University of Minnesota - Department of Forest Resources

The City of Ramsey Tree Survey Plan

Protecting Ramsey's Green Assets

University of Minnesota – Urban Forest Management/Managing Greenspaces for People
FNRM 4501/5501
5/1/2018

Introduction

Author: Lydia Voth.

The City of Ramsey

The City of Ramsey is located in Anoka County, Minnesota, approximately forty minutes northwest of the twin cities of Minneapolis and Saint Paul (Figure 0.1). It is about 29 square miles in size and lies along Highway 10, near the confluence of the Mississippi and Rum Rivers. As of 2010, the total population was 23,688.

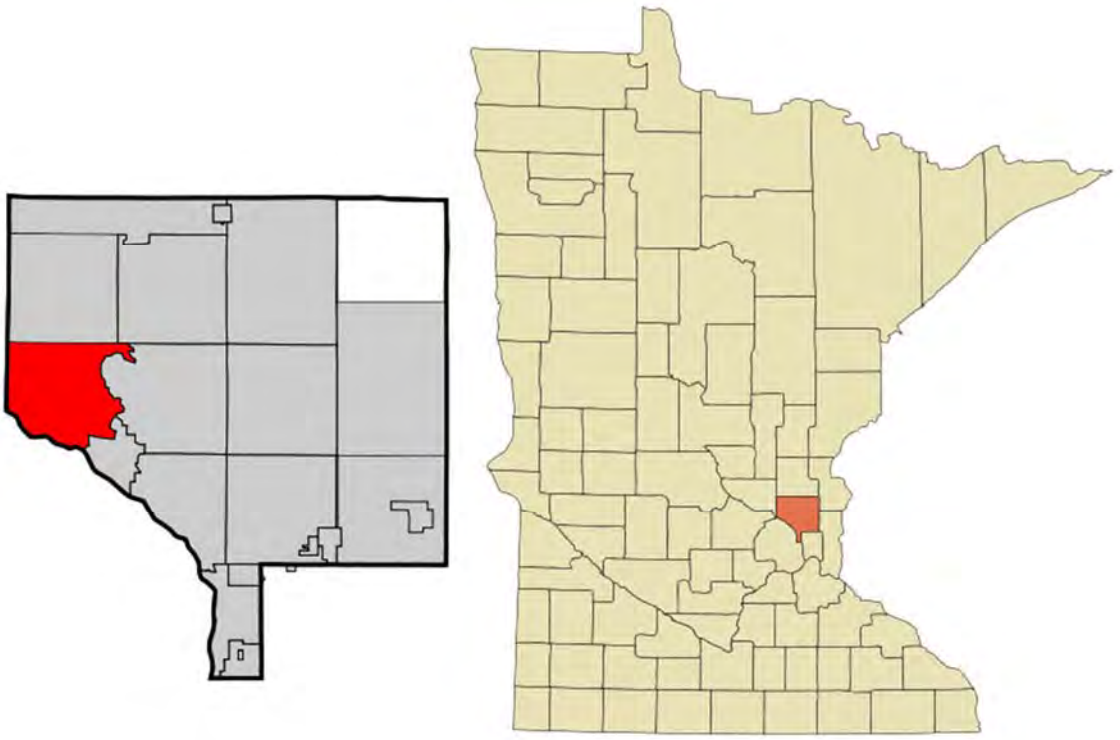


Figure 0.1- Location of Ramsey within Anoka County, MN

The rural character and natural features such as wetlands and wildlife attract residents to Ramsey. Housing options include farms, single-family homes with either small or large acreages, town homes, and senior living apartments. Ramsey has three business parks—Energy Park, Business Park 1995, and Gateway Park. According to its 2018 Strategic Plan Update, the city aspires to keep its citizens involved in and directing its expansion. Due to its closeness to the Twin Cities, Ramsey is a rapidly growing city. This growth includes considerable work on its roads as well as the addition of numerous other assets, such as trails, traffic lights, signs, etc. At the same time, Ramsey aims to maintain its natural resources, as its residents have distinguished them as a fundamental aspect of the city.

Approximately 80-90% of Ramsey's native landscape has been modified by humans in some way. The land cover consists of artificial surface (51%), planted cover (13%), forest (9%), woodlands (2%), shrublands (3%), wetlands/herbaceous vegetation (19%), and open water (3%). Along with the Mississippi and Rum Rivers, the other main water bodies are Trott Brook, Itasca Lake, and Grass Lake. The sub-humid climate of east-central Minnesota influences the types of trees and shrubs that are able to survive there, as they must be adapted to the drastic temperature variations between the cold winters and warm summers.

