Madison School Forest. 1960

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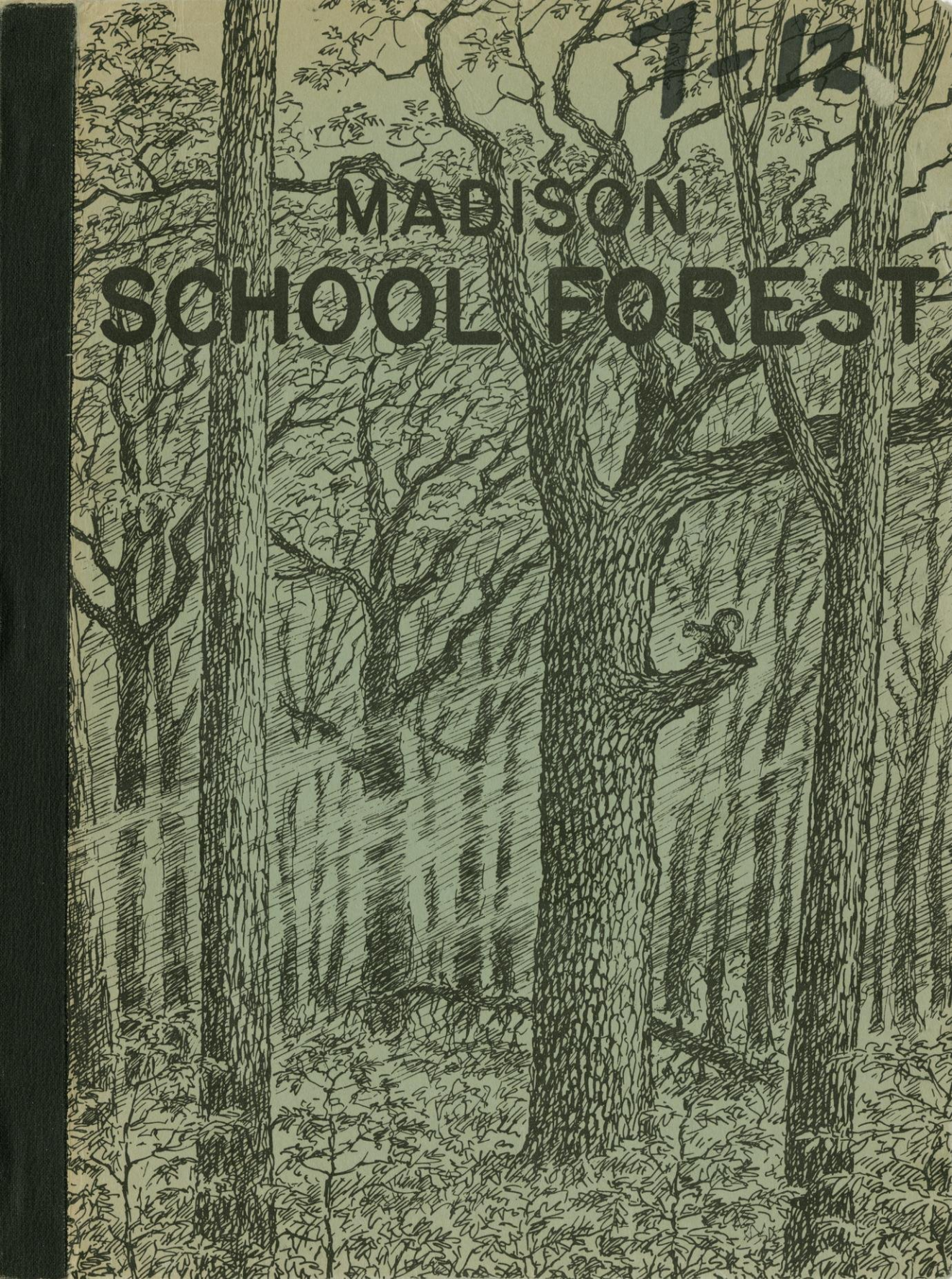
MADISON SCHOOL FOREST



Aerial Photo of the School Forest

" ... on a still night sit quiet and listen, and think hard of everything you have seen and tried to understand. Then you may hear it - a vast pulsing harmony - its score inscribed on a thousand hills, its notes the lives and deaths of plants and animals, its rhythms spanning the seconds and the years."

- Aldo Leopold

PURPOSE AND ACKNOWLEDGEMENTS

It is the purpose of this book to gather into a single volume considerable material and information about a particular piece of ground - the Madison School Forest.

It is the hope of the Madison Schools that students and teachers and other interested youth and adults may find in this study of a limited area some initial answers and conjectures which may lead to further inquiry and understandings concerning the relations between Man and the Land.

Many people have helped in compiling this volume. We would like especially to thank and acknowledge the work of -

Professor Daniel M. Benjamin of the University of Wisconsin for his Chapter on Insects of the Forest.

Professor Grant Cottam of the University of Wisconsin for his assistance on the history and ecology of the Forest and for his continuing assistance as a member of the Forest Advisory Committee.

Professor Francis D. Hole of the University of Wisconsin for his Chapter on Soils of the Forest.

George J. Knudsen - Game Biologist with the Wisconsin Conservation Department - for his Chapter on Birds and Mammals of the Forest

Tom Rausch and Kenneth Robert - Foresters with the Wisconsin Conservation Department-for their help on the Chapter devoted to the "Managed Area" and their active participation in carrying out forestry plans on that area.

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Alvin M. Peterson for loaning to us the leaf prints from which our plant illustrations were made.

James H. Zimmerman for the detailed descriptions of plants and the ecological notes contained in the Fieldbook portion of the book and for his Chapter on the "Natural Area".

Chapters 1, 2, 3, 6, and 9 are mine. I cannot begin to acknowledge the many sources from which my ideas, notions, and possible prejudices have come.

Thus was the book compiled and assembled as a source book to further the study of the Madison School Forest.

Paul J. Olson

For the Board of Education
Spring 1960

TABLE OF CONTENTS

Chapter 1 - Setting the Scene 1
by Paul J. Olson

Chapter 2 - Plant Communities and Plant Succession 5
by Paul J. Olson

Chapter 3 - The Past Century in the Forest 11
by Paul J. Olson

Chapter 4 - The "Natural Area" 15
by James H. Zimmerman

Chapter 5 - The Soils of the Forest 29
by Francis D. Hole

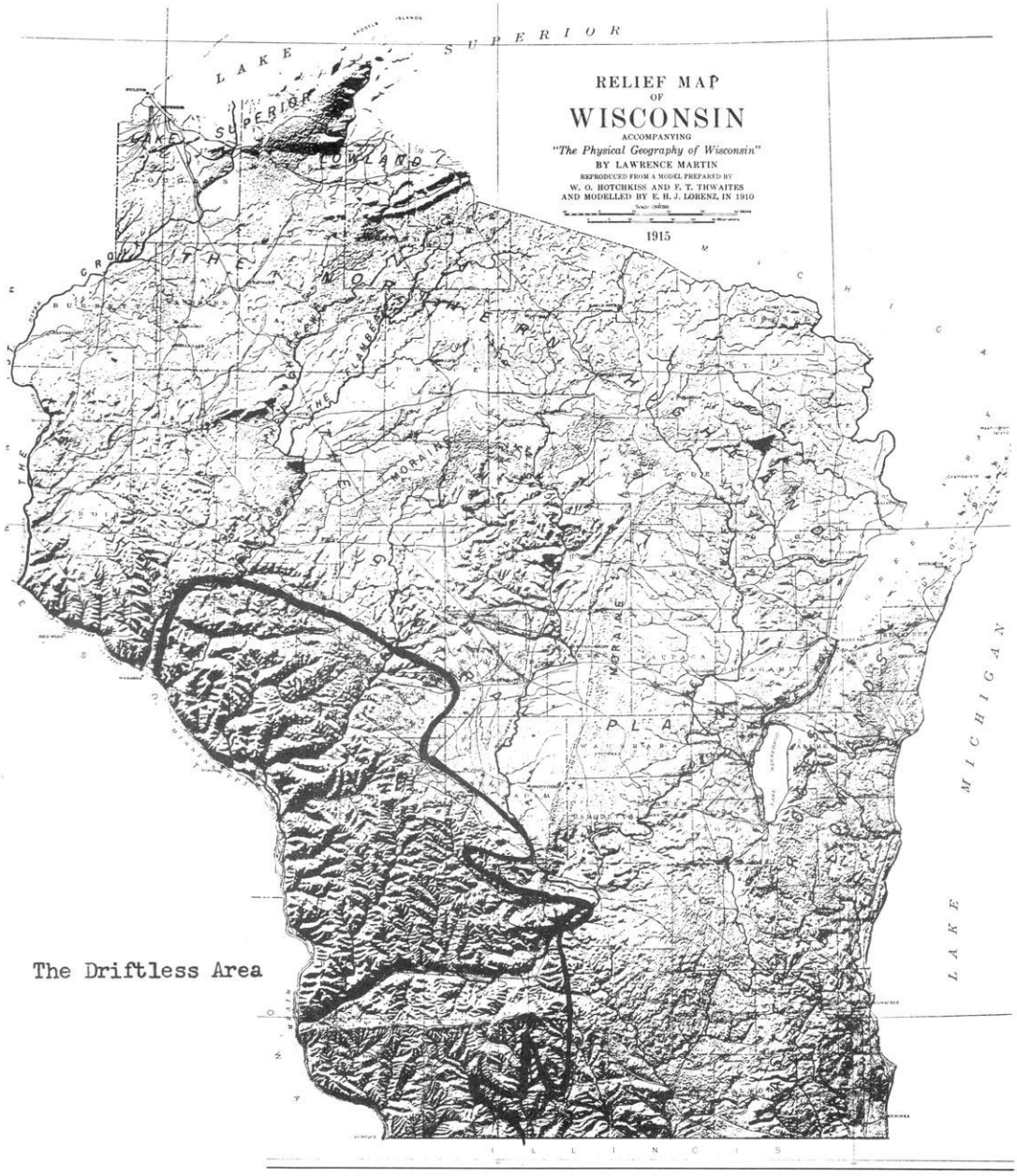
Chapter 6 - Wildlife - Its Place in the Community and Some General Principles 33
by Paul J. Olson

Chapter 7 - Birds and Mammals of the Forest 47
by George J. Knudsen

Chapter 8 - Insects of the Forest 58
by Daniel M. Benjamin

Chapter 9 - The "Managed Area" 65
by Paul J. Olson

Chapter 10 - Fieldbook of Plants Found in the Forest 79
by James H. Zimmerman



Note that the "Driftless area" coincides very closely with the rough, uneven but well drained topograpgy of southwestern Wisconsin.

Figure 1

Chapter 1
SETTING THE SCENE

This is the story of a piece of land. It is a small piece of land as we measure our state - only one half mile square - and yet, as is the case with every piece of land, every part of the earth's surface, this half mile has had its part in the vast and often violent changes that are the earth's history. In that sense, any spot on which you stand, anywhere upon the earth, you are on historic ground, because no place is ever always the same.

Looking backward, one is impressed with the sense of change, and this chapter will seek briefly to outline some of these changes. Our half mile, for example, has on several occasions been part of the ocean floor. The last time is thought to have been about 380 million years ago during what geologists call "Ordovician" time. It was then that the sand and lime that form the mantle rocks of our half mile were washed in as sediment in ancient shallow seas. Later, came an uplifting of the earth's crust in our part of the world, and what had been ocean floor became the land forms we know now.

During all these ages since the last great uplifting, erosion has been tirelessly at work, and much of the earlier sedimentary rock has long since been washed away. Thus, those rocks which we find so quickly beneath our feet and which record the earth's past history are only eternal in that they are long lasting, but they were not always there, and much of their upper layers has already disappeared. Eternal means only a long time and is best understood in terms of man's brief history.

The Glaciers

The most recent of the many changes our half mile has witnessed was an event that just missed our piece of land. Only three and one half miles away, and not very long ago compared to those earlier ages that built the mantle rocks, the massive ice sheets we call "glaciers" inched past. Four times the green-blue ice, thousands of feet thick, ground down out of its centers in Labrador and Keewatin and four times the ancient and now worn-away mountains to the North shunted the ice sheets away from our half mile.

These now vanished mountains that served as a shield to our area record a history much earlier than even our Ordovician seas - they are the remnants of our state's "dawn" history when volcanic action and all its attendant violence pushed up the igneous or "fire-formed" rocks during that earliest period labeled "pre-Cambrian".

But the northern mountain shield was here during the glacial period, and the ice was shunted aside. Here in southwestern Wisconsin and northern Illinois was the land "the ice forgot" called the "Driftless" by geologists. All around the Driftless as far South as the Ohio Valley, extending to the Atlantic Ocean and as far West as the Rocky Mountains the glaciers plowed, ground, and reshaped North America in the greatest earth moving project in history. The Driftless, and tucked barely inside the Driftless, our half mile, stood on the sidelines.

The Driftless Not Truly an Island

Sometimes this Driftless area is called an island, but really the term is not correct. It is thought that at no one time was the Driftless ever completely

surrounded by ice. Rather the various glaciers at various times appeared on all sides, but never on all sides at once. Thus, a connection was never lost between the area and other larger land masses not covered with ice.

This sort of penninsular connection with other areas is important when one considers the source of plants which moved in to reclothe the land following glaciation. It is equally important to remember that there were long interglacial periods when the ice melted back into the North before renewing its assault.

However, because the Driftless always escaped the ice, its surface character is different. It is an "older" preglacial face of the land - more hilly, more deeply carved by erosion, more perfectly and completely drained and hence, with fewer lakes and marshes. Also, although its climate was different during glacial periods, it was probably not severely different than it is today. Certainly, plants and animals survived here when the ice destroyed all life nearby. It thus may be that the Driftless was the major "refugium" from which plants and animals moved out to reclaim the newly uncovered and nearby soils.

The Layer of "Loess"

Although the soils of our half mile escaped the bulldozing of the glacier, the area did receive a rich glacial gift. Rock flour, finely ground and pulverized was carried by the melt waters down a then much greater, much vaster Mississippi River and deposited in mud flats along the shores as the waters slowed down. Westerly wind then carried this rock flour as dust in great storms, depositing the dust as far East as Milwaukee in our state. Dust must have drifted much as snow does today all along the east bank of the Mississippi and all along its long course. On our half mile this wind-blown, dusty soil runs as deep as forty-two inches. Near the Mississippi the "loess" (wind deposited dust soil) is as deep as twenty-four feet.

Changes Since the Glacier

Since the last glacier (called the Wisconsin) all of our state, in fact all of the Middle West, has experienced less exciting and vigorous times. The word, exciting, may turn out to be not the right word because some of the changes brought by living things may seem even more dramatic and certainly more complex.

Climate Since the Glacier

Climate did not stand still although the ice was gone. Pollen studies show the vegetational and with it the climatic history of the past 12,000 years. Pollen studies are made in bogs - areas of deep peat which were once a lake, then a swamp, and now an area filled in with largely vegetational remains. Pollens of plants have a waxy coating and although very small are exceedingly long lasting. Wind today, as in the past, blows this pollen about and some of it settles on lakes and in sinking to the bottom becomes part of the lake bed.

By careful use of auger-like drills botanists can sample different levels of a peat bog. They can then identify the pollens and reconstruct a picture of the vegetation at the time that level of peat was laid down. Dating these levels is difficult, but recent advances in radioactive carbon dating help greatly here.

The Story From the Bogs

These bogs which have been called "the History Books with the Quaking Covers" tell this story about climate since the last glacier. The immediate post-glacial period was cool and wet much as one might expect; next came a still somewhat cool but more dry period; then came a considerably warmer and much more dry period (about 3,000 years ago) and now we are back to a somewhat cooler and more moist period than the one immediately past.

How can the bogs tell us this? Well, the pollen in the lowest layers of the peat (the earliest period) comes from Spruce and Pine, a vegetation now found largely north of Lake Superior. (One theory has it that the Spruce may have grown directly on top of the glacier itself in a layer of thin wind deposited soil.) The second layer finds the Spruce gone and Pine dominant, much like northern Wisconsin today. In the warm-dry period we find Oak and a considerable amount of grass pollen which would indicate a prairie-like climate, and finally, in the upper layers we find again the Oaks and with the grasses greatly diminished, our present climate.

The Story of the Land is the Story of Change

Thus, one cannot escape the conclusion that the story of the land is the story of change - change brought by violence, by the rising and sinking of continents, by vast ice sheets of continental size, by tremendous ancient dust storms, by continual erosion and down-hill wash, by even an earlier history of volcanic action, and there is also the change on the face of the land brought by the living things that call it home.

These living things, the plants and animals, work their changes in the upper layers - the soil. Most of this book will now be confined to these changes. We will try to record and to give some understanding of those changes which come about through the activity of life - of living and dying - of the struggle of plants and animals to obtain from the earth those needs which will permit them to continue in their time and place upon the earth and to leave progeny to follow them.

We will continually point out that no place is ever quite the same when some life has lived there. We will declare that inhabiting the earth changes it, and we will argue slyly that mere inhabiting the earth does not guarantee that offspring will in turn inherit a good earth. The greatest lesson of the "Forest Story" may be that lesson.

And so now, the story of our half mile becomes the story of the changes which living things cause and bring. Very briefly we have leaped through billions of years to reach our day. Our backwards looks will now be much shorter ones and our forward looks will be those which present knowledge and uses of the land seem to force upon us. Everywhere we look in the forest we will find some of the life so abundantly present - our job is to try to understand this life.

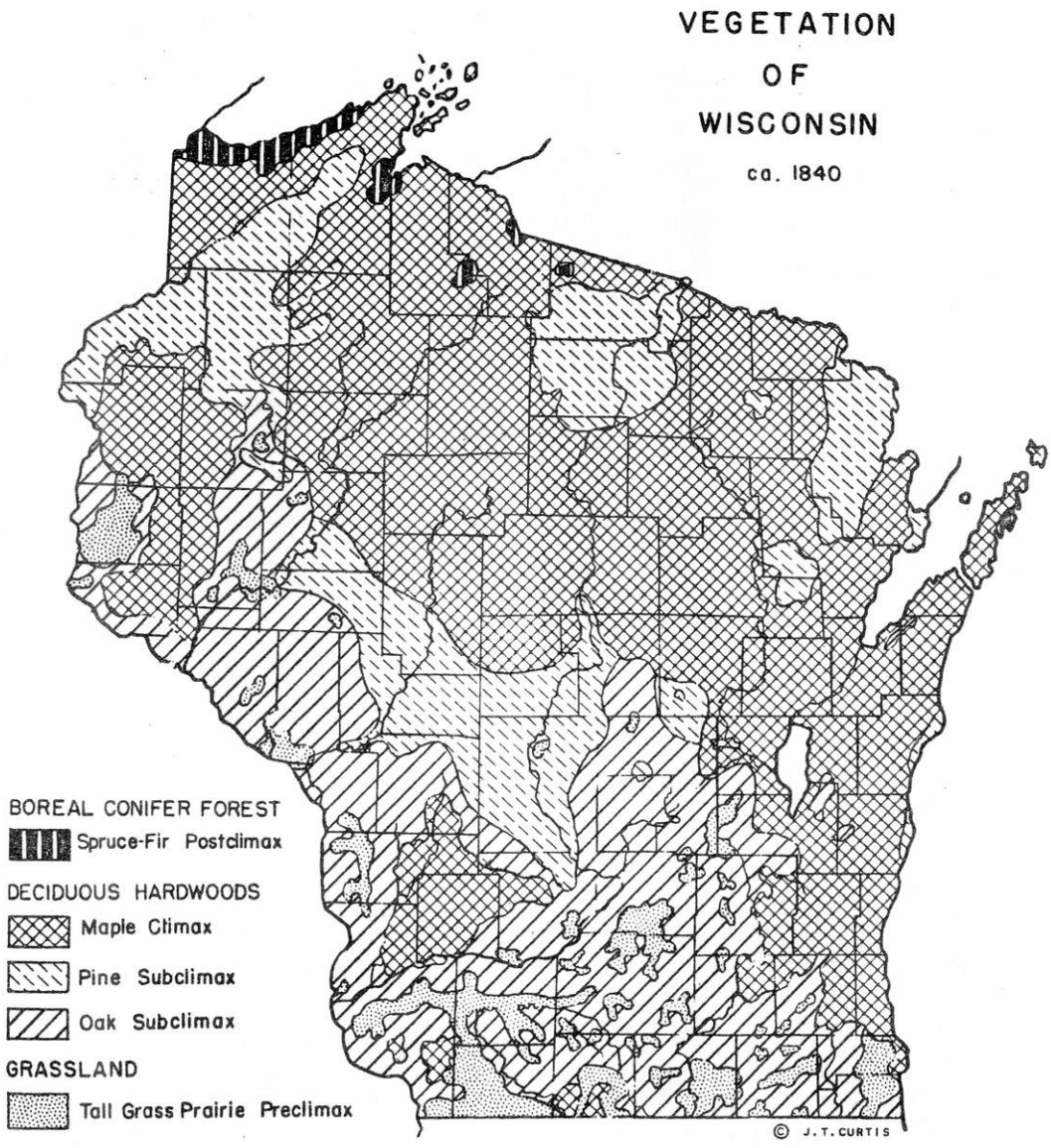

VEGETATION
OF
WISCONSIN
ca. 1840
BOREAL CONIFER FOREST
Spruce-Fir Postclimax
DECIDUOUS HARDWOODS
Maple Climax
Pine Subclimax
Oak Subclimax
GRASSLAND
Tall Grass Prairie Preclimax
© J. T. CURTIS

Figure 2

Chapter 2
PLANT COMMUNITIES AND PLANT SUCCESSION

In pre-Columbian days, before the white man had changed the face of our state, Wisconsin was largely a forest. The term "largely a forest" is accurate enough but it must be remembered that Wisconsin was not entirely a forest or entirely one kind of a forest. As a matter of fact, our Dane County and considerable area around us existed in what was known as "Oak opening", a sort of combination forest and grassland.

Pre-Settlement Vegetation

Figure 2 shows the "original" or pre-settlement (early 1800) vegetation of Wisconsin. You will note grasslands or prairies - the so called prairie peninsula - extending as fingers into southern Wisconsin and existing as well as scattered islands both in southern and western Wisconsin. You will note most of our own area in an "Oak sub-climax", a term we will talk about later, You will note other areas in "Pine sub-climax" and "Maple climax", and a small northern area in "Spruce-Fir post-climax".

These areas represent undisturbed vegetation cover - that is undisturbed in relation to white man and the forces he has used to influence the land. These areas represent, then, many thousands of years of adjustment but it should not be understood to have always been that way even before man, nor would these communities have continued exactly like they were had white man not come to Wisconsin.

Nature Dynamic

The important point to remember is that natural communities of especially plants, and to a nearly equal degree animals, are dynamic - that is, they change. Plant associations or communities are subject to these changes by many natural forces outside of the influence of man - climatic changes involving temperature and rainfall - erosion even when original cover was undisturbed, disease and insect infestations, fire of so called natural origin, even vast uplifting and lowering of continents in geologic change. As a factor or factors change and press in upon a community, conditions are created that throw the balance - the margin of success - from one type of plant to another. In a later chapter we will note that animals too react to changing conditions.

Towards the Climax

Basically it can be said, however, that barring changes of a catastrophic nature (such as glaciation, fire, etc.) plant communities move towards a position of balance in which they can reasonably maintain themselves. This condition is called the "climax".

Some Success Factors in a Community

There exists in any plant or animal community both competition and cooperation. Plants compete or struggle with each other for water, for sunlight, for soil fertility or nutrients (food), for living space. This competition is most intense as the supply of these essentials becomes limited. Plants compete with members of their own kind or "species" as well as other species - it is a

continual, relentless struggle. This never ending competition gives rise to the notion of the "survival of the fittest", and there is much to be said for this point of view.

Dependence

Sometimes overlooked in the emphasis given competition is the opposite factor of dependence and, indeed, cooperation. Many dependent species are not so large, showy or noticeable, but these species can exist only because of some special condition (such as shade) which other plants create. Sometimes the dependent species are harmlessly dependent, sometimes they are parasitic and can on occasions reach such proportions that they destroy their friendly host and with it themselves. On the other hand we have species whose role is entirely cooperative (such as many soil bacteria) and whose presence is vital to bhe well being of a community.

Forest a Complex Community

Perhaps it can best be summed up by saying that a forest or a prairie is a complex community of living things. It is not just trees nor is a prairie just grass. A forest is literally hundreds of competing, dependent and cooperating organisms both very large and very small, which struggle together and work together to achieve some degree of livability in close space relationship to each other.

Impact of Agriculture on Plant Communities

Man is and has been very successful in changing and reorganizing these plant communities. His greatest success perhaps has been in agriculture, where he has "favored" certain food plants by preparing the ground, sowing seeds, cultivating to eliminate competition from other plants, fertilizing and irrigating to provide even further cooperation, and generally smoothing the path for the success of these favored plants. Whether or not continued favoring of certain plants over all others and at all times and the ever more total destruction of wild plants can be successful in the long run is not yet clear. Certainly there has been enormous success to date, but there is also apparent certain danger signals such as excessive erosion, apparent moisture loss and reduced natural fertility and less desirable soil structure which loom in the picture.

From the theoretical standpoint the organization of a cultivated field is more simple than a natural one. The many, the almost unbelievably large number of complex relationships which exist in nature, are greatly reduced. Thus, in agriculture we seem to turn aside from the processes by which nature built the things we are now losing, and thus, from a theoretical standpoint, we may be heading for so much trouble that even a greater degree of "favoring" may not turn the trick.

The Theory of Plant Succession

One of the most useful notions leading to an understanding of the outdoors is the theory of plant succession. This is quite a recent theory although the facts upon which the theory is based have been observed and discussed for centuries. Very roughly and briefly stated, the theory holds that under given conditions of climate (largely temperature and to a lesser degree rainfall) there is a certain type of plant community that must develop. Before this final community which must develop can develop, there will be a history of many other

communities which thrived for a time preparing the way for this, the later communities of plants. This final or last community which must develop can then maintain itself indefinitely if climatic conditions do not radically change, and this community is called the "climax". It represents to a degree the "end of the road".

Role of Temperature in the Climax Pattern

One of the most important factors in determining which climax will finally occur is temperature. Thus, the climax forest of the temperate regions will be a different forest than that of the tropics, which will in turn differ most markedly from a boreal (or northern) forest. Rainfall also enters the picture. If rainfall is too slight the climax will not be a forest at all, but a prairie or under even and much more severe conditions, a desert community.

The variation from one type of climax (or finally best suited association of plants) to another and based on temperature and rainfall can be best illustrated by ascending a mountain. Here "life zones" of vegetation can be easily and quickly observed. In a short drive up a mountain temperature varies so greatly that the much warmer vegetation of the foothills quickly disappears and "zonation" appears, which if the mountain is high enough finally reaches conditions similar to arctic "tundra". To a degree when one ascends a mountain one is "traveling north with the sun" - that is, one is experiencing a climate change of several thousand miles in climbing only several thousands of feet.

Unfortunately we have no mountains in Dane County to illustrate this change, but on your next trip West, look for it - watch the changing plant scene slip beneath your car as you go up, and remember that these plants did not "just happen" to be there. You will be looking at one of the fundamental processes or laws of nature.

Primary Succession

We want to pursue the idea of plant succession even further because it will be a fundamental notion in your study of both forestry and wildlife, and our attempts to manage an area for such purposes.

Primary succession starts from a bare area - a spot so cruel that originally no plant life exists. There are not many such areas - none in our forest - but a totally bare rock ledge or an area of extreme erosion or perhaps a recent lava flow would serve to illustrate such "cruel" places. Here the conditions are so inhospitable to life that the plants which first invade them - the so called pioneers - must have special adaptation (or abilities) in order to exist at all.

Moisture conditions are especially critical and control what kinds of plants these first pioneers will be. If the "habitat" or spot is very dry, such as bare rock, it is called "xeric"; if very wet, such as a lake, it is called "hydric"; if intermediate it is "mesic", but to any habitat whichever it is, plants will come. These plants will be suited to survive in the area and under the conditions - lichens or mosses, perhaps, on the rock, floating leaved aquatics on the lakes.

Now comes a most important notion - the plant succession, the gradual taking over of the habitat by a very slow invasion of plants and with them soils - will always change the habitat towards average moisture conditions. Thus,

whether we start with a lake or a rock we will in enough time arrive at an in between or average moisture condition and one that is clothed with soil, and with a plant cover that thrives in these new conditions.

All nature moves towards the average - the medium, the least extreme situation. Xeric habitats become more moist, hydric become more dry, and thus although the original pioneer plant species vary greatly if enough time goes by, both habitats will be the same and will finally be covered with the same plant community.

Secondary Succession

Much more common and easily noticed is secondary succession. Here a field might be laid bare by cultivation, lumbering, fire or some other factor. However, in most such cases the moisture conditions are already reasonable, the soil is not too greatly damaged, and the future is close at hand. There are always dormant seeds in the ground and roots ready to sprout and nearby there are always established plant communities of a satisfactory or nearly satisfactory type to serve as sources of the new colony. Then plant cover will appear quickly and here succession may be at first most rapid.

The usual first year cover is often annual weeds. Another year or two and the annuals will give place to perennials and then to brush or shrub growth and then after a time to a young forest if moisture is sufficient. As the centuries roll past that first forest, too, will change to a different sort of forest.

The kind of trees which make up a "climax" forest - a final "end of the road" forest - are largely dependent upon shade as the final factor. Thus, while Jack Pine frequently are the first invaders or pioneers on a central Wisconsin "burn", Jack Pine cannot continue itself because young Jack Pine need considerable sunlight. More shade tolerant trees must now move in (such as White Pine) and after soils and perhaps moisture and finally deep shadow come to the forest, only those shade tolerant trees such as Maple, Basswood, Beech, Birch and Hemlock can thrive. We have come to a "Maple climax".

Each Stage in Succession Carries Within It its Own Defeat

We come then to the summary of an important idea. Each successional step - each plant community is for a time successful because conditions are right for its particular requirements. This association becomes dominant, but as it becomes increasingly dominant it creates its own disaster by changing the conditions that were initially favorable. Litter increases on the forest floor, shade increases, moisture moves one way or the other toward the average, soil acidity and with it soil bacteria may change and finally a community "successes" itself out of business. Because a community changes conditions as a result of its own prosperity, it creates conditions no longer suitable to itself but now suitable to other communities.

Thus, a new succession, a new community, takes over in force after first existing weakly on the site. It in turn prospers and again changes the habitat and then bows out to still another succession until finally we arrive at a community which no longer creates its own death trail - this is the climax.

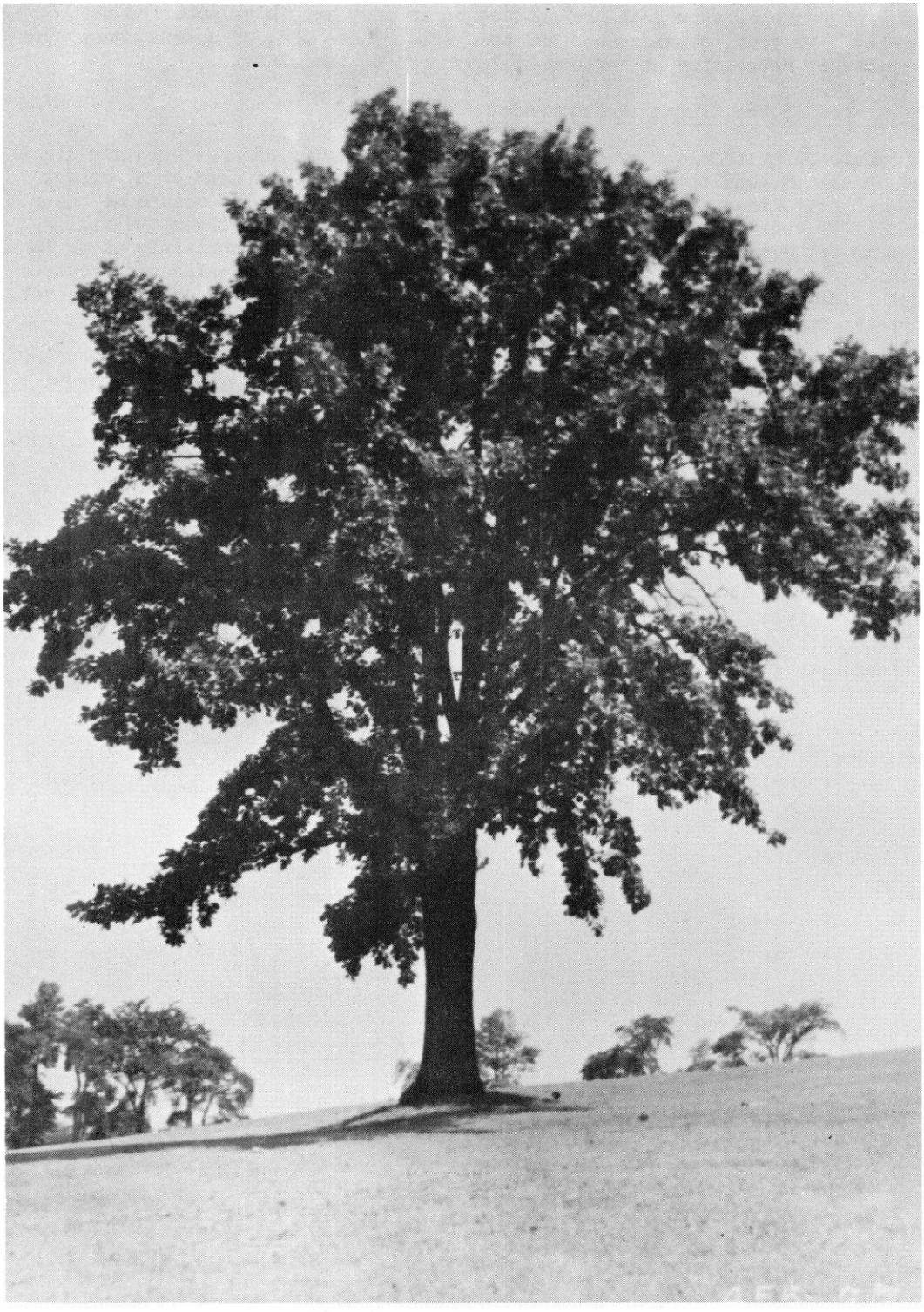
Rarity of the Climax

Now such conditions as described are on the face of things highly improbable. The chances of having a succession go all the way to the finish is unlikely

because of the enormous time span needed. In the time needed so many things, so many accidents, can happen that the fact is that they usually do. A fire can, for example, turn back the succession as can certainly lumbering or farming. However, climaxes can and do exist. There are, of course, many more examples of succession at various stages short of the climax.

Importance of the Climax in Management

It should be quite clear by now that if we are managing an area with our sights set on climax conditions and if our present conditions are near or at climax we are lucky, because all nature is working with us. Also it should be clear that if we seek to continue conditions at less than climax stages, we will need to put forth much greater effort and skill. This is abundantly clear in farming, which aims at a very early stage (that of annual plants) and requires much labor and a continuing increase in skill to keep the show going. However, this too can be done.



Chapter 3
THE PAST CENTURY

You will recall from earlier pages something of the earlier "geological" history of our forest. We turn now especially to the last 100 years of plant history.

This Was Not Always a Forest

The Madison School Forest was not always a forest. In fact, this is a very young forest - it really represents only one generation of mature trees. At the time of settlement and the original survey (1830's), this area was an "Oak opening".

Oak openings were a quite common occurrence in southern Wisconsin in those days and are a condition almost totally gone today. An Oak opening was a sort of park-like combination of mostly Bur Oaks in single trees or scattered clumps of trees and prairie (grasslands).

Why the Oak Openings?

There is some debate among botanists on "why a prairie" in Wisconsin, where rainfall is sufficient to support a forest and forests are better competitors in the succession. We are going to settle for the fire theory as by far the best explanation although drought and disease are other factors to be thought about.

One of the most common errors in the thinking of most people is to assume that fire greatly increased with the coming of the white man. Fire is thought of as sort of a modern curse we have placed upon the land. We are so used to hearing and thinking about the "burning of the north" following lumbering that we assume that fire is a new factor in our state. Just the opposite was true in southern Wisconsin.

Fire stopped in our area with the coming of settlement. Early roads and fields split up the area in fire breaks, farmers made efforts to control fires and the annual burning, largely Indian set, stopped. It should be remembered that despite what one reads, prairie fires are easier to set than forest fires and a more valuable means of driving game. Also a forest fire is a thing of fierceness but a prairie fire is a fire gone briefly mad.

The constant burning of the grasslands kept the forest of our area from developing and thereby shading out the grass. Each year such seedling trees as grew from seeds or sprouted ambitiously from older roots were killed back. Each year the grass was given the advantage and grass can withstand fires where trees cannot. It should also be stated that grass can also withstand drought. Grass has a great advantage here - it can wait.

One of the features of the grasslands described by early naturalists was the presence of "grubs" - huge underground Oak roots in some cases already a century old that threw up annual shoots into the prairie. These grubs were most difficult for early farmers to remove and represented a continual nuisance in their hard won fields.

The Importance of Oak in the Openings

But Oak trees did survive the fires here and there. Luck and fortunate placement gave them a start and then the fire resistant and insulating qualities of their bark kept them going. A prairie fire while disasterous in its progress is not a long lasting fire, and trees of some size frequently survive the effects. Bur Oaks are the most fire resistant of the Oaks and early surveyors' notes indicate that originally our area had mostly Bur Oaks. White Oaks are a good second and they, too, were found in numbers, and perhaps especially on our half mile. These Oaks, "veterans of the prairie war", were scattered throughout the grasslands or existed in small groups. Seldom were they so closely spaced that their tops interlaced. A rather remarkable piece of research working from early surveyors' notes places these trees about sixty feet apart on the average. When the fires ceased acorns from these Oaks and sprouts from the "grubs" supplied a thick growth of young trees to start our forest.

A Century of Growth

About 100 years ago then, in the period just prior to 1860, the Madison School Forest made its start. The new trees were remarkably closely crowded and caused much debate about this sudden "irruption" of Oak trees in Wisconsin and in those places where plow and cattle did not keep them down. In a short time these new trees were overtopping and gradually killing the earlier and open grown trees. Thus, our forest has its "veterans" now moving into the end of their time upon the land, gnarled, knobby and spreading with most of the Bur Oaks (less shade tolerant) already gone and the new forest of straight and tall trees, much better timber, growing around them. Together they show the history of a century on the land.

More Trees Here Now

We hear so much about our forests having been removed or destroyed that it is instructive to realize that such is not true here. We have at least ten times as many trees in the Madison Forest as we had a century ago. Furthermore from a lumber standpoint we have more lumber. This is true, of course, because the forest is a new feature of the land - but there are many other hillsides in our county where this is equally true. It should also be pointed out that this is not true in the originally forested counties to the North.

Going Back Even a Longer Time

It is interesting to try to piece together the history of our forest for an even longer period of time. We have seen how today we have a young forest which sprang from the Oak openings of pre-settlement. What was it even earlier?

Probably for long periods of time and at least prior to about 1650 it was then too a forest. This seems true because its soils are forest soils - that is, the upper layers of soil are those typically laid down by the accumulation of forest litter (duff) on a forest floor. The soil is not at all the kind laid down under a grass cover. Furthermore the scatter pattern of trees and their age at the time of the survey suggests a few trees grimly hanging on as the remnants of an earlier forest rather than the invasion of the grasslands by trees pushing in from its borders. You can observe this forest invasion on any abandoned field, look for it especially in the sand counties as you drive North on a fishing trip.

So probably long ago we had a forest, that forest was destroyed - perhaps by drought, perhaps by disease, but most likely by fire - a few trees continued and the prairie moved in beneath them - the delicate balance was kept open by Indian fires and finally with the control of fire in our century, the forest won again.

How About Glacial Days?

One more look at the history of the land before we move on. Although the area of our forest was not covered with ice and the scraping and filling of the glacier did not occur here, the vegetation of the period no doubt suffered from cold. Actually, areas near a glacier are not anywhere near as cold necessarily as you might think, and certainly the Pines and Spruces of the North moved South with the ice sheet and then fought their way back again. Probably Pines and even Spruces grew once in our Oak-Hickory community and we still have some under-story plants which are typical of such a community.

