Wisconsin Department of Agriculture
and Markets Bulletin

No. 146

Madison, Wisconsin June, 1933

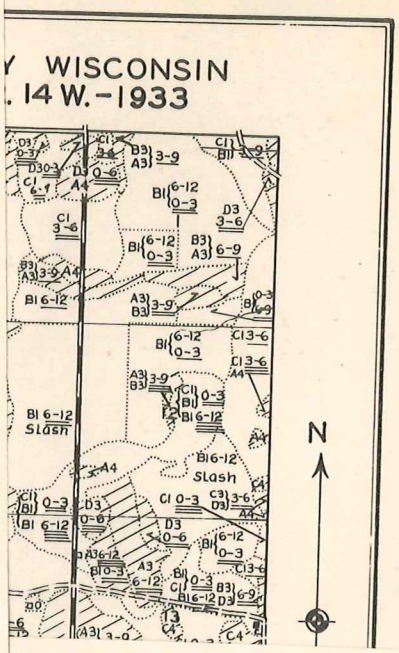
Land Economic Inventory
of
Northern Wisconsin

DOUGLAS COUNTY

By
John S. Bordner, *in charge*
William W. Morris, *forester*
Lamar M. Wood, *associate*
John H. Steenis, *associate*

Division of Fairs and State Development

WISCONSIN
DEPARTMENT OF AGRICULTURE AND MARKETS



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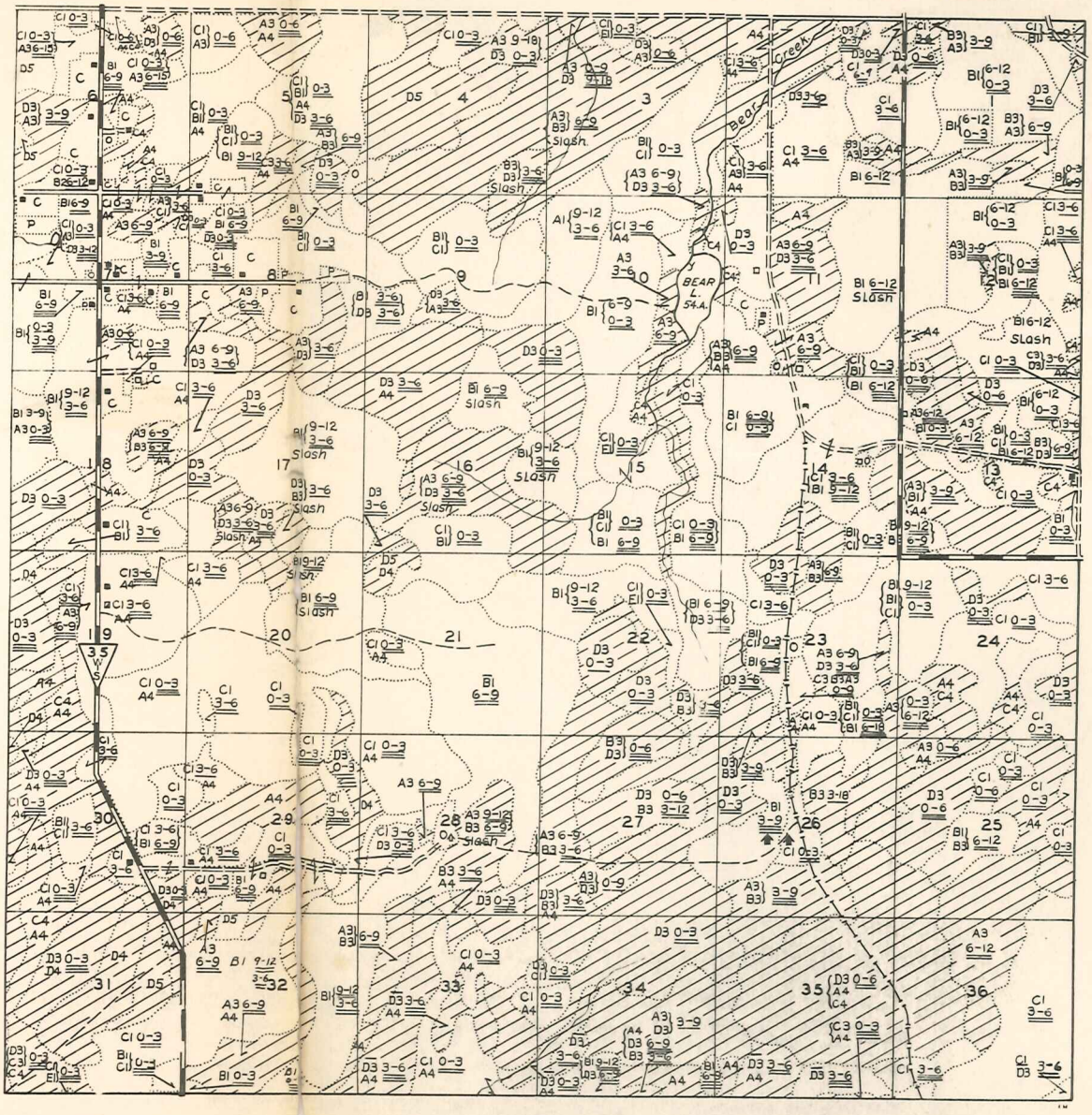
LAND ECONOMIC INVENTORY-DOUGLAS COUNTY WISCONSIN
FOREST AND GENERAL COVER MAP-T. 45 N.R. 14 W.-1933



LEGEND

UPLAND-FOREST NUMERALS 1-2	LOWLAND-FOREST ALL NUMERALS-3	POPPLE C1 C1 PLANTING RECOMMENDED	INFERIOR FOREST COVER O-D1-D5-E1	OPEN SWAMP ALL NUMERALS-4	FARM LAND C-CA-PP-SP- A	ALL SWAMP LAND NUMERALS 3-4

LAND COVER

- COVER BOUNDARY
- A1-HARDWOOD
- B1-HARDWOOD WITH SOME CONIFERS
- B1-INFERIOR B1
- C1-POPPLE WITH SOME WHITE BIRCH
- C1-NON-COMMERCIAL-C1
- D1-SCRUB OAK AND SOME RED MAPLE
- E1-PIN-CHERRY
- A2-HEMLOCK WITH HARDWOODS
- B2-WHITE PINE
- C2-RED PINE(NORWAY)
- D2-JACK PINE
- A3-BLACK ASH, ELM, AND MAPLE
- B3-WHITE CEDAR
- C3-TAMARACK
- D3-SPRUCE (BLACK)
- D3-BALSAM
- A4-TAGALDER, WILLOW, RED DOGWOOD, ETC.
- B4-CAT-TAIL MARSH
- C4-GRASS MARSH
- C4-SEDGE MARSH
- D4-LEATHERLEAF-BOG
- D5-RECENT BURN
- O-OPEN LAND (NO FOREST GROWTH)
- C-CLEARED FARM CROP LAND
- CA FARM CROPLAND WITH STUMPS
- PP-PERMANENT PASTURE
- SP-STUMP PASTURE
- A-IDLE OR ABANDONED FARM LAND

DENSITY OF STAND

GOOD MEDIUM POOR SCATTERED

DIAMETER CLASSES

0-3, 3-6, 6-12, ETC. (IN INCHES) AVE-DIAM-CLASS FOR AREA

0 MILE

ROADS AND IMPROVEMENTS

- HARD SURFACED ROADS
- IMPROVED GRAVEL ROADS
- PARTIALLY GRAVELLED ROADS
- IMPROVED DIRT ROADS
- UNIMPROVED DIRT ROADS
- -X-X- FIRE LANE
- OCCUPIED HOUSE
- UNOCCUPIED "
- SUMMER HOME
- NUMBER OF
- TELEPHONE LINE
- RAILROAD
- FIRE TOWER
- STORE
- LOGGING CAMP
- CEMETERY
- ----TRAIL
- SCHOOL
- CHURCH
- POST OFFICE
- FILLING STATION
- SUMMER HOTEL
- POWER LINE
- ABANDONED R.R.
- SAWMILL
- CREAMERY
- CHEESE FACTORY

AQUATIC VEGETATION

P-PLANKTON LAKE BLOOMING
FP-DUCK WEED AND LIKE PLANTS
SP-SUBMERGED PONDWEEDS
EP-ROOTED WATER PLANTS WITH FLOATING OR EMERSED LEAVES AND STEMS
EP-SEDGES AND REEDS

LAKE MAPPING

- SHORELINE
- BOG SHORE LINE
- STRAND 10' WIDE
- BANK 10' HIGH
- FLAT DUE TO WATER RECESSION 75' WIDE BANK 10' HIGH
- ST-SHOAL BOTTOM WITH DEBRIS
- B- " " " OF STONES
- B- " " " MUCK
- C- " " " CLAY
- Y- " " " SAND
- b- " " " GRAVEL
- CAMP SITE
- 5A-AREA OF ENTIRE LAKE IN ACRES (EXCEPT LAKES ON COUNTY BOUNDARY)

L. LAKE P-POND
B.P BEAVER POND
B.D. " DAM
X-BATHING BEACH

HARDNESS OF WATER

VS-VERY SOFT M.H-MEDIUM HARD
S-SOFT M-MEDIUM H-HARD

* NAME NOT YET APPROVED BY THE STATE GEOGRAPHIC BOARD.

WISCONSIN DEPT. OF AGRICULTURE AND MARKETS IN COOPERATION WITH THE WIS. CONSERVATION DEPT. AND THE WIS. GEOL. AND NAT. HIST. SURV.

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(Issued monthly)

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WM. F. RENK, *Commissioner*
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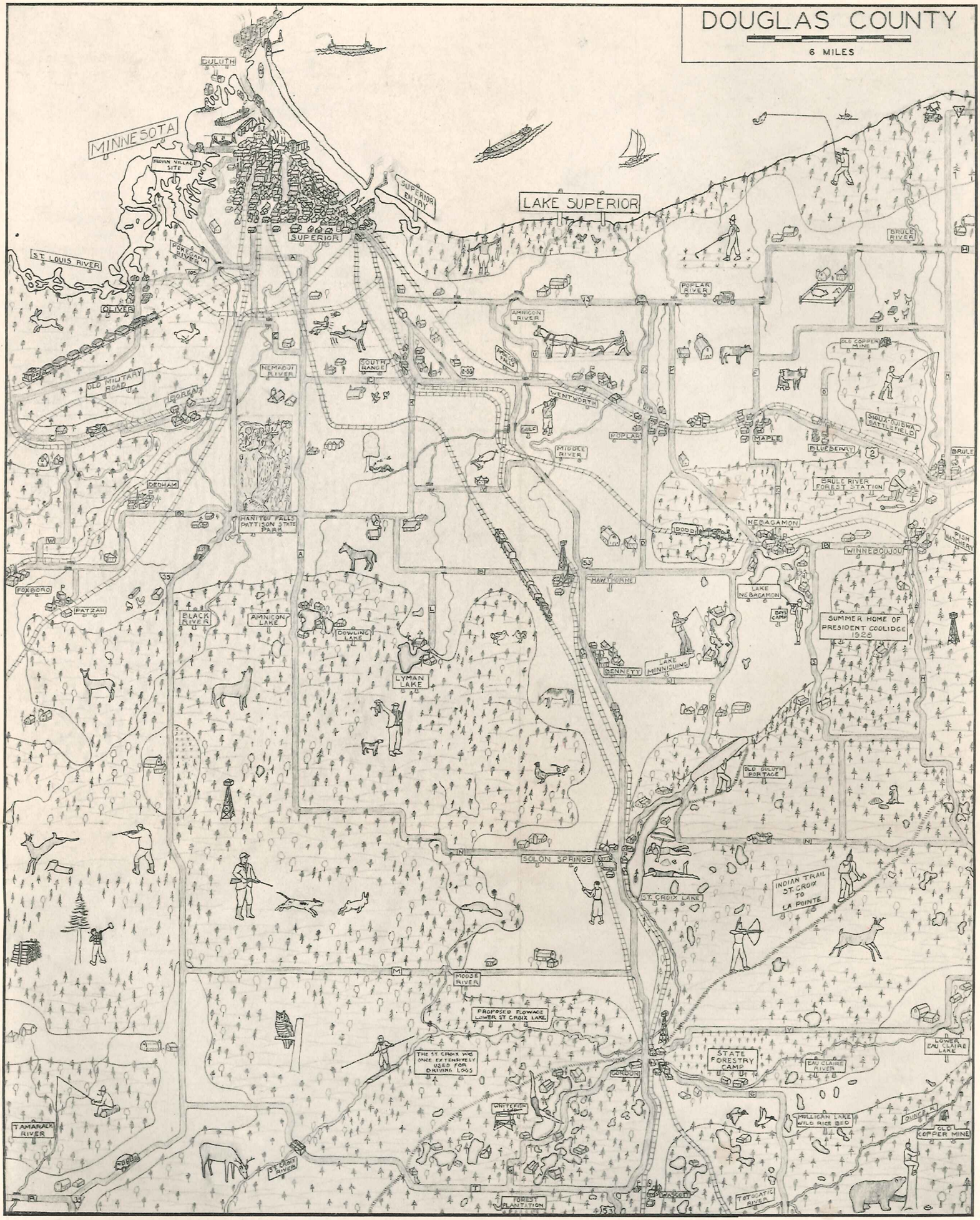
DOUGLAS COUNTY
6 MILES
DULUTH
MINNESOTA
INDIAN VILLAGE SITE
SUPERIOR ENTRY
LAKE SUPERIOR
SUPERIOR
ST. LOUIS RIVER
POKEGAMA RIVER
OLIVER
BRULE RIVER
POPLAR RIVER
AMNICON RIVER
OLD COPPER MINE
OLD MILITARY ROAD
NEMADJI RIVER
GULL RANGE
WENTWORTH
SIOUX-CHIPPEWA BATTLEFIELD
POPLAR
MAPLE
BLUEBERRY
MIDDLE RIVER
BRULE RIVER FOREST STATION
DEDHAM
NEBAGAMON
WINNEBOUJOU
HAWTHORNE
FOXBORO
PATZAU
BLACK RIVER
AMNICON LAKE
DOWLING LAKE
LAKE NEBAGAMON
SUMMER HOME OF PRESIDENT COOLIDGE 1928
LYMAN LAKE
LAKE MINNISUING
BENNETT
OLD DULUTH PORTAGE
SOLON SPRINGS
ST. CROIX LAKE
INDIAN TRAIL ST. CROIX TO LA POINTE
MOOSE RIVER
PROPOSED FLOWAGE LOWER ST. CROIX LAKE
THE ST. CROIX WAS ONCE EXTENSIVELY USED FOR DRIVING LOGS
STATE FORESTRY CAMP
EAU CLAIRE RIVER
LOWER EAU CLAIRE LAKE
GORDON
WHITEFISH
MULLIGAN LAKE WILD RICE BED
TAMARACK RIVER
OLD COPPER MINE
FOREST PLANTATION
TOTOGATIC RIVER

Plate I

Table of Contents

LAND ECONOMIC INVENTORY OF NORTHERN WISCONSIN

Introduction

"Land utilization involves more than a mere determining of what each and every acre of land can be used for, or what crops it can best grow. This is the first step; but having made that determination, we arrive at once at the larger problem of getting men, women, and children—in other words, population—to go along with a program and carry it out." *Quotation from President Franklin D. Roosevelt's book* "Looking Forward".

Land is frequently referred to, as the only inexhaustible natural resource. This implies, of course, that it is not being wasted, and that it is being used to produce some product of use to society. It also implies that the commodity produced is the one best adapted to the land and most useful to society as a whole.

Before the white man, the Indians occupied the land of Douglas county. Their wants were few, and though comparatively few in number, they were frequently without food, and their migrations and warfare can be attributed largely to lack of knowledge of how to make land productive. In Douglas county as elsewhere the transition in land use came with the advent of the white man, and land use planning has become important.

Where land has been scarcely used at all except in harvesting its virgin crop of timber, planning is relatively simple as compared with regions long occupied. Douglas county lies in one of these regions. Much of the virgin forest with which the county was covered was harvested only recently, and scarcely any was cut prior to 60 years ago. This virgin forest is now practically all gone; partly harvested and partly destroyed by fire. The development of land for farm use started without any plan, and some land was not well selected. Much of this land not well suited to farm use has now been abandoned. This land has produced good timber and should be put to that use again.

The economic inventory of Douglas county land has been taken therefore as a guide for a planned land use. Much of this data is already in the hands of the county's land use committee, and has been used by them as a guide in allocating land to different uses. Land better adapted to forest use has been blocked out for county and state forests. The areas where agriculture has progressed and maintained itself have been carefully delineated as a guide to those who are engaged in farming. The same has been done with respect to recreational use. The county and the state are therefore in a position to adjust the population of the county to this planned use, and thereby reduce the immediate cost of state and county government and increase the ultimate income of the county through increased industry, agriculture and commerce.

Cooperating Agencies

We are indebted to the following for assistance given us in the preparation of this bulletin:

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The Wisconsin Conservation Department cooperating in a financial way.

The Wisconsin National Guard for loan of camping equipment.

DOUGLAS COUNTY

LOCATION

Douglas County is in the extreme northwest corner of Wisconsin. The St. Louis river and Lake Superior form the boundary on the north. Minnesota borders it on the west. The harbors of Superior and Duluth lie opposite the county's northernmost point. These ports are at the end of the proposed deep sea waterway.

ELEVATION

The water level of Lake Superior is about 600 feet above sea level. The lower portion of the Lake Superior lowland bordering Lake Superior is on an average about 100 feet above the present lake level.

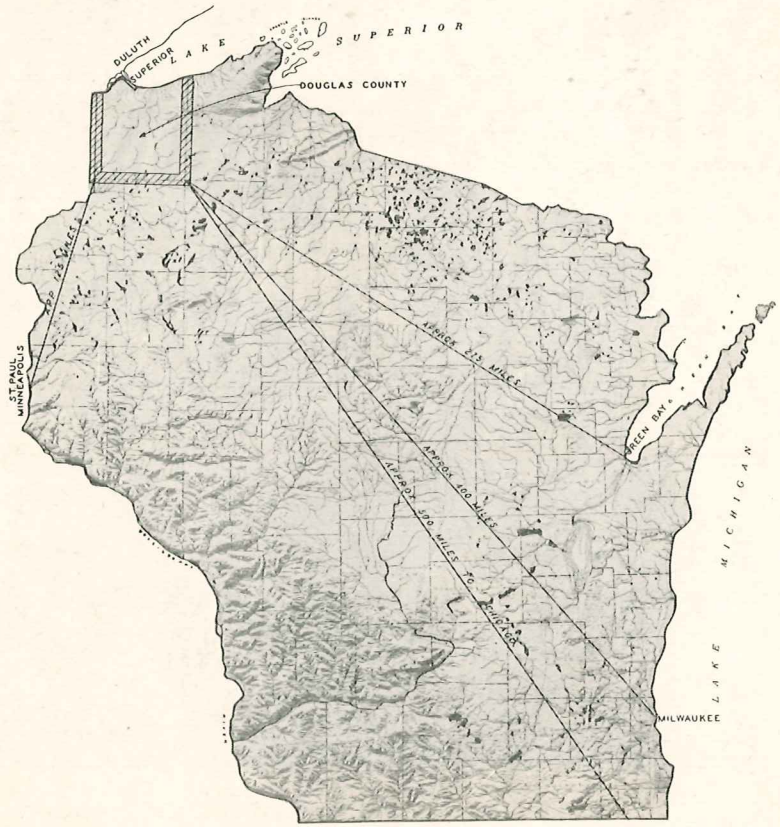
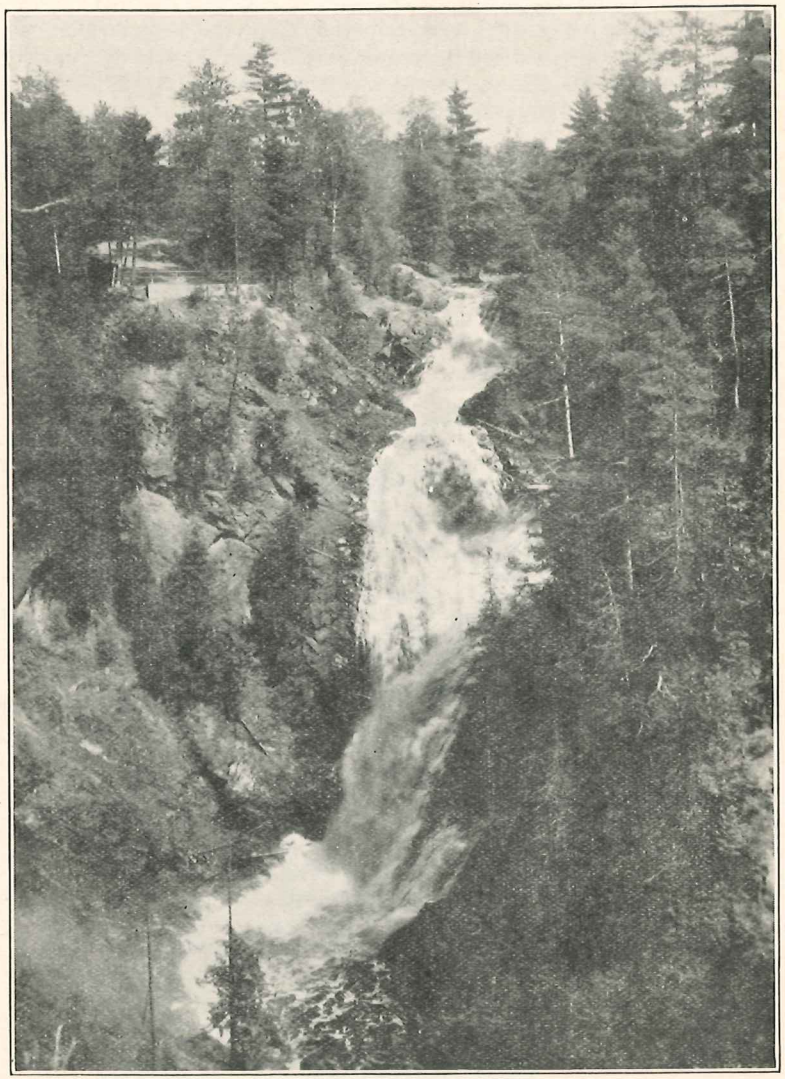


Plate II

There is a gradual rise within this low land west and south. On the Minnesota line the lowland is more than 200 feet above the lake level. A similar rise, though more abrupt, follows the Black river south and east. The top of Manitou Falls on the Black river, is about 400 feet above the lake level. Amnicon and Lyman lakes, just out of the lowlands, are about 600 feet above Lake Superior. The divide of the



Courtesy Wisconsin Conservation Department

Manitou Falls in Pattison State Park

drainage north to Lake Superior and south to the Gulf of Mexico, has numerous ridges which are as much as 700 feet above the present level of Lake Superior, and some hills within this region reach 780 feet. The divide crosses the county from southwest to northeast. Southward the elevation above the Lake Superior level recedes quite rapidly. St. Croix lake is approximately 450 feet higher than Lake Superior. Where the St. Croix river crosses the southern Douglas county line, it is approximately 100 feet lower than Lake St. Croix. South of the St. Croix river there are a few places with elevations approximately 600 feet above Lake Superior, and one hill on the Bayfield–Douglas county line in Town 43 N. Range 10 West, reaches an elevation of 638 feet.

TOPOGRAPHY

The Superior lowlands are level to slightly undulating. The stream valleys, due to recent origin and heavy surface drainage, are deep and narrow. In many places the slopes are almost precipitous, and are frequently more than 100 feet in height. Many stream valleys are still so young that they are little more than deep, narrow ravines. This area lies within an old lake bed. The shore line of this old lake is approximately 550 feet above the present level of Lake Superior. This is shown as a heavy black line in Plate III.

The Lake Superior–Mississippi divide lies some distance south of this old shore line. This region is a table land with an undulating to flat surface, with occasional hills. There is much land in this region that is poorly drained. This is due to a sluggish surface run-off and poor vertical drainage, resulting from a rather shallow earth mantle over old bed rock.

The Heavy Sand Drift to the southeast is level to rolling. The extreme southeastern portion of the county (Ounce–Totogatic area) is similar to the table land of the Lake Superior–Mississippi divide.

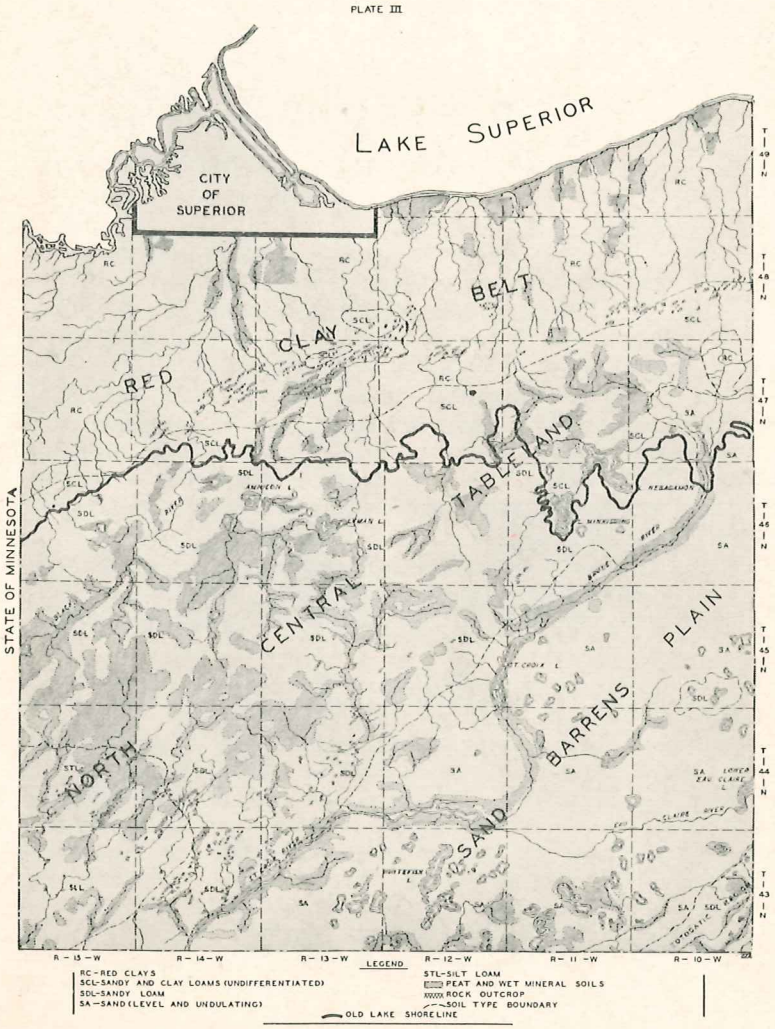
ROCK OUTCROPS

Conspicuous rock outcrops appear within the Lake Superior lowlands. Manitou Falls in Pattison Park is 165 feet high, where the water of the Black river drops over the edge of a rock outcrop. South Range just south of the village of South Range is another very conspicuous outcrop. Eastward from South Range, this same rock formation comes to the surface in numerous places. Other very conspicuous outcrops appear along the lower St. Croix and in the extreme southeastern part of the county. Smaller and therefore much less conspicuous outcrops appear in portions of the table land of the Lake Superior–Mississippi divide. These rock outcrops were explored for copper as early as 1850.

EARTH MATERIAL

The earth material from which Douglas county soils have been developed can be attributed largely to glacial action, except within the Lake Superior lowlands. Here the earth material, largely clay, is sedimentary material laid down in the water of the older lake. The earth material of the table-land to the south is extremely variable in texture, depth and stoniness. This indicates that the glacier carried part of it a long distance and some was picked up nearby. An example of the latter, is pockets of red clay occasionally encountered

PLATE III



on this table-land but more often near the old lake beach. Successive glacial movements have also brought earth material from different sources.

The sand plain lying south of the Lake Superior–Mississippi table-land, and reaching to the vicinity of the Ounce river, is composed of a deep mantle of sandy material. This was spread over this area by water flowing from in front of the melting glacier. This mantle of sandy material varies in depth. It is known to be at least 100 feet deep near the Bayfield county line in the town of Highland. At the junction of the Eau Claire and St. Croix rivers the old stream bed is cut down into this bed of sandy material so that its depth is only a few feet over red clay.

