. 1957a. Review of deeryard management, 1956. Maine Dept. Inland Fish and Game, Game Div. Bull. 5, 61 pp.

_____________1957b. Effects of pulpwood cutting practices on deer. Proc. Soc. Am. For., 1957. ?:137-140.

Habeck, J. R. 1960. Winter deer activity in the white cedar swamps of northern Wisconsin. Ecology, 41:327-333.

Hamerstrom, F. N., Jr., and J. Blake, 1939. Winter movements and winter foods of white-tailed deer in central Wisconsin. Journ. Mamm. 20:296-315.

Laramie, H. A., Jr. and S. A. Dole, Jr. 1957. Experimental deeryard management in New Hampshire. Trans. N. A. Wildl. Conf. 22:501-520.

Nelson, T. C. 1951. A reproduction study of northern white cedar. Mich. Dept. Cons., Game Div. Bull. 100 pp.

Passmore, R. C. 1953. Snow conditions in relation to big game in Ontario during the winter of 1952-53. Ont. Dept. Lands & For., Div. Research. Wildl. Res. Report 2, 12 pp. Proc.

Roe, E. I. 1947. Thinning in cedar swamps. Lakes States Forest Exp. Sta. Misc. Report 3, 6pp. Proc.

Rudolph, P. O. 1949. Handling northern white cedar stands for wood and wildlife in the Lake States. Lake States For. Exp. Sta., Misc. Report 3, 6 pp. Proc.

Severinghaus, C. W. 1947. Relationship of weather to winter mortality and population levels among deer in the Adirondack region of New York. Trans. N. A. Wildl. Conf. 12:212-223.

______________________ 1953. Springtime in New York - another angle. What goes on in our Adirondack deeryards. N. Y. State Conservationist 7:2-4.

Silver, H., N. F. Colovos and H. H. Hayes. 1959. Basal metabolism of white-tailed deer - a pilot study, Journ. Wildl. Mgt., 4:434-438.

Switzenberg, D. F., T. C. Nelson and B. C. Jenkins. 1955. Effect of deer browsing on quality of hardwood timber in northern Michigan. For. Science, 1:61-67.

Thornton, P. L. 1957. Problems of managing Upper Michigan's coniferous swamps. Journ. For. 55:192-197.

Veatch, J. O., L. P. Schoenmann, F. R. Lesh and Z. C. Foster. 1929. Soil survey of Alger County, Michigan. U. S. D. A. Bull. 32, 41 pp.

Watson, R. 1936. Northern white cedar, U. S. Forest Service, R-9, 44 pp. Proc.

Webb, W. H. 1948. Environmental analysis of a winter deer range. Trans. N. A. Wildl. Conf., 13:442-450.

Weitzman, S. and R. R. Bay. 1959. Snow behavior in forests of northern Minnesota and its management implications. Lake States For. Exp. Sta. paper 69.

Zazada, A. A. 1952. Reproduction on cut-over swamplands in the Upper Peninsula of Michigan. Lake States Forest Exp. Sta., Station paper 27, 15pp. Proc.

Ecological Classification
of Deeryarding Areas in Northern Michigan

	Class I	Class II	Class III	Class IV
Forest Type	Swamp conifer; cedar 75-100%, pulpwoods & hardwoods 10-25%.	Swamp conifer; cedar 50-75%, pulpwoods and hardwoods 25-50%.	Swamp conifer; cedar 75-100%, other species as in Class I.	Mixed swamp conifer-hardwoods; cedar 25-50%, other species 25-50%.
Stocking	Full, 500-1000 trees/acre, 200-250 sq. ft. B.A.	Full-sparse; 150-200 sq.ft. B.A.; patchy structure, very variable.	Full, 500-700 trees/acre, 175-225 sq. ft. B.A.	Full-moderate; 100-150 sq. ft. B.A., variable.
Structure	Even-aged; 3-12 in. d.b.h., mostly 5-9; 30-50 ft. in height.	Mostly even-aged; 3-15 in. d.b.h., mostly 5-12; 25-60 ft. in height.	All-aged or two-storied; 1-20 in. d.b.h., mostly 9-15; 1-60 ft. in height.	Mostly even-aged; 1-15 in. d.b.h., variable age and structure.
Shelter Value	High; canopy closure 75-100%; uniform, self-pruned.	High-low; variable canopy closure, mostly 50-75%.	Moderate; uneven canopy, closure 50-75%.	Moderate-low; depends on hardwoods composition and stand structure.
Snow	Low depth; level, settled and dense, crusts later, but stronger.	Moderate-low depth; variable density and crusting.	Irregular depth; generally mounded, variable crusting.	High depth; uneven, crusting early but weak.
Travel	Direct; trails easily maintained, unobstructed, high mobility for deer.	Variable; lower mobility than Class I, trails follow heavy cover.	Circuitous; restricted to denser cover, unsure footing.	Restricted; travel difficult in fluffy snow, good when compacted.
Comfort	High; minimal wind flow, slight daily temperature changes.	High-moderate; lower rating than Class I, but locally adequate.	Moderate; relatively high wind flow, daily temp. fluctuate excessively.	Inadequate; generally low night temperatures, excessive wind movement.

Table 1, (Continued)

Protection	High; good seclusion, visibility, escape facilities.	Variable; somewhat less than Class I for dense timber.	Moderate; seclusion adequate, but escape travel difficult.	Moderate-low; visibility obstructed, escape difficult.
Food Value	Low-none; limited browse do to shading by dense canopy.	Moderate-none; varies greatly with stand stocking structure and prior browsing.	High; browse largely unshaded, unutilized.	Moderate-low; varies with stand composition, structure and site.
Conifers	Few bent or broken cedar tops available.	Frequently bent or windthrown cedar and pulpwoods.	Cedar browse very abundant on trees and saplings.	Cedar and pulpwoods often heavily browsed.
Hardwoods	Some seedling-saplings and shrubs, heavily browsed.	Highly variable stocking, wide variety, heavily browsed.	Low abundance and few species, largely of *Ericaceae* and alder.	High-low. Often in high variety and availability, usually heavily used.
Seasonal Use	High throughout winter if next to food producing sites.	High throughout winter; food and cover on same range, hence all plants overbrowsed.	Low-none; marginal shelter and unsuitable habitat.	High, early and late winter, throughout if starvation imminent or winter mild.
Miscellaneous	Primary or first choice yarding concentration area.	Stand will not perpetuate without hard reduction and logging.	Areas usually isolated, transition to bogs and marshes beyond.	Often consist of ecotones or result from overcutting and hardwood invasion.

	Class V	Class VI	Class VII	Class VIII
Forest Type	Swamp hardwoods; often pure or with scattered conifers.	Swamp conifer; cedar 70-90%, pulpwoods and hardwoods 10-30%.	Swamp conifer; cedar 35-75%, other pulpwoods and hardwoods 25-65%.	Ecologically complex; mixed lowland-upland conifers and hardwoods.
Stocking	Full; generally uncut due to low value.	Full; 5,000-10,000 stems/acre, uniformly dispersed or in thickets.	Moderate-low; 1,000-5,000 stems/acre, often patchy.	Fully; usually in mature timber unless heavily cut-over.
Structure	Variable; age and structure depends on site and logging history.	Even-aged, 1-3 in. d.b.h., 10-20 ft. in height.	Even-aged, 1-3 in. d.b.h., 10-20 ft. in height.	Variable; mature even-aged stands common.
Shelter Value	Low-none; hardwoods provide poor overhead cover.	Low-none; overstory cover inadequate height although densely stocked.	Low-none; overstory cover inadequate height, sparse stocking.	High-moderate; varies with species composition and age of stand.
Snow	High depth; level due to low interception, crusts early.	High depth; mounded on vegetation, crusts early.	High depth; level, dense, crusts early.	Low depth; level, dense if crown interception adequate.
Travel	Restricted; deep, often fluffy snow, early in winter.	Difficult; travel hazardous on uneven snow cover.	Restricted; snow trails drift in, good mobility early and late winter.	Direct; trails easily maintained, high mobility.
Comfort	Low; extreme temperature changes and high wind flow.	Low; extreme temperature changes and high wind	Low; extreme temperature changes and high wind flow.	High-moderate; depends on amount of conifers in over-story.
Protection	Low; good visibility, but deer flounder in snow during escape.	Low; poor visibility, deer flounder in snow during escape.	Low; poor concealment, deer flounder in snow during escape.	High; visibility, concealment, escape adequate.

Table 1, (Continued)

Food Value	Low; moderate if preferred browse reproduction present.	High; variety and abundance of browse generally available.	Moderate-low; varies with stocking and composition.	Low; higher if recently cut-over or on good site.
Conifers	Mostly few unpalatable conifers.	Cedar very abundant and available, some stems snow covered.	Moderate cedar unless previously browsed or snow covered.	Few conifer stems in understory unless all-aged in transition to conifer type.
Hardwoods	Quality and stocking varies greatly.	Excellent variety and abundance of preferred species, many stems snow covered.	High density of reproduction, often heavy to alder, many stems snow covered.	Variable; usually low but maples and other reproduction on good site.
Seasonal Use	Low-none; early or late winter use if near good shelter.	High-moderate; all winter use if near good shelter, or weather is mild.	Moderate-low; early and late winter use only unless snow is heavily crusted or winter mild.	High; used throughout winter for shelter if food is available nearby.
Miscellaneous	Type infrequently, found and not too important in yard ecology.	Results from clearcutting and/or fire, immature stage of Class I or II.	Results from clearcutting and/or water table change, or overbrowsing of Class VI.	Limited occurrence; often on organic-mineral soil site as in river bottom.

REPORT ON OPENING OF DUCK SEASON ON OCTOBER 7, 1961, IN LAKE SIMCOE DISTRICT

by
A. A. Wainio, R. H. Trotter and J. S. Dorland

Abstract

For the third successive year personnel from various sections of the Department in the Lake Simcoe District assisted the Fish and Wildlife staff in covering the opening of duck season in Holland Marsh. All access points into the Marsh were patrolled. The hunters began shooting before the opening time, 12 o'clock noon, but during the afternoon and evening they proved very helpful in supplying information. In Holland Marsh, 598 hunters shot 506 ducks giving a hunter's success of .85. A similar coverage was carried out on opening day in Matchedash Bay near Waubaushene. Here, 172 hunters bagged 143 ducks for a hunter's success of .83 ducks per hunter. Recommendations for next year's season include a morning opening rather than the present noon opening on the first day of the duck season.

Holland Marsh

This is the third successive year that the District has carried out a complete coverage of Holland Marsh for the opening day of duck season, which fell on October 7th. As in the past two years, the Department recruited men from Fish and Wildlife, who were in charge of the operation, Parks, Reforestation, County Forests and Severn River Management Unit. The R.C.M.P. patrolled Cook's Bay and Lake Simcoe.

At all the access points into the marsh Department personnel were told to warn the hunters of the 12 noon opening time and try and keep them out of the marsh until 11:30 a.m. Hunters coming to the marsh received a sheet outlining the opening time, closing time and the daily bag limit. Even though the Department personnel were at their posts at 6:00 a.m. Saturday morning, there were some hunters who had arrived earlier and were already stationed in the marsh well before 6:00 a.m.

Because of the dense cattails and other aquatic growth which surrounds the best duck shooting area on the west side of the marsh, it is practically impossible to apprehend hunters who shoot before the opening hour of 12 o'clock noon. When you consider that there are over five hundred men in the marsh trying for their limit of ducks, it goes without saying that if the ducks are disturbed by some trigger happy hunter, it sets off a chain reaction and everyone in the area cuts loose. In areas of such dense cover it would take an army of men to stop the shooting once it gets started. For this

reason, we tried to keep all hunters out of the marsh till 11:30 a.m. This gave them one-half hour to take up their position before the noon opening.

This has worked out quite well for the past two years, but this year we had trouble with impatient hunters who insisted on going into the marsh to get established before 11:30. As we could not legally keep the hunters out, it was decided to let them go at 11 o'clock on the west side of the marsh, where over two hundred hunters were getting very impatient. By 11:30 there was considerable shooting in that area and before noon it had spread throughout the entire marsh.