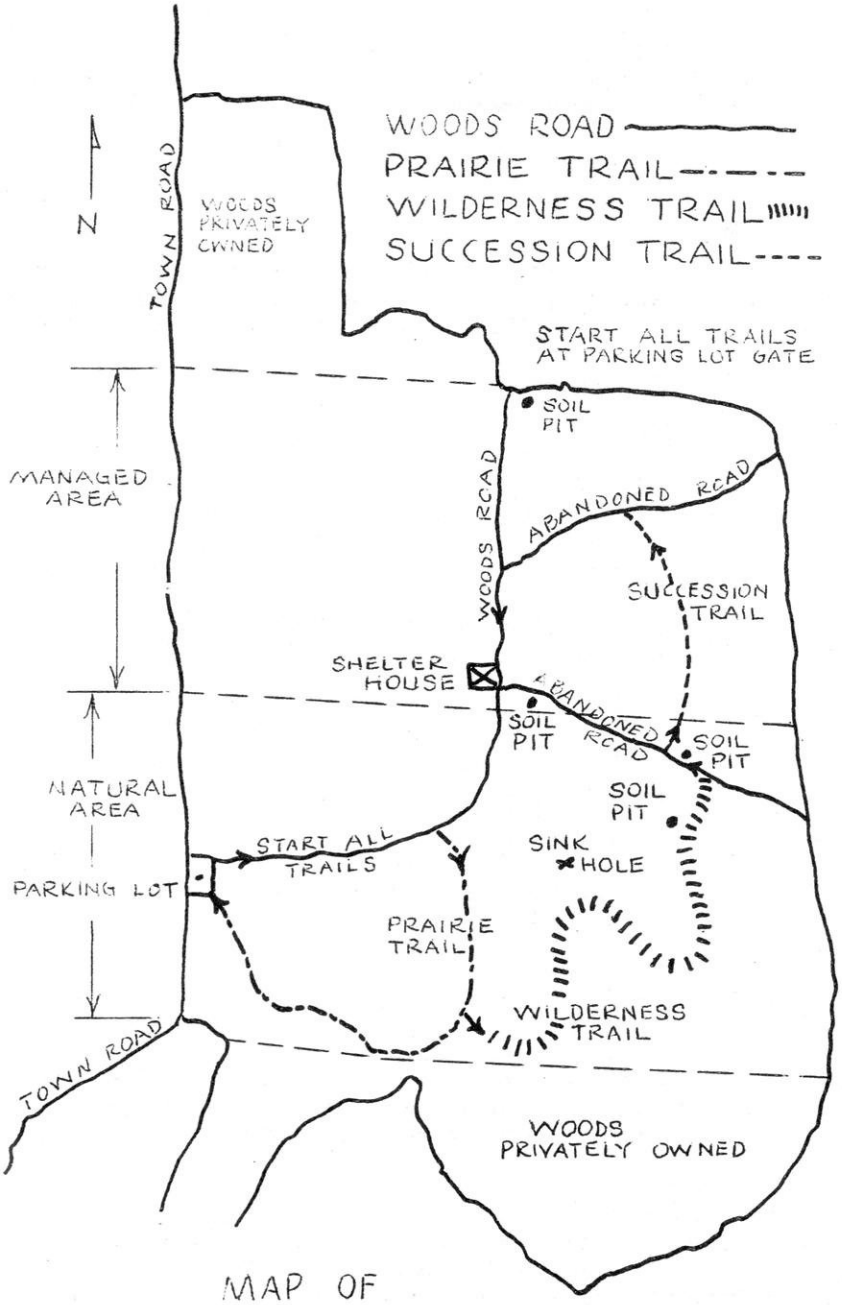
These northern under-story plants are "relics" - pages torn from a book long past and existing now because of special favor shown them in certain parts of our woods. When we point these plants out to you we will do so with a certain special pride. They don't really belong here and they certainly will not always survive. They show the surprising toughness of both plants and animals to "make a go of it" in areas not really suitable. They are not colonists but remnants fighting a rear guard action against the better suited and therefore more prosperous Oak community.

Probable Future of Our Forest

In part of our forest we propose to manage the trees for timber stand improvement. This means that here we shall attempt to remove the poor trees, poor both as to kind and individual specimen value. We will try to raise more and better Oak. This will mean favoring Oak over all other plants and eliminating competing factors. We will attempt to "freeze" the succession at the Oak sub-climax stage.

In the rest of the forest and in a long enough period of time and if nothing happens - no great fires, no extreme outbreaks of disease or insects, no big climatic change such as a very prolonged and extreme drought - if these things do not happen, our forest at least to the most part will move over into a Maple climax. The botanists call it an Acer-Tilia stage. Maple and Basswood are already making a small start but only a careful eye over a period of time will note this change.

The Oak-Hickory community is a long lasting one. There are experts who argue that Oak-Hickory is itself a climax and certainly it is so long lived a period that the term "sub" climax is deserved. But we are going to accept the Maple climax as the most probable end point of our forest story. You and I won't see this prediction come true, but we may see quite a stride in that direction. The climax species are deadly competitors. In time they always win.



MAP OF SCHOOL FOREST

Figure 3

Chapter 4
THE NATURAL AREA

Half of this forest will be left unmanaged, undisturbed, and reserved for study. The map of the forest on the left shows this area and the trails which have been established so far to guide you through the forest. The idea of keeping some land in a "natural state" is a growing one. Besides the unique recreational value of wilderness, it is now realized that nature was the source of all we know and still has much to teach. To alter the last tiny fragments now remaining of prairie, forest and wetland may be to destroy forever certain clues to the future as well as the past.

The Natural Communities of Southern Wisconsin

A natural community differs from a garden or a zoo, or a farm or a managed woodlot; it is formed and maintained all by itself. It includes those plants and animals which can survive in a certain habitat - that is, that require or at least tolerate its climate, soil and moisture conditions. But these plants and animals must be able to get along together without the help of a caretaker. In southern Wisconsin most of the wild communities may be grouped under the following nine headings:

A. Lowland Communities

1. Cat-tail - Duck Potato Marsh: quiet shallow water, abundant producer of frogs, waterfowl and muskrats.

2. Sphagnum - Tamarack Bog: fabulous floating gardens with Owls, orchids, insectivorous plants - often ringed with a moat and a hedge of Poison Sumac.

3. Sedge - Bluejoint Meadow: hummocky home of Marsh Hawks and Mice and source of mint-fragrant marsh hay.

4. River floodplain Forest: mosquitoey jungles of Elm and Silver Maple hung with Poison Ivy, our last real wilderness - rich in birds and all wildlife.

B. Upland Communities

5. Prairie: our richest and most colorful flora amid man-tall Bluestem and Indian Grass - now nearly extinct because prairie soil is best for crops.

6. Sugar Maple - Elm Forest: stately trees above a dark and shrubless floor - famous for fall color and dense carpets of brief spring wildflowers.

7. Oak Forest: sturdy nut trees, squirrels, brambles and burs. The Madison School Forest is one of the finest and largest Oak stands.

C. Weedy Communities

8. Kentucky Bluegrass: dense sod, like prairie but much quicker to get started and with fewer associated plants - lawns, fields, roadsides, pastures and meadows.

9. Short-lived Weeds: still quicker to invade bare ground and just as quickly invaded in turn by grass, but maintained wherever soil disturbance is repeated (cultivation, erosion, etc.)

Each of these communities consists of from 50 to 300 kinds of wild plants and their associated birds, mammals, insects and lower forms of life. The first six communities are rare today - having succumbed to plowing, pasturing or changes in drainage. The last three (including our forest) have benefited from man's activities in one way or another and are today more abundant than they were a century ago.

Structure and Composition of an Oak Forest

Because Oaks cast less shade than most trees, Oak Woods have a well developed shrub layer. Thus, the plants may be grouped into three layers or stories:

1. The CANOPY or dominant tree layer including four kinds of Oaks - Bur, White, Red, and Black Oaks. With these Oaks one almost always finds Shagbark Hickory and Wild Black Cherry, and, on the edge, Quaking Aspen.

2. The UNDERSTORY or shrub layer which includes some saplings and the following characteristic shrubs: Blackberry, Chokecherry, Gooseberry, Hazelnut, Gray Dogwood, Nannyberry and Wild Plum. Others such as Crab and Sumac prefer the edge. Several woody vines are also present such as Grape and Bittersweet.

3. The GROUND COVER or herb layer including many plants. The sixteen most important species on the combined basis of both presence and abundance in Wisconsin Oak stands are:

Pennsylvania Sedge
Enchanter's Nightshade
Woodland Tick-Trefoil
Bedstraw (Three varieties)
Wild Geranium
Sweet Cicely (two varieties)
Hog Peanut
Lopseed
Greater False Solomon's Seal
Wild Sarsaparilla
Bracken Fern
Poison Ivy
Woodbine

Poison Ivy and Woodbine are really woody vines but they seldom climb. Over 40 other herbs - from Arrowleaf Aster to Woodland Blue Violet - are common members of the Oak Forest. Most of these you will find illustrated and discussed in Chapter 10.

Animal Life in Relation to the Three Storied Plant Layers

Each plant layer has its special animal life. Cicadas and Flycatchers prefer the treetops, Tree Crickets and Catbirds the shrubs, and Thrashers and Ground Beetles prefer the leafy forest floor.

However, most animals use several layers or even several plant communities. Most birds sing higher than they feed, and nest in between. Many insects spend their larval or "eating" stage low and then fly, mate or sing high. Thus, many animals that use several communities account for the importance of diversified plant cover (a high ratio of edge to total area) for the maximum production of wildlife. For example, this forest is large enough to demonstrate that fewer kinds of birds nest in its interior than near its margins or openings.

However There is a Need for Large Blocks, Too

On the other hand, wildness is important to certain species. Placing a field in the forest's center would probably increase the Buntings, Thrashers, Flickers, Blue Jays, Cardinals, Catbirds and Towhees but probably decrease the Ruffed Grouse, Vireos, Thrushes, Whip-poor-Wills, Warblers and Tanagers. These latter birds seem to require the large areas of a quiet forest. Thus, there are psychological and behavioral requirements of animal species quite independent of plant cover which help to determine suitable habitat and thus abundance.

Ecology of the Oak Forest

Even what little is known about the ecology of the Oak community would fill several books. The following headings, which will be discussed in some detail, suggest a few approaches worth further study in a "natural" forest. These major headings or problems will be:

1. The Problem of Soil Fertility
2. The Problem of Shade
3. The Problem of Erosion
4. The Problem of Seedling Survival
5. The Problem of Community Permanence

Soil Fertility and Tick-Trefoil

Ecologists use the word community because there are some parallels between natural plant and animal groups and our society. For example, the Woodland Tick-Trefoil sells insurance.

But to back up a bit - Nitrogen is an essential component of all living cells. Most of the world's nitrogen is found in the air about us - 80% nitrogen gas. As a free gas in the air nitrogen does little good for plants or animals. Animals can get their nitrogen by eating the protein built by plants, but green plants must get their nitrogen in the form of nitrate ions and sometimes ammonium ions largely in water solution from the soil. These nitrate ions are seldom abundant in the soil because they are readily water-soluble and wash away. Their chief source in the soil is from the gradual decomposition of organic matter - dead leaves, stems, bark, roots, and fecal material - which

beetle and worms work into the soil.

Very important in the nitrogen cycle are bacteria which live on organic matter and comprise the nitrogen bank. Plants withdraw nitrate savings each year and redeposit it in the form of dead materials. But, the bacteria are careless tellers in the nitrogen bank and sometimes hand out more nitrates than are requested. The excess is then leached out by rains.

There are as well occasional large thefts by bank robbers - fires which convert the organic-stored nitrogen back to nitrogen gas. There are also "embezzlers" - bacteria which use up nitrates for themselves or convert some of it back to freely escaping nitrogen gas.

Three Forms of Nitrogen Insurance

Fortunately there are three kinds of insurance companies which operate to restore the nitrogen bank's balance: First, there is the occasional lightning bolt which converts a little nitrogen gas to nitrates. Secondly, some bacteria in the soil are able to make their living by converting nitrogen gas into nitrates.

Thirdly, another group of bacteria which must live as parasites on the roots of certain plants (usually legumes) can also utilize and convert nitrogen gas directly. These parasites thus give their hosts an added source of nitrogen in exchange for some of the sugar made by the legume plant. Hence, for a given amount of plant body the legumes put back into the soil more nitrogen than they withdraw.

Woodland Tick-Trefoil is the only important perennial legume in the Oak forest. The annual dying back of Tick-Trefoil leaves and rootlets, like plowed-under alfalfa and clover, greatly enriches the nitrogen bank. Similar legumes are common among the weed and prairie communities, but only a few species of legumes have become able to survive the forest's shade.

Hog Peanut, an annual forest legume, is also a very important nitrogen insurance agent. This is especially true because of the mobility of this plant which enables it to invade burns and other openings quite quickly. Also, it releases all of its nitrogen every year and thus in two ways boosts the soil fertility just at the times and places of most rapid forest growth.

Still another nitrogen insurance agent is Naked Tick-Trefoil. This is a much less common legume but it is locally quite abundant in our forest. Because much of our forest has light, sandy soil, it is fortunate that this plant is here to help in the nitrogen supply.

Two of the prairie plants here also harbor the nitrogen-fixing bacteria. Both Lead Plant and New Jersey Tea (which is not a legume) help to add to the nitrogen total but they do poorly in the shade and must be considered unreliable insurance agents in the forest.

The Problem of Shade

Few problems below the canopy of a forest compare with the overwhelming problem of shade. In addition to the building materials for growth - carbon dioxide from the air, water and some 15 minerals from the soil - energy must come from the sky in the form of light.

In the open, productivity of plants may be held back by lack of minerals, or water, or oxygen in the soil, or by the limited amount of carbon dioxide in the air - but light is always sufficient. Under the trees, however, plants are almost always hindered by the extreme scarcity of light.

So serious is this scarcity of light in the forest that seldom will the improving of any other factor alone give much help to any of the plants below the canopy trees. How, then, have forest plants been able to adapt themselves for survival in shade?

Survival in the Shade - Technique 1 - Leaf Size and Exposure

In general, all plants can and do respond to shading by developing broader, thinner, darker green leaves and holding them more horizontally. In so doing they expose a maximum amount of chlorophyll per unit of area to such sunlight as penetrates to them. This response of leaf size and "holding" can be seen by comparing the same plant grown in sun and in shade, or indoors and outdoors, or leaves from the top or bottom branches of the same tree.

Within limits then, this behavior enables every plant to make best use of the available light. There is, however, also a dilemma - the same dilemma that has faced plants ever since they left the sea. The more surface you expose to absorb light and carbon dioxide the more water you will lose to the air through transpiration. Thus, land plants could not be really successful until they developed a waxy coating to conserve water (and incidentally permit pupils to polish apples). But, wax can reduce or keep out the needed carbon dioxide and oxygen too - hence, a further invention, the ingenious valves (stomata) which can be closed when the plant is losing more water than the roots can replenish. Thus, the amount of leaf surface that a plant body can risk to exposure is limited by the fact that some water is always lost to the air through both the "valves" and wax.

"Microclimate"

The silver lining for plants living in the shade is that the "microclimate", the special conditions on the forest floor or at least below the canopy, includes "air-conditioning". That is, because of the shady tree cover it is cooler, more moist and less windy. This permits plants to increase the surface of leaves as well as cut down on light-absorbing devices for protection against too much sunlight. This greater sensitivity which develops in shade-grown leaves may be demonstrated by moving a potted plant out of the shade or by observing the ground plants where trees are cut in the summer. The formerly shaded leaves will now wilt, curl up or may even turn yellow or brown.

Technique No. 2 - "Grow Tall"

The Brambles and such herbs as Woodland Lettuce and Joe-Pye-Weed have another technique - they quickly shoot up and grow taller than other herbs and even some shrubs. So does the huge bush-like Spikenard. Thus, these plants place themselves above other herbs and in a more favorable position to receive what light there is.

The annual Hog Peanut takes the same plan by climbing on other plants and in effect borrows their cellulose for support while putting its own energy into seeds to give its offspring a rapid growth habit next spring. The Bedstraws borrow support by sticking to other plants with their rough hairs.

Technique No. 3 - "Keep Moving"

The long-runner habit is found in 14 of the 23 shrubs and in 17 of the 64 woodland herbs and also in 10 of the 23 prairie herbs illustrated for this forest. Runners are useful in reproduction anywhere but certainly there is a special value in the ability to explore new areas of the forest floor. Plants with the runner habit are able to move, to seek out bare spots which admit more light, as well as to escape from areas too thickly crowded by other plants.

The runner plants continually play a game of free-for-all tag with each other. For this purpose runners are superior to seeds since seeds have less stored food to draw on in getting through the leaf litter and avoiding other plants. It is also true that seeds do not find favorable moisture conditions every year.

Technique No. 4 - "Escapers"

Another mechanism of living with shade is to escape it - that is to modify the growth pattern to a period before the forest comes into leaf and hence into shade.

Most forest plants come up and flower early in contrast to the late and gradual development of prairie plants (where shade is no problem). The very best shade escapers are those that beat the trees into leaf, like Spring Beauty, Toothwort, Dutchmans Breeches, Fawn Lily, Wild Leek and Floerkea, and then show "fall" color and go underground in late May. These are Maple forest plants called "Spring Ephemerals" but in the Oak forest Wood Anenome and Shooting Star behave similarly and by late summer several others have withered - such as Sweet Cicely and Jack in the Pulpit. The advantage of this habit, shrewdly put: if little food can be made during the shady summer, why bother to feed a full set of leaves?

In addition to Spring growth, some, like Sweet Cicely, Waterleaf, and Honewort send up a second set of leaves in September to catch a little sunshine after the leaves of most trees and shrubs have fallen. Annual Bedstraw and White Avens germinate in September and thus likewise make most of their food in shade-free October and before late May.

How the Escapers Do It

Early Spring development requires rapid growth at low temperatures. This is achieved through (a) pre-formation of leaves and flowers during the previous summer, (b) storing of food for quick growth in enlarged underground stems (bulbs, rhizomes, tubers, and thickened roots) and (c) a considerable use of water rather than cellulose in support. Thus, with water cheap, especially in the spring, and cellulose always more expensive or at least slower from hard-won sugar (made in sunlight), these plants can get an early jump and then quit for the year.

Instead of being thick-walled and rigid bricks, the cells of these plants in the spring are more like balloons, owing their firmness to water pressure within. This is why Spring wildflowers wilt soon after being picked.

A disadvantage to the watery growth is the ease with which forest herbs are crushed by the foot. The need for pre-formation of next year's shoots and the need to store every bit of Spring-made food for these new buds means that the plant cannot afford the additional food needed for regrowth if it is trampled,

browzed by cattle or picked. The plant must simply wait another year when it can only send up a weaker, smaller shoot from its small reserve of food.

Technique No. 5 - Slow Growth or "Take It Easy" - The "Endurers"

All "closed communities", plant groups that live together for long periods in crowded conditions, show slow growth habits.

Compare a weedy type of plant, Corn, with an Enchanter's Nightshade. In 90 days a corn plant may produce 500 starch-packed kernels while in the same time the Nightshade has formed but three white tubers the size of a corn kernel. Each plant is geared to its habitual growth rate - the corn won't form a single kernel in the shade; it is fast or nothing. Forest plants, even when they can get all the light they want, still won't produce much more, setting perhaps ten tubers and twenty seeds per stem. It is not surprising that most forest plants take 3 - 10 years from seed to first flowering. They survive because they refuse to be in a hurry.

Insects Know This Too

The final proof is to look for insects - the second link in the food chain. In grassland you will find them everywhere. In the forest a few are visible on saplings, shrubs and herbs but not very many - there is no food here. To find forest insects you must go where the bulk of the forest's annual crop is - the treetops, the fallen leaves and the dead wood.

Trees and Shade

Lordly trees have their shade problems too. Even the shade-tolerant species - Sugar Maple, Elm, Basswood, Ash, Yellow Bud Hickory, Butternut and Cherry - make best growth in the sun. Some of them may germinate better, however, in the shadier, moister forest conditions. By observing Cherry or Maple saplings you may note that growth in height may be as little as an inch a year in shade and as much as two feet in the sun.

Thus, trees can, if need be, adopt the "no hurry" philosophy of the forest herbs - apparently barely staying alive while waiting for a taller, older tree to die. At that time the trees shift over to the "in a hurry" pattern of the corn plant. This story of sudden, "released" growth can be read in the annual rings of many a stump of a forest grown tree - first narrow, then suddenly wider. Blackberries and most shrubs likewise show their preference for more light by becoming a veritable jungle where the forest is opened up by cutting.

In contrast to the shade-tolerant trees, the Pines, the Oaks, Shagbark Hickory, and Aspens tolerate little shade and suppression. They characterize the early stages of the plant succession, for they cannot wait too long - they must have light fairly soon or else.

The Problem of Erosion

But the forest has other problems besides that of shade - and in fact the problem of erosion is made more difficult in the forest because of shade. Erosion is hard enough to stop anywhere when once started, but in a forest it is next to impossible to control.

Most importantly, no sod-forming plants are shade tolerant. Pennsylvania Sedge is one exception, but even this plant requires considerable light for good

growth. For erosion control the forest must depend on a substitute for sod to absorb rain, check run-off and ease penetration. This substitute is the layer of fallen tree leaves but they in turn act further to exclude sod-forming grasses.

We come now to an opportunity to point out the dependence of the trees upon the lowly herbs. Examine a downslope road of a forest path and compare the amount of litter present and the amount of erosion with the adjacent forest floor. Or visit a grazed or a burned woodlot. You will note that the denser the ground cover the less the leaves will be blown around or moved by water in fall and spring and hence remain in position to stop erosion.

Trees Alone Are Not Enough

Trees are sometimes planted to prevent or check erosion. But it must be understood that trees alone will not accomplish this objective. In fact, trees may worsen the situation by shading out pre-existent ground cover which had earlier served to anchor the litter and soil.

It is only the entire complex of leaf litter, humus held in place by the low stems and fine shallow roots of the herbs and shrubs, which prevents erosion in a forest. But shade-adapted plants as noted earlier are slow to grow, slow to spread, and have sparse stems, held apart to expose their horizontal leaves.

As a result, forests are very easily abused and degraded. One bridle path or heavily used trail can become a gully in a single year on a slope of sufficient grade. Sometimes run-off waters from a field above a forest will create too great a problem for the precariously perched litter. Then the forest, which was left on this lower, steeper slope to prevent erosion, will merely enter into the problem!

Herbs and the A_1 Layer

The litter-holding, shade-adapted herbs benefit the trees in still another way, by building a nutrient bank of decaying leaves (the A_1 layer of forest soils discussed in the next chapter).

Tree leaves - forming a large share of the forest's annual crop - contain much of its resources - both minerals and stored energy. These leaves feed countless worms, adult beetles and beetle grubs, sowbugs, centipedes, snails, fungi and bacteria which borrow the mineral nutrients in return for changing the ground litter into humus. Thus, the forest keeps using and re-using its resources and keeps losses outside the community to a minimum. Burning or grazing woodlots cause many-sided losses. Cows need only a corner for shade; the forest herbs are among the world's worst forage plants. (Burning on rare occasions can be a management tool when expertly used for a special purpose, but its bad effect on forest herbs and litter are nonetheless severe.)

The Problem of Seedling Survival

A well-anchored leaf litter does much to solve the forest's problem of erosion but typically one solution helps to create a new one. A germinating seed, having very limited resources, is truly low man on the forest totem pole. Leaf litter obstructs and shades its tiny shoot in addition to the three layers of herbs, shrubs, and canopy above - as well as hungry rodents.

Seeds must have a continuous supply of moisture until they have developed a root and further moisture to develop a shoot with either seed leaves or true leaves exposed above the ground and litter, and an adequate supply of light - all before the stored food runs out.

Seedling Requirements are Very Important Factor in Presence

There are many subtle variations whereby seedlings accomplish this early growth. The distribution, abundance and even presence in the forest of many of the herbs is tied closely to this problem of seedling survival. In older forests (closer to the climax type) even the trees and shrubs share this seedling survival problem.

Special seed requirements account for the absence of many shade intolerant plants. These plants would not do well under forest conditions and oddly many of them then refuse even to germinate. There is survival value in not starting to grow if the situation is hopeless anyway. Most weeds and probably most prairie plants require the conditions found in a bare, sunny mineral soil to trigger germination. It may be light, oxygen, heat, or the absence of chemicals found in decaying leaves, but be it what it may, shade intolerant seeds do not germinate well in a forest. The vast majority of such seeds simply remain dormant in the soil waiting for the day the forest burns, or is opened up by grazing, or is ravaged by erosion. After such occurences the appearance of these seemingly endless new plants can be spectacular.

Seed Behavior Roughly Follows Size

The behavior of forest plants roughly follows seed size. Nuts must be buried by rodents and sometimes it takes a whole year or two to soften the hard shells of Hickories and Butternuts to allow germination. A month or two is enough for acorns which sprout the first spring. White Oak acorns behave somewhat exceptionally and frequently sprout immediately in a wet fall even before burial and occasionally may get their tap root anchored in that same fall.

Supplied with abundant food, nut seedlings and acorns can easily get above litter and ground herbs. It is this feature which when added to the carrying and burying habits of squirrels enable Oaks and Hickories to invade the dense sod of the grasslands. Deep tap roots give these pioneer trees drought and fire resistance as well, which are useful qualities in such an invasion.

Medium Sized Seeds

Climax trees like Basswoods, Maples, and Elms, on the other hand, have medium sized seeds and belong with the litter-piercing herbs. Such trees require moist soil to germinate and have shallow roots even when mature. Hence, they seldom invade undisturbed grassland.

By litter-piercing is meant sending up a long shoot or long leaf-stalks which get above the fallen leaves. Some herbs have shade-escaping seedlings, coming up in early spring - Virginia Waterleaf, Hog Peanut, and especially Sweet Cicely and Jewelweed.

The rest have adopted the slow growth habit of their parents whose own shade they must tolerate. Many are so slow that they send down only a root the first year and their first leafy shoot appears the second (Solomon's Seals, Bellworts). In the shade-endurers, the seed leaves often remain below ground, furnishing

only stored food. In the shade-escapers these seed leaves have a dual role and also form the first green leaves to help make hay while the sun shines.

Small Seeds

The really small seeds must of necessity be litter-avoiders and, like the sun-loving weeds, prefer a bare spot for germination. Arrowleaf Aster, White Snakeroot, Small-flowered Crowfoot and Charming Sedge are examples here. Because such plants are "weedy" in regard to germination and yet are adapted for the forest's shady, cool, moist environment as adults, these plants are good indicators of local disturbances in the forest.

Most annuals and biennials of the forest belong in this group - Clearweed, Pellitory and Woodland Lettuce. White Avens uses still another trick in escaping the litter: its seeds germinate in late summer by which time the earth worms have cleaned up most of the leaves and bare spots are more available. By October White Avens has formed a large enough rosette not to be "snowed under" by the newly falling leaves.

Dormancy Period

Summer and fall germination in seeds is rare, however. Perhaps because there is more moisture in the spring, and also because a full season equips the plant with more root and stored food for survival, spring germination is the rule. Most wild seeds do not sprout in fall because they first require a month or more of cold treatment in moist soil. Individual seeds of the same plant vary in the length of this dormancy period and many will not grow the first year even if conditions are favorable but remain stored in the soil. There is much survival value in not putting all your eggs in the same basket.

And After the Seedling is Up

Once the seedling is up the fun has only begun. The forest is a closed community - one already well occupied by a close mosaic of well established plants which usurp just about all of the light, water, minerals, and space available. Seedling establishment is therefore an annual game of musical chairs.

As the mature plants struggle together occasionally one will be eaten, succumb to disease, or be knocked down. Any seedling lucky enough to be on the spot when this happens has a brief chance to attain some size before the opening closes again. The rest of that year's seedling crop dies. In trees this is known as "gap-phase" reproduction and forms the basis for selective cutting procedures.

The Problems of Community Permanence

After all these pages we come to the question, "Where does the Oak forest fit?" In an earlier chapter it was pointed out that theoretically such a forest was a "sub-climax". What does our natural area have to say to this theory?

What the Herbs Say

Perhaps the herbs are the best indicators because they have the least to say concerning the forest environment. One group of herbs was given earlier on these pages - those found in all Oak stands. Curiously, a second group of

herbs discussed in Chapter 10 are prairie plants and a third group are found in the climax Maple forest.

SOME PRAIRIE HERBS PRESENT IN THIS FOREST

Smooth Sumac*	Pussytoes
Wild Rose*	Shooting Star
Lead Plant*	Krigia
New Jersey Tea*	Comandra
Golden Alexanders	Flowering Spurge
Yarrow	Upright Bindweed
Wild Strawberry	Common Goldenrod
Five-Finger	Early Goldenrod
Coreopsis	Smooth Aster
Culver's Root	Starry False Solomon's Seal
Wild Bergamot	Spiderwort
Lance-leaved Loosestrife	Big Bluestem Grass
Spreading Dogbane	(* are shrubs)

SOME HERBS FOUND HERE AND ALSO IN MAPLE FOREST

Virginia Creeper*	Hog Peanut
Alternate Dogwood*	Enchanter's Nightshade
Maidenhair Fern	Solomon's Seal (hairy)
Virginia Waterleaf	Greater False Solomon's Seal
Sweet Cicely	Bellwort
Early Meadowrue	Carrion Flower
Wild Sarsaparilla	Wild Leek
Honewort	Bottlebrush Grass
Jack-in-the-Pulpit	(* are woody plants)

Our conclusion is that the Oak forest environment is a hybrid between the prairie and Maple communities - both climax in their own right - but with Oak occupying an intermediate stage in light and moisture between the two.

Environment Not Uniform

The herbs also tell us that the environment in our forest is not uniform. This is reasonable enough because both topography and soil vary and such would be expected. Where the soil is shallow or sandy and especially on the hilltops and southwest slopes where it is exposed to dry warm winds the vegetation is thin to begin with. Because Black Oak and Aspen, which tolerate these conditions best, also cast the least shade, the effect of soil and exposure is further exaggerated here. Hence, in such areas there is an abundance of prairie plants.

The Northeast exposures and sandy soils have another microclimate effect within this forest: they support Blueberry, Bush-honeysuckle, Pipsissewa, and Canada Mayflower, which prefer acid soils and cool summers and are now more common in Northern Wisconsin.

Age Composition of the Forest Trees

Take a swing along one of the paths and make an actual count of all the trees on either side for say 100 feet. We think your chart would look much like the one on the following page.

Species of Tree	Old, Open-Grown	Straight, Forest-Grown	Saplings ½-grown 6-30 ft.	Small Saplings 1-3 ft.	Germinating Seeds
White Oak	some	many	some	some	?
Red Oak		few	some	some	?
W.B. Cherry		few	some	some	?
Slippery Elm		few	some	some	?
Butternut			few	?	?
Sugar Maple			few	?	?
others					

Here then is a picture of forest succession. Can you predict the result and tell why?

The question marks indicate that the number of germinating seedlings will vary greatly with the year. The few Sugar Maples and Butternuts probably came from afar and may each have come in only once in the past. Until they reach seed bearing age there may be no further seedlings of these trees; after that there will probably be many.

As for the Oaks, Cherries, Elms and other trees, the number of seedlings and small saplings present will depend not only on their shade tolerance but also on factors like: the size of last year's seed crop, the density of Squirrels and Chipmunks, which some years consume most of the seed crop, the population of rabbits and mice, which may kill or severely set back an already established sapling. Are the Cherries and especially the Elms doing better than the Oaks - and especially which Oaks?

A Dynamic Forest

Our conclusion must be that our Oak forest is dynamic in contrast to the more static condition of climax forest or prairie. Not only is it intermediate, but it is steadily changing. Though it is a self-extinguishing community, the process is so gradual we can study in detail its road to suicide. Here in Wisconsin the two great floral empires meet - the prairie and the forest - and our Oak woods represents this meeting grounds. The climate of Wisconsin now favors the forest climax but it barely does so. The Maple flora cannot invade the drier grasslands except through the previous suicidal invasion of the Oaks and thus, Oak forests are important in the transition from prairie to Maple climax forest.

Further Evidence of the Road This Forest is Taking

Some Oak stands show more prairie flora than ours, some less - the same is true also of the Maple flora present, but in reverse order. The Oak community is really a series of plant groupings along a continuous gradient with prairie

species most abundant at one end and Maple herb and shrub species at the other. Oak shrubs reach their peak nearer the prairie end, often acting as invaders of the prairie, while the Red Oak and Black Cherry tend to peak towards the Maple side (very few shrubs peak at Maple end). This plant gradient is really an expression of four gradients: in site (soil and exposure), in plant adaptations (light and moisture requirements), in plant influences (light penetration and moisture retention) and in time (plant succession which has resulted from previous gradients).

Relics or Invaders?

How can we tell that the prairie plants are relics and not invaders? If any are reproducing satisfactorily from seed they could be coming in rather than going out. This needs study, but in general the prairie plants show weak growth and lack of flowering and if even the adult plants are not doing well, the seedlings can have but little chance.

On the other hand, the Maple herbs listed above seem to be thriving. The complete absence of such characteristic Maple herbs as Baneberry, Bloodroot, Blue Cohosh, Dutchman's Breeches, Woods Phlox, Spring Beauty, Toothwort, Fawn Lily, and Trillium may be ascribed to the youth of this forest and its isolation from Maple woods.

Thus, the herbs have many stories to tell. The northern herbs lag behind climatic shifts to show ancient history, the prairie plants are evicted with difficulty by the Oaks to show more recent history and recent plant succession, and the Maple herbs tend to follow the invasion of the climax trees, but enough are appearing to indicate future trends.

The herbs tell us these things by their abundance, distribution, and vigor as well as their presence or absence. This is one way a "natural area" - lacking man's influence on the plants - has value. Our forest has much else to offer in its natural area. Its present dominant - the White Oak - is little affected by Oak wilt and should escape that ravage. The forest has suffered little from cutting, fire, grazing or erosion. It is an ideal place to become aware of and to study the push and pull of natural forces within a self-sufficient community.

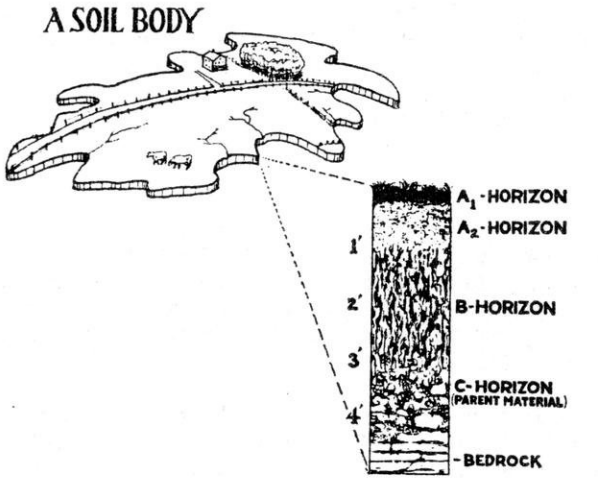


Figure 4

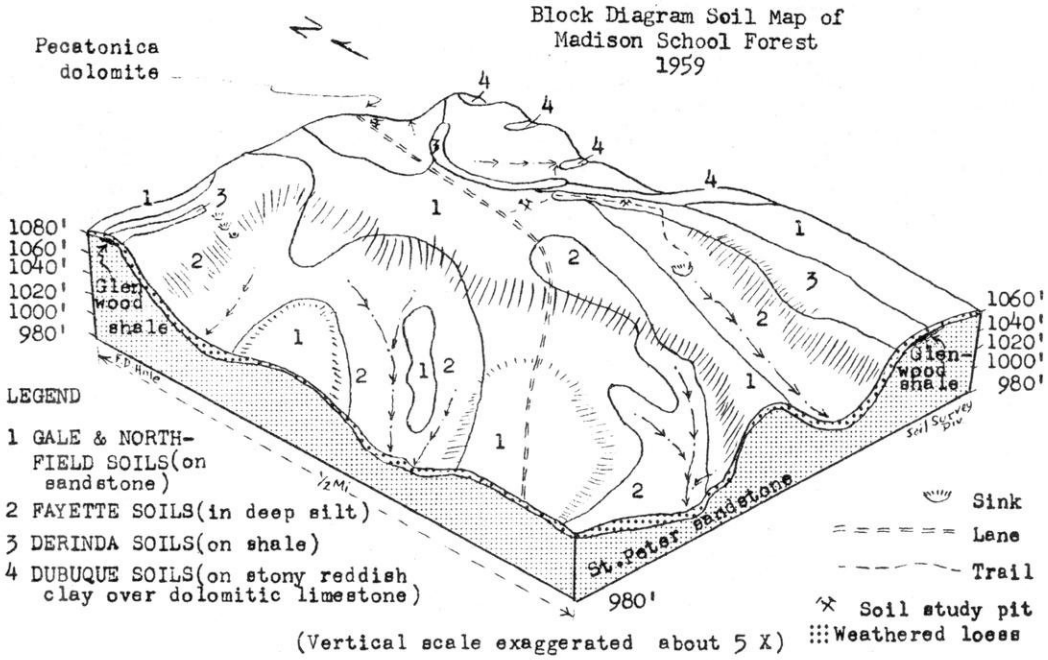


Figure 5

Chapter 5
SOILS OF THE SCHOOL FOREST

The accompanying sketch of "a soil body" and "a soil profile" shows what we are talking about when we use the word "soil". A lake is a body of water. A soil body is simply a body of soil. The shores of a lake are easy to see. The boundaries of a soil body are usually difficult to see, unless all cover has been removed. In a plowed field, dark colored and light colored soil bodies are distinctly visible, showing that the landscape is like a jig-saw puzzle of soil bodies fitted together. Some soil bodies are droughty, some are moist most of the year, some are acid, some are limey. It is a good idea to know about the soil bodies in a landscape in which you are interested.

Soil Profiles

But until you dig into it, a soil body is like an untapped watermelon: you don't know its quality. A plug out of a watermelon shows a green layer, a white layer, and a red layer with dark seeds in it. A soil plug three or four feet deep, taken with an auger or spade out of a soil body, may show a dark layer, then a pale layer, then a browner, stickier layer with some stones in it. This cross-section or plug of soil is called a "soil profile". It makes a lot of difference whether the subsoil is a buried layer of sand, or clay, or bedrock.

Soil Map

The soil map in Figure 5 is drawn as a block diagram, showing a view of the School Forest property as it might look from an airplane flying southwest of the Woods, and as it would look if the trees were transparent. This soil map shows the soil bodies and portions of soil bodies which lie in the property. It also shows the kinds of bedrock underlying the soils, and the approximate elevations above sea level.

An archaeologist who digs into the floor of a cave which was once inhabited by ancient peoples may find layer upon layer of soil and charcoal and pottery fragments. The lowest layers record what happened first in the cave, and the higher layers reflect later conditions. We can examine the layers in the hills in the School Forest and try to read the record there, not of people, but of the rocks and soils, which are very old indeed.

Gale and Northfield Soils, No. 1

Underlying the entire woods is the St. Peter Sandstone, which was laid down about 470 million years ago, according to geologists, in a shallow sea, which withdrew at intervals, allowing the sand to blow in dunes. The sand grains are frosted like dune sand; yet, the beds lie like sea bottom sands. This rock was named in 1847 after the St. Peter River, which is the old name of the Minnesota River, in Minnesota. Parts of this rock are hard, and where the hard sandstone lies as shallow as 6 to 24 inches below the surface, we find the Northfield soils. Parts of the St. Peter sandstone are soft, and where these parts lie within 1 to 3 feet of the surface, we find the Gale silt loam. Both Gale and Northfield soils are found in the soil bodies number "1" on the map. By using a soil auger, you can bore down and find the hard sandstone spots of

the Northfield soils, and the soft sandstone spots of the Gale soils.

Derinda Soils, No. 3

The soil bodies numbered "3" on the soil map are called "Derinda" soils. They are underlaid by a 468 million-year-old greenish sea mud, later compacted into a shale. There are some fossil shells in this shale which record sea life on the muddy bottom of the ancient ocean.

Dubuque Soils, No. 4

At the north-east part of the woods are several bodies of Dubuque soil, numbered "4" on the soil map. This soil is underlaid by a reddish-brown clay full of chert stones on top of a 466 million-year-old limestone laid down in clear, deeper ocean water. This limestone is the Pecatonica dolomite, which contains a variety of fossil shells of sea animals called "brachiopods". We believe that the stony reddish-brown clay is all that remains of a hundred feet or more of limestone which has dissolved away. Rain waters gradually washed away the soluble part of the limestone, leaving behind the old clay particles which were originally scattered throughout the limestone. When the limestone still to be found under the north-east part of the woods has dissolved away, a thin layer of reddish-brown, stony clay will be left behind, like an old skeleton of the former rock. Where the limestone and sandstone have collapsed, sink-holes have formed, which are like huge funnels in the ground. Black soil occurs in the bottoms of the sink holes.

The "Loess"

There is a sort of blanket or layer of flour-like material lying over most of the property. This is wind-blown silt, called by the German scientific term, "loess". This silt was laid down by winds during dust storms about 18,000 years ago, when glaciers lay in the northeastern part of Wisconsin. It varies in depth from about four feet, where the deep Fayette soils occur, to about 6 inches in some shallow Northfield soils. Sandstone outcrops have no "loess" silty covering at all.

Modification of the Soil by Plant Communities

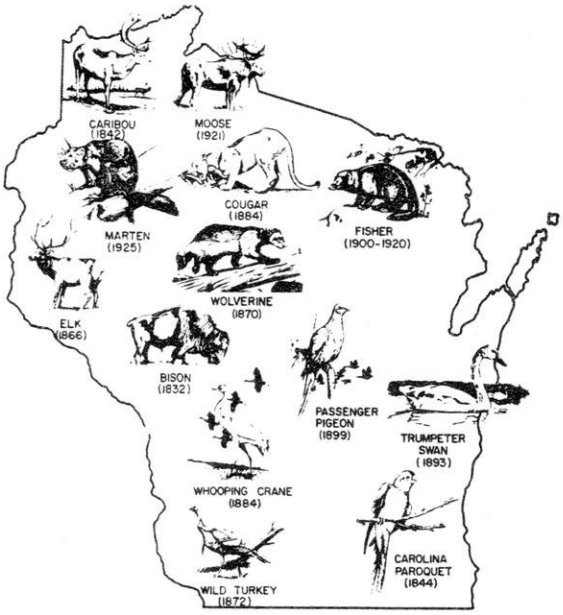
Although the kinds and character of plants in the School Forest show that prairie vegetation and forest vegetation have both flourished here, the soils for the most part are typical "forest soils". That means that the dark topsoil is thin, rather than thick and deep as in prairies. The thin dark topsoil was formed chiefly by the action of earth worms mixing leaves into the soil as the worms fed on the leaves. Below the dark topsoil is a pale brownish layer which has been bleached by rainwaters and organic acids from decaying leaves. Below that is the subsoil, which in the Fayette and Gale soils is a stronger yellowish brown, somewhat clayey layer. This dries out in the summer into blocky pieces like angular gravel. Through this "B" horizon tree roots penetrate to deeper layers.

Long History of These Soils

The glaciers apparently never reached the School Forest site. Therefore, this piece of land has been exposed to the elements, uninterruptedly, for thousands and possibly millions of years. Perhaps it has been above the ocean level for as long as 50 million years. But the soils which we see are not that old.