PHYSIOGRAPHIC PROVINCES

Douglas county land can be divided into at least four distinct areas, the nature of which are directly attributable to location, elevation, topography, and the origin, nature and manner of deposition of the earth material found in these provinces. These are (a) The northern red clay belt: (b) The north central table-land; (c) The south central or sand barrens plain and (d) the Ounce–Totogatic region. (See Plate III)

LAND ADAPTATION

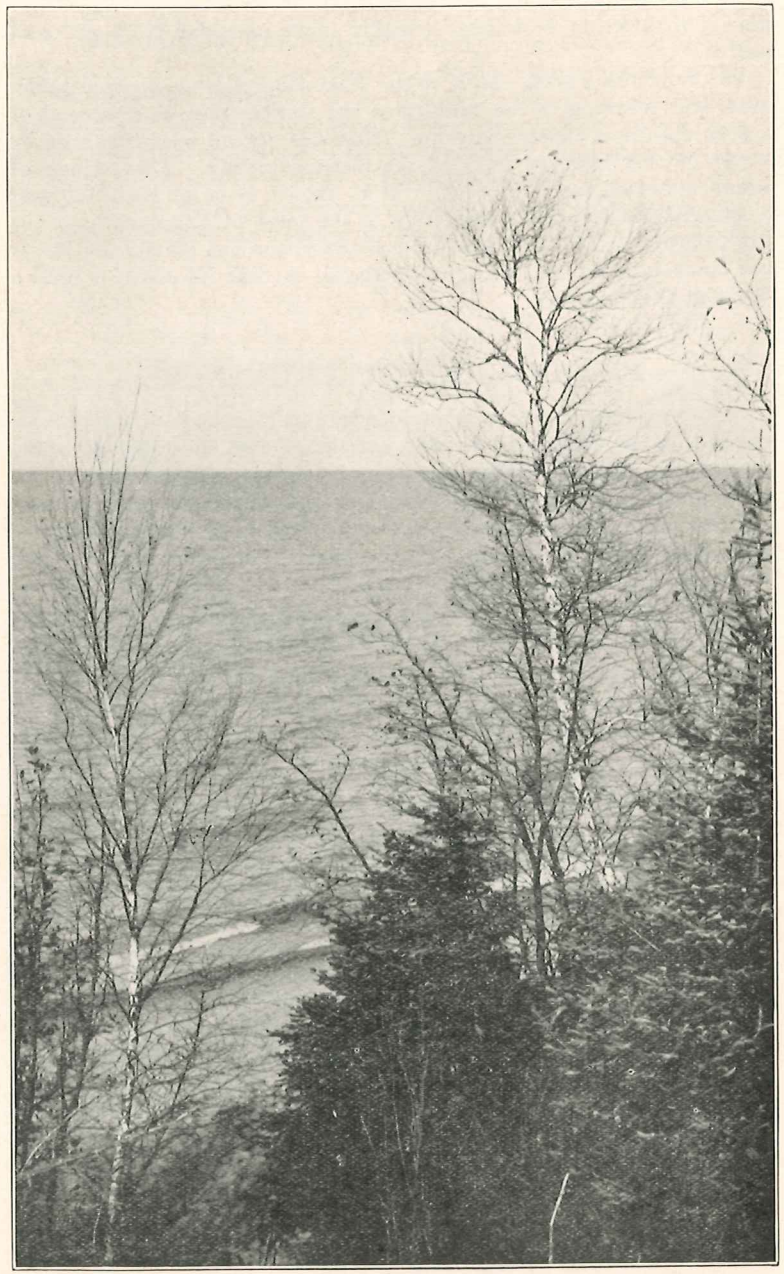
The adaptation of the land in these four distinct physiographic areas as far as their utilization by man is concerned, depends upon **markets, climate,** and **soil.**

MARKETS

The material products from Douglas county land will always be in part from farms and in part from forests, lakes, and streams. Duluth and Superior form local markets for farm produce. The county is also well supplied with water and rail transportation to outside points. Diversified production of farm produce depends largely on local markets. Other factors limiting this diversification are, of course, climate and soil. Thus far dairy products have constituted the primary buying power coming from Douglas county farms, and forest products from lands not used for farms. The thousands who are annually attracted by the county's fine summer climate to her lakes and streams, add materially to the home market for farm produce, and add liberally to the gross income of the county for services.

CLIMATE

Summer days in Douglas county are hot, but the nights are generally cool, and conducive to comfort and health. The winters are cold but the atmosphere is dry and invigorating. The Lake Superior lowland is also favored with a very mild autumn season. The frost free season, mean seasonal temperature and seasonal distribution of



Shore of Lake Superior, Douglas County

rainfall are the primary climatic factors determining land use. The Lake Superior lowland has its growing seasonal temperature so influenced by the waters of Lake Superior, that it has a growing season of about the same duration as Clark county in central Wisconsin. The balance of the county has a growing season of about the same duration as Chippewa, Barron, and Rusk counties.

The average rainfall per month for the months of June and July is 4.2 inches; August and September, 3.2 inches, and April and May about 2.5 inches. Approximately 60 per cent of the annual precipitation falls during these six months. The average annual precipitation in Douglas county is about 28 inches.

SOIL

The nature of any particular soil determines the natural adaptation of land within any particular climatic condition. The nature of any soil depends on:

1. The earth material from which it has developed.
2. Topography, drainage, and stoniness.
3. The extent of soil development.

The sources of earth material now found in Douglas county have already been discussed, and the major land provinces are shown on Plate III page 10. Topography, drainage and stoniness, have also been discussed.

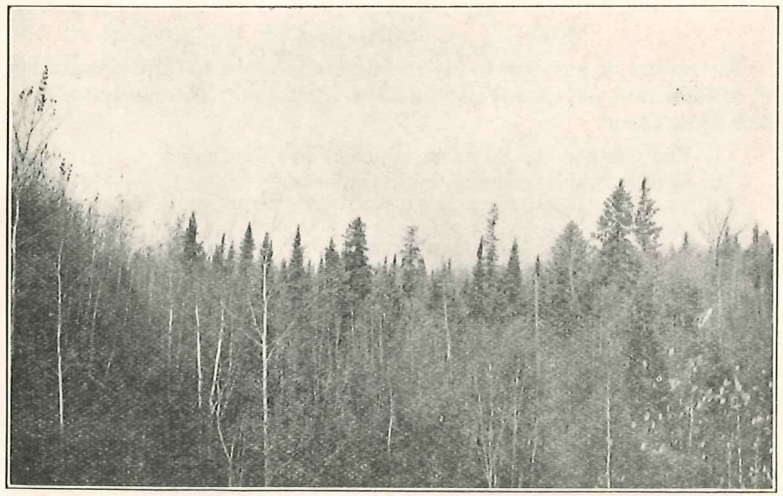
Mineral Soils

Soil Development in the Lake Superior Lowlands

This old lake bed is composed largely of red clay, containing considerable calcareous material. This basic material is very helpful in making this heavy, sticky clay more friable. The extreme fineness of this clay, however, slows up vertical drainage and air penetration into the soil to such a degree that this soil is not well developed. Seasonal dryness causes this soil to shrink and crack at times to a considerable depth which may favor soil aeration but makes tillage extremely difficult. This soil does not dry out readily in the spring, and the planting of crops is therefore delayed. A cut five feet in depth in a red clay bank several miles east of Foxboro, showed the soil discoloration to be very shallow, in places scarcely more than six inches. This top soil was somewhat nutlike in structure, and was brown in color due to discoloration coming from the decay of the organic matter on the surface. At two feet the clay was almost as sticky and tight as it was at five feet. There was no evidence of blue clay within this five foot profile, which shows that there is no constant water saturation in this clay to this five foot depth. Where sand is mixed with this red clay, it becomes more friable, and takes on the nature of a loam. This is quite common in the area between the old lake shore line and the lowland red clay. Frequently this sand was left as a mantle of beach sand over the red clay, and is covered with a typical sandy soil vegetation. Where it is not too deep, tillage soon mixes the sand and clay and produces a sandy clay

loam. This red clay belt requires drainage to improve its texture. This, of course, is an expensive process and can only be engaged in when the crop yields will pay for the expense incurred.

Crops best adapted to this clay belt are: pasture, hay, clover seed, small grains and root crops. Potatoes do not do well except where there is considerable sand mixed with the clay. The virgin timber was largely white pine. Very little pine remains. Aspen "popple", and balsam fir with some scattering better hardwoods,—the latter largely in the deep narrow stream valleys, form the present forest cover of this lowland red clay area. There is evidence that there



Typical Poorly Drained Land in Red Clay Belt

were some hardwoods of poor quality growing in the virgin forest. The badly eroded land of this red clay belt should again be reforested with white spruce and white pine.

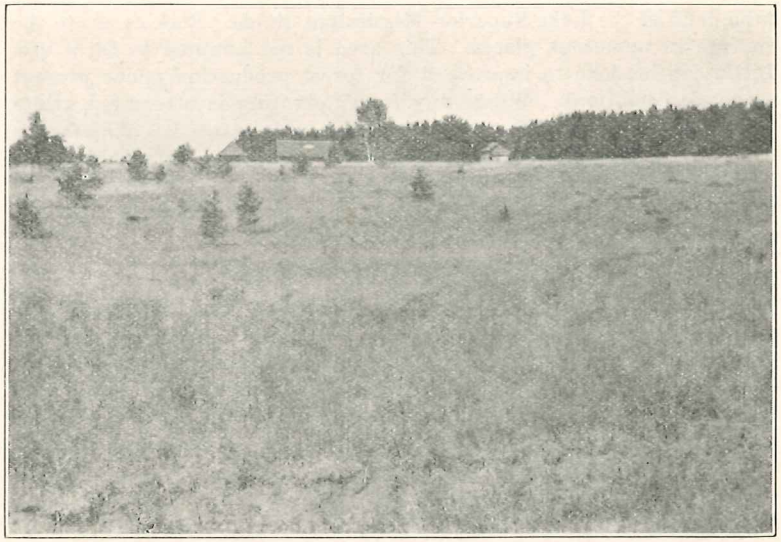
The Lake Superior–Mississippi Highland

The soil within this region is sometimes referred to in places as a soil complex because the earth material varies greatly. Patches of red clay as one extreme and sand as the other, may be found within a ten acre area. This is particularly true in the region bordering the old lake beach. South of this old beach and extending west from Lake Nebagamon to Black lake, the depth and composition of the earth material is extremely variable, but pockets of lake clay are not common. The immediate vicinity of the Nebagamon lake region is composed of a fairly uniform and well assorted earth material of considerable depth. While the topography is not the most desirable for farm land, the soil, which has been developed from this earth material containing some red clay, is well adapted to farm use. A soil

profile in this region shows that the movement of air and water are sufficiently free to have developed a relatively deep mellow soil. This soil produced the best hardwood in the county, and also was an optimum site for white pine.

The region adapts itself to a diversified agriculture. Good yields of small grains and potatoes are common. The region of this highland extending westward from Solon Springs and Bennett, is better adapted for forests. The ridges and slopes have a fairly well developed soil but stoniness is general. There is also a very large acreage of peat and wet mineral soil swamp. This is due to rock relatively close to the surface and poor surface run-off.

This western highland region shows very little agricultural development and a very high percentage of tax delinquency and county forest land. While there is some land adequate for farm use, such use should be limited to land on well established highways. The wet land in this region is largely wet mineral soil. The ridges frequently are full of cobblestones. Balsam fir and aspen are common throughout this region. This growth has come largely since the pine was cut. Much of this second growth has been removed in recent years. Fires have destroyed much reproduction. Extensive areas are open or covered with a scattering growth of pin cherry and aspen. Much of this area adapts itself to the production of white spruce, and this species should be used to supplement the natural reproduction. Norway spruce and, in some cases white pine, may also be used. The pine should be used on the better drained ridges and spruce on the more



Courtesy Conservation Department

Abandoned farm showing field growing up to jack pine. In the background may be seen a good stand of jack pine

moist sites. The peat swamps are not recommended for planting sites. Forest growth on these sites should however be protected and managed, for watershed and game protection.

The Sand Barrens Plain

This region is part of the sandy drift which extends in a northeasterly direction toward the Apostle Islands. While the earth material is largely sand, there are a few places where it is of finer texture. One such place is east of Rock lake where there is an area of sandy loam. There is also some loamy sand along the Eau Claire river. Vertical drainage is excessive throughout this region. Where not shaded by some sort of forest cover, the soil heats up very quickly and excessive evaporation results. Land abandonment for farm use has been very general in this region. This in itself is a very clear index that fertility and moisture for adequate farm returns are lacking. Much of the area is being zoned out for forest use. Where fire protection is adequate, large areas will again produce jack pine naturally. Sod grown and scrub oak and aspen areas must be planted. The species to use depends upon the soil. Where some evidence of cementation in the soil appears at depths of from two to three feet, there is no reason why Norway and white pine should not be planted. Soil profiles indicate that cementation is quite common throughout this region, wherever scattering aspen "popple" is present.

The Ounce–Totogatic Region

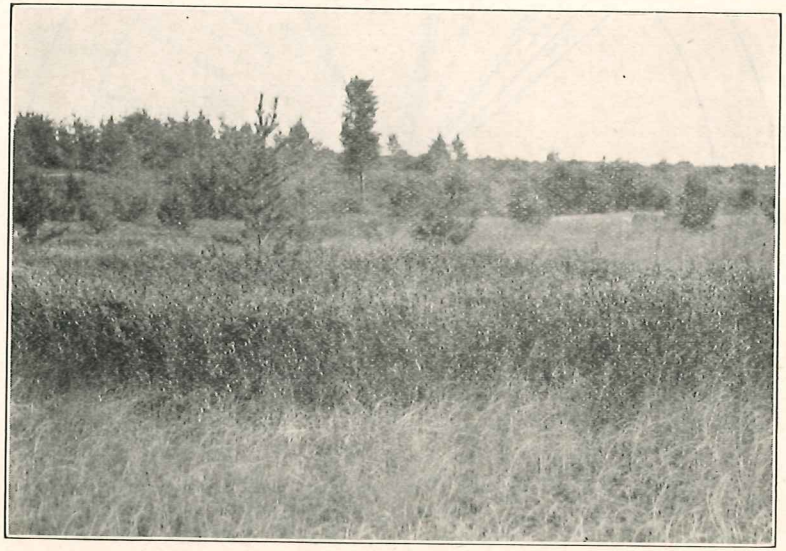
This region is not extensive. Its nature is similar to much of the table-land of the Lake Superior–Mississippi divide. Rock comes to the surface in numerous places. This area is not adapted to farm use. Little can be done to improve it for forest production under present economic conditions. Where any forest planting is attempted, white spruce and possibly Norway spruce, should be used. White pine should never be used here because wild currants and some wild gooseberries are found everywhere. It is doubtful whether these host plants of the white pine blister rust can ever be eradicated in this area.

Peat Soils

Within the four major physiographic provinces are numerous areas of land where the water table is so near the surface that soils known as muck and peat have been produced. These areas are surrounded by borders of wet mineral soil. Since such soils are not adapted to farm use under normal economic conditions, except for very special uses, they are classified and discussed only from the standpoint of timber production. The depth of peat was not determined since it is known that most of these peat beds are shallow. The nature of these peat soils as determined by the plant growth upon them was followed in this classification. At the one end of the series appears the dark brown to black peat capable of growing good grass and swamp hardwoods such as elm, black ash, and red maple, and frequently tamarack

and cedar, and at the other end is found the leather leaf, sphagnum moss bog.

All suffer from too much water. Seasonal drainage, however, is favorable to overflow lands, and these have the darker and more fertile peat. Where some mineral sediments have been mixed with this peat, the soil is called muck. This is common in overflow lands. Next in order come cedar swamps where there is always some drainage, but the decomposition of the peat (largely woody) is slow, due to the water being very cold. This cold condition also favors the production of sphagnum moss. As time passes, this spongelike material of sphagnum slows up drainage and poisons the water held within its spongelike mass. With this change comes the transition to the black spruce type. The succession continues until only black spruce remains, and finally as the acidity of the peat mass becomes unfavorable to black spruce, the final succession is the leather leaf-sphagnum bog. Deep sphagnum bogs produce the peat of commerce of Germany and Ireland. The sphagnum bogs of Wisconsin are too young to have much commercial value. All swamp areas have an underlying so-called perched water table, which is almost impermeable to water in vertical drainage. This perched water table varies from blue clay to a black colloidal mass similar to rubber in texture. Artificial drainage causes these perched water tables to disintegrate through oxidation, and in extreme cases, excessive vertical drainage may result. Such has been the case where shallow peat beds perched over a sandy subsoil have been drained.



Courtesy Conservation Department

Partly burned bog near the Washburn–Douglas county line. In the bog are jack pine, wire grass and dense masses of leather leaf. Such bogs make excellent roosting grounds for sharp tailed grouse and prairie chickens. In the background may be seen open jack pine grassland.

Since no drainage in the utilization of Douglas county swamp land is economically feasible at present, the classification of the swamp lands is made in terms of their present adaptation. The classification follows:

(a) The best type of swamp, (dark peat and muck) capable of producing grass, swamp hardwood, and tamarack and balsam, depending upon drainage.

(b) Swamp capable of producing primarily cedar.

(c) Swamp capable of producing primarily black spruce.

(d) Swamp capable of producing only leather leaf-sphagnum vegetation.

CLASSIFICATION OF TOTAL AREA

DOUGLAS COUNTY

1931

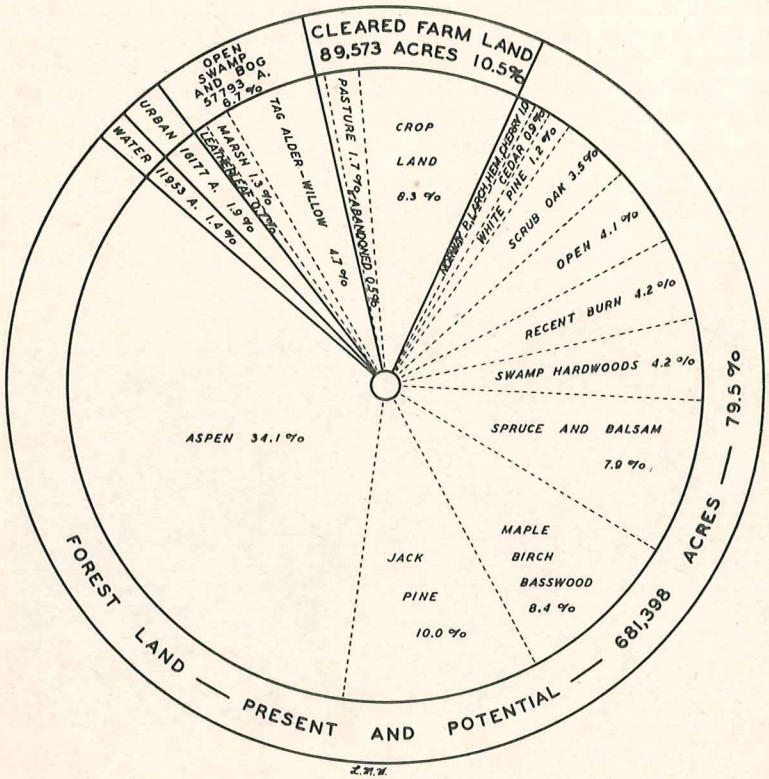


PLATE IV

TABLE I. DOUGLAS COUNTY COVER CLASSIFICATION IN ACRES BY TOWNSHIPS BY TYPES.

DESCRIPTION						SWAMP FOREST LAND																																
						*SPRUCE PREDOMINANT									LARCH PREDOMINANT						CEDAR PREDOMINANT									ASH & ELM PREDOMINANT									JACK PINE PREDOMINANT					
						DIAMETER CLASSES IN INCHES																																				
						0—3			3—6			6—12			0—3			3—6			0—6			6—12			12—18			0—6			6—12			12—24			0—3			3—6			6—12		
						DENSITY OF STAND																																				
TOWNSHIP	RANGE	WATER	LEATHER LEAF	MARSH	TAG ALDER WILLOW	G	M	P	G	M	P	G	M	P	G	M	P	G	M	P	G	M	P	G	M	P	G	M	P	G	M	P	G	M	P	G	M	P	G	M	P	G	M	P	G	M	P
43 N	10 W	197	382	327	639		35	14	89			48				83		32	48		5									100	13	80	1	272	1				99	1115	1291	299	1006	1998	32	152	80
43 N	11 W	1045	879	524	200		248	32	112	704	160					32	120		240		1										5			48	48				296	512	768	280	1026	1462	232	320	387
43 N	12 W	2040	249	150	1250	50	122	702	86	173	360					32	8															144		48					208	629	544	1416	3289	2065	80	102	123
43 N	13 W	983	60	224	311	101	27		1	1595	128								32						143							776		112	208			365	1162	864	224	919	3213	22	8	483
43 N	14 W		161	503	1753	96	106			92	208		46							128									267	32	48	416	1081	16						272						
43 N	15 W		24	459	1984	239	160	219	176	623	294	48	48					16	69	114									14	265	234		1054	342			112									
44 N	10 W	560		223	484	256	152	2	88	8																				64		8						1476	1647	2001	1531	1663	1028	696	1456	440
44 N	11 W	361	372	510	569		231	1		50	65				48				16			160	129	64							98						885	1355	589	543	1587	1339	176	40	321
44 N	12 W	348	2	702	2064	48	448	416	83	312	88	16	48						32	64		472								48	16		1022	113	2				144	513	160	728	486	2390	14		112
44 N	13 W	49		38	1839	80	464		690	942	200	768	307	178				72				64		523	80					1	344	128	1146	232	66			160	3			158	2	275			
44 N	14 W		176	503	1723	2	861	314	56	1250	813		65			8				32		8	32			64		183		2	156		216	2482	600											
44 N	15 W		35	1494	1021	371	241	289	96	1614	687		212	154				1	80			5	96		178					32	221	600	40	475	64											
45 N	10 W	382	64	333	69	75	5	1		81					5																													
45 N	11 W	694	22	349	13		45	2	672	1373							5				112	16															3575	3917	2953	579	2535	504	322	757	176
45 N	12 W	659	96	105	1698				272	263	176		96	305						16		96								128		3					800	1675	1830	131	818	176	480	651	16
45 N	13 W			797	1824	232	437	119	82	418	181		231	256					286		2	20	267		98	208				456	3		399	1036	232					64	149	53		80		98	
45 N	14 W	56	433	412	1009	177	938	726	224	1810	627		47	56						58		50	168	101	90	178				35		8	336	167											
45 N	15 W	129	1603	424	1961	20	221	1351	288	731	350	318	435	101							179	24	32		8				205	127	80	352	1865	408			2					176			
46 N	10 W	24	1	3	10	80	3		3	22			762						3			85	80		304				576	215	101	1275	428	48											
46 N	11 W	1113	11	80	363	259	602	148	430	236	101	48	130				1			32		3		399									144					128	1298	1353	318	405	601	240	1188	3590
46 N	12 W	6	124	356	2061	675	243	348	452	965						83			144	64	48	328	147						34	114	24	259	293						66		66	153	147		80	348
46 N	13 W	629	294	525	2168	118	171		1090	707	907	185	520			2						32		168	115				175	822	274	2	319	80					2						
46 N	14 W	423	773	922	3122	320	2	200	112	792	358		234												112				651	6	32	98	379	80											
46 N	15 W	22	66	151	550		34	112	160	784	651			96	2	2			6			88			96					758		80	350	416		48	96								
47 N	10 W	57	40	166	227	13	333	112	322	230	101	113				5			309	40	472	379	32		72					421	240	48	377	16			48								
47 N	11 W	711	19	164	1208	16	69	48	822	734							2	64			80	178			64				424	256	16	96	104	16				184	374	319	118	176	216	162	59	96
47 N	12 W			73	985		278	224	3	66	224			74							16	46							64	296	224	190	362	16								58			
47 N	13 W		2	189	1655			240		186	661																			270		48		88											
47 N	14 W	2	36	134	215		8	211	148	320	664	416	341																		88	88	112	455											
47 N	15 W				199		56	48			224			112																228	56		53	24											
48 N	10 W			45	274		39	339	392	1044	567		204	295								40								48			104											
48 N	11 W			8	520		264		198	95	194	2																			208	327											
48 N	12 W	102		80	1023			128	80	458	384		304	16						3			5						296	32		32	64											
48 N	13 W				2071		464			283	128		128																	16		66											
48 N	14 W	9		293	807		96		240	499	505	8	144									32	192	192					400	192			1228			301								
48 N	15 W	1176		16	56			496																					224														
49 N	10 W	96		48	960	48		32		283	416		1362	144																			64											
49 N	11 W	32		57	1266		232	320		187	168	278	438																															
49 N	12 W	48		2	112				240	1090	176	128																															
49 N	13 W																																											
49 N	14 W				212					45			79																															
49 N	15 W			5																																								
TOTALS BY DENSITY						3276	7635	7194	7707	21065	10766	2376	6181	787	2	300	136	185	1265	551	915	2126	1180	1590	1217	450		183		3449	5653	2417	6776	3719	3361	256	48	719	8163	14329	13093	6444	14123	15670	2456	4911	6172
TOTALS BY TYPES		11953	5924	11394	40475	67,987 ACRES									2,439 ACRES						7,661 ACRES								36,398 ACRES									85,361 ACRES								
% BY TYPES		1.4	0.7	1.3	4.7	7.9 %									0.3 %						0.9 %								4.2 %									10.0 %								

*SPRUCE PREDOMINANT INCLUDES BALSAM FIR.

ABBREVIATIONS : GOOD - G MEDIUM - M POOR - P.

PINE FOREST LAND

NORWAY PINE PREDOMINANT

DIAMETER CLASSES IN INCHES

0 — 3			3 — 6			6 — 12			12 — 30		
DENSITY OF STAND											
G	M	P	G	M	P	G	M	P	G	M	P
	64	224			136			150			
						8	16	32			
						32	158	11			
					128					2	2
							50	296			48
	50						96	2			
	2			64			32	125			
							84				
								11			
	32					32					
32			96			8		1	8	109	104
96						48	197	1123			
				224							
				192							
			176		442		56	314		16	
					144						
128	148	224	272	480	850	144	689	2065	8	127	154

5,289 ACRES

0.6 %

WHITE PINE PREDOMINANT

DIAMETER CLASSES IN INCHES

0 — 3			3 — 6			6 — 12		
DENSITY OF STAND								
G	M	P	G	M	P	G	M	P
	111			2			136	
						5	48	
							73	
						2		16
								144
								67
				1			89	
							16	
							48	
							64	645
	64			126			3	
	112						64	
							3	
								64
								243
		2						8
				3				
				68				208
		206				17	5	40
		144						48
	3				112			578
				160	232		19	485
				746	1219		88	1827
		80					32	608
					112		158	
			5	68	145		197	73
290	432		5	1174	1820	24	1043	5054

9,935 ACRES

1.2 %

OR-P.