If we have a noon opening in the Holland Marsh next year, it will be necessary to use a different preventative measure to stop the early shooting. It will take a lot of men equipped with breast waders to get out into the marsh where the shooting takes place. The most practical solution would be to revert back to the one-half hour before sunrise opening and let light be the governing factor. If we could legally keep the hunters out of the marsh till 11:30, the hunters could be controlled by about 20 men to cover all points of access into the marsh.

It was an ideal day for duck hunting with warm sunny weather and a light breeze blowing. Most of the hunters were successful and there were very few violations other than the early shooting. There appeared to be more hunters than last year. More were definitely checked this year, 598, as compared to last year's 269. Table 4 compares the results of the opening day of duck season for the three years, 1959, 1960 and 1961. Far more ducks were shot this year than in either of the two previous years. The Department personnel at the various access points collected duck wings for later identification and study at District Office.

Matchedash Bay

This year as in 1960, duck hunters in Matchedash Bay had warm and sunny weather to greet them, with temperatures ranging well into the seventies. Shooting in the bay began at 11:55 a.m. which must be considered good cooperation on the part of the hunters as many of the access points were unmanned. Twelve officers, four each from Parks, Timber and Fish and Wildlife, manned ten of the more important access points into the bay from 6:00 a.m. until 8:00 p.m. or until the last hunter had returned.

Although large flocks, mostly blue bills, (Lesser Scaup) and Mallards were seen during their morning flights and on previous days, the hunters in the afternoon failed to flush these ducks from the many reed beds that surround the bay. Consequently the harvest must be considered only fair for the opening day.

Number of ducks per hunter - .83
Man-hours per duck harvested - 6.1

All hunters at the manned access points were warned regarding the noon opening previous to entering the marsh. Most hunters who entered the marshes in the early morning to build make-shift blinds, left their firearms on the shore, returning for them previous to the opening. As the day was quite warm, many fishermen in boats spotted the bay throughout the day fishing for pike and bass which were taking the bait offered very well.

The data compiled in Table 3 show Lesser Scaup as the largest species harvested during the opening day. A scarcity of dogs is also noted in the report and may be partly responsible for the poor harvest recorded.

TABLE 1:

Results of Opening Day of Duck Season
October 7, 1961, in Holland Marsh

	Males		Females		Lost	Ducks Identified but not Aged, etc.	Cripples Found
	Adult	Juvenile	Adult	Juvenile			
Mallards	73	14	38	14	14	3	5
Blacks	44	3	15	2	17		
Pintail	11	13	1	4			
Green-winged Teal	31	4	19	7	5	2	
Blue-winged Teal	18	7	7	5		1	
Wood Duck	8	1	5	2	2		
Lesser Scaup	2	1	1	1			
Greater Scaup		1	2				
Ring-necked Duck	1	2					
Hooded Merganser	1	1	1				
Baldpate (American Widgeon)	3	4		6			
Coot	67						
Snipe	5						
Woodcock	1						

Unknown ducks shot - 122
Unknown ducks lost - 169

No. of resident hunters - 584
No. of non-resident hunters - 14
No. of hunters checked - 598
No. of man-hours - 3442½
No. of dogs used - 31
No. of ducks shot - 506
No. of ducks per hunter - .85
No. of man-hours per duck - 6.8

TABLE 2:

Results of Opening Day of Duck Season September 23, 1961, in Brock Township
(Central District)

No. of hunters checked - 64
No. of man-hours - 317

Blacks - 26
Blue-winged Teal - 18
Wood Duck - 9

No. of ducks shot - 53
No. of ducks per hunter - .83
No. of man-hours per duck - 6.0

TABLE 3:

Results of Opening Day of Duck Season October 7, 1961, in Matchedash Bay

	Males		Females			
	Adult	Juvenile	Adult	Juvenile	Unknown	Total
Mallard	3	2	6	4	1	16
Black	7	2	2	4	3	18
Pintail		1		1		2
Green-winged Teal	8		3	2		13
Blue-winged Teal	8	2	5	7		22
Baldpate (American Widgeon)				3		3
Wood Duck	2		1	3	1	7
Ring-necked Duck				6		6
Greater Scaup	2	2	2			6
Lesser Scaup	7	11	9	5	2	34
Common (American) Merganser	11	1	1	3		16
					Total	143

Number of hunters checked in - 147
Number of parties checked out - 74
Number of hunters checked out - 172
Number of parties hunting with dogs- 5
Number of man-hours hunted - 877
Number of ducks harvested - 143
Number of cripples - 25
Number of ducks per hunter - .83
Man-hours per duck harvested - 6.1

TABLE 4:

Comparison of Hunting Success in Holland Marsh in 1959, 1960, 1961.

	Per cent of Bag		
	1959	1960	1961
Mallard	14.5	17.6	31.8
Black	21.0	21.6	12.6
Pintail	4.4	7.6	5.7
Green-winged Teal	25.7	23.7	12.5
Blue-winged Teal	12.4	10.4	7.5
Wood Duck	5.9	6.5	3.2
Baldpate (American Widgeon)	1.5	1.1	2.6
Hooded Merganser	1.8	.72	.59
Unknown	10.4	7.2	24.1
Others	2.4	3.6	2.2

	Overall Summary		
	1959	1960	1961
Number of hunters checked	615	269	598
Number of ducks shot	338	278	506
Number of ducks per man	.56	1.03	.85
Number of man-hrs. per duck	9.2	5.8	6.8
Number of ducks per man-hr.	.11	.17	.15
Number of cripples lost	130	57	207

TABLE 5:

Comparison of Hunting Success in Matchedash Bay in 1959, 1960, 1961

Per cent of Bag

	1959	1960	1961
Mallard	30.2	23.2	11.2
Black	19.5	19.2	12.6
Pintail	.98	.8	1.3
Green-winged Teal	8.8	8.9	9.0
Blue-winged Teal	20.0	10.4	15.3
Wood Duck	5.9	12.8	4.9
Lesser Scaup	7.8	-	23.8
Hooded Merganser	3.9	12.0	-
Greater Scaup	-	6.4	4.2
Ring-necked Duck	.49	2.4	4.2
Baldpate (American Widgeon)	-	-	2.1
Common (American) Merganser	-	-	11.2
Others	2.4	4.0	

Overall Summary

	1959	1960	1961
Number of hunters checked	146	162	172
Number of ducks shot	205	125	143
Number of ducks per hunter	1.4	.77	.83
Number of man-hours per duck	2.9	7.5	6.1
Number ducks per man-hour	.34	.13	.16
Number of cripples lost	40	16	

SUMMARY OF FALL, SPRING AND SUMMER GOOSE AND DUCK KILLS, IN PATRICIA EAST, 1961

by
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Conservation Officer

Abstract

Statistics are presented on the kill of geese and ducks by hunters and Indian families in the James Bay area of Patricia East during 1961. Data were collected by Lands and Forests personnel from two checking stations, licensed hunting camps and from Indian families in the area. A total of 1292 hunters killed 15,200 geese and ducks. Waterfowl killed by Indian families during the fall of 1960 and spring of 1961 was 28,910. The number of kills for the past four years are compared.

Statistics were taken from the check stations at the mouth of the Moose River, Len Hughes' Camp, Fort Albany, Bill Anderson, Fort Albany, James Bay Goose Club at North Bluff, 22 miles along the west coast from Moosonee and Ontario Northland Goose Camp, Hannah Bay, approximately 50 miles east of Moosonee along the east coast. Data were also collected from the Indian families for their fall, spring and summer kills in Patricia East portion.

This year's data were collected as in the past four years, such as; the hunter's name, address, licence number, species and number of kills.

A Patrol activities and collection of data from the hunters and Indian families at the two check stations were carried out by Lands and Forests personnel. Statistics from the licensed hunting camps were collected by the R.C.M.P. personnel.

Peter Kataquapit, Conservation Officer and the writer collected data from all the Indians families from Lake River, Attawapiskat, Fort Albany, Moose Factory and Moosonee areas for the Fall, Spring and Summer kills. Data from each individual Indian were sent to Maple and the District Office with the annual report. A summary of the kills is included in this report.

Convictions

There were five charges laid this fall, all for hunting on the Moose River Bird Sanctuary. A few minor infractions were settled in the field.

All five charges laid were against our local residents, three were white and two were Indians. However, on the whole the hunting regulations were observed by both outside hunters and local people.

Hunting Preasure

Hunting pressure was lighter last spring and this fall by the local Indians, due to the Air Force Base at Moosonee, which is under construction and using approximately 75 local Indians and white status which could only hunt on week-ends. Weather conditions were not too favourable for the treaty Indians last spring, as we had quite a few days of north winds. When the birds were migrating north they took advantage of the favourable winds and the majority went through to their nesting grounds which accounts for fewer kills. The juvenile population was very low this fall, and as yet the cause is not known. Possibly weather conditions and predation might be factors. There was a heavy Snowy Owl migration this fall and in four cases, birds were seen killed by Snowy Owls. Snowy Owls were seen disturbing ducks and geese on the Bird Sanctuary, from the 15th, of October to November 5th, when the birds left for the south.

Forty-two (42) bird bands were collected at the check stations this fall.

Patrols

Goose patrols were carried out extensively by the Department of Lands and Forests staff this fall as the R.C.M.P. did not have the help and equipment required as in previous years.

Weather

Comparing weather conditions for the past five years for goose hunting is as follows:

Seasons - 1957 - fair
1958 - good
1959 - good
1960 - good
1961 - fair

Recommendation

Due to extreme variation among personnel working at the Check Stations and on Patrols, an attempt to provide more consistent results may possibly be reached by using local employees who have a knowledge of the James Bay coast, the surrounding area and the local guides. This would help provide more accurate results.

INDIAN FAMILIES IN PATRICIA EAST PORTION-KILLS FOR FALL, SPRING AND SUMMER

(Data of Summer kills from Treaty Indians are included in the Fall kills.)

SUMMER AND FALL OF 1960 SPRING OF 1961

	Canada Geese		Blue-Snow Geese		Ducks	
	Fall	Spr.	Fall	Spr.	Fall	Spr.
Moosonee	83	836	260	389	4	463
Fort Albany	427	1981	4502	1352	932	645
Attawapiskat	731	2727	6211	3240	1873	723
	1241	5544	10973	4981	2809	1831

1961 DATA FROM MOOSE RIVER CHECKING STATIONS FROM SEPT. 15, TO NOV. 5

	Killed by Licensed Hunters		Killed by Treaty Indians	Totals
Blue Geese				
Adults	1559		3606	5265
Juveniles	521		578	1026
			Geese Salted	61
			Geese Smoked	12
		(*)	10% Added	636
				7000
Snow Geese				
Adults	283		133	416
Juveniles	61		7	68
		(*)	10% Added	48
				532
Canada Geese	71		125	196
		(*)	10% Added	20
				216
Ducks	1176		1179	2355
		(*)	10% Added	236
				2591

(*) For the birds not accounted for such as eaten in the field, wounded birds that were lost, poaching and Quebec Indians killing birds in Ontario 10% of the kill was added as a conservative estimate.

TOTAL GOOSE KILL FROM THE CHECKING STATIONS AND LICENSED CAMPS

Blue and Snow Geese	11477
Canada Geese	316
Ducks	3407
	15200

Number of Canadian Hunters --	615
Number of American Hunters	226
Number of Treaty Indians	480
	1321
Number of Hunters with no kills	172
Total number of Hunters	
	1493

Number of Kills for the Past Five Years from the Moose River Checking Stations and Licensed Camps. 10% Added to Kills.