The silty upper parts of the soils are possibly 18,000 years old. They overlie rock materials which are nearly 10,000 times as old as that.

It is fortunate for the soils here that the forest is left to perpetuate itself. The soil is thereby protected from accelerated erosion. The leaf litter, which is thickest from autumn through spring, protects the soil from rain-drop impact and washing by storm waters. The roots of the trees and smaller plants bind the soil together. Except on the footpaths and ruts of the roads, the soil is for the most part soft and spongy, and can absorb large quantities of rain water and transmit it safely to the lower soil and rock layers. Some of this water, particularly in the early spring and late autumn, percolates deep and replenishes the ground water storage in the bedrock.



SOME VANISHED WISCONSIN BIRDS

AND MAMMALS

(and general location and date of last record in the state)

MAMMALS, BIRDS AND FISH INTRODUCED BY MAN

Exotics Introduced	When*	Where	Successfully Established?
Pheasant	1916	Waukesha Co.	Yes
Hungarian partridge	1908	Waukesha Co.	Yes
Chukar partridge	1936	Sheboygan Co.	No
Valley quail	1935	?	No
Capercaillie and black grouse	1949	Outer Island (Experimental)	No
San Juan rabbit	1954	Manitowoc Co.	?
Rocky Mt. elk	1917	Vilas Co.	Killed out
Carp	1884	?	Yes
Rainbow trout	1884	?	Yes
Brown trout	1886	?	Yes
Chinook salmon	1874	Lakes Mendota, Monona, Geneva	No
Coho salmon	1951	?	No
Atlantic salmon	1875	Elkhart, Cedar, Rock, and Devil's Lakes	No
Lake Atlantic salmon	1875	Lakes Mendota and Oconomowoc	No
Cutthroat trout	1942	?	No
American grayling	1906	Lake Nebagemon	No
Natives Re-introduced			
Wild turkey	late 1930's; 1954, 1956	Sauk Co., Juneau Co.	No; ?
Willow ptarmigan	1941	Wood Co.	No
Jackrabbit	1900	Waushara Co.	Yes
Marten	1953	Stockton Island	?
Fisher	1956	Nicolet Nat'l. Forest	?

* Many stocking attempts have been made with most species. Each date represents an early known record of an introduction.

Chapter 6
WILDLIFE - ITS PLACE IN THE COMMUNITY AND SOME GENERAL PRINCIPLES

Vegetative Basis of Animal Life

All animal life rests on the back of the plant community. Plants alone among living things are capable of combining the energy of the sun and the nutrients and the water of the earth to start the "food chains". It is from this point, this basic process called "photosynthesis", that all life branches out, or, one could say, from our vantage point "reaches back". Here is the beginning.

Food Chain Idea

The idea of the food chain is to trace the steps, the twists, the turns, by which the basic food needs of all life is met. There are short food chains - such as the corn-mouse chain which grows longer when we have the corn-mouse-fox chain or a corn-pheasant-man chain or perhaps a grass-grasshopper-pheasant-man chain and many more. Each chain as it is extended has other links branching into it but no matter how complex or how many steps are involved, the chain starts with some basic plant material.

The Importance of the Start

Thus, the plant community is the first step to be understood in dealing with animals and to seek abundance of animals without the needed plant community base is to finally face failure. All of our previous discussions about plants and plant succession is background information to the understanding of animal communities.

It cannot be overemphasized that the natural fertility of the soil, the rainfall and the temperature, the factors that produce vegetation also produce animals. One can raise some rabbits on a dry, hot, sand plain but not nearly so many or such healthy specimens. The plant, the animal, the man reflects the basic fertility of the soil and the appropriateness of the climate. Each in his own way reflects other things too but soil fertility and climate is always reflected.

Wildlife Lives on the "Left Ones"

It should as well be remembered that much of our wildlife land today is poor land. We cannot expect the great abundance and diversity of wildlife comparable to the days before the best land on the continent had been taken over for direct food production for man.

With some notable exceptions the wildlife manager faces the task of seeking to increase game on a shrinking acreage of the poorer land for an increasing horde of hunters. This task is no easy one but it is not to say it is impossible.

The Pyramid of Life

The notion of the "pyramid of life" is an elaboration of the food chain idea. Here we get glimpses of the other factors besides the food need of life. Animals as well as man do not "live by bread alone" - but sometimes the great importance of food supply causes one to play down or neglect the other factors.

GAME PYRAMID

WOLF-

GAME PYRAMID

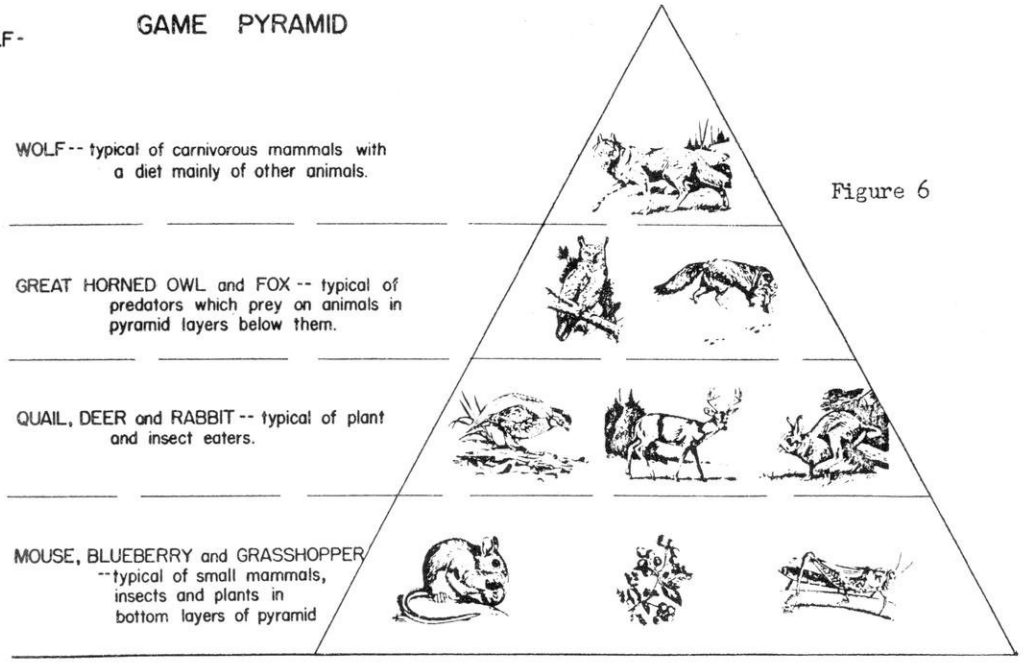


Figure 6

FISH PYRAMID

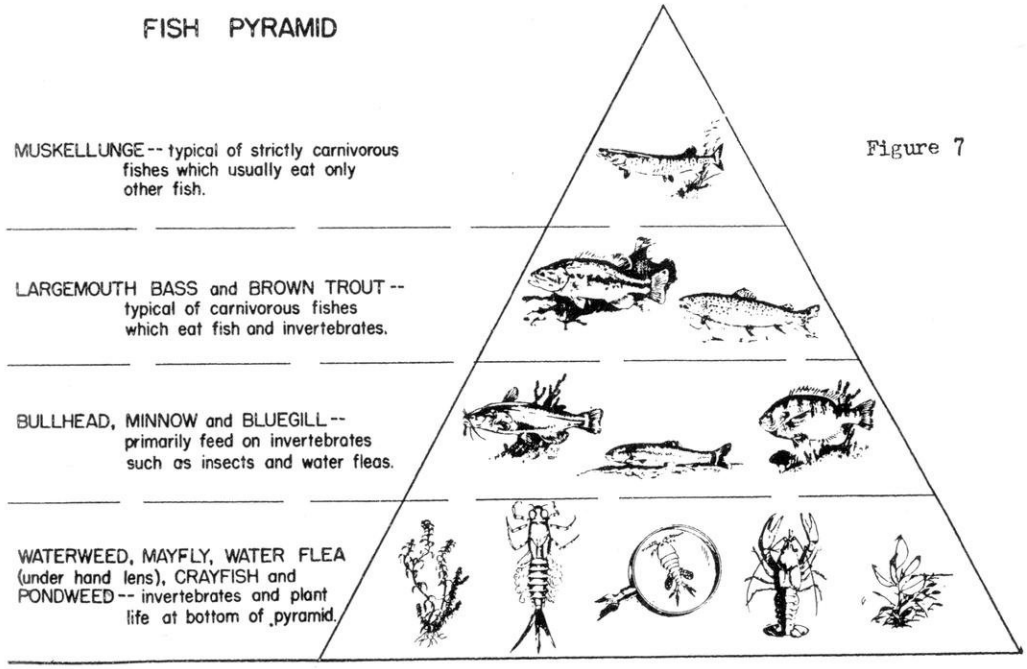


Figure 7

Figures 6 and 7 are diagrams of both the wildlife and the fish pyramids. To my mind the illustrations would be more accurate if the base of the pyramids were more broad, and the pyramid more squat, and the apex more greatly blunted. What I am arguing is that the bottom population is even greater in relationship to the top than is shown in the diagrams.

Man in the Pyramid

Primitive - very early man - occupied a middle position in the pyramid. Probably before his discovery of the use of fire and the invention of weapons his impact on the animal community could be likened to that of say the bears.

Today man is at once the master predator but also the manipulator of all parts of the pyramid. Man stands alongside the pyramid and sometimes forgets that he also stands upon it or at least within its shadow - and he forgets as well that he cannot yet live in the full sun as the only living thing on earth. The major lesson that man must learn is that he is part of the community of living things - that the life shadow of the pyramid is also his life shadow.

"The Way to Abundance"

The phrase "the way to abundance" is a favorite one. It seeks to point out what things must be done in order that we may maintain or increase our wildlife.

A great many things have been tried in the past - many of them of an artificial nature. Most of these things have not worked or have worked poorly. It probably can be safely said that a workable program must start with an understanding of the needs and requirements of animals and then attempt to meet these needs.

The above prescription seems simple enough. The problem has been that even today we do not really and completely understand these basic needs of wild life, or else understand them very poorly. Wildlife research - just plain hard study - is the most important first item on "the way to abundance". Our hope is that the patient doesn't die before the doctor diagnoses the disease, let alone finds a remedy.

Habitat Requirements

The needs of all animals fall into this statement - suitable places to feed, hide, rest, sleep, play and reproduce and that these various places must be within the cruising range of the species. Note that the s is doubly underlined. We are speaking of places not place. Ideal habitat then is really not a place but a mixture of places and it is as weak as any one of these places is weak or as strong as their total is strong. Too often habitat is thought of as "food and cover". This would be O.K. if we had a sufficiently big idea of cover. Cover as a mere hiding place is necessary but is not enough in itself - food, rest, sleep, play and breeding areas are needed also.

"Edge"

Another much used term which will help us in our understanding is the term "edge". Edge refers to the meeting place of several kinds of habitat - a spot where woods meets prairie, or marsh, or water, or all are intermixed - where instead of a single type of vegetation, several kinds occur; here we have conditions which meet many needs. Aldo Leopold, Wisconsin's great leader in wildlife research, used to point out that a city which had all of its kitchens

in one ward, all of its living rooms in another, all the bedrooms in a third, all the bathrooms in still another - such a city would not be efficient and few people in comparison could live there.

In actuality we have instead of the city Leopold described, single home units where all the needs are more or less met in one building. This is "edge" in the human sense - you can find your needs nearby within your "cruising range". Thus, "edge" meets the requirement of the several needs more closely, and the more "edgy" the edge, the better. A solid stand of anything, be it trees or grasses, is less desirable than a mixture, and, of course, there are mixtures and mixtures - but, basically, areas broken up into many vegetation types are most desirable because "edge" is where increased sunlight means more food as well as more bushy growth for cover.

"Cruising Radius"

The second part of our ideal habitat definition referred to the "cruising radius of the species". In simple language this means how far will the animal or bird normally travel to reach its needs. These distances vary greatly, but for the most part are much smaller than usually supposed.

A good example of limited cruising range is found with the cottontail rabbit. For the past two years this group has participated in Professor Bob Ellarson's rabbit census study. Here we have set up nets and driven rabbits to these nets. The rabbits are then ear-marked by tatooing so that they can later be recognized after being again captured or shot.

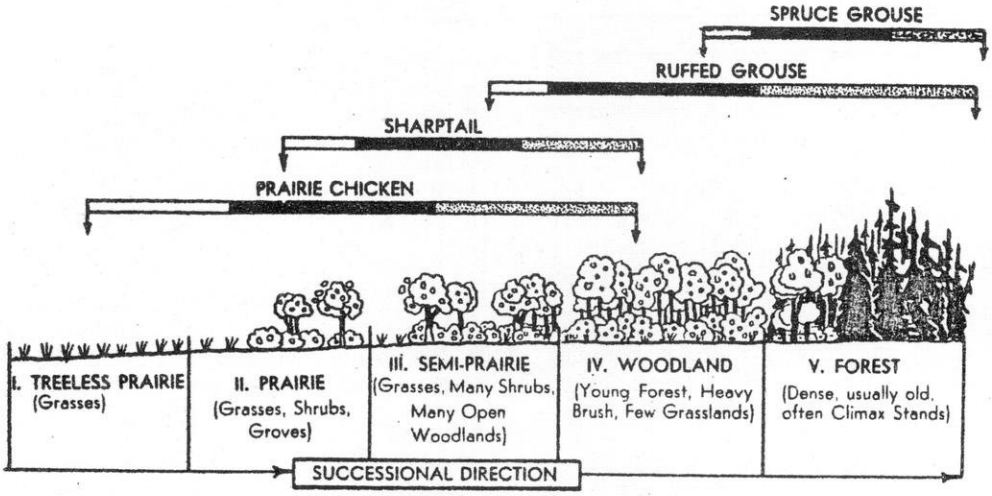
This study shows that the cruising range of rabbits is very small, only several hundred yards in a life time. Other studies on quail, on pheasants, on prairie chicken, on deer and other species, show surprisingly limited distances. Most wildlife are not great travelers and when forced to travel to meet their needs they tend to be reduced rapidly and greatly in numbers.

Migratory birds are another matter, but here again we cannot escape the need for suitable habitat scattered all along the migration route. We must have the Spring breeding and nesting grounds in the North and the Wintering grounds in the South, but we must also have suitable stopovers for resting and feeding on the way. All habitat requirements need be met - but in this case the cruising range is continental in size rather than a limited area.

There Are Habitats and Habitats and Living Things That Fit Them Galore

One of the amazing things about life is that there are species, both plant and animal, designed to fill most every niche there is. The kinds and forms of life upon the earth are a source of constant wonder. Here is a fruitfulness beyond belief. Animals with special adaptations to face the water shortage thrive in the desert, some plants and animals are able to stand the cold of the North, others fit into the easier life of the tropics. Every given foot of land will turn up a variety of life - insects, bacteria, etc.

Life is a great, tremendous, buzzing success on this planet. There is nearly no place without some living thing. Our problem, however, is not to extend life in general, but to favor certain kinds of life and to make them abundant.



ECOLOGICAL DISTRIBUTION of WISCONSIN GROUSE SHOWING HABITAT OVERLAP

HABITAT USED DURING YEAR

A B C

A. Lower Habitat Threshold
B. Optimum Habitat
C. Zone of Exclusion by Succession. Partial or complete.

Sketch by N. Barger.

Figure 8

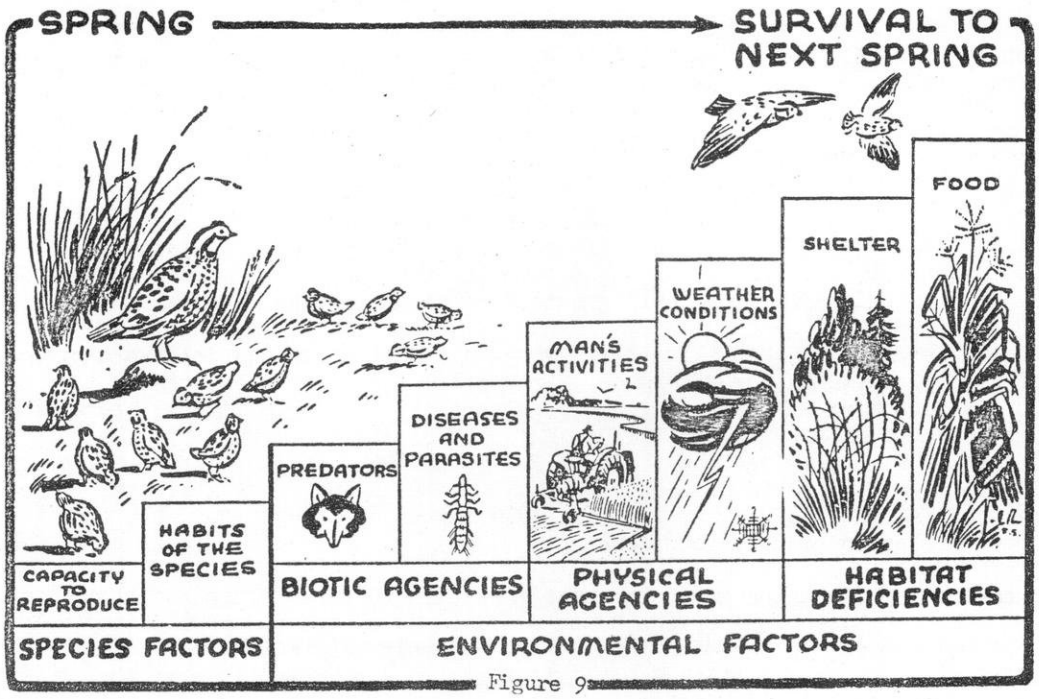


Figure 9

Grouse As An Example of Special Habitat Requirements

The four species of Wisconsin grouse illustrate well the dependence of some species on rather special habitats. There are four varieties or species of grouse in Wisconsin - the prairie chicken, the sharptail, the ruffed grouse (commonly called partridge), and the spruce grouse or "fool hen".

The illustration by Norval Barger, Figure 8 indicates very well the special needs of each species. The prairie chicken is a bird of the grasslands and when the forest succession invades the grassland the chicken will begin to disappear.

Sharptail overlap the chicken habitat. The sharptail will tolerate a little more woodland and brush, and frequently, after the grass has moved over into a very young forest, sharptails will still be found where a few years before prairie chicken was the principal bird.

As the forest grows bigger the ruffed grouse drums on a log in the region where once the prairie chicken boomed and later the sharptail did its hooting dance. Finally, in a mature forest stand all three early succession grouse are gone and the spruce hen has found its habitat niche.

Study the grouse chart carefully. When you have it well in mind you have learned a great deal. You will know, for example, that even though you might prefer prairie chicken to spruce grouse in your favorite area, attempting to force prairie chicken by stocking, etc. is plain folly. This is not to say you couldn't have prairie chicken - it is only to say that then you must return the habitat to the early succession stage before you will succeed. Otherwise you might as well stock squirrels in a lake and plant trout in an Oak-Hickory community. Wildlife will persist only when its requirements are met and if the requirements are narrow, then the problem gets more critical.

Some Historic Periods of Abundance

Within the white man's time in our state there have been periods of great abundance as well as periods of decline, scarcity and extinction. Wisconsin woodland caribou, our buffalo, our elk are gone. The passenger pigeon has vanished entirely from the earth - but some wildlife species are more common today or have had periods of their greatest abundance in the near past.

Again, the prairie chicken illustrates very well that abundance follows habitat improvement, accidental or otherwise. Originally the chicken existed in the South and Southwest Oak opening country - our section. Early farming increased the grassland habitat and with it the abundance of chicken. Probably the all time high in Wisconsin was about 1850. Following 1900, chicken declined with more intensive farming in the South but multiplied as lumbering and burning opened up the North. Probably the year 1912 saw the greatest abundance of prairie chicken in central counties.

With control of fires the North began to grow back to first brush and then trees. The good farm land of the South was used ever more and more intensively, and the chicken is now squeezed into a comparatively tiny 50,000 acres in the sand counties of the mid state. Here it exists as our presently most threatened species. Remember, heavy hunting did not reduce the chicken - disappearing grassland did the trick.

Similarly, deer originally most common in the South followed the loggers North but seemed during the period around 1918 to be seriously declining. Again, the cessation of fires and eruption of our brush forests favored deer and the year 1943 undoubtedly saw the greatest abundance of deer that this state ever witnessed in all history.

Deer are now somewhat reduced in numbers and unless some special change occurs in habitat, they will continue to decline. There is no danger that they will disappear from the Wisconsin scene - but the overall abundance of 1943 is an accident of habitat not likely to happen again.

The ruffed grouse, too, has made abundance gains. Probably (and again due to the growth of the new northern forest) ruffed grouse reached an all-time high in the period 1951-53. Ruffed grouse abundance will hold well and somewhat longer but the growth of the woods is a threat that cannot be denied. The point is that man's use and re-use of the land has had occasional very real advantages to wildlife as well as some very real disasters. It points to the basic fact that habitat - not stocking, not even special hunting seasons or predation - is the clue to abundance.

Wildlife an Annual Crop

It should also be remembered that wildlife like corn is nearly an annual crop. Leaving a field of corn unpicked in the fall in order that even more corn will be there the following year is obvious nonsense. Similarly most wildlife is on a year-to-year basis - "a one year plan".

Most wildlife makes spectacular increases each spring and, of course, the year's high for any species is at the time of the hatch or birth of the new "year class"- this year's young. From this time on there will be declining numbers with our winters sometimes taking a heavy toll. How heavy a toll all the "decimating factors" - killing influences - will have depends upon many things.

Figure 9 is an excellent chart by Durwood Allen showing factors which influence the survival of quail. Note that Professor Allen splits these factors between what he calls "Species factors" and "Environmental factors" and gives his guess as to the relative importance of these factors.

Species Factors in Survival

To begin with the "capacity to reproduce" or breeding potential is important. Quail which commonly carry off a clutch of 10-12 young have a considerable population increase each spring - they can stand more "decimating" than say a two-egged bird like the eagle or a fawn-and-one-half ratio like deer. Don't let this fool you, however. Even deer can increase tremendously given a chance, but obviously quail have a breeding advantage. Still another factor to be considered is the fact that the birds are ready for parenthood the next season. Hence, we have a high birth rate coupled with an early parenthood, and it is thus possible for a species to really erupt or increase fabulously if everything else is right.

A second set of species factors include such items as territorial or range tolerance. Some species establish definite territories and exclude all others of their own kind from it. Thus, a cock pheasant sets up his territory and fights off other cocks and collects a harem of hens. This territoriality limits the number of birds which might otherwise inhabit the range. Such

items as "flocking" in the fall, spring and fall "shuffles" where birds leave areas for no apparent reason but obviously seeking new range - these are other items in "species habits".

Still another species factor is the tendency of deer to "yard" in the winter. Here we have deer crowding in special areas - at best a Cedar swamp - in large numbers. Not only is food more limited but numbers in a small area are greatly increased. If deer scattered rather than "yarded" in winter, deer management would be easier.

Why do deer yard? The best explanation is deep snow. Here again we have a species habit that makes things difficult.

Environmental Factors in Survival

(A) Predators

First of all in the environmental group, but least in importance according to Allen, are predators. Predators are such a hot issue that we will make a special note of them later but notice at least one expert's opinion.

Make no mistake, predators kill game not just mice - just as automobiles kill skillfully dodging pedestrians not just old ladies in dark clothes and small kids chasing balls - but we are going to talk more about predators later.

(B) Disease and Parasites

All animals are parasitized and all of them at some time in their lives become ill, even as you and I. Allen rates disease and parasites as more important factors in decimation than predators and certainly sometimes disease reaches such epidemic proportions that the entire species seems in danger. Disease is usually most epidemic when populations are high. Hence, keeping a population below peak levels - "cropping" - may reduce disease.

(C) Man's Activities

We have already discussed man's use of the land as a decimating factor. We have, as well, pointed out that on some occasions man's use of the land has led to unprecedented if short-lived abundance. In any event man must use the land. Our problem is to use the land in such a way that wildlife is not unnecessarily harmed.

Of interest in our area in this respect is haying and grazing as these activities relate to the pheasant, our chief game bird. Many experts feel that the heavy Wisconsin activities in haying and grazing and the accompanying nesting disturbance is the main reason why Wisconsin never approaches the Dakotas as a pheasant factory. Others grant this as an important factor but point to hard winters as the more major factor.

(D) Weather

Here is another factor before which we are helpless, and which comes in for its share of both blame and misunderstanding. I think it is important in attempting to understand the role of weather that one remembers that average weather may be less important than occasional extreme weather. For example, a heavy rain at just the wrong time may destroy a pheasant hen's nest. If this is followed by another heavy rain at the time when the hen makes her

second attempt to nest we will probably lose that year's production. Those two rainfalls in an otherwise average and really nice spring and early summer have spelled brood disaster but might easily pass unnoticed to a casual observer. In checking weather records one might better note the extremes than the average.

(E) Shelter

Shelter is what most folks mean by cover and it is an important point. Shelter must be adequate for weather; it must also protect against predation. In this respect travel lanes connecting the various aspects of habitat are very important.

(F) Food

Ours is a hungry world. Food is the big and the number one factor, but once again food alone is not enough.

Given sufficient high quality food, most of our native game can make out in even scant cover during very severe weather. However, food must be constantly available. Loss of food for only a few days during extreme weather can mean serious losses. Food is the largest single limiting factor in Wisconsin winters.

There are first rate foods and starvation rations. Frequently what looks like first rate food to us is only poor food to animals. Animals have been found which have starved but with full stomachs. Things have been eaten but it really wasn't food.

Limiting Factors in Total

We have discussed, then, some of the factors which each year take the fabulous production of new wildlife and cut it steadily down until once again next spring comes the "time of the increase". Taken all together these limiting or decimating factors add up to the carrying capacity of the range. Once again it should be noted that a single factor can get so badly out of hand that the capacity is then limited. It is also possible that many factors each slightly below par can add up to a poor year. It should also be remembered that factors change from season to season and even from week to week. Thus, deer that live in a summer green garden of Eden often find themselves in a death house during the winter yarding period.

Study Professor Allen's chart well. There is much understanding here. It is a good outline from which to start your thinking.

"Cycles" - the Ultimate Mystery

As if all the variables already discussed were not enough, we come now to a factor in abundance so fascinating and so mysterious that no reasonable answer has yet been given.

It is well recognized (but somewhat disputed) that many of our wildlife species especially in the North and to a degree those on the limits of their best range pass through periods of scarcity and abundance in a regular up and down period of about 10 years. Species which exhibit cyclical behavior are grouse, rabbits, fox, lynx and perhaps Wisconsin pheasant and quail. It is a picture of

"boom and bust".

All kinds of reasons have been given for cycles including the one that the whole business is imagination. However, there seems to me to be enough solid evidence to accept the grouse, fox, rabbit, lynx cycle as a fact.

Disease is one of the factors that has been given as a cause but just why diseases should grow more deadly every 10 years no one has explained. Nor have we found evidence in the field of more diseased animals to coincide with the low.

Weather has been given as a cause but weathermen can find no 10-year pattern to weather.

Even sun spots have been used to explain the cycle and while the pattern fits reasonably well, no one has been able to trace any connection.

Whatever the cause, the wildlife of this continent appears to pulsate in abundance on this slightly more than 10-year period. A rule of thumb is 7 come 11. Each decade ending in 7 comes close to the low such as 1947, 1957. Each decade ending in 1 such as 1951, 1961 approximates the high.

Here then we have a completely unexplained and final mystery. Furthermore, it appears that we can do little about it. Improved habitat may keep the low from sinking beyond the limits of existence but it will not stop a very undesirable decline.

Well, Let's Get to Predators

A predator is an animal that lives on other animals called prey. Owls, eagles, foxes, wolves, coyotes, some snakes and a lot of others fall in this category.

According to many people this diet of flesh is bad especially if the flesh happens to be some game they would like for themselves. Often scarcity of sought after game is blamed on predators and then it is easy to declare war on foxes to apparently help pheasants. This warfare is carried to the extent of paying people to shoot, trap or in some manner kill foxes under a system called the "bounty".

Once again it must be said that there is no question that foxes and other predators kill some very desirable game and it would seem that in getting rid of them you are reducing one adverse factor which holds down game abundance.

But Bounties Don't Work

The proof of the pie, however, is in the eating, and the blunt fact is that the bounty system after more than half a century of trial has been found not to work. We have spent huge amounts of money and still have foxes.

It is possible that if we spent enough money (say $100 per fox) we would come close to pushing that little ten pound dog off the earth, but the question is: Would we really help the pheasants as much as it cost us, or indeed at all?

Predator - Prey Cycle, "A Way of Life"

Actually the predator - prey cycle is so deep a process that it is fundamental to all living things. It is a "way of life". Prey species uniformly have high birth rates and early parenthood - they have built in predator resistance- their very ability to multiply indicates that they are by nature intended to be very severely reduced by predation, and without it their populations can easily get out of hand. Predators are the natural check to prevent over-population of prey species. Thus, owls have been called "flying mouse traps" and fox and coyotes too assist in keeping mice in check.

Recently in Texas, a famous bounty state, coyotes have been protected and foxes have in some cases actually been stocked in an attempt to increase their numbers. It is increasingly (but a long way from universally), recognized that in the balance of nature developed over thousands of years there is a very real place for predators.

It is also increasingly recognized that the real villians are not the snarling killers, the bloody claw and fang, but the overnumerous rabbits and mice who destroy the vegetative base of the community - the overnumerous deer that eat themselves out of range. Durwood Allen puts it, "Beware of the gentle eyed nibblers, they are the ones that will destroy you."

More Boom and Bust

To look just a little closer at the problem we point out again that with no natural check the enormous productivity of prey species will create a problem. Overpopulation lends to the destruction of first the best foods, then second rate and finally a range where the vegetation is poverty stricken in relation to its ability to feed wild life.

Finally, then, overpopulation will crash of itself - perhaps through starvation. We also frequently find disease epidemics made easy by overcrowding. We find as well the surviving population of a less healthy type - under developed and at the period of the crash with declining birth rate and even exhibiting tendencies which we call "shock" in human beings.

Sometimes the recovery of the species will be rapid after the crash - but more often the range destruction that preceded the crash will only permit a much lower high when the new one does develop.

Therefore, unrelenting struggle between predator and prey is a healthy situation. The fox is really the best friend of the rabbit - not that particular rabbit that just furnished his dinner - but the rabbit race in general which is now in better shape because there are fewer of them.

Unrelenting and Indecisive Competition is the Highest Form of Cooperation

Total victory is the first step in defeat. Only when the struggle is such that neither side quite wins is the situation best. This is a law of nature - it may or may not also be a law of man.

Game Management - or What To Do About It?

In the past a number of methods have been tried with varying success to produce satisfactory quantities of game. An early method was the hunting season - the

limiting of human predation by controlling the time of year and length of time to hunt, controlling the bag limit and even in our day controlling the number of hunters. Another method has been "stocking" - raising animals under artificial conditions and then releasing them to supplement the "natural" game. Another method has been the creation of refuges. Still another has been the introduction of foreign birds and animals called "exotics".

Actually none of these have struck at the fundamental lesson of this manual which is that game will increase if it has the proper places to fee, hide, rest, play, sleep and breed within its cruising range. The refuge does, however, have some aspects of this idea provided it has some recognizable habitat values and isn't just an odd corner set aside for game because it appears to be otherwise useless.

Hunting Seasons

The sense of the hunting season is to so limit the kill so that suitable numbers will remain for next year's brood stock. In our day of efficient guns, easy transportation, much leisure time, seasons are certainly a necessity on our larger and most desirable game species. Seasons are also necessary on such game as waterfowl which tend to congregate and hence are more easily hunted at some times of the year. The modern hunter is so numerous and his weapons so efficient that even a remarkable number of extremely poor hunters can make a tremendous dent. Here is predation with a vengeance.

The hunting season is, nevertheless, a very loose method. No one can tell, for example, if a 15-day deer season will leave too many or too few deer in the woods. Hunting success which depends on many things (notably weather) is not predictable in advance and while this success may be related to the numbers of game before the season there is no guarantee that as a management tool it will do its job.

Nor is it accurate to blame overhunting for the great reductions that have occurred in some species. Much more frequently loss of habitat has been the reason. Buffalo alone probably stand as a species nearly wiped out by overhunting - but even if they had not fallen to the gun there is still no question that their range would have been reduced and hence their numbers.

Tailoring seasons to fit the situation - "controlled hunting" or "permit hunting" is the nastiest word in the modern sportsmen's vocabulary. None of us and particularly outdoorsmen like regulations, but we may face some. My hope is we do not talk ourselves into their necessity before they are really necessary.

"Stocking"

This looks like another good sensible direct approach. If there is not enough game - raise some and turn them loose. It should not be denied that this does increase game some. This increase is especially true during the time when the range is somewhat empty - the summer and fall - but permanent increase is under the unyielding control of carrying capacity. The biggest objection to stocking is that it is very expensive and unless we are willing to pay much more for our outdoor recreation we cannot depend on stocking as an answer.

Refuges

Here again we seem to have a good idea. If we close the area and protect the game we should then expect an increase which will overfill the area and spill out to cheaply stock the surrounding country. Again it sounds better than it works.

First of all the refuge to be of much value must be prime habitat and such areas are not easy to come by. Secondly, the overflow will not occur unless the surrounding area is also good habitat and seriously understocked. Game does not move out nearly as much as one might think. As a matter of fact, the tendency not to move is almost maddening sometimes.

Wildfowl refuges for migratory birds are an entirely different matter and a real necessity. Here we have short period of very large population which exposes them to heavy hunting. The birds just have to have a place to sit down and rest and feed in their flights of thousands of miles.

"Exotics"

Another often tried method has been introducing foreign birds and fishes. Sometimes this has been the result of wanting game similar to that in our ancestors' native lands and sometimes it is a matter of thinking that game successful on one continent ought to work well on ours. It is an application of a sort of the theory that "the grass is greener on the other side of the fence", and it overlooks the fact that all native species are especially well suited to our area because for thousands of years they persisted here.

For the most part exotics have not proven to be the answer, and on some occasion have turned out to be a real menace. Notable in the menace column are the rabbit in Australia, nutria now ruining our southern marshes and that most damnable fish, the carp.

In the success column we should be pleased to put the pheasant who is the best suited game bird for modern farming conditions, the Hungarian partridge that should really do better than he does, and the brown trout. These exotics are a real valuable addition to North American game and fishes.

On the whole, however, there are more minuses than pluses and future use of exotics is likely to be given a real careful eye.

Isn't There Anything That Works?

The rather dismal preceding pages recording more disappointment than enthusiasm with past methods might lead one to wonder if there is indeed any "way to abundance". Actually, what these pages say is that there are no short cuts and that to thinking conservationists the old free-wheeling days should be over.

The only way to abundance is the habitat road - all the other are temporary or disasterous, or too expensive or completely outside of the American outdoors tradition. Before we get too far on the habitat road, it might be best that we have a real understanding of that tricky word, habitat, as well. And that means research. Now habitat restoration takes time, and the research to really understand habitat will take still more time.

Photo by Wisconsin Conservation Department

Chapter 7
WILDLIFE OF THE FOREST - ITS BIRDS, MAMMALS, REPTILES AND AMPHIBIANS

A study was made of the Madison School Forest to determine how many species of birds might be encountered in this forest, its edge and the fields immediately bordering it. It is apparent that the area is an excellent place to expect a large variety of migrating, visiting and resident birds.

From observations made in nearby areas very similar to this area and from actual sight records in this area, it has been possible to compile a list of 167 species of birds that may use this wooded area and its field edge through the years. One cannot expect, of course, to find all of these species in one day or even in a year's time no matter how hard one tried, but it is safe to say that at least 100 species could be found in the course of a year with moderate effort.

The Bird Chart

A chart has been made to accompany this report and the list includes all the species that can be expected within this woods, along its edge and in or over the fields adjacent to this woods. Each species listed has a definite preference for one of these three habitat categories but most of the species will use the other two categories on many occasions. The "edge" habitat type is the one most often used by most of the species listed. Forest species can be found regularly on the edge of the woods and very commonly in or over the fields nearby. Forest edge species can be regularly found well into the center of the woods and commonly in the fields. However, many of the true field species will be found less commonly in the edge brush and quite rarely in the deeper parts of the forest.

Winter Species

Winter residents total about 17 species with another 27 species listed as winter visitors. It is difficult to establish these numbers with great accuracy due to the many factors governing bird movements. The resident winter species generally are those species which have little need to roam far to find all their requirements. These species are commonly the same ones that are residents during the summer months also. The visiting winter species are generally those species that wander farther, from woods to woods, or field to field and include many birds that visit Wisconsin only in the wintertime, such as Juncoes, Tree Sparrows, Rough-legged Hawks, Evening Grosbeaks, etc.

Summer Species

About 78 species can be expected as summer residents and nesters. Many of these are the same species listed as winter residents, but the majority of them are migrating species that are present only during the warm months. Most of them raise their broods here during the summer and as winter approaches, they and their young head south to more favorable climates.

It will be noted that the summer visitor column lists only a few species. The resident summer species could also be carried in this column because individuals of these species probably visit this area from other nearby areas. The species actually listed in this visitor column are those that are summer residents and

nesters in different habitats nearby and visit this area while hunting food for themselves and their young.

Migrants

The transient or migrating species total 134 on this list. These are the birds that are apt to come through the area during migrations in spring and fall. During March, April and May and again in August, September and October, these great bird movements take place. It is during these two periods that the greatest variety of bird life will be found in the Madison School Forest. Some individuals of many migrating species will find the School Forest and fields to their liking and will stay on as residents nesting during the summer, or just plain living during the winter.

When to Observe These Birds

It is during migration time that this area will be especially interesting and an attempt should be made by those interested to spend at least a half day in this area. Birds of all colors, sizes and habits will be seen by careful observers. Spring and fall migration months are the best times for classes to go to the Madison School Forest as the weather is more favorable for these outings.

During the rest of the year, fewer species will be present in the area but field trips will, nevertheless, be very interesting.

How to Observe the Birds

To observe birds at close range, one must travel slowly and very quietly through the area, looking and listening very intently. Early morning or late afternoon are the best times since birds are more active during these two periods. On windy days, birds concentrate in sheltered spots. When a bird is seen or heard, stealthy stalking will often bring you close enough to see its identifying characteristics. Binoculars are very helpful, but not essential. If the observer wears dark clothes, this will be of great help also in approaching the more timid and sharp-eyed birds.

When birds are flitting through the woods in large numbers, as they often do in spring and fall, it pays to pick a good brushy spot and stand still. Soon birds will be moving by right in front of you. If you will squeak with your lips, many small species will come very close to you in order to satisfy their curiosity.

If a large class goes to the forest, it will be a good idea to split into smaller groups to observe the birds. Two groups working slowly toward each other will often chase birds to within easy observation range between groups.

Learning the songs of most birds is quite easy and very interesting and with a little concentration, study and patience it will become very easy to locate many kinds of birds by just listening for them.

Equipment Needed

A good field book for identifying birds is essential. "A Field Guide to the Birds" by Roger Tory Peterson costs only $3.95 at most book stores and is excellent. A pocket-size notebook and a pencil are two handy items to have

along also to record the species seen and other notes. Binoculars are a great help if you have access to a pair.

Recommended Areas

The whole area is very good for observing birds and almost any spot will produce a number of species to observe, but the following locations are the best:

1. The area around the "sinkhole" and the slopes to the west of it. Here is much brush, there are large trees and there are relatively open areas, and birds are very common.

2. The area north of the "soil profiles". This would be the northeast quarter of the woods. This area has abundant brush and is, therefore, very good for attracting birds.

3. The whole eastern edge of the forest.

4. The fields to the east of the forest.

Recommended Spots for Observing

1. The slope just west of the "sinkhole" and the area just north and east of the "soil profiles" have Ruffed Grouse in them and "drumming" birds can be heard here in the spring. The "drumming logs" may be found by the careful stalker. (Male grouse make a drumming sound with their wings to attract females.)

2. The area immediately surrounding the "sinkhole" is an excellent place to observe Woodpeckers, Nuthatches, Blue Jays and Chickadees.

3. Just down the "big hill" on the "Wilderness Trail" south of the "sinkhole" sign there is an old Crow nest that might sometime be taken over by a Cooper's Hawk or another family of Crows. It's a large twig nest in the crotch of a tree.

4. There is an immense twig and branch nest of a Red-tailed Hawk in the northeast quarter of the woods only 60-70 yards from the eastern edge of the woods and in the lowest part of this section. You'll marvel at its size. It may be used for a number of years yet.

5. Any large tree with a medium to large cavity in it should be looked at closely for signs of owl use. Screech Owls, Barred Owls and Horned Owls nest in these types of tree cavities.

Importance of Birds

After observing the tremendous variety and outstanding beauty of the birds of this area, you will certainly agree that these animals are of high aesthetic value. That is, they are a source of great pleasure, they're to enjoy if you will, but take the time to become acquainted with them.

It is hoped that you will become acquainted with the pleasures of observing birds and that you will learn many things about them that you did not previously know.

Mammals of the Madison School Forest

While the Madison School Forest was being studied to determine what species of birds use this area, a study was also made to determine what mammal species could be found here. The same area was used; the forest, its edge and the fields immediately adjacent to the forest.

A chart was made for presentation of the mammal data and it is similar in lay-out to the chart made for the bird data. The list of mammal species is not so large as the bird list, but it is substantial and a careful observer may see any one of the listed species if he is very quiet and watchful.