TOTAL AREA OF DOUGLAS COUNTY----856,894 ACRES

SUITABLE FOR SPRUCE AND PINE — HARDWOODS AND POTENTIAL FARMLAND

DIAMETER CLASSES IN INCHES — DENSITY OF STAND

	PREDOMINANT						HEMLOCK PREDOMINANT						PIN CHERRY PREDOM.			SCRUB OAK PREDOMINANT						ASPEN PREDOMINANT									HARDWOODS YELLOW BIRCH-MAPLE PREDOMINANT									HARDWOODS BASSWOOD-BIRCH-MAPLE PREDOMINANT									OPEN	RECENT BURN	CLEARED PASTURE	CROP LAND	ABANDONED CLEARED LAND	URBAN LAND	ROCK OUTCROP	TOTAL
	6—12			12—30			0—6			6—12			0—3			0—3			3—6			0—3			3—6			6—12			0—6			6—12			12—30			0—6			6—12			12—30										
	G	M	P	G	M	P	G	M	P	G	M	P	G	M	P	G	M	P	G	M	P	G	M	P	G	M	P	G	M	P	G	M	P	G	M	P	G	M	P	G	M	P	G	M	P	G	M	P								
		136									54						96	64				692	955	224	2162	739	296	8	184	192		64	16	256	568	131	400	400		72	112		176	13		48	342		1547	2158	15	1301	83			22752
	5	48														114	304	2032				104	168		381	326	81		3			112																69	4642	2421	349	1718	344	82		23040
														8	64	383	2157	1955		80			56		136		16																						419	3157	174	350	76			23102
																486	477	672			32		64	256		436	110		96		344				290	64													1025	6196	150	221	207			23219
																						514	5044	474	1311	1873	208	1287	33	398	331	408	328	280	1528	397							190	9	16				66	2490	116	423	37	2		23055
																						408	3920	710	176	625	254		184	813		401	613		492	1521			72										65	3837	277	691	27			21580
		73														50	387	242		34		1016	802	401	293	192	64		66					34	145	96								2					1893	1369	40	876	400	48		22722
	2		16													68	2677	3207				8	941	478	151	80						64																	4135	101	128	827	452	48		23040
			144														769	373	32	160		403	1422	146	565	1419	48		32		194	336		336	218	400													2935	16	373	1486	119			23040
																		256				1486	1179	42	3054	752		80			1544	1077		8	768	560	192	1120	43	97	112	246			304		80	272	170	208	107	431	35			23032
														3								165	1498	1913	1082	1764	128	65	64	17	176	722	80	638	1385	1443	144							48					388	1541		244				23054
			67																			446	2628	1598	115	307	50		114	48	96	451	402	673	925	655		112	313						70				32	4423	56	301				21888
		89														186	354	854				304	381	3		80		48	34		517	250		2	338	304							2	3					1993	64		312	283			22848
																456	1398	1466				48	637	672	219	536						240			2														6389	383	20	427	125			23040
		16														96	404		48	40		2454	1527	400	667	1472	304	48	1248	58	1380	1050		558	1502	322				156			5	33			48		332	160	321	1217	119	336		23040
																						949	3354	305	4137	5505	192	96	436		304	154	16		894	224	4							24	48				7	7	19	124	19			23040
		48																				208	2136	815	455	1462	115				270	1156	6	349	2848	1767								14				64	122	321	46	333				23040
														80								691	404	391	1445	1243	664	2	32		416		32	530	2178	1529	475	64											167	219	62	233	22			21697
					64											289	1448	3076	24			1235	983	840	867	268	2		2																				2313	48	27	333	155			22977
		64	645											2		784	224	417		2		855	2224	1299	1570	419	372	528	13		80	608	566	452	339	833													308	287	394	2355	334			22978
		3							8							18				32		1954	2661	1647	474	1330	59				6				80	593				211	17	93		62	676				49	1216	850	2792	221	80		23040
		64												8	80					64		2418	2819		3469	482	214	176	256		416	547	80	277	646	528		54								2				234	144	847	8			23046
		3																				590	3373	1234	3083	2753	286		692	48	259	381			192	208			80												172	364	11			23039
														82								494	4251	285	1877	3154	894	48	8		320	1178		203	656	397		32	191										2	128	996	2289	58	73		21586
			64													64	707	92				1262	4357	1989	1142	1508	552			1	16		5			48													1561	498	413	2201	283	58		23040
			243															157				1000	3833	752	3052	1417	222		80	64	166	979	41		80							365							55		839	3203	73	528		23042
			8																			558	4774	2943	1450	3266	695		32	154	80	288			34	138			112										274		942	4572	163	35	61	23040
															16	32						865	2317	784	1944	2202	1106	112		3	205	757	720	88	576	48				2		16							312	707	864	4838	51		798	23042
			208														112			46		586	3148	1348	1645	3457	592	144		43	224	298	104	61	337	373					95	49	32	16					30		879	5910	230	3		23040
																						1038	1464	2260	4651	4520	914		259					2															428		874	3011	28	16		20256
	17	5	40		29																		976	3871	188	1614	296		102		226	1645	304		1138	750					48								140	3074	1185	3290	58	5	59	23040
			48															160				331	2186	2709	1298	2506	723				61	1564	80		148														168	48	1628	7519	9			23040
2			578																			213	4386	2318	2079	3111	424					2			80														167	194	622	5944	95	34		23038
2		19	485																			1	2638	2968	633	3066	1774	432	864	672																			1701		260	3130	157	774		23040
9		88	1827																			176	1691	5259	366	476	792				2	67	240		40														539		191	3346	35	802		23040
		32	608																				1665	2662	406	1906	1755					112	336																640		74	263	10			12517
2		158																					2594	3326	160	4691	707	382	263	48																			201		724	1541	39			18399
																							279	1499		787	1795		332																						213	866				8749
																							128		446	752	64																						126	64						3376
																																																						3971		3971
5		197	73																				254	182		1116	42																								60	135		9282		11895
																										8	59					23																				339				434
0	24	1043	5054		93				8		54			183	160	3026	11514	15023	104	458	32	23472	80117	49003	47149	63620	16869	3456	5429	2559	7633	14934	3969	4747	18427	13329	1215	1782	811	538	384	769	405	128	114	50	470	405								
	…5 ACRES						62 ACRES						343 ACRES			30,157 ACRES						291,674 ACRES									66,847 ACRES									5,417 ACRES									35341	35569	14604	70603	4366	16177	918	856894
	…2 %						0.0 %						0.0 %			3.5 %						34.1 %									7.8 %									0.6%									4.1	4.2	1.7	8.3	0.5	1.9	0.1	100%

OPEN MAY INCLUDE SOME SCATTERED TREES →

Of course it must be understood that variable phases occur in peat soils as in mineral soils, and that therefore changes from one swamp type to another are very difficult to delineate in detail, where land is crossed at intervals of one-half mile.

LAND UTILIZATION

Douglas county like all other counties of upper Wisconsin, found itself in recent years with vast areas of land which were not producing any revenue and therefore were being abandoned by the owners. This abandonment caused these lands to become county property. Land may be a practically non-perishable resource, but only what it produces becomes a usable asset. These counties have found themselves therefore with millions of acres of a non-perishable resource, but with no liquid assets with which to carry on until this land again produces. Putting the county's land to work has therefore called for a classification based upon natural adaptation for: a. farms, b. forests, and c. recreation. Plate IV on page 18 shows the classification of land in Douglas county at the present time.

The above figure represents the area and proportion of the county occupied by each type of land use, within the large natural groups (shown by heavy lines)—forest land, cleared farm land, open swamp and bog, urban land, and water. The first three groups are divided into the various types of which they are composed. The aspen type is outstanding, as it covers one-third of the county. Forest land comprises 79 per cent of the county, cleared farm land 10 per cent, open swamp and bog 6.7 per cent, urban land 1.9 per cent, and water 1.4 per cent. All farm woodlands are included under forest land. The urban land is almost all within the city limits of Superior, and includes considerable aspen and brush land.

Under agricultural zoning the greatest changes are most likely to occur on the better hardwood type and the large area of aspen land. A gradual shifting of the agricultural lands to the better soils will take up part of the better hardwood land. The aspen stands under forest management should gradually be converted into pine or spruce forests.

PRESENT STATUS OF LAND COVER

Table I shows the acreage for all the land cover in Douglas county, by townships, types, and sites. Within the forest types the acreage of all diameter classes of timber and densities are given for each township, and the sum of each is added up at the bottom of the table for the county as a whole. The percentage and acreage of each type is also shown at the bottom of the table.

The total amount of land now growing some type of forest cover in Douglas county, including scrub oak and pin cherry, is 609,570 acres. Of this area, 81 per cent, or 492,432 acres, is covered with small-sized material running from 0–6 inches in diameter. Twenty-three per cent of this 0–6 inch cover, or 112,468 acres, is good stocking; 49 per cent

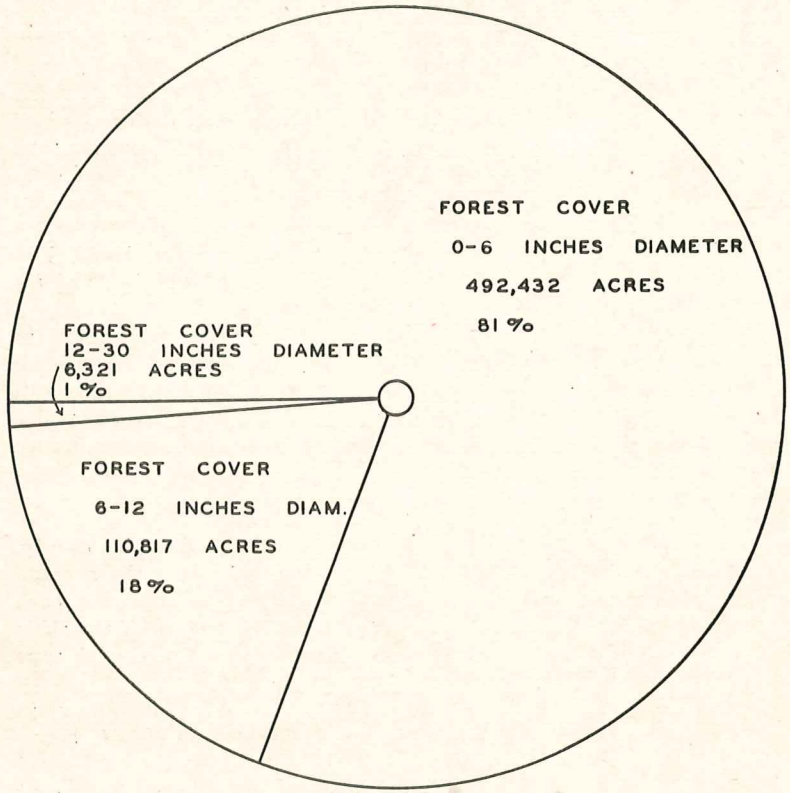
or 239,798 acres, is medium stocking, and 28 per cent, or 140,166 acres, is poor stocking. Ninety-nine per cent of all the forest cover by acreage runs from 0–12 inches in diameter; 18 per cent, or 110,817 acres, averages 6–12 inches in diameter. Of this, 20 per cent, or 21,974 acres, is good stocking; 48 per cent, or 52,952 acres, is medium stocking; and 29 per cent, or 35,891 acres, is poor stocking. Only approximately one per cent of the forest area of the

PLATE V

AREA[x] AND PERCENTAGE OF TIMBER

ACCORDING TO SIZE

DOUGLAS COUNTY 1931



[x] TOTAL FOREST AREA IS 609,570 ACRES (INCLUDING PIN CHERRY AND SCRUB OAK, AND ALSO ALL FARM WOODLOTS).

county, or 6,321 acres, contains timber 12 inches or over in diameter, showing clearly that practically the entire county has now been cut or burned over. Twenty-four per cent, or 1,529 acres, of this 12–30 inch material is good stocking, 43 per cent, or 2,703 acres, is medium stocking, and 33 per cent, or 2,089 acres, is poor stocking.

Deducting all the scrub oak and pin cherry land which includes 30,500 acres, there remains in the county a total of 132,841 acres that are well stocked; 283,298 acres that are medium stocked, and 162,931 acres that are poorly stocked. If to the 68,431 acres of poorly stocked aspen land is added 27,370 acres of medium and poorly stocked pin cherry and scrub oak land, 35,341 acres of open area, and 35,569 acres of recent burn, there is shown a total of 166,711 acres in need of immediate reforesting. See plate VI, page 23.

The forest type containing the largest acreage is the aspen "popple" type, which covers 291,674 acres, or 34 per cent of the total area of the county. The next largest type is the jack pine type covering 85,361 acres, or 10 per cent of the county, and the next is the hardwood type comprising 72,264 acres, or 8.4 per cent of the county.

There are 114,485 acres of swamp timber in the county comprising 13.3 per cent of the total area, and 57,793 acres of open or brush swamp such as leather-leaf bog, grass or sedge marsh, and tag alder, comprising 6.7 per cent of the total land area. This shows swamp land to comprise 20 per cent of the area of the county, or 172,278 acres.

Open water in lakes comprises a very small percentage of the county; namely, 11,953 acres, or only 1.4 per cent.

There are 89,573 acres of crop land and cleared pasture land in the county, which constitutes 10 per cent of the total area, but 4,366 acres or almost 5 per cent of the above amount of farm land has been abandoned.

CLASSIFICATION OF LAND AREA FOR FUTURE USE

An estimate of the land area that could be used for the growth of commercial forests in Douglas county may be found by deducting the present and potential farm land, as well as the total area of lakes, treeless bogs, open grass and sedge marshes, tag alder and other brush swamps from the total area of the county.

This may be shown as follows:

Total area of Douglas county		856,894 acres
Total present area of plowland	*70,603 acres	
Total area pasture, farm woodlots, etc.	102,729 "	
All other land	16,656 "	
Total area in lakes	11,953 "	
Total area of treeless bogs	5,924 "	
Total area of grass and sedge marsh	11,394 "	
Total area of tag alder and other brush swamp	40,475 "	
Total for farms, lakes, and open or brush swamp	259,734 acres	
Balance		597,160 acres

* Total present area of plowland is from the Land Inventory figures of 1931.

With due allowance for roads, townsites and urban land, railroad rights of way, etc., these figures would indicate at least a total of 550,000 acres remaining in Douglas county for timber production.

The present total area of timber land in Douglas county is divided among the various forest types as follows:

FOREST COVER TYPES AVERAGING OVER 12 INCHES IN DIAMETER

Species Predominant	*Dia. Class*	*Acreage*
Cedar	12–18 inches	183 acres
Ash and elm	12–24 "	1,023 "
Norway pine	12–30 "	289 "
White pine	12–30 "	93 "
Hardwoods (yellow birch)	12–30 "	3,808 "
Hardwoods (Basswood)	12–30 "	925 "
Total old timber left		6,321 acres

FOREST COVER TYPES AVERAGING UNDER 12 INCHES IN DIAMETER

Species Predominant	*Dia. Class*	*Acreage*
Spruce	0– 3 inches	18,105
Spruce	3– 6 "	39,538
Spruce	6–12 "	10,344
Tamarack	0– 3 "	438
Tamarack	3– 6 "	2,001
Cedar	0– 6 "	4,221
Cedar	6–12 "	3,257
Ash and elm	0– 6 "	11,519
Ash and elm	6–12 "	23,856
Jack pine	0– 3 "	35,585
Jack pine	3– 6 "	36,237
Jack pine	6–12 "	13,539
Norway pine	0– 3 "	500
Norway pine	3– 6 "	1,602
Norway pine	6–12 "	2,898
White pine	0– 3 "	722
White pine	3– 6 "	2,999
White pine	6–12 "	6,121
Hemlock	0– 6 "	8
Hemlock	6–12 "	54
Pin cherry	0– 3 "	343
Scrub oak	0– 3 "	29,563
Scrub oak	3– 6 "	594
Aspen	0– 3 "	152,592
Aspen	3– 6 "	127,638
Aspen	6–12 "	11,444
Hardwoods (yellow birch)	0– 6 "	26,536
" " "	6–12 "	36,503
" (basswood)	0– 6 "	1,691
" "	6–12 "	2,801
Total young forest cover		603,249
Grand total of the present forest cover		609,570

If to this grand total is added the sum of the open and recently burned areas, there is a total of 680,480 acres which represents the total forest land area.

The above forest cover includes the farm area classified as woodland pasture and woodland not pastured, all of which the 1930 census places at 82,022 acres. If this figure is deducted from the 609,570 acres, it leaves 527,548 acres of land outside of farm land having now some type of forest cover. The present acreage of forest cover could probably stay therefore much as it is, although it might be shifted

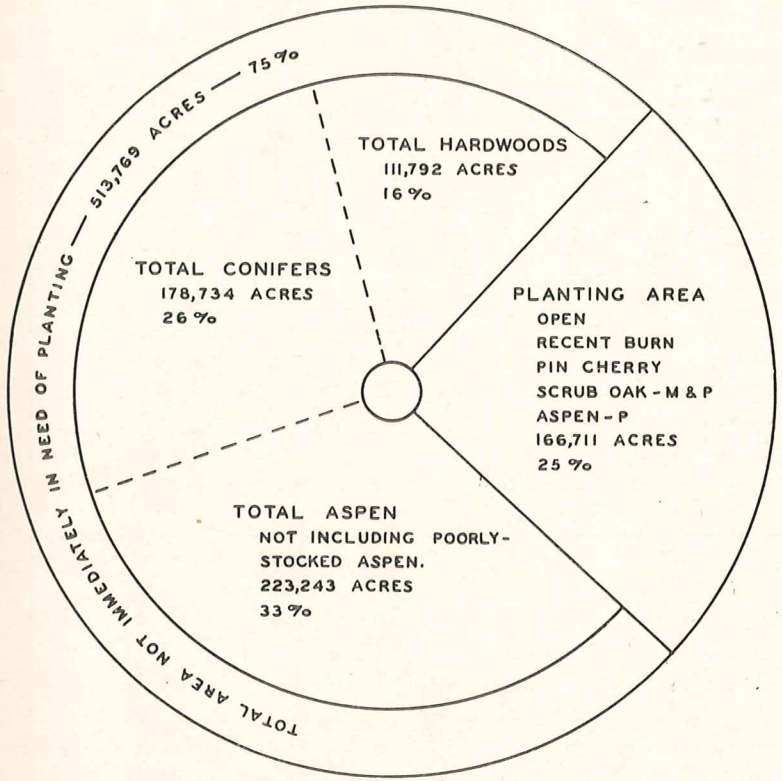
PLATE VI

TOTAL FOREST LAND

SHOWING

PLANTING AREA

DOUGLAS COUNTY 1931



NOTE: TOTAL FOREST LAND AREA -- 680,480 ACRES.
M AND P INDICATE MEDIUM AND POOR STOCKING.
SCRUB OAK, GOOD STOCKING, IS INCLUDED WITH HARDWOODS.

somewhat. Farm expansion, if any, would take place on the better hardwood lands, and any forestry expansion on the poorer soils. This might mean eventually taking over some of the present hardwood

TABLE II

CENSUS DATE	1900	1910	1920	1925	1930
NUMBER OF FARMS	257	853	1,557	2,366	1922
TOTAL ACRES IN FARMS	29,111	92,461	154,671	184,595	169,961
TOTAL ACRES IN CROPLAND	5,234	19,920	40,428	49,713	50,576
TOTAL ACRES IN CLEARED PASTURE				5,563	7,066
PERCENT OF FARMS CLEARED AND PLOWABLE	14.5	21.5	26.0	30.0	34.0
TOTAL ACRES IN WOODLAND AND OTHER PASTURES				75,506	70,727
TOTAL ACRES IN WOODLAND NOT PASTURED				53,823	41,592
PERCENT OF TOTAL OF COUNTY IN FARMS	3.3	10.7	18.0	21.6	19.9
TOTAL NUMBER OF LIVESTOCK			19,395	20,765	21,160
TOTAL NUMBER OF CATTLE			10,199	14,348	17,092
TOTAL NUMBER OF MILCH COWS AND 2 YR. OLD HEIFERS			2,668	9,294	8,706
AVERAGE ANNUAL MILK PRODUCTION IN POUNDS PER COW			3,976	4,676	5,576

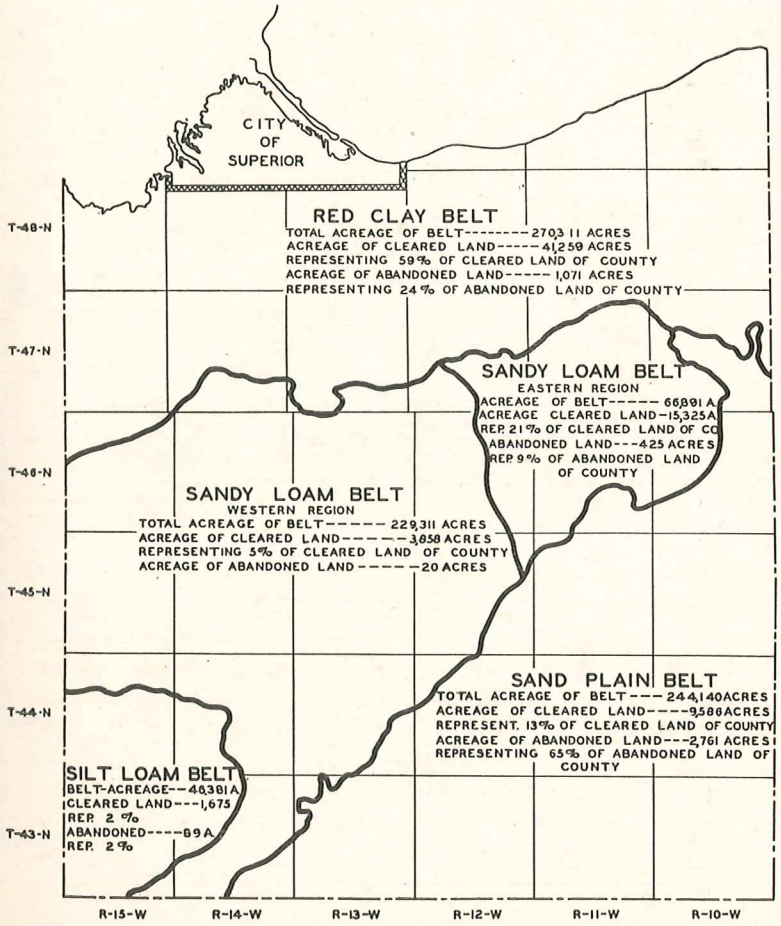
INVENTORY DATE 1931	RED CLAY BELT	SANDY LOAM BELT EASTERN	SANDY LOAM BELT WESTERN	SILT LOAM BELT	SAND PLAIN BELT
TOTAL ACRES IN AREA	270,311	66,891	229,171	46,381	244,140
TOTAL ACRES CLEARED LAND	41,259	15,325	3,858	1,675	9,586
TOTAL ACRES CLEARED LAND IN AREA ABANDONED	1,071	425	20	89	2,761
PERCENT OF CLEARED LAND IN AREA ABANDONED	2.4	2.5	0.3	5.3	27.0

stands for agriculture as well as reforesting some of the poorer agricultural land. According to the above figures it would be possible to increase the present forest cover by about twenty-three thousand acres in order to make the estimated 550,000 acres which could be managed for commercial forests.

Of the present 680,480 acres of forest land, about 393,084 acres or 58 per cent, are either aspen, scrub oak, pin cherry, recent burn, or open land. Assuming the same ratio exists with regard to the 550,000 acres of forest land recommended for permanent forest cover, it would make a total of approximately 319,000 acres of open, scrub oak, pin cherry and aspen land, gradually to be converted into pine or spruce. Seventy-four thousand acres of this is aspen of good density, which would require considerable work to convert into a pine or spruce stand.

PLATE VII

TREND IN FARM LAND USE



The first work should probably be done in planting the open areas, old burns, pin cherry, poorly stocked aspen, and medium and poorly stocked scrub oak land, making a total of about 167,000 acres.

After this should follow the gradual conversion of aspen stands to more valuable species by underplanting with spruce or white pine in poorly-stocked aspen stands, by clear-cutting and planting, by partial cutting and planting, or by partial cutting in dense stands near pine seed trees. A light stand of aspen is often helpful in underplanting as it retains the soil moisture. Spruce is more desirable for underplanting than pine as it has the ability to endure more shade.