		No. of Hunters	Fall	Blue-Snow Geese	Canada Geese	Ducks
Check Stations						
	-	809	1957	3504	124	1567
American Hunters	7%	944	1958	7821	166	1329
American Hunters	8%	1034	1959	11557	204	1482
American Hunters	4.6%	1336	1960	11745	296	1824
American Hunters	4%	1150	1961	7532	216	2590
O.N.R. Hannah Bay, including guide kills						
	-	131	1957	1136	31	568
American Hunters	90%	95	1958	1185	10	228
American Hunters	78%	101	1959	924	20	219
American Hunters	81%	145	1960	1663	19	297
American Hunters	52%	155	1961	2777	27	458
James Bay Goose Club						
	-	85	1957	562	10	113
American Hunters	40%	63	1958	797	10	122
American Hunters	40%	68	1959	735	13	166
American Hunters	63%	32	1960	288	11	23
American Hunters	50%	2	1961	6	0	2
Len Hughes, Fort Albany						
	-	107	1957	1038	36	72
American Hunters	80%	97	1958	1142	11	81
American Hunters	81%	101	1959	1039	17	219
American Hunters	78%	103	1960	1286	56	314
American Hunters	77%	111	1961	774	50	208
B. Anderson, Fort Albany						
	-	-	1957	-	-	-
American Hunters	33%	53	1958	370	8	18
American Hunters	51%	41	1959	459	11	68
American Hunters	3%	33	1960	344	5	29
American Hunters	36%	44	1961	388	23	149

CHECKING STATIONS, LICENSED CAMPS AND INDIAN KILLS IN PATRICIA EAST PORTION

	1961	1960	1959	1958	1957
Canada Geese	6022	7850	9097	6685	4124
Blue - Snow Geese ..	27727	33926	31158	30844	22736
Ducks	8121	7414	8067	7963	6229
Total Birds Killed..	41870	49190	48322	45492	33089

FOREST EXISTING IN ONTARIO COUNTIES ABOUT 1885

(Extracted from "Canadian Forests" by H. B. Small, 1885)

Abstract

This brief historical excerpt gives the percentage of forest still existing in the counties of Ontario about 1885. The chief kinds of trees are given as well as their principal uses.

Prescott and Russell

About forty-seven and half per cent of the entire area is under timber, consisting of hemlock, cedar, tamarac, beech, birch, elm, basswood, ash, balsam,pine, spruce, walnut, butternut, whitewood, dogwood, soft maple, and red and black cherry; used principally for lumber, fencing, firewood, railway ties and saw logs.

Glengarry, Stormont, and Dundas

Probably about thirty per cent of the entire area of these counties is still timbered with hard and soft maple, beech, birch, ash, tamarac, elm, basswood, hemlock, spruce, balsam, and some pine; used for fuel, lumber, railway ties, telegraph posts and shingles.

Carleton

About 287,000 acres of land in this county are still uncleared.

Leeds and Grenville

In all the townships, except South Burgess and North Crosby, which have suffered from the ravages of bush fires, there is a large amount of standing timber, consisting mainly of hard and soft woods; used for firewood, fencing, lumber, buckets and pails.

Lanark

About twenty-four per cent of the uncleared land is covered with timber or bush. The timber is chiefly pine, beech, maple, basswood, ash, birch, cedar and tamarac. A considerable export trade in hardwood is carried on, and there is a large local consumption for railway ties, fencing, fuel, etc. A great destruction of pine took place from the great fire in 1870.

Renfrew

About forty-six per cent of the entire area is still timbered. Red and white pine exist in large quantities. There is also an abundant supply of ash, elm, maple, basswood, spruce, cedar, tamarac, balsam, poplar, beech and hemlock. Lumbering is extensively carried on for exportation to European and American markets. The hard woods are chiefly used for fuel and cedar for fencing.

Frontenac

As nearly as can be computed, about fifty per cent of the land in Frontenac is still timbered with pine, basswood, ash, hemlock, beech, balsam, tamarac, cedar and maple; principally used for lumber, fencing and fuel.

Lennox and Addington

Owing to the returns being in several instances obviously inaccurate, the extent of land in the counties under timber cannot be estimated. Four-fifths of Denbigh and associated townships are, however, reported to be under pine, maple, beech and cedar, and lumbering is extensively carried on. There is also a considerable quantity of timber land in North and South Fredericksburg, in Camden and in Sheffield.

Prince Edward County

About sixteen per cent of the entire area is still covered with timber, consisting of beech, maple, elm, cedar, oak, black ash and some pine; used for lumber, fuel, coopers' staves, fencing and building.

Hastings

A large proportion of the acreage is still covered with timber - in some townships to the extent of seventy-five per cent.

Haliburton

About eighty per cent of the entire area is still under timber, consisting principally of maple, beech, birch, hemlock, basswood, elm, ash, pine, tamarac and cedar; used for lumber, fencing, railway ties, telegraph poles, shingles, bolts, saw-logs, etc.

Peterborough

A large proportion - not far short of one-half of the area - is under timber, consisting of pine, cedar, beech, maple, hemlock, basswood, tamarac, birch and ash; used for timber, fencing, firewood, shingles, bolts, railway ties and telegraph poles. Bush fires have destroyed large tracts, particularly in the township of Harvey.

Northumberland and Durham

About eighteen per cent of the total acreage is still timbered with hardwood, cedar, pine, hemlock and tamarac. The former is used principally for fuel, the latter for building, fencing, and barrel staves.

Victoria

Probably about fifty per cent of the uncleared land is under timber, consisting of cedar, pine, hemlock, maple, birch, beech, basswood, black ash, mountain ash, balsam, tamarac, oak and elm; used for lumber, fuel, building and fencing.

Ontario

About seventeen per cent of the area of Ontario is still under timber (excepting the township of Reach, which returns no percentage). The timber consists of pine, maple, beech, basswood, tamarac, balsam, cedar, black ash, hemlock and elm; used mainly for lumber, fuel, fences, staves and domestic uses.

York

About twenty-two and a half per cent of the area of York is still under timber, consisting of beech, maple, elm, basswood, pine, hemlock, cedar, tamarac and birch; used for building purposes, fencing and firewood.

Simcoe

It is impossible to glean from the returns the total acreage under timber, but probably over one-half of the entire county area is under maple, beech, elm, basswood, tamarac, pine, hemlock, cedar, balsam, birch, ash and oak. Lumbering operations are very extensively carried on in several of the townships, and there is a large amount of business done in hemlock bark (which is largely used within the county, and also exported for tanning purposes), and in railway ties, telegraph poles and shingles. The hardwoods are principally used for fuel, and the soft woods for building and fencing.

Peel

About eleven per cent of the entire acreage is still under timber, consisting of beech, maple, hemlock, cedar, white and red oak, ash, elm, hickory and basswood. A few pine are scattered in Chinguacousy and Toronto townships. The timber is generally used for fuel, fencing and domestic purposes.

Halton

About seventeen per cent of the entire area is still timbered, chiefly with hardwood and a limited amount of pine. The timber is principally used for lumber, fencing and fuel.

Wentworth

Fourteen and a half per cent probably under timber consisting of pine, beech, maple, elm, black ash, cedar, tamarac, oak, hickory, walnut and chestnut; used for lumber, firewood, fencing, building and general purposes.

Lincoln

Exclusive of the township of Caistor, which does not report the area of land still timbered, Lincoln has over 24,000 acres still covered with beech, black ash, maple, elm, oak, hickory and some pine; used for firewood, fencing, building and manufacturing purposes, also for ship timber and railroad ties.

Welland

About eighteen per cent of the area is still under timber, consisting of beech, maple, oak, ash, basswood, elm, hemlock, poplar, birch, chestnut, walnut and butternut; used for shipbuilding, housebuilding, fencing and fuel.

Haldimand

About twenty-four per cent of the acreage is still timbered, consisting chiefly of hardwoods; used for fencing, fuel and building purposes.

Norfolk

About twenty-four per cent of the entire area is still timbered, and the standing timber consists chiefly of pine, oak, maple, chestnut, black and white ash, elm and cedar; used for railway ties, lumber, fencing, firewood and general purposes.

Brant

About twenty-five per cent is yet in timber of maple, beech, elm, oak, pine, cedar, basswood, tamarac, hickory and ironwood.

Waterloo

About twenty-two and a half per cent of the area is still timbered with pine, oak, beech, maple, cedar, ash and hemlock.

Grey

About thirty-four per cent of the land is still timbered, chiefly with hardwood. Very little pine exists, and only sufficient cedar for fencing purposes.

Bruce

About twenty-five per cent of the land is timbered. Maple, basswood, elm, hemlock, cedar, ash, beech and birch predominate; there is also some pine.

Huron

About twenty-nine per cent is covered with timber; hard and soft woods.

Perth

About twenty-one per cent is covered with timber consisting of beech, elm, maple, basswood, black and white ash, pine, hemlock, cedar, birch and tamarac.

Oxford

Seventeen per cent under pine, cedar, beech, maple, elm, ash, basswood and oak.

Elgin

Thirty per cent is timbered with most of the indigenous woods excepting cedar.

Middlesex

Thirty-five per cent under hardwood and some pine.

Lambton

Forty-eight per cent covered with oak, ash, elm, beech, maple, basswood, hickory and some pine.

Kent

Thirty-seven per cent in oak, black and red ash, hickory, hard and soft maple, cherry and sycamore, some black walnut and some tulip.

Essex

Two-thirds still under bush, consisting chiefly of whitewood, oak, ash, elm, hickory, bass, sycamore and other woods.

Wellington

About fifteen per cent is still timbered with beech, maple, elm, cedar, hemlock, basswood, ash and balsam.

According to Mr. Ward, Ontario furnishes 4,474,000 pieces, equal to 2,600,000 standard pine logs of 200 feet each, producing 520,000,000 feet of lumber; 6,790,090 cubic feet of white and red pine, or 81,000,000 feet b.m.; dimension timber, 23,000,000 feet b.m.; hardwood, cedar &c., equal to 5,000,000 feet - making in the aggregate 635,500,000 feet b. m.; paying to the Provincial Government for timber dues $501,000, and ground rents $46,000, with eighteen thousand square miles under license.

FOREST AND MOOSE MANAGEMENT IN NORWAY AND SWEDEN

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Abstract

The objective of the paper is to present background information on forestry and moose management and to bring out aspects of their interrelationships. The paper is based on personal observations, made during a 10-day tour of private and state forests, and on literature obtained as a result of the trip.

Much of the forest land is owned by private interests, however, forestry practices are intensively regulated by law. In Sweden, much of the timber on crown lands is cut by the Forest Service and then sold to private companies or to a crown corporation. The forests are intensively managed and the greater part of the labour force is employed on a permanent basis.

The moose is the most important game animal in both countries. The annual kill has increased steadily since the 1930's. It now exceeds 32,000 in Sweden and 6,000 in Norway. Authorities in both countries favour regulations which permit control of the kill on the basis of relatively small units. The damage of forest reproduction by moose is of great concern and has been the subject of a doctoral dissertation in Sweden. The study indicates that damage to pine reproduction reaches serious proportions when moose densities exceed 2 per square mile.

During the course of moose research in Newfoundland I became interested in the management of moose in the Scandinavian countries. The interest has gradually broadened to include the forests and the general field of resources management.

I once expressed the thoughts that the Scandinavian races come closer to living in harmony with their environment than any other group of people in the world; that they have a better sense of balance in the use of natural resources than North Americans demonstrate. These were simply impressions that I had gained from reading, since I had not visited Scandinavia or very little of the rest of the world. The short period I spent in Norway and Sweden in 1960 provided some interesting background on these thoughts. It increased my desire to spend a much longer period learning about their methods in resource management. It suggested that the Swedish and Norwegian people have indeed progressed far in the field of forest and game management.

During June, 1960 I attended the conference and the related technical sessions of the International Union for the Conservation of

Nature and Natural Resources. The main purpose of the trip was to give a paper on the ecology and management of North American moose. This report is based on a side trip that I made into Norway and Sweden during the period June 25 - July 7, on my return trip to Canada. Since my visit was to be a very short one and since I was primarily interested in the interrelationships of forestry and big-game management, I made the principal objective of my visit quite specific -- "to gain first-hand knowledge of the interrelationships of forest and big-game management in Norway and Sweden." My objective here is to attempt to synthesize the knowledge I acquired in the field, and from literature, on forest and big-game management in Scandinavia. The picture will not be a complete one. This will be especially true in the case of Norway where I had no direct contact with governmental officials during my visit.

Planning and Itinerary.

The planning for the trip was of a last minute nature since approval for the trip to Warsaw was received only a few days before the opening date of the I.U.C.N. Conference. On the way to Warsaw I attempted to make telephone contact with officials of the Swedish Hunter's Society from Copenhagen, Denmark. However, I was not successful and finally I arrived in Stockholm with many ideas but with definite plans still pending. On arrival in Stockholm I contacted Mr. Wallerstedt of the Swedish Hunters' Society, Mr. Torsten Wenmark of the Swedish Forest Service and Mr. Knut Rom (Oslo) of the Norwegian Hunters' Society. The co-operation of the three gentlemen made it possible to work out an interesting itinerary.