Mammals are much more difficult to observe than are birds as they are very wary and most of them prefer to move about at night. They can best be seen in early morning or late afternoon. Mammals leave very characteristic evidence of their presence, or "sign" as it is called. Mammal sign is much more readily seen than bird sign, especially by the experienced observer. Tracks are the most common types of "sign" and these may be seen on the dusty or muddy parts of the hiking trails and the farm road along the eastern edge of the forest. In winter, track study on fresh snow is very interesting and a study such as this will indicate to you what species are present. You will be surprised at the numbers of different kinds of tracks you see even on a short hike on new snow. The abundance of the tracks will also prove to you that there are many mammals in the forest that are very active, yet you will have difficulty in seeing them regularly.

Places where animals have fed, rested or dug dens and burrows will be seen commonly if you look for these signs and by studying them and tracks, you can with a little imagination, practically picture the particular animal that made these "signs". To an experienced observer, animal "sign" seems to "come to life".

Mammal Chart

The chart indicates that 34 species of mammals may be expected to use the area at one time or another and that most of these species are residents. Some of the bat species are seen here only in summer, for some hibernate here and others migrate south. A few other species probably occur only as visitors at certain times. About one-third of the species listed here can be considered occasional to rare in this area and, therefore, they and their sign will be difficult to find on most trips to this woods.

The chart indicates many things that are known about each species and with the help of this information, it should be a bit easier to locate some of these mammals for observations.

On one hike two days after a fresh snow, the tracks and other evidence of 14 different kinds of mammals were seen.

Reptiles and Amphibians of the Madison School Forest

This area is not well suited to most species of reptiles and amphibians and just a few kinds will be encountered. Actually, there are relatively few species of these classes in the whole state of Wisconsin, since they are sub-tropical and tropical animals for the most part.

BIRD CHART OF THE SCHOOL FOREST

Symbols used in chart -
- C - common species
- U - uncommon species
- R - rare species
- N - possible nester, species usually nests in such habitats
- E - "edge" species found most often at junction of forest and fields, absence of "E" means species usually found within the forest.

SPECIES	Summer Resident	Summer Visitor	Transient in Spring and Fall	Winter Resident	Winter Visitor
1. Goshawk			R		R
2. Sharp-shinned Hawk	R,N	U	U		
3. Cooper's Hawk	R,N	U	U		R
4. Red-tailed Hawk	R,N	C,E	C,E		U,E
5. Red-shouldered Hawk		R,E	U,E		
6. Broad-winged Hawk			R		
7. Rough-legged Hawk			U,E		U,E
8. Marsh Hawk		U,E	C,E		R,E
9. Peregrine Falcon			R,E		
10. Pigeon Hawk			U,E		
11. Sparrow Hawk	R,N	C,E	C,E		R,E
12. Ruffed Grouse	U,N			U	
13. Ring-necked Pheasant	U,E,N			U,E	
14. Killdeer	U,E,N	U,E	C,E		
15. American Woodcock			R		
16. Upland Plover			R,E		
17. Herring Gull			R,E		
18. Ring-billed Gull			R,E		
19. Rock Dove		C,E			C,E
20. Mourning Dove	U,N	C,E	C,E		R,E
21. Yellow-billed Cuckoo	U,N		U		
22. Black-billed Cuckoo	U,N		U		
23. Screech Owl	R,N		R		
24. Great Horned Owl	R	R	(nests Feb.)R		R
25. Snowy Owl					R,E
26. Barred Owl	R,N	R	R		R
27. Long-eared Owl		R	R		
28. Short-eared Owl		R,E	R		R,E
29. Saw-whet Owl					R
30. Whip-poor-will	U,N		U,E		
31. Common Nighthawk	C,N		C,E		
32. Chimney Swift		C,E	C,E		
33. Ruby-throated Hummingbird	R,N	C	C		
34. Yellow-shafted Flicker	C,N		C		
35. Pileated Woodpecker		R			R
36. Red-bellied Woodpecker	U,N		R		
37. Red-headed Woodpecker	C,N		U		
38. Yellow-bellied Sapsucker	R,N		U		
39. Hairy Woodpecker	U,N		U		
40. Downy Woodpecker	U,N		U		
41. Eastern Kingbird	U,N,E		C,E		
42. Great Crested Flycatcher	R,N		U		

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SPECIES	Summer Resident	Summer Visitor	Transient in Spring and Fall	Winter Resident	Winter Visitor
43. Eastern Phoebe			U		
44. Traill's Flycatcher			R		
45. Least Flycatcher		U,N	C		
46. Eastern Wood Pewee		U,N	C		
47. Olive-sided Flycatcher			R		
48. Horned Lark		C,N,E	C,E		R,E
49. Tree Swallow		U,E	C,E		
50. Bank Swallow		R,E	U,E		
51. Rough-winged Swallow		R,E	U,E		
52. Barn Swallow		R,E	U,E		
53. Cliff Swallow			U,E		
54. Purple Martin		R,E	U,E		
55. Blue Jay		C,N		C	
56. Common Crow		C,N			C,E
57. Black-capped Chickadee		C,N		C	
58. Boreal Chickadee					R
59. Tufted Titmouse		U,N		U	
60. White-breasted Nuthatch		C,N		C	
61. Red-breasted Nuthatch					R
62. Brown Creeper		U,N	U		R
63. House Wren		U,N	U		
64. Winter Wren			U		
65. Carolina Wren			R		
66. Catbird		C,N	C		
67. Brown Thrasher		U,N	C		
68. Robin		C,N	C		
69. Wood Thrush		U,N	C		
70. Hermit Thrush			C		
71. Swainson's Thrush			C		
72. Gray-cheeked Thrush			C		
73. Veery		R,N	C		
74. Eastern Bluebird		U,N,E	C		
75. Blue-gray Gnatcatcher			U		
76. Golden-crowned Kinglet			U	U	U
77. Ruby-crowned Kinglet			C		
78. Bohemian Waxwing					R
79. Cedar Waxwing		R,N	C		U
80. Northern Shrike			R,E		R,E
81. Loggerhead Shrike		R,N,E	U,E	U,E	
82. Starling		C,N	C,E	U	C,E
83. White-eyed Vireo		R,N	U		
84. Yellow-throated Vireo		R,N	U		

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SPECIES	Summer Resident	Summer Visitor	Transient in Spring and Fall	Winter Resident	Winter Visitor
85. Solitary Vireo			U		
86. Red-eyed Vireo		C,N	C		
87. Philadelphia Vireo			U		
88. Warbling Vireo		U,N	C		
89. Black-and-white Warbler		R,N	C		
90. Prothonotary Warbler			R		
91. Golden-winged Warbler		R,N	C		
92. Blue-winged Warbler			U		
93. Brewster's Warbler (hybrid)			R		
94. Lawrence's Warbler (hybrid)			R		
95. Tennessee Warbler			C		
96. Orange-crowned Warbler			R		
97. Nashville Warbler		R,N	C		
98. Parula Warbler			U		
99. Yellow Warbler		R,N	C		
100. Magnolia Warbler			C		
101. Cape May Warbler			U		
102. Black-throated Blue Warbler			U		
103. Myrtle Warbler			C		
104. Black-throated Green Warbler			U		
105. Cerulean Warbler			U		
106. Blackburnian Warbler			U		
107. Chestnut-sided Warbler		R,N	C		
108. Bay-breasted Warbler			U		
109. Blackpoll Warbler			U		
110. Pine Warbler			R		
111. Palm Warbler			C		
112. Ovenbird		U,N	C		
113. Northern Waterthrush			R		
114. Louisiana Waterthrush			R		
115. Kentucky Warbler			R		
116. Connecticut Warbler			U		
117. Mourning Warbler			U		
118. Yellowthroat		R,N	U		
119. Yellow-breasted Chat			R		
120. Hooded Warbler			R		
121. Wilson's Warbler			U		
122. Canada Warbler			U		
123. American Redstart		U,N	C		
124. House Sparrow		U,N,E	C,E		U,E
125. Bobolink		C,N,E	C,E		
126. Eastern Meadowlark		C,N,E	C,E		R,E

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- N - possible nester, species usually nests in such habitats
- E - "edge" species found most often at junction of forest and fields, absence of "E" means species usually found within the forest.

SPECIES	Summer Resident	Summer Visitor	Transient in Spring and Fall	Winter Resident	Winter Visitor
127. Western Meadowlark	C,N,E		C,E		R,E
128. Redwinged Blackbird	R,N,E	C,E	C,E		
129. Orchard Oriole			R		
130. Baltimore Oriole	U,N		C		
131. Rusty Blackbird			U		
132. Brewer's Blackbird	U,N,E		C,E		
133. Common Grackle	U,N		C		R
134. Brown-headed Cowbird	U,N		C,E		
135. Scarlet Tanager	U,N		U		
136. Cardinal	U,N			U	
137. Rose-breasted Grosbeak	U,N		C		
138. Indigo Bunting	U,N,E		C,E		
139. Dickcissel	R,N,E		U		
140. Evening Grosbeak					U
141. Purple Finch			U		U
142. Pine Grosbeak					R
143. Common Redpoll					U,E
144. Pine Siskin					R
145. American Goldfinch	C,N		C		C
146. Red Crossbill					R
147. White-winged Crossbill					R
148. Rufous-sided Towhee	U,N		C		
149. Savannah Sparrow	U,N,E		C,E		
150. Grasshopper Sparrow	U,N,E		C,E		
151. Henslow's Sparrow	R,N,E		R,E		
152. Vesper Sparrow	U,N,E		U,E		
153. Lark Sparrow	R,N,E		R,E		
154. Slate-colored Junco			C,E		C,E
155. Tree Sparrow			C,E		C,E
156. Chipping Sparrow	U,N,E		C,E		
157. Clay-colored Sparrow			U,E		
158. Field Sparrow	U,N,E		C,E		
159. Harris' Sparrow			R,E		
160. White-crowned Sparrow			U,E		
161. White-throated Sparrow			C		
162. Fox Sparrow			C		
163. Lincoln's Sparrow			R		
164. Swamp Sparrow			R		
165. Song Sparrow	C,N,E		C,E		R,E
166. Lapland Longspur			U,E		U,E
167. Snow Bunting					R,E

Mammal Chart

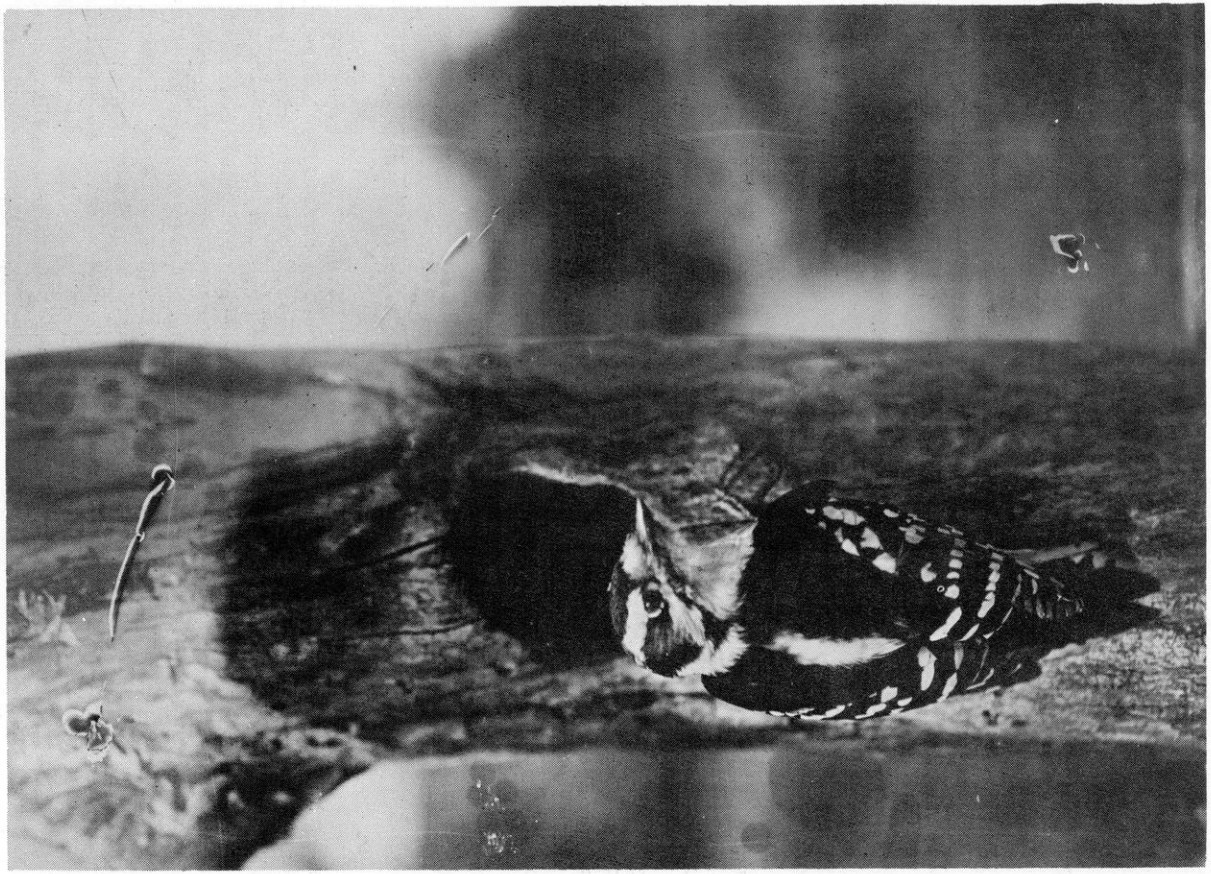
C- Common
U- Uncommon
R- Rare
W- Woods
E- Fields and woods "edge"

Species	Resident All Year	Visitor	Does it Hibernate?	Where Does it Hide	When is it Most Active
Opossum	C,W,E		Holes up in coldest weather	Brush and rock piles, dens in ground, hollow trees	Usually night, often day
Eastern Mole	C,E,W		No	Ground tunnels	Day or night
Masked Shrew	C,E,W		No	Underground, surface debris	Day or night
Short-tailed Shrew	C,E,W		No	" " "	" " "
Little Brown Bat	C,E,W	C(summer)	Yes. Some migrate	Hollow trees, under bark	Twilight and dark
Keen's Bat	R,E,W	R(summer) E,W	" " "	" " " "	" " "
Silver-haired Bat		R(summer)	No. All migrate	" " " "	" " "
Big Brown Bat	C,E,W	C(summer) U,E,W	Yes. Some migrate	" " " "	" " "
Red Bat		(summer) R,E,W	No. All migrate	Hangs in tree	" " "
Hoary Bat		(summer)	" " "	" " "	" " "
Eastern Pipistrelle (bat)	R,E,W	R(summer)	Yes. Some migrate	Hollow trees, under bark	" " "
Raccoon	U,W,E		Holes up in coldest weather	Hollow trees, big squirrel nests (leafy)	Usually night, often day
Short-tailed Weasel	R,W,E		No	Under debris, rock piles and hollow logs	" " " "
Long-tailed Weasel	R,W,E		No	" " " " "	" " " "
Least Weasel	R,E		No	Under debris, mole tunnels	" " " "
Striped Skunk	C,E,W		Holes up in coldest weather	Ground dens, rock piles, hollow logs	" " " "

Mammal Chart

C- Common
U- Uncommon
R- Rare
W- Woods
E- Fields and woods "edge"

Species	Resident All Year	Visitor	Does it Hibernate?	Where Does it Hide	When is it Most Active
Badger	R,E		Holes up in coldest weather	Ground burrows	Usually night, often day
Red Fox	C,E,W		No	Ground dens, brush piles	" " " "
Gray Fox		U,E,W	No	Rock crevices,hollow logs occasional ground den	" " " "
Woodchuck	U,W,E		Yes	Rock piles,ground burrows	Daytime
Striped Ground Squirrel	C,E		Yes	Ground burrows	"
Eastern Chipmunk	C,W		Yes	Hollow logs,ground burrows	"
Gray Squirrel	C,W		No	Hollow trees, leafy nests	"
Fox Squirrel	C,W		No	" " " "	"
Flying Squirrel	U,W		No	" " " "	Nighttime
Deer Mouse	C,W,E		No	Corn shocks, grass and hay piles,hollow logs,ground burrows, under debris	Usually night, often day
White-footed Mouse	C,W		No	Brush piles, hollow logs, squirrel nests	" " " "
Meadow Vole	C,E		No	Grassy nests, tunnels in grass, ground burrows	Night and day
Prairie Vole	R,E		No	" " " "	" " "
Harvest Mouse	U,E		No	Grassy nests	" " "
House Mouse	R,E		No	Corn shocks,grass & hay piles, buildings	Usually night, often day
Meadow Jumping Mouse	R,E		Yes	Ground burrows,grassy areas	" " " "
Cottontail	C,E,W		No	Ground burrows,brush piles hollow logs	" " " "
White-tailed Deer	U,E,W	C,E,W	No	Brushiest areas	" " " "



Chapter 8
INSECTS OF THE FOREST

Among the biotic agents that influence trees and all plants, directly or indirectly, are the insects. These small, six-legged creatures are associated with all types of trees and plants at all stages of their growth. They may literally overwhelm the tree by force of numbers or their numbers may be so low that they may simply remove enough food to cause the tree to stagnate. By selecting particular parts, such as the leaders of the trees, they may deform them severely. Or, they may be beneficial by feeding on injurious fungi, by serving as pollinators, by helping to break up the debris on the forest floor, or by destroying dying or dead lower limbs help the tree to prune itself.

Whenever a given tree type increases, its insect enemies also increase in numbers and eventually reduce the abundance of that tree type. Insects destroyed the overmature and sickly trees. They removed competition in dense stands. Insects thus serve as regulators of the forest.

Insects and the Forest Succession

To understand the insect problems in Wisconsin forests it is necessary to examine briefly the recent history of our forests and their present condition. However, to interpret this properly, one must know a little about the successions which occur in plants under normal conditions. By ecological succession of plants is meant the orderly replacement of forms until a stable type of vegetation is reached. This succession does not occur by chance; it terminates in what is known as a climax type. The climax is the same whether the succession starts in water or on bare ground. In each case the habitat is first invaded by species of plants that can withstand rather rigorous growing conditions. These plants are called pioneers. Each plant changes its environment somewhat and in so doing creates conditions that are favorable for another type of plant. The next or ensuing type may then enter, become abundant, and may literally shade out the first type. This process is repeated until the climax, which is capable of continued self-perpetuation, is reached. By the very nature of their requirements then, all plants are doomed to pass out of the picture and will be replaced in the normal course of events until the climax is reached.

Turning now to our present problem of the serious insect damage to the forest, a few general points of importance should be emphasized. In most areas of Wisconsin, forestry has been set back many generations by the logging and burning practices of the past. Our virgin forests, relatively resistant to insect attack, no longer exist. Pioneer trees sprang up to start the succession over, in many cases forming solid stands. They appear in large stands which are often nearly pure and even aged. This has left the State with a great preponderance of young stock and with the mature timber nearly gone. The succession had been disrupted by man.

Pure stands (fire types) of forest are subjected to much insect injury. Perhaps this might be thought of in a little different manner. The pioneer (and later) species are destined by nature for removal and replacement. Consequently nature has developed means of removing them as the succession proceeds. Insects play quite an important role in this removal process. Therefore, in general, the more pioneer the stand the more abundant and more successful are its insect

enemies. This is true except where stands reach maturity, when the insect pressure always becomes intense.

A Little About Insects Themselves

Insects belong to a great group in the animal kingdom, the Insecta, characterized by having jointed appendages and an outside skeleton. This group also includes the crayfish, spiders and other similar creatures. The Insecta may be recognized by the presence of six legs, by having the body divided into head, thorax and abdomen, and by usually having two pairs of wings. They fall into two great groups as far as their development (metamorphosis) is concerned. In the first of these, the newly hatched insect looks like a minature of the adult. In this case the young one is called a nymph. Through growing and shedding its outside skeleton a number of times, it gradually comes to look more and more like the adult. The wings appear as pads and grow successively larger. At the last molt the final adult form is assumed. The grasshopper illustrates this type of development, the stages in the life cycle being: egg-nymph-adult.

In the other group, the tiny animal hatches from the egg in a form which does not resemble the adult at all. It is worm-like and is commonly known as a caterpillar, grub or maggot. This stage is called the larva. The larva grows and molts a number of times, keeping its same general form. Then it undergoes a resting stage during which the animal is reorganized. This resting stage is called the pupa and the process of changing from a larva to a pupa is known as pupation. Often the pupa may be found in a cocoon made of silk threads spun by the larva to form a place where the delicate pupa will be protected. After the transformation is completed, the adult emerges. The butterfly, beetle and fly illustrate this type of development, the stages in the life cycle being: egg-larva-pupa-adult.

Numbers of Insects in an Epedemic

As one begins to examine the insect life in his locality, he soon comes to realize that there are tremendous numbers of insects, both in actual individuals and in kinds, and that they occur in all sorts of places within the area. While insignificant as individuals, en masse they play a great role in any environment. For instance, during an outbreak of the pine tortoise scale in northern Wisconsin the area was sprayed and as many as one hundred seventy five crawlers per square inch dropped on glass plates placed on the ground. Each crawler, which had just hatched from the egg, was very small, being only about as long as the shank of an ordinary straight pin is thick. However, using the one hundred seventy five per square inch as a basis (and this is probably very much on the low side) there were 1,097,712,000 insects per acre. While one of the insects can suck only a small amount of sap from a tree, when taken together they were capable of killing the trees quite rapidly. Assuming 1,000 trees per acre, each tree was subject to attack by over a million of the tiny creatures. A man who had to try to support over a million lice would certainly be in a bad way - and so is a tree when such conditions occur.

Species of Insects

Not only may there be tremendous numbers of one kind of insect but there are also over 1,500,000 species of insects known. They differ from each other as much as rabbits, dogs, birds and elephants differ. In fact, they differ even more in their body shapes. So the job of recognizing them and naming them

accurately is a difficult one. This task becomes especially complicated when the various appearances in the different life stages are considered. Of course, each kind must have its own name so that there can be no confusion about the thing being written or talked about. Hence, the scientific name - which often seems long, unpronounceable and awkward because of unfamiliarity with it.

Food Habits of Insects

Insects select their food carefully; they are also very fussy about the portion of a tree they will attack at all. Some feed on the growing tips, others on the bark, others bore into the wood or feed only in the cambium. Some select the nuts or cones and still others attack the root system. They also are choosy about the kind of tree they attack, and often they will attack only a particular kind of tree when it is in a particular condition. For example, most bark beetles are able to recognize and select weakened or stagnating trees. Some insects, however, prefer vigorous trees. What is really happening is that the insect selects the location and conditions where it can live successfully and where the young can find the food to grow to maturity.

How Insects Damage Forest Trees

Periodically, widespread stripping of the forest by insects and spectacular killing of trees occurs during severe epidemics. These outbreaks are obvious to all, but the more insidious assault resulting in reduction in growth, and stunting is less noticeable but equally important. From the time the seed is formed to even after the young tree has grown to maturity and has been manufactured into a marketable product, the onset of insects is unrelenting. Scarcely a tree can be found in the woods that has not been fed upon by some insect. It is when this attack threatens to become serious that emergency control action is required. Obviously, it is better to prevent insect attack rather than to try to remedy it after it occurs.

Direct and Indirect Damage by Insects

Insects attack and injure trees in many ways. They may directly threaten the life of the tree or destroy the usefulness of its products. They may cause reduction in growth or distort the trees. Such losses are called direct losses. From another standpoint, the attack may produce secondary effects, not killing the trees outright but rendering them more susceptible to attack by other insects or by disease, or resulting in lowering the value of the products derived from the tree. Also included among these indirect losses due to insect attack is the disruption of sustained forestry management practices. Indirect damage may also occur through the change which insects may cause by their regulation of cover types.

Insects as Carriers of Disease

In addition to directly attacking and killing forest trees, and injuring them through causing growth reduction, stunting and lowering of their quality, insects play a very important role as carriers of disseminators of tree diseases. They may merely carry the disease causing organism with them and accidently introduce it into tree wounds made by some other agent - frost cracks, wind breakage or logging damage. Or the insect may transmit the disease when it becomes contaminated and then bores into the bark or wood of healthy trees, or it may introduce decay organisms into recently cut logs. In some instances the insect attack alone is relatively insignificant - the wound

it causes becomes infected and disease then follows. In a few cases, the insect is dependent upon a disease causing fungus for food and the fungus is dependent upon the insect for its spread. Here the combination may result in the death of trees or destruction of their products. As carrier of diseases of trees, insects play a very dangerous role. For instance, long distance transmission of Oak wilt may occur when an insect which feeds on the mat produced by the fungus is attracted by a fresh wound in a tree. The Dutch Elm disease is also spread by insects.

From the brief discussion of types of damage it is clear that there are two main types of insects as far as feeding habits are concerned - sucking and chewing forms. The sucking forms always have a beak which may be extremely slender. These insects pierce the tissues of the plant and withdraw plant sap. In general, insects which feed with sucking mouthparts include mosquitoes, stink bugs, plant lice, scales, leafhoppers, spittlebugs, and spider mites. The beak may be seen projecting downward from the lower part of the head.

The defoliators (needle miners, sawflies, beetles, caterpillars, grubs, bark beetles, wood borers and stem and shoot feeders) all possess chewing mouthparts. This type of mouthpart, as found in the grasshoppers and caterpillars, may project downward or forward depending upon the species of insect concerned.

How Forest Insects May Be Controlled

The control of insects attacking forest trees must be approached intelligently and with care. The overall purpose must be clearly recognized, the likelihood of long lasting success must be understood, and the financial aspects of the undertaking appreciated. Insect control work in the forest is costly, and if improperly conducted, it may make conditions far worse than existed previously. In fact, unless great care is taken, other insects may increase and cause more damage than the one at which the control program is directed.

It must be recognized that with few exceptions most of the insects damaging forest trees in Wisconsin are native insects. They have been here for years - even centuries - they have not swept into the state from outside - they have always been with us. True, a few pests have been introduced from Europe and Asia, and have caused severe destruction, but on the whole, these new denizens are in the minority. In the case of native insects or well established foreign pests, it is virtually impossible to eradicate them completely.

And a Final Word of Caution

In the average year, most species of insects cause little damage in the forest. Their numbers are low and it may be even difficult to find them. Periodically, however, populations of a particular species may increase tremendously and then serious injury may occur. This condition may continue for several years before the pest again become scarce. The outbreaks may occur at intervals of several decades or as frequently as every few seasons. Some insects may be present in numbers sufficient to cause damage almost continually. It is during epidemics or threatening epidemics that control work is necessary.

A Few Insects to Watch For, and See What They Eat and Who Eats Them

Springtails -- Tiny jumpers on damp litter or water - spring, fall.

Damsel and Dragon Flies -- On shrubs or hovering in search of prey - openings, summer and fall.

Grasshoppers -- Small brown ones, litter, spring; others later - each with different song.

Long-horned Grasshoppers or Katydids -- Sing in shrubs and treetops in late summer, fall; many nocturnal.

Crickets -- Black or brown, on ground, some sing, some fly.

Tree Crickets -- Green, in shrubs, sing summer, fall, at night.

Walking Sticks -- Sometimes a forest pest, usually just a curiosity, summer and fall.

Cicadas -- Large, noisy, sing in treetops summer, fall (4 kinds).

Spittle-bugs -- On shrub or herb stems surrounded in white frothy mass, summer.

Tree-hoppers -- On various plants, often look like thorns but will move.

Leaf-hoppers -- Smaller, various, jump; a few are found in very cold weather on leaf litter; rest, on green plants.

Plant Lice or Aphids -- Tiny, numerous, on leaves and stems; tended by ants; treetop species cover ground plants with honeydew; flying forms fill air in late fall.

Scale Insects -- Still smaller, hidden under waxy shields on stems.

Mealy Bugs -- Like plant lice but cottony; some jump.

Bugs -- Differ from beetles in having outer wings half translucent and overlapping. Stink bugs and many others.

Lace Bugs -- Tiny, exquisite forest insects on leaves.

Ambush Bugs -- Hide in flowers, often colored like them, late summer.

Lacewings -- Aphid-eaters which fly slowly on gauzy wings; some have unpleasant odor and golden eyes; spring, summer, fall.

Ant-lions or Doodle Bugs -- Larvae trap ants in pits in sand; adults resemble Damsel Flies

Butterflies -- Club-tipped antennae distinguish them from Moths; some kinds occur only in forests.

Moths -- Very many kinds, often nocturnal; larvae include loopers or measuring worms which occasionally defoliate trees and force them to leaf out twice in one year: leaf-rollers and many others occur too. The 4 giant silkworm moths are canopy eaters but rare.

Gnats or Blackflies - Get in one's eyes in hot weather.

Midges -- Mosquito-like; mating flight in evening makes audible hum.

Mosquitoes -- The damper the forest, the more there are.

Crane Flies -- Overgrown mosquitoes with long legs - harmless.

Blue and Green Flies -- Useful to locate animal droppings.

Deer Flies -- Beautiful eyes, fast silent wings, stinging bite; humid hot weather.

Snout Beetles or Weevils -- Well named; common forest insects.

Ground Beetles -- Black or Brown, in leafmold, active.

Rove Beetles -- Wings don't reach tail, which may turn up as if to sting you: strangely, they can fly.

Lady Beetles -- Aphid-eaters; some found at all seasons.

Click Beetles -- Long, heavy, snap when caught; the larvae are wireworms in leafmold.

June "Bugs" -- Conspicuous nocturnal fliers May-June; fat grubs common in leafmold.

Fireflies -- Each kind has different time of emergence and different code of flashing signal. Some glow but don't fly.

Long-Horned Beetles -- Many kinds; often large; larvae eat dead wood.

Engraver Beetles -- Strip the bark from dead Elm wood to see the radiating galleries made by the grubs: Adults tiny, brown, carry Dutch Elm Disease fungus.

Ants -- Important forest dwellers, often nesting in trees; help distribute the heavy seeds of forest herbs; tend aphid colonies and carry them to fresh pastures.

Bees -- Many are solitary like the leaf-cutters, or few like the bumblebee; but we have at least one honeybee tree in the forest.

Wasps -- Solitary ones carry anesthetized caterpillars or spiders to egg chamber; paper-wasps and other colonial species are common tree dwellers.

Ichneumon Wasps -- Parasitize other insects; some have spectacular ovipositor for piercing dead wood.

Gall Wasps (and flies)-- Tiny, rarely seen as adults; but the swellings and growths caused by larvae in plants are everywhere (100 kinds in Oaks alone).

Spiders -- From litter to treetops, and including leaf-rollers and many other kinds. Jumping spiders make no net.

Centipedes and Millipedes -- In leafmold and rotting wood.

Sowbugs -- Damp places - under stones, rotting wood.

Snails -- Land snails are frequent but small. Slugs, lacking shells, are common in litter; eat green plants.

Worms -- Note their castings and accumulations of leaf litter.

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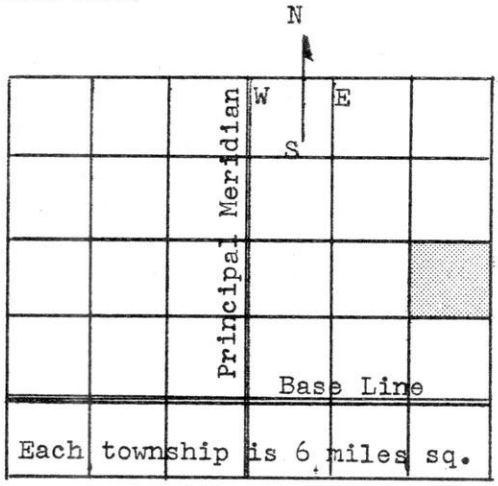
Worms -- Note their castings and accumulations of leaf litter.

The starting point of the survey is a principal meridian running north and south, and a base line running east and west. Descriptions in Wisconsin are based on the 4th Principal Meridian which runs north and south between Grant and Iowa counties and extends the full length of the state. (Parts of Minnesota and Illinois are surveyed from the same meridian). The base line is the southern boundary of Wisconsin.

Measuring from the principal meridian and the base line, square townships - 6 miles on each side - are laid off in a checkerboard pattern. Each "survey" township is identified by its location relative to the meridian and the base line.



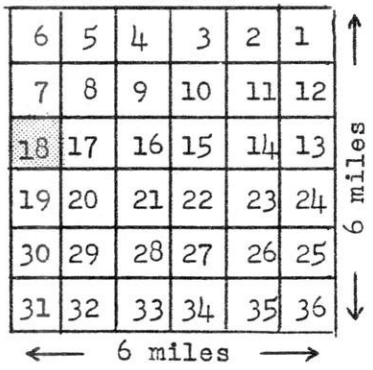
The shaded township in this diagram would be described as:

"Township 2 North, Range 3 East".

It is in the second tier of townships north of the baseline, and in the third range east of the principal meridian.

In Wisconsin, all townships are north of the base line. Darlington (in Lafayette County) is in "T 2 N, R 3 E", and Hurley (in Iron County) is in "T 46 N, R 2 E". Wisconsin townships may be either east or west of the principal meridian. The city of LaCrosse is partly in "T 15 N, R 7 W", and Sheboygan is in "T 15 N, R 25 E". Note that La Crosse and Sheboygan are about 32 townships apart, measuring east and west.

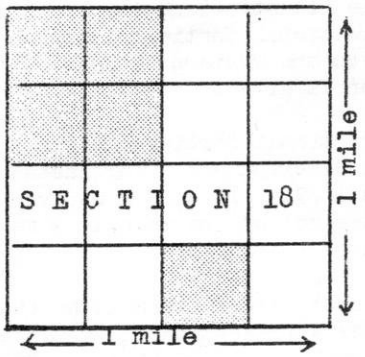
Each full-sized survey township is a square, 6 miles on each side, and includes 36 square miles. Each section (square mile) is identified by a number. Section 1 is in the northeastern corner of the township, and the numbers run to the left and then double back and forth, ending with section 36 in the southeastern corner.



The shaded section in this survey township would be described as "Section 18"

Since there is a section 18 in every township, you would have to know the township and range numbers and directions to locate a particular section 18.

Each full-sized section is a square mile, including 640 acres. Each section is divided into quarter-sections of 160 acres each, and each quarter-section is further divided into "forties" of 40 acres each.



The larger of the two shaded areas is a 160-acre tract described as "Northwest quarter of Section 18"(or NW$\frac{1}{4}$, Sec. 18")

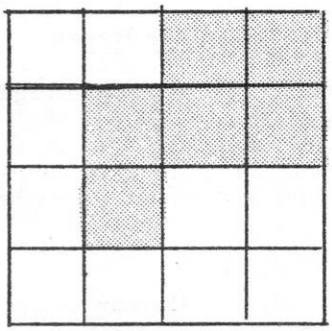
The smaller tract (of 40 acres) would be described as "the southwest quarter of the southeast quarter of Section 18", often abbreviated as "SW SE, Sec. 18".

A farm description would include the appropriate combination of quarter-sections and forties, plus the section number and the township identification.

The shaded area would be described as:

"NE$\frac{1}{4}$ and SE NW and NE SW, Section 18, T 2 N, R 3 E, 4th Prin. Meridian"

(If there were such a farm, it would be located a few miles southwest of Darlington in LaFayette County, and would consist of approximately 240 acres.)



Section 18

Because of the curvature of the earth's surface, townships cannot be exactly square and seldom include exactly 640 acres. The fractional descriptions are usually laid out on the northern and western borders of the township, where "forties" may be substantially larger or smaller than 40 acres.

The boundaries of lakes and streams are often specially surveyed or ("meandered"), and the odd-sized remnants are laid out in "lots", as in the following illustration.

Information about sizes and shapes of odd parcels can be obtained from the County Register of Deeds, and is sometimes given on detailed plat maps or the plat books that may be obtained at county offices.

In this illustration, the exact acreages of "fractional forties" along the northern and western borders of this section is given.

The fractional forties are given their normal descriptions, (for instance, NE NW, Sec. 29, T 12 N, R 4 W) even though they are not of the regular size or shape.

The "lots" are referred to by number, together with section, township and range numbers. (For example, "Govt. Lot 2, Sec. 29, T 12 N, R 4 W").

"Lots" of this kind are usually designated as "Government lots" to avoid confusion with the sub-dividers' lots laid out in cities and resort areas. For information on sub-divisions, city or county records must be consulted.

Legal Description of Our Forest

Our 160-acre tract is shown in Figure 3. It is described as the east $\frac{1}{2}$ of the southeast $\frac{1}{4}$ of section 31 and the west $\frac{1}{2}$ of the southwest $\frac{1}{4}$ of section 32 of the town of Verona. The town of Verona is described as township 6 north, range 8 east. This, then, is where we are. The village of Verona in sections 15 and 22 gives you some idea roadwise.

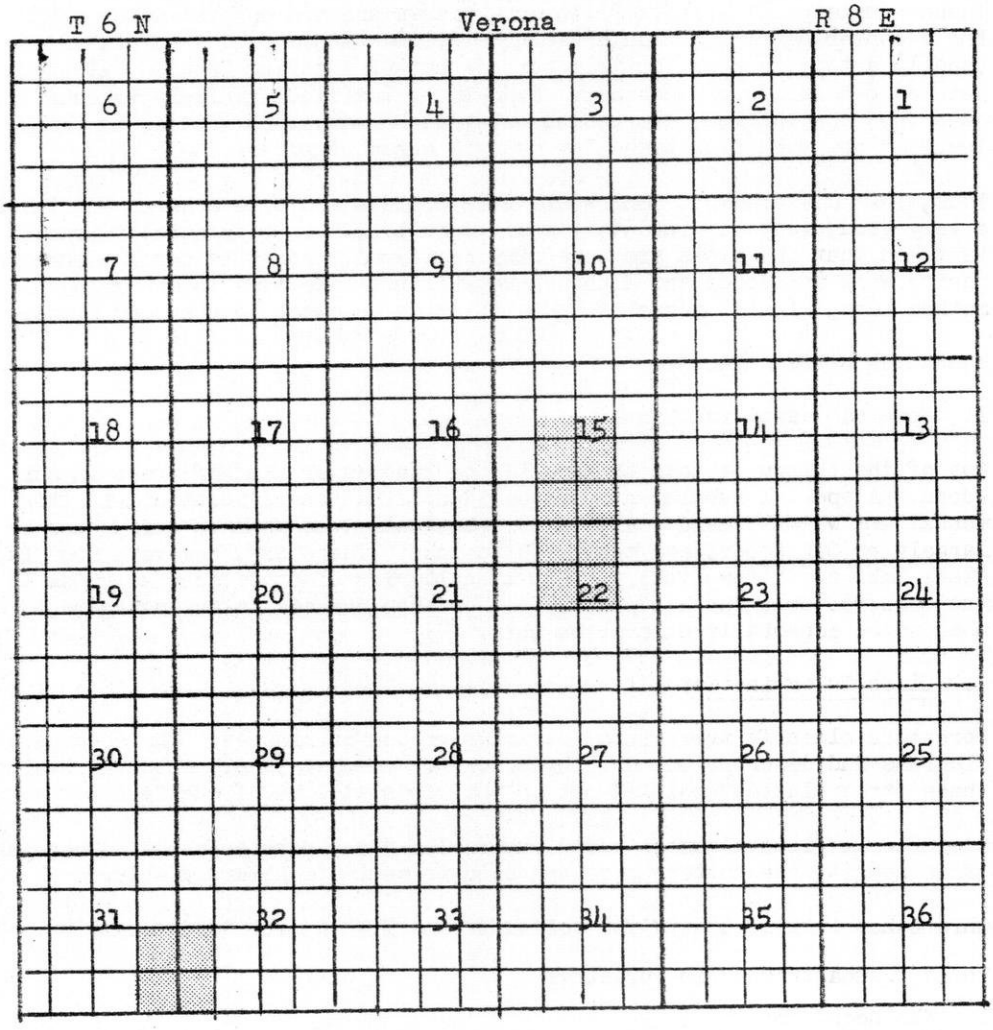
The Cruise

We are now ready to make our cruise of the woods. In the old days timber cruisers were expert woodsmen who would walk an area sometimes for many weeks and from their notes and expert guesses estimate the amount and kind of timber growing there so that lumber companies could make bids and plan lumbering operations. Our methods will be a little more refined but we certainly will lack a lot of the expertness the oldtimers had.

Getting Ready for the Cruise

The first step in a modern cruise is for the forester to obtain an aerial photo of the area. These photos are available from the ASC offices (Ag. Stabilization Com.) in each county seat. In our case we have purchased such a photo and we will use it in the field from time to time.

Using these photos and "dot grids", it is relatively easy to determine the acreage of the woods to be cruised.



Location of Madison School Forest
East ½ of the SE ¼ of Section 31
West ½ of the SW ¼ of Section 32
of T 6 N , R 8 E (Township of Verona)

The "Village" of Verona is shown by shading to lie in Sections 15 & 22 of the Township of Verona

Establishing Sample Plots

In a woods of any size it would probably be impractical to count and tally every tree. It has been found by experience that "sample plots" give a close enough estimate and are in fact surprisingly accurate.

These sample plots are one fifth acre pieces and are determined by establishing a center point and then creating a circle with a radius of 52.7 feet. Usually a tape is used for this purpose but if a string is used, it should be watched carefully for accuracy. Everything inside this circle is counted, described and tallied, everything outside, no matter how close, is ignored. There is one such plot taken for every 5 acres of woods.

Thus, in a 40-acre woods one would take 8 plots and by averaging and totalling, a very good cruise or inventory would result. This is especially true if care is taken that the plots are carefully scattered. For this purpose compass and pacing work is needed and although we will not take time to describe this method here, we will acquaint you with it as we start to take our plots.

Mechanics of Plot Taking:

1. Species Identification

One of the things we need to know is the species or kind of trees in our woods. A special supplement on tree identification is contained in this manual and we will help you with it. Basically, as we have said, ours is largely an Oak woods, and mostly White Oaks. There are, however, some Red and Black Oaks and a few Hickory, with a scattering of other species. Oak is also the most valuable species present and because our aim is Oak management, we need to be especially careful on this.