PLATE VIII

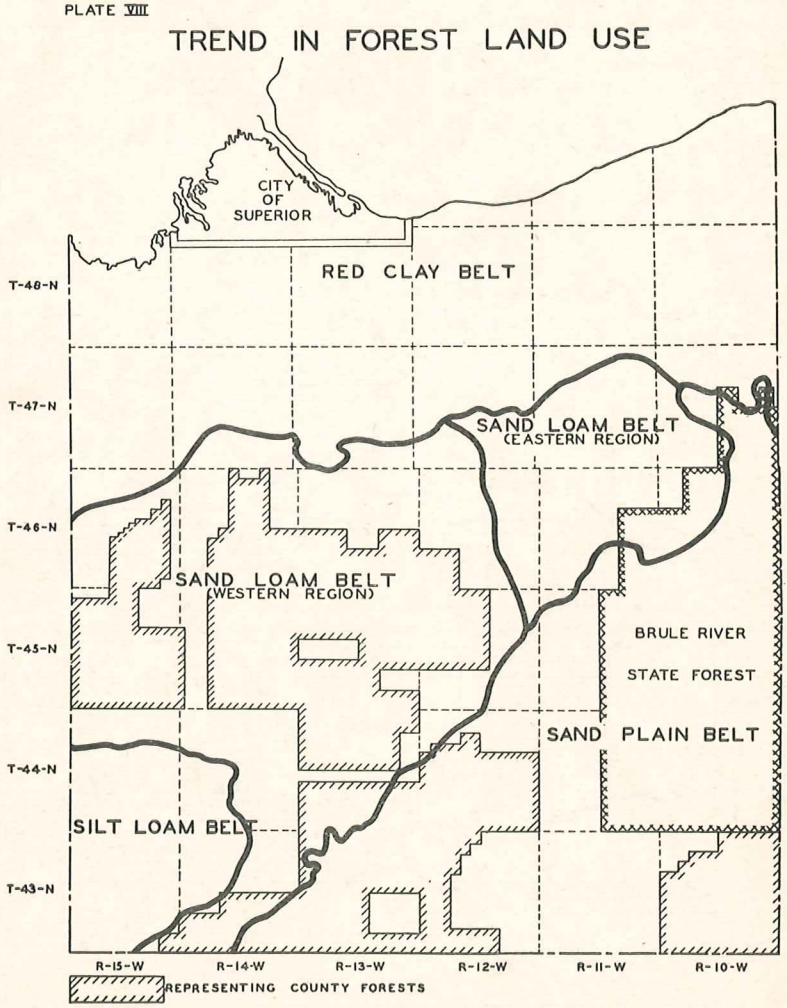


TABLE III

ESTIMATE OF TIMBER, PREDICTION OF GROWTH, AND POSSIBLE YIELDS
DOUGLAS COUNTY

LAND COVER TYPES (NAME GIVEN IS THE PREDOMINANT SPECIES)	DIAMETER CLASS AND DENSITY OF FOREST COVER	AREA OF EACH TYPE OF COVER	PRESENT YIELD IN TERMS OF MARKET UNITS	PRESENT GROSS STUMPAGE VALUE	AVE. DIAMETER AND DENSITY 25 YRS. HENCE	YIELD IN TERMS OF MARKET UNITS 25 YRS. HENCE	STUMPAGE VALUE 25 YEARS HENCE	ADDITIONAL POSSIBLE YIELD AND VALUE IN 50 YEARS IF PLANTED TO PINE AND SPRUCE	
								YIELD IN 50 YEARS AT 50 CORDS PER A.	STUMPAGE VALUE IN 50 YRS. AT $2.00 PER CORD
	IN.	ACRES		DOLLARS	IN.		DOLLARS	CORDS	DOLLARS
BLACK SPRUCE AND BALSAM	0-3 G	3,276			5 1/2 G	36,036 CORDS	$ 144,144		
	0-3 M	7,635			5 1/2 M	45,810 " "	183,240		
	0-3 P	7,194			5 1/2 P	7,194 " "	28,776		
	3-6 G	7,707	77,070 CORDS	$ 308,280	7 1/2 G	200,382 " "	801,528		
	3-6 M	21,065	126,390 " "	505,560	7 1/2 M	294,910 " "	1,179,646		
	3-6 P	10,766	21,532 " "	86,128	7 1/2 P	32,298 " "	129,192		
	6-12 G	2,376	71,280 " "	285,120	9 G	71,280 " "	285,120		
	6-12 M	6,181	105,077 " "	420,308	9 M	105,077 " "	420,308		
	6-12 P	1,787	8,935 " "	35,740	9 P	8,935 " "	35,740		
TAMARACK (LARCH)	0-3 G	2			5 1/2 G	22 " "	22		
	0-3 M	300			5 1/2 M	1,800 " "	1,800		
	0-3 P	136			5 1/2 P	136 " "	136		
	3-6 G	185	2,960 " "	2,960	7 1/2 G	4,810 " "	4,810		
	3-6 M	1,265	11,385 " "	11,385	7 1/2 M	17,710 " "	17,710		
	3-6 P	551	1,653 " "	1,653	7 1/2 P	1,653 " "	1,653		
CEDAR	0-6 G	915			7 G	212,280 POSTS	8,491		
	0-6 M	2,126			7 M	233,860 " "	9,354		
	0-6 P	1,180			7 P	37,760 " "	1,510		
	6-12 G	1,590	368,880 POSTS	14,755	10 G	184,440 POLES	46,110		
						184,440 POSTS	7,378		
	6-12 M	1,217	133,870 " "	5,355	10 M	66,935 POLES	16,734		
						66,935 POSTS	2,677		
	6-12 P	450	14,400 " "	576	10 P	7,200 POLES	1,800		
						7,200 POSTS	288		
	12-18 M	183	5,490 POLES	1,373	13 M	5,490 POLES	1,373		
			10,980 POSTS	439		10,980 POSTS	439		
SWAMP HARDWOODS (ASH AND ELM)	0-6 G	3,449			5 1/2 G	27,592 CORDS	27,592		
	0-6 M	5,653			5 1/2 M	22,612 " "	22,612		
	0-6 P	2,417			5 1/2 P	2,417 " "	2,417		
	6-12 G	6,776	203,280 CORDS	203,280	10 G	216,832 " "	216,832		
	6-12 M	13,719	205,785 " "	205,785	10 M	219,504 " "	219,504		
	6-12 P	3,361	16,805 " "	16,805	10 P	20,166 " "	20,166		
	12-24 G	256	1,280 M BD. FT.	6,400	15 G	1,280 M BD. FT.	6,400		
	12-24 M	48	144 M BD. FT.	720	15 M	144 M BD. FT.	720		
	12-24 P	719	719 M BD. FT.	3,595	15 P	719 M BD. FT.	3,595		
JACK PINE	0-3 G	8,163			7 G	146,934 CORDS	293,868		
	0-3 M	14,329			7 M	143,290 " "	286,580		
	0-3 P	13,093			7 P	26,186 " "	52,372		
	3-6 G	6,444	103,104 CORDS	206,208	9 G	193,320 " "	386,640		
	3-6 M	14,123	141,230 " "	282,460	9 M	211,845 " "	423,660		
	3-6 P	15,670	47,010 " "	94,020	9 P	47,010 " "	94,020		
	6-12 G	2,456	103,152 " "	206,304	10 G	103,152 " "	206,304		
	6-12 M	4,911	122,775 " "	245,550	10 M	122,775 " "	245,550		
	6-12 P	6,172	49,376 " "	98,752	10 P	49,376 " "	98,752		
NORWAY PINE	0-3 G	128			8 G	5,632 " "	11,264		
	0-3 M	148			8 M	4,144 " "	8,288		
	0-3 P	224			8 P	1,568 " "	3,136		
	3-6 G	272	3,264 CORDS	6,528	11 G	19,856 " "	39,712		
	3-6 M	480	3,360 " "	6,720	11 M	19,200 " "	38,400		
	3-6 P	850	1,700 " "	3,400	11 P	12,750 " "	25,500		
	6-12 G	144	8,640 " "	17,280	14 G	4,320 M BD. FT.	43,200		
	6-12 M	689	20,670 " "	41,340	14 M	11,024 M BD. FT.	110,240		
	6-12 P	2,065	20,650 " "	41,300	14 P	8,260 M BD. FT.	82,600		
	12-30 G	8	200 M BD. FT.	2,000	16 G	200 M BD. FT.	2,000		
	12-30 M	127	1,905 M BD. FT.	19,050	16 M	1,905 M BD. FT.	19,050		
	12-30 P	154	154 M BD. FT.	1,540	16 P	154 M BD. FT.	1,540		
WHITE PINE	0-3 G								
	0-3 M	290			7 M	4,350 CORDS	8,700		
	0-3 P	432			7 P	1,296 " "	2,592		
	3-6 G	5	45 CORDS	90	9 G	300 " "	600		
	3-6 M	1,174	5,870 " "	11,740	9 M	35,220 " "	70,440		
	3-6 P	1,820	1,820 " "	3,640	9 P	14,560 " "	29,120		
	6-12 G	24	1,560 " "	3,120	12 G	720 M BD. FT.	7,200		
	6-12 M	1,043	40,677 " "	81,354	12 M	17,731 M BD. FT.	177,310		
	6-12 P	5,054	50,540 " "	101,080	12 P	10,108 M BD. FT.	101,080		
	12-30 M	93	1,581 M BD. FT.	15,810	15 M	1,581 M BD. FT.	15,810		
PIN CHERRY	0-3 M	183						9,150	$ 18,300
	0-3 P	160						8,000	16,000
SCRUB OAK	0-3 G	3,026							
	0-3 M	11,514						575,700	1,151,400
	0-3 P	15,023						751,150	1,502,300
	3-6 G	104	1,456 CORDS	1,456					
	3-6 M	458	2,748 " "	2,748				22,900	45,800
	3-6 P	32	32 " "	32				1,600	3,200
ASPEN "POPPLE"	0-3 G	23,472			5 G	563,328 CORDS	563,328		
	0-3 M	80,117			5 M	961,404 " "	961,404		
	0-3 P	49,003			5 P	147,009 " "	147,009	2,450,150	4,900,300
	3-6 G	47,149	801,533 CORDS	801,533	8 G	1,697,364 " "	1,697,364		
	3-6 M	63,620	572,580 " "	572,580	8 M	1,272,400 " "	1,272,400		
	3-6 P	16,869	33,738 " "	33,738	8 P	67,476 " "	67,476	843,450	1,686,900
	6-12 G	3,456	124,416 " "	124,416	9 G	124,416 " "	124,416		
	6-12 M	5,429	108,580 " "	108,580	9 M	108,580 " "	108,580		
	6-12 P	2,559	10,236 " "	10,236	9 P	10,236 " "	10,236	127,950	255,900
HARDWOODS (YELLOW BIRCH, MAPLE, ETC)	0-6 G	7,633			5 G	68,697 " "	68,697		
	0-6 M	14,934			5 M	74,670 " "	74,670		
	0-6 P	3,969			5 P	3,969 " "	3,969		
	6-12 G	4,747	137,663 " "	137,663	11 G	189,880 " "	189,880		
	6-12 M	18,427	313,259 " "	313,259	11 M	368,540 " "	368,540		
	6-12 P	13,329	79,974 " "	79,974	11 P	106,632 " "	106,632		
	12-30 G	1,215	14,580 M BD. FT.	72,900	12-30 G	14,580 M BD. FT.	72,900		
	12-30 M	1,782	10,692 M BD. FT.	53,460	12-30 M	10,692 M BD. FT.	53,460		
	12-30 P	811	811 M BD. FT.	4,055	12-30 P	811 M BD. FT.	4,055		
HARDWOODS (BASSWOOD, BIRCH, MAPLE, OAK, ETC.)	0-6 G	538			5 G	4,842 CORDS	4,842		
	0-6 M	384			5 M	1,920 " "	1,920		
	0-6 P	769			5 P	769 " "	769		
	6-12 G	405	11,745 CORDS	11,745	11 G	16,200 " "	16,200		
	6-12 M	1,282	21,794 " "	21,794	11 M	25,640 " "	25,640		
	6-12 P	1,114	6,684 " "	6,684	11 P	8,912 " "	8,912		
	12-30 G	50	600 M BD. FT.	3,000	12-30 G	1,450 M BD. FT.	3,000		
	12-30 M	470	2,820 M BD. FT.	14,100	12-30 M	2,820 M BD. FT.	14,100		
	12-30 P	405	405 M BD. FT.	2,025	12-30 P	405 M BD. FT.	2,025		
HEMLOCK	0-6 P	8			6 P	16 CORDS	16		
	6-12 M	54	1,890 CORDS	1,890	10 M	2,160 " "	2,160		
OPEN AND RECENTLY BURNED LAND		70,910						3,545,500	7,091,000
TOTALS		680,480 ACRES	3,805,923 CORDS 528,130 POSTS 5,490 POLES 35,891 M BD. FT.	$ 5,752,218 (CORDS) 21,125 (POSTS) 1,373 (POLES) 198,655 (BD. FT.) $ 5,983,373 TOTAL		8,325,000 CORDS 753,455 POSTS 264,065 POLES 88,904 M BD. FT.	$ 11,893,506 (CORDS) 30,137 (POSTS) 66,017 (POLES) 720,285 (BD. FT.) $ 12,709,945 TOTAL	8,335,550 CORDS	$ 16,671,100

HISTORY OF AGRICULTURAL DEVELOPMENT

There were only 257 farms in Douglas County in 1900. These farms averaged about 20 acres of crop land to each farm. It is quite possible that nothing was produced on these farms that did not find a ready market at home. Table II, page 24 shows the trend in agriculture since 1900.

THE PRESENT TREND IN FARM DEVELOPMENT

It is obvious that the area where agricultural expansion has progressed without any material abandonment of farm land has ample land similar to the land now occupied for farm use. The trend in land utilization for farms throughout the county does not indicate any material expansion of the farm base. It is quite possible that there are as many farms now as there were in 1925. The shift has been from the sandy region onto the better loams, particularly to the silt loam area in the southwestern part of the county.

The total acreage of land, cleared and not now used for farm production, was shown by the inventory to be 4,366 acres, of which 65 per cent falls within the sandy belt of the county. The present trend in land use shows that county and state forest areas now occupy the major portions of the sand plain belt and the western region of the sandy loam belt. The relative number of dairy cows was somewhat lower in 1930 than it was in 1925, while the average annual production of milk per year was materially increased. This can be attributed to herd improvement, better pastures, and better winter feeds, and indicates an improvement of the existing farms both in the culture of the cleared land and in the removal of brush and debris from the pasture land.

FORESTS

Past Forest Conditions of Douglas County

The four major physiographic provinces of Douglas county were responsible for the appearance of three distinct timber associations of different species in mixture. The northern one-third of the county, which is a red clay belt, was mostly a pinery with some admixture of hardwoods such as white and yellow birch with some cedar, tamarack, spruce, and balsam fir.

The region to the south of this red clay area extending to the St. Croix river and east to the Brule, also had much pine but contained a somewhat heavier mixture of hardwoods than occurred on the red clay. The southeastern part of the county, south and east of the St. Croix river, was a true pinery on sandy soil, consisting mainly of jack and Norway pine with stands of white pine on the loamy sands. The Ounce–Totogatic area had a tree association similar to the north central belt. The pine was first cut along the shore of Lake Superior, the St. Croix river and the railroads. In 1897 it was estimated that

TABLE IV

BASIS FOR ESTIMATE OF PRESENT YIELD

COVER TYPE	DIAMETER CLASS (INCHES)	DEGREE OF STOCKING	VOLUME PER ACRE
BLACK SPRUCE	3-6	GOOD	10 CORDS
		MEDIUM	6 CORDS
		POOR	2 CORDS
	6-12	GOOD	30 CORDS
		MEDIUM	17 CORDS
		POOR	5 CORDS
LARCH	3-6	GOOD	6 CORDS
		MEDIUM	9 CORDS
		POOR	3 CORDS
		MEDIUM	9 CORDS
CEDAR	6-12	GOOD	232 POSTS
		MEDIUM	110 POSTS
		POOR	23 POSTS
		GOOD	120 POSTS
			60 POLES
		MEDIUM	60 POSTS
			30 POLES
SWAMP HARDWOODS	6-12	GOOD	30 CORDS
		MEDIUM	15 CORDS
		POOR	5 CORDS
	12-24	MEDIUM	3.000 BD. FT.
JACK PINE	3-6	GOOD	16 CORDS
		MEDIUM	10 CORDS
		POOR	3 CORDS
	6-12	GOOD	42 CORDS
		MEDIUM	25 CORDS
		POOR	8 CORDS
NORWAY PINE	3-6	GOOD	12 CORDS
		MEDIUM	7 CORDS
		POOR	2 CORDS
	6-12	GOOD	60 CORDS
		MEDIUM	30 CORDS
		POOR	10 CORDS
	12-30	GOOD	25 M BD. FT.
		MEDIUM	15 M BD. FT.
		POOR	1 M BD. FT.
WHITE PINE	3-6	GOOD	9 CORDS
		MEDIUM	5 CORDS
		POOR	1 CORDS
	6-12	GOOD	65 CORDS
		MEDIUM	39 CORDS
		POOR	10 CORDS
	12-30	GOOD	30 M BD. FT.
WHITE PINE	12-30	MEDIUM	17 M BD. FT.
		POOR	2 M BD. FT.
HEMLOCK	6-12	GOOD	59 CORDS
		MEDIUM	35 CORDS
		POOR	9 CORDS
	12-30	GOOD	12 M BD. FT.
		MEDIUM	6 M BD. FT.
OAK	3-6	GOOD	14 CORDS
		MEDIUM	6 CORDS
		POOR	1 CORDS
ASPEN	3-6	GOOD	17 CORDS
		MEDIUM	9 CORDS
		POOR	2 CORDS
	6-12	GOOD	36 CORDS
		MEDIUM	20 CORDS
		POOR	4 CORDS
HARDWOODS (WITH SOME CONIFERS) & HARDWOODS (BASSWOOD, BIRCH, MAPLE)	6-12	GOOD	29 CORDS
		MEDIUM	17 CORDS
		POOR	6 CORDS
	12-30	GOOD	12 M BD. FT.
		MEDIUM	6 M BD. FT.
		POOR	1 M BD. FT.

TABLE V

BASIS FOR ESTIMATE OF YIELD 25 YEARS HENCE

COVER TYPE	AVE. DIAM. (INCHES)	DEGREE OF STOCKING	VOLUME PER ACRE
BLACK SPRUCE	5	GOOD	11 CORDS
	*(0-3)	MEDIUM	6 CORDS
		POOR	1 CORDS
	7	GOOD	26 CORDS
	(3-6)	MEDIUM	14 CORDS
		POOR	3 CORDS
LARCH	SAME AS FOR SPRUCE		
CEDAR	10	GOOD	116 POLES
	(6-12)	MEDIUM	116 POSTS
		MEDIUM	55 POLES
			55 POSTS
		POOR	16 POLES
			16 POSTS
SWAMP HARDWOODS	5	GOOD	8 CORDS
	(0-6)	MEDIUM	4 CORDS
		POOR	1 CORDS
	10	GOOD	32 CORDS
	(6-12)	MEDIUM	16 CORDS
		POOR	6 CORDS
JACK PINE	7	GOOD	18 CORDS
	(0-3)	MEDIUM	10 CORDS
		POOR	2 CORDS
JACK PINE	9	GOOD	30 CORDS
	(3-6)	MEDIUM	15 CORDS
		POOR	3 CORDS
	10	GOOD	42 CORDS
	(6-12)	MEDIUM	25 CORDS
		POOR	8 CORDS
NORWAY PINE	8	GOOD	44 CORDS
	(0 3)	MEDIUM	28 CORDS
		POOR	7 CORDS
	11	GOOD	73 CORDS
	(3-6)	MEDIUM	40 CORDS
		POOR	15 CORDS
	14	GOOD	30 M BD. FT.
	(6-12)	MEDIUM	16 M BD. FT.
		POOR	4 M BD. FT.
WHITE PINE	7	GOOD	31 CORDS
	(0-3)	MEDIUM	15 CORDS
		POOR	3 CORDS
	9	GOOD	60 CORDS
	(3-6)	MEDIUM	30 CORDS
		POOR	8 CORDS
	12	GOOD	30 M BD. FT.
	(6-12)	MEDIUM	17 M BD. FT.
		POOR	2 M BD. FT.
HEMLOCK	6	GOOD	25 CORDS
	(0-6)	MEDIUM	12 CORDS
		POOR	2 CORDS
	10	GOOD	67 CORDS
	(6-12)	MEDIUM	40 CORDS
		POOR	12 CORDS
ASPEN	5	GOOD	24 CORDS
	(0 3)	MEDIUM	12 CORDS
		POOR	3 CORDS
	8	GOOD	36 CORDS
	(3-6)	MEDIUM	20 CORDS
		POOR	4 CORDS
HARDWOODS (WITH SOME CONIFERS) & HARDWOODS (BASSWOOD, BIRCH, MAPLE)	5	GOOD	9 CORDS
	(0-6)	MEDIUM	5 CORDS
		POOR	1 CORDS
	11	GOOD	40 CORDS
	(6-12)	MEDIUM	20 CORDS
		POOR	8 CORDS

* FIGURES IN PARENTHESES SHOW DIAMETER CLASS 25 YEARS AGO

TABLE VI
BASIS FOR OBTAINING STUMPAGE VALUES

SPECIES	VALUE PER UNIT	SPECIES	VALUE PER UNIT	SPECIES	VALUE PER UNIT
HARDWOODS	$1.00 PER CORD 5.00 PER M BD. FT.	PINE	$ 2.00 PER CORD 10.00 PER M BD. FT.	SPRUCE	$4.00 PER CORD
HEMLOCK	1.00 PER CORD 3.50 PER M BD. FT.	POPPLE	1.00 PER CORD	CEDAR	.10 PER TIE .04 PER POST $25.00 PER HUNDRED POLES

NOTE: THESE VALUES CLOSELY APPROXIMATE NORMAL CONDITIONS

three and one-half billion feet of pine remained, which estimate was the largest made at that time in any county for the remaining pine timber. Very little of the hardwood timber had then been cut, but much had been burned in the burning off of the pine slashings. In some regions where hardwood was cut, oak formed a large percentage of the yield. It was estimated that 700,000,000 feet of hardwoods remained in the year 1897 (information from Bulletin 1, Wisconsin Geological and Natural History Survey). A later estimate of the standing timber in Douglas county made by the State Conservation Commission in 1923 placed the amount of standing pine at only 20,000,000 board feet, and hardwoods at about 60,000,000 board feet, together with 660,000 cords of fuel and pulpwood.

Timber Estimates

Table III shows the total estimate and value of all the timber in Douglas county, and also an estimate of the volume and value of the young growth in twenty-five years, assuming no loss from wind and fire. It also shows the additional value that would accrue to the county in fifty years if all the area on which worthless timber is now growing or areas not now producing anything were planted to pine and spruce. The land recommended for immediate planting includes all the open and recently burned land, all the pin cherry and scrub oak areas (except scrub oak, good stocking), and all the aspen areas classified as poorly stocked.

These areas which need to be restocked with spruce and pine are:

Open and recently burned areas	70,910 acres
All pin cherry land	343 "
All scrub oak land exclusive of good stocking	27,027 "
The poorly stocked aspen land	68,431 "
Total	166,711 acres

See Plate VI page 23.

Probably over one-third of this acreage could safely be planted to spruce. If the good and medium stocked aspen stands are added to the above amount, all of which should eventually be converted into a better type of timber, they would total 389,954 acres. The soil type best suited for planting spruce would include most of the area lying in the sand loam belt between the southeastern pinery and the red clay belt on the north. This total area includes about 340,000 acres of potential spruce land. The open, burned, pin cherry, scrub oak and poorly stocked aspen land on this area, consisting of 43,668 acres, could be planted to spruce at once.

Prediction of Forest Growth in Natural and Planted Stands

The predicted natural growth of the present stand of young timber in twenty-five years is made for all lands which contain some forest growth, exclusive of pin cherry, scrub oak, and mature timber mostly over 12 inches in diameter. In these older stands of mature timber,

it is assumed that death and decay offset growth and, therefore, their volume is considered the same twenty-five years from now as at present and no increased growth is shown. The acreage of young timber, therefore, on which a substantial growth can safely be predicted as outlined above, includes 562,828 acres, while 46,702 acres are composed of mature timber on which no increase in forest growth has been estimated.

The table shows that in twenty-five years these 562,828 acres of young timber will grow in value $6,726,572 or at the rate of approximately $269,063 a year, which means an average growth increase of approximately 48 cents per acre per year for the average forest growth of the natural stands. If young trees of the right species are planted on the 166,711 acres of poorly stocked aspen, scrub oak, pin cherry, open and recently burned land, the value of the growth per year could be increased to $2.00 per acre or more. The table shows that the entire growth on this area recommended for immediate forest planting would produce a total added income of $16,671,100 in fifty years if planted to spruce or pine.

TABLE VII

ESTIMATE OF TIMBER BY SPECIES DOUGLAS COUNTY

SPECIES	BOARD FEET	CORDS	POSTS	POLES	TOTAL STUMPAGE VALUE
BLACK SPRUCE		410,284			$ 1,641,136
LARCH		15,998			15,998
CEDAR			528,130	5,490	22,500
SWAMP HARDWOODS	2,143 M	425,870			436,585
JACK PINE		566,647			1 133,284
NORWAY PINE	2,259 M	58,284			139,158
WHITE PINE	1,581 M	100,512			216,834
HEMLOCK		1,890			1,890
OAK		4,236			4,236
ASPEN (POPPLE)		1,651,083			1 651,083
HARDWOODS (YELLOW BIRCH & HARD MAPLE) WITH SOME CONIFERS	26,083 M	530,896			661,311
HARDWOODS (BASSWOOD, YELLOW BIRCH, HARD MAPLE.)	3,825 M	40,223			59,348
TOTAL	35,891 M	3,805,923	528,130	5,490	$ 5,983,373

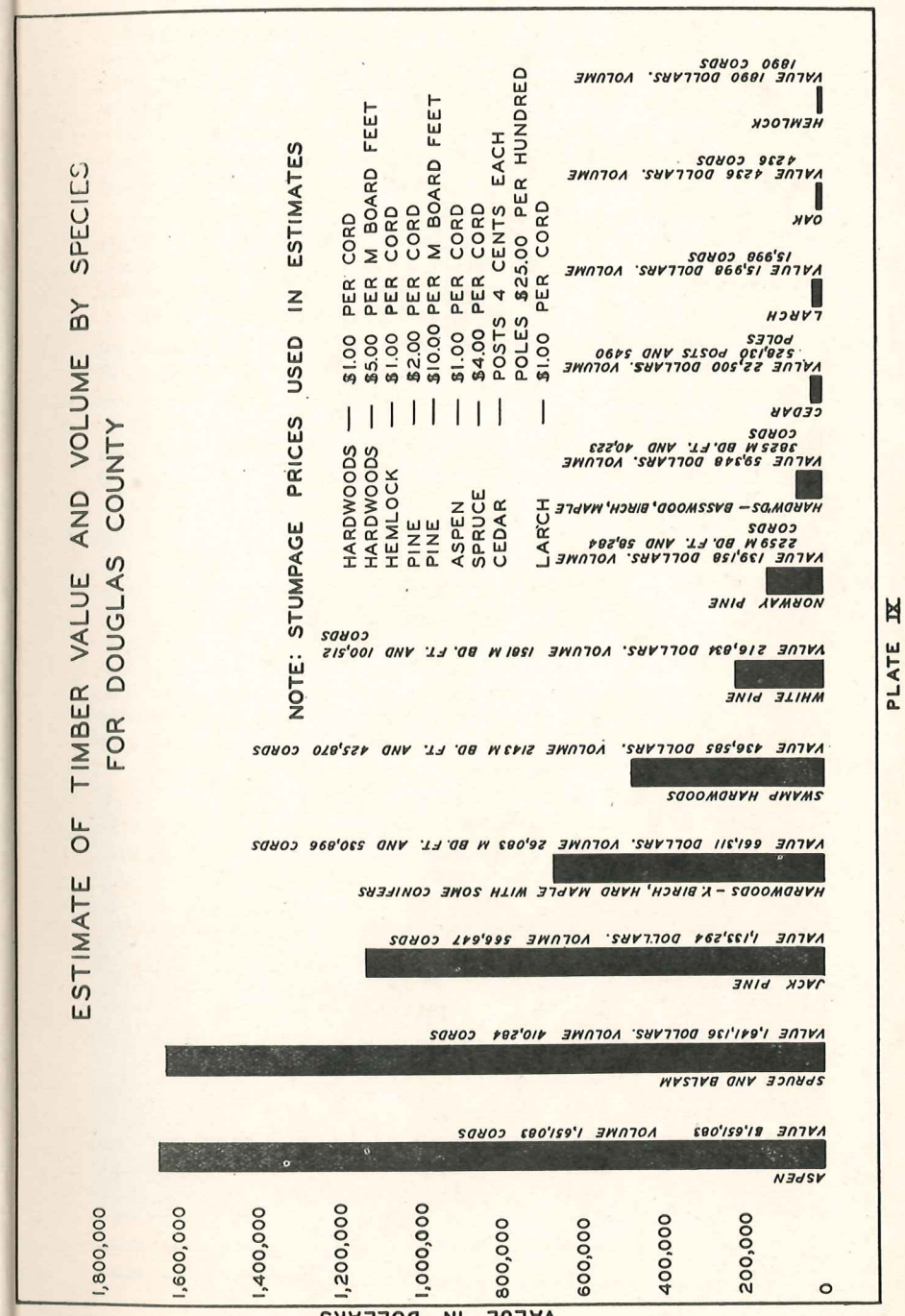


PLATE IX

Discussion of Timber Values

Plate IX shows in graphic form the relative importance of the various species in Douglas county in terms of total stumpage values based on the volume of these species in cords or board feet, and the approximate normal stumpage value of either of these units of measurement. The figures used are obtained from Table VII, "Estimate of Timber by Species".

The values shown do not therefore represent the value to the county of the finished product or what might be termed the industrial value. This value would include the logging, transportation, and manufacturing of the material, which is the big asset to any community.

The aspen type covers a much greater acreage than any other and there are almost three times as many cords of aspen as there are of any other species. However, it is not likely that much of the aspen is now of commercial value. The figure of $1.00 per cord would probably not apply for all the little scattered units which have been grouped together as a whole, even with normal conditions, as few of these units would be large enough for profitable logging. It is, therefore, the aggregate amount of aspen that makes it conspicuous on the graph rather than its commercial value.

There is less than one-third the amount of spruce and balsam than there is of aspen, but the demand for these two species is much greater than for aspen. The need of such woods, particularly spruce, in the pulp and paper industry, make them a valuable product. Practically all the spruce in this estimate is the swamp black spruce. The spruce recommended for planting is either the white spruce, a native of Wisconsin, or the Norway spruce, an imported species. Both of these species grow on the uplands.

A stumpage price for spruce of $4.00 a cord, or four times that of aspen, has been used. This makes its total value almost as high as for aspen at $1.00 a cord. These stumpage figures were the figures obtained a few years ago under more normal conditions. (Their present use would probably not obtain. They can if necessary be readily discounted to present day values.)

Jack pine is another important commercial species of Douglas county as shown on the graph. It occurs mainly in the southeastern sandy pinery. Based on a stumpage value of $2.00 a cord, which should be about right for normal conditions, it shows on the chart a present stumpage value for the entire stand of jack pine in the county of over $1,000,000. Jack pine is in demand for pulp material and in box construction.

The hardwoods are also of importance as the graph shows, the sum total of their stumpage values for all the hardwoods combined being $1,157,244, based on stumpage values of $1.00 a cord and $5.00 a thousand board feet.

Aspen, spruce and balsam, jack pine and all the hardwoods, exclusive of a very slight amount of scrub oak, taken as four types com-

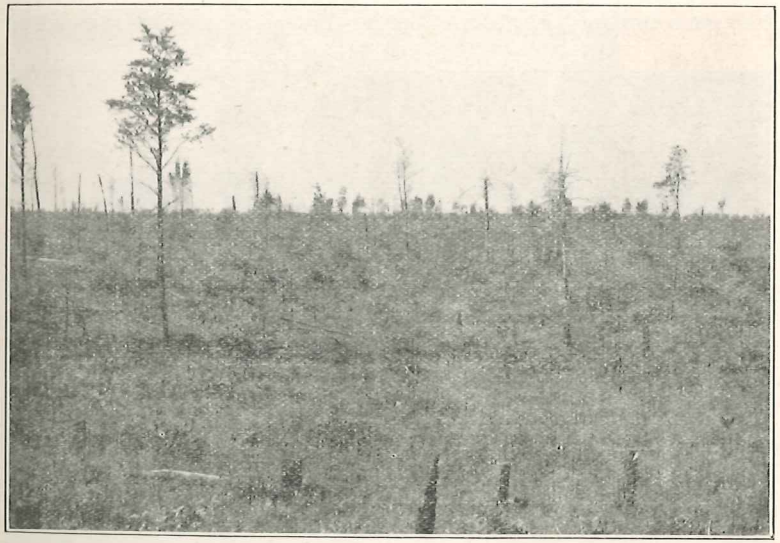
pose 93 per cent of the present stumpage value of the timber. Each one of these types averages in value over $1,000,000. The remainder of the types shown are comparatively insignificant in value at the present time.