Ramsey has been acknowledged as a Tree City USA for 26 years and looks to maintain this accomplishment while still bettering their forestry practices in the future. This status means that they maintain a tree board (in their case, the Environmental Policy Board), have a tree care ordinance, have a budgeted community forestry program, and celebrate Arbor Day. One of the notable steps that Ramsey is taking to improve their urban forest is the completion of a citizen-volunteer based tree survey, aka, a citizen scientist project.

Tree Survey

Trees are an often-overlooked asset of communities, but they provide a vast array of economic, environmental, personal, and social benefits. Trees reduce both heating and cooling costs, as they provide shade, cool the air, and provide a windbreak for buildings. This reduces energy consumption, which also benefits the environment. The shade they provide also protects roads from weathering. In addition, they sequester CO2 from the atmosphere, filter the air of other pollutants and particles, and simultaneously make the air more breathable through oxygen release. Trees protect water quality by reducing polluted stormwater runoff through canopy interception, increasing soil filtration, and transpiration. As trees also simply beautify areas, they often raise property values, create greater place-attachment, and provide mental restoration. Studies have shown that trees and greenspaces reduce physical and mental stress and generally improve human health. Even planting and caring for trees is a way to create stronger relationships within a community.

A tree survey is a method of assessing factors such as species, condition, and age class of the trees in an urban forest. Conducting a tree survey of street/boulevard trees in Ramsey is advantageous as it provides a more concrete basis for planning in the future. Before the survey, Ramsey's city planners did not have an adequate image of the composition of their street tree population. A DNR tree survey of the top ten genera from 2010 (Figure 0.2) was the primary source of information. Not knowing enough about their tree resource becomes a challenge when attempting to develop a resilient urban forest. A diversity of species is crucial in preventing significant canopy losses from pests and pathogens. Potent examples of this in Minnesota have been Dutch elm disease and, more recently, emerald ash borer. It will be critical for Ramsey's planners to know which of its species are most abundant so they can prepare to lessen the impacts of those and similar outbreaks. In addition, information about the trees' ages and physical conditions will provide guidance in the development of future urban forest management goals and strategies.