2. Class Determination

Foresters classify trees into four main groups or classes. The accompanying diagrams and descriptions will help you to remember them. Actually having these "tree classes" pointed out in the woods will be of much greater value.

Sometimes a fifth class is added and called "near merchantable". These are trees nearing the cutting size and help to estimate future yields.

This class figures 8 - 9" for softwoods and 9 - 10" for hardwoods.

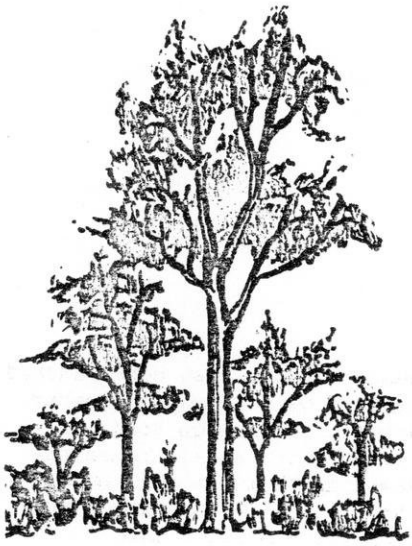
Units of Measurement in Forestry:

1. The Board Foot

The fundamental unit of measurement in forestry is the board foot. A board foot is a piece of lumber 1 foot by 1 foot by 1 inch thick in the rough cut. A piece one foot by one foot by 2 inches would then be two board feet, or a piece 1 foot by ½ foot by one inch would be ½ board foot.

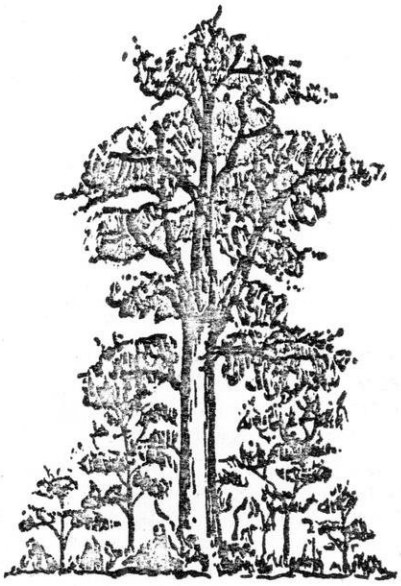
After rough sawing, boards are usually planed or smoothed before they are sold at the lumber yard. This planing operation removes wood and reduces the size of lumber. A common size is the 2 x 4, and beginners are usually upset to discover that such a piece is really one and five-eighths by three and five-eighths in actual measurement. You can rest assured, however, that it was a

Classifications of Trees



"Good growing" trees are vigorous young trees making good growth and providing for future cuts. They are the forest's immediate future.

Good Growing trees



"Reserve" or storage trees are trees that are near the market stage. If a larger cut is really needed to supply lumber they perhaps could be cut now. However, if they are left considerable growth will still occur, there is little danger of deterioration of the wood, and young trees growing in the area are not being unreasonably suppressed.

Reserve trees

"Harvest" trees are those that have reached maturity and should be cut now for lumber. They are no longer "putting on wood" to any degree, but they are still in healthy condition. Removing them now will enable the forester to harvest the maximum lumber and provide room for younger trees.

Harvest trees

"Cull" trees are poorly shaped, suppressed or defective trees with little lumber value. Often they occupy growing space in the forest and are usually removed in an "improvement cut". Very frequently, however, such trees, especially hollow ones and those with large holes, are left as "den" trees for wildlife. Sometimes, too, they are left as nurse trees to force the growth of younger trees. Sometimes removing them would open up the canopy too much.

Cull trees

2 x 4 when cut and had best take these new dimensions into your planning when you build.

2. "DBH"

In estimating standing timber in the woods the "DBH" is used. This means diameter breast high, and is technically 4½ feet on high side of the tree. For most people the need does not exist to actually make the measurement, but to estimate from one's own height.

3. "DIB"

When timber is on the ground a "scaling" operation takes place to estimate the board feet of lumber in the log. After experience on thousands of logs, foresters have developed tables which will allow for saw "kerf" and other probables. One needs, however, to know the "DIB", the diameter inside the bark at the small end of the log, and also its length. Then the table will give you a close estimate.

4. The "Log"

Most of us think of a log as being any reasonable sized post like timber. In forestry a log is a timber 16 feet long and not less than 10 inches (in hardwood) at the small end. A half log is 8 feet; a two log tree would be twice 16 feet. It goes without saying that there are not many three log trees left in Wisconsin.

In cutting logs there is always an overage or extra 4 inches left for trim. Half logs cut "scant" or without this trim allowance sometimes cannot be sold because they would saw up into less than 8 foot boards, and these odd sizes are not easily sold at lumber yards.

Working Around the Circle

Having arrived at our plot and with some idea what to look for, we start at the north end and work clockwise around the circle. This is done, of course, only to develop a uniform pattern and hence avoid mistakes.

We first determine the species of a tree, whether it be Red or White Oak or Hickory or some other species.

Next we determine DBH. The DBH reading is taken by means of a "cruiser's stick" - a yardstick-like instrument which is marked off to read diameter directly. The stick is held horizontally against the tree at DBH height, and the reader steps back until the eye is 25" from the stick. Boys with long arms will need to learn to judge this distance.

Next the number of logs in the standing tree is estimated. Here we back off one chain (66 feet) and using the cruising stick estimate how many 16-foot lengths or half fractions thereof can be cut to the lowest large defect or 10-inch top diameter. It is really surprising how close one can quickly guess. Checking against the tree when it is on the ground serves to sharpen one's estimates.

One more measurement is taken but not on each individual tree. We want to know how much wood our good growing trees are putting on. To do this we use

an increment borer, and we use the nearest good growing tree to center of the plot.

An increment borer is a hollow, auger like device with which you can make a small hole in a tree and pull out a core of wood - something like tapping a watermelon. We can then count the annual rings in the last inch, which will give us a picture of the tree's recent growth. If there are 6 or fewer rings to the inch our tree is doing well. It is, indeed, "good growing".

Tally Sheets

All cruise information is recorded on a tally sheet. Such a sheet is included in this manual, and its use will be explained during the cruise.

Tools Needed in a Forestry Operation

Besides the tools or instruments already mentioned, the major tools needed are the axe (usually two bitted), the two man cross cut saw, the wedge, splitting mauls and cant hooks plus considerable muscle and judgment. All cutting tools are safest when they are very sharp, and a good woodsman is careful to start with such tools and to keep them that way. Loose handles are another hazard which should never be permitted.

Lumbering is one of the hardest and most dangerous jobs there is. We have not had an accident and we will insist on complete discipline during our work in this phase.

"Timber"

The most exciting cry there is in the woods is "timber", the traditional call as a tree starts its fall. One of the greatest aggravations there is, is to have that tree "hang up" on another. Furthermore, these "widow makers" are much more dangerous to get down than is a standing tree.

Considerable care is needed then to make sure a tree falls where you want it to fall. The "lean" of a tree, the balance of its top, the slope of the ground, obstructions in the way, the direction of the wind, are all factors. A good logger takes great pride in "dropping" one where he said he would.

After you have decided where to fell the tree, we get now to the muscle work. The first cut made on the tree is the undercut, which should be about one fourth of the diameter of the tree and a foot or so above the ground. Stumps do not provide any lumber, and as close as possible without undue effort is the rule. The undercut is made in the direction of fall desired, and is made with the two man cross cut saw. This is an awkward position, and it requires real cooperation and a sense of rhythm between sawyers to make the cut easily. "Pinch" and "bind" are two terms you will get to know with a certain real distaste. A "V" shaped notch is then cut from above with the axe or saw to clean out the undercut.

The felling cut starts from the opposite side of the tree using the cross cut saw and about two inches higher. If the cut is properly made the two inches allowed will act as a hinge to ease the tree into its fall. Hollow trees do unexpected things - be careful of them. Sometimes wedging the opposite corner can twist a tree slightly to aid its direction of fall.

Special Dangers in Felling

I keep harping on dangers because these kinds of accidents only happen once. Tree felling can be done with safety, and we want every safety precaution taken. Shifting winds are a real danger and can upset plans. When winds tend to shift or become gusty it is a good idea to abandon the whole operation. Sharp tools again are emphasized - not only do they do better work, but they do not force a logger to overextend himself, become tired and accident prone. Brush should be cleared away from the tree so as not to catch the axe or cause you to stumble. Always check overhead to see if you have clearance for the upswing of the axe. Make plans on how you will leave the site of tree when the tree starts to fall. Stumbling or running into each other could be disasterous. All members of the crew should talk this final exciting but dangerous moment over together. Sing out the call "timber" so everyone hears it.

"Swamping and Bucking"

When the tree is on the ground the next job is to limb it off, a process called "swamping" by loggers. Then the tree is cut into desired log lengths by using a cross cut saw and being careful to remember the 4 inches of overage or extra allowance. Cutting into log lengths is known as "bucking".

It should be remembered to keep to standard lengths - that is, from eight feet to ten, then twelve, etc., plus trim allowance. An 11-foot log, for example, is only a 10-footer with a wasteful trim.

"Skidding"

Logs are now skidded out of the woods in our day by tractor and are piled in the "deck". Cant hooks are surprisingly useful tools in moving logs into position. All lumbering operations tear up the woods somewhat and skidding can be as bad as any. Logging roads are usually established and if care is not taken, these skid rows can be the beginnings of future erosion. They can also be excellent openings for wildlife, as we will learn later.

"Sawmilling"

In our operations we will next bring in a portable sawmill which will "rip" the logs into boards, 2 x 4's, 2 x 6's, etc.

After sawmilling it is possible to compare the actual yield in board feet to the yield estimated earlier by scaling.

Piling for Air Drying

Most lumber nowadays is kiln dried, but we will stack ours carefully for air drying. Air drying takes longer, but it is an excellent method. A slightly pitched platform is built and the lumber is carefully stacked so that every board has air space around and between it. The pitch should be 1½" per foot, and the stack should be made in the open to permit free circulation of air.

You will be surprised by the weight of "green" Oak lumber. Such lumber weighs about 5 lbs. per board foot. Air drying to 12% will reduce this weight to about one half. In other words, about half of the weight of freshly cut lumber is "sap" or moisture.

The "slabs", waste pieces with bark, etc., are also piled. They make excellent fireplace wood and kindling.

Such pretty much is the forestry operation in our woods.

Coniferous Forests

Pines are becoming quite common in our area, and it is well to gain some knowledge and experience with them.

These Pine forests in our part of the state are almost certain to be the result of planting and hence, the term plantation. This is not really Pine country, but there are sandy spots where Pines seem to do quite well.

The Wisconsin Conservation Department operates very extensive nurseries and provides well over 40 million young conifers for planting each year, and at very reasonable prices. The most popular tree is the Red Pine, followed by White Pine, White and Norway Spruce, and White Cedar. These trees are two-year old seedlings, three-year old seedlings, and four-year old transplants.

Very few deciduous trees (those which lose their leaves) are raised in the nurseries. Many of these trees have long "tap" roots, which make transplanting difficult. Usually such trees are started by planting nuts or acorns or by cuttings, such as in the case of willows along creek banks.

Spacing in Plantations

Five by five or six by six spacings are usually favored in establishing plantations. Many areas suited to plantations are abandoned sand fields and relatively level. Here a planting machine, tractor drawn, can plant as many as 10,000 trees a day. It goes without saying that the more hilly, rocky or clogged with brush your location is, the more difficult machine planting will be. However, when you can, a planting machine saves time and backache.

A 5 by 5 spacing requires 1,742 trees to the acre. A six by six takes 1,210 trees.

Why So Close?

Trees are deliberately planted much closer than they could ever be expected to mature. This is done so that the trees will quickly "close in" or cover the ground with their shade. Sand soils are usually very dry soils and, protecting the soils from blowing, preventing evaporation both by shade and cutting down the wind, is important. Furthermore, trees crowding each other grow up rather than spread out, and close spacing forces this growth. Another factor is that because there is certain to be some die out, a better stocked plantation will result if it is overstocked to begin with.

Thinning is Necessary

It is probable that at 8 to 10 years a thinning operation will be necessary. It might be desirable to take as many as one third of the trees in the plantation if the survival and growth has been good. These trees can often be sold as Christmas trees, and represent a cash crop that will not be equalled again for many years.

Pruning

Somewhere around 15 years in a successful plantation there will be a need for pruning. Sometimes further thinning is also needed now. The owner usually hates to do this thinning. There is no sale, as a rule, for the trees cut and many owners feel that they have given so much time and effort that they hate to cut a tree down.

Pruning is needed because by this time the tops have formed so complete a canopy that the bottom branches are dying from lack of sunlight. The sooner these dead branches are removed the sooner the trunk will heal over the scar and form a healthy, knot free stick.

Pruning should always leave at least one half in living top, and should be at least up to nine feet, which will give an eight-foot log and a one-foot stump.

Never prune with an axe and be careful to make a clean saw cut. Exposed areas are the entrance points for disease and insects - any torn bark, any stub left, just increases the size and length of time that the tree is exposed.

The "slash" (branches, etc.) represent a fire hazard. They should be removed from the immediate base of the tree, and further if possible.

Another common fault in pruning a plantation is to prune all the way to edge. This looks nice and neat and gives a sort of parklike appearance. It also permits all the drying winds to enter and robs the plantation of moisture. Always leave three or four rows on the outside edge of a planting.

Final Stand

We aim at a final stand of about 150 - 200 trees to the acre. These trees will reach timber size in perhaps 80 years. In the meantime the owner (if he lives that long) has perhaps cut one crop of Christmas trees and maybe two cuttings of fence posts or pulp wood in thinning operations. Tree farming is thus a long and slow process with very few periods of income.

In selecting and pruning trees for the final stand one keeps in mind form, trunk size, crown, and generally freedom from defects. These trees represent perhaps the best tenth of the original planting, and one should lavish some real care on them.

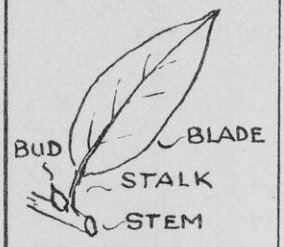
On the other hand, there are very few satisfactions as great as watching your Pines grow. A worn out field quickly gets a look of prosperous greenness for a time, at least, wildlife benefits, and finally it's real fun to walk down a mature plantation now that the work is all done. Tree farming is not for the "quick buck" guys, but we do plant over 40 million a year anyway.

Forest Values to a Watershed

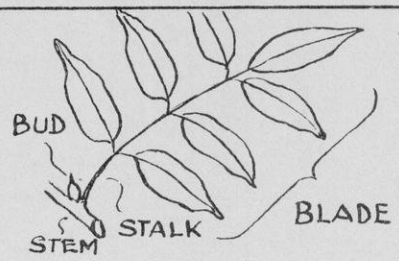
Besides the values for recreation, for actual timber produced, for wildlife, forests help greatly to control run off waters. Forest floors, either coniferous or deciduous, act as wonderful sponges to absorb, hold and slowly release water. Snows stay longer in the shaded woods and Spring floods which result from rapid melting are by that much reduced.

A watershed in good shape has its hills forested, its less steep slopes in grasslands, and its more gentle slopes contour plowed and terraced. Make no mistake, however, we get some rains each summer and some thaws nearly each spring which the best planned and managed watershed would never hold. Long before the white man chopped down the woods and drained the swamps, the rivers flooded. DeSoto, when he first saw the Mississippi, saw it in a tremendous flood. It seems that now, however, the floods are worse and more frequent. There always was a downhill wash, and there always will be - but in scalped watershed we lose more soil, dig more gullies, fill more reservoirs, and flood more cities than need be.

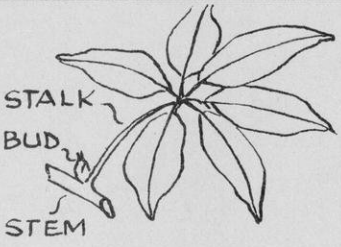
AIDS FOR IDENTIFYING PLANTS



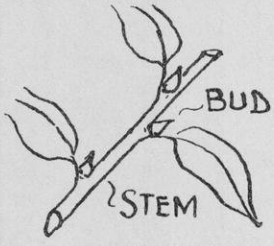
SIMPLE LEAF



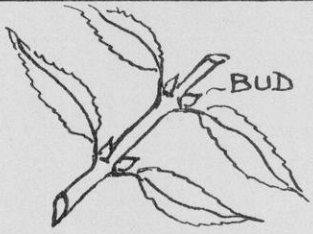
PINNATELY COMPOUND L.



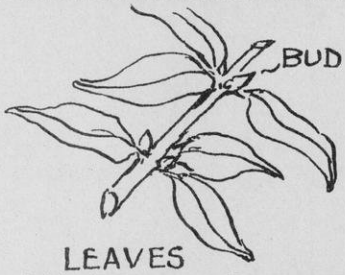
PALMATELY COMPOUND L.



LEAVES ALTERNATE



LEAVES OPPOSITE



LEAVES WHORLED

LOBED MARGIN

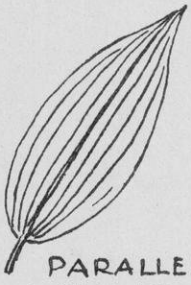
PINNATE

PALMATE

LOBES & VEINS

MAIN VEINS

SMOOTH M.



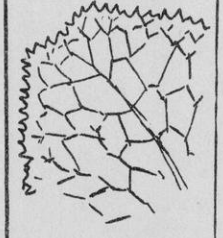
PARALLEL VEINS

TOOTHED MARGIN

SINGLE

DOUBLE TOOTHED

FINEST VEINS



NETTED (SEED PLANTS)

OPEN FORKING (MOST FERNS)

ROSETTE OF LEAVES

OPPOSITE LEAVES

ALTERNATE LEAVES

SIDE VIEW

THE ANNUAL CYCLE IN PLANTS

WINTER 1	SUMMER 1	WINTER 2	SUMMER 2	WINTER 3
GROWTH PATTERN OF A WOODY TWIG →	NEW TERMINAL BUD; BRANCH BUD; NEW GROWTH OR SECTION OF TWIG; SCALE SCARS; LEAF SCAR	TERMINAL BUD; LEAF SCAR; BUD; LEAF SCAR; STEM (2 ANNUAL RINGS)	SCALE SCARS; SCALE SCARS; DORMANT BUD; STEM	SCALE SCARS; LEAF SCAR; SCALE SCARS; STEM (3 ANNUAL RINGS)
TERMINAL BUD COVERED BY SCALES; LEAF SCAR; STEM				
GROWTH PATTERN OF AN HERB WITH RUNNERS →	BRANCH; OLD STEM; NEW BUDS; RUNNER	DEAD STEM	NEW RUNNER	
DEAD STEM; BUD; CROWN; ROOTS				
WINTER 1	SUMMER 1	WINTER 2	SUMMER 2	WINTER 3

Outline of Woody Plants found in Chapter 10

40 woody plants of the Forest are illustrated in this chapter. They include trees, shrubs, and some vines. "Woody" means that the above ground stems live over winter and grow in length and diameter each year.

A. Compound Leaves

1. Leaves pinnately compound

a. Leaves opposite on stem - page 82

b. Leaves alternate on stem - pages 83-85

2. Leaves palmately compound (all alternate)

a. Spiny stemmed shrubs - pages 85-86

b. Non-spiny stems (often resembling herbs) - page 87

B. Simple Leaves, Deeply Lobed

1. Leaves palmately lobed

a. Leaves opposite - pages 88-89

b. Leaves alternate - pages 89-90

2. Leaves pinnately lobed (all alternate) - pages 90-92

C. Simple Leaves, Unlobed or Slightly Lobed

1. Leaves opposite (all unlobed) - pages 92-94

2. Leaves alternate

a. Leaves double toothed or slightly lobed - pages 94-96

b. Leaves single toothed - pages 97-100

c. Leaves smooth margined - pages 100-101

For Herbs see outline on page 102

BOX ELDER or
ASH-LEAVED MAPLE

Usually 5 leaflets per leaf in the sun, 3 in shade.

Leaflets have few coarse teeth.

Top growth twigs are bluish; the rest green.

Pollen in April - tree really is a Maple - winged seeds hang on all winter, liked by squirrels. Box Elder beetles live on female trees.

Small, crooked, hardy, fast growing tree - never important in forest stands, but tending to invade burned or disturbed ground, dumps etc., especially where moist.

Tolerates considerable shade.

WOODY, PINNATELY COMPOUND, OPPOSITE

COMMON ELDERBERRY

Basal leaflets sometimes lobed or pinnate.

Stems mostly pith, very weak.

Flowers in flat clusters in summer. Berries purple-black in late summer.

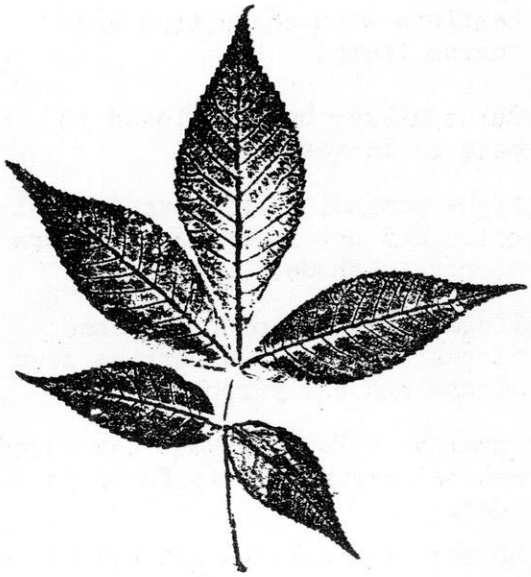
Fast growing, solitary shrub.

Grows best in open meadows and roadsides.

In the forest indicates a moist location.

Tolerates shade but flowers poorly in shade.

WOODY, PINNATELY COMPOUND, OPPOSITE



Three end leaflets are largest.

Thick twigs with huge buds whose pink to buff scales expand flower-like in spring.

Older bark looks like reversed barrel staves.

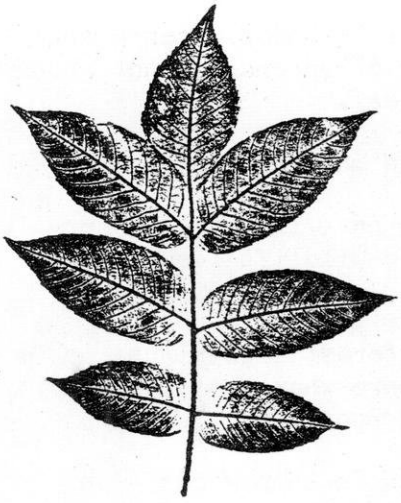
Pollen in May. Nuts good eating but thick shelled. Squirrels are very fond of nuts.

A pioneer forest tree with high light requirements.

Reciprocal dependence with squirrels and chipmunks probably the result of co-evolution.

SHAGBARK HICKORY

WOODY, PINNATELY COMPOUND, ALTERNATE



Leaves up to 2½ feet long with 7 to 11 pairs of leaflets.

Sticky hairs cover leaves and nuts.

Thick twigs sparsely branched (General rule the larger the leaf, the coarser the branching.) Pollen in May.

Bark at first smooth and gray - later interrupted by rough dark diamonds.

Differs from Walnut in fringed upper edge of leaf scar - end leaflet is always present - nut is oblong and hairs sticky.

A climax forest tree, tolerant of shade, just coming into its own here. Squirrels will carry the nuts a long way.

BUTTERNUT

WOODY, PINNATELY COMPOUND, ALTERNATE

SMOOTH SUMAC

Leaflets with sharp tips and coarse teeth.

Juice milky; buds enclosed in base of leaves.

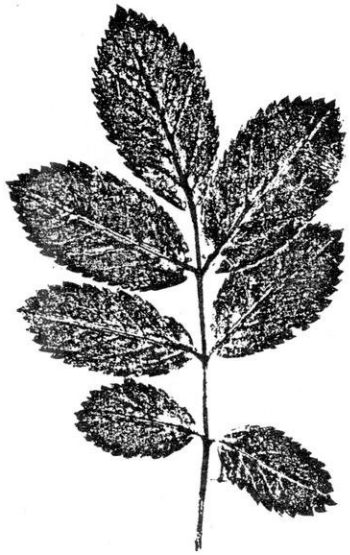
Light demanding - famous for Fall color but not in shade. Flowers poorly in shade.

Flowers green, in June; dense masses of fuzzy red berries feed grouse and early robins.

Harmless - Poison Sumac has round smooth margins and is found in bogs.

Shrub: forms large patches by underground runners in dry grasslands and forest edge.

WOODY, PINNATELY COMPOUND, ALTERNATE



WILD ROSE

Many sharp, even teeth on leaflet.

Low shrub with slender often prickly stems. Pair of appendages(not shown) at base of leaf.

Flowers large and pink in June.

Fruit are "hips", large red, berry-like and good wildlife food during winter.

Prairie and forest edge plant. Persisting here where not too shady but blooming poorly.

Note location in this woods - on sandy, dry SW facing slopes where tree cover is least dense.

WOODY, PINNATELY COMPOUND, ALTERNATE

Many small rounded leaflets with smooth margins but with bristle tips.

Plant covered with grayish hairs. Plant owes name partly to gray color, partly to presence of this prairie legume on the dry, fire-swept hilltops of early Southwestern Wisconsin. It was pure coincidence that these hills, where fire prevented the trees from replacing the prairie community, were also capped with Galena Limestone - the source of lead mined in the Civil War days. Thus, the plant seemed useful to early prospectors as an "indicator" although it had nothing to do with lead.

In the sun it becomes a small shrub, very gray, with spikes of blue flowers in July. In our woods it barely hangs on as a herb struggling in the openings.

LEAD PLANT

WOODY, PINNATELY COMPOUND, ALTERNATE

Five leaflets, very sharp and strong spines on 3-8foot arching canes.

Flowers showy, white, midsummer; berries black when ripe in August.

This is the dominant shrub of this forest and many Oak woods. It is well equipped for survival with long underground runners and rapidly growing new canes which enable it to outrun and overtop other plants.

Really a forest-prairie border plant, as seen from its spectacular growth when the woods are cut, admitting more light. Rapid growth permits rapid recovery from rabbit or fire damage.

The tall varieties are Blackberries, low-creeping forms are Dewberries. A few prairie Dewberries persist.

BLACKBERRY

WOODY, PALMATELY COMPOUND, STEMS ARE SPINY

RED RASPBERRY

WOODY, PALMATELY COMPOUND, STEMS SPINY

Three leaflets, stems slender and densely soft bristly.

Flowers whitish, drooping; berries red when ripe in July-August.

Forms dense shrubby patches by underground stems, found in Oak forests, grasslands, low meadows and wet woods.

In the forest usually indicates a rather open and moist location, but will bear fruit even in shade in wet years.

The raspberries differ from blackberries in the way the berries break off, leaving the hulls on the bush. Both called brambles.

Indigo buntings nest in brambles.

BLACK RASPBERRY

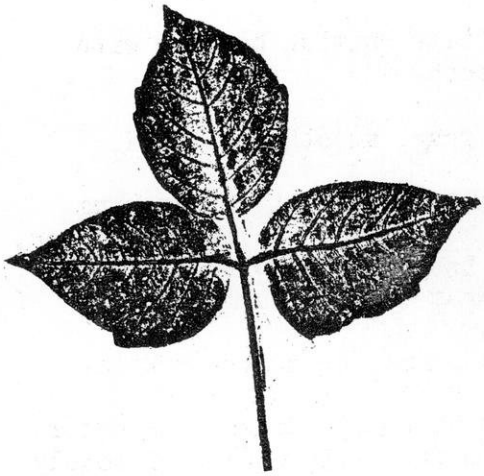
WOODY, PALMATELY COMPOUND, STEMS SPINY

Three leaflets, strongly whitened beneath; stems bluish, arching with sharp prickles.

Flowers greenish, erect; berries black when ripe in July.

Another forest-prairie edge shrub but differs from the other two brambles in having no underground runners. Instead, first year canes take root at tip, to form additional bushes. A flowering second year cane may be rooted at both ends.

All brambles are unique shrubs - their stems live two years. First year canes grow tall, leafy; second year they branch, bear flowers and fruit, then die.



POISON IVY
DO NOT TOUCH

Compare Box Elder, Trefoils, Hog Peanut, Wild Sarsaparilla.

LEAFLETS THREE, sometimes with a few, irregular teeth. Herb-like.

Flowers green in June, berries dull, yellowish white, eaten by many birds. Fall color usually dull yellow.

Underground stems send up shoots at intervals to form patches. Most shoots very short - bearing 1-5 alternate leaves per year. Usually confined to ground cover but on humid sites can climb by aerial roots to tree tops.

VERY IRRITATING - Learn to avoid. Fire carries irritant to eyes.

Ranges from swamp forest to dry prairies - favored by light.

WOODY VINE, PALMATELY COMPOUND, STEMS NOT SPINY

WOODBINE or
VIRGINIA CREEPER

Leaflets five, with regular teeth; leaves may reach a foot across.

Flowers where unshaded, green, in June; berries, blue, resembling grape but unpalatable. Red stalks. Fall color can be spectacular, clothing tree in yellow to wine red.

Growth habit like Poison Ivy, but most of its horizontal stems are on the surface of ground sending out roots and shoots at swellings.

Very abundant in most kinds of forests, resembling an herb and often dominating acres of ground cover. In opening will climb to tree tops - first by grape-like tendrils, then by aerial roots into the tree bark.

WOODY VINE, PALMATELY COMPOUND, STEMS NOT SPINY

RED MAPLE
One of the soft Maples

Leaf definitely whitish beneath with numerous teeth.

Bark light gray, smooth until old.

Flowers small and bright red, making whole tree reddish before leaves appear, in April. Large paired winged fruits called Samaras drop in summer.

Maples have paired branches as well.

In southern Wisconsin Red Maples occur with Oaks in dry hilly woods. Probably they make more efficient use of light and hence may be increasing here.

Red Maples tend to sprout at their base and often have several trunks.

WOODY, SIMPLE LEAVES, PALMATELY LOBED, OPPOSITE

SUGAR MAPLE
Hard Maple

Broad leaf merely pale green beneath. Teeth few and large.

Bark soon irregular and dark. Twigs slender. Buds long and slender.

Flowers greenish on long stalks in May but not every year. Samaras small and in the fall. Famous tree for Fall color.

Broad, horizontal leaves make for maximum interception of light. Most influential member of the climax forest. Only a few saplings found in our woods so far but only fire will halt their invasion. Saplings can live a long time in the shade waiting their chance at more light. Selective cutting thus will favor Maples over Oaks.

WOODY, SIMPLE LEAVES, PALMATELY LOBED, OPPOSITE

MAPLE-LEAVED VIBURNUM

Shrub; leaves 3 lobed, velvety, hairy beneath: twigs velvety.

Flowers whitish, rare in shade, berries blackish in fall.

Like its relative, the Nannyberry, it is frequently present in a woods that is not too shady. Oaks do not cast as much shade as Maples and Elms.

Thus, the Oak forests have many kinds of shrubs including this one. Oak forests are thus difficult to walk through compared with the Maple climax forests.

Imitation of the Maple may be a case of plant mimicry.

WOODY, SIMPLE LEAVES, PALMATELY LOBED, OPPOSITE

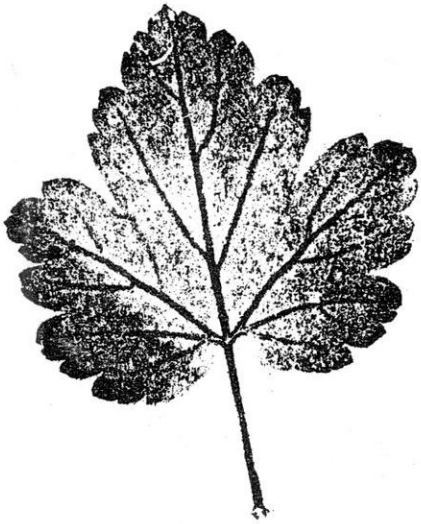
WILD GRAPE

Abundant woody vine climbing by long tendrils; leaves sometimes scarcely lobed in the two varieties present.

Flowers green in May, extremely fragrant. Fruit bluish in September. Most abundant and least sour in sunny locations.

More apt to smother trees than Woodbine since it covers the smaller branches with its broad leaves. However, only occasionally does it get enough light to reach the treetops.

WOODY, SIMPLE LEAVES, PALMATELY LOBED, ALTERNATE



GOOSEBERRY

Several varieties in forest, each slightly different but all palmately lobed and toothed.

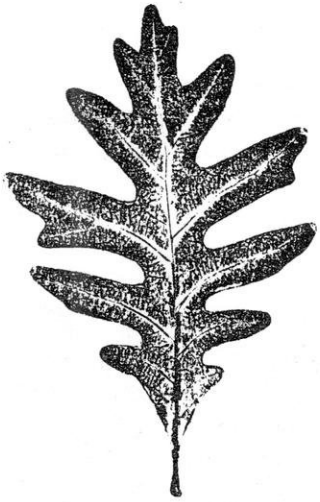
Stems very spiny, especially on new growth.

First shrub to leaf out in April. Green flowers in May. Berries green to black, sometimes with spines on berry.

A solitary shrub normally infrequent in an Oak forest but can become abundant where woods are grazed.

Alternate host of White Pine blister rust and in Pine regions attempts are often made to eradicate it.

WOODY, SIMPLE LEAVES, PALMATELY LOBED, ALTERNATE



WHITE OAK

Leaves often less deeply lobed than in this figure. Underside of leaf whitish green. Bark more grayish than other Oaks.

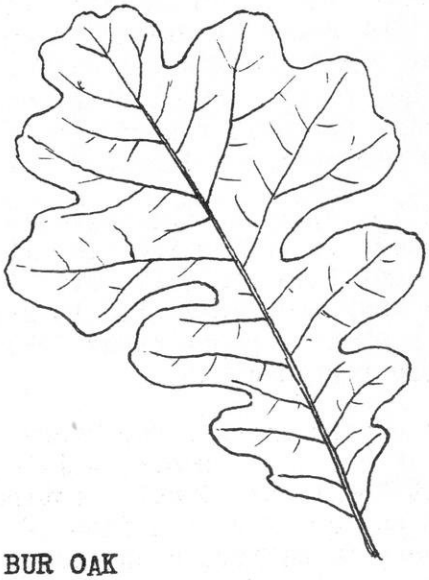
This is the dominant tree of this forest.

Represented in this woods by a few open-grown, broad topped trees - the originals of this stand; and many smaller but taller straight forest grown trees. There are some trees with several trunks, no doubt of sprout origin.

Although many young Whites can be found, on the whole, the Oaks are not making satisfactory reproduction. This is without question owing to the poor shade tolerance of Oaks.

Rabbit browse is a problem for young Oaks, especially where growth is slow anyway.

WOODY, SIMPLE LEAVES, PINNATELY LOBED, ALTERNATE



BUR OAK

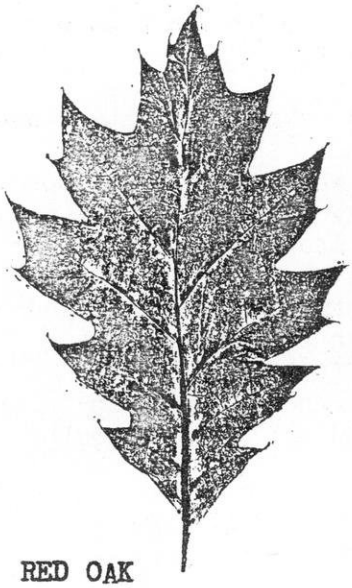
WOODY, SIMPLE LEAVES,
PINNATELY LOBED, ALTERNATE

Typical Bur Oak differs from White Oak in having leaves much more whitened beneath and upper part of leaf much less deeply lobed than lower portion.

Bark often thick and corky even on twigs and deeply ridged on trunk. Acorn-cups shaggy.

Bur Oaks of this forest are somewhat intermediate between typical Bur Oak and Whites. Hybrids are common in Oaks, which are all wind pollinated at the same time.

Burs are the most drought resistant and fire resistant trees; hence, they are first to advance onto the prairies, but their low shade tolerance leaves them as relics here.



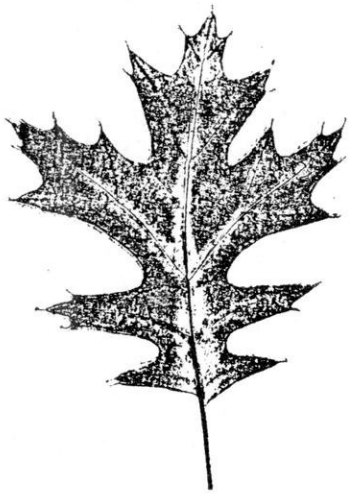
RED OAK

As might be guessed from its broad leaves Red Oak is the most shade tolerant of the Oaks and requires the most moisture for its early growth. When it gets a chance (light, moisture, rich deep soil) it makes rapid growth. Because it grows best in sheltered places, other trees are usually present to keep it straight and knot free: hence, a tree of high timber value.

Until Maples and Elms become more abundant selective cutting will favor Red Oak reproduction. Judging from reproduction in this woods, the Reds will become dominant after the Whites and before the Maples.

The decline of the Red Oak stage is hastened by Oak wilt but a few Red Oaks may be expected even in a climax forest.

WOODY, SIMPLE LEAVES, PINNATELY LOBED, ALTERNATE



BLACK OAK

The Black Oak-Red Oak group differs from the White-Bur Oak group in having sharp bristle-tipped teeth. Black Oak differs in turn from Red in its deep lobing and with lobes often narrowed towards their bases; acorns narrower and leaves shinier.

Blacks are ecologically at the opposite extreme from Reds requiring the most light but the least moisture and soil fertility. In this woods they are restricted to sandy outcrops too poor to support other Oaks, and make little reproduction.

Black-Red Oak acorns require two years to mature - Whites but one. Hence, a late frost will not spoil the forest's entire acorn crop in any one year - a fact of great importance to squirrels and other Oak-dependent animals of the forest.

WOODY, SIMPLE LEAVES, PINNATELY LOBED, ALTERNATE

NANNYBERRY

Many, very tiny teeth on a rather broad, shiny leaf.

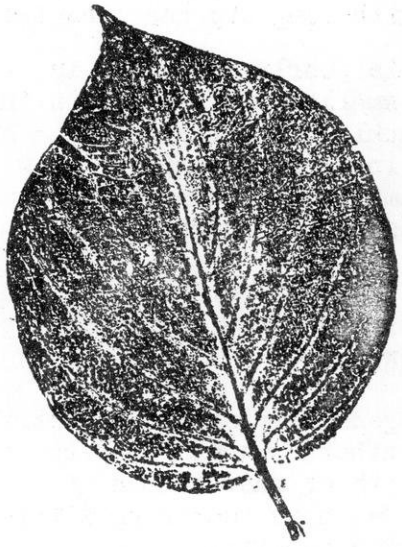
Only two scales cover the winter buds.

Flowers small, white, in flat-topped clusters in May. Flowers scarce in shade. Fruit black in fall.

Sturdy, tall shrub frequently found in woods, though seldom abundant.

Note that its branches occur in pairs, as in Maples and all other opposite-leaved plants.

WOODY, SIMPLE LEAVES, UNLOBED, OPPOSITE



ROUND-LEAF DOGWOOD

Dogwoods have smooth margins and veins curving toward leaf apex.

This Dogwood has very broad leaves, often nearly circular.

Large, solitary shrub with twigs greenish to red-brown.

Flowers small, whitish in flat-topped clusters in May. Berries bluish on red stalks.

A common shrub of woods and rocky places, but in Southwest Wisconsin usually restricted to cool north slopes. It may benefit from the sheltered hollows in this forest.

WOODY, SIMPLE LEAVES, UNLOBED, OPPOSITE

GRAY DOGWOOD

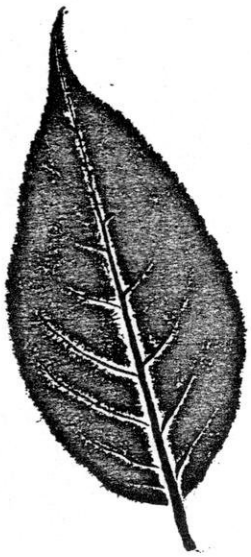
The Roundleaf Dogwood has the broadest leaf - the Gray, the narrowest. Again, curving veins are prominent, appearing to avoid meeting the margins.

This is a medium shrub forming thickets by underground runners. Twigs are red when young but soon turn light gray.

Flowers small, creamy white in cone-shaped clusters in June and are abundant where exposed to light. Berries white on bright, red stalks in September. The persistent red stalks give the alternate name "Red Panicled Dogwood".

A forest edge plant often pioneering onto grasslands in absence of fire. Persists in forests as long as Oaks dominate. One of the first to go when the shadier Maples and Elms take over.

WOODY, SIMPLE LEAVES, UNLOBED, OPPOSITE



BUSH HONEYSUCKLE

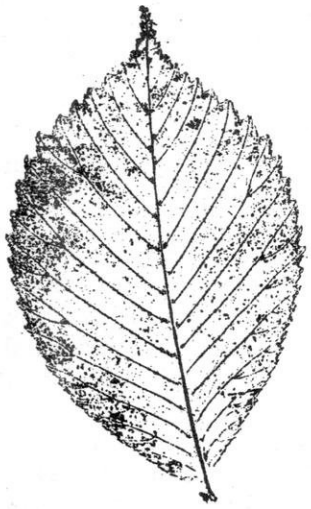
Long leaf with long tip and fine teeth.

This plant is poorly named; it is almost the smallest of the plants in the honeysuckle group and hardly a bush. It behaves in this woods like a low shrub or semi-herb forming colonies usually under a foot high.

Stems arch toward the horizontal bearing small pale yellow flowers at tips in midsummer.