The first three columns in the graph representing values of aspen, spruce and balsam, and jack pine, make up 74 per cent of the total value of the present stand of young timber.

White and Norway pine, formerly infinitely greater in value than any other species, have now dwindled to almost nothing, and appear sixth and seventh on the graph. The total value of nearly $6,000,000 here shown for the entire present small stand of mixed and inferior material is insignificant compared to the value when the area was stocked with pine.

The balance of the timber consists of a slight amount of cedar, tamarack, and oak, with just a trace of hemlock. It is interesting that in Douglas county hemlock has about dropped out of the picture, while in Sawyer county which touches Douglas on the southeast corner, hemlock leads all other species in value.

For a proper readjustment of species, therefore, and for the production of the greatest values, the first, or aspen column should rightly represent pine (white and Norway). Spruce and balsam should probably stay second on the list, though by planting, white and Norway spruce will spring into prominence rather than black spruce. Such a program of forest management for the county would greatly increase the total value of the forest cover for the county as a whole.



Courtesy Conservation Department

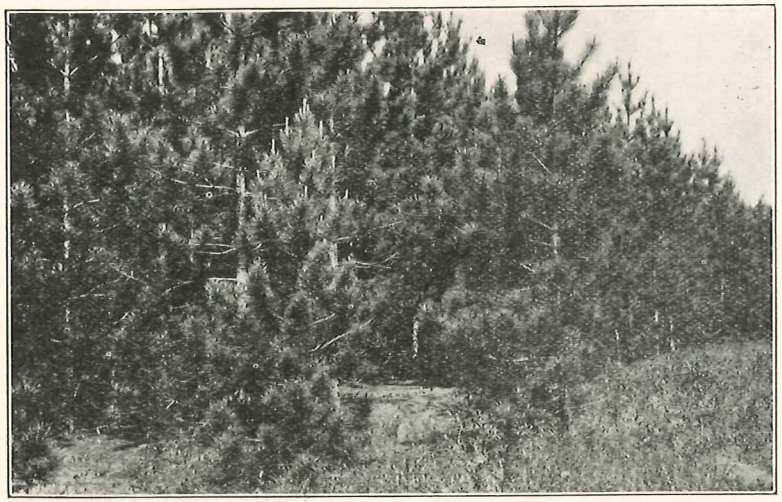
Jack pine grasslands in Douglas county. They now are a cover for sharp tailed grouse but should be reforested

RATE OF GROWTH AND WOOD PRODUCTION FOR PLANTED STANDS IN SOUTHEASTERN DOUGLAS COUNTY

The southeastern portion of Douglas county lying south and east of the St. Croix river is a sandy pinery. This region has an area of about 375 square miles and consists of fairly level sandy land much of which is open or partly open with scattered jack pine and is ideal for forest planting. Little of this area is suitable for agriculture and should be growing timber.

As a measure of the productivity of this land for growing trees, studies have been made on their growth in the Nye–Hayes forest plantations west of Wascott. (A complete and interesting account of the history and development of these forest plantations has been prepared by Mrs. Frank Hayes the owner, entitled "An Adventure in Reforestation.") These trees are growing on soil representative of this sand plain region. These plantations are quite outstanding, showing a rapid growth in height and diameter, and they are a good criterion as to what may be expected from pine planted on any part of the southeastern portion of this county. Measurements have been taken on Scotch, Norway, and white pine.

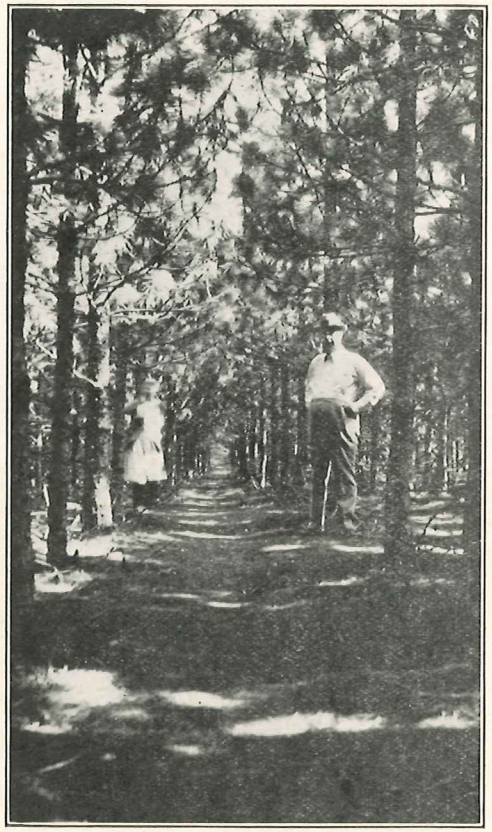
The first planting was made in the spring of 1914 when Scotch and Norway pine were planted. In 1915 white pine was planted and in 1916 more Norway pine was planted. The measurements were made in June 1931, and only the growth measured up to and including the growing season of 1930. Thus trees set out in the plantation in 1914 had gone through seventeen complete growing seasons by the end of



Edge of Norway Pine Plantation Near Wascott, Wis.

1930, as well as a portion of another growing season in the spring of 1931 when the plantations were studied. The remarkable early growth attained by these plantations has been due in a large measure to cultivation of the trees for the first two or three years.

In making the height measurements, sample trees were measured along the stem between whorls of growth from and including the 1930 growth at the top down to the first year's growth on the ground. The whorls of growth for each individual year in Norway and Scotch pine are very clearly marked. In Norway pine especially, this height growth is quite regular. In white pine the growth is usually quite erratic, due principally to the inroads of the white pine weevil in certain years. As most of these stands are quite even in height, especially the Norway pine plantation, a tree of average height and diameter is easily determined. In getting the average diameter, all the trees were measured at diameter breast high and the average



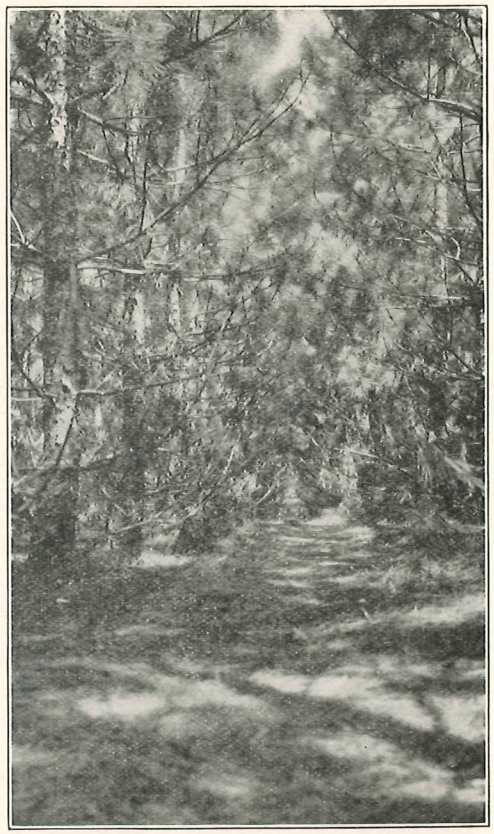
Courtesy Mrs. Frank Hayes

Nye–Hayes Plantation Near Wascott

diameter determined by the average basal area. This average diameter was then taken in finding the average sample tree.

All the planting was done using a spacing of approximately 6 x 6 feet, that is, every small tree was set about six feet apart, which makes 1210 trees to the acre. In converting solid cubic feet into cords, the converting factor of 70 was used, that is, for small logs of the average diameter found in these plantations, it takes about 70 solid cubic feet to make a cord which has a gross dimension of 128 cubic feet. The average yearly volume production in cubic feet shown for these plantations is very good, considering their extreme youth, as they have now just about arrived at an age when rapid growth in volume begins.

The results of the measurements of these three species of pine follow:



Nye–Hayes plantation of Norway pine near Wascott. This plantation was fifteen years old when picture was taken.

TABLE VIII

RESULTS OF PLANTATION MEASUREMENTS

	Scotch pine	*Norway pine*	*White pine**
Area of plot studied	.18 acre	.73 acre	.78 acre
Total average height	25.5 ft.	23.5 ft.	18.0 ft.
Av. diameter breast high	4.7 in.	4.1 in.	3.4 in.
Years in plantation	17	15	16
No. of trees in plot	211	691	807
**No. of trees per acre	1172	947	1035
No. of dominant trees	142—67%	512—74%	307—38%
No. of intermediate trees	56—26%	166—24%	430—53%
No. of trees suppressed	13—7%	13—2%	70—9%
Volume per plot	217.8 cu.ft.	542.4 cu.ft.	212.2 cu.ft.
Volume per acre	1210 cu.ft. or 17 cords	743 cu.ft. or 10.6 cords	272 cu.ft. or 3.9 cords
Volume growth per acre per year	71 cu.ft. or 1 cord	49.5 cu.ft. or about .7 cord	17.0 cu.ft. or .24 cord

* Includes 52 Norway pine.
** Based on number and size of plot studied.

TABLE IX

AVERAGE HEIGHT GROWTH OF WHITE, NORWAY, AND SCOTCH PINE PLANTATIONS BY CALENDAR YEAR, GROWING ON THE SANDY LANDS OF DOUGLAS COUNTY

(Nye–Hayes Plantation)

Year	*Ht. growth per year—inches Scotch pine*	*Ht. growth per year—inches Norway pine*	*Ht. growth per year—inches White pine*
1914	3	2.0	2.0
1915	7	2.3	2.5
1916	13	3.1	5.5
1917	17	5.7	9.7
1918	17	10.2	7.8
1919	22	16.5	17.2
1920	25	20.2	13.7
1921	19	16.0	10.0
1922	23	26.4	14.5
1923	23	23.1	22.7
1924	22	25.4	27.2
1925	22	20.1	21.2
1926	20	24.2	12.5
1927	17	26.1	15.8
1928	17	23.6	13.0
1929	18	20.1	12.5
1930	19	17.5	11.5
	304 inches	282.5 inches	219.3 inches
Av. Total ht. ft.	25.5	23.5	18.3
Av. per yr. ft.	1.5	1.6	1.1

Note: Slower growth of white pine due to white pine weevil. The Scotch pine plantation had had 17 growing seasons, the white pine 16 growing seasons, and the Norway pine 15 growing seasons in the plantation when this study was made.

Maximum Height Growth

The height growth was also measured for the largest Scotch and Norway pine tree. This maximum height growth shows the possibility for growth of these two species on this soil under the most ideal conditions. These ideal conditions are mainly dependent on moisture and other less important factors and also doubtless to certain characteristics for growth inherent in the seed from which the tree has been produced. This maximum height growth was as follows:

TABLE X

Year	*Norway pine D.B.H. 6.8 inches Planted 1914 Plantation age 17 Ht. gr. made in inches*	*Scotch pine D.B.H. 6.8 inches Planted 1914 Plantation age 17 Ht. gr. made in inches*
1914	2	11
1915	7	16
1916	15	16
1917	21	16
1918	16	24
1919	27	27
1920	31	17
1921	20	31
1922	26	21
1923	32	19
1924	31	19
1925	14	16
1926	30	23
1927	29	23
1928	31	23
1929	26	18
1930	24	22
Total ht.—inches	382	342
Total ht. ft.	31.8	28.5
Av. growth per yr. inches	22.5	20.1

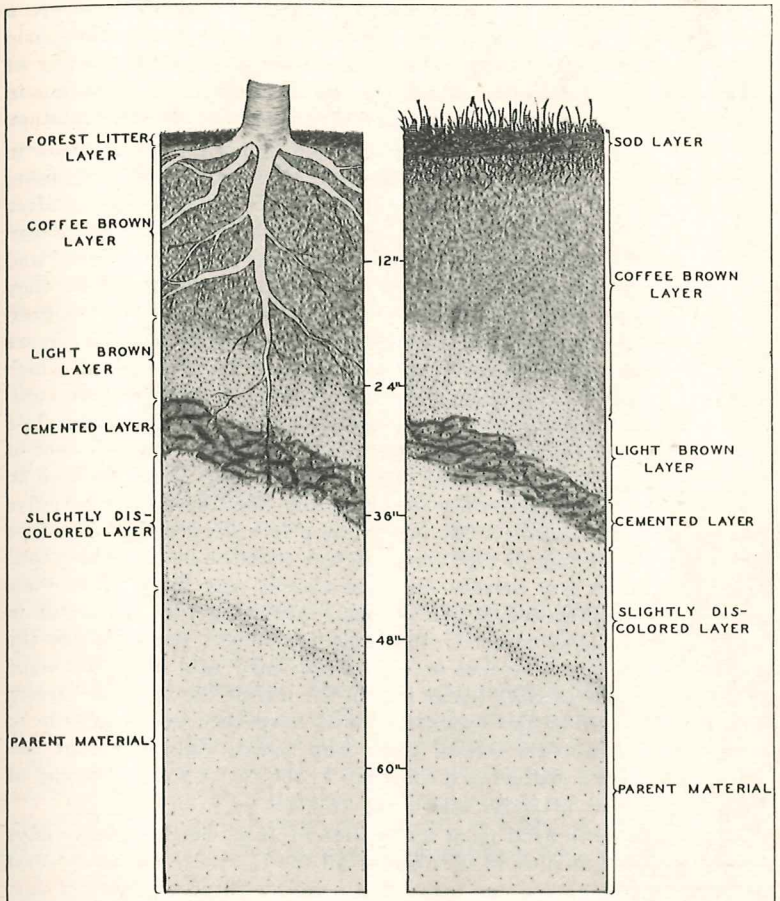
FORESTS AND THE CONTROL OF SOIL WATER

The Relative Water Content of a Sandy Soil in a Fifteen Year Old Forest Plantation of Norway Pine, as Compared With the Same Soil Covered With a Sod

It is a generally accepted fact that the evaporation of free water in a prairie soil is greater than in a forest soil. In order to determine just what the difference in free water content due to evaporation is, investigations were made by the Wisconsin Land Inventory at the Nye–Hayes Forest Plantation near Wascott located on the sandy soils of southern Douglas county.

The method of procedure was to find the relative loss of free water by weight from soil samples taken in the interior of a forest planta-

PLATE X



THE TOTAL PRECIPITATION ON BOTH SOILS FOR THE PERIOD FROM JUNE 1ST. TO JULY 12TH, 1931 WAS APPROXIMATELY 6.5 INCHES. THE LAST HEAVY RAIN FELL ON JULY 12TH, 1931. THE WATER DETERMINATION WAS MADE JULY 14TH, 1931 AT WHICH TIME THERE WERE 53 TONS OF WATER PER ACRE IN THE TOP 12 INCHES OF THE FOREST SOIL AND 38 TONS OF WATER PER ACRE IN THE TOP 12 INCHES OF THE SOD COVERED SOIL. AFTER THE RAINLESS PERIOD FROM JULY 12TH TO JULY 30TH, 1931 1.06 INCHES OF RAIN FELL DURING 18 HOURS PREVIOUS TO 4 P.M. JULY 31ST, 1931. THIS PRECIPITATION HAD PENETRATED THE FOREST SOIL TO A DEPTH OF 12 INCHES AND THE SOD COVERED SOIL TO A DEPTH OF 6 INCHES AT 4 P.M. JULY 31ST, 1931.

THE FOREST COVERED AREA WAS ADJACENT TO THE SOD COVERED AREA. THIS SHOWS THAT EXCESSIVE EVAPORATION OCCURS IN OPEN SOD COVERED LAND.

tion and in an open field adjacent, by exposing them to the air until uniformly dry.

The two types of land selected as a basis of comparison were a fifteen year old stand of Norway pine and an open sod covered field adjacent. The young Norway pine were set out with a spacing of six by six feet in the plantation in 1916, and averaged four inches in diameter and twenty-two feet in height at the time of the investigation.

A rain gauge located at the plantation showed that previous to taking the soil samples, there had been sufficient rainfall to thoroughly soak the soil. The samples were taken about forty-eight hours after the last heavy rainfall. They consisted of thin slices of soil taken twelve inches deep under the needle duff of the forest plantation and also from the open sod field nearby. After taking these samples they were quickly enclosed in paraffin paper wrappers, immediately weighed on a chemical scale, and their weights recorded. The paraffin papers were then opened and the soil exposed to the air for five days in which the free water was allowed to evaporate until the samples were uniformly dried. All samples were again weighed and the water loss determined. These water losses were then figured for an acre foot of soil from the forest plantation and the open field. Since the soil in this section of Douglas county is very sandy, the figure of twenty-five hundred tons was used for the normal acre foot soil weight. The free water in the acre foot of the forest soil was found to be fifty-three tons and in the open sod covered field the weight was thirty-eight tons. This shows a difference of fifteen tons. Assuming that the water in both soils was approximately the same forty-eight hours before the samples were taken, or just after the last hard rain of a prolonged rainy period, the greater water loss in the soil of the open sod grown field as compared to the forest soil must have been due primarily to evaporation. In other words, there was twenty-eight per cent less water in the open sod covered soil than in the forest soil at the end of forty-eight hours after the last heavy rainfall.

There was no rainfall from the twelfth of July, which was two days before the soil samples were taken, until the thirtieth and thirty-first of July, at which time one inch of rain fell, with no evidence of surface run-off. The average penetration of this one inch of rainfall was found to be six inches in the sod covered field and twelve inches in the forest soil. This difference in depth of penetration shows the extreme dryness of the open sod covered soil as compared to the forest soil at the end of a period of about eighteen days without rain.

It would seem, therefore, that an adequate forest cover is the prime essential in the control of free soil water and that this is especially true in regions with such sandy soil as is found in southeastern Douglas county.

*THE WHITE PINE BLISTER RUST SITUATION IN DOUGLAS COUNTY

A plant disease commonly known as white pine blister rust is now well established in northern Wisconsin. This disease attacks and kills the white pine. Unlike some other serious tree diseases, blister rust can be controlled.

The importance of white pine trees to the people of the state is quite well recognized, but the seriousness of blister rust which causes considerable loss in white pine, particularly to the young trees, is not so well understood. An appreciation of the damage that blister rust may cause to pine stands unprotected against the disease should be of importance in molding public sentiment toward the further protection of white pine from this disease.

Blister rust was found killing white pine in Douglas county for the first time in 1930 in the vicinity of Hawthorne. Since then other infection-centers have become established; the principal one of these centers is in the Brule river region. Currant and gooseberry bushes infected with this rust have also been found near the city of Superior.

Blister rust is a form of fungus disease that lives alternately on white pine and on the leaves of currant and gooseberry plants. Ordinarily it does not seriously affect the currant or gooseberry plant but it is deadly to white pine. The fungus grows in the inner bark of the tree and kills it by girdling it and stopping the flow of sap. Death occurs from three to twelve or more years after infection takes place, depending upon the size of the diseased tree and the number and location of the parts affected. The fungus reproduces itself by means of spores which correspond to seeds of the higher plants. These spores are very minute and are, therefore, easily disseminated by the wind.

The disease requires both white pine and a currant or gooseberry plant to complete its life cycle. For this reason the blister rust cannot spread from an infected pine directly to a healthy pine but must pass part of its life on a currant or gooseberry bush and from there go to a white pine.

Under Wisconsin forest conditions a stand can be protected from blister rust by the removal of all currant and gooseberry bushes within the pine stand and for a distance of 900 feet around it and by removal of all cultivated black currants within one mile. The cultivated black currant is so much more susceptible to infection that it is an important agent in the long distance spread and local establishment of blister rust in disease-free areas. Therefore it should not be grown in white pine regions.

White pine blister rust, similar to many of our serious plant diseases of foreign origin, was brought into the United States from Europe on white pine planting stock before this country had enacted plant quarantine laws. As is often the case with introduced diseases,

* This article contributed by Mr. T. F. Kouba, in Charge of Blister Rust Control. Dept. of Agriculture and Markets.

the blister rust organism proved to be more destructive in this country than in Europe. The first outbreak in Wisconsin occurred in Polk county in 1915; since then it has spread to some thirty-three counties in the state. Before blister rust became established here currant and gooseberry bushes and white pine trees could safely grow side by side but now any pine stand that harbors these bushes is in danger of contracting white pine blister rust.

During late April and in May is the best time to look for blister rust on white pine. It can be recognized at that time by the bright orange-yellow blisters which burst through the diseased bark. These blisters are about the size of a navy bean, and occur in groups. Blister rust can be seen during the summer and early autumn on the underside of infected currant or gooseberry leaves as small rust spots. If you find the disease either on pines or currant and gooseberry bushes send specimens to the State Entomologist, State Capitol, Madison, Wisconsin.

A type of work in reforestation which is becoming more and more important is the examination of prospective white pine planting sites before planting in order to determine whether currant or gooseberry bushes are, or are not, abundant on the area. There are, for instance, rare situations where it is not feasible to plant white pine because of an extremely heavy growth of currant and gooseberry bushes on the area. The Ounce–Totogatic region is such an area. Fortunately, Douglas county has many acres of excellent white pine planting sites that support but few currants and gooseberries. The few bushes on the area should be removed before the white pine are planted. This protects the plantation against loss from blister rust and aids in safeguarding the pine-owner's investment. It should be remembered that white pine probably has no more enemies than many of its associated species of the forest, and that few forest pests lend themselves to control measures that are effective and still practicable and comparatively inexpensive. Once a white pine stand is rid of currant and gooseberry bushes it remains protected permanently against blister rust invasion.

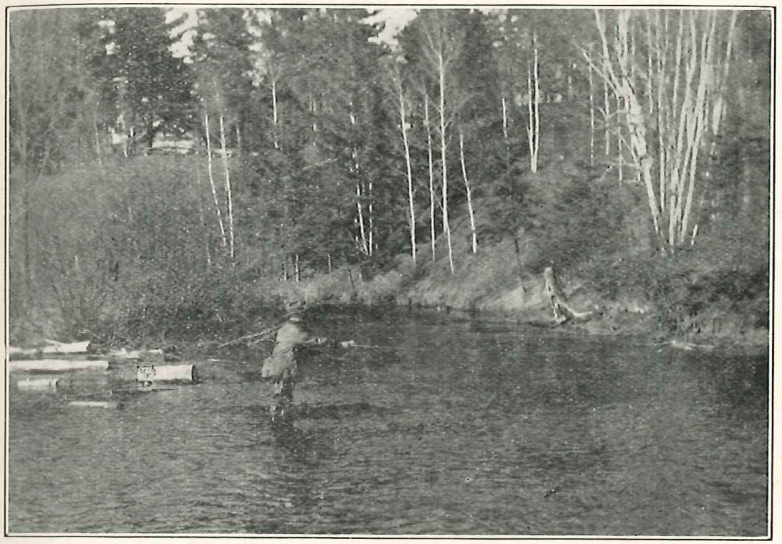
RECREATION

Douglas county has great recreational facilities. It has many fine lakes as well as many splendid trout streams. The famous Brule is known to all fly fishermen for its fine trout. Much forest land adjacent to lakes and streams will continue privately owned because of its recreational value. Recreational land will therefore continue productive while a new timber crop is growing.

Improvement of this recreational land may be accomplished in some instances by again surrounding lakes with densely wooded shore lines. It may be by stocking the lakes with fish which will thrive in their water. It may be by adding to the plant life in the lakes, plants important to fish life already there. It may be by delineating the

present extreme fire hazards in certain areas so clearly that proper measures to reduce this hazard will prevent fires in the future, thereby making it practical to reforest areas especially well adapted to timber production.

Some counties are now planning extensive programs of fish propagation and when necessary, are transplanting aquatic vegetation to improve fishing conditions. They are beginning to realize that these lakes and streams must be kept well stocked with game fish or tourists will not continue to visit them. In order to know what is necessary,

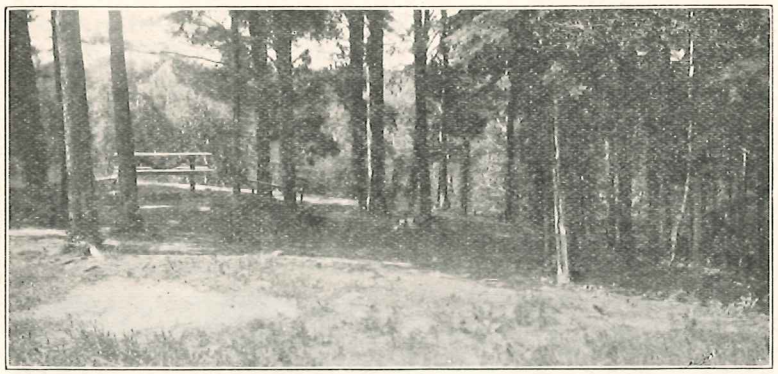


Courtesy Conservation Department

Fisherman on the Brule River

it is therefore important to inventory water, as well as land, as a guide in increasing the recreational assets of the county and to bring about a well balanced plan of land use.

Much that is historic in character and colored with the romance of adventure of the red man from the age of the mound builder to and including the advent of the white man has contributed to the lake and land lore of Douglas county. Many lakes and streams, waterfalls and trails bear the musical and descriptive names of Indian origin. The great spirit Manitou still lives in the falling water of the Black river as it did many centuries back. The thousands who annually visit Pattison Park, St. Croix Lake, the Bois Brule, and the many other places made famous by Indian traditions, will find the summation of this early history of Douglas county of ever increasing interest. They will find the detailed inventory of the lakes no less interesting. An adventure in the improvement of lakes, streams, and



Courtesy Conservation Department

Picnic Grounds in Brule State Forest

forest based upon inventory data, and coupled with a study of Indian lore, will give new zest to the lives of those who have an urge to recreate themselves.

EARLY HISTORY OF DOUGLAS COUNTY

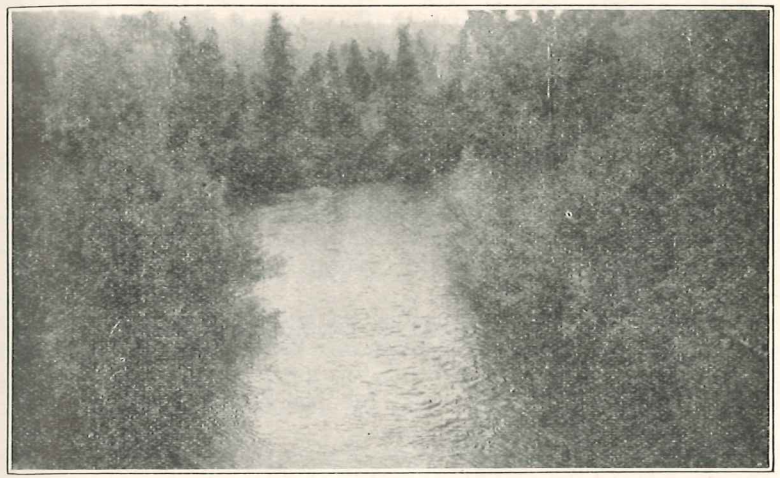
By Charles L. Emerson

Author's Note.—The history of Douglas County is necessarily the story of the Indian—a misnomer applied to a race of men more noble than their white conquerors and exterminators. Benjamin Armstrong, who spent some thirty years among the Chippewa and Sioux in and about the county, from 1840 onward, says they had a very pure religious life and a high spiritual development; they worshiped one god, Manitou, and they believed that all must stand at a river's edge in the Hereafter for final judgment; food was placed on the graves of the dead as a sacrifice, because it was scarce always and therefor the most precious thing they had. Among their head men was spoken a second language, "Chief talk", the language of a secret society to which but few were admitted. Progress through the various stages of the society was fostered in degrees, much like the purer forms among the whites. They were taught that the earth and everything in it belonged to Manitou; that men are but tenants here temporarily; and that all should share alike in the fruits of the earth. It required the higher culture and the more advanced civilization of the white man to teach the Red Men deceit and treachery. The original owners welcomed the whites, innocently believing the intruders would respect the Red Man's views. When he saw his forests denuded, the game destroyed, and himself forced onto the narrow confines of sterile reservations, he said simply: "The earth is the white man's heaven, and money is his god".