The itinerary was planned so that I might visit some forests that were under state and others that were under private ownership. A second consideration was to outline the areas so that it would be possible to make a circuitous trip and hence to take advantage of the economical rail fares that exist for long continuous trips. (The rail fare per unit travelled becomes progressively less as distance increases. For example, the second-class fare for the first 100 kilometers is approximately $2.50, while the rate per 100 kilometers for a journey of 2,000 kilometers is approximately one dollar. During my trip I travelled approximately 2,200 kilometers, or almost 1,400 miles, for a cost of $28.00.)

During the trip I visited six different forests. In Sweden these included small state forests near Söderhamn and Vänesborg, and the largest private holdings in Sweden, those of Swedish Cellulose near Sundsvall. In Norway I visited small company forests near Oslo (Løvenskhold), at Hurdahl (Mathiesen-Eidsvold Vaerke) and at Verdal (Verdalsbruket).

I was conducted on trips in the various areas by many interesting and knowledgeable people. These varied from hunting consultants to chief foresters. The diversity of interests of my companions enabled me to gain insight from many points-of-view. I am deeply grateful to all those who took time out to travel with me and to talk to me about their areas, their methods and their problems.

Forests and Forest Management in Norway and Sweden

Land Area, Forest Types and Land Ownership.

The total land area of Sweden is between 158,000 and 159,000 square miles. Productive forests comprise approximately 88,500 square miles (56 per cent) of the land area (Hedlund and Tamm, 1957). The forests are classified broadly into two principal regions, the beech region of the south and the coniferous regions of Central and Northern Sweden. The coniferous region has two subdivisions, the southern region which is characterized by the occurrence of oak (Quercus pedunculata) and the northern region where oak is absent. Throughout the coniferous region the dominant trees are Scotch pine (Pinus sylvestris) and Norway spruce (Picea excelsa) (Streyffert, 1958).

Private ownership of forests and forest lands is much more common in Sweden than in Canada. State forests comprise only 19 per cent of the total area while limited companies hold 25 per cent and other private interests 50 per cent of the forest land. The remaining 6 per cent are public forests owned by other governmental bodies such as those of counties and municipalities. In marked contrast to Canadian practice, no single private forest industry in Sweden is dependent on the wood from crown forests.

The land area of Norway is approximately 125,000 square miles of which 30,000 square miles (24 per cent) is forested. The forest cover is similar to Sweden, however, spruce appeared to constitute a considerably higher percentage of the volume.

As in Sweden, private forests are predominant and comprise 80 per cent of the forest land (16 per cent company forests and 64 per cent small holdings). Of the remaining, 17 per cent are public forests and 3 per cent are listed as Parish Commons (Fogh, 1953).

One of the most vivid impressions of my trip is of the monotypic nature of the forests. By the time a stand has passed the early stage of reproduction, approximately 25 years, it is usually pure pine or pure spruce. In many areas it is possible to look out across the country for long distances and scarcely see a deciduous tree in the forest canopy. This monotypic condition is considered highly desirable and a great deal of work is done to achieve it. Much of the deciduous component is eliminated by cleaning operations, and now more commonly in the large holdings, by either aerial or ground spraying with herbicides.

Knowing of the soil problems that have arisen in parts of Europe where silvicultural practises had resulted in generation after generation of conifers, I inquired about the wisdom of this "pure conifer policy". Invariably I was told that soil conditions were being carefully watched and that as yet no serious problems existed. The use of burning to break down the raw humus and the present experimental use of fertilizers were cited as work being done to maintain or increase microbiological activity in the humus-rich horizons.

Whatever the economic desirability of clean forestry and monotypic stands - this was the side of Scandinavian forestry that held least appeal for me. Aesthetically, their pure forests rank far below the mixed forests of central Ontario. My prayer is that by the time we have reached the Scandinavian level of utilization, we will also have achieved a diversification of our forest industries so that a conglomerate of tree species will not be economically undesirable.

Forest Laws and Policy.

One of the most striking features of forestry in Norway and Sweden is the extent to which it is regulated by law. I believe that in Canada comparable laws would be considered gross infringements on the rights of private ownership, for the laws apply to both public and private lands.

In the case of Sweden, where an English translation of The Swedish Forest Law is available (Streyffert, 1958), the most important of the regulations are those that govern the regeneration of cut-over areas, the stage at which final cutting can be done and the conversion of forested land to other purposes such as agriculture.

The Forest Law is administered by County Forestry Boards which were established in each of the 25 counties when the law was passed in 1903. Each board has three members comprised of two owners of private forests and of a chairman elected by the Forest Service. These individual boards are responsible to a governmental agency, the Central Board of Forestry, which was established in 1941. According to Streyffert (1958) the Boards have been highly successful in their work. He attributes this to their member composition (each board includes two of the most respected and responsible of the small private forest owners) and to the degree of autonomy which they have. The County Forestry Boards are much more than regulatory bodies. They provide technical advice and assistance to owners of small forests and also mark many of the stands for cutting.

This method of application of a forest law is one of the exemplifications (we shall see another in the section on game management) of the basic differences which exist between the Scandinavian countries and Canada. In our country laws pertaining to natural resources are made by the government and enforced directly by governmental agencies and personnel. In Scandinavia the regulations, although made by the government, are enforced by local bodies which are only indirectly controlled by governmental agencies.

It appears to me that there is more to the success of this method of operation than the two points mentioned by Streyffert (1958), i.e., the inclusion of respected citizens and autonomy of operation. I believe that the people of Scandinavia, from the forest worker or hunter to people in high places, have developed an ingrained sense of discipline of action and an ability to consider

the common good over personal gain to a much higher degree than have North Americans. Fortunately for them, they started early and had time to develop these graces before modern technique and equipment could despoil their countries. Unfortunately, we in North America started later and must by force of circumstances learn faster if we are to be equally successful in living in harmony with our environment. As in practically every area of the world sustained yield forestry is the goal of forest management in Scandinavia. An important thing is that in these countries it is not simply a goal but a documented achievement.

There have been three national forest inventories in Sweden in the 1923 to 1955 period. These inventories demonstrated an increase in the growing stock from approximately 61 million cubic feet to 76 million cubic feet over the period (Hedlund and Tamm 1957). A continuous type of inventory has now been instituted which will give revised data for specific areas at intervals of approximately 10 years.

The Forest Services

The Forest Services and the Forest Laws of Norway and Sweden appear to be similar in many respects. In both cases they come under the Minister of Agriculture and are headed by a Director General. Since I did not have the opportunity to gain first hand information on the Norwegian organization, the great part of the following discussion will pertain to Sweden. In the case of this country I had contact with a number of members of the Swedish Forest Service and was also given a copy of a publication (Anonymous, 1956) which outlines the scope and function of the service.

Administration and Organization: The administrative set-up of the Forest Service is similar, in broad outline, to the Ontario Department of Lands and Forests. The Board of Crown Lands and Forests is the management body of the Forest Service. It is headed by a Director General (Deputy Minister) and a Director-in-Chief who also functions as Deputy Director General. The Divisional Directors are also members of the Board. The head office organization is comprised of seven divisions and a crown prosecutor's office, which in effect constitutes the eighth division. In the field organization the country is divided into 10 conservancies (comparable to our districts) which in turn are divided into a total of 106 forest districts. In southern Sweden these districts average about 40 square miles in size while those in northern Sweden are six to seven times as large. The districts in turn are subdivided into Forester's Beats each of which is managed by a forester. The Forester's Beats are the operational units of the Forest Service and number 460. The Forest Service employs 250 forest officers, who are graduates of the Royal School of Forestry, and 700 foresters who are graduates of Forestry (Forest Ranger) schools. One of the interesting aspects of the organization is that it does not contain any specific fish or game management section. The responsibility for administering these resources is with the first and second forestry divisions which administer the 10 conservancies. At the

field level the work is so closely integrated that fish and wildlife are part of the responsibility of the forester in charge of a Forester's Beat. At this point it is necessary to recall that the rights to, or ownership of, fish and wildlife are invested in the ownership of the land and not directly in the state. This means that the Forest Service is directly responsible only for these resources as they occur on lands which it administers. Matters pertaining to fish and game management on private lands are handled by local boards in conjunction with the Swedish Hunter's Society. There is a Nature Protection Section in the Board of Crown Lands and Forests, however, its function is primarily with non-game species and with landscape preservation.

There are two aspects of the activities of the Forest Service which do not have any Canadian counterpart. These are the method of handling timber sales and the administration of agricultural domains. In the former there has been a steady trend toward the sale of felled rather than of standing timber. At the present time less than 40 per cent of the timber is sold standing.

For the industrial part of its operations the Forest Service has a special business status and simply submits an annual statement of income and expenditures. The expenditures for normal administrative aspects of the service are handled in a normal parliamentary budget.

In the industrial aspects of its operation the Forest Service employs between 4,000 and 5,000 permanent forest workers. This comprises approximately 80 per cent of the labour force. The labour force works under a reciprocal guaranteed annual working period agreement. "This means that the worker is guaranteed work during a certain number of days each year and he, for his part, undertakes to perform this work". The Forest Service provides housing, as do many of the companies, for permanently employed forest workers and, in some instances, low-interest housing loans to seasonal workers.

These provisions of guaranteed annual working periods, housing, low interest housing loans, as well as special hunting privileges, for forest workers exemplify one aspect of Scandinavian forestry which greatly impressed me. Everywhere I went I saw evidence of the deep-rooted interest in the man at the bottom. Forestry officials constantly referred to the desirability of a permanent working force. I became very aware that a great deal is being done to make forestry work a desirable vocation.

The Forest Service owns a company (The Royal Swedish State Forest Industries Ltd.) which operates as a financially independent crown corporation. A considerable part of the production from crown forests in northern Sweden is processed by this company.

The Forest Service administers farm properties which are owned by the state. These comprise between two and three per cent of the cultivated land of the country. The most important of the properties are the agricultural domains, which are located in southern

and central Sweden. These domains vary in size from approximately 50 to 1,000 acres. The arable land and buildings are leased while the associated forests are managed by the local forest district.

Forestry (Forest Ranger) Schools: There are seven government, and one private, forestry training schools in Sweden. The course is of one year's duration. All applicants must be experienced woodsmen and are required to take a four-month pre-training course prior to being admitted. The schools graduate about 100 foresters a year. (The only wildlife management school of equivalent status is operated by the Swedish Hunter's Society. It is supported to a large extent by a government grant.) The administration and supervision of the schools is closely integrated with the forest conservancies and districts.

Pensions: Permanent staff members receive non-contributory pensions. Retirement ages vary, depending on the degree of responsibility held by the officer. A supervisor can be pensioned at 63 but can remain until he is 65, while the corresponding ages for a forester are 60 and 63. Pensions average approximately 65 per cent of the final salary.

Indoctrination Courses: All forest officers are required to take a 14-day course prior to commencing work.

Unions: Forest Service officials may belong to a union, and most do belong to one of the four principal organizations.

Housing: The Forest Service provides housing for 35 to 40 per cent of its forest officers and foresters.

Salaries: Salary scales appear low by our standard, however, there is more to it than a direct conversion from kronars to dollars. It seemed evident to me that the buying power of a dollar is 30 to 50 per cent higher in Sweden than in Ontario.

The most striking feature of the salary question is the relatively confined range within the various classes. District forest officers' salaries ranged (1956) from approximately $4,800, on appointment to $5,200 at the upper limit, while foresters' salaries ranged from approximately $2,200 to $2,600 per annum.

Reserve Funds: In addition to having financial independence in the logging industry aspects of its operation, the Forest Service has two funds from which to draw for land acquisition and forest regeneration purposes. Some agricultural and forested lands, which because of location or size cannot be handled profitably, may be sold to private interests. The money from these sales is placed in a land fund and used to purchase forested lands that can be operated more profitably. In the mid-fifties this fund contained about $7,500,000.

There is also a "Reserve Fund for Regeneration Costs". Each year a percentage of the net revenue of the Forest Service is allocated to this fund by the government. In the mid-fifties this fund contained about $9,000,000.

Forest Management by a Private Corporation.