A plant of generally northern distribution; in Southern Wisconsin characteristic of north or east slopes in partial shade, thus remaining within a northern micro-climate.

WOODY, SIMPLE LEAVES, UNLOBED, OPPOSITE



SLIPPERY ELM

Elms have a strong "herringbone" vein pattern and unsymmetrical leaf bases.

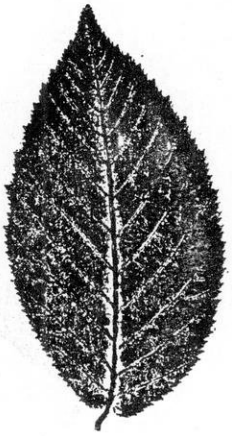
Slippery Elm differs from the American Elm of city streets in having larger leaves which are very rough on both sides; twig bark is gummy when chewed, larger seeds lacking fringe on wing, and red-hairy buds.

Flowers tiny and brownish in April; winged seeds drop in May. Fall color, yellow.

Elms are climax forest trees, requiring moisture for seedings, tolerant of shading for long periods, casting dense shade, but vulnerable to drought and fire.

In this woods it is an invader. Dutch Elm disease may be expected to reach this stand and eventually kill some of the older elms. Oaks may benefit hereby.

WOODY, SIMPLE LEAVES, ALTERNATE, DOUBLE TOOTHED OR SLIGHTLY LOBED



IRONWOOD

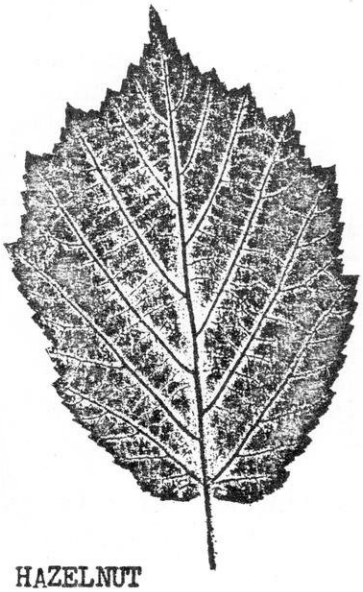
Very similar to Elm but more "refined": very fine teeth, small thin leaves, very fine twigs, a small tree.

In openings bears green, leafy, hops-like clusters of flowers in May.

Like Elms tolerates and casts considerable shade. Generally associated with cooler, more moist environment of climax forests. Invades Oak forests first on protected hollows and north facing slopes.

Often occurs in colonies. Note how little ground vegetation occurs beneath Ironwood colonies.

WOODY, SIMPLE LEAVES, ALTERNATE, DOUBLE TOOTHED OR SLIGHTLY LOBED



HAZELNUT

Main teeth larger and fewer than in Elm.

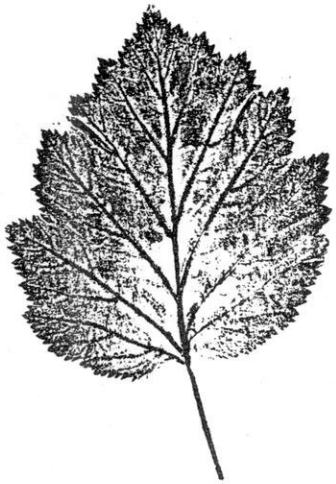
A shrub with sticky brown hairs covering leaves, new twigs and the hulls of nuts.

First plant to bloom: catkins may shed pollen in late March; nuts often stolen by rodents before fully ripe in early fall. However, nuts eaten out by insects are avoided though they look all right from the outside.

A pioneer shrub of the brushy Oak forest edge, fruiting poorly in shade but persisting until shading is dense.

Spreads by underground runners which are of value in invading the tough prairie sod as well as in resprouting after fires.

WOODY, SIMPLE LEAVES, ALTERNATE, DOUBLE TOOTHED OR SLIGHTLY LOBED



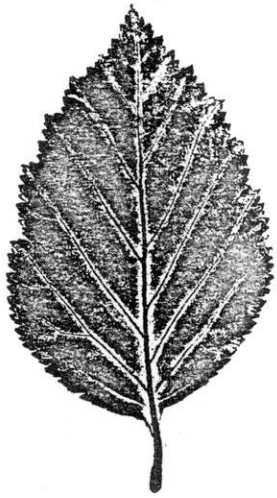
THORNAPPLE or
HAWTHORN

Leaves vary from sharply lobed to merely double toothed.

Small tree with abundant long, sharp thorns.

Flowers clustered, white in May. Fruits bright red in Autumn, developing poorly in shade.

A plant of the forest edge or fence-row, sometimes invading pastures. In the shade it persists in spite of plant lice and other insects which attack and cause its leaves to curl.



WOODY, SIMPLE LEAVES, ALTERNATE, DOUBLE-TOOTHED OR SLIGHTLY LOBED

WILD or PRAIRIE
CRAB

Large rounded teeth or lobes on leaves.

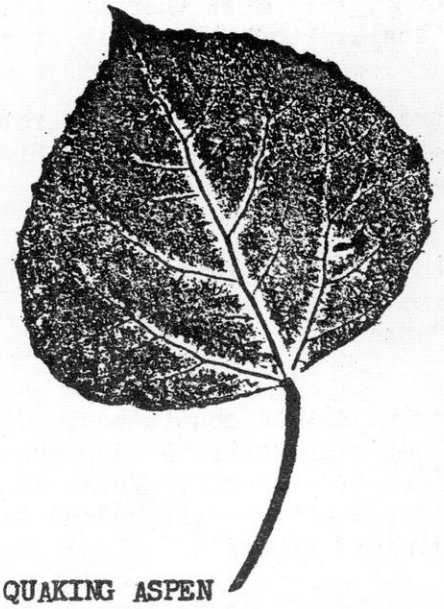
A small tree or open shrub with numerous short (spur) branches (not thorns) thus similar to its close relative the cultivated apple.

Flowers large, pink, clustered and fragrant in May, but scarce in shade. Fruit a small green apple.

A forest edge plant forming colonies by underground runners and by this means advancing from the forest edge onto the prairie or roadside.

Persists in Oak woods but not for a very long period.

WOODY, SIMPLE LEAVES, ALTERNATE, DOUBLE TOOTHED OR SLIGHTLY LOBED



QUAKING ASPEN

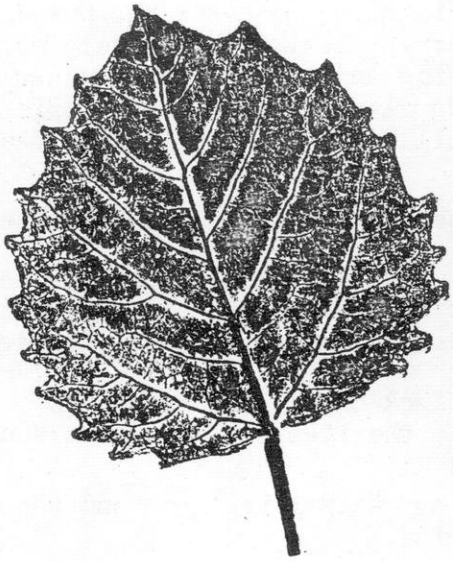
Because of their unusually shaped stalks, the leaves of the "popples"- (Aspens or Poplars) wobble sideways with the faintest breeze.

Quaking Aspen is a small tree with small, even teeth on small roundish leaves. Bark is smooth, sometimes gray, sometimes as white as Birch.

First tree to flower in this woods. Fuzzy catkins shed pollen in April. Tiny, cottony seeds blow from female trees in May.

Forms colonies by underground stems. A light-requiring pioneer tree found on prairie, in meadows, in burned forests, or on open hilltops.

WOODY, SIMPLE LEAVES, ALTERNATE, SINGLE TOOTHED, FLATTENED LEAF STALK



LARGE-TOOTHED ASPEN

Large leaf with coarse teeth, gray-green when unfolding in May.

Somewhat taller tree than Quaking Aspen shedding pollen and seeds a little later. Fall color likewise a clear yellow.

"Popple" seeds being tiny have little stored food and must have light for their first growth. Short lived seeds must grow immediately or die. Hence, these trees colonize ground which is both bare and moist at the time the seeds fall.

Sites which have been burned or are eroding in May spring up in dense stands if rains following seeding.

Aspens are the best place to find Sapsuckers and Myrtle Warblers in April as their sticky buds attract insects.

WOODY,SIMPLE LEAVES,ALTERNATE,SINGLE TOOTHED,FLATTENED LEAF STALK

WILD BLACK CHERRY

Leaf rather narrow, shiny; like most Cherries it has two tiny bumps on stalk. (Look carefully at a leaf)

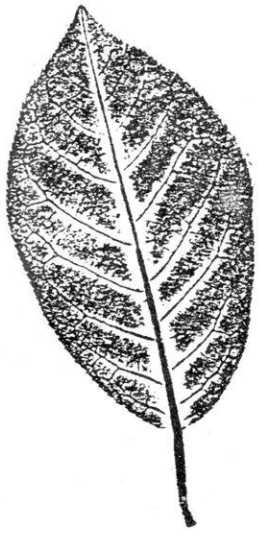
Our only tall Cherry tree. Bark is gray at first, peeling like Birch; later, black with large, thin, roundish scales. Twigs very fine in treetop silhouette.

Flowers small, white in long "bottlebrush" clusters in early June. Cherries are small and black in August, have "puckery" taste but much sought by birds.

A tree of both pioneer and climax conditions: often advances on grassland but will tolerate much shade in its early stages of sapling growth. Thus, if canopy is opened in time, saplings will become tall, straight trees with valuable timber.

Note both mature trees and saplings in this forest.

WOODY, SIMPLE LEAVES, ALTERNATE, SINGLE TOOTHED, STALKS NOT FLAT



CHOKE CHERRY

Leaf variable in size and shape but broader than Black Cherry. Leaf is definitely more broad towards tip and is dull rather than shiny. The two glands on the stalk typical of Cherries will help to tell it from other shrubs.

A fungus causes black swellings in branches.

Shrub or small tree with rather smooth, dark bark. Spreads by underground stems forming colonies. These colonies are short lived.

Flowers like Black Cherry but in May as leaves unfold. Cherries earlier, more sour, less abundant.

Either Cherry may skip a year now and then without flowering.

Common Oak forest shrub but does best in openings or forest edge.

WOODY, SIMPLE LEAVES, ALTERNATE, SINGLE TOOTHED, STALKS NOT FLAT

JUNEBERRY or
SHAD-BUSH or
SERVICE-BERRY

Leaf variable, not always as large or broad as the one shown and tending to be blue-green. Buds slender, reddish.

Tall shrub or small tree with gray, smooth bark.

Flowers rather large, white, clustered in April-May as leaves unfold. Fruit small and reddish resembling Huckleberries.

A plant of rather open or hilly Oak woods.

Unusually abundant in this forest, filling the forest with its showy flowers in spring.

WOODY, SIMPLE LEAVES, ALTERNATE, SINGLE TOOTHED, STALKS NOT FLAT

BITTERSWEET

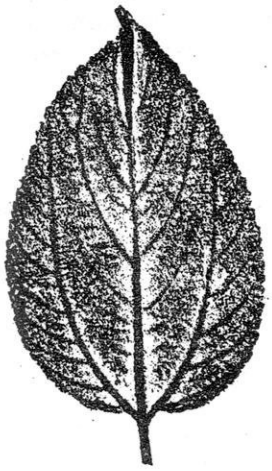
A vine, climbing by twining stems with buds almost perpendicular to stems.

Underground parts are bright orange. Flowers are tiny and green in late May.

The true Bittersweet is much sought after for its dry, split open, orange fruits in the fall. Some individuals being wholly staminate bear no fruit. Flowering is scanty except in tree tops or on fences where exposed to light.

Each of the four important, woody forest vines has its own way of reaching sunlight. Woodbine and Poison Ivy hug the bark with tendrils or roots; Grape has long tendrils that fasten to small branches. Bittersweet twines and thus can climb only on small vertical twigs. All 4 require considerable light to reach the tree tops, and the latter two must climb on shrubs first. Bittersweet can force a sapling into corkscrew shape.

WOODY, SIMPLE LEAVES, ALTERNATE, SINGLE TOOTHED, STALKS NOT FLAT



NEW JERSEY TEA

Leaf with three main veins, finely hairy beneath.

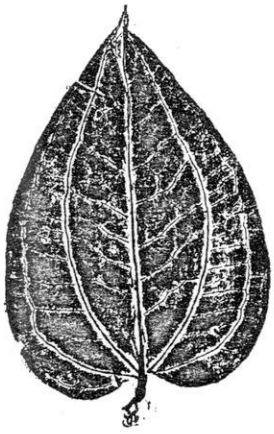
Very low, solitary shrub of the Prairie persisting here almost as an herb, like Lead Plant.

In the open bears oval clusters of grayish white flowers in July, and the cup shaped remains of the seed capsules persist through the winter.

Though not a legume, its roots are reported to harbor nitrogen fixing bacteria as do Lead Plant and the other legumes.

Leaves are reported to have been used as tea during the American Revolution.

WOODY, SIMPLE LEAVES, ALTERNATE, SINGLE TOOTHED, STALKS NOT FLAT



GREENBRIER

Stems climbing or trailing, green, with dark spines.

Leaves parallel veined, bearing two tendrils at base.

Flowers green borne in "umbels" in June. Fruits black, berry like, unpalatable to man but eaten by birds. Flowers only in the open.

A vine frequently found in shady woods, where it seldom is of importance; but in openings or on isolated trees may climb as high as ten feet.

Similar leaf shows relationship to a forest herb, the carrion flower--illustrated later.

WOODY, SIMPLE LEAVES, ALTERNATE, SMOOTH MARGINS

Like other Dogwoods has veins tending to curve towards leaf tip, and has smooth margins, but its leaves are alternate (look carefully).

A solitary, tall shrub with an unusual growth pattern: shoots grow very rapidly bearing few leaves or buds, then grow very slowly forming almost a rosette, so that arrangement of leaves and buds is not easy to determine. The crowding of leaves and later branches at certain points results in an open, "tiered" habit that earns the name "pagoda dogwood" when cultivated. Stems are greenish.

Flowers are whitish in flat clusters in May.

Berries are blue-black and red stalked.

Tolerates considerable shade and is found in both Oak forest and climax stands.

ALTERNATE-LEAVED DOGWOOD

WOODY, SIMPLE LEAVES, ALTERNATE, SMOOTH MARGINS

Branch bearing six leaves shown.

Tiny leaves (actual size shown) are finely hairy on edge and underside.

A small shrub up to about a foot. Flowers urn shaped, white in May located near branch tips. Berries blue in summer and not abundant in shade.

Blueberries prefer acid soils and are abundant in open land across the North. In Southern Wisconsin they are usually found in bogs or on sandstone outcrops such as in this forest. Hence, they may be used as indicators of poor dry soil in this region along with Hair-Cap Moss and Black Oaks.

An evergreen relative, Prince's Pine, is really a three inch shrub--illustrated later.

BLUEBERRY

WOODY, SIMPLE LEAVES, ALTERNATE, SMOOTH MARGINS

Outline of Herbs found in Chapter 10

Herbs have non-woody stems which die back to the ground each year. Most herbs live longer than do trees.

1. Ferns - Leaves unroll from base to tip; finest veins are usually open-forked; bear microscopic spores - pages 103 - 106

2. Seed plants- Leaves develop more or less uniformly; finest veins form network bear flowers and seeds.

   A. Compound Leaves

      1. Leaves pinnately compound - pages 106 - 108

      2. Leaves palmately compound

         a. Leaflets themselves compound - pages 109 - 111
         b. Leaflets lobed or toothed - pages 111 - 114
         c. Leaflets smooth-margined - pages 114 - 116

   B. Simple Leaves - deeply lobed

      1. Leaves pinnately lobed - pages 116 - 118

      2. Leaves palmately lobed - pages 118 - 120

   C. Simple Leaves - unlobed and with pinnate or palmate veining

      1. Leaves whorled - pages 121 - 123

      2. Leaves opposite
         a. Leaves toothed - pages 124 - 126
         b. Leaves smooth-margined - pages 127 - 130

      3. Leaves alternate - often in rosettes
         a. Leaf base heart-shaped - pages 130 - 131
         b. Leaves evergreen , thick , glossy - pages 132
         c. Leaves in fround rosette - pages 133 - 134
         d. Leaves all on erect stem - pages 135 - 137
         e. Leaves in rosette and on erect stem - pages 137- 139

   D. Simple Leaves - unlobed, parallel-veined

      1. Leaves relatively broad - pages 140 - 143

      2. Leaves relatively narrow - pages 143 - 145

SENSITIVE FERN

Leaf deeply pinnately lobed, almost compound. ½ to 2 feet tall, the blade triangular, tilted back and pale green.

Unlike other ferns the finest veins form chain or net.

Spores borne on special vertical brown leaves.

Spreads by long creeping branches to form sizable colonies.

Name comes from withering at first frost in low meadows where it is more often found than in woods.

Note its location here in a humid hollow.

FERN- LEAVES UNROLL FROM BASE TO TIP- SPORES- UNIQUE VEIN PATTERNS

INTERRUPTED FERN

This is just one leaflet of a leaf 2-4 feet tall! Pinnately compound, with leaflets deeply pinnately lobed and with the lobes smooth margined.

Spores borne on special brown leaflets just below middle of larger leaves; these leaflets soon drop off leaving gaps in the leaves in summer.

These vase shaped ferns gradually form large colonies on cool north and east slopes in the woods. Excellent preventers of soil erosion; note huge masses of brown roots close to the surface of the soil. (These roots are sold to florists for growing orchids because their loose, fibrous masses are like the bark of tropical trees where orchids naturally grow.)

The first fern to appear in the spring with stout fuzzy "fiddleheads"--the unrolling leaves.

There are tree ferns in the tropics, but all our ferns are herbs.

FERN- LEAVES UNROLL FROM BASE TO TIP- SPORES- UNIQUE VEIN PATTERNS

LADY FERN

This is just one leaflet of a leaf 1-3 feet tall! Leaf pinnately and twice compound with ultimate leaflets long and narrow, pinnately lobed and with the lobes being toothed. Few scales on stalk.

The larger leaves of mature plants are covered on the underside by dot like brown clusters of spore cases as shown here. (This is not a disease!)

A common, medium sized fern found in every Oak woods. Solitary or small clumps. Each clump originated with a single microscopic windblown spore. Lacking much stored food, the spore must have immediate light. The tiny resulting plant--lacking roots, water tubes and waxy coating--must have constant moisture--such as bare ground in a low spot, or by a rotting log, or a stone on which moisture condenses in hot, humid weather. If moisture continues, tiny roots and true leaves are formed by fall. After several years, the leaves attain typical size and shape.

FERN- LEAVES UNROLL FROM BASE TO TIP- SPORES- UNIQUE VEIN PATTERNS

SPINULOSE WOOD FERN

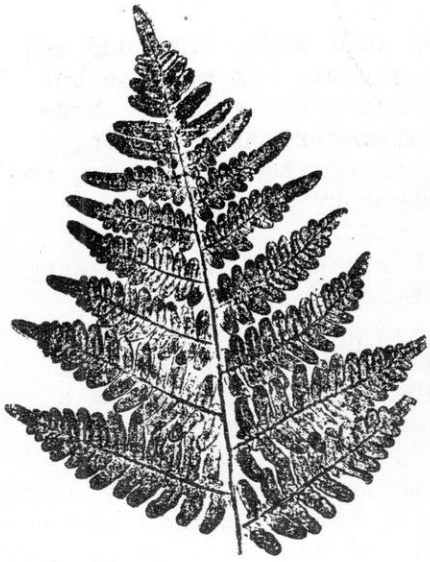
This is an entire leaf but a rather small one. Leaf pinnately twice compound with ultimate leaflets short and blunt, pinnately lobed and with the lobes being toothed.

Often smaller than the Lady Fern and with abundantly scaly stalks and with the blade darker green and evergreen (look for last year's leaves still present in spring).

Spore case clusters on underside of some leaves appearing similar to Lady Fern.

A solitary fern of the woods often preferring a moist or cool site. Like most ferns its distribution is restricted by the exacting conditions required by the tiny early stages of growth. Adults, however, can be transplanted to sites too dry or too crowded for initial successful growth from spores.

FERN- LEAVES UNROLL FROM BASE TO TIP- SPORES- UNIQUE VEIN PATTERNS



BRAKE or BRACKEN FERN

This is one third of a palmately compound leaf. Each leaflet like this one is pinnately twice-compound. Note long tips on the rounded secondary leaflets and smooth or lobed inrolled margins. Stalk is grooved.

Spores borne under inrolled margins of the larger leaves.

Solitary, knee high leaves arise here and there from long, slender, deep underground stems. A common fern of Oak woods often covering large areas but seldom as dense as it can be in the North.

Tolerates dry or poor soil where it benefits from lack of competition. This fern has almost world wide distribution.

FERN- LEAVES UNROLL FROM BASE TO TIP- SPORES- UNIQUE VEIN PATTERNS

GRAPE or RATTLESNAKE FERN

One third of leaf shown. Though smaller, leaf has construction and triangular shape of Bracken; but ultimate leaflets narrowed at base - sharp toothed and not inrolled. Stalk round.

Spores borne on special yellow-brown leaf held above the green one--found only on older plants.

A solitary fern bearing only one stalk per year. Common in Oak woods and found even where dry if shade and leaf-mold are present.

Unlike Bracken sensitive to sunlight; also young stage is underground, non-green, living on a fungus. Hence, unlike other ferns, its distribution may be set by the light and moisture needs of adult fern rather than the sporeling.

FERN- LEAVES UNROLL FROM BASE TO TIP-SPORES-UNIQUE VEIN PATTERNS

MAIDENHAIR FERN

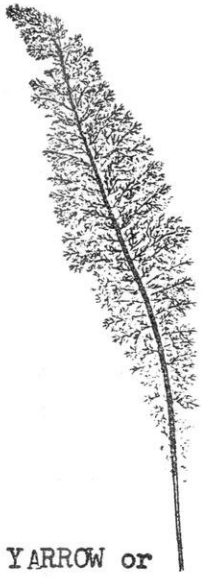
Leaf 1-2 feet high, compound and neither pinnate nor palmate but forking (like the veins). Note also, unsymmetrical leaflets, blue-green horizontal blades, and shiny mohagany stalks.

Spores borne under inrolled margin on one side of leaflet.

Spreads by branching, creeping stems and forms dense clumps a foot or more in diameter.

Most abundant in rather rich woods, those with high fertility and considerable accumulation of leafmold, such as characterize a climax forest.

FERN- LEAVES UNROLL FROM BASE TO TIP- SPORES- UNIQUE VEIN PATTERNS



YARROW or
MILFOIL

This flowering plant outdoes the ferns in the fineness of its leaf divisions! Leaves first in rosette, later alternate on stem; when crushed, leaves have a characteristic odor.

Flowers small, white in flat topped clusters, Summer.

A common grassland and roadside plant which quickly invades abandoned fields, paths or parking lots--wherever there is open ground and light.

Since it is not a forest plant, its presence is a good indicator of non-forest conditions. Note where it is found.

HERB, LEAVES PINNATELY COMPOUND

LESSER RAGWEED or
ROMAN WORMWOOD

Another fern-like seed plant. Leaflets with rounded lobes, and connected by winged bases. (Leaf could be considered simple and deeply lobed.)

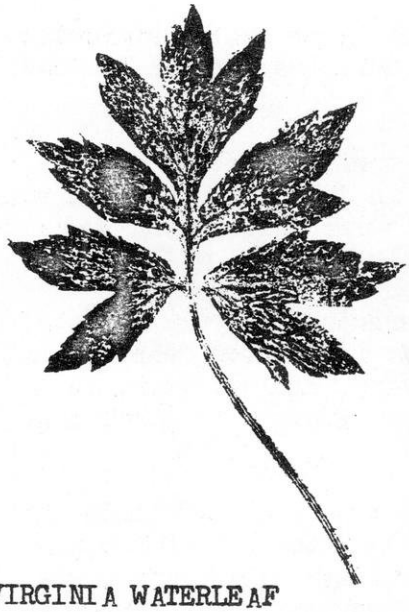
Annual, with leaves opposite and alternate on same plant - green, wind pollinated flowers in terminal spikes in August-September. Chief cause of hay fever. Height 2-30 inches.

A common weed, one of the few native to America. Found everywhere where there is considerable light. Excluded from forest except in openings and along paths and edges. Grows poorly in sod.

This Ragweed depends on man for habitats favorable to abundant tall growth. Before man, it grew well only where Buffalo, rodents, fire or flood exposed bare soil on the prairies.

Seeds large and rich in fats - much sought by birds.

HERB, LEAVES PINNATELY COMPOUND



VIRGINIA WATERLEAF

Leaflets sharp-lobed and sharp-toothed. Some leaves mottled with whitish areas in spring.

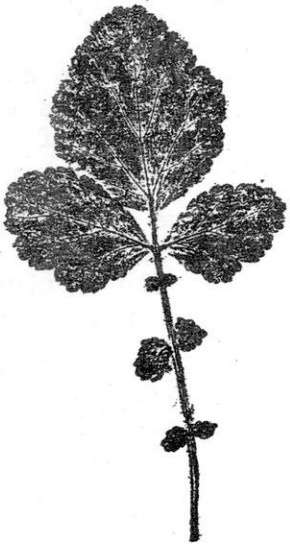
Forms low clumps 5-15 inches high from creeping stems. Flowers lavender to white with protruding stamens, clustered, in May-June.

Well equipped for forest environment, sending up two sets of leaves per year, one set as trees leaf out, the other as leaves drop. Stems watery.

Found in moist or rich woods, tolerating dense shade, but thriving in Oak as well as Maple forests.

Strangely for a climax plant, it becomes weedy where there is trampling or where leaves are removed from a shady garden.

HERB, LEAVES PINNATELY COMPOUND



WHITE AVENS

Rosette leaf (left) with rounded leaflets, the terminal one largest. Stem leaves variable but more sharply toothed and lobed. Leaves sometimes mottled with whitish areas. Unlike Waterleaf, has leafy outgrowths on stalks.

Rosettes in spring and fall. Small white flowers on 2-3 foot stems in June. Burs later disintegrate into tiny hooked seeds.

Infrequent but very characteristic Oak woods plant.

One of few short-lived perennials of the forest: Thus does not stay long in one place. Small seeds require bare ground: thus its presence indicates local disturbance or erosion.

HERB, LEAVES PINNATELY COMPOUND

AGRIMONY

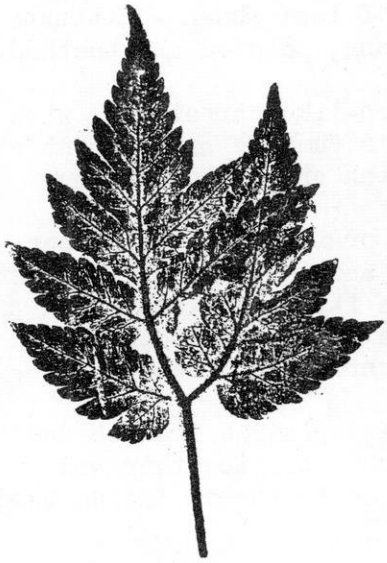
Rose-like teeth and large leafy outgrowths at base of stalk indicates kinship to Rose and Strawberry.

Late to awaken in spring; reaches peak growth (3-4 feet) in July with terminal spike of small yellow flowers followed by green burs that fall whole.

Infrequent but characteristic Oak forest plant. Where shade is not too deep its tall growth may compensate for late start in utilizing the lesser amounts of light available after spring.

The Oak forest has more kinds of seeds that stick to fur than does the climax Maple forest. Such plants may benefit from the many trips made by animals seeking nuts in the fall.

HERB, LEAVES PINNATELY COMPOUND



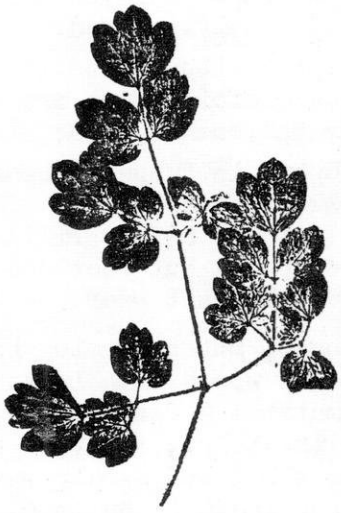
SWEET CICELY

Part of upper stem leaf at left, part of Fall rosette leaf at right. Leaves are variable and fern-like with sheathing base characteristic of carrot family.

Flowers clustered atop 2-3 foot stem, tiny and white in May. Seeds long, black and spiny which stick to clothes. Plant dries up in summer - thick root sends up second rosette in fall.

Two varieties both very common Oak woods plants. One very hairy the other smooth and ainse flovered. Short-lived perennials whose long-leaved seedlings abound in spring even in leaf litter.

HERB, PALMATELY COMPOUND, LEAFLETS COMPOUND



EARLY MEADOWRUE

Only part of leaf shown - several times palmately compound, ultimate leaflets roundish, lobed at tip, stalked.

This is a Buttercup relative that tries to look like the carrot family (sheathing bases, compound leaves) but ends up like some trees with no petals - sexes on separate plants and pollinated by wind!

Most Meadowrues are tall prairie and meadow plants with white or colored stamens in August. This variety got smaller (1-2 ft), took to the woods, lost its color, came up earlier, and now flowers in May.

A common herb of both Oak and Maple forests. Sometimes forms large colonies.

HERB, PALMATELY COMPOUND, LEAFLETS COMPOUND

Only part of leaf shown - ultimate leaflets long, pointed and toothed.

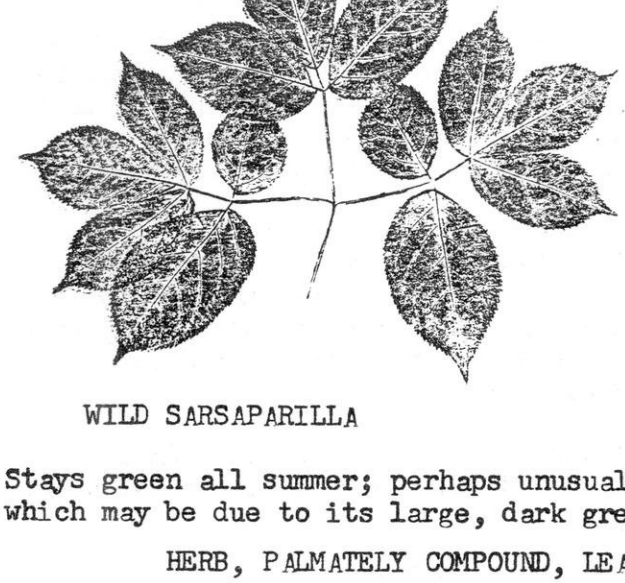
Another fern-like carrot kin, with the family's "umbel" arrangement of flowers which are yellow in May.

A relic of prairie days which persists here and there in this forest to indicate its past history and also serves to locate spots least shaded by shrubs and trees.

Most of these prairie "relic" species will be found near together and especially on Southwest facing sandy slopes.

GOLDEN ALEXANDERS

HERB, PALMATELY COMPOUND, LEAFLETS COMPOUND



One small whole leaf shown. Larger leaflets pinnately compound - ultimate leaflets finely toothed.

Compare with Poison Ivy and Tick Trefoil which are similar and common associates.

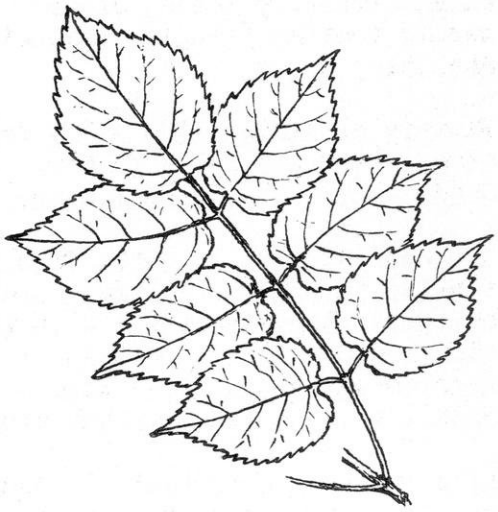
Flowers in "umbels" beneath leaves, green in May. This is not the Sarsaparilla in root beer, but root does have pleasant odor.

Robust, patch forming herb of Oak woods with leaves sometimes 2 feet across. As in Violet, its true stems are short and barely appear above the soil surface.

WILD SARSAPARILLA

Stays green all summer; perhaps unusually efficient in using light which may be due to its large, dark green leaves and slow growth.

HERB, PALMATELY COMPOUND, LEAFLETS COMPOUND



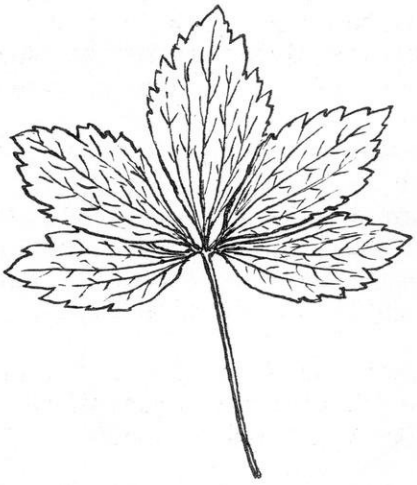
SPIKENARD

Leaves 3-4 feet long, nearly as broad. This is Wisconsin's largest herb - often 5-8 feet tall! Only part of leaf shown.

A large, economy sized version of Wild Sarsaparilla but later to rise, bearing its "umbels" of green flowers along the stout, erect stem in summer. Berry-like purple fruits in late summer.

A solitary, occasional but characteristic Oak woods plant. It solves the problem of shade by growing above the ground herbs and even the shrubs and saplings! Probably requires many years to attain mature size.

HERB, PALMATELY COMPOUND, LEAFLETS COMPOUND



WOOD ANEMONE or
WINDFLOWER

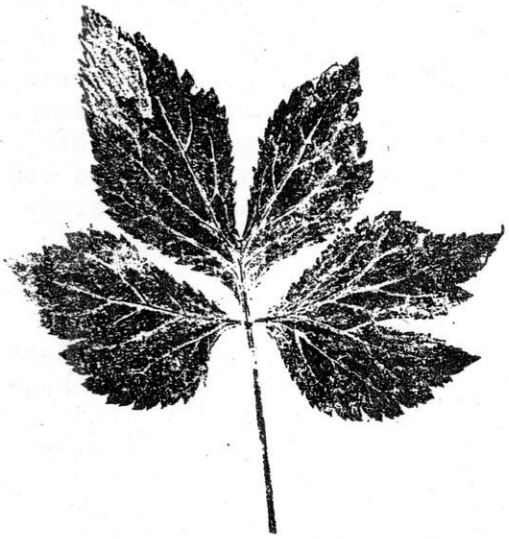
In contrast to Spikenard, this is one of our smallest herbs - seldom over 4 inches high.

Young plants bear a single 3-parted leaf. Older plants bear a stem with a whorl of three 3-parted leaves surrounding a single white flower, reddish outside.

This is one of the shade escaping herbs coming up very early, flowering in April-May and often showing Fall color already when the trees reach full leaf. The plant then remains underground until next April.

Curiously, however, it is not a plant of the shady climax Maple forest but of Oak woods, pastures, brush and even prairies. By runners a plant forms a patch 1-2 feet wide.

HERB, PALMATELY COMPOUND, LEAFLETS LOBED OR TOOTHED



HONEWORT

Some of the leaflets deeply and unsymmetrically lobed, others merely toothed (singly or doubly). Sheathing bases.

Flowers clustered atop a 2-3 foot stem - tiny and white in May. Seeds short, curved, not spiny.

A close relative of Sweet Cicely-similar in habit and life history, but generally associated with the climax end of the forest succession while Cicely is also abundant in the earlier Oak stage.

Like Virginia Waterleaf, it can become a pest in paths and in raked wildflower gardens.

HERB, PALMATELY COMPOUND, LEAFLETS LOBED OR TOOTHED

BLACK SNAKEROOT

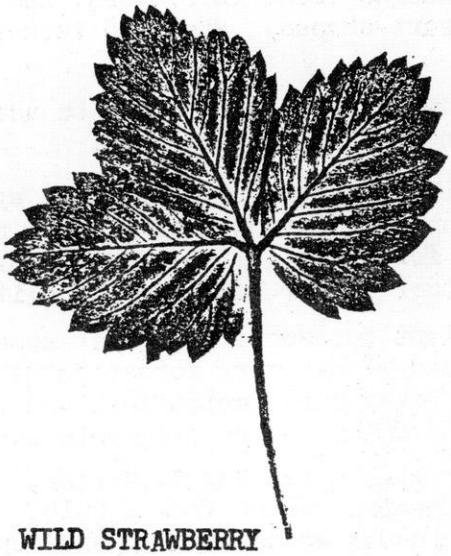
Leaves rounded, 3-5 parted appearing 5-7 parted because the two basal leaflets are divided almost to base. Very dark green - sheathing bases.

Flowers tiny, green or yellowish in small balls atop 2-3 foot stalks in June, followed by small green burs. Only a few flowers in each ball have pistils and develop fruits.

Sometimes solitary, sometimes in colonies but present in almost all Oak stands.

Another carrot family feature is lack of runners.

HERB, PALMATELY COMPOUND, LEAFLETS LOBED OR TOOTHED



WILD STRAWBERRY

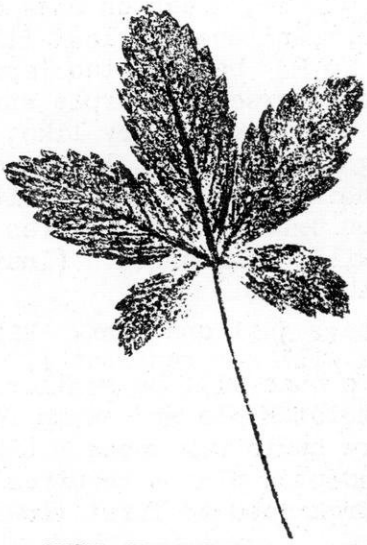
Three equal unlobed leaflets each veined like Elm - appendages at leaf base (not shown).

Very similar to cultivated varieties but often less coarse. Flower white in May. Berries red and small. In the shade the few that develop are eaten prematurely by 4-6 footed people. In sunny places berries are pure delight.

Spreads by special arching runners that touch ground and then root at each leaf.

This prairie and meadow plant persists very frequently in open woods where its early growth is an asset.

HERB, PALMATELY COMPOUND, LEAFLETS LOBED OR TOOTHED



FIVE FINGER or
OLD FIELD CINQUEFOIL

Resembles Strawberry in many respects and is closely related. Differs in:

Leaflets five, flowers yellow, borne mostly on the long runners, fruit smaller and not juicy.

Early growing prairie plant often found in open Oak woods, especially where dry, hilly or sandy, as such spots are usually lacking in dense tree or undergrowth cover.

Early growth is not the rule in the prairies - Spring fires, in fact, punish early growth. The fact that most of the prairie relics persisting in Oak woods are early growers, argues strongly for the value of early growth to forest herbs in escaping the starving effect of tree shade.

HERB, PALMATELY COMPOUND, LEAFLETS LOBED OR TOOTHED

YELLOW WOOD SORREL

Like clover, leaflets three, smooth margined, and droop at night, but the leaf stalk lacks the basal appendages found in clovers, and the leaflets are heart-shaped. Stem 4-8 inches high.

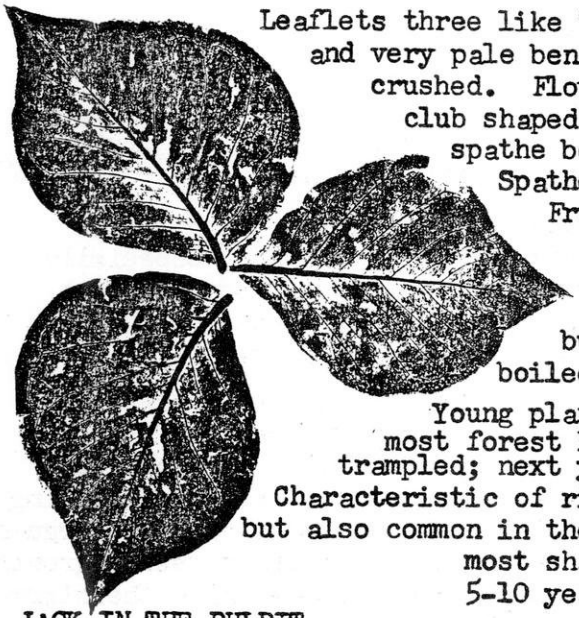
Delicate plant with sour taste - can be used like the garden Nasturtium in salads.

Flowers in small cluster, bright yellow, symmetrical, in summer. Narrow green 5 sided pods spit seeds out for a foot or so. Occasionally spreads by slender runner but usually solitary.

Not a forest plant but sooner or later some individuals found along every forest path. Apparently, it likes bare, moist soil and cool or humid air and tolerates considerable shade.

Violet Wood Sorrel, a small May flowering, summer dormant prairie plant from a bulb, often persists in Oak woods and may show up here too.

HERB, PALMATELY COMPOUND, LEAFLETS LOBED OR TOOTHED

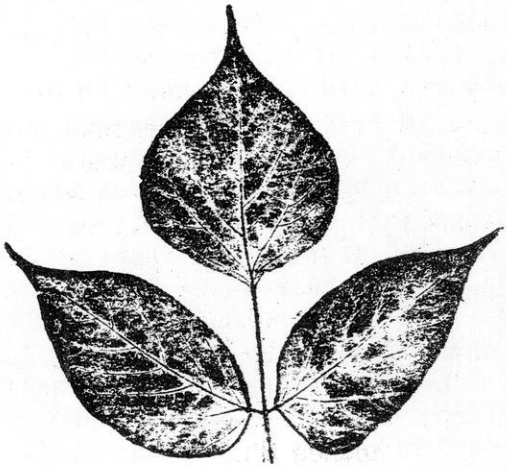


JACK-IN-THE-PULPIT
or INDIAN TURNIP

Leaflets three like Trilliums but pinnately veined and very pale beneath; stems watery and easily crushed. Flowers minute, green on base of club shaped spadix enclosed in leaf-like spathe borne in May between two leaves. Spathe may be green or purple striped. Fruits clustered, berry like, bright orange red, late summer remaining after leaves wither, soon eaten. Both berries and bulb will burn tongue. (Indians boiled bulb first.)