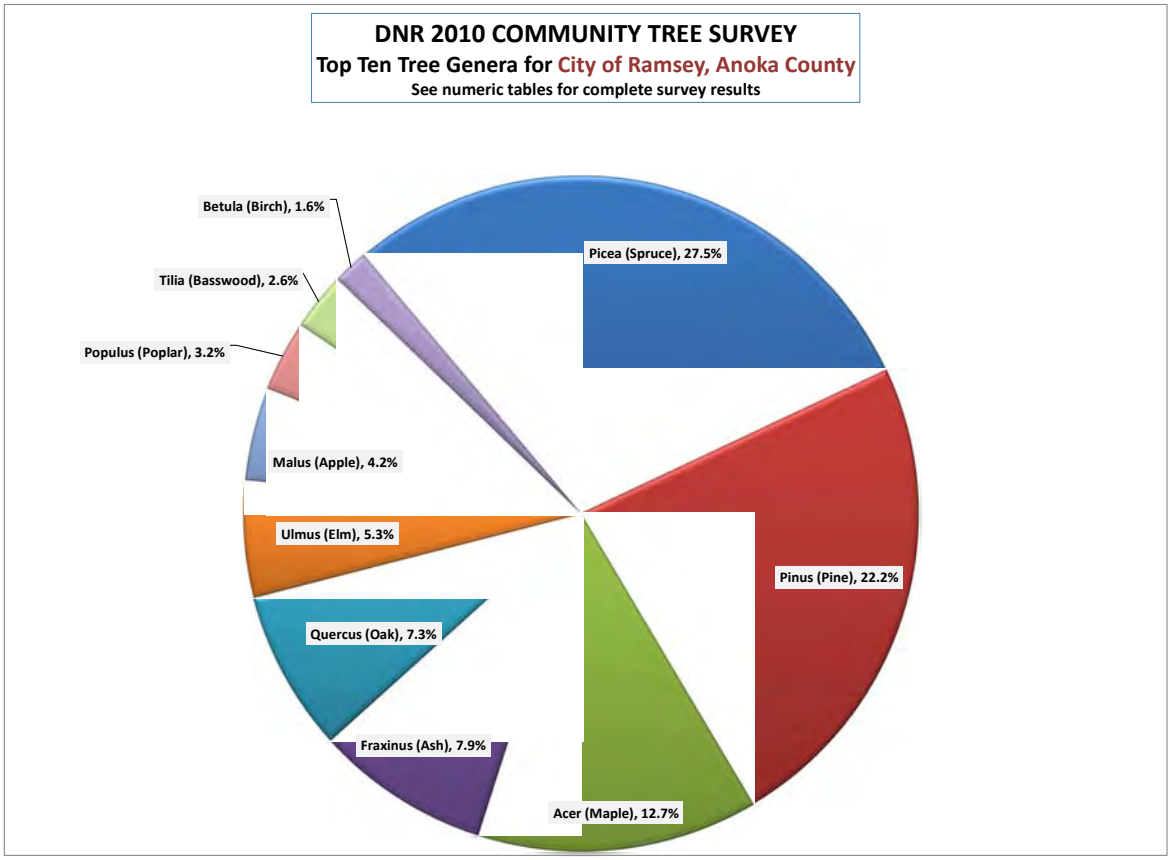


Figure 0.2- 2010 Chart of Top Ten Genera in Ramsey

Objectives

- To develop a weighted, stratified survey of public trees in Ramsey in order to give the City a better sense of what needs to be managed
- To design a training curriculum for volunteers, conduct training workshops, and provide technical assistance for the volunteers, aka, citizen scientists
- Through the survey, to provide the community with a better idea of:
    - The genetic diversity of its urban forest
    - The age-class diversity of its urban forest
    - The assessed condition of its urban forest
    - The relative canopy contribution by species to the overall canopy cover of the community
- To give the community sufficient data to use the i-Tree® suite of urban forest assessment tools
- To create a more engaged cadre of urban forestry citizen-scientists

References

Ramsey city, Minnesota. *United States Census Bureau, American FactFinder*. Retrieved from https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml

Tree City, USA. *City of Ramsey.* Retrieved from http://www.ci.ramsey.mn.us/248/Tree-City-USA

Parks & Recreation. *City of Ramsey.* Retrieved from http://www.ci.ramsey.mn.us/269/Parks-Recreation

Natural Resources & Environment. *City of Ramsey*. Retrieved from http://www.ci.ramsey.mn.us/234/Natural-Resources-Environment

Final Report: Natural Resource Inventory. Sept 28 2007. *City of Ramsey.* Retrieved from http://www.ci.ramsey.mn.us/DocumentCenter/View/246

Strategic Plan Update: 2018 Update. *City of Ramsey*. Retrieved from http://www.ci.ramsey.mn.us/documentcenter/view/932

Protecting Our Investments Asset Management Plan: University of Minnesota–City of Ramsey Scope of Work Agreement. Dec 15, 2017.

McPherson, E., Simpson, J., Peper, P., Gardner, S., Vargas, K., Maco, S., & Xiao, Q. Midwest Community Tree Guide: Benefits, Costs, and Strategic Planning. *USDA Forest Service, Pacific Southwest Research Station.*

Figure 1- Location of the city of Ramsey within Anoka County, Minnesota. Digital image. Wikimedia, 2009. Retrieved from https://upload.wikimedia.org/wikipedia/commons/7/73/Anoka_Cnty_Minnesota_Incorporated_and_Unincorporated_areas_Ramsey_Highlighted.png

Figure 2- DNR 2010 Community Tree Survey. Digital image. Minnesota Department of Natural Resources.

Chapter 1
Sampling Methods and Data Collection

Authors: Ivy Nunvar, Jared Walhowe, Mathew Lochner, Kevin Chen, Lane Moser, Alex Miller

Introduction

In partnership with the City of Ramsey, the role of the Sampling Methods and Data Collection team was to set up the sampling and data management methods to conduct a survey of the public trees that are under the jurisdiction of the city.

The methods laid out in this chapter are referred to as a *stratified and weighted random sample*. This technique has been widely used and is based in applied research. The methods used were adapted from the methods described in Jaenson et al., 1992 (1). This method is not a tree inventory, which implies that every tree would be sampled and recorded. With the adapted methodology from the *stratified and weighted random sample* technique a random sample will be taken of the public trees in the City of Ramsey. This survey method saves time and still allows for an accurate and pragmatically precise estimation of the total tree population and its attributes.