On July 5 I spent a most interesting day touring a small part of the limits of Swedish Cellulose (Svenska Cellulosa, Aktiebologet) with Mr. B. Hagström, Chief of Forestry. At the end of the day Mr. Hagström took me to one of the company's seed orchards and to his office at Sundsvall. He gave me a brief insight into many aspects of the cost accounting methods, investigation of world markets and competition, silvicultural procedures and programs for forestry workers that are conducted by the company. I was amazed at the detail and the thoroughness of their approach. I had not realized that forestry, in any part of the world, had achieved the degree of scientific and engineering efficiency of this company. In addition to amazement, my feelings contained an element of fear occasioned by the wide-scale use of herbicides, the experimental draining of bog lands and by the vast burning programs.

Swedish Cellulose is the largest private company in Sweden. The company owns over 7,000 square miles (1,188,000 hectares), of which approximately 75 per cent is productive land. During 1958-59, 61 million cubic feet were cut, an estimated 70 per cent of the annual growth. In addition the company buys large quantities of wood, in some years equal to the cut in their own forests, much of it from farm forests. The company produces a very wide variety of products from lumber and prefabricated houses on one side to many forms of paper, plastic, cellulose and liquid products, on the other. The diversification means that there is a market for all the wood that is harvested.

Although I was aware that they occurred, I was amazed by the extent of cleaning and thinning operations. They provide approximately 40 per cent of the material produced on company lands. After the final clear-cutting approximately 60 per cent of the areas are burnt-over and planted. Reproduction on the remainder of the areas is obtained by seed trees or by sowing, usually accompanied by scarification. Scotch pine is considered more desirable than spruce and many areas that originally produced spruce have been converted to pine.

The planting program requires approximately 24 million seedlings a year. These are largely provided by company nurseries. Additional requirements are met through the nurseries of country forestry boards. Seed is obtained from high quality stands after logging, and from seed orchards of which the company now has four in operation. It is anticipated that within a relatively short period the bulk of the seed required will be provided by the orchards. The orchard stock has been provided from the superior, or plus, trees in five different zones which have been defined for SCA limits. The orchard planning has been done on the basis for the estimated seed requirements for each of the zones.

Forestry is a year-round operation with the multiplicity of operations that are included in the various cuts, burning, seeding and spraying operations and in other work such as road building. Because of this, Swedish Cellulose is striving to build up a stable, permanent work force. As I mentioned earlier one of the most vivid impressions of my trip was the steps that are being taken to make forestry a more desirable vocation. The benefits that the company offers its forest workers include permanent employment, a guaranteed annual work period of 240 days, life insurance and pensions, special annual grants during the period when a worker is between 62 and 67 years of age, low interest housing loans, free building sites, loans to buy mechanical equipment and hunting privileges.

As elsewhere in northern and central Sweden the moose population and the kill has been increasing on the forest lands of Swedish Cellulose. However, considering the area involved it is still relatively light. In 1959, for example, 1,500 moose were killed on company land. This was approximately one moose per 5 square miles. A hunting license for company land costs workers approximately $2.00 (10 kronar) and in addition they pay $20.00 (100 kronar), or deliver a hindquarter, for each moose shot. This represents the lowest moose-hunting fee that I heard of in the course of my visit.

Moose and Moose Management in Norway and Sweden

In a previous paper (Pimlott, 1959) I reviewed some of the aspects of moose management and moose hunting in Norway, Sweden and Finland. However, for the purpose of bringing things together into one place I will cover some of the same ground here. I will not, however, discuss hunting methods. Persons who are interested in this subject can refer to my previous paper and to a report by Cumming (1961), in which he tells of the hunts in which he actually participated during his trip to Europe in 1959.

History of Moose Hunting.

Sweden: The documented history of moose hunting goes back over 400 years. For almost two hundred years, 1593 to 1789, hunting was restricted to nobility. The first half-century after the restriction was dropped is said to have been a difficult period for moose and they were almost extirpated by 1825. The first closed season was put into force at that time and lasted through 1835. The next hundred years saw much juggling of the hunting seasons, however, there has never been another completely closed season on moose.

The moose herd was at a low point during the 1920's when hunting was not permitted over large areas of the country. After wide-scale hunting was resumed in the late 1920's the annual kill began to increase steadily. The average annual kill for the 1930's was approximately 7,000, for the 1940's 12,000 and for the 1950's close to 25,000. The kill for 1960 was 32,280 (Svensk Jakt, July, 1961).

One of the remarkable facts about the moose is that they occur over large areas of southern and central Sweden where there is a relatively high human population. Stockholm County (2,500 square miles), for example, has a population of over a million people and yet during the late 1950's had annual moose kills of 800 and 900 animals.

The greater part of the increase in the moose kill since the 1940's occurred in the northern two-thirds of the moose range where the kill was formerly quite low. In 1959, for example, the kill in northern Sweden still had not reached the level of central Sweden of approximately 35 moose killed for each 100 miles of range.

Norway: The granting of hunting privileges to landowners in Norway did not come until 1863, almost 100 years after Sweden. Each landowner was then permitted to kill one moose on his own land regardless of the size of the holding. The law remained in force for 68 years until 1931. During the period seasons varied in length or were closed in specific areas in attempts to control population levels. As in the case of Sweden, the most extensive period of restricted and closed seasons occurred during the 1920's. The annual kill, although much lower than Sweden's, has had the same upward trend since normal seasons were re-established. It increased from 1,000-1,200 in the late 1920's to approximately 6,000 in the late 1950's.

Regulatory Organizations.

In the regulation of hunting in Scandinavia, hunting organizations have a most unusual role. This is particularly true of Sweden where the Swedish Hunters' Society (Svenska Jägareförbundets) is virtually the counterpart of the Fish and Wildlife Branch of our department. The organization is supported by an assessment of members of county organizations and by an annual grant from the Swedish Forest Service. This grant is from the moneys received from the sale of hunting licenses. A considerable element of government control is achieved through the appointment of a chairman to the executive committee from the Riksdag (Swedish Parliament) and by a requirement that the budget be submitted to and approved by the government. Important policy matters are debated at the Hunters' Congress and recommendations are then made to the Riksdag.

The Society maintains a staff of hunting consultants (Game Management Specialists) throughout the country. It also has a small research station at Boda Bruk.

The Norwegian Society is a true private organization but also obtains some funds from the government. It is a powerful organization and undoubtedly influences policy decision, however, it does not have the role of formulating and implementing policy that the Swedish Society has. Cumming (1961) has given a more detailed account of these two organizations.

Hunting Regulations.

Before discussing moose seasons and hunting regulations it is well to point out again that in both Norway and Sweden the game is the property of the landowner and not of the crown. It appears to me that Scandinavian hunters have a much higher regard for hunting regulations than do North American hunters. I have wondered if perhaps a sense of personal ownership may be a contributory factor to this difference of the outlook of so many people.

Sweden: Moose hunting is done under a dual-season system. The two seasons are referred to as the general and special seasons. In the case of the general season the period of hunting is restricted (most commonly to 3 days but varying from 2 days to a week) but there is no limit to the number of animals that may be killed. In the case of the special seasons, the season frequently extends for a month, however, the number of animals that may be killed is determined in advance and is rigidly adhered to. There is a very strong movement to bring all moose hunting under the special-season system.

For many years cows and calves were rigidly protected over most of the country. With the build up of the moose population the concept of protection of calves began to break down. In 1953 calves were shot in a number of counties during the general season. In the interim the killing of calves has become more widespread and by 1960 calves comprised over 10 per cent of the total kill (3,825 of 32,280, Anonymous, 1961).

Norway: The rigid control of kill by areas which Sweden aspires to was adopted by Norway in 1951. Under this system hunting permits are issued for specific areas, the size of which depends largely on the density of the moose population. Owners, or the owners of hunting rights of sub-minimal areas must unite to meet the area requirements.

The Control of the Moose Kill by Areas - Pros and Cons.

The rigid control of the kill of moose by areas is considered in Scandinavia as the ultimate stage in hunting season regulations. The system is advocated as the means by which the kill can truly be regulated on the basis of the relationship of the moose to the range, and to economic aspects of damage caused by moose to forest reproduction and to crops. Prior to visiting some of the areas, I subscribed to the idea that it was indeed the ultimate in control of the kill. I considered that it represented a stage of management that is still very distant as far as North America is concerned. My rapid passage across the land did not permit me to make a detailed appraisal for any area in Sweden that has made extensive use of special seasons which connote control of kill by area. However, in Norway I gained impressions that made me realize that adoption of the system did not necessarily mean the end of problems or the attainment of the ultimate goal of management in control of the kill.

In Norway the annual kill varies from 70 to 80 per cent of the prescribed or desired kill. An example is the forests of Løvenshold Company on the outskirts of Oslo. The Company holdings comprise approximately 225 square miles (56,000 hectares) and the present allowable annual kill is approximately 50 moose. The annual kill, however, seldom exceeds 35 animals, or 70 per cent of the allowable kill.

The forests of the company at Verdal (Verdalsbruket) comprise approximately 360 square miles (90,000 hectares) of which 100 square miles (25,000 hectares) are productive forests. The annual kill for their forests is presently established at 40 moose. The kill is achieved each year by the use of a relatively simple device - the hunting fee of 740 kronar ($120) per moose must be paid in advance and is not refunded to unsuccessful hunters. However, problems still exist in the workings of the system. The allowable annual kill is established by a local committee. This committee includes many persons who do not have an intimate knowledge of the moose or the range. Although they are advised by the state hunting consultant and by foresters, they do not accept all the advice that is offered. Mr. Leif Lykke, Chief Forester of the company, states that the annual kill is much too low. As a result the browsing pressure on winter range is too heavy and is resulting in extensive damage to forest reproduction and to shrub species.

As a part of his campaign to get the annual kill of moose increased, Mr. Lykke prepared a detailed brochure on the question and, just prior to my visit, had sponsored a tour of newspaper writers through areas of winter range. A few days later I followed in their footsteps and saw areas where browsing on willow and juniper was so heavy that many stems were dying.

The moose kill on the limits of Mathiesen-Eidsvold appeared to be closer to optimum than in either of the areas just discussed. In the hunting area centered around Hurdal community there is an allowable kill of 100 moose in an area of approximately 375 square miles (150,000 hectares). In 1959, 98 moose were shot. The local committee is fairly flexible in establishing the allowable kill and overbrowsing of range is found in only very limited areas.

What does the Norwegian experience have to offer as far as Sweden is concerned? Will Sweden have comparable problems if they finally succeed in eliminating the general season? It is obvious that when it can be as difficult to adjust the annual kill as it is proving in the case of the area in the vicinity of Verdal, Utopia has still not been reached. In Sweden local committees are also influential in the establishing of allowable kills. It will be interesting to watch how they make out in this important aspect of game management. I believe that there is more to be said in favour of the general season than is generally recognized. Swedish hunters know their hunting areas very well and with their dogs and their specialized hunting methods are very efficient. This combination of factors probably means that the kill, during the general season, is greatly influenced by the density of moose. In other words, if

the moose population increases the kill is correspondingly higher. It seems to me that they would do well to consider the possible results of their actions before they eliminate this important "automatic" pressure value on the moose population.

Interrelationships of Forest and Moose Management

In the course of travelling across the countryside and of visiting three forests in Sweden it became obvious to me that conditions of food and cover are on the average much better for moose there than they are in comparable areas of eastern Canada. However, the most important factors either occur naturally or are related to aspects of the forestry program. They have not resulted as direct efforts to manage moose. Scotch pine, by far the most important tree species, is palatable to moose and forms a considerable part of their winter diet in most areas. Cumming (1961) portrays the importance of the pine to the moose herd in his statement, "It was as if black spruce had suddenly become the favourite food of moose in northern Ontario". In addition, the area occupied by pine stands is actually increasing with the conversion from spruce to pine after the final clear-cut.

In Norway it appeared to me that the balance between the occurrence of palatable and unpalatable tree species more closely approximated conditions in Ontario. Spruce, which is unpalatable to moose, is more common, over much of the country, than is pine. Based on annual growth data (Anonymous, 1951) the ratio of spruce to pine in Norway is of the order of 2.5:1. Although I do not have comparable data for Sweden, I feel certain that the ratio of the two species is, at the very least, inverse to that of Norway.

Another important fact is the very wide dispersion of cutting operations across the landscape. The forest operations of Swedish Cellulose, for example, are divided into three main forest districts and into 66 sub-districts. In virtually all of these sub-districts there are forests in stages from early reproduction to maturity. A fairly common Canadian situation, the cutting of huge blocks and their subsequent abandonment for the greater part of a rotation period, appeared to me to have no counterpart in Swedish or Norwegian forestry practise.