Young plants bear just one leaf. Like most forest herbs will not resprout if trampled; next year's bulb will be smaller. Characteristic of rich moist Maple and swamp forest. but also common in the more humid Oak woods. Like most shade adapted plants requires some 5-10 years from seed to first flowering.

HERB, PALMATELY COMPOUND, LEAFLETS SMOOTH MARGINED



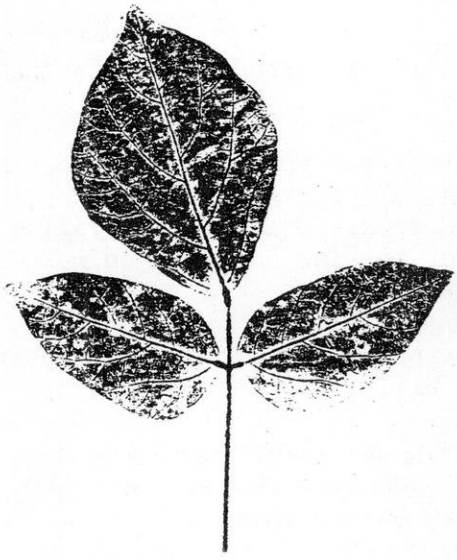
WOODLAND TICK-TREFOIL

Leaflets often broader than in Poison Ivy, long pointed, toothless; leaf stalk swollen at base with two small appendages.

Late to rise; stem 3-4 feet tall with broad cluster of leaves half way up. Flowers like small pink Peas along leafless upper parts in July. Pods divided into purse-like segments, sticky hairy, adhering like ticks to clothes while still green.

Common, very characteristic Oak woods plant and often abundant. One of the few showy summer forest flowers. Long lived, sturdy, solitary forest legume, probably very important in maintaining forests soil's supply of available nitrogen.

HERB, PALMATELY COMPOUND, LEAVES SMOOTH MARGINED



NAKED TICK-TREFOIL

A much smaller edition of the Woodland Tick-Trefoil (its leaves often resemble those of Hog Peanut).

Here the leafless flower stalk arises from the base of the leafy stem.

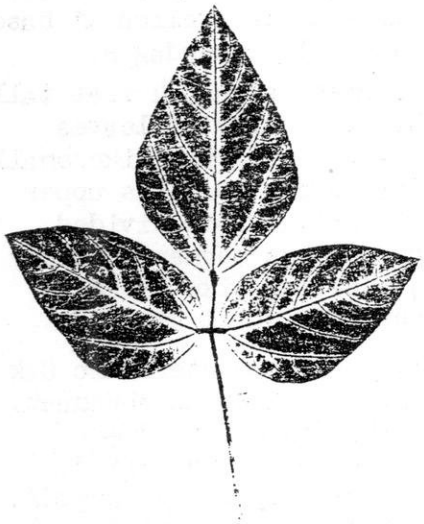
Very late to rise-bearing its pink flowers in August. Fruits similar to Woodland variety.

Less common than Woodland but usually found with it when it does occur.

It can be abundant but inconspicuous when not in flower.

Because steep or sandy soil is able to hold the least quantity of mineral nutrients, this forest benefits from having two nitrogen-pumping perennial legumes.

HERB, PALMATELY COMPOUND, LEAVES SMOOTH MARGINED



HOG PEANUT

Slender annual twining vine with alternate leaves. Flowers like small Peas, clustered along stems, white to lavender in August. Pods split in fall, the halves coiling in each dry period through the winter. Paired-leaved seedlings appear in May.

Found also in Prairies and meadows but most important as a forest legume. Remains small in shade but becomes vigorous in openings just when added nitrogen is needed by fast growing saplings. Short life means quick release of nitrogen and ability to invade openings quickly.

Solves shade problem by vine habit, large seeds and burial of own seeds and self-pollination. Last two accomplished by underground branches which bear tiny special self-fertile flowers which form seed pods right in the ground. Leaflets curiously change position, erect in sun, horizontal in shade and droop at night.

HERB, PALMATELY COMPOUND, LEAVES SMOOTH MARGINED

WOOD BETONY or
LOUSEWORT

Narrow fern-like leaf, lobes paired, round toothed, dark green.

A low plant with rosettes occurring in small patches, stems 6-12 inches high, alternate-leaved, hairy, bearing a short, thick spike of small pale yellow flowers in May. One of the few Snap-Dragon relatives that flower in the spring.

Generally associated with dry or sandy soil either in open prairie or on hilly, sloping Oak woods.

In the Snap-Dragon group the flowers provide a "lip" or platform for bees to land on. Here the lip is curiously curved to one side.

HERB, LEAVES SIMPLE, DEEPLY PINNATELY LOBED

Leaves opposite, on stems 2-3 feet high. Plant inconspicuous until late summer. Probably a late riser.

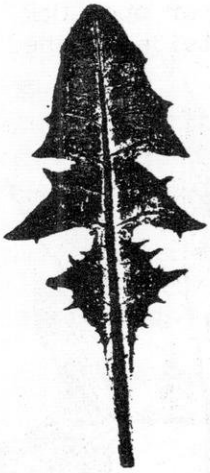
Flowers broadly trumpet shaped, butter yellow in August followed by winter-persistent black capsules. Plant turns black if picked.

This handsome plant of dry or grassy Oak woods or Oak openings has not been grown in gardens because its requirements remain a mystery. Some believe its roots are partially parasitic on other plants.

Its ecology is certainly unusual since it belongs to neither prairie nor Oak forest, but appears to fit best to a transitional stage between them.

SMOOTH FALSE FOXGLOVE
or YELLOW GERARDIA

HERB, LEAVES SIMPLE, DEEPLY PINNATELY LOBED



Leaf variable in depth and fineness of lobing; no two plants exactly alike. Juice milky, flowering stalk hollow.

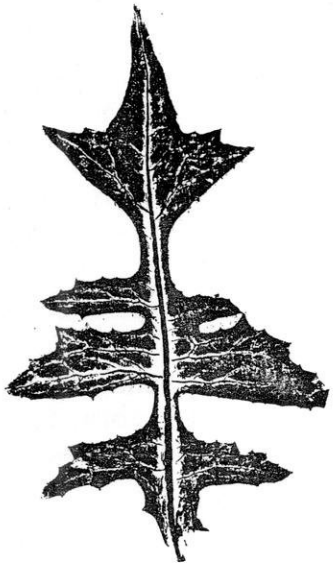
Like Violet, has no true stem above ground; leaves form rosette on very short stem atop vertical taproot. Can flower almost any month of the year except winter, but chiefly in the spring. Seeds float on downy parachutes; blow everywhere.

This abundant perennial weedy plant of lawns, pastures and abandoned fields has one Achilles heel-intolerance of shade.

Hence, it is absent from healthy forest. Unless the shrub, herb, and tree layers are simultaneously opened up by Man or fire or grazing, it will not appear. Note well where it is found in this forest.

DANDELION

HERB, LEAVES SIMPLE, DEEPLY PINNATELY LOBED



WOODLAND
WILD LETTUCE

Leaves very variably lobed but generally like enlarged Dandelion leaves; juice milky, as in fresh store lettuce.

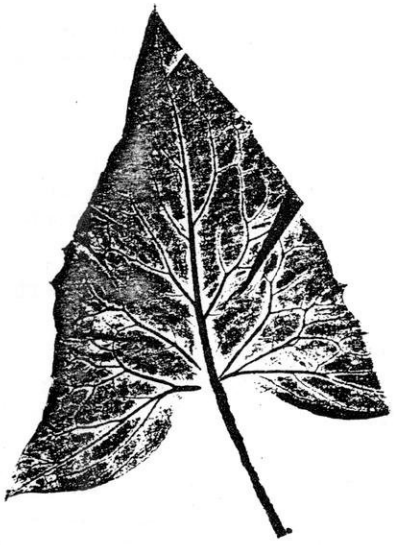
Unlike Dandelion is a biennial or triennial with rosettes 1 or 2 years, then tall 3-8 ft., hollow leafy stem the final year.

Flowers tiny, bluish white in August in terminal branched clusters. Seeds float on white hairs but are smaller than Dandelion's.

A rather watery plant of moist soil in the forest openings and sometimes marshes; seems to benefit from moist air in the shade but does poorly unless there is some opening in the canopy. It is also partial to exposure of bare soil, perhaps because the seeds require light for germination.

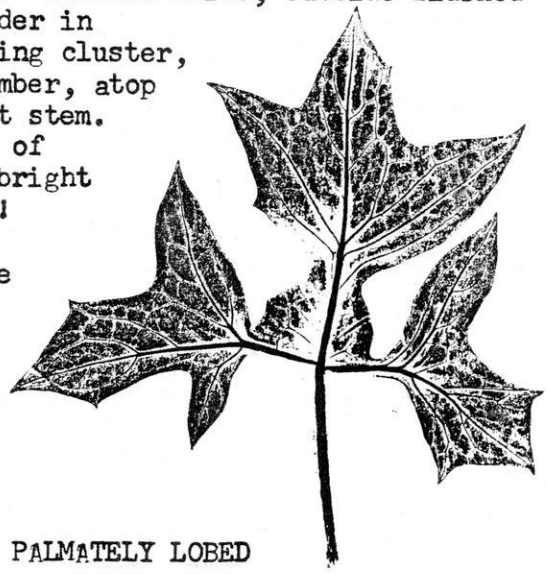
Thus, it is often found in ravines where water washes away the leaf litter in the spring or deposits some silt.

HERB, LEAVES SIMPLE, DEEPLY PINNATELY LOBED

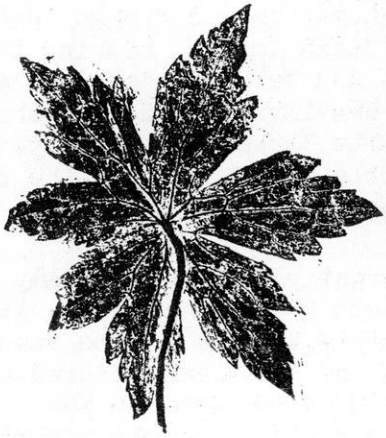


RATTLESNAKE ROOT or
WHITE LETTUCE or
LION'S FOOT

Another lettuce plant with distinctive triangular leaves sometimes hardly lobed. Solitary short-lived perennial, infrequent but characteristic of rather open Oak woods. Flowers white, outside flushed lavender in drooping cluster, September, atop 3 foot stem. Hairs of seed bright brown! Until mature plant bears only one leaf per year.



HERB, LEAVES SIMPLE, DEEPLY PALMATELY LOBED



CRANESBILL or
WILD GERANIUM

Leaves reddish underneath when young; blades form almost complete circle of lobes with stalk at center. Short, stout, branched reddish underground stems form small but leafy clumps.

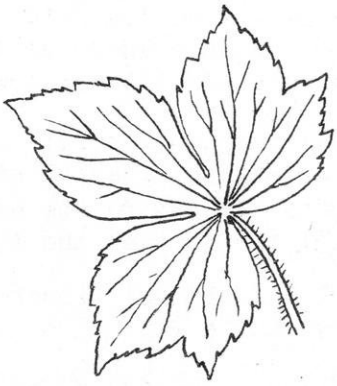
Although one of the May wildflowers, it keeps growing in size and the peak of flowering comes in June.

Flowers symmetrical, 5-petaled, pink and loosely clustered on 1-3 foot stems.

Curious pod splits into five outwardly curving strips each snapping one seed into the air as it breaks away.

A very abundant and characteristic Oak woods herb.

HERB, LEAVES SIMPLE, DEEPLY PALMATELY LOBED



HOOKED CROWFOOT

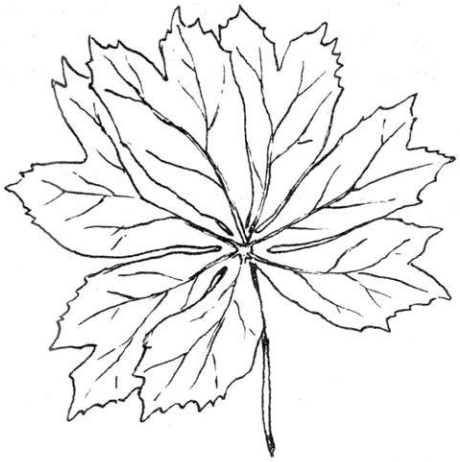
Leaves quite flat, smooth, clear green; stems and stalks with spreading stiff hairs. Flowers small, green, June. Tiny hooked green seeds.

A small solitary herb whose rosettes are conspicuous in June and September.

Often found along paths where there is little litter. Prefers moist spots in the woods but occurs in Oak as well as swamp forests. Fall growth enables plant to store food twice a year - or after, as well as before, the season of full tree shade.

The Crowfoots or Buttercup group has lobed or compound leaves but lacks the basal appendages found in the rose and legume families.

HERB, SIMPLE LEAVES, DEEPLY PALMATELY LOBED



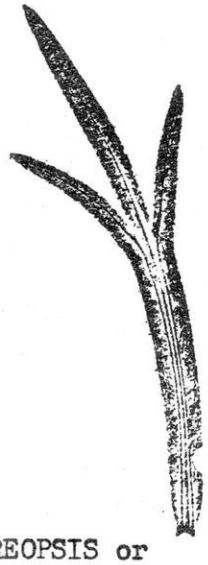
MAYAPPLE or MANDRAKE

Large, shiny umbrella-like leaves ½-1 foot across in large patches formed by underground stems.

Young shoots bear a single leaf; mature stems forked, bearing two leaves, and between them a single, large, heavily scented, cup-shaped, waxy white flower in late May. Fruit pale green, shaped like a small lemon--edible but sickly sweet.

This forest plant is unusually persistent once established; it will thrive even after the trees are cut and the land pastured--yet, it does not grow in the native prairie. Perhaps its seeds grow only under forest conditions for its initial introduction.

HERB, LEAVES SIMPLE, DEEPLY PALMATELY LOBED



COREOPSIS or TICKSEED

Narrow lobes branch from middle of leaf.

Leaves opposite on 1-3 foot stems; a prairie plant forming small dense stands, each stem topped in July by a bright yellow Daisy. It often persists in open Oak woods although its growth there is weak and flowers few.

Summer flowering prairie plants rarely persist in woods, but this plant's erect stem and underground shoots may retard its extermination here, by helping it seek the light.

The garden Coreopsis has similar flowers but long strap-shaped leaves.

The Daisy family is characterized by many small flowers clustered in heads. Each head looks like one flower. The outermost flowers often look like single petals.

HERB, LEAVES SIMPLE, DEEPLY PALMATELY LOBED

FINE or ELEGANT BEDSTRAW

Delicate dark green plant forming tangled masses 8 inches high; stems finely bristly, sticking to other stems for support. Leaves in whorls of 5's or 6's along stem as shown here.

Tiny pure white flowers are held in airy clusters above the leaves in July.

Forms small patches by fine underground shoots. Very characteristic of Oak stands.

This is the finest of the Bedstraws all of which have very slender, weak basal stems and very shallow roots; this one hardly extends below the leaf-mold layer.

HERB, LEAVES SIMPLE, UNLOBED AND WHORLED ON STEM

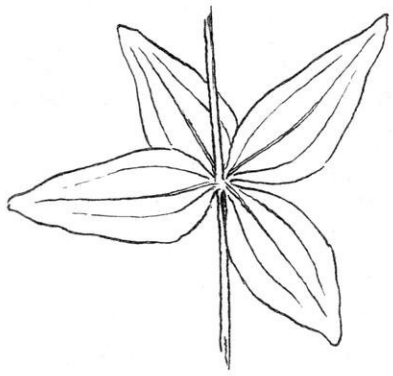
SWEET-SCENTED BEDSTRAW

Leaves about 6 to a whorl, stem sticky bristly. Much larger than fine Bedstraw with several floppy 1-2 feet stems radiating from a single point. Leaves bristly along edges, gradually smaller towards stem tip as shown.

Flowers often in 3's along stem--small and green in July. Fruits tiny, round and covered with tiny hooked hairs like those of Tick Trefoil. Stem reportedly sweet smelling after drying.
Solitary, often infrequent but very characteristic member of Oak community.

The Bedstraw group, also known as the Cleavers and Goosegrass, has a unique way of conserving scarce light energy - like other vines, they put a minimum of carbohydrate into stem strength but rely on bristles to keep them from slipping down into the shade of adjacent plants.

HERB, LEAVES SIMPLE, UNLOBED AND WHORLED ON STEM



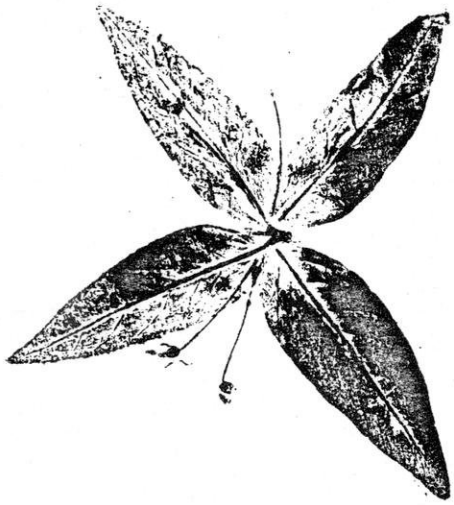
WILD LICORICE

One of the largest Bedstraws - only 4 leaves in a whorl; thus, resembling whorled Loosestrife, but not that large. Flowers green, tiny in summer. Fruits small, round and bristly.

Origin of name "Wild Licorice" uncertain; the true Wild Licorice is a legume with pinnate leaves and large gummy roots.

A solitary woodland plant, never abundant and not found in all stands. A good example of a plant we know very little about. Yet, it may be useful some day either medicinally or as an ecological indicator.

HERB, LEAVES SIMPLE, UNLOBED AND WHORLED ON STEM



WHORLED LOOSESTRIFE

Leaves in 4's or 5's, one whorl shown. Flowers in 4's also, star like, yellow with dark spots, in June.

Forms patches by underground stems.

Common in dry, sandy or rocky and sloping places and grows quite well in woods, where it is not too shady.

Perhaps, if one were to map its location in this woods, it would be found to coincide with certain soil types or underlying rocks. (Refer to map of Soils of the Madison School Forest by Professor Frances Hole.)

HERB, LEAVES SIMPLE, UNLOBED AND WHORLED ON STEM

CULVER'S ROOT

Leaves 3-7 at a point, usually 5 forming star-like whorls on the stem, dark green.

Stems erect 2-4 feet high in July topped with showy bottle brush spikes of small white flowers which have fuzzy stames at right angles to the spikes.

Found in a variety of places but best considered to be a prairie plant which often persists in Oak woods, being one of the few showy summer prairie flowers to do so.

Forms clumps or small colonies. Growth may be tall but it is rather weak in the shade.

HERB, LEAVES SIMPLY, UNLOBED, WHORLED ON STEM

WOODLAND
JOE-PYE-WEED

Largest leaves of the whorled plants. Leaves occur in 3's - 5's. A tall herb whose stems may reach 8 feet or more. Flowers in tiny, pink heads, the heads numerous in a large dome shaped mass on top of the stem in August.

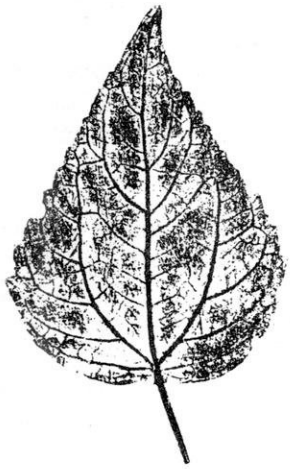
Like Woodland Lettuce, it is characteristic of the forest even though it grows better in moist openings in the woods.

Our two similar Joe-Pye-Weeds illustrate divergent evolution in both ecology and plant form. The wet meadow species has flat topped masses of flowers and requires more sun and more moisture than the woodland variety.

Other examples are Wild Lettuce, Blue Violet, and Meadowrue, each of which has both forest and prairie counterparts.

Name comes from Joe Pye, a New England indian, who used the plant in remedies for fever.

HERB, LEAVES SIMPLE, UNLOBED, WHORLED ON STEM



WHITE SNAKEROOT

Best identified by the insect that eats it. Leaves are dark green, almost always infested with leaf-miners whose tiny green larvae leave winding whitish trails where they have eaten the "meat" of the leaf while leaving the upper and lower "skin" intact.

Two foot stem, solitary or at best several from center of a dense mass of radiating roots just below the soil surface. Leafy stems "do nothing" all summer, then suddenly produce large flat topped clusters of small white heads in September followed by tiny Dandelion-like seeds that blow after first frost.

Normally infrequent, but after fire, erosion or grazing, becomes very abundant and weedy; hence, an excellent indicator of land abuse.

Plant is poisonous to cattle and through milk to man. This fact was discovered during widespread forest grazing in Depression Days.

HERB, SIMPLE LEAVES, UNLOBED, OPPOSITE, TOOTHED

LOPSEED

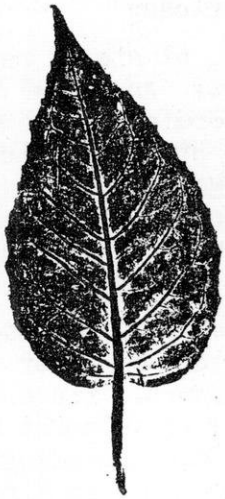
Very closely resembles White Snakeroot but lacks leaf miners; squarish stem slightly swollen where leaves attach; roots sparse.

Stem leafy, usually solitary; flowers small, pinkish in terminal spike in July. Curious one-seeded fruits look like tiny grasshoppers ready to jump off spike. Three-hooked bristles on each fruit cling fast to clothing, even to the hair of one's arm!

Individuals infrequent but very characteristic of Oak woods. Like White Snakeroot, tends to increase with disturbance, but is more sensitive to full sunlight.

Unlike the Spring herbs that have a single stem, it has dormant buds on stem base; if one breaks stem, these will resprout the same season and restore some loss of stored food. New sprouts are not as vigorous as original and growth in shade is slow so that even with its resprouting technique, makes a poor forage plant.

HERB, SIMPLE LEAVES, UNLOBED, OPPOSITE, TOOTHED



Leaf thin, smooth, concave on margin between shallow teeth. Small plant (6-12 inches) with delicate, watery, semi-translucent stem swollen where leaves attach.

Early light green rosettes benefit from Spring sunshine - note position of leaves along two axes at right angles, characteristic of opposite arrangement in plants.

In summer leaves horizontal, flat, dark green. In July stem bears spike of tiny white flowers followed by tiny melon-shaped, sticky-hairy burs, green to brown.

Forms loose colonies because several long, slender runners in leafmold end in small white tubers which store food in late summer for early growth of rosettes in May.

A very common herb of both Oak and Maple forest. Like most shade plants it flowers best where shrubs and large herbs are absent.

ENCHANTERS NIGHTSHADE

HERB, SIMPLE LEAVES, UNLOBED, OPPOSITE AND TOOTHED

Grasp it very firmly or not at all! Entire plant covered with hollow hairs which, when merely brushed and not broken, act like tiny hypodermic needles and inject an irritant which burns for several minutes.

Stems tough, slender, up to 6 feet tall bearing among upper leaves clustered spreading spikes of many tiny greenish flowers in July. The lower flowers contain stamens which explode one by one each producing a puff of air-borne pollen visible in a shaft of sunlight.

This weedy but long lived perennial of disturbed wet places is occasionally found in moist spots in the woods.

Forms clumps with large masses of underground roots and short stems.

The fact that it invades only bare ground probably indicates high light requirements often associated with small seeds.

TALL or STINGING NETTLE

HERB, SIMPLE LEAVES, UNLOBED, OPPOSITE AND TOOTHED

CLEARWEED or
RICHWEED

Leaf teeth large, as in its relative, the Nettle; but it lacks stinging hairs. Has three very prominent veins and very translucent stems. Leaves glossy.

Flowers green and tiny, clustered near top of leafy stem in August. An annual and, hence, size varies according to the favorability of the habitat at the particular place and season. Crowded in shade, mature plants may be only an inch tall; in a moist but open and sunny spot, a solitary plant may reach 2 feet or more.

Quick growth may be possible in shade because the stem relies more on water than on carbohydrate for support. Its dependence on water restricts it to moist or humid spots but it is found in almost every forest stand - but hard to find in droughts.

HERB, SIMPLE LEAVES, UNLOBED, OPPOSITE AND TOOTHED

WILD BERGAMOT

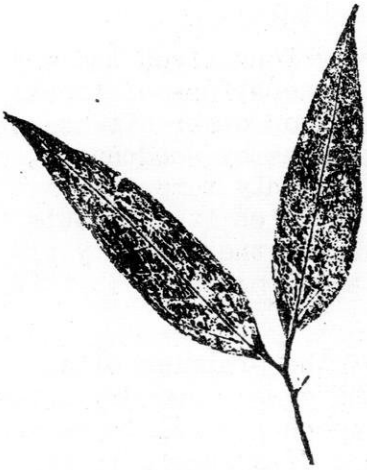
Leaf narrow, pointed - with forward pointing teeth. Stem square; entire plant has pleasant scent, indicating membership in the mint family.

The familiar prairie and roadside plant, 2-3 feet tall, topped by circular, horizontal clusters of showy lavender flowers in July.

Flowers poorly in shade but though flowering poorly, it is found here and there in this Oak forest as one more reminder of the forests, prairie or Oak opening origin.

Plant rather short lived or at least moves to new spots via its slender runners at soil surface. It is assumed to be a relic rather than a repeated invader via seed; yet, it remains for someone to prove this assumption. A little close observation here would soon tell.

HERB, SIMPLE LEAVES, UNLOBED, OPPOSITE, TOOTHED



ROUGH or WOODLAND SUNFLOWER

Leaves very rough like sandpaper, the larger ones sometimes with a few teeth. (Small leaves are shown here.)

Forms dense patches of upright stems 3-5 feet tall, each ending in a large Daisy in July.

A very abundant prairie and Oak woods plant, growing best in grassy openings.

Spreading in chain reaction fashion, each stem base sends out each fall two or three underground runners, each ending in a food storing tuber; stems and runners die, leaving tubers to grow in spring.

With stored food to aid early growth, the stems soon overtop other plants, but their mode of spreading is so successful that they tend to overcrowd each other. Then, only the stems on the outside do well.

HERB, SIMPLE LEAVES, UNLOBED, OPPOSITE, SMOOTH MARGINS

SELF-HEAL or HEAL-ALL

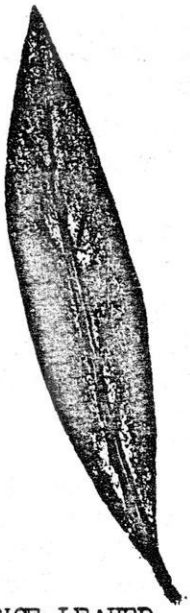
Leaves varying in length, often very blunt, often wavy margined or slightly toothed.

A low plant of prairies, lawns, roadsides and along paths, even in considerable shade. In summer 2-8 inch stems are topped with a close green to reddish head, from which emerges small 2 lipped blue and white flowers which resemble orchids, although it is really of the Mint family.

Its preference for paths indicates that both herbs and leaf litter hinder its growth or at least the germination of its small seeds.

Its tolerance of some trampling and mowing indicates either tough stems or readiness to resprout--perhaps both. Sometimes it will form a small patch probably because its stems will take root if pressed onto the ground.

HERB, SIMPLE LEAVES, UNLOBED, OPPOSITE, SMOOTH MARGINS



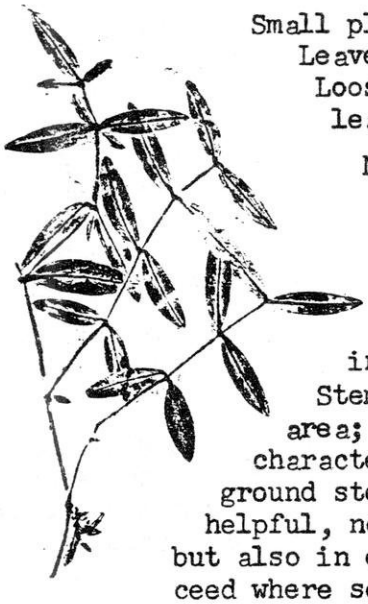
LANCE-LEAVED
LOOSESTRIFE

Leaf pointed; short and unbranched, 2-4 inch shoots in groups or patches connected by underground stems. Flowers yellow in July, near top of stems and scarce in shade.

Though small, this herb is very long lived and may easily have outlived several generations of trees! In fact, only some fatal fungus or other disease can kill such a plant. Fires, grazing by woodchucks, or defoliating by grasshoppers are only temporary set backs because of the ease with which it resprouts from underground stems. Probably the majority of our wild herbs are as tough and long lived as this one.

A small ground cover plant of the prairies often persisting in Oak woods in the grassy and dry spots. In the open the patches may reach several yards in diameter. Here it shows signs of struggle in its few weak stems. Thus, it does have one fatal enemy--dense forest shade.

HERB, SIMPLE LEAVES, UNLOBED, OPPOSITE AND SMOOTH MARGINS



Small plant 2-6 inches, often with stem branched. Leaves somewhat shorter and more blunt than Loosestrife. Flowers white in May among leaves.

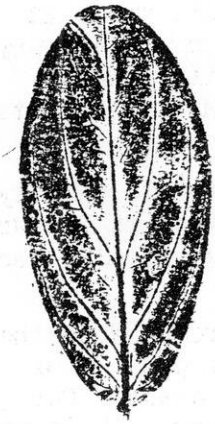
Most Sandworts are confined to sandy soil and prefer the open. This one does well in considerable shade and does not have to have sand.

A rather common woodland plant, inconspicuous like Bedstraws except when in flower.

Stems are found scattered over a considerable area; and then none for some distance. This is characteristic of all plants that spread by underground stems or runners. The runner habit is very helpful, not only in searching for less shady spots, but also in escaping depleted soil. Runners can succeed where seeds may fail.

WOODLAND or SIDE-FLOWERED
SANDWORT

HERB, SIMPLE LEAVES, UNLOBED, OPPOSITE, SMOOTH MARGINS



DOTTED
ST. JOHN'S-WORT

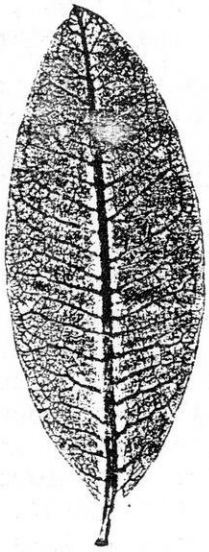
The St. John's-Worts have small roundish, smooth leaves and often bear small leafy rosetts along the stem. Look for tiny dots all over the leaf.

Flowers small, yellow each lasting but a day, clustered atop 2-3 foot stems in July-August. The petals are streaked with dark lines, especially in the bud. Seeds are dust like.

An infrequent plant of forest openings and grassy Oak woods or along paths. Another plant that follows the rule: small seeds mean tiny seedlings which require light directly on the ground from the very start. Hence, it gets started only where there is neither litter nor sod or other ground herbs.

Once established, the plant can hold its own if the neighboring plants are not too shady.

HERB, SIMPLE LEAVES, UNLOBED, OPPOSITE AND SMOOTH MARGINS



COMMON MILKWEED

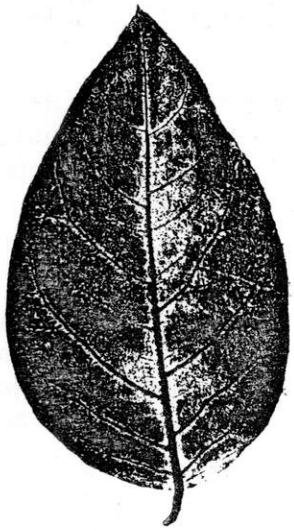
Robust, coarse plant, milky juice, thick leaves with strong midrib and fine net of veins.

The best known of the Milkweed group, forming patches by underground stems in fields, roadsides, meadows and prairies. Flowers in large "umbels" along the stem, old rose, in July, followed by warty pods which release thistle-like silky-hairy seeds in fall.

Though not a forest plant, a few are certain to persist in or invade the openings in every Oak woods--where they rarely bloom.

There is also present in this stand a forest Milkweed whose leaves are sharp pointed at both ends but whose drooping flowers have the typical Milkweed's reflexed petals and curious 5-sided central "pollen automat" from which bees of the right size are able to lift pre-packaged masses of pollen. This plant is so infrequent that only a keen scout will find one (flowers in June).

HERB, SIMPLE LEAVES, UNLOBED, OPPOSITE, SMOOTH MARGINS



SPREADING DOGBANE

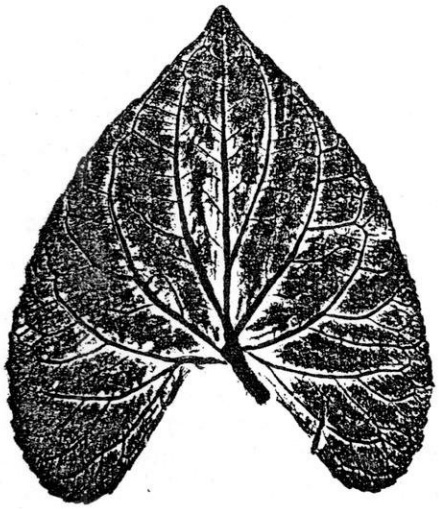
Stems often bearing spreading leafy branches near the top - juice milky.

Stems scattered, connected by long underground runners. Flowers small, pink, at branch tips in June followed by long, very thin, hanging pods bearing silky seeds. Though it is related to the Milkweeds, its flowers are constructed differently.

A prairie and forest border plant commonly persisting in weakened condition in Oak woods but seldom accumulating enough surplus carbohydrate to flower.

Again the problem arises - are we sure the Dogbanes are relics of former prairie or invaders via their windblown seeds? Our guess is that a plant requiring much light for maximum growth would be unlikely to succeed as a small seedling except in a very sunny location. We'll stand by the relic theory.

HERBS, SIMPLE LEAVES, UNLOBED, OPPOSITE, SMOOTH MARGINS



WOODLAND BLUE VIOLET

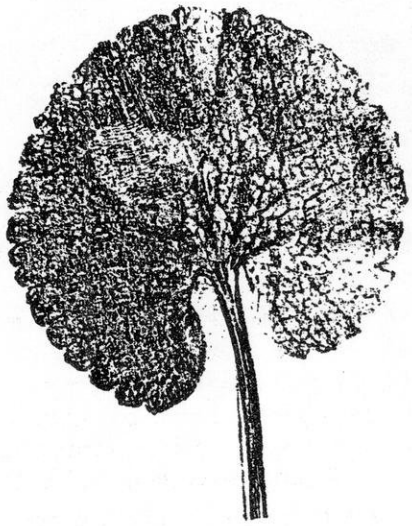
Violet leaves vary from heart shapped to almost round, but always have a tough central fiber in their stalks.

Most violets, like this one, have no true stems above ground; leaves and flower stalks arise directly from fat, short branched stems on or in the soil.

A common forest herb, bearing two kinds of flowers, big spurred ones for the benefit of man and bees in May, and tiny self-fertile ones all summer which add to the seed crop. Chipmunks like to eat the pods before they have split into 3 parts and sent the hard round seeds into the air. These seeds are probably then carried by ants--important forest seed dispersal agents.

The pre-formed Spring flowers need only a brief cold to trigger bloom; they sometimes flower in long Falls.

HERB, SIMPLE LEAVES, UNLOBED, ALTERNATE, HEART-SHAPED BASE



SMALL FLOWERED CROWFOOT

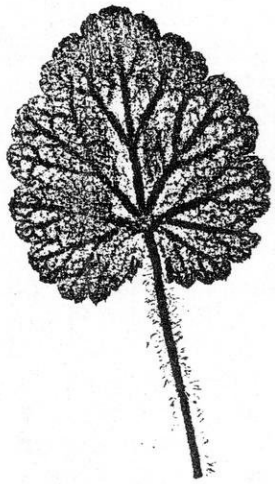
Teeth rounded. Leaves sometimes closely resemble those of Violet; but plant sends up an erect, branched 6-12 inch stem in April or May which has very different, lobed or slender leaves. Plant solitary.

Flowers of this Buttercup are disappointing: pale yellow but very tiny in May followed by tiny clusters of green seeds.

A common herb found in many habitats in the spring but best developed on bare ground in partial shade. Certain to be found in every Oak stand.

A study of its distribution might give valuable information as an indicator of such items as moisture, erosion and animal activity.

HERB, SIMPLE LEAVES, UNLOBED, ALTERNATE, HEART-SHAPED BASE



ALUM-ROOT

Leaves doubly toothed or slightly lobed, resembling its relative, the Gooseberry, but covered with long hairs.

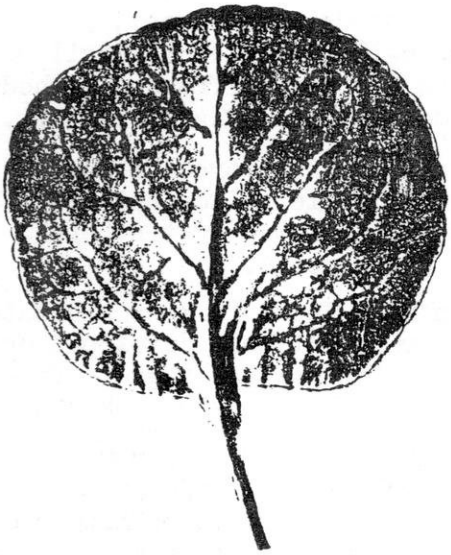
A plant of prairies and rocky, wooded bluffs, here persisting in shade but flowering poorly.

Flowers are inconspicuous, green with orange stamens, on loosely branched, hairy 1-2 foot stems in May-June.

One of the few runnerless prairie herbs in this Oak stand. Note it is found where slopes or sandy soils keep tree and shrub and herb cover from becoming too dense.

Because its habitat overlaps both prairie and forest, Alum-Root reminds us that our classification of plant communities is arbitrary.

HERB, SIMPLE LEAVES, UNLOBED, ALTERNATE, HEART-SHAPED BASE



SHIN-LEAF

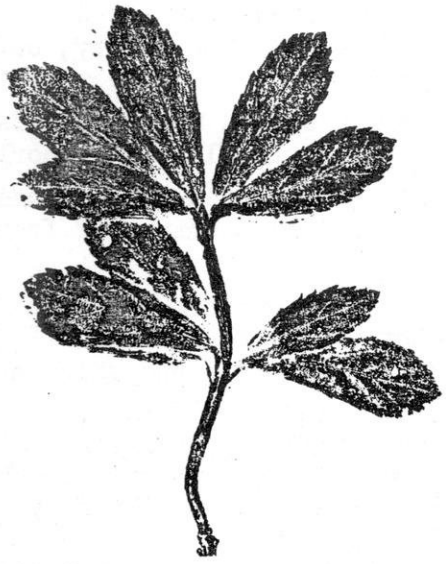
Leaves round and shiny, living over winter. In spring, green or bronzy; replaced by new leaves in summer.

Rosettes scattered over area often several yards in diameter connected by long, slender underground runners. Each year a few of these rosettes send up bare 6-inch stalks in July, bearing several white, waxy very fragrant flowers with curving pistils.

The only Evergreen seed plant characteristic of the Oak community--with which it may have recently become associated. Most of its relatives are found under Evergreen trees and probably evolved with them.

Very few low Oak herbs flower in summer instead of spring.

HERB, SIMPLE LEAVES, UNLOBED, ALTERNATE, EVERGREEN



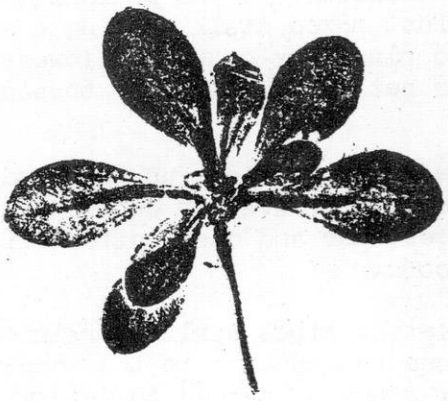
PIPSISSEWA or PRINCE'S PINE

Leaves thick, toothed, glossy, dark green. Really a tiny Evergreen shrub since erect 2-4 inch stems winter over with the leaves and add further top growth the next season. Result: a stem with 2 groups of leaves, as shown.

Growth habit is as in its relative, the Shin-Leaf; flowers pinkish white, waxy and fragrant in July atop leafy stem.

A plant of dry, sandy, acid woods and usually associated with Pines. Its presence here is thought to indicate that in dryer, cooler eras Pines grew on these sandy hilltops. While Pipsissewa seeds perhaps germinate only in Pine communities, the plant once established can live almost forever if the environment does not change too much!

HERB, SIMPLE LEAVES, UNLOBED, ALTERNATE, EVERGREEN



PUSSYTOES or LADIES' TOBACCO

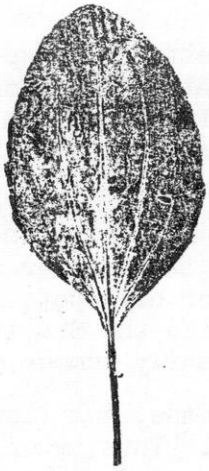
Leaves small, white-hairy in rosettes connected by underground runners forming small colonies.