Creating a Sample

The sampling methods described here produces estimates to accurately represent the total tree population with a probability of 95% and a relative error of ± 10%. To set up a sample for the tree survey, four basic steps were followed:

1. Identifying zones - divide the city into zones (*stratification)*
2. Identifying segments - dividing the streets into pre-sampling segments
3. Pre-sample (gathering of basic information per zone). This is the "weighting" perspective of the survey
4. Randomly select street segments within each zone to sample

Identifying Zones (Stratification)

The main objective was to divide the city into areas that were similar in terms of development style, time, or use. With the aid of the City of Ramsey's official zoning map, three zones were identified:

Zone A - High to Medium Density Residential

Zone B - Business District

Zone C - Low Density Residential

City of Ramsey, Tree Survey Zoning

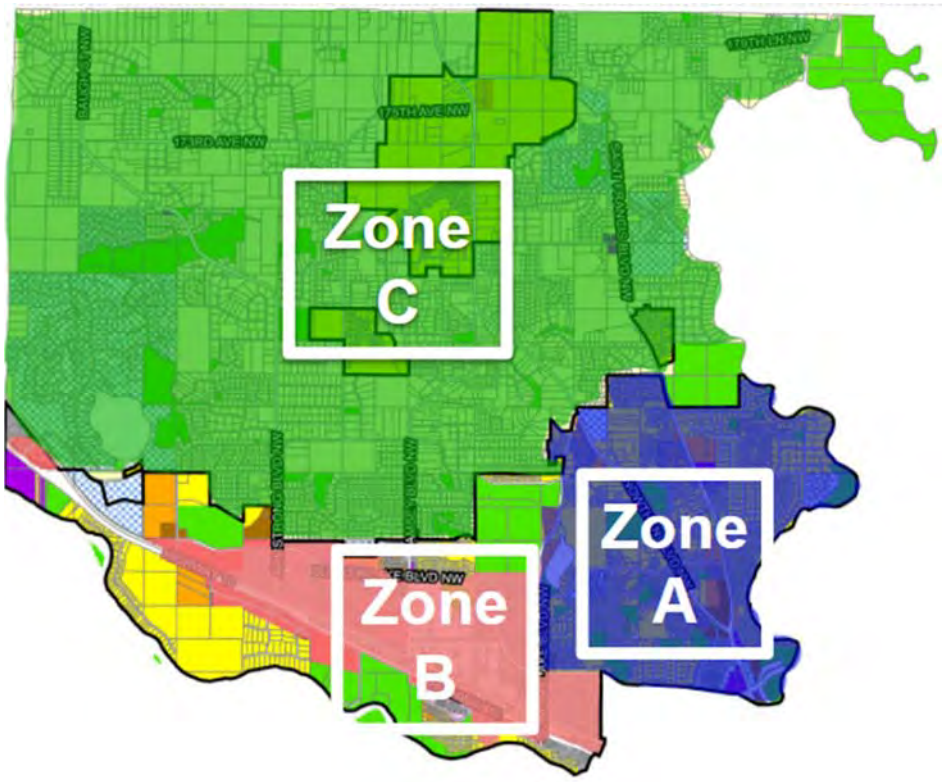


Figure 1.1. Map of Stratified Land Use Zones in City of Ramsey.

Jaenson et al (1992) recommended segmenting communities into three primary zone types; rectilinear residential (neighborhoods made up of square blocks), curvilinear residential (non square block neighborhoods), and downtown (business and commercial areas). It is also recommended that these zones consist of a minimum of 20 sample units. Somewhat uniquely, the City of Ramsey consists of many square block but none of which are of equal size or clustered into clumps of 20 or more. For this reason the city was stratified based on the use of the area and housing density (fig. 1.1).

Identifying Segments

All streets under Ramsey jurisdiction were divided into segments approximately 1407 ft in length. In many communities a single square block would be used as a baseline sample unit. In these situations, trees are sampled along the inner perimeter of the block. However, block perimeter sampling does not translate well to curvilinear neighborhoods where blocks are either difficult to define or non-existent. A curvilinear sample is a road segment that is equivalent in length to half of the perimeter of a block that can be sampled. When using curvilinear segments both sides of the road are being sampled, which is why the segment only needs to be half the distance of the block perimeter.

An average block perimeter length for the City of Ramsey is 2,814 ft (1,407 feet on both sides of the street) and was calculated by pre-sampling the perimeters of 20 randomly selected square blocks (figure 1.2) using ArcGIS. Therefore a street segment length of 1,407 ft was used and

determined by dividing the average perimeter by 2 to account for sampling trees on both sides of the road within curvilinear segment. The City of Ramsey does not contain any standard sized square blocks; therefore curvilinear sampling was used across the entire community.

Using ArcGIS all city streets were broken in 1,407 ft segments. After removing segments that would be potentially dangerous or impractical for volunteers to sample (such as segments adjacent to major highways), preparation began to gather some basic information with the pre-sample.

Pre-Sample

In order to determine how many segments would be sampled for the survey it required an estimate of how many public trees there are in Ramsey and where they are located. This information helped correctly identify how many segments would be sampled from