The mixing of stands of all ages, which occurs on industrial forest land, is paralleled by conditions on farm-forest lands which are particularly common in Sweden. In addition to a mixing of age classes, the interspersion of fields adds a tremendous area of "forest-edge conditions" which are important to forest ruminants.

The cleaning and thinning cuts which take place at various stages of the rotation are also important contributors to the success of the moose herd. The objective of retaining a relatively constant stand volume throughout the last half of the rotation period appears to result in more and more light reaching the forest floor as the stand becomes older. Although the shrub component is

periodically removed by cutting or spraying, the end result still is a greater availability of food during the latter stages of the rotation than is common in coniferous forests in eastern Canada.

Moose and Forest Workers.

In most areas the forest labour force is relatively stable. The workers spend much of the year, and often much of their lives, in the various aspects of the forestry operations in a relatively small area. They become very familiar with the terrain and with the moose of the area. The end result is that a great deal of knowledge about the moose population is obtained as a by-product of normal day-to-day work. When special studies are being undertaken, such as the country-wide moose inventories of 1945 and 1953, much of the work is done by forestry personnel or by landowners.

In the discussion of Swedish Cellulose I mentioned that hunting has now become one of the privileges extended to forest workers. This is becoming quite common in both countries, and is one of the interesting interrelationships of the two resources. Forest workers and land owners constitute a very efficient hunting force. They make control of moose population by hunting a practical possibility. The North American situation, of not being able to get hunters to go where they are most needed, rarely exists in Scandinavian countries.

Moose and Forest Reproduction.

Soon after becoming interested in moose management in Scandinavia I realized that foresters were vitally interested in the question of the effect of moose browsing on forest reproduction and on ultimate quality and yield of stands. The interest is evidenced by articles and editorials on the question which have appeared in Svensk Jakt (the publication of the Swedish Hunters' Society) during the past decade. In addition, the extent of the damage to forest reproduction is always one of the important considerations when moose seasons and allowable kills are being discussed.

In Sweden a detailed study of the problem was conducted by Hans Westman and was presented as his doctoral thesis at the Royal School of Forestry in 1958 (Westman, 1958). The study was conducted in six state forests in southern and central Sweden and was of a comprehensive nature. In Norway work is also being done by Mr. Yngvar Hagen of the State Service and by Mr. Jon Lykke of Verdalsbrukket and the Royal Norwegian School of Forestry.

During the course of my trip I spent a day with Hans Westman and saw conditions on one of his study areas at Halle-Hunneberg. I also spent a day with Jon Lykke and received considerable insight during the field trip with him and on field trips with Arne Krafft of Mathieson-Eidsvold and Svante Bjuralt of the Swedish Forest Service.

One of the most important aspects of the problem is that Scotch pine, the most valuable commercial species, is quite palatable to Scandinavian moose. The browsing of pine is often intensified by cleaning and thinning operations that remove many of the palatable shrubs and bring the young pine stands to a desirable density.

In the six areas which were studied by Westman the estimated moose density varied from 0.8 to 7.5 moose per square mile. The highest densities of 5.5 and 7.5 occurred in the forests of Halleberg and Hunneberg. The following text-table gives the estimated moose density and the percentage of pine stems that were lightly and heavily browsed in young stands in the various forests.

Forests studied	Ebbegärde	Naversjö	Karlsby	Halleberg	Hunneberg	Skinskatteberg
Moose density per square mi.	0.8	2.0	3.5	5.5	7.5	3.0
% of stems browsed-lightly	29	38	25	9	9	11
-heavily	15	4	44	81	87	73

The stems included in the heavily browsed class varied from those that had the leaders clipped or severely injured to those where more than 90 per cent of the needles had been removed. Many of the stems in the upper range of the class die or are so badly deformed that they are unlikely to produce merchantable trees.

Westman's conclusions and statements on browsing and on the influence of browsing on stand development were very interesting. I will summarize some of them.

(1) He found that aspen and oak had a very high palatability. Where they were abundant the browsing of other species, such as pine and birch, was markedly reduced.

(2) Moose do much of their feeding in young stands. The smaller the proportion of young stands the more intensive the damage becomes.

(3) A high browsing level does not necessarily result in heavy economic loss. Stand density is an important variable. Westman states that the loss in dense stands is less serious because a greater number of reserve stems remain after the moose has taken its toll.

(4) Large areas of pure, even-aged pine stands have the best chance of escaping severe damage. He believes that this is partly the result of open-grown pines being less palatable to moose than are those that grow under heavy competition or in shade.

(5) He stated, "There unquestionably exists today a very great need of measures to prevent damage by elk (moose). In the course of the years, numerous methods have been tried in Sweden, but it seems justified to claim that no really effective solution of these forestry problems has yet been found - aside, of course, from a general decimation of the elk population".

(6) His final conclusion was, "... it should be borne in mind that the management of young stands with due regard to elk (moose) may, in many cases, involve a greatly impaired forest economy. This consideration is of prime importance in the present respect and should, therefore, receive attention in future discussions on the appropriate size of the elk population."

References

Anonymous

1951 The northern countries. The Foreign Ministries of Denmark, Finland, Iceland, Norway and Sweden. 154 pp.

1956 The Swedish Forest Service. Swedish Forest Service. 44 pp.

1961 The 1960 moose kill. Svensk Jakt, 99(7):324. In Swedish.

Cumming, H. G.

1961 Report on Investigation of European Wildlife Management Methods. Fish and Wildlife Management Report No.55. 62 pp.

Fogh, I. F.

1953 Journey in Scandinavia. The Canadian-Scandinavian Foundation. 35 pp.

Hedlund, H. and O. Tamm.

1957 Your guide to the Swedish forests. Swedish Forestry Association. 30 pp.

Pimlott, D. H.

1959 Moose harvests in Newfoundland and Fennoscandian countries. Transactions North American Wildlife Conference, 24:422-448.

Streyffert, T.

1958 Forestry in Sweden. School of Forestry, Oregon State College. 55 pp.

Westman, H.

1958 The damage caused by elk (moose) to young stands. Bull. No. 28. Royal School of Forestry, Stockholm, Sweden. 148 pp. In Swedish with English sub-titles and summary.

FORESTRY IN SOUTH AFRICA

by
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Abstract

This is largely a review of the book, "Conifers - South African Methods of Cultivation" by W.E.Hiley, describing the approach to forestry in South Africa where suitable foreign conifers were deliberately sought, and where these exotic trees grew successfully and now form the largest proportion of the forest. Indigenous species form only a small part of the total forest area. The silviculture that is used is according to the formula of a Dr. I. J. Craib, and is based on wide spacing, and on freeing growth by thinning as soon as any increment reduction appears. Live pruning is also an essential feature. Special nursery and planting techniques are used, and only first quality sites are planted. While this system has shown phenomenal success in South Africa, it is not necessarily completely suitable for other species or regions. It does, however, show some interesting and unusual developments in forestry by departure from beaten paths.

This book is a most complete account of the distinctive methods of silviculture and regulation applied to the growing of conifers in South Africa. South Africa is unique in having a larger area of planted[1] than of indigenous forest. The country has a warm temperate climate and a great deal of the area is very dry, merging into desert, but a range of hills or low mountains on the eastern side provides a zone of sufficient rainfall for tree growth. The rate of increment there is extremely rapid. Outside the tropics, only New Zealand, Great Britain and the northern Pacific coast of North America have comparable rates of growth, but the Southern States of the U.S. are nearly as high.

These conditions have led to very distinctive forestry techniques, particularly in regard to thinning. This suggests a thorough analysis of thinning techniques in other regions to

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[1] Mainly of pines, such as Pinus patula selected from similar latitude and climate zones in Mexico and Central America.

determine the most profitable method of growing saw-timber. The techniques used in South Africa have largely been introduced by Dr. I. J. Craib[2] who obtained a doctorate from Yale University a number of years ago. He worked with Professor Toumey on root competition, and this led to many of the ideas that he has introduced in South Africa.

The distinctive features of South African forestry which are brought out in Hiley's book would seem to be mainly the following:

The fast rate of growth due to the warm temperate climate, good soil and sufficient rainfall.

9 x 9 planting resulting in 530 trees per acre. In some cases, 12 x 12 planting has been used.

Entire dependence on pruning to secure clear lumber. The pruning is carried to 22 feet in three stages, and it is suggested that it might pay to carry it to the top of the second log. Pruning is essential because of the wide planting spacing and the very heavy thinning.

Lifting so-called "sods" from the transplant beds and transporting them to the planting site in boxes without disturbing the soil around the individual seedlings. These boxes have an inside measurement of only 14" x 10". Immediately before planting, a knife is run between the rows of seedlings so that the seedlings and the surrounding soil can be taken out intact. It seems to be much the same idea as our tubelings, but with larger stock.

Selecting times of planting very carefully, not only when there has just been a rain, but when it may be expected that the following two or three days will either have continued rain or at least be cloudy. Only about 30 days a year are considered suitable for planting and this in a warm temperate climate with a long frost-free period.

The preparation of the planting site is rather elaborate, the area cultivated ranging from the whole area to planting strips 3 feet wide or 3 feet square for each tree. While the techniques would probably not be applicable to our conditions, they might be suggestive of possible changes that could be made in some of our methods.

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[2] "Some Aspects of Soil Moisture in the Forest", I. J. Craib, 1929. Yale University School of Forestry Bulletin No. 25.

Poor sites are avoided as not yielding an economic return on establishment costs.

Wide spacing used in planting and early and heavy thinning is practised with the idea of eliminating almost altogether any crowding of one tree by another.

In regard to the last point, it is felt that any crowding of the final crop trees causes reduction in the crown development which is never made up, even though the trees are later given additional room. This reduces their capacity for growth and delays the growth to saw-log size. The 530 trees per acre originally planted are reduced to 300 trees at an age specified for each site class, later to 150 trees and finally to 100 trees. Hiley places considerable emphasis on this method of what he terms "numerical thinning", but this would not seem to me to be essentially different from the European practice of using normal yield tables as guides to indicate the number of trees that should be left after the thinning at each age. For this purpose, the Danish yield tables give data for two-year intervals at the youngest ages.

There is a lack in the book of ordinary mensuration data such as the average diameters of the trees at different ages. This is primarily due to the fact that they have not yet grown stands through to the end of the rotation, which is 30 years for Site 1, 40 years for Site 2, and 50 years for Site 3. Lacking data of diameters at different ages, Figure 1 in this review is based in part on Figure 1 in Hiley's book giving average heights at different ages. It shows for each site the number of trees when the stand has reached the average height indicated on the horizontal axis. Similar figures for Scotch pine in Germany classified as being very heavily thinned, show how extremely low the densities in South Africa are, particularly at the younger ages.

It may be noted that in both South Africa and Germany, the number of trees is smaller for a given height on the poor sites, and the practice in South Africa in this respect would not seem to be very different from the practice in Europe, although perhaps carried out in a little more extreme fashion in South Africa. This practice of giving more room to the individual trees on poor sites is based on the theory that the poor sites have less moisture and in order to get as rapid growth as possible on them, the trees should be spaced more widely than on good sites. Dr. Craib places considerable emphasis on this point due to his work on root competition at Yale.

The degree of thinning in South Africa is so heavy that the pruning of stands is absolutely necessary to produce clear lumber, and the trees are pruned first to 8 feet when the trees are 20 feet tall, to 15 feet when their height is 30 feet, and to 22 feet when their height is 40 feet.