One of the first prairie and sand barren plants to flower, sending up small white heads in April. Female plants later bear small white-fuzzy seeds.

In sun forms extensive, dense, low sods which compete with grass by producing a chemical which hinders the growth of other plants.

In shade rosettes are much more sparse but its early growth and tolerance of poor soil enable it to persist in Oak woods, mostly on the more open, poorer and drier SW slopes where other growth is thin.

HERB, SIMPLE LEAVES, UNLOBED, ALTERNATE, IN GROUND ROSETTE



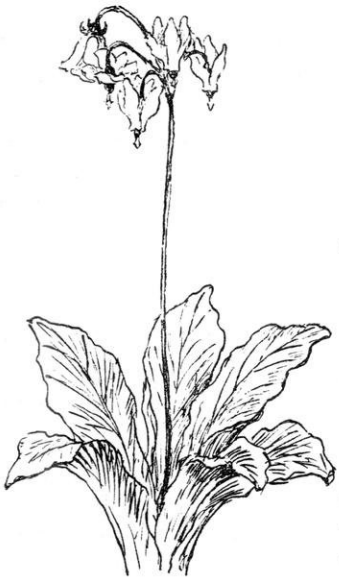
COMMON PLANTAIN

Leaves medium to large, without hairs, in solitary rosettes. Leaf stalk contains strong fibers. As in some forms of Pussytoes, the veins tend to be palmately arranged; worse still, they go almost to the leaf tip, thus making the leaf almost parallel veined. Problems like these make the species of these last pages most difficult.

A very late plant to start growth, seldom conspicuous till summer. Leafless 3-10 inch spikes of tiny green flowers are sent up in July-August.

One of our few really shade tolerant weeds, but it is soon excluded by litter or dense ground herbs. Found in lawns, especially shady ones and along paths in woods. Can stand trampling and mowing. Lacking runners, it must reproduce frequently by seeds, for individuals appear to be short lived. Thus, its dust-like seeds explain its preference for bare ground.

HERB, SIMPLE LEAVES, UNLOBED, ALTERNATE, IN GROUND ROSETTE



SHOOTING STAR

Leaves long, tongue-like, without hairs, often reddish on stalk or mid-vein, light green. Solitary rosettes conspicuous in the spring.

A well known wildflower of the prairie, sending up a 1-2 foot naked stalk bearing a showy cluster of drooping pink or white flowers in late May. The petals are strongly turned back.

The rather fleshy roots store up food and then the leaves wither away in June; hence, it is a shade escaper and does quite well in a shady Oak woods.

Probably persisting since earlier prairie days but perhaps reproducing in the shade as well. Further study is needed to determine the success of its seedlings in grass sod compared to Oak leaf litter.

HERB, SIMPLE LEAVES, UNLOBED, ALTERNATE, IN GROUND ROSETTE

KRIGIA

Leaves tongue-shaped with winged stalk, often bluish with a slight bloom. Milky juice

In May-June the solitary rosette sends up a 2-3 foot stalk bearing a sheathing leaf or two and several small bright yellow Dandelion-like heads. Seeds have smaller parachutes than Dandelion.

This Dandelion relative is a little known but attractive plant of prairies and poor or sandy soils. It persists in open or dry spots in Oak woods, perhaps because like the Shooting Star it goes underground in early summer.

Rarely flowers well in the shade, but flowering plants sometimes die out. Thus, when it does flower, it may have to reproduce by seed in order to maintain itself here.

HERB, SIMPLE LEAVES, UNLOBED, ALTERNATE, IN GROUND ROSETTE

Leaves very small and rather bluish-green, smooth-margined. Stems in small groups connected by underground runners. No hairs.

Flowers small, white, very long lasting, in flat topped clusters in May atop 6-inch stems.

A plant of dry, sandy ground found in prairie and open Oak woods. Said to be parasitic on other plants.

Where trees are scattered it forms rather dense patches but here the growth is weaker and more sparse.

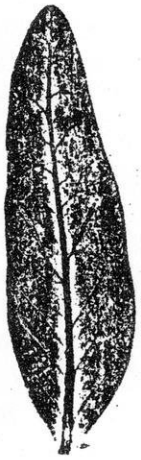
Perhaps the plant could be used as an indicator of soil type or moisture, but its need for light and a proper host plant complicates exact value.

COMANDRA

HERB, SIMPLE LEAVES, UNLOBED, ALTERNATE, ALL ON ERECT STEM

Somewhat larger than Comandra, with milky juice; stems single or in solitary clumps of a few. No hairs.

Loose flower clusters atop 3-foot stems in July. Flowers tiny, green, surrounded by five small rounded white petal-like leaves resembling a flower, just as its relative the Poinsettia surrounds its green flowers with huge red leaves.



Spurge is a prairie and sand plant, apparently persisting here from less shady times and suggesting that the soil is probably very light and dry; but poor, sandy soil is also the place of the least-shading Black Oaks and the sparsest herb cover, where prairie plants are spared extinction. Hence, the whole concept of plant indicators can be tricky business.

FLOWERING SPURGE

HERB, SIMPLE LEAVES, UNLOBED, ALTERNATE, ALL ON ERECT STEM

UPRIGHT BINDWEED

Leaf usually abruptly squared off at base. Stems very short with a few leaves; juice milky but plant does not twine like the other Bindweeds.

Stems scattered over a large area from long underground runners. This plant of the prairies and open dry or rocky places probably benefits from its runner habit by seeking out openings between other plants, but here shade is too dense to permit it to develop its huge white Morning Glories.

This is a rather common member of Oak woods like Dogbane; likewise, is rarely identified because flowers are so scarce in the woods. Even the growth is weak; the stems are floppy instead of erect.

HERB, SIMPLE LEAVES, UNLOBED, ALTERNATE, ALL ON ERECT STEM

PELLITORY

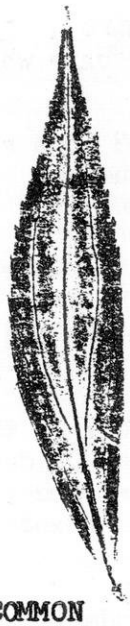
Leaves small, very pale green, rarely with a few teeth or lobes, on delicate watery stems 2-8 inches high.

An annual which develops very rapidly in spring and is in seed before one realizes it has even flowered! Flowers are tiny, green, buried in leafy rosettes all along the stem.

Related to, but more drought resistant, than Clearweed, sometimes found in open sunshine; often found in gardens under shrubs where best growth is towards center of bush, indicating a preference for humid shade over dry, full sunlight. In woods confined to bare ground.

Its delicate nature indicates extent to which it blows itself up with water for its support. Water is cheap, permits quick growth; cellulose on the other hand is hard to come by--especially where shade limits sugar production.

HERB, SIMPLE LEAVES, UNLOBED, ALTERNATE, ALL ON ERECT STEM



COMMON GOLDENROD

Leaves narrow, toothed, finely hairy beneath, numerous on stems; plant has resinous odor when crushed. Forms very dense patches of upright stems 3-4 feet tall, each ending in a one-sided mass of tiny yellow flowers in July-August. Seeds tiny with grey parachutes. Its sticky-waxy pollen is insect carried and probably seldom causes allergy. Many insects hide in its flowers. Its stems are often covered with red or brown plant lice; bulges harbor gall fly larvae.

An abundant prairie and Oak woods plant growing best in grassy openings. Like Rough Sunflower, it is also common in fields and roadsides everywhere. It spreads in the same chain-reaction fashion by underground shoots sent out from each stem in several directions so that each original stem is replaced by several next year. Likewise, it eventually chokes itself and older colonies flower best on the periphery.

HERB, SIMPLE LEAVES, UNLOBED, ALTERNATE, ALL ON ERECT STEM

EARLY GOLDENROD

Lower growing than Common Goldenrod; stems and leaves with few or no hairs; only a few of the rosettes in a patch develop into stems in summer. Rosette leaves are larger than stem leaves. Stems occur on edge of colony.

Flowers, yellow in early July and rare in shade.

This Goldenrod seldom strays from the original prairie; hence, it is a good indicator of prior existence of a prairie flora on this site. Its poor flowering even in grassy openings indicates its high light requirements.

Again some questions - why does this Goldenrod stay with the prairie flora while Common Goldenrod strays into fields, meadows and even open forests? That is--what makes its requirements different in regard to light, etc?

HERB, SIMPLE LEAVES, UNLOBED, ALTERNATE, ROSETTE AND LEAFY STEM

SMOOTH ASTER

Leaves bluish green, very smooth (no hairs), rather narrow but broadly winged to the base which clasps around the stem.

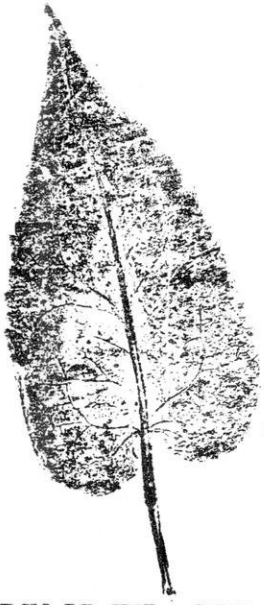
Flower heads in loose cluster atop a 2-3 foot stem in September with ray flowers bright blue and central flowers yellow turning reddish.

The Asters, like most of the Goldenrods to which they are related, send out runners in the fall; but the new plants are few and close to the old dead stem.

This handsome prairie plant will grow well in the garden in sun or partial shade; yet, like Goldenrod in nature, it is strictly a prairie plant and its persistence in Oak forests points to the stand's prior prairie origin.

The Asters are a large group with 20 kinds in Wisconsin--each with different ecology.

HERB, LEAVES SIMPLE, UNLOBED, ALTERNATE, ROSETTE AND LEAFY STEM



ARROW-LEAVED ASTER

Lower leaves arrow shaped, rather rough, dark green, with narrowly winged stalk; stem leaves narrow.

Flower heads numerous, rather small, branched clusters atop 2-3 foot stem in September. Ray flowers white or pale blue, central flowers yellow, turning reddish. Aster seeds are airborne like Dandelion and Goldenrod and are intermediate in size.

This Aster is more characteristic of Oak woods than of prairie--being found almost always with trees; but it prefers openings or places where shrubs and herbs are sparse, and it will become weedy where fire, mowing, grazing or erosion keep down other plants. Thus, its ecology is much like that of White Snakeroot, but it seldom becomes as abundant as Snakeroot even in an abused woods.

HERB, LEAVES SIMPLE, UNLOBED, ALTERNATE, ROSETTE AND LEAFY STEM

Shown is an "average" leaf; rosette leaves may be broader, stem leaves very small and without teeth. Rather slender, delicate plants--especially in the shade. Usually behaves as a biennial, and one may find some new first year rosettes in the fall.

Flower heads several, atop one or a few 2-3 foot stems in June-September, like small Daisies with very many fine ray-petals surrounding a yellow center.

This plant is found in every field, prairie and roadside, and a few continually try to make a go of it along paths in the forest. Its weedy nature is indicated by its quick invasion of fallow fields; but it is a "nice" weed which retires to the status of an occasional plant when dense sod becomes established. Notice that it avoids leaf litter too. Most weeds can be managed very simply--by maintaining a soil covering of sod or litter.

DAISY FLEABANE

HERB, SIMPLE LEAVES, UNLOBED, ALTERNATE, ROSETTE AND LEAFY STEM

Plant covered with stiff short hairs. Leaves tongue shaped. Flowers like orange-yellow Asters in August.

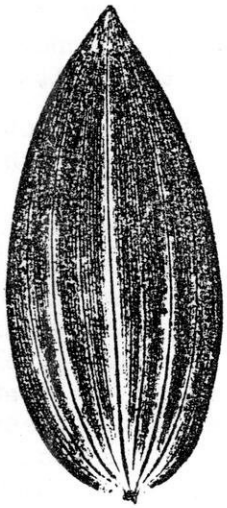
An infrequent but characteristic solitary plant of dry, sandy or grassy Oak woods.

The weedy Hawkweeds which spread by runners (flowers red-orange to yellow) are well known. Again, study is needed to reveal why closely related plants behave so differently. This one is never abundant even in its favorite habitats.

Note that except for a few--Pussytoes, Krigia, and Dandelion--the Daisy family tends to bloom in late summer and fall. In fact, flowering will not occur until nights reach a certain length. Remember too, that late flowering is common in the prairie where plants may store up food all summer. It is thus not surprising that the few woodland members of the family seldom do well in dense shade--where this long period of light gathering is denied them.

BRISTLY HAWKWEED

HERB, LEAVES SIMPLE, UNLOBED, ALTERNATE, ROSETTE AND LEAFY STEM



Stems ½ - 3 feet tall, curving towards horizontal, without hairs. Leaves not stalked.

Flowers green, bell-like, hanging in groups along stem in June. Loved by bumblebees. Blueberries in fall (not good eating).

Thick underground horizontal food-storing stem (rhizome) inches forward and sends up one leafy stem each year. Probably the rhizomes branch occasionally, since colonies are common.

One variety has leaves finely hairy and whitish beneath. More common in the North but occurs here in cool moist woods like this one.

Other variety is altogether smooth, with leaves green on both sides. It is larger and characterizes the prairie-forest border, getting along well in both grasslands and Oak woods.

SOLOMON'S SEAL

HERB, LEAVES PARALLEL VEINED, BROAD

Stem ½ - 3 feet tall, curving towards horizontal, finely hairy, slightly zig-zag.

Plant resembles Solomon's Seal but finely hairy leaves have slight stalks and longer tips. Flowers very many, tiny, creamy-white, in a large cluster at stem tip in June. Berries speckled with brown, in fall turning bright red.

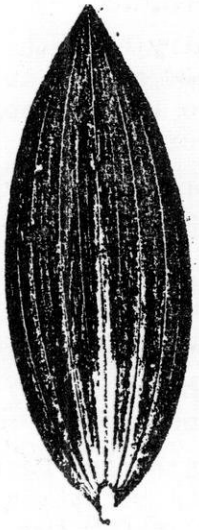
Underground parts as in Solomon's Seal, with scars where old stalks were attached, but rhizome is brownish rather than white.

The plant's age is only suggested by the many scars on the rhizome; the early parts have already died away. Hence, diameter is a better indicator of age than is length. May require 5 - 10 years from seed to first flowering.

A very common and characteristic Oak Woods plant.

GREATER FALSE SOLOMON'S SEAL

HERB, LEAVES PARALLEL VEINED, BROAD



STARRY FALSE SOLOMON'S SEAL

Stem ½ - 2 feet tall, curving only after flowering, smooth; leaves smooth, light or bluish- green, often rather narrow.

Flowers at tip of stem, May, white, numbering only 3 - 14 in cluster. Berries striped with brown, finally dull red.

A prairie, meadow and forest edge plant, in sun forming crowded colonies up to several yards across. In shade, as here, the slender rhizomes do not branch much, and one finds only solitary stems or a group.

Though earlier to rise than True or False Solomon's Seals, this plant obviously suffers more from shade than the other two. Thus, we cannot generalize about plant behavior. These three Solomon's Seals illustrate the importance of accurate recognition if one is to read the landscape properly.

HERB, LEAVES PARALLEL VEINED, BROAD

CANADA MAYFLOWER or WILD LILY-OF THE-VALLEY

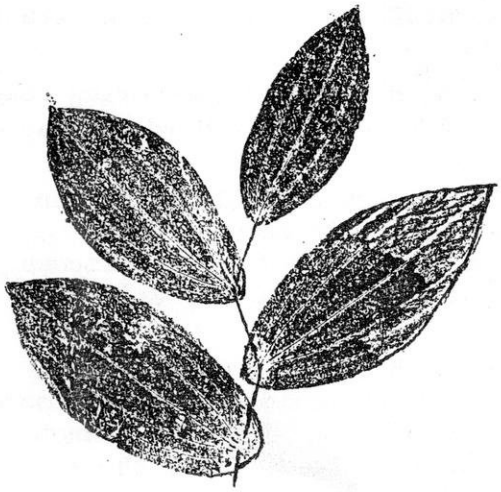
Stems only 2-6 inches high; leaves heart-shaped at base, often slightly hairy.

Young shoots bear one leaf per year; mature ones two or three leaves and a small cluster of white flowers in May; berries finely speckled with brown, finely red.

Forms extensive colonies by underground runners. Found everywhere in the North woods but in southern Wisconsin confined to cool woods and north-facing sandy bluffs. In this forest only three colonies have been found. Hence, their great size can be measured. By measuring the annual advance of the edge, one could estimate their great age!

This is the only member of the Lily family with flower parts in 4's instead of 6's. Otherwise, it is just a small edition of the False Solomon's Seals.

HERB, LEAVES PARALLEL VEINED, BROAD



Base of leaves extend all around the stem as shown here.

Leaves bluegreen, hairy beneath. 1-2 foot stem branched above, at each branch bearing a large drooping pale yellow flower in May.

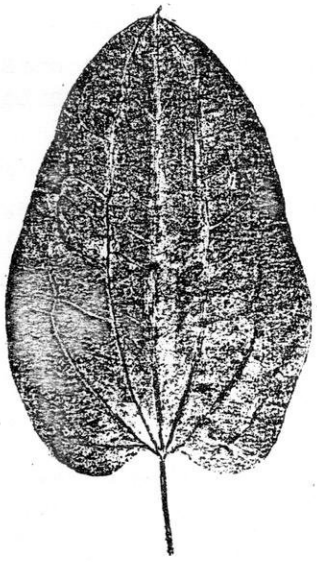
In June the plant spreads out, with horizontal leaves hiding the green 3-angled pods. Like many forest herbs the seeds are rather large, round and heavy with stored food for growth through dense leaf litter.

First year seedling has 2-3 tiny leaves and is 2 inches high.

Forms dense clumps with many roots. Usually infrequent but sometimes very abundant - in both Oak and Maple woods.

BELLWORT or MERRYBELLS

HERB, LEAVES PARALLEL VEINED, BROAD



Leaves often have two tendrils at base.

Flowers green, in small umbels among the lower leaves, ill-smelling and therefore pollinated by flies. Berries shiny, black in fall.

Two forms occur. The woodland variety flowers in May and the stems are only 2-3 feet high, in clumps, not climbing.

The single stem of the forest-edge species rises like a huge Asparagus in June and may reach 15 feet, the upper part of the stem clinging by its tendrils. More common on fence rows than in woods, but sometimes persists where Oaks have taken over prairies.

Both species flower poorly in dense shade, but they have an iron constitution! One clump under observation has not flowered for 20 years and is still waiting for the shrub leaning over it to die!

CARRION FLOWER

HERB, LEAVES PARALLEL VEINED, BROAD

Very pretty ground rosettes of smooth blue-green leaves with network of white veins. 6-8 inch fuzzy spikes of greenish-white flowers in July.

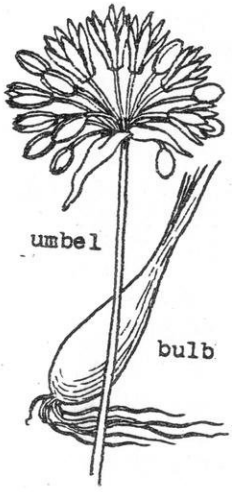
Forms small loose colonies by underground stems. Characteristic of dry, sloping, sandy evergreen and Oak woods with some leafmold but little ground vegetation.

A true wild orchid though its flowers are very small. Most orchids have very exacting requirements. For one thing their seeds are almost microscopic with no stored food. Seedlings often must be fed by a specific ground fungus until they reach some size. Thus, the environment must suit the fungus as well as the mature orchid if it is to grow.

Notice carefully just where Rattlesnake Plantains occur in this woods.

RATTLESNAKE PLANTAIN

HERB, LEAVES PARALLEL VEINED, BROAD



Long, smooth, strap-shaped fleshy leaves in rosettes in May, with strong onion odor.

In June, after these leaves wither away, a naked 6-12 inch stalk appears bearing an umbel of greenish-white star-like flowers. Later each dry fruit splits into 3 parts to expose smooth round shot-like seeds with a pearly gray luster.

This is a native onion with an underground bulb which can be used in outdoor cooking (a little goes a long way!).

A shade-escaping, food storing member of the climax Maple forest, here beginning to invade the Oaks and not yet common. Growth probably is very slow, since the leaves are present only one twelfth of the year! The late flowering habit may take advantage of pollinating insects not abundant before the trees are in leaf.

WILD LEEK

HERB, LEAVES PARALLEL VEINED, NARROW

Plant hairy. Leaves long and narrow, blue-green with short inflated sheaths surrounding very juicy thick stem.

Flowers atop 2-3 foot stem in June, blue, 3-petaled, withering by noon into blobs of purple ink.

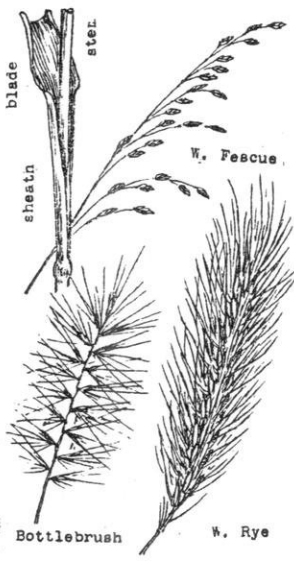
A very handsome prairie and sand plant, occasionally persisting in openings of Oak forest where it may flower but is weak-stemmed.

A clump-forming plant whose fleshy stems and roots account for its success in dry, sandy soil.

The fact that it comes up early and then withers in mid-summer may help Spiderwort survive in the shade.

SPIDERWORT

HERB, LEAVES PARALLEL VEINED, NARROW



Grass leaves have a sheath and a blade. The sheath surrounds the stem but usually is open with sides overlapping - easily seen in Corn, our largest Grass. About 200 kinds of grass grow wild in Wisconsin.

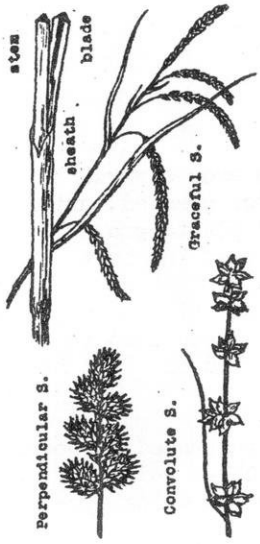
The sod-forming, erosion-preventing grasses are all sun loving. Bluegrass grows poorly in the shade as lawn owners know. Narrow Fescues ("shady place" grass) will make a lawn under scattered Oaks but even they fail under Maples and Elms.

The Tall Bluestem of the prairie does persist along with some Bluegrass in the larger openings in this forest. The weedy Quack and Nimblewill have invaded the clearing.

But there are many forest grasses - solitary, usually relatively broad leaved. Woodland Fescue, Bottlebrush Grass, and Wild Rye are found here. All have 3-foot stems flowering in June-August.

GRASSES

HERB, LEAVES PARALLEL VEINED, NARROW



SEDGES

Sedges resemble grasses but: sheaths are always closed (may break in age); leaves are in 3 rows on stem instead of 2, and rarely are hairy. Stems often triangular. Of the 200 wild Wisconsin Sedges five are common in Oak woods. Found here --

Pennsylvania: the only sod former; fine leaves, red-brown bases and runners, yellow stamens on 6-inch stems, May, dry ground.

Convolute: fine leaves and stems radiate from one point, tiny green seeds with black corkscrew pistils, June.

Graceful: wide leaved, clumps purple based, in colony from runners; drooping green spikes atop 2-3 foot stems, June, moist spots.

Charming: very wide short leaves all from one point, prefers bare ground.

Perpendicular: medium leaves, straight 2-3 foot stem with several knob like green spikes near tip in July.

HERB, LEAVES PARALLEL VEINED, NARROW

YARD RUSH

The Rushes are a third group of the grasslike plants numbering 20 in Wisconsin. In most Rushes the leaves are round, quill-like; many, like this one have two tiny appendages at juncture of blade and sheath. Flowers, unlike Grasses and Sedges, have true petals, numbering 6, like very tiny Lilies though colored brown.

Most Rushes are beach and marsh plants, but Yard Rush is a very common weed with the same ecological characteristics as Plantain: It is small, tough and resistant to trampling, has dust-like seeds, tolerates some shade, is fast growing, but comes up late and flowers in midsummer.

It dislikes competition by other herbs and avoids dense shade or sod or leaf-litter. Like Plantain it follows man along his paths, even into the forest.

HERB, LEAVES PARALLEL VEINED, NARROW

FINGERPRINTING WILD PLANTS

by Alvin M. Peterson

The best way to know wild plants is to grow them in a garden over several years. Next best is to build an "Herbarium" - a library of of pressed, dried labelled and mounted plant specimens. But because most wild plants grow and spread so slowly, and are now so rare, we would exterminate them in short order if everyone dug or picked them.

The next best thing is to make prints of single leaves, like those used in this book. Like fingerprints, leaf prints reveal that each kind of plant has a different pattern of veins as well as a different shape.

Equipment: A pane of glass, 10 x 12 inches; printer's ink (purchased in pound cans at art stores); a jar of vaseline; a putty knife; two rubber rollers such as used by photographers for pasting photos on cardboard; smooth white typewriter paper; rags, waste newspaper.

Step 1: Collect 2 or 3 typical leaves from each plant, making sure you know the identity of each. If not to be printed at once, place leaves between pages of a magazine, or in water to prevent wilting.

Step 2: Using putty knife, place equal amounts of ink and vaseline on the glass, mix well, and then spread uniformly over as much of the glass as needed. Prepare only a little ink at a time; say, the amount that sticks to the knife when dipped into the can of printer's ink. Experience will soon tell you how much to make.

Step 3: Ink one of the rubber rollers by rolling it over the inked surface of the glass.

Step 4: Place a leaf on the inked glass and ink it with the inked roller, running this back and forth until the leaf is uniformly covered with ink on both sides.

Step 5: Place the inked leaf between two sheets of typewriter paper and lay them on a flat surface. Place a piece of newspaper on top. Now do the printing by running the clean roller over the newspaper. Use considerable pressure but keep it uniform. The result is two prints, one of the upper leaf surface and one of the lower.

It takes experience to get the best prints. Some leaves print best when newly picked. Others, especially thick fleshy leaves, and those with thick soft stalks, should first be pressed for a day or even several days between pages of magazine or newspaper. Be sure several pages separate one leaf from the next. Place the magazine between two boards and place some bricks or other weights on the resulting "sandwich".

The first or earliest leaves are more tender and easily torn than the same leaves later in the season. Older, tougher leaves make the best prints.

The underside print often shows the veins best. But some leaves have hairy undersides. It takes more skill to get a satisfactory print of a hairy leaf.

Most of the illustrations in this book were made from leaf prints. Some were reduced photographically, others not. For example, Wild Black Cherry was reduced more than the Chokecherry; Bittersweet more than Juneberry. Even worse, the Juneberry print happened to be an unusually large leaf to begin with. Thus, the size of leaf illustrated is not to be compared with the other leaves in the book. It does not matter because on any plant one can find both large and small leaves.

In the field, however, the general size of the majority of the leaves is a good clue to the plant's identity in many cases (Blueberry leaves are always very small, Nannyberry leaves are quite large, and Wild Sarsaparilla leaves are about ten times as large as that! Butternut and Spikenard leaves may reach a yard long!).

Index to Plants of the Forest

The number of seed plants and ferns which grow wild in Wisconsin is estimated to be 1800. About one ninth of these have been found to date in the Madison School Forest - 49 woody plants and 149 herbs. All of these plants are listed by their popular names with their scientific names following in parenthesis. Page numbers are given for the 40 woody plants and 86 herbs illustrated in Chapter 10.

Some 25 mosses occur in the forest - mostly on tree bases. Mushrooms and other fungi are abundant. These lower plants also deserve attention but they need further study here before listing.

INDEX

-Page

Adam-and-Eve Orchid (Aplectrum)-------
Agrimony (A.gryposepala)---------- 108
Alexanders,Golden (Zizia aurea)------ 110
Alum-root (Heuchera richardsonii)---- 131
Anemone, Tall (A.virginiana)---------
Anemone,Wood (A.quinquefolia)--------- 111
Arrow-wood (see Viburnum, Maple Leaf)
Aspen, Large Toothed (Populus grandidentata)- 97
Aspen, Quaking (Populus tremuloides)-- 97
Aster,Arrow-leaved (A.sagittifolius)-- 138
Aster, Smooth (A.laevis)---------- 138
Aster, White Marsh (A.simplex)-------
Avens, White (Geum canadense) ------ 108
Basswood (Tilia glabra) ------------
Bedstraw, Fine or Elegant (Galium concinnum) 121
Bedstraw, Sweet-scented (Galium triflorum)-- 121
Bellwort, Large Flowered (Uvularia grandiflora)--- 142
Bergamot, Lavender Wild (Monarada fistulosa)----- 126

Betony, Wood (Pedicularis canadensis)- 116
Bindweed, Upright (Convolvulus spithamaeus)----- 136
Bittersweet (Celastrus scandens)---- 99
Blackberry (Rubus allegheniensis)----- 85
Black-eyed Susan (Rudbeckia hirta)----
Blueberry (Vaccinium myrtilloides)--- 101
Blue-eyed Grass (Sisyrinchium sp.)----
Box Elder (Acer negundo) ----------- 82
Brambles - see Blackberry,Raspberry
Burdock (Arctium minus)--------------
Bush Honeysuckle (Diervilla lonicera)- 94
Butternut (Juglans cinerea) -------- 83
Carrion Flower(Smilax herbacea) ----- 142
Carrion Flower (Smilax ecirrhata)---- 142
Cat-briar- see Green-briar
Chickweed (Stellaria media)
Cicely,Sweet (Osmorhiza claytoni & longistylis)---------- 109
Cinquefoil,Old-field (Potentilla simplex)------- 113
Cherry, Choke (Prunus virginiana)--- 98
Cherry, Wild Black (Prunus serotina)- 98
Clearweed (Pilia pumila) ----------- 126
Clover, Yellow Hop (Trifolium procumbens)-----
Comandra (C.richardsiana) ---------- 135
Coneflower, Yellow (Ratibida pinnata)-
Coreopsis (C.palmata) --------------- 120
Cowbane (Oxypolis rigidior) ---------

-Page

Crab, Wild or Prairie (Malus coronaria)------ 96
Cranesbill (Geranium maculatum)------- 119
Cress, Rock (Arabis lyrata) ---------
Crowfoot, Hooked or Green (Ranunculus recurvatus)-- 119
Crowfoot, Small-flowered (Ranunculus abortivus)--- 131
Culver's Root (Veronicastrum virginicum)----- 123
Currant, Black (Ribes americanum)------
Dandelion (Taraxacum officinale) ----- 117
Dewberry, Prairie (Rubus sp.)---------- 85
Dock, Bluntleaf (Rumex obtusifolius)--
Dogbane, Spreading (Apocynum androsaemifolium)- 130
Dogwood, Alternate-leaved (Cornus alternifolia)--- 101
Dogwood, Grey (Cornus racemosa) ------ 93
Dogwood, Round or Large-leaved (Cornus rugosa)----- 93
Elderberry, Common (Sambucus canadensis 82
Elm, Slippery (Ulmus rubra)---------- 94
Enchanter's Nightshade (Circaea quadrisulcata- 125
False Foxglove, Smooth (Gerardia grandiflora)--- 117
False Solomon's Seal, Greater (Similacina racemosa)--- 140
False Solomon's Seal, Starry(Smilacina stellata)--- 141
Fern, Brake or Bracken (Pteridium aquilinium)--- 105
Fern, Evergreen Grape (Botrychium multifidium)---
Fern, Goldie's (Dryopteris goldiana)---
Fern, Grape or Rattlesnake (Botrychium virginianum)---- 105
Fern, Interrupted (Osmunda claytoniana- 103
Fern, Lady (Athyrium angustum) ------- 104
Fern, Maidenhair (Adiantum pedatum)--- 106
Fern, Sensitive (Onoclea sensibilis)-- 103
Fern, Spinulose Wood (Dryopteris spinulosa)----- 104
Fireweed (Epilobium angustifolium)-----
Five-finger (Potentilla simplex) ---- 113
Fleabane (Erigeron philadelphicus)---
Fleabane, Daisy (E.strigosus &annus)-- 139
Geranium, Wild (G.maculatum) -------- 119
Gerardia, Yellow (Gerardia grandiflora 117
Goldenrod, Common (Solidago altissima)- 137
Goldenrod, Early (solidago juncea) ---- 137
Goldenrod, Elm-leaved (S. ulmifolia)--
Goldenrod, Gray (S. memoralis)--------

Index Continued

-Page

Gooseberry (Ribes missouriense)----- 90
Goosefoot, Pigweed (Chenopodium album)--------
Grape, Wild (Vitis aestivalis & riparia)--------- 89
Grass, Canada Blue (Poa compressa)-- 144
Grass, Kentucky Blue (Poa pratensis- 144
Grass, Blue (P.alsodes)----------
Grass, Tall Bluestem (Andropogon gerardi)---- 144
Grass, Bottlebrush (Hystrix patula)- 144
Grass, Brome (Bromus kalmii) -----
Grass, Woodland Fescue (Festuca obtusa)--- 144
Grass, Manna (Glyceria striata)----
Grass (Muhlenbergia mexicana) -----
Grass, Nimblewill (Muhlenbergia schreberi) ----- 144
Grass, Quack (Agropyron repens)--- 144
Grass, Wide-leaved Panic (Panicum latifolium)----
Grass (Panieum philadelphicum)------
Grass, Wild Rye (Elymus villosus)--- 144
Green-brier (Smilax tamnoides)------ 100
Hawkweed, Bristly (Hieracium scabrum)------- 139
Hawkweed, Canada (Hieracium canadense)
Hawthorn (Crataegus sp.)---------- 96
Hazlemut (Corylus americana)------ 95
Heal-all (Prunella vulgaris) ------ 127
Hepatica (H. americana)----------
Hickory, Shagbark (Carya ovata)---- 83
Hog Peanut (Amphicarpa bracteata)-- 116
Honewort (Cryptotaenia canadensis)-- 112
Honeysuckle,Bush (Diervilla lonicera)----- 94
Honeysuckle, Climbing (Lonicera prolifera)-
Hop-hornbeam - see Ironwood
Horse-gentian (Triosteum sp.)-----
Indigo, White False or Wild (Baptisia leucantha)------
Ironwood (Ostrya virginiana) ------- 95
Indian Turnip (Arisaema atrorubens- 144
Ivy, Poison (Rhus radicans)-------- 87
Jack-in-the-Pulpit (Arisaema atrorubens)--- 144
Jewelweed, Spotted or Orange(Impatiens capensis)---

Joe-Pye-Weed , Woodland (Eupatorium purpureum)--- 123
Juneberry (Amelanchier)---------- 99
Krigia (K.biflora)---------- 134
Lady's Slipper, Large Yellow (Cypripedium calceolus)--
Ladies' Tobacco (Antennaria sp.)---- 133
Lamb's Quarters (Chenopodium album)-
Leek, Wild (Allium tricoccum)------ 143
Lead Plant (Amorpha canescens)------ 85
Lettuce, White (Prenanthes alba)--- 118
Lettuce, Woodland Wild (Lactuca biennis)--- 118
Licorice, Wild (Galium circaezans)- 122
Lily-of-the-Valley, Wild (Maianthemum canadense)- 141

-Page

Linden (Tilia glabra)----------
Lion's Foot (Prenanthes alba)-------- 118
Lobelia, Pale Blue (L.spicata)-------
Locust, Black (Robinia pseudacacia)--
Lopseed (Phryma leptostachya)-------- 124
Loosetrife, Whorled or 4-leaved (Lysimachia quadrifolia)----- 122
Loosestrife, Lance-leaved (Lysimachia lanceolata)------ 128
Lousewort (Pedicularis canadensis)--- 116
Lupine, Blue (Lupinus perennis)-----
Mandrake (Podophyllum peltatum)------ 120
Maple, Ash-Leaved (Acer negundo)----- 82
Maple, Red (Acer rubum)---------- 88
Maple, Sugar or Hard (Acer saccharum) 88
Matrimony Vine (Solanum dulcamara)---
Mayapple (Podophyllum peltatum)------ 120
Mayflower, Canada (Maianthemum canadense)------- 141
Meadow Rue, Early (Thalictrum dioicum)--------- 109
Merrybells (Uvularia grandiflora)---- 142
Milkweed, Common (Asclepias syriaca) 129
Milkweed, Poke or Woodland (Asclepias exaltata)---- 129
Milfoil (Achillea millefolium)------- 106
Nannyberry (Viburnum lentago)-------- 92
Nettle, Tall or Stinging (Urtica procera)---- 125
New Jersey Tea (Ceanothus americanus) 100
Nightshade, Bittersweet (Solanum dulcamara)--
Nightshade, Black (Solanum nigrum)---
Nightshade,Enchanter's (Circaea quadrisulcata)------ 125
Oak, Black (Quercus velutina)------- 92
Oak, Bur (Quercus macrocarpa)-------- 91
Oak, Red (Quercus rubra) ---------- 91
Oak, White (Quercus alba) ---------- 90
Orchid , Green Rein (Habenaria viridis bracteata)--------
Orchid, Rattlesnake Plantain (Goodyera pubescens)------ 143
Oxeye, Rough (Heliopsis scabra)-----
Partridge Berry (Mitchella repens)---
Peanut, Hog (Amphicarpa bracteata)--- 116
Pellitory (Parietaria pennslyvanica) 136
Pigweed (Chenopodium album)
Pilewort (Erechtites hieracifolia)--
Pipsissewa (Chimpaphilia umbellata)-- 132
Plantain, Common (Plantago rugelii)-- 133
Plantain, Rattlesnake (Goodyera pubescens)------- 143
Poison Ivy (Rhus radicans)---------- 87
Pokeweed (Phytolacca americana)------
Popple - see Aspen
Prickly Ash (Zanthoxylum americana)--
Prince's Pine (Chimaphilia umbellata) 132
Pussytoes (Antennaria sp.)---------- 133
Ragweed, Lesser (Ambrosia artemisiifolia)--- 107
Raspberry, Black (Rubus occidentalis) 86
Raspberry, Red (Rubus idaeus) ------- 86
Rattlesnake Plantain (Goodyera pubescens)----- 143
Rattlesnake Root (Prenanthes alba)--- 118

Index Continued

-Page

Richweed (Pilea pumila)---------- 126
Roman Wormwood (Abrosia artemissifolia) 107
Rose, Wild or Prairie (Rosa blanda)--- 84
Rush, Wood (Luzula multiflora)---------
Rush, Yard (Juncus tenuis)---------- 145
St.John's-Wort, Dotted (Hypericum punctatum)------ 129
Sandwort, Woodland (Arenaria lateriflora 128
Sarsaparilla, Wild (Aralia nudicaulis)- 110
Sedge, Charming (Carex blanda)--------- 145
Sedge, Convolute (Carex convoluta)---- 145
Sedge, Graceful (Carex gracillima)----- 145
Sedge, Pennsylvania (C.pennsylvanica)-- 145
Sedge, Perpendicular (C. narmalis)----- 145
Self-heal (Prunella vulgaris)---------- 127
Service-berry or Shadbush (Amelanchier sp.)------- 99
Shin-Leaf (Pyrola elliptica)----------- 132
Shooting Star (Dodecatheon meadia)----- 134
Snakeroot, Black (Sanicula marilandica) 112
Snakeroot, White (Eupatorium rugosum)---------- 124
Solomon's Plume - see Solomon's Seal, Greater False
Solomon's Seal, Greater False (Smilacina racemosa)--------- 140
Solomon's Seal, Hairy (Polygonatum pubecens)------- 140
Solomon's Seal, Smooth (Polygonatum canaliculatum)------ 140
Solomon's Seal, Starry False (Smilacina stellata)------ 141
Sorrel, Yellow Wood (Oxalis stricta)-- 114
Spiderwort, Blue (Tradescantia chiensis)--------- 144
Spikenard (Aralia racemosa)----------- 111
Spurge, Flowering (Euphorbia corollata) 135
Star-toadflax (Comandra richardsiana)-- 135
Sickweed, Virginia (Hackelia virginiana)-------
Strawberry, Wild (Fragaria virginiana)- 113
Sumac, Smooth (Rhus glabra)----------- 84
Sunflower, Rough or Woodland (Helianthus strumosus)----- 127
Sweet Cicely (Ozmorhiza claytoni & longistylis)--------- 109
Tea, New Jersey (Ceanothus americanus)- 100
Tickseed (Coreopsis palmata)---------- 120
Tick-trefoil, Naked (Desmodium nudiflorum)------- 115
Tick-trefoil, Woodland (Desmodium glutinosum)-------- 115
Thornapple (Crataegus sp.)------------ 96
Vervain, White (Verbena urticaefolia)--
Viburnum, Maple-leaf (V.acerifolium)--- 89
Violet, Bird's Foot (Viola pedata)-----
Violet, Downy Yellow (Viola pubescens)-
Violet, Sweet White (Viola incognita)--
Violet, Woodland or Hairy Blue (Viola sororia)------ 130
Virginia Creeper (Parthenocissus inserta 87
Virginia Waterleaf (Hydrophyllum virginianum)-------- 107
Willow, Prairie (Salix sp.)----------
Windflower (Anemone quinquefolia)------ 111
Winterberry (Ilex verticillata)--------

-Page

Witch-hazel (Hamamelis virginiana)----
Woodbine (Parthenocissus inserta)----- 87
Wood Sorrel, Yellow (Oxalis stricta)-- 114
Yamroot, Wild (Dioscorea villosa)-----
Yarrow, Achillea millefolium)--------- 106
Yellow Star Grass (Hypoxis hirsuta)---

Science, Gr. 7 - 12

Madison School Forest

Madison Pub. Sch. Local Matls

Madison School Forest
Science
Gr 7-12
Madison Pub. Sch. Local Materials