In the beginning were the Mound Builders, a mysterious advanced culture, who mined copper in the Minong Range and at Manitou Falls on the Black River, using both water and fire in securing the metal. They beat it into weapons, implements and ornaments; with their

dead they buried it in the curious mounds which remain as mute testimony of their vanished glory. More than five hundred years ago they flourished—and vanished: forest growths of the same age in their mine pits and on their mounds, evidence the construction of the mounds and the abandonment of the pits before the year 1400 A.D. Indian religion forbade their delving in the earth for Manitou's hidden treasures; it is possible that a wholly different race of men built the mounds and dug the pits.

Then there were the "People of the Fire", the Mascoutins, a branch of the Potawatomi, "The Fire Nation", trapping the beaver and harvesting the wild rice, spearing the succulent white fish and trailing



Courtesy Conservation Department

Trout Stream in Brule State Forest

the timid deer. Upon their sandy plains and rolling prairies, appeared a huge, snorting trampler with shaggy mane blown over bloodshot eyes, a grotesque hump on its back—the American bison, the buffalo, migrating westward from the Atlantic coastal plain.

Before Columbus was born in Genoa, perhaps a century or more, the Dacotah (Otceti-ca-kowin, "The Seven Council Fires", they called themselves) left their homes in the Piedmont and on the Atlantic coastal plain in what are now Virginia and the two Carolinas, forced out by the Iroquois (Naud-o-waig, "Like unto the adders") to the north and the Algonquian stock to the south; and, trailing the bison westward through the Cumberland Gap in the Appalachians, across the Kentucky Blue-grass, over the waving prairies of the Illini, they came to the Wees-kon-san, "Where the waters gather", and spread northwestward to the Mese-ce-be, "Father of Waters", and the Wahni-ti, "Winding River", at the north. Rendered ferocious by their

hardships, the Dacotah drove out the more pacific Mascoutins, who then settled along the Wees-kon-san and the Fox rivers.

Then came the O-dug-am-eeg (Outagamie), "The opposite-side people", and the O-saug-eeg (Saugis, Sauk, Sac), "Those who live at the entry", Algonquian peoples forced westward by the Iroquois. With the Dacotah they shared the wild-rice lakes around the Bois Brule—St. Croix headwaters. They trapped the beaver and other small game, while the Dacotah learned to slay the buffalo by surrounding a herd and firing the grass, spearing and shooting with arrows the frightened animals as they fled.

About the year 1400 A.D. there began another momentous migration: the Ojibway, "To roast till puckered up", an Algonquian people, fled their Atlantic coastal homes north of the St. Lawrence river, forced out also by the Iroquois. They tarried in various regions, moving slowly through the years, until they reached the Michilimackinac, "Turtle island", at the head of the lake of the Hurons. Here they separated eventually: the Potta-wat-um-ees, "Those who make or keep a fire", drifting southward and settling along the western and southern shores of the lake of the Illini (lake Michigan); the Ot-tah-way, "Traders", remained in the Mackinac region; while the Ojibway main branch moved northward and established their principal village at the Sault Ste. Marie. This village existed until the British occupation, the French calling all the Ojibway "Saulteux" because of the location of this town.

It was during their stay here that the Ojibway first met the Dacotah, evidenced by the name the latter gave them: Ra-ra-to-oans, "The people of the falls". The Dacotah, the new arrivals called Naud-o-wes-se-wug, "The snake-like ones", for their ferocity. It seems they were at war from the first.

Even here the Ojibway were attacked by the implacable Iroquois. So they resumed their westward movement, eventually reaching Shan-ah-waum-ik-ong (Chequamegon Bay) in 1492—the year Columbus landed on San Salvador. But the Dacotah and the fierce Outagamie (Fox, "Les Reynards" to the French) combined to oppose them, forcing their withdrawal to Mo-nung-wah-na-can-ing, "The place of the golden-breasted woodpecker" (now corrupted to Madeline Island), in the bay. There they built a village and planted their maze and pumpkins. And from there they hunted for game on the mainland; until their growing strength and their incursions so alarmed the Dacotah and the Fox that they combined to drive out the intruders. In a terrible battle (1612), the Ojibwa crushed the allies and gained a foothold on the mainland, spreading to the south and west, and disputing bitterly with the Dacotah for control of the rice lakes and the small game hunting fields about the Bois Brulé, Wa-sah-que-da-ce-be, "Burnt river", and the Ah-gich-che-se-be, "Pipestem river", the St. Croix. An occasional battle was fought with the Menomoni, "The rice-eaters", an Algonquian people who came into the Wees-kon-san before the Ojibwa, and whose principal villages were to the southward where they shared the hunting-grounds with the Wee-ni-bee-gog, "Foul or

turbid water", Winnebago; the latter had followed their kinsmen, the Dacotah, as a rear-guard from the east.

Then came the French (1618): Stephen Brulé, a voyageur for Champlain, coasting along Cha-jik-o-ming, "The largest body of fresh water we know of", and meeting the Ojibwa, carried back to Quebec some copper specimens and a glowing account of the region. In 1632 appeared Champlain's map showing Cha-jik-o-ming as "Lac Superior de Tracy", and the lower end shore as "Fond du Lac".

During those years, the Ojibwa were acquiring the white man's culture: fire-arms and a craving for strong drink, and the realization that rich peltries would secure those things for them. They plunged into the land of small lakes about and to the southeastward from the headwaters of the Bois Brulé, where the small furred animals were most abundant. They destroyed the Fox villages north of the Minong escarpment, forcing them southward. On a new ground they disputed with the Dacotah, whom the French called Naudewescioux (their translation of the Chippewa name Naud-o-wes-se-wug, and which has since been shortened to Sioux). The latter had villages in and about the Upper St. Croix lake region until dislodged by the Ojibwa with fire-arms before 1695. A Sioux principal village stood on the south shore of Wah-ni-ti near its mouth on the Fond du Lac, until 1671. (See Plate I, page 2a)

In 1653 came the gentle Father Menard, baptizing Sioux and Ojibwa alike on the Fond du Lac. Two years later, Radisson and Grosseilliers, French voyageurs, explored the Fond du Lac; they returned in 1658, coming overland from LaPointe with an Ojibwa hunting party along the old trail to the lower St. Croix, passing Block Lake, through the site of Gordon, skirting Bardon Lake, and passing southwestward between the Persons Lakes and the bend of the Totogatic river. (See Plate I, page 2a) On this journey they seem to have discovered the Mississippi river, fully fourteen years before Joliet saw it. (It is thought that Jean Nicolet was on the Mississippi in 1634, but that is not verified.)

The fervent Jesuit Claude Allouez picked up Menard's work (1668); and two years later we find the enthusiastic Marquette on the Fond du Lac, fleeing eastward with the Ojibwa to escape the Sioux. A truce between them was effected by Nicolas Perrot, first French governor of the Northwest, at Sault Ste. Marie (1671), by which the Sioux agreed to yield to the Ojibwa the village sites along the Fond du Lac. Together the ancient enemies hunted the beaver along the Amnicon and the Cha-ba-de-ba, "Black river"; travelled the important portage from Upper St. Croix lake to the Bois Brulé; and harvested wild-rice in the lakes of the region. (See Plate I, page 2a for location of portage) The Ojibwa carried furs from these valleys and basins to the French on the St. Lawrence in eastern Canada.

The Sieur Randin, La Salle's trading agent, was among the Red Men on the Fond du Lac in 1673. Six years later came Daniel Greysolon Du L'Hut (Duluth), cousin of Henri de Tonty, La Salle's lieutenant; he coasted along the Fond du Lac, exploring the rivers trav-

ersing the region, and ascending the Wah-ni-ti, "Winding river", which he re-named St. Louis for Louis XIV of France, he of evil memory. The next year he traversed the Bois Brulé—St. Croix portage down to the Mississippi, where he learned of Friar Louis Hennepin's captivity among the Sioux two hundred forty miles below.

That same year, Nicholas Perrot built his fort about the middle west shore of Upper St. Croix lake, to guard the movement of furs along the portage route. The hostile Fox to the south had closed the usual Fox–Wisconsin route. Fort, lake, and river he named alike St Croix, for one of his men (says Le Sueur) who drowned at the river-mouth below.

About 1690, the Sioux of Mille Lacs in Minnesota murdered some visiting Ojibwa from the Fond du Lac. Whereupon the Ojibwa raised the war-whoop and drove the Sioux from the Upper St. Croix and the rice lakes in a series of battles and running skirmishes. In 1693, Pierre Charles Le Sueur traversed the Brulé–St. Croix portage to build a fort on the Mississippi near the present site of Red Wing, Minnesota, from which he treated with the warring nations. Two years later he effected a treaty, bringing peace to this region and establishing a dividing line between the two nations south of here.

In 1746, the Ojibwa rallied to the call of the French and helped in driving their old enemy, the Fox, from the Wisconsin and Fox rivers to the Mississippi. Four years later, the Sieur Marin, who commanded that expedition, was traveling the old foot trail through Gordon, La Pointe to the lower St. Croix. Meanwhile, the name Ojibwa was becoming corrupted to Chippewa and the name was applied to the river Puk-wa-wanuh, toward which they were spreading. (See Plate I, page 2a, for old trail)

But the Sioux and Chippewa were never at peace for long: the French war with Britain terminated, and in 1766, Captain Jonathan Carver, an American officer in the British army, great-grandson of Governor John Carver of Plymouth colony of 1620, effected a peace between the turbulent tribesmen on the lower St. Croix. By 1783, not a Sioux village remained in this region.

Arrowsmith's map (London, 1796) shows the Bois Brulé as the "passage into the country of the wild-rice Indians". The Chippewa on the wild-rice lakes came to be known as mun-o-min-ik-a-sheenh-ug, "Rice-makers".

The Sioux then began acquiring horses from the Mandan nation (1802–3) and were then able to pursue the bison mounted. They betook themselves to the plains country to westward, leaving the wild-rice lakes to the Chippewa. But their wars were not over by any means.

The Frenchman Curot visited the rivers Brulé and Amnicon (1804) and reported in detail on the many rapids in the latter.

Captain Thos. G. Anderson had a trading post on the Upper St. Croix in 1810–11; he it was who led the British in their successful attack on Fort Crawford at Prairie du Chien in the War of 1812. Here he met Onketah-Endutah (Red Whale), War Chief of the Sioux.

Territorial Governor Lewis Cass and Federal Judge James Duane Doty inspected the Fond du Lac and its tributary rivers (1820), and ascended the river St. Louis to the Southwestern Company's trading post. Later (1835), General Cass met with the Chippewa, Sioux, Potawatomi, and the Sacs and Foxes at Prairie du Chien, and concluded a treaty, whereby the Sioux relinquished all claim to this region.

At St. Peter, Minnesota, in 1837, Colonel Snelling, U. S. Army, and Major Walker of Missouri, by deliberate deceit secured a complete and unconditional surrender of all Chippewa lands in the lower part of this region; representing the cession to be for *pine timber and minerals only*, and stating positively that the Red Men would not be disturbed in their occupancy and hunting. Five years later, at La Pointe, the same subterfuge induced the St. Croix and Superior Chippewa to make a similar cession. In each instance the Chippewa "touched the quill", i.e., they signed in good faith, being unable to read. But when, in 1849, the removal of the Chippewa westward was ordered, they refused to go, declaring they had been tricked. The Indian Agent from the Federal Department of the Interior refused to pay them their annuities in their old habitat. He fed them on spoiled foodstuffs until some one hundred fifty had died; he then fled with their money.

Up rose one Benjamin G. Armstrong, an Alabaman trader at La Pointe on the Upper St. Croix regions since 1840. He conducted a delegation of Chippewa head men to Washington, D. C., where they, after many obstacles had been placed in their path, finally got the ear of President Millard Fillmore, who sent them home rejoicing with promise of protection in their old habitat.

It was on October first, 1842, that Mr. Armstrong witnessed a signal victory of some two hundred fifty Chippewa under old chief Buffalo, over a vastly superior number of Sioux under Old Crow. The battle was fought at the east bank of the Brulé north of the town of Brulé. The Sioux lost one hundred killed, the Chippewa only thirteen. (See Plate I, page 2a)

Through Mr. Armstrong, the St. Croix and Superior Chippewa secured a good reservation on the Fond du Lac in the treaty of 1854, Mr. Armstrong receiving a square mile of land, but west of the St. Louis river at its mouth.

In 1847, the Chippewa of this region journeyed southward to the whiskey-shop of John Drake on Lake Pokegama to buy firewater; while a missionary named Boutwell journeyed up here from the same lake to combat the evil influence. At this time, the Chippewa chief at the Fond du Lac was Hole-in-the-Day, a brave young leader who signed away the Chippewa rights there in a treaty with Hon. H. M. Rice. This marked the beginning of the end of Chippewa control in the region.

White settlers began to pour in, cutting the timber and prospecting for minerals. In 1852, the county survey into townships was completed. That same year the first settlers founded the city of Supe-

rior. The next year the Chippewa along the Fond du Lac suffered so severely that the heroic Father Baraga, from L'Anse, journeyed 250 miles on snowshoes to minister to them. In 1854, a party of them, returning peaceably from La Pointe over the old foot trail through Gordon toward their homes westward, were ambushed by a Sioux war party and their chief and his family slain.

The Federal Land Office was opened at Superior in 1855. This marked the beginning of the white man's transformation. Homestead, mining, and lumbering sites were rapidly taken up. Villages sprang up about the prospects and on the forested plains; some took the names of trees, others honored lumber and real estate men and politicians. In 1857 James Bardon, the historian, arrived to settle at Superior. At this time the Chippewa chief on the Fond du Lac was Na-gon-ub, "The Foremost Sitter".

The county was formed and took the name of Douglas (1854), honoring Stephen A. Douglas, the Little Giant of Democracy, who was deeply interested in the first land company formed to exploit the site of Superior. It is of interest that Generals McQueen of South Carolina and John C. Breckenridge of Kentucky got through Congress a grant for a railroad, Superior to Hudson.

In 1861, when the War of the Rebellion arose, Governor Randall offered to Circuit Judge Henry D. Barron, who sat in Douglas county, the colonelcy of the Eighth Wisconsin Volunteers, the famous "Old Abe" regiment. The judge was obliged to decline because of ill-health; but he was throughout the war active in enlistment.

The village of Gordon was founded in 1862, on the site of Antoine Gordon's old trading post. Solon Springs (White Birch) grew up near the site of Perrot's vanished fort of 1673. Other towns perpetuate the beautiful names given by the Red Men to localities, streams, and lakes. (See Plate I, page 2a)

Superior was incorporated as a city in 1887. Two years later West Superior was the scene of the memorable Superior Air Line Railway strike. The laborers were in dire want, not having been paid. Militia was called out against possible riot. Governor Rusk sternly rebuked the railway officers, expressing public sentiment in the historic words: "These men need bread, not bullets!" They got their pay.

The state Normal School was established at Superior in 1896. Many institutions of learning have sprung up since, each village having its school. In the fall of 1914, the Chippewa interred on Wisconsin Point at Superior were torn from their resting places and buried in one of the city cemeteries. The Chippewa were very wroth, but were obliged to acquiesce.

The state has located two of its parks within the county. Pattison is twelve miles south of the city of Superior at Manitou Falls of the Black river. It comprises 660 acres, the gift (1920) of Martin Pattison of Superior. Brulé park is along the historic Bois Brulé river, comprising 640 acres, the gift (1906) of the Nebagamon Lumber Company. President Calvin Coolidge spent the summer of 1928 along the

course of this dashing, tumbling stream. It is renowned for trout fishing.

The denuding of the forest went forward at an alarming pace. Much logged-over land was turned over to the state as a gift to escape payment of taxes. Fortunately, the state department of agriculture has formulated and is pressing a re-forestation program, which promises to re-clothe these rugged hills and rolling plains in the verdure of their primeval glory.

GLOSSARY OF DOUGLAS COUNTY NAMES

*Bibliography**

Wees-kon-san (Chippewa) "Where the waters gather."—Applied to the river because of the myriad brooks and rivulets that form the stream.

Douglas Co.—Named for U. S. Senator Stephen A. Douglas, of Illinois, who was heavily interested in the original townsite company formed to promote a city at the head of Lake Superior.

Amnicon R. and Lake (Chippewa) Ah-min-ah-con-ning, "A place where fish spawn"—White fish go up this river in fall to spawn. Early settlers pronounced it "Ah-min-icon"; Michael Corot notes (Wis. Hist. Coll.) "May 24, 1804 camped early at the river La Meckanne."

Allouez Bay—After Claude Allouez, who preached to Indians on its shore, 1650.

Bardon Lake—In southern part of county, for Hon. James Bardon of Superior.

Bass Lake—For its fish.

Bond Lake—For himself by a realtor who published a map, 1884.

Brule River—One of the oldest on the map. French "burnt". Early explorers and Indians called it Bois Brule, Burnt Wood.

Eau Claire River and Lake—Clear Water; French, named XVII century.

Leader Lake—For W. J. Leader, county clerk, named about 1895.

Lyman Lake—Old Horse Shoe Lake; named for Geo. N. Lyman, Milwaukee, 1884.

Middle River—Between Amnicon and Brule Rivers.

Minnesuing Lake (Chippewa) Min-nah-su-ing, "The place of the island."

Nemadji River (Chippewa) "On the left hand"—Coming in from Lake Superior in canoes.

Nebagamon Lake (Chippewa) Nee-bay-go-moh-win, "Place to hunt deer by fire, from the water."

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* Cyclopedia of Wisconsin by Geo. W. Peck; Reports of Bur. of Amer. Ethnology; Douglas Co. names by S. W. Powell, 1897.

Moose River—Once favorite running ground for this ruminant.
Ox Creek or River—Early French "River au Beauf."
Pokegama Bay (Chippewa) Po-kah-gah-mah, "Water at the side of a river."
Person Lake—Person family, living on this lake.
Safford Lake—From L. W. Safford, early West Superior settler.
Spruce River—Early French, Riviere des Epinette (spruce).
St. Louis River—Named by DuChut for Louis XIV. Indian name was Wah-ni-ti (Winding River).
S. Croix R. and Lake—"Holy Cross". Old. Franquelin's map of 1688 shows a Ft. St. Croix near site of present Solon Springs. LeSueur (1700) says it was named for a voyaguer St. Croix, drowned at its mouth.
Superior (Lake)—Named by Champlain (1632) Lac Superior de Tracy.
Totogatic River (Chippewa) "A place that sinks," "Boggy."

Towns, Post-offices and Railway Stations

Amnicon—For the river.
Amnicon Falls—R. R. Sta. Falls of Amnicon a few yards to the north.
Bennett—For founder Richard Bennett, 1884.
Blueberry—For the early blueberry thickets.
Borea—The North Wind, modern Italian.
Boyleston—Dedham—Foxboro—For same in Massachusetts.
Dewey—For Admiral Dewey.
Dobie—For David Dobie, lumberman.
Nutt—For E. J. Nutt, farmer there.
Gordon—For Antoine Gordon, French trading post, 1862.
Hawthorne—For thicket of hawthorn, early there.
Highland—Highlands of Brule River.
Hillcrest—Top of hill going up railway from Lake Superior.
Hines—Edward Hines, Chicago lumberman.
Lakeside—Borders 12 miles on Lake Superior.
Lake Nebagamon—For the lake.
Maple—See Blueberry.
Parkdale—Asylum station.
Parkland—Coined by county board.
Patzau—For a town in Bohemia.
Poplar—See Blueberry.
Rockmont—For rocky peak overlooking village.
Solon Springs—Original name "White Birch"; changed for Thomas F. Solon, first settler.
South Range—For the hills of that name.

Superior—Incorporated 1887. Named for the lake.
Walbridge—For Horace S. Walbridge of Toledo, railway promoter.
Wascott—For W. A. Scott, once president of Omaha railway.
Wentworth—For Lumber Company.
Wiehe—Chris. Wiehe, secretary of Hines Lumber Company.
Winnebijou—The Chippewa hero and demi-god, who slept once on this spot. North Wind a favorite. Threw pebbles in Superior after a deer, up sprang the Apostle Islands.
Connor's Point—For Benj. H. Connor, settler.
Chaffey—For colony of 1890.
Summit—Top of Superior–Mississippi Divide.
Billings Park—For Frederick K. Billings, philanthropist.
Dean Park—For Denis and Peter Dean; Denis, 1st postmaster of Superior; Peter gave park to city.

LAKES OF DOUGLAS COUNTY

There are 80 lakes in Douglas county that cover twenty or more acres. The total area of these lakes is about 11,900 acres. During the summer of 1931 thirty-six of the larger lakes were surveyed and studied in detail. Many of the smaller lakes that were not studied are landlocked and too shallow to support fish life.

ORIGIN

Lakes of Douglas county owe their origin to glacial action which completely altered the topography of the land causing partially drained and undrained depressions that became swamps and lakes. Many lakes in the pine plain barrens are relic lakes. These are found in the deeper depressions of the old Glacial Barrens Lake bed which once covered the southeastern part of Douglas county.(1)

LAKE STUDY

Lake data tabulated in Table XI describe conditions of lakes considered important in regard to their utilization. This study provides information essential for knowing the environment for fish found in each lake. A comparative study of lakes is necessary for a better understanding of fish ecology so that a more efficient fish planting program can be conducted.

Information in regard to water level variations, fishing conditions, and other data was obtained from personal observation and from people living in the vicinity of lakes.

The bottom in practically all lakes studied was covered with a dark greenish black organic material termed muck. The depth recorded in some of the lakes is somewhat greater than the actual depth since the sounding weight often sank some distance into the muck bottom.

Temperature and water for analysis of lakes were taken at the surface and in some cases near the bottom.

The carbon dioxide content was determined by Seyler's method.(2) "Carbon dioxide may exist in water in three forms, free carbon dioxide, bicarbonate, and carbonate. One-half the carbon dioxide as bicarbonate is known as the half-bound carbon dioxide. The carbon dioxide as carbonate plus one-half that as bicarbonate is known as the bound carbon dioxide."(3)

The degree of hardness and softness of lake water may be determined by the pH. A pH of 7 is neutral, below 7 soft or acid, and

(1) Aldrich, H. R. and Fassett, N. C.
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(2) Seyler, C. A.
1894, Chemical News, Vol. 70.
Birge, E. A. and Juday, C.
1911, Inland Lakes of Wisconsin, Wisconsin Geological and Natural History Survey, Bulletin 22.

(3) Sixth Edition.
1925, Standard Methods of Water Analysis, American Public Health Association, 370 Seventh Avenue, New York, N. Y.

TABLE XI—DOUGLAS COUNTY LAKES

Name of Lake	Location of Lake		Date Visited	Drainage	Max. Depth in Feet	Lake Area in Acres	Temp. of Air	Temp. at Surface	Temp. at Depth	Water as to Hardness and softness	Analysis of Water						Appearance of Water	Water Level during Period of years	Nature of Lake Bottom in Shoal Water	Nature of Lake Bottom in Deep Water	Lake Vegetation as to Abundance and Variety	Plant Duck Foods	Fish Common in Lake before Lake was Stocked	Lake has been Stocked with	Fish Common in Lake at Present	Suggestions for Stocking with W. E. pike and L. M. bass	Other Data
											Approximate Parts per Million of				Approximate pH												
											Free CO^2		Fixed CO^2														
	Township North	Range West									At Surface	At Depth in Feet	At Surface	At Depth in Feet	At Surface	At Depth in Feet											
Alexander	43	11	July 24	Land-locked	12	48	72°F.	74°F.		V. S.	2		4		6.8		Clear	Dropped 4 ft., 1923-'31	Mucky	Sandy. Sandy overlaid with thin layer of muck. Mucky in N. and S. part	Scarce and not varied	None	Rock bass, bluegills, sunfish	W. E. Pike, 1910 & 1925. L. M. bass	Rock bass, bluegills, sunfish		
Amnicon	46	14	July 27	Inlet and outlet	21	312	88°F.	86°F.	76°F.-20′	M.	3	5-17′.	15	16-17′.	7.6	7.5-17.′	Slight brown stain	Fairly constant	Mucky	Sandy in most places. Mucky in N. & S. part	Abundant and varied	Fairly abundant	N. pike, L. M. bass, muskellunge, pan fish	W. E. pike several years	W. E. pike, N. pike, L. M. bass, muskellunge, pan fish	W. E. pike	
*Bass	43	12	July 1	Land-locked	23	110	88°F.	84°F.		V. S.	1		3		6.8		Clear	Dropped 5-6 ft. 1891 to 1931	Mucky	Sandy. Sandy overlaid with thin layer of muck.	Fairly abundant and not varied	None	N. pike, L. M. bass, blue gills	W. E. pike 1927. Crappies	N. pike, L. M. bass, crappies, bluegills	L. M. bass	
Bond	43	12	July 9	Land-locked	64	162	67°F.	71°F.	65°F.-67′	M.	1	9-50′.	13	15-50′.	8.2	6.6-50.′	Clear	Dropped 2-3 ft. 1926-'31	Mucky	Sandy	Abundant and varied	Scarce	N. pike, L. M. bass, bluegills, perch	W. E. pike 1923-'31. L. M. bass	N. pike, L. M. bass, bluegills, perch	L. M. bass	
Clyde	43	11	July 23	Land-locked	11	37	73°F.	78°F.		V. S.	4		2				Clear	Dropped	Mucky	Sandy. Mucky. Sandy overlaid with thin layer of muck in S. & W. part.	Scarce and not varied	None	None	W. E. pike, L. M. bass, bluegills, sunfish, perch	Few W. E. pike, L. M. bass, bluegills, perch		
Cranberry	43	13	July 9	Inlet and outlet	17	286				M. H.	3		27		8.3		Slight brown stain	Fairly constant	Mucky. Sandy and gravelly in spots.	Sandy. Inlet and outlet mucky	Abundant and varied	Fairly abundant	N. pike, L. M. bass, crappies, bluegills, bullheads	No stocking, 1924-'31	N. pike, L. M. bass, crappies, bluegills, bullheads	L. M. bass	
Crystal	43	13	July 2	Land-locked	19	320				S.			5		8		Clear	Dropped 1 ft. from 1924-'31	Mucky	Sandy	Abundant and varied	Scarce	N. pike, L. M. bass, bluegills, perch	W. E. pike 1920-'31	N. pike, L. M. bass, bluegills, perch	L. M. bass	
Dowling	46	13	July 27	Inlet and outlet	12	121	92°F.	93°F.	77°F.-7′.	M.	4		14		7.2		Heavy brown stain	Fairly constant	Mucky	Sandy. Sandy overlaid with thin layer of muck. Mucky in S. part	Scarce	None	Muskellunge, L. M. bass, pan fish	W. E. pike, several times	Muskellunge, L. M. bass, pan fish		
Ellison	45	10	June 25	Land-locked	17	95		76°F.	66°F.-16′.	M.	2		11		7.7		Clear	Dropped 5 ft. 1924-'31	Mucky	Sandy. Sandy overlaid with thin layer of muck	Fairly abundant & varied	Scarce	L. M. bass, bluegills, sunfish, perch	W. E. pike, 1920-.30. Bluegills, 1928	L. M. bass, W. E. pike, bluegills, sunfish	L. M. bass or W. E. pike	
*Island	45	11	July 15	Land-locked	17	93	84°F.	75°F.		V. S.	2		3		7		Clear	Dropped 3½ ft. 1921-'31. Water level rising now	Mucky	Sandy. Sandy overlaid with thin layer of muck	Fairly abundant and not varied	None	L. M. bass, pan fish	L. M. bass, N. pike	L. M. bass, N. pike, pan fish	L. M. bass	
Leader	43	12	July 9, 10	Land-locked	56	89		73°F.	65°F.-21′.	M.	5	6-55′.	13	14-55′.	8.5	6.9-55′	Clear	Dropped 2-3 ft. 1926-'31	Mucky	Sandy. Sandy overlaid with muck in bays. Mucky in S. E. part	Abundant and varied	Scarce	L. M. bass, N. pike, bluegills, perch	W. E. pike, 1928-'29. L. M. bass 1929.	L. M. bass, N. pike, bluegills, perch	L. M. bass	
*Loon	45	10	June 13	Land-locked	16	65		71°F.		M.	3		18		8		Clear	Dropped 4-5 ft. 1924-'32	Mucky	Sandy. Sandy overlaid with thin layer of muck. Mucky in S. part	Fairly abundant & varied	Scarce	L. M. bass, pan fish	W. E. pike 1907 and other times	L. M. bass, W. E. pike, pan fish	L. M. bass or W. E. pike	
Lower Eau Clair	44	10	July 16	Inlet and outlet	39	897	86°F.	84°F.	68°F.-30′.	M. H.	2	4-30′.	29	29-30′.	8.6	8.4-30′.	Clear	Periodic	Mucky	Sandy. Sandy overlaid with thin layer of muck in places	Abundant and varied	Fairly abundant	N. pike, L. M. bass, rock bass, bluegills, perch	W. E. pike 1914-'31, L. M. bass	N. pike, L. M. bass, rock bass, bluegills, perch	W. E. pike	
Lower Ox	44	11	July 17	Inlet and outlet	12	62	81°F.	79°F.		M. H.	2 neg.		24		9.3		Clear	Fairly constant	Mucky	Mucky	Abundant and varied	Fairly abundant	N. pike, W. E. pike, L. M. bass, bluegills, sunfish, perch, bullheads		N. pike, W. E. pike, L. M. bass, bluegills, sunfish, perch bullheads	W. E. pike	
Lyman	46	13	Oct. 31	Inlet and outlet	11	466	45°F.	45°F.		M.	4		15				Heavy brown Stain	Periodic	Mucky	Sandy overlaid with thin layer of muck. Mucky. Sandy in N. part	Fairly abundant & varied	Scarce	Muskellunge, L. M. bass, bluegills, perch	W. E. pike, L. M. bass, bluegills, perch	Muskellunge, L. M. bass, bluegills, perch	L. M. bass	
Macdougal	44	10	July 21	Land-locked	24	130	70°F.	77°F.		V. S.	1		4		6.6		Clear	Dropped 7-8 ft. 1920-'31	Mucky	Sandy	Scarce & not varied	None	None		None		
Minnisuing	46	11	July 29	Inlet and outlet	39	564	76°F.	84°F.		M. H.					24		Brown stain	Fairly constant	Mucky	Sandy. Mucky in places	Abundant & varied	Fairly abundant	L. M. bass, N. pike, rock bass, sun fish, bluegills	W. E. pike, crappies, 1921-1931	L. M. bass, N. pike, W. E. pike, crappies, bluegills, sunfish	L. M. bass or W. E. pike	