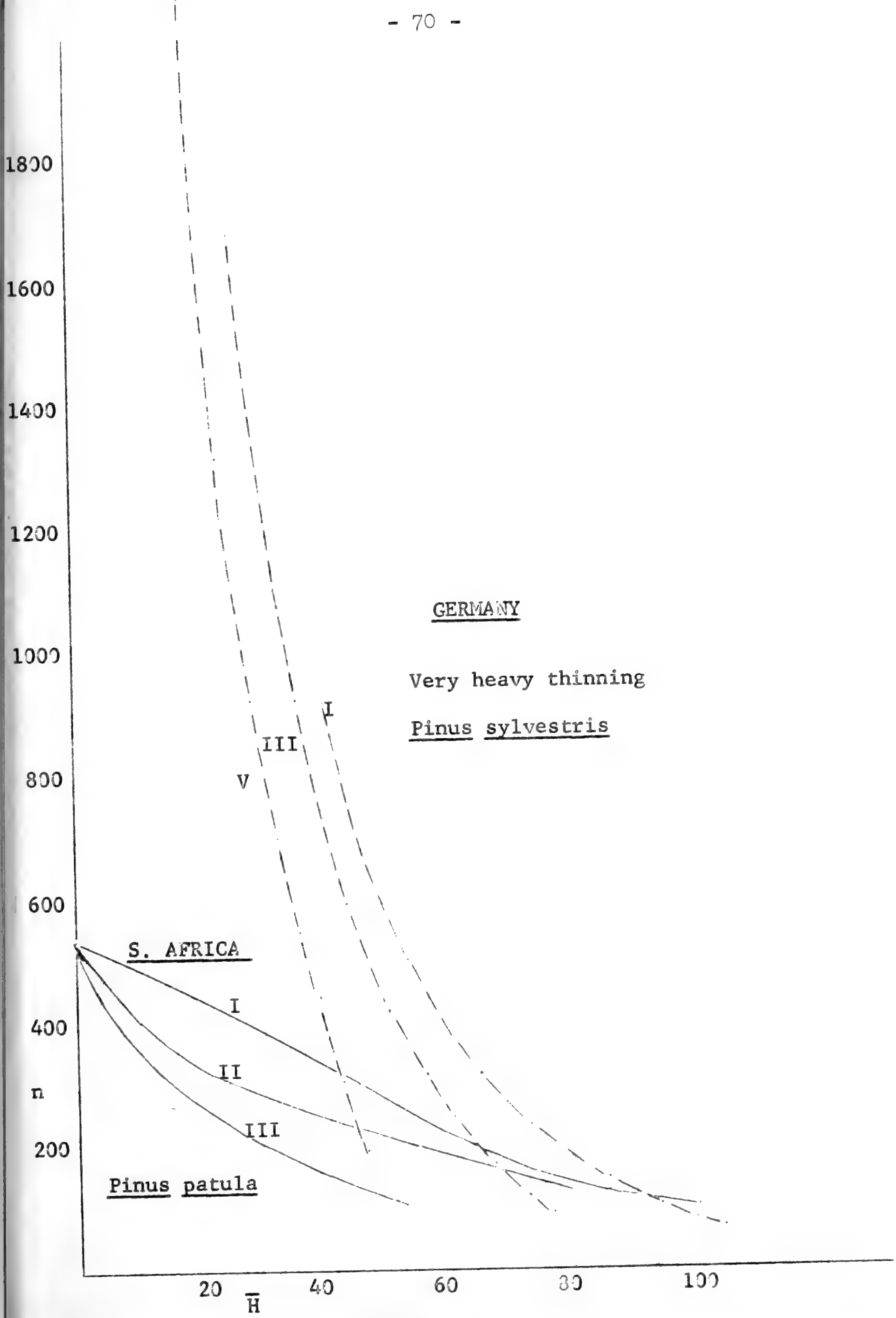
1800
1600
1400
1200
1000
800
600
400
n
200
20
40
60
80
100
$\overline{H}$
GERMANY
Very heavy thinning
Pinus sylvestris
I
III
V
S. AFRICA
I
II
III
Pinus patula

Figure 1

The rates of diameter growth illustrated in Figure 2 are taken from a 1947 article by Craib,not given in Hiley's book. They were obtained in a 14-year old plantation of Pinus patula. Plots were planted at the densities shown and never thinned. The graph shows that when 300 trees per acre were planted, a diameter of 9.6" was reached as compared with a diameter of only 4.7" with 1740 trees per acre. The attained heights, as indicated by the ordinates at which the curves end, show how very rapid the growth was.

Figure 3 is based upon a unique series of sample plots, all of which were planted to 1200 trees per acre and later thinned to varying densities. Once a plot had reached its intended density, no further thinning was carried on. The thinnings were made as soon as there was any sign of competition between the individual trees. This graph is the same as Figure 3 in Hiley's book except that diameter is plotted over height instead of vice versa. This makes the curves look like ordinary growth curves with height to indicate the stage of development instead of age. The steep curve on the left indicates the rate of diameter growth of trees that were continuously thinned so that there was no restriction on crown development at any time. The more horizontal curves branching off to the right show how the rate of diameter growth fell off when thinning was stopped. The numbers of trees per acre at the time thinnings were stopped are entered at the right hand end of the curves. The curve for 300 trees per acre is not very different from the top curve on Figure 2, for a stand with an initial density of 300 trees per acre.

These curves emphasize the importance of eliminating competition between individuals as far as possible if a maximum rate of diameter growth of individual trees is to be attained. The usual thinning practice in Europe delays thinning in young stands until a considerable amount of natural pruning has taken place, since that is depended upon to produce clear stems. The South African practice requires artificial pruning.

The broken lines on the same graph depict diameter growth of heavily thinned Scots pine stands in Germany. These curves show slow initial growth which corresponds to the high densities at early ages in Germany as depicted in Figure 1. The much more rapid growth later on could be explained by the continuance of thinnings throughout the life of the German stands, which was not done in South Africa.

The figures in brackets alongside the curves for Sites I and III at 70 feet, and at the end of the curve for Site V at a height of 47 feet, indicate the numbers of trees per acre when the stands reached those heights. Interpolation between the South African curves would indicate that stands having similar average diameters at those stand heights would have densities of 450, 250 and 340, or nearly double the densities in Germany.

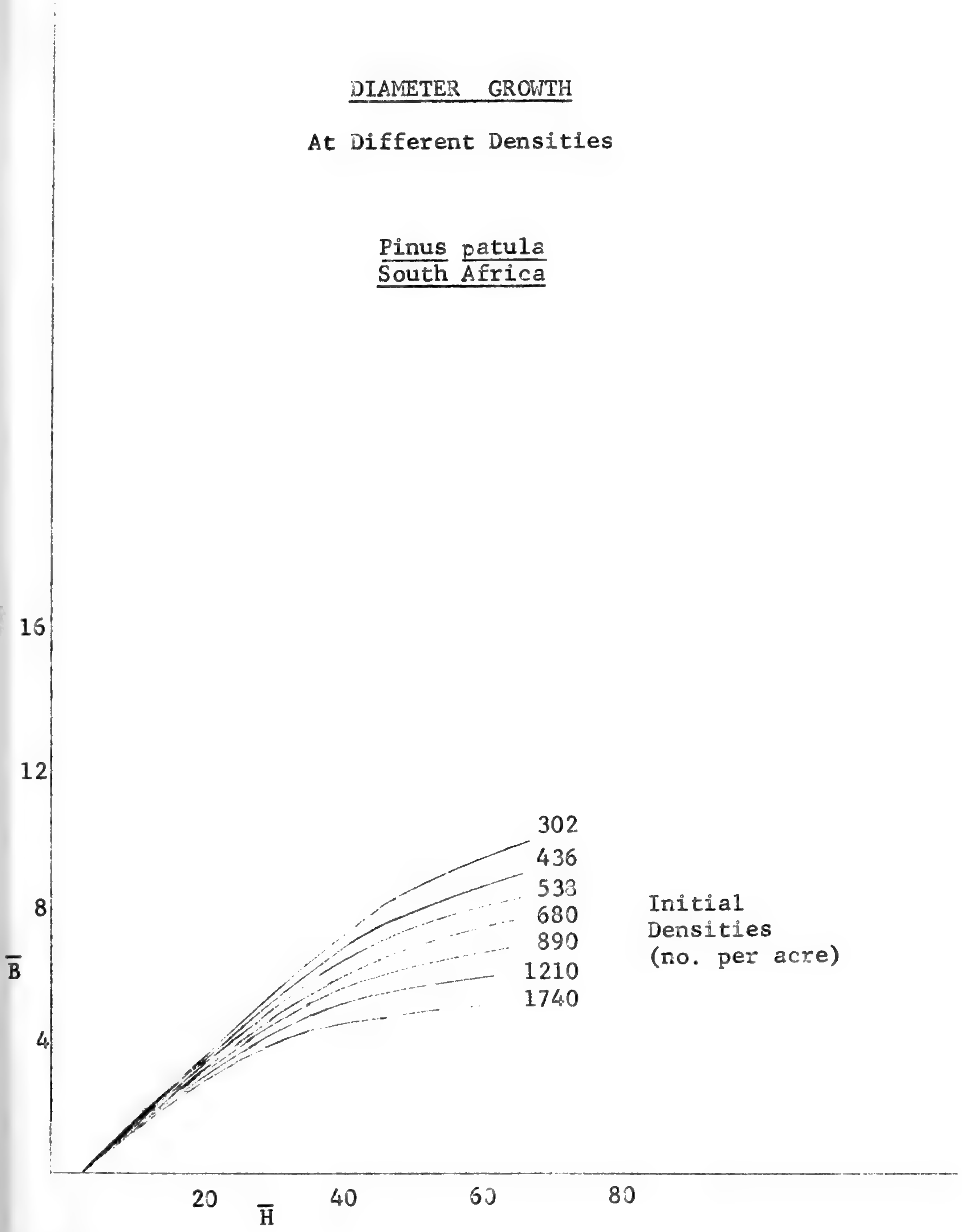
DIAMETER GROWTH
At Different Densities
Pinus patula
South Africa
16
12
8
$\overline{B}$
4
20
$\overline{H}$
40
60
80
302
436
538
680
890
1210
1740
Initial
Densities
(no. per acre)

Figure 2

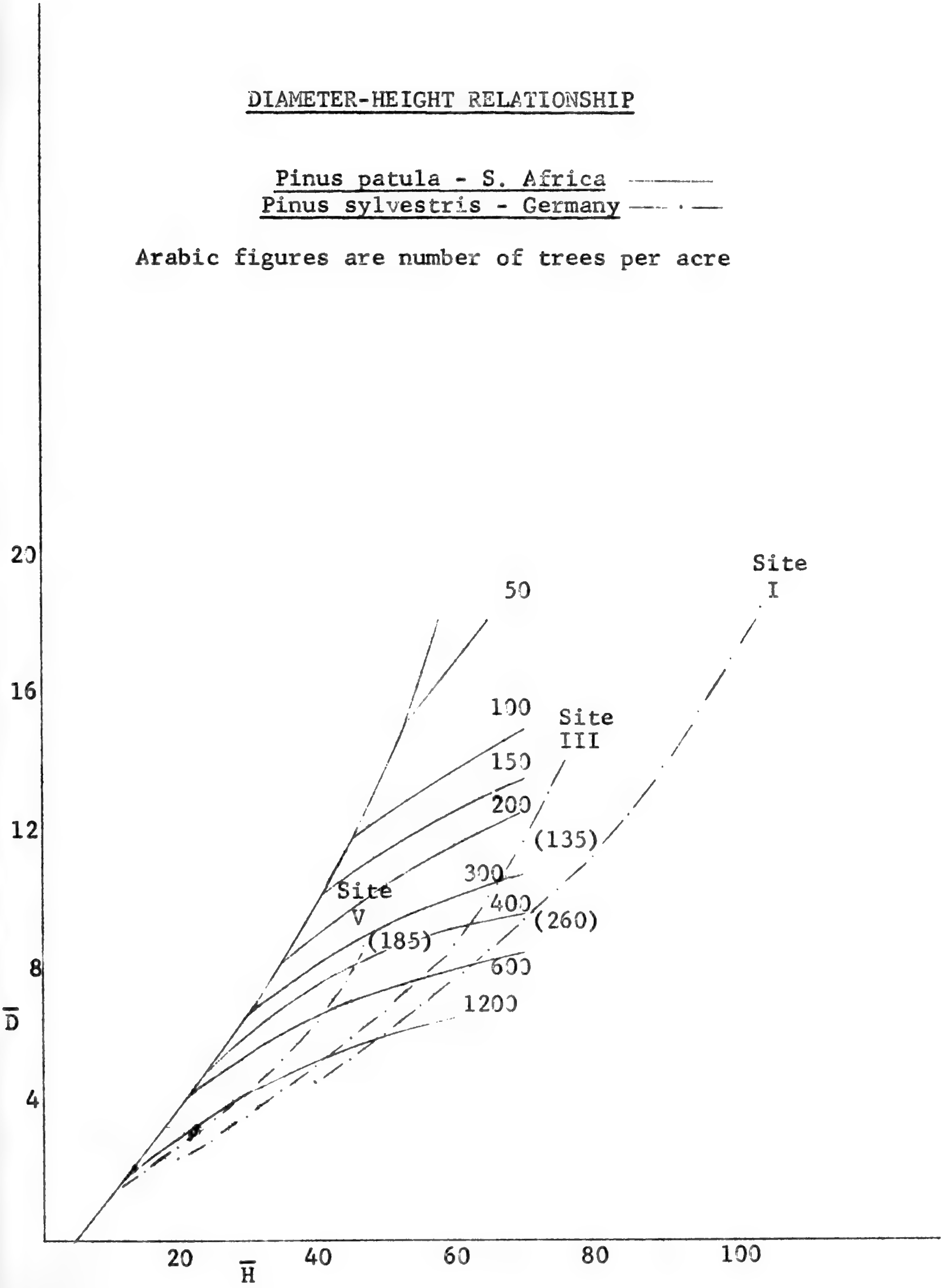
DIAMETER-HEIGHT RELATIONSHIP
Pinus patula - S. Africa
Pinus sylvestris - Germany
Arabic figures are number of trees per acre
20
16
12
8
4
D̄
20
40
60
80
100
H̄
50
100
150
200
300
400
600
1200
Site I
Site III
Site V
(135)
(260)
(185)

Figure 3

Data regarding total basal areas, volumes of thinnings and residual stands in South Africa are not available. Therefore comparisons with European yield tables cannot be made of total basal areas and yields of final crops and of total production figures.