TABLE XI—DOUGLAS COUNTY LAKES (Continued)

Name of Lake	Location of Lake		Date Visited	Drainage	Max. Depth in Feet	Lake Area in Acres	Temp. of Air	Temp. at Surface	Temp. at Depth	Water as to Hardness and softness	Analysis of Water						Appearance of Water	Water Level during Period of years	Nature of Lake Bottom in Deep Water	Nature of Lake Bottom in Shoal Water	Lake Vegetation as to Abundance and Variety	Plant Duck Foods	Fish Common in Lake before Lake was Stocked	Lake has been Stocked with	Fish Common in Lake at Present	Suggestions for Stocking with W. E. pike and L. M. bass	Other Data
											Approximate Parts per Million of				Approximate pH												
											Free CO^2		Fixed CO^2														
	Township North	Range West									At Surface	At Depth in Feet	At Surface	At Depth in Feet	At Surface	At Depth in Feet											
Mulligan	43	11	June 22	Outlet	8	77				M. H.	4		20		7.2		Slight brown Stain	Fairly constant	Mucky	Mucky (wild rice straw)	Abundant & varied	Abundant	N. pike, bullheads		N. pike, bullheads		Wild rice bed
Murray	45	10	June 24	Land-locked	12	25		71°F.		V. S.	4		4		7.3		Clear	Dropped 4-5 ft. 1923-'31	Mucky	Sandy	Scarce and not varied	None	L. M. bass, perch	L. M. bass	L. M. bass, perch		
Nebagamon	46-47	11	July 28	Inlet and outlet	54	950	76°F.	74°F.	56°F.-47.′	M. H.	5		29		8.3		Brown stain	Fairly constant	Mucky	Sandy	Abundant & varied	Fairly abundant	N. pike, L. M. bass, rock bass, bluegills, sunfish, perch	W. E. pike, 1906-'31. L. M. bass, 1930	W. E. pike, N. pike, L. M. bass, rock bass, bluegills, sunfish, perch	W. E. pike	
Pagan (Haugan)	43	10	July 24	Land-locked	21	32	72°F.	91°F.		V. S.	2		3	6.7			Clear	Dropped 4 ft. 1923-'31	Mucky	Sandy. Sandy overlaid with thin layer of muck	Scarce and not varied	None	L. M. bass, sunfish		L. M. bass, sunfish	L. M. bass	
Person	43	13	July 10	Land-locked	8	171		72°F.		V. S.	1		3				Clear	Dropped 3-4 ft., 1929-'31	Mucky	Sandy. Sandy overlaid with thin layer of muck. Mucky in bays	Scarce and not varied	None	L. M. bass, N. pike, rock bass, bluegills, perch	L. M. bass	L. M. bass, N. pike, rock bass, bluegills, perch		Many fish reported dead along shore in spr'g '31
*Railroad	43	13	July 12	Land-locked	14	64		72°F.		V. S.	1		4		7.4		Clear	Dropped some	Mucky	Sandy	Abundant and not varied	Scarce	L. M. bass, bluegills, perch	L. M. bass 1922. Sunfish W. E. pike	L. M. bass, bluegills, sunfish	L. M. bass	Private lake
*Round	43	13	June 30	Land-locked	69	30		83°F.	64°F.-60′.	V. S.	1	4-60′.	3	3-60′.	7.2	6.8-60′.	Clear	Dropped Periodic	Mucky	Sandy	Scarce and not varied	None	L. M. bass, perch	Lake trout, 1908. S. M. bass 1922	L. M. bass, S. M. bass, lake trout, perch	L. M. bass	Private lake
Red	43	11	June 23	Outlet	39	294		72°F.	69°F.-25′.	M.	4	4-19′.	14	14-19′.	8		Clear	Fairly constant	Mucky	Sandy in E. & W. part. Mucky in N. part. Sandy and mucky in S. part	Abundant & varied	Fairly abundant	L. M. bass, N. pike, rock bass, bluegills, perch, bullheads	W. E. pike, 1906-'07, 1922-'31. calico bass.	W. E. pike, N. pike, L. M. bass, rock bass, bluegills, perch, calico bass, bullheads	L. M. bass or W. E. pike	
Sauntry Pocket	43	10	July 6	Outlet dammed	8	106				M.	2 neg.		15		9.5		Clear	Dropped 3 ft. 1928-'31	Mucky	Mucky	Abundant & varied	Fairly abundant	N. pike, sunfish, bullheads.	W. E. pike, 1929	N. pike, sunfish		Many fish died during summer of 1931
Steele	47	11	Oct. 24	Outlet	10	190	56°F.	55°F.	55°F.	M.	8		18		7.7		Clear	Fairly constant		Mucky. Sandy in spots	Abundant & varied	Scarce	N. pike, perch		N. pike, perch		
Simmes	44	10-11	July 22	Land-locked	41	282	72°F.	75°F.	67°F.-40′	M.	1 neg.		4		8.8		Clear	Dropped periodic	Mucky	Sandy	Scarce and not varied	Scarce	Perch	W. E. pike, 1909, 1913. bullheads	Perch, bullheads	L. M. bass?	
Snake	43	10	July 22, 23	Outlet	38	77	74°F.	76°F.	67°F.-35′	M.	3		13		8.1		Clear	Fairly constant	Mucky	Sandy; sandy overlaid with thin layer of muck in E. & W. part, Mucky in N. & S. part	Abundant & varied	Fairly abundant	L. M. bass, N. pike, sunfish, bluegills		L. M. bass, N. pike, sunfish, bluegills	L. M. bass	
Spider	43	12	July 14	Land-locked	17	63	84°F.	76°F.		M.	3		11		7.5		Clear	Dropped	Mucky	Sandy	Abundant & varied	Scarce	L. M. bass, bluegills		L. M. bass, bluegills	L. M. bass	
St. Croix	44-45	12, 11, 12	July 27	Inlets and outlet	24	957		81°F.	71°F.-20′.		4	16-20′.	14	14-20′.	7.7	7.3-20′.	Clear	Fairly constant	Mucky. Sandy in spots	Sandy. Mucky at outlet	Abundant & varied	Fairly abundant	N. pike, L. M. bass, S. M. bass, perch	W. E. pike, 1917-'31. L. M. bass 1916 or '17. Crappies, catfish	N. pike, W. E. pike, L. M. bass, S. M. bass, crappies, perch, catfish	L. M. bass or W. E. pike	
Swenson	44	11	July 15	Land-locked	14	11	83°F.	79°F.	75°F.-12′.	V. S.	3		4		6.7		Clear	Dropped 2-3 ft. 1926-'31	Mucky	Sandy. Mucky in spots	Scarce and not varied	None	Perch		Perch	L. M. bass	
(Upper) Ox	44	11	July 14	Inlet and outlet	20	66	91°F.	90°F.		M. H.	2 neg.		27		9.8 or above		Brown stain	Fairly constant	Mucky	Mucky. Sandy overlaid with thin layer of muck	Abundant & varied	Fairly abundant	N. pike, W. E. pike, L. M. bass, rock bass, bluegills, sunfish, perch, bullheads	W. E. pike, 1923-'31. L. M. bass	N. pike, W. E. pike, L. M. bass, rock bass, bluegills, sunfish, perch, bullheads	W. E. pike	
Two Mile	43	12	June 28	Land-locked	29	112	71°F.	74°F. -25′	72°F.-25′.	V. S.	1		1		6.6		Clear	Dropped	Mucky	Sandy	Scarce and not varied	None	Perch	W. E. pike	Perch	L. M. bass?	
Wilson	43	13	June 30	Land-locked	17	23	93°F.	89°F.		V. S.	2		4.5		7		Clear	Dropped ½ ft. 1929-'31	Mucky	Sandy overlaid with thin layer of muck. Sandy. Mucky in NE. corner	Scarce & not varied	Scarce	L. M. bass, bluegills, perch	W. E. pike, L. M. bass	L. M. bass, bluegills, perch	L. M. bass	
Whitefish	43	12	June 28	Land-locked	100	918	94°F.	79°F.	64°F.-90′.	S.	2		7	6-90′.	7.6	6.6-90′.	Clear	Dropped 12-14 ft. 1891-1931	Mucky	Sandy	Scarce and not varied	Scarce	N. pike, L. M. bass, rock bass, bluegills, perch, white fish, ciscoes, lake trout.	W. E. pike, 1928. L. M. bass 1927 & '29 crappies 1929	N. pike, L. M. bass, crappies, rock bass, bluegills, sunfish, perch, white fish, ciscoes, lake trout	L. M. bass	

*Name not yet approved by State Geographic Board.

above 7 hard or alkaline. The pH was determined by testing water samples with color dye indicators and comparing the reaction color result with a pH color chart.

The hardness and softness of lake water (as determined in Table XI) was based on the amount of bound carbon dioxide present in the lake water which usually remains fairly constant, rather than on the pH, since the pH of lake water is variable. Professor C. Juday of the Wisconsin Geological and Natural History Survey furnished the following table from which the nature of the lake water was determined:

0–5 parts per million of bound carbon dioxide yields a very soft water (V. S.).
5–10 parts per million of bound carbon dioxide yields a soft water (S.).
10–20 parts per million of bound carbon dioxide yields a medium water (M.).
20–30 parts per million of bound carbon dioxide yields a medium hard water (M.H.).
Over 30 parts per million of bound carbon dioxide yields a hard water (H.).

The Effect of Seasonal Temperatures on Lakes[4]

Seasonal temperature changes alter the character of the water. In spring when the temperature of the water is uniform, a complete circulation of the water is possible, and the gases dissolved in the water are distributed in a fairly uniform manner. As the season progresses the surface water becomes warm while the lower water remains fairly cool. This condition is accompanied by the zoning of water into an upper and lower region, and the water circulation tends to become restricted within its respective zones.

In the lower water zone which does not have access to the air, the decomposition or decay of the organic matter and the respiratory processes of aquatic life result in the oxidation and the accumulation of carbon dioxide. If the oxygen becomes sufficiently lacking in the deeper water, a condition will develop that is not suitable for aquatic animal life. Great Lakes fish such as white fish, lake trout, and ciscoes that require deep, cool water only exist in the lower deep water zone where there is a sufficient supply of oxygen during the summer months. Since in most inland lakes of Wisconsin only the shallower portions of lakes are suitable for fish life during the summer months, the stocking of inland lakes with Great Lakes fish has not been successful.[5] The effectiveness of the zoning of water is extremely variable since there are many factors to consider such as wind, current,

(4) Needham, J. G. and Lloyed, J. T.
1916, Life of Inland Waters. Chapter II. The Nature of Aquatic Environment, Comstock Publishing Company, Ithaca, New York.
Birge, E. A. and Juday, C.
1911, Inland Lakes of Wisconsin, Wisconsin Geological and Natural History Survey.

(5) Juday, C. and Wagner, G.
1906, Dissolved Oxygen as a Factor in the Distribution of Fish. The Transaction of the Wisconsin Academy of Science, Arts, and Letters, Volume 7, Part I.

depth, type of bottom, and the like. In fall the lowering of the water temperature on the surface is followed by the seasonal overturn, and a homogeneous water condition results.

Mineral Nutrients

Aquatic life, like terrestial life, is directly and indirectly dependent on the balance of available nutrients existing in a mineral form which are transformed by plants into available foods for other types of life. In very soft water lakes there is usually a lack of variety and abundance of both plant and animal life. This fact is well brought out in Table XI. In such lakes the stocking of wall-eyed pike showed that this fish may develop and merely exist, but does not propagate, and in most cases does not even develop. In very soft water lakes, other fish often remain small and do not become abundant. Many of these lakes are or have been considered good fishing lakes for bass and pan fish, but it is quite noticeable that in most cases these lakes become easily depleted by excessive fishing because fish propagation in very soft water lakes is a slow process.

Biological Relation to Changing Water Level

In the lakes of Douglas county, particularly the land locked lakes in the southeastern part of the county, the water level has dropped considerably because the infiltration of water into lakes does not equal the seepage and evaporation of water from them. If a lake was already quite shallow, this drop of water level is accompanied by conditions unfavorable for fish life as was the case in Sauntry Pocket (T. 43 N., R. 11 W.), where a large number of fish died during a prolonged period of hot weather. In shallow lakes a thorough freezing over of ice may also bring on an unfavorable condition for fish probably due to a lack of oxygen.

If the water level is suddenly raised due to the damming of the outlet, the sudden change is not favorable for aquatic plant life. If the level is maintained in such lakes, better fishing and wild fowl conditions can be hastened and improved upon by the planting of aquatic plants.[6]

Importance of Plant Life

The type of plant cover in a lake region is of consequence in regard to its effect on lakes. The importance of forest cover can not be overemphasized. The water level of Douglas county lakes has dropped considerably since glacial times as indicated by the numerous beaches and ice pushes seen along the shore. There are numerous extinct lake

(6) Terrell, C. B.
1917, Wild Fowl and Fish Attraction for South Dakota, Game and Fish Commission, Pierre, S. D.
McAtee, W. L.
1917, Propagation of Wild-Duck Foods, Bull. of the U. S. Dept. of Agriculture, No. 465.

beds several of which have dried up in the memory of those who live in this vicinity. Several lakes such as Round Lake (T. 43 N., R. 13 W.), have a periodic change of water level during a period of several years, but the trend of the water level in these lakes is downward. A forest cover in a lake region would lessen the evaporation of water and tend to slow up the lowering of the water level. In Germany, Professor M. W. Harrington observed that the evaporation of water in a forest area was found to be approximately half as much as that of a similar area that was not covered with forests.[7]

A forest cover is also advantageous since it shades and protects the water of lakes from wind. This is beneficial for aquatic plant life. A forest cover particularly in the head waters serves as a regulator of river flow, which in turn causes a more constant water level in lakes of a river system.

Aquatic plant life both minute and large, directly and indirectly furnishes food for aquatic animal life. F. C. Baker refers to herbivorous animals such as small snails and clams as being flesh producers in the sense that other forms of aquatic life prey upon them and these in turn, are often preyed upon by higher forms of life such as game fish.[8]

Other forms of animal life that utilize aquatic plants for food and shelter are ducks and muskrats.

Most of the long lax stem and leaf plants (Fig. 2) are duck foods. Some other plants that are important foods for ducks are wild rice. *(Zizania aquatica)*, wild celery *(Vallisneria americana)*, and wapato *(Sagittaria latifolia)*. Plants of the upright type (Fig. 5) furnish cover. Wild rice is one of the most important duck plants, since it furnishes food and also excellent cover. Mulligan Lake (T. 43 N., R. 11 W.) is a lake having excellent cover and food for ducks.

Muskrats use the long lax plants for food, but they are particularly fond of the pad leaved plants (Fig. 3) such as water lilies. The upright emersed plants also serve as food and shelter.

From a comparative study of Douglas county lakes it appears that the type of aquatic plants found in these lakes can be correlated with the hardness and softness of the water. This fact is significant because the type of vegetation is basically important for the study of fish habitats, and also as an indicator of the kind of environment desirable for different species of fish.

Survey of Aquatic Vegetation

A survey of lake vegetation was made which, though not complete, is adequate in showing the relation that exists between the kind of

(7) Mead, D. W.
1919, Hydrology, pages 148–149, published by McGraw–Hill Book Co.
(8) Baker, F. C.
1918, The Relation of Shellfish to Fish in Oneida Lakes, New York Circular No. 21, The New York College of Forestry.

lake water (as to hardness and softness) and the type of plant cover. It is to be regretted that no study was made of the minute plant life such as the slime or filamentous algae, fixed colonial algae, and free colonial algae as plankton. The writer is indebted to Professor N. C. Fassett of the Botany Department of the University of Wisconsin and Mr. N. Hotchkiss of the Biological Survey, United States Department of Agriculture, for aid in the identification of plants. Professor M. L. Fernald of the Gray Herbarium at Harvard University identified the narrow leaved pondweeds *(Potamogeton spp.)* using the names published in his pager.[9] The plants were divided into types similar to that used by Professor Fassett.[10] The aquatic plant species are listed under plant type headings in "The Outline of Aquatic Vegetation," the plant types being illustrated in figure 1 through 5.

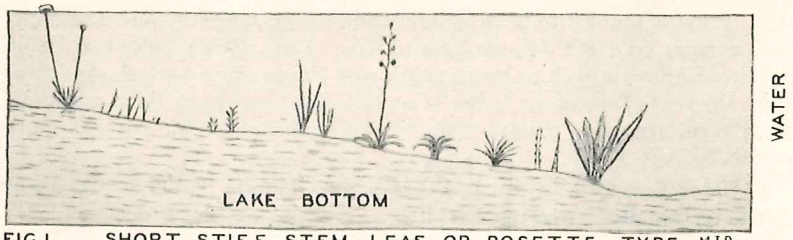


FIG. 1. SHORT STIFF STEM, LEAF, OR ROSETTE TYPE MJD

Outline of Aquatic Plant Types of Douglas County

Short Stiff Stem, Leaf, or Rosette Type

	Common Name	Scientific Name[11]
1.	Waterwort	*Elatine minima* (Nutt.) Fisch. & May *(E. americana* Gray's Man., ed. 7 in part)
2.	Needle rush	*Eleocharis acicularis* (L.) R. & S.
3.	Pipewort	*Eriocaulon septangulare* With. *(E. articulatum)*
4.	Quillwort	*Isoetes spp.*
5.		*Juncus pelocarpus* Mey. f. *submersus* Fassett.
6.	Water lobelia	*Lobelia Dortmanna* L.
7.		*Myriophyllum tenellum* Bigel.
8.	Creeping buttercup	*Ranunculus reptans* L.
9.		*Sagittaria cuneata* Sheldon *(S. arifolia)*
10.		*Sagittaria graminea* Michx.

(9) Fernald, M. L.
1932, The Linear Leaved North American Species of Potamogeton in the Memoirs of the American Academy of Arts and Science, Vol. XVII, Part I.

(10) Fassett, N. C.
1930, Plants of Some Northeastern Wisconsin Lakes, The Transaction of the Wisconsin Academy of Science, Arts and Letters, Vol. XXV.

(11) Where scientific names other than from Gray's Manual, ed. 7 are used, the latter are placed in parenthesis.

Long Lax Stem and Leaf Type

11.	Water marigold	*Bidens Beckii* Torr.
12.	Water starwort	*Callitriche autumnalis* L.
13.	Coontail, Hornwort	*Ceratophyllum demersum* L.
14.	Muskgrass, Stonewort	*Chara spp.*
15.	Elodea, water-weed	*Elodea canadensis* Michx.

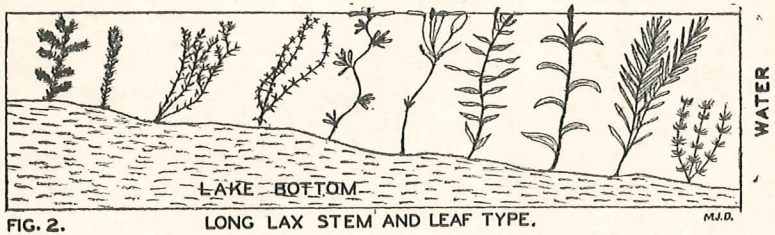


FIG. 2. LONG LAX STEM AND LEAF TYPE. MJD

16.	Water star grass, Mud plantain	*Heteranthera dubia* (Jacq.) MacM.
17.	Small water milfoil	*Myriophyllum alterniflorum* DC.
18.	Water milfoil	*Myriophyllum spicatum* L.
19.	Water milfoil	*Myriophyllum spp.*
20.	Naiad, Najas, Bushy pondweed	*Najas flexilis* (Willd.) Rostk. & Schmidt.
21.	Water smartweed	*Polygonum spp.*
22.	Pondweed, Musky weed, Bass weed	*Potamogeton amplifolius* Tuckerm.
23.	Leafy pondweed	*Potamogeton epihydrus* Raf.
24.	Pondweed	*Potamogeton Friesii* Rupr.
25.	Variable pondweed	*Potamogeton gramineus* L. var. *graminifolius* Fries. *(P. heterophyllus)*
26.	Floating pondweed Floating brown leaf	*Potamogeton natans* L.
27.	Pondweed	*Potamogeton obtusifolius* Mertens & Koch
28.	Sago pondweed Fennel leaved pondweed	*Potamogeton pectinatus* L.
29.	White stemmed pondweed, Musky weed, Bass weed	*Potamogeton praelongus* Wulf.
30.	Narrow leaved pondweed	*Potamogeton pusillus* L.
31.	Narrow leaved pondweed	*Potamogeton pusillus* L. var. *mucronatus* Filbes.
32.	Pondweed, Musky weed, Bass weed	*Potamogeton Richardsonii* (Benn.) Rydb.
33.	Pondweed	*Potamogeton Robbinsii* Oakes.
34.	Pondweed	*Potamogeton spirillus* Tuckerm. *(P. dimorphus)*
35.	Eel grass pondweed	*Potamogeton zosteriformis* Fern. *(P. zosterifolius)*
36.	Pondweed	*Potamogeton spp.*

37. Water crow foot----*Ranunculus aquatilis* L. var. *capillaceus* DC.
38. Stiff water crow foot ----------*Ranunculus longirostris* Godr. (R. *circinatus* of Gray's Man., ed. 7)
39. Aquatic sedge----------*Scirpus subterminalis* Torr.
40. Smaller bladderwort ----------*Utricularia minor* L.
41. Common bladderwort----------*Utricularia vulgaris* L.

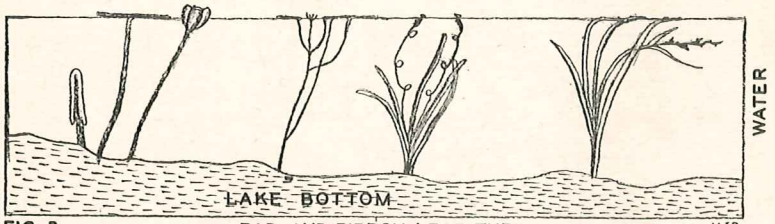


FIG. 3. PAD AND RIBBON LEAF TYPE. MJD.

Pad and Ribbon Leaf

42. Water shield----------*Brasenia Schreberi* Gmel.
43. White water lily----------*Castalia tuberosa* (Paine) Greene
44. Small yellow pond lily----------*Nymphozanthus microphyllus* (Pers.) Fern. *(Nymphaea microphylla)*
45. Medium sized yellow pond lily----------*Nymphozanthus rubrodiscus* (Morong) Fern. *(Nymphaea rubrodisca.)*
46. Yellow pond lily----------*Nymphozanthus variegatus* (Engelm.) Fern. *(Nymphaea advena* var. *variegata.)*
47. Bur-reed, Narrow ribbon leaf--*Sparganium angustifolium* Michx.
48. Bur-reed, Broad ribbon leaf----------*Sparganium fluctuans* (Morong) Robinson
49. Wild celery, Eel grass, Tape grass----------*Vallisneria americana* Michx. *(V. spiralis* L. of Gray's Man., ed. 7)

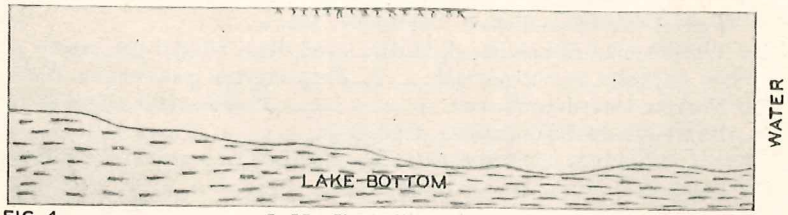


FIG. 4. FREE FLOATING TYPE MJD.

Free Floating Type

50. Duckweed, Duck's-meat----------*Lemna perpusilla* Torr.
51. Duckweed, Duck's-meat ----------*Spirodela polyrhiza* (L.) Schleid.

TABLE XII

AQUATIC VEGETATION OF DOUGLAS COUNTY LAKES

NAME OF LAKE	TOWNSHIP-NORTH	RANGE-WEST	DATE VISITED
VERY SOFT WATER			
TWO MILE	43	12	JUNE 28
CLYDE	43	11	JULY 23
BASS	43	12	JULY 1
ISLAND	45	11	JULY 15
PERSON	43	13	JULY 10
PAGAN	43	10	JULY 24
ROUND	43	13	JUNE 30
RAILROAD	43	13	JULY 12
MURRAY	45	10	JUNE 24
MAC DOUGAL	44	10	JULY 21
SWENSON	44	11	JULY 15
ALEXANDER	43	11	JULY 24
WILSON	43	13	JUNE 30
SOFT WATER			
CRYSTAL	43	13	JULY 2
WHITEFISH	43	12	JUNE 28
SIMMS	44	10	JULY 22
MEDIUM WATER			
SPIDER	43	12	JULY 14
ELLISON	45	10	JUNE 25
SNAKE	43	10	JULY 23
BOND	43	12	JULY 9
LEADER	43	12	JULY 10
DOWLING	46	13	JULY 27
ST. CROIX	44-45	11-12	JUNE 27
RED	43	11	JUNE 23
LYMAN	46	13	OCT. 31
AMNICON	46	14	JULY 27
SAUNTRY POCKET	43	10	JULY 10
STEELE	47	11	OCT. 24
LOON	45	10	JUNE 13
MEDIUM HARD WATER			
MULLIGAN	43	11	JUNE 22
MINNISUING	46	11	JULY 29
LOWER OX	44	11	JULY 17
CRANBERRY	43	13	JULY 9
OX	44	11	JULY 14
NEBAGAMON	46-47	11	JULY 28
LOWER EAU CLAIRE	44	10	JULY 16

SHORT STIFF STEM OR ROSETTE TYPE

NAME OF LAKE	1 ELATINE MINIMA	2 ELEOCHARIS ACICULARIS	3 EBIOCAULON SEPTANGULARE	4 ISOETES SPP.	5 JUNCUS PELOCARPUS F. SUBMERSUS	6 LOBELIA DORTMANNA	7 MYRIOPHYLLUM TENELLUM	8 RANUNCULUS REPTANS	9 SAGITTARIA CUNEATA	10 SAGITTARIA GRAMINEA
VERY SOFT WATER										
TWO MILE	X	X			X					
CLYDE		X	X		X					
BASS		X	X	X	X	X	X			
ISLAND		X	X		X		X			
PERSON	X		X		X	X	X			X
PAGAN	X		X		X		X			X
ROUND		X	X	X	X					
RAILROAD	X	X	X		X	X	X			
MURRAY		X			X					
MAC DOUGAL	X		X	X			X			
SWENSON	X	X	X	X	X		X			
ALEXANDER	X				X					
WILSON	X	X	X			X	X			
SOFT WATER										
CRYSTAL				X	X	X	X			X
WHITEFISH		X	X	X	X	X	X			
SIMMS		X		X	X		X	X		
MEDIUM WATER										
SPIDER		X	X		X					
ELLISON							X			
SNAKE	X	X	X	X		X	X			X
BOND		X			X	X				
LEADER				X	X	X	X			X
DOWLING				X						
ST. CROIX	X	X		X	X	X				
RED						X			X	X
LYMAN										
AMNICON				X						X
SAUNTRY POCKET	X	X			X					X
STEELE	X									
LOON										
MEDIUM HARD WATER										
MULLIGAN										
MINNISUING										X
LOWER OX										
CRANBERRY							X			X
OX										
NEBAGAMON										X
LOWER EAU CLAIRE			X	X						X

LONG LAX STEM AND LEAF TYPE

NAME OF LAKE	11 BIDENS BECKII TORR.	12 CALLITRICHE AUTUMNALIS	13 CERATOPHYLLUM DEMERSUM	14 CHARA SPP.	15 ELODEA CANADENSIS	16 HETERANTHERA DUBIA	17 MYRIOPHYLLUM ALTERNIFLORUM	18 MYRIOPHYLLUM SPICATUM	19 MYRIOPHYLLUM SPP.	20 NAJAS FLEXILIS	21 POLYGONUM SPP.	22 POTOMOGETON AMPLIFOLIUS	23 POTOMOGETON EPIHYDRUS	24 POTOMOGETON FRIESII	25 POTOMOGETON GRAMINEUS VAR GRAMINIFOLIUS	26 POTOMOGETON NATANS	27 POTOMOGETON OBTUSIFOLIUS	28 POTOMOGETON PECTINATUS	29 POTOMOGETON PRAELONGUS	30 POTOMOGETON PUSILLUS	31 POTOMOGETON PUSILLUS VAR. MUCRONATUS	32 POTOMOGETON RICHARDSONII	33 POTOMOGETON ROBBINSII	34 POTOMOGETON SPIRILLUS	35 POTOMOGETON ZOSTERIFORMIS	36 POTOMOGETON SPP.	37 RANUNCULUS AQUATIEIS VAR. CAPILLACEUS	38 RANUNCULUS LONGIROSTRIS	39 SCIRPUS SUBTERMINALIS	40 UTRICULARIA MINOR	41 UTRICULARIA VULGARIS
VERY SOFT WATER																															
TWO MILE																															
CLYDE																															
BASS																															
ISLAND																															
PERSON												X	X																		
PAGAN																															
ROUND				X																											
RAILROAD				X	X																										
MURRAY												X			X																
MAC DOUGAL													X																	X	
SWENSON																															
ALEXANDER																															
WILSON													X																		
SOFT WATER																															
CRYSTAL	X			X						X		X			X	X			X				X								
WHITEFISH				X											X								X								
SIMMS				X											X																
MEDIUM WATER																															
SPIDER										X	X	X			X	X															
ELLISON				X											X				X							X					
SNAKE	X		X	X				X		X	X	X			X	X							X			X			X		
BOND	X			X					X			X			X							X	X		X						
LEADER				X						X		X			X							X	X	X	X						
DOWLING													X																		
ST. CROIX	X		X	X	X		X	X		X		X			X				X			X	X								X
RED		X	X					X		X	X	X			X				X	X		X			X	X	X		X		X
LYMAN								X		X	X	X				X			X			X	X								X
AMNICON	X		X	X			X	X		X	X	X			X	X					X	X									
SAUNTRY POCKET				X											X					X			X		X						
STEELE	X			X								X							X												X
LOON	X											X													X						
MEDIUM HARD WATER																															
MULLIGAN			X																							X					
MINNISUING		X	X		X			X		X	X	X	X	X	X							X		X		X					
LOWER OX			X	X		X						X	X				X	X	X			X	X		X			X			
CRANBERRY	X		X		X			X		X		X			X				X	X		X			X						X
OX	X		X	X				X				X	X	X				X	X			X	X		X	X					X
NEBAGAMON		X		X	X	X		X		X			X		X						X	X	X		X						X
LOWER EAU CLAIRE			X		X			X		X		X			X							X			X						

PAD AND RIBBON LEAF TYPE; FREE FLOATING TYPE

NAME OF LAKE	42 BRASENIA SCHREBERI	43 CASTALIA TUBEROSA	44 NYMPHOZANTHUS MICROPHYLLUS	45 NYMPHOZANTHUS RUBRODISCUS	46 NYMPHOZANTHUS VARIEGATUS	47 SPARGANIUM ANGUSTIFOLIUM	48 SPARGANIUM FLUCTUANS	49 VALLISNERIA AMERICANA	50 LEMNA PERPUSILLA	51 SPIRODELA POLYRHYZA
VERY SOFT WATER										
TWO MILE					X					
CLYDE	X									
BASS	X	X								
ISLAND					X					
PERSON	X				X	X				
PAGAN					X	X				
ROUND										
RAILROAD					X					
MURRAY		X								
MAC DOUGAL	X	X	X		X					
SWENSON					X	X				
ALEXANDER					X					
WILSON	X				X					
SOFT WATER										
CRYSTAL	X	X			X	X		X		
WHITEFISH										
SIMMS										
MEDIUM WATER										
SPIDER	X	X			X	X				
ELLISON	X	X			X					
SNAKE	X	X			X			X		
BOND		X			X			X		
LEADER					X			X		
DOWLING					X		X			
ST. CROIX	X	X			X	X	X			
RED	X	X			X			X		
LYMAN					X			X		
AMNICON			X	X	X		X	X		
SAUNTRY POCKET		X			X					
STEELE					X			X		
LOON		X			X					
MEDIUM HARD WATER										
MULLIGAN		X		X	X				X	X
MINNISUING		X			X			X		
LOWER OX	X	X			X		X	X		
CRANBERRY		X			X			X		
OX		X	X		X			X		
NEBAGAMON		X		X	X			X		
LOWER EAU CLAIRE		X			X			X		

UPRIGHT EMERSED TYPE

NAME OF LAKE	52 ACORUS CALAMUS	53 CALLA PALUSTRIS	54 CAREX COMOSA	55 DECODON VERTICILLATUS	56 DULICHIUM ARUNDINACEUM	57 ELEOCHARIS PALUSTRIS VAR. MAJOR	58 EQUISETUM LIMOSUM	59 PHRAGMITES COMMUNIS	60 PONTEDERIA CORDATA	61 POTENTILLA PALUSTRIS	62 SAGITTARIA LATIFOLIA	63 SCIRPUS ACUTIS	64 SCIRPUS AMERICANUS	65 SCIRPUS TORREYI	66 SCIRPUS VALIDUS	67 SPARGANIUM AMERICANUM	68 SPARGANIUM CHLOROCARPUM VAR. ACAULE	69 TYPHA LATIFOLIA	70 ZIZANIA AQUATICA VAR. ANGUSTIFOLIA
VERY SOFT WATER																			
TWO MILE																		X	
CLYDE					X				X										
BASS																			
ISLAND					X	X													
PERSON					X	/					X				X				
PAGAN					X	X			X	X									
ROUND																			
RAILROAD					X														
MURRAY						X			X										
MAC DOUGAL					X	X					X			X					
SWENSON					X										X				
ALEXANDER					X				X	X									
WILSON					X	X				X					X				
SOFT WATER																			
CRYSTAL					X	X					X	X	X					X	
WHITEFISH													X			X		X	
SIMMS						X						X							
MEDIUM WATER																			
SPIDER					X							X							
ELLISON						X						X							
SNAKE	X	X	X		X	X			X		X	X		X				X	
BOND						X						X							
LEADER					X	X		X	X	X		X							
DOWLING						X						X							
ST. CROIX			X			X	X			X		X					X	X	X
RED	X	X	X		X	X			X	X	X	X						X	X
LYMAN						X	X		X	X		X						X	
AMNICON	X	X		X	X	X	X	X	X	X	X	X						X	X
SAUNTRY POCKET			X		X	X				X	X	X							
STEELE			X		X	X					X							X	
LOON					X						X								
MEDIUM HARD WATER																			
MULLIGAN	X	X	X							X	X				X		X	X	X
MINNISUING					X	X		X		X								X	
LOWER OX			X	X		X					X	X				X		X	X
CRANBERRY			X		X			X		X	X	X						X	
OX			X				X			X	X				X		X	X	
NEBAGAMON				X		X					X	X	X			X		X	X
LOWER EAU CLAIRE						X				X	X				X	X		X	

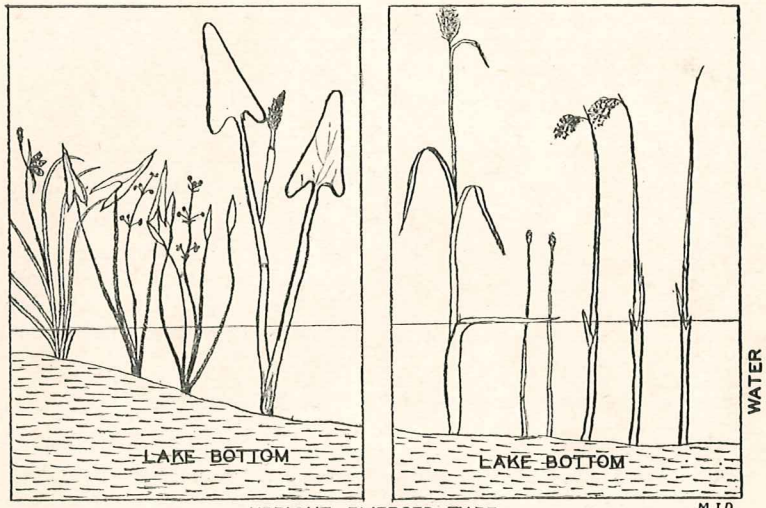


FIG. 5. UPRIGHT EMERSED TYPE.

Upright Emersed Type

52. Sweet flag---*Acornus Calamus* L.
53. Water arum---*Calla palustris* L.
54. Sedge---*Carex comosa* Boott.
55. Swamp loosestrife, Water willow--*Decodon verticillatus* (L.) Ell.
56. ---*Dulichium arundinaceum* (L.) Britton.
57. Spiked rush-*Eleocharis palustris* (L.) R. & S. var. *major Sonder.*
58. Pipes---*Equisetum limosum* L. *(E. fluviatile* L.)
59. Common reed---*Phragmites communis* Trin.
60. Pickerel-weed---*Pontederia cordata* L.
61. Marsh five finger---*Potentilla palustris* (L.) Scop.
62. Arrow leaf, Wapato, Duck potato---*Sagittaria latifolia* Willd.
63. Bulrush---*Scirpus acutus* Muhl. *(S. occidentalis)*
64. Bulrush, Three stem rush---*Scirpus americanus* Pers.
65. Bulrush, Three stem rush---*Scirpus Torreyi* Olney.
66. Soft stem bulrush---*Scirpus validus* Vahl.
67. Bur-reed---*Sparganium americanum* Nutt.
68. Bur-reed ---*Sparganium chlorocarpum* Rydt. var. *acaule* (Beeby) Fern. *(S. diversifolium* var. *acaule.)*
69. Cat-tail---*Typha latifolia* L.
70. Wild rice, Indian rice-*Zizania aquatica* L. var. *angustifolia* Hitchc.

Plants found in different lakes are tabulated in Table XII. In this table plants are numbered to correspond with plants numbered and listed in "Outline of Aquatic Vegetation." In order to bring out the relationship that exists between the hardness and softness of lake water and the type of plants existing in lakes, the lakes are listed as to the relative amounts of carbonates found in the water, the lakes

having the least carbonates (such as the very soft water lakes) being named first. In order to avoid confusion it should be understood that the correlation of plant life to the kind of water was made for lakes studied and does not necessarily hold for lakes in other regions.

Fish of Douglas County Lakes

In Douglas county fish may be divided into five groups: the Great Lakes fish, larger game fish, pan fish, minnows, and rough fish, of which the larger game fish are the most important.

Great Lakes fish found in inland lakes are whitefish *(Coregonus clupeaformis)*, cisco or lake herring *(Leucichthys spp.)* and lake trout also known as Superior trout, Great Lakes trout, or Mackinaw trout *(Cristivomer namaycush)*.

Larger Game Fish found in Douglas county lakes are:

Common Name	Scientific Name
Large mouth (L.M.) bass L. M. black bass, L. M. Oswego bass, L. M. green bass.	*Huro floridana (Micropterus salmoides)*
Small mouth (S. M.) bass S. M. black bass, S. M. Oswego bass, S. M. green bass.	*Micropteris dolomiu*
Wall-eyed (W. E.) pike W. E. perch, Pike perch.	*Stizostedion spp.* (Probably mostly *Stizostedion vitreum)*
Northern (N.) pike Pickerel.	*Esox lucius*
Muskellunge Musky, Tiger musky, Northern musky.	*Esox masquinongy*

Several common names for the same fish often result because the fish appears somewhat different in size, shape, and in shade of color.

Pan fish sometimes referred to as boys' fish are the smaller edible fish. Pan fish common in Douglas county lakes are:

Common Name	Scientific Name
Common crappie or croppie White crappie, White bass.	*Pomoxis annularis*
Black crappie or croppie Spotted crappie, Calico bass.	*Pomoxis sparoides*
Rock bass, red-eye	*Ambloplites rupestris*
Sunfish, pumpkin seed	*Eupomotis spp.*
Bluegill, blue sunfish	*Lepomis pallidus*
Perch, yellow perch Ringed perch.	*Perca flavescens*
Bullhead	*Amiurus spp.*

Minnows are mostly members of the minnow family *(Cyprinidae)*. These fish are important because they serve as food for larger fish.

Rough fish reported in lakes of Douglas county are the gar *(Lepisosteus spp.)*, dog fish *(Amia calva)*, and suckers and redhorse of the sucker family *(Catostomidae)*. Gar are found in most lakes of a river or stream system. Dog fish were reported in Lake St. Croix (T. 45, 44 N., R. 11, 12 W.). Gar and dog fish are very destructive to other fish life. Suckers and to a lesser degree redhorse are common in most Douglas county lakes. Though the suckers and redhorse are scorned by most fishermen, they undoubtedly are of importance as food for game fish. In Sawyer county the Hayward Rod and Gun Club recognizes the value of suckers since in their supervision of seining of lakes they leave small suckers under a pound in weight in the lakes to serve as food for such game fish as muskellunge and bass.

THE IMPROVEMENT OF LAKES

One of the attractions that causes Wisconsin to be called the playground of the middle west is its many fishing lakes.

In view of the fact that intensive fishing of inland lakes has resulted in a scarcity of fish in these lakes, efforts have been made to conserve good fishing by protective fish laws and by stocking lakes with fish.

Fish Laws

Fish laws have done much to retard fish depletion. However there are many reports of dynamiting of lakes, illegal seining of fish, and fishing out of season. Perhaps this breaking of fish laws can be decreased not so much by the complaint of individuals as by the cooperation with the game wardens, resorters, and others interested in conservation in order to enforce a more strict obedience of fish laws. This is an important question to consider because fish laws not only protect and conserve the game fish, but preserve the attractive value of recreation of Northern Wisconsin in much the same way that the laws of order against theft and abuse of property protect farmer's crops and live stock. If the attractive value of recreation or the crops and livestock of farms are destroyed, those involved in the activities of recreation and farming will suffer.

Fish Stocking

In order to offset fish depletion directly, an extensive fish stocking program has been conducted. However, the planting of fish in the inland lakes of Wisconsin has been inefficient in many cases.

In former years many inland lakes were extensively stocked with such Great Lakes fish as whitefish, lake trout, and ciscoes. Successful results are to be found in few lakes. In Douglas county whitefish, lake trout, and ciscoes are reported in White Fish Lake (T. 43 N., R. 12 E.) and lake trout are found in Round Lake (T. 43 N., R. 13 E.).

Many lakes have been stocked with wall-eyed pike. In lakes where wall-eyed pike have already existed, stocking results have been suc-

cessful in most cases. Under normal conditions wall-eyed pike, on an average, will become of legal size by the fourth summer.[12]

The stocking of wall-eyed pike in lakes where they are not native has had varied success. This fact is well illustrated in Table XI Douglas county lakes. In many lakes where wall-eyed pike were planted they have not developed (as in Simmes Lake T. 44 N., R. 10, 11 W.), and in other lakes a few wall-eyed pike of the thousands planted develop and merely exist (as in Clyde Lake T. 43 N., R. 11 W.), while in a comparatively few lakes the planting of wall-eyed pike has been successful (as in Amnicon Lake, T. 46 N., R. 14 W.).

The planting of wall-eyed pike in lakes where they have never existed often disturbs the balance of nature in a way found to be unsatisfactory for the existing fish, particularly young bass. If the introduction of wall-eyed pike should result in the replacement of the present fish, by a greater number of wall-eyed pike, the attractive value of recreation in lakes would be increased, but this is rarely the case.

In lakes where a few wall-eyed pike of the many planted survive, some pike often become quite large and are very voracious. Naturally, they devour many small fish, particularly small bass. This destruction of young bass plus the fishing out of the larger bass results in so few bass that the fishing attractiveness for larger game fish is lessened. If a wall-eyed pike is caught in such a lake, the lake is often reported to be full of pike, though they "won't bite". A halo of fish dreams developing around such lakes heightens the fishermen's expectations and increases his ardor, even if his "luck" is bad. If fish stocking could be looked upon in the same way that farmers study the results of seed planting from crop yield, much error of the past could be eliminated. Fish dreams and expectations are not results; fish caught are results.

Fish Ecology

In order that a more efficient fish stocking program can be carried out, suggestions for fish stocking with wall-eyed pike and large mouth bass were placed in Table XI. Since no quantitative study of fish was made, these stocking suggestions were intended to serve as a guide only for the planting of fish and not as an indicator of lakes that need stocking. Conservation groups, such as rod and gun clubs, that have knowledge of fish depletion, should supervise the planting of fish in lakes.

Though the study of Douglas county lakes tabulated in Table XI was not comprehensive, it is sufficient in most cases to show certain facts of basic importance in fish ecology, or the relation of fish to its

(12) Juday, C. & Schneberger, E.
April, 1933, Age and Growth of Game Fish in Wisconsin Waters, Notes from the Biological Laboratory of the Wisconsin Geological and Natural History Survey.
Schneberger, E.
June, 1933, Scales Tell the Age of Fishes Wisconsin Survey Reveals, Our Own Out of Doors, Edited by M. T. Caine, St. Paul, Minnesota.

environment. Four factors of importance in regard to fish ecology are drainage, depth, hardness or softness of water, and aquatic vegetation.

Drainage and Depth

Drainage of lakes by an outlet means a change of water which results in a better environment for fish life. However, if the change of water conditions is not sufficient, or if lakes are land locked, the lakes should be deep enough, so that the amount of oxygen dissolved in the water will not be consumed during the winter freeze up, or during a prolonged hot weather spell that is accompanied by excessive decay and utilization of oxygen. Oxygen is essential for the respiratory processes of fish life.

The depth essential for fish life naturally depends on the character of the lake. In very soft water lakes the accumulation of organic matter is small as compared with lakes of higher carbonate content. Soft water lakes should be at least 12 feet in depth. If the depth is 12 feet or less, it is quite possible that they may become unsatisfactory for existing fish life, due to a lack of oxygen. Land locked lakes of higher carbonate content that have abundant vegetation should be deeper than very soft water lakes since more oxygen is required for the decay of the larger amount of organic matter.

Hardness and Softness of Lake Water

Conditions associated with the amount of carbonate in lake water are of biological significance. The carbonate content in lakes is important in determining the fish capacity and the species of fish that will develop and propagate.

Very Soft Water Lakes. Very soft water lakes of Douglas county are land-locked lakes lacking in variety and abundance of vegetation. Plants common in very soft water lakes are the short stiff stem, leaf, or rosette type (Fig. 1) which are inconspicuous and of little or no significance in the relationship that exists between plant and animal life. Most of these lakes lack the long lax stem and leaf type of plants (Fig. 2) such as the pondweeds *(Potamogeton)* which are important because of the interrelation that exists between these plants and animal life. Such plants that improve fishing conditions, and will grow in very soft water lakes are water smartweed *(Polygonum natans)*, ribbon leaf pondweed *(Potamogeton epihydrus)*, floating brown leaf or pondweed *(Potamogeton natans)*, common bladderwort *(Utricularia vulgaris)*, certain species of muskgrass *(Chara spp.)*, and water milfoil *(Myriophyllum verticillatum)*.

Most of this long lax vegetation that is found in very soft water lakes seems to grow best in those areas where the pad and ribbon leaf type (Fig. 3) of vegetation is found. A water-weed *(Elodea sp.)* was found in great abundance in Loon Lake (T. 43 N., R. 13 W.).

This Elodea found in Loon Lake and other flexious stemmed plants introduced into very soft water lakes, would greatly improve fishing conditions. The upright emersed type of vegetation (Fig. 5) is of little value to fish in very soft water lakes.

A comparative study of lakes of three northern Wisconsin counties reveals that lakes of low carbonate content (very soft water lakes) do not have the type of environment essential for wall-eyed pike, consequently the planting of wall-eyed pike in these lakes has been unsuccessful.

Bass, particularly the large mouth bass, are the most desirable game fish to plant in such lakes. Northern pike thrive and propagate in very soft water lakes particularly in those lakes adjoining swamp areas that have some shoal water vegetation. Since the presence of northern pike in several of these lakes that lack vegetation has been observed to be harmful to bass, northern pike should not be planted in those lakes if bass are desired. Pan fish with the possible exception of crappies seem to thrive in very soft water lakes.

Because of the scarcity of fish food and shelter in very soft water lakes, fish propagation is a slow process. Such lakes are easily depleted by excessive fishing and difficult to replenish because the young fry that are planted in lakes have no means of hiding from such carnivorous fish as perch. People desiring to improve fish environment in very soft water lakes should plant aquatic vegetation, and place clumps of brush in the shoal water regions so that small fish will have shelter.

Soft Water Lakes. Soft water lakes represent a transition group between the very soft water lakes and the medium to hard water lakes. Crystal Lake (T. 43 N., R. 13 W.) is a soft water lake that has abundant vegetation and is a good lake for large mouth bass and northern pike. Though the presence of northern pike seemed harmful to bass in very soft water lakes, both northern pike and bass seem to thrive when found together in lakes of higher carbonate content that have abundant aquatic plant cover. **Wall-eyed pike should not be planted in soft water lakes since they rarely develop and when a few of the many planted become of legal size they are not sufficient in number to add to the recreational value, in fact they actually lower this value by destroying young bass.**

Medium to Hard Water Lakes. The medium to hard water lakes have a more abundant and varied vegetation which is associated with better fish environment. In Table XII there is not the noticeable lack of the long lax stem and leaf type of vegetation that was observed in very soft water lakes. These lakes can stand extensive fishing since a better environment exists for the propagation of a larger number of fish.

Land locked lakes of higher carbonate content such as Bond Lake and Leader Lake (T. 43 N., R. 12 W.) are good lakes for northern pike and large mouth bass. It is usually not desirable to stock these

lakes with wall-eyed pike since they often will not develop and will not propagate in a way that will increase the number of game fish in these lakes. There are some land locked lakes such as Loon Lake and Ellison Lake (T. 45 N., R. 10 W.) where wall-eyed pike has been successfully introduced at the expense of bass which are becoming extinct in these lakes.

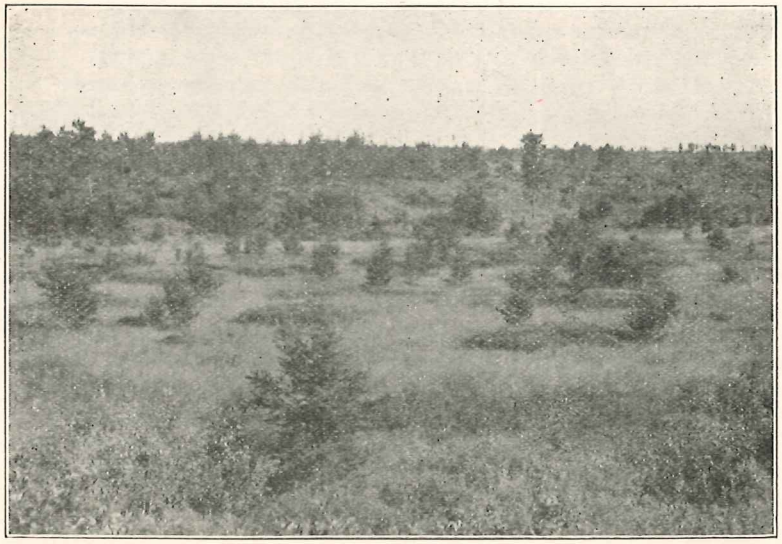
Most lakes having outlets, especially those lakes whose outlets are passable by fish, have the variety of conditions that are essential for wall-eyed pike. In such lakes it should be decided whether wall-eyed pike or bass are the fish desired in the lake. However, some of the larger lakes that have an abundance of vegetation, such as St. Croix Lake (T. 44 N., R. 12 W., T. 45 N., R. 11, 12 W.), Nebagamon Lake (T. 46, 47 N., R. 11 W.), and Amnicon Lake (T. 46 N., R. 11 W.) have both bass and wall-eyed pike in them, but it is quite noticeable that bass fishing is impaired.

WILD LIFE TALLY

The wild life within a county is a real asset, not always directly in terms of dollars and cents, but as an attraction for the tourist, the hunter, and the fisherman. The benefit to the residents of that county is paramount, as they receive the trade of visitors to the county and also enjoy the recreational advantages themselves. It is increasingly evident that the practice of forestry is justified by the values of a forest cover for game protection, soil protection, watershed protection, and for beauty, disregarding its value for timber production. Here the public interests are involved, and those interests cannot have a money profit motive; they are long-time interests which are social and to some extent economic.

In discussing the value of wild life, one should consider not only the game birds and animals, but also the birds and animals which are not called game, as well as fish.

The Land Inventory of Douglas county tallied the game birds and animals seen by the mappers as they ran their lines at half-mile intervals. The number spotted and their location are significant only as showing the relative amount and distribution of game in the county, and for comparison with the game tallies in other counties. The number seen at each spot was given, and the location indicated on the maps.



Courtesy Conservation Department

Jack pine grasslands in Douglas county. A good cover for sharp tailed grouse

In Douglas county there were tallied 150 deer, 773 sharp-tail grouse (some prairie chickens among them), 624 partridges (ruffed grouse), 24 ducks, 4 Chinese ring-necked pheasants, 4 black foxes, and one bear.

Sawyer county, which is only slightly larger in area than Douglas county, shows 216 deer, 490 sharp-tail grouse (with possibly some prairie chickens), 630 partridges, 98 ducks, and one bear.

Ducks, of course, are migratory birds and are not often seen during the summer while the survey work is in progress. However, the tally indicates that there are more ducks in Sawyer county, apparently because of more water and food.

There is a marked difference in the number of sharp-tail grouse in the two counties, Douglas county has more open land, farms and other clearings, than Sawyer county, which accounts for the greater number of these birds, as they are seldom found in heavily wooded country.

Partridges were tallied in almost the same number.

Chinese ring-necked pheasants have been introduced into Douglas county. They are always found near farm lands. One albino fawn was seen. There were many indications of beaver and muskrats, although none were seen. Beaver dams, houses and flowages, and muskrat houses, were often seen. Many rabbits, a few squirrels, porcupines, skunks, etc., were seen. The merry chirp of song birds added to the enjoyment of the woods.

Sharp-tail grouse were conspicuously absent from the wilder, poorly-drained portion of the Lake Superior–Mississippi table land. In this same area the deer were more plentiful than in other parts of the county, over half the total number being seen on this area.

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