Two definite comparisons between the growth in the two regions in relation to average height of stand should not be made on account of the great difference in growth rate and in the ages at which various heights are attained. The graphs, however, do illustrate the marked influence of density on diameter growth. The lack of definiteness with which most of the relationships are known even in connection with European yield tables points to the desirability of conducting investigations into such matters in our own forests. Dependance should not be placed on foreign data to give an understanding of growth in our own forests.

KENORA DISTRICT CREEL CENSUS - 1960

by
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Fish Management Officer

Abstract

Creel census data collected by Conservation Officers during routine patrols from May to November, 1960 in Lake of the Woods, Eagle Lake, the Winnipeg and English River chain, Wabigoon Lake and the Manitou Lakes are considered in this report. Fishing success throughout Kenora District was somewhat higher for 1960 than for 1959. Lake of the Woods, which attracted the largest percentage of anglers showed an increase from 0.73 fish per hour in 1959 to 1.30 fish per hour in 1960. The amount of time required to catch a fish in all waters combined decreased from 1.58 hours in 1959 to 1.17 hours in 1960.

Introduction

As in the past only a very few of the numerous lakes in the Kenora District were utilized to any extent by anglers during the 1960 season.

Only those lakes which are most accessible and experience relatively heavy fishing pressure were sampled and are included in this creel census.

These lakes are Lake of the Woods which is fished by the largest percentage of anglers, followed by Eagle Lake, the Winnipeg and English River chain, Wabigoon Lake and the Manitou Lakes in that order.

Many of the district waters are fished by fly-in anglers on occasion but the amount of angler pressure in these lakes is considered to be negligible and little or no data have been collected. Included in this group of lakes are those which are fished specifically for lake trout during the spring and fall and occasionally in winter. These lakes are numerous and probably all are fished occasionally. It has been impossible to obtain any creel census data for these waters due mainly to lack of transportation facilities and shortage of staff.

Method

All creel census data included in this report were collected by personal contact of anglers by Conservation Officers during routine patrols. These data were recorded in the field on form M.F. 122, creel census forms. Information collected covers the entire open water season from May through to November. Little winter fishing data were collected.

The Creel Census Fishing Log Books (form M.F. 105) which were distributed in 1959 were not used during the 1960 season. The use of these books was considered and, although a comparison of figures from both methods in 1959 showed a striking similarity, and a considerable amount of information was received through this method, it was felt that sufficient information could be collected by personal contact. It was also decided that while Conservation Officers were in the field to check on anglers for infractions, creel census information could be obtained simultaneously and first hand.

During past years it was necessary to compile separate reports for various bodies of water or for various areas in the same lake. For this reason this report will present the results of the 1960 creel census in six parts as follows:

(a) All waters in the Kenora District combined.
(b) Lake of the Woods.
(c) Other waters.
(d) Lake of the Woods (North of Aulneau Peninsula).
(e) Lake of the Woods (South of Aulneau Peninsula).
(f) Lake of the Woods (Sioux Narrows Tourist Area).
(g) Winter Angling - Eagle Lake.

Amount of Information Obtained

During the open water period of 1960, Conservation Officers contacted a total of 1083 anglers. These anglers had spent 3824 angling hours on district waters.

Information as to average size of species taken was collected but this, in all cases, was merely an estimate either by the angler in the case of released fish or by the Conservation Officer for fish retained. Average size of species, therefore, will not be included in this report because of the inaccuracy of information.

Angling Success

Table I indicates angling success for the entire district broken down into specific areas.

"Other waters" include all inland waters sampled excluding Lake of the Woods.

Although the amount of information collected from other waters is comparatively small, it includes data on waters fished specifically for certain species such as lake trout and maskinonge. Fishing for these two species is in most cases extremely slow and is governed by the experience of the angler as well as seasons and weather conditions. Therefore, the rate of success on other waters is far below Lake of the Woods.

On the other hand, angling on Lake of the Woods is almost entirely in search of walleyes which are abundant and may be taken by any angler regardless of experience.

Section (f) of Table I shows the Sioux Narrows Tourist Area to have the highest rate of success. This is due to the accessibility of numerous excellent walleye "holes". Another influencial factor in the high success rate of this area, as well as the remainder of the Lake of the Woods, is that during patrols of the lake it is only in these favourite spots that anglers are encountered. Seldom is an angler checked who is fishing for maskinonge, lake trout or even northern pike which are more difficult to catch.

The percentage composition of catch by species in order of abundance for Lake of the Woods is shown in Table II (B) - Walleye 74.5%, Northern Pike 12.3%, S.M. Bass 11.2%, Lake Trout nil, Maskinonge nil, and other 1.5%. Although lake trout and maskinonge are considered to be quite numerous in this lake, none were encountered during the collection of these data.

Species included in "other species" are, in order of abundance, crappie, sauger, perch, rock bass, bullhead and whitefish.

Crappies may be taken by the hundreds by an angler during the spring in many parts of Lake of the Woods. This species was not included in the census when an angler was encountered with a large quantity taken while specifically angling for this species. This would have increased the angling success greatly and thus been a misrepresentation in determining angling success for sport fish which is the main purpose of the creel census.

A comparison of angling success for Lake of the Woods "1959 Kenora District Creel Census Report" by A. R. Olsen and the angling success for the same lake for 1960 shows a marked increase in success from 0.73 fish per hour in 1959 to 1.30 fish per hour in 1960.

The percentage of walleyes in the creel for 1959 was 63.9% as compared with 71.6 for 1960.

These two factors indicate as previously mentioned that more effort is expended in capturing the more vulnerable species.

In previous years it was assumed that there was a slight error in recording actual fishing time. When asked the length of time spent fishing, many anglers included travelling time on the water in their estimation. For the 1960 census every effort was made to ensure that only actual fishing time was logged. This too, may be a reason for increased angling success on Lake of the Woods as shown in this report.

Summary

Fishing success throughout the entire Kenora District is somewhat higher for 1960 than for 1959, with Lake of the Woods showing a considerable increase.

The amount of time required to catch a fish in all waters combined has decreased from 1.58 hrs. in 1959 to 1.17 hrs. in 1960, whereas the time required to catch a fish in Lake of the Woods for the same two periods has decreased from 1.36 hrs. to .77 hrs. showing this considerable increase in success rate.

The most logical supposition arrived at for the comparatively stable success rate for all waters combined and the extremely high rate of increase in success for Lake of the Woods is that <u>other waters</u> are being fished by sportsmen with fishing experience, and not merely satisfied with filling their creel with the largest possible number of fish but are willing to gamble time and experience against larger but fewer fish.

On the other hand, Lake of the Woods tends to entice a larger percentage of the other type of angler who angles for quantity not quality and who does not have the experience or patience to expend in quest of prize winners.

As this report has been delayed and precedes the 1961 report by only a short period, any suggestions for future collection and compilation of creel census data will be included in the latter.

Suggestions made in the 1959 report were not followed in all respects due to the changes in staff members and transfers within the district of other members, therefore, many of the prosposed methods could not be followed through.

TABLE I

Body of Water	No. of Anglers	No. of Fishing Hours	No. of Fish Caught	No. of Sport Fish	No. of Other Species	% of Sport Fish	% of Other Species	Hours Spent per Fish	Fish Caught per Hr. Fished
A All Waters Combined	1108	3607	3070	3022	48	98.5	1.5	1.17	.85
B Lake of the Woods	330	1115	1445	1418	27	98.1	1.9	.77	1.30
C Other Waters	778	2492	1625	1604	21	98.7	1.3	1.53	.65
D Lake of the Woods North of Aulneau Peninsula	188	581	750	723	27	96.4	3.6	.77	1.29
E Lake of the Woods South of Aulneau Peninsula	142	534	695	695	nil	100.0	nil	.77	1.30
F Lake of the Woods Sioux Narrows Tourist Area	117	350	511	505	6	99.0	1.0	.68	1.46
G Winter Angling Eagle Lake	75	217	98	98	nil	100.0	nil	2.61	.38

TABLE II - Species by Number and Percentage of Total Catch and Percentage of Catch by Species Retained and Released

Body of Water		Walleye	N.Pike	S.M.Bass	Lake Trout	Maskin-onge	Others	Total
A All Waters Combined	# Caught	2270	594	210	44	2	48	3168
	% of Total Catch	71.6	18.7	6.7	1.3	0.2	1.5	
	% Retained	77.3	49.3	76.1	100.0	100.0	39.5	
	% Released	22.7	50.7	23.9	nil	nil	60.5	
B Lake of the Woods	# Caught	1077	179	162	nil	nil	27	1445
	% of Total Catch	74.5	12.3	11.2			2.0	
	% Retained	70.7	34.6	80.8			3.7	
	% Released	29.3	65.4	19.2			96.3	
C Other Waters	# Caught	1110	400	48	44	2	21	1625
	% of Total Catch	68.3	24.6	3.0	2.7	.2	1.2	
	% Retained	81.9	54.0	60.4	100.0	100.0	85.7	
	% Released	18.1	46.0	39.6			14.3	
D Lake of the Woods North of Aulneau Peninsula	# Caught	513	70	140	nil	nil	27	750
	% of Total Catch	68.4	9.3	18.7			3.6	
	% Retained	69.7	40.0	78.5			3.7	
	% Released	30.3	60.0	21.5			96.3	
E Lake of the Woods South of Aulneau Peninsula	# Caught	564	109	22	nil	nil	nil	695
	% of Total Catch	81.1	15.7	3.2				
	% Retained	71.6	31.1	95.4				
	% Released	28.4	68.9	4.6				
F Lake of the Woods Sioux Narrows Tourist Area	# Caught	389	55	61	nil	nil	6	511
	% of Total Catch	76.1	10.8	11.9			1.2	
	% Retained	73.3	43.6	78.6				
	% Released	26.7	56.4	21.4			100.0	
G Eagle Lake (Winter)	# Caught	83	15	nil	nil	nil	nil	98
	% of Total Catch	84.6	15.4					
	% Retained	100.0	100.0					
	% Released	nil	nil					

TABLE III - Comparison of Angling Success by Year
Lake of the Woods and Other Waters Combined

Year	No. of Anglers	No. of Fishing Hours	No. of Fish Caught	No. of Sport Fish	No. of Other Species	% of Sport Fish	% of Other Species	Hours Spent per Fish	Fish Caught per Hour Fished
1958	1002	4475	3825	3407	418	89.1	10.9	1.16	.85
* 1959	3774	21900	13900	13185	715	94.1	5.1	1.58	.63
1960	1108	3607	3070	3022	48	98.5	1.5	1.17	.85

* Data from log books, M.F. 105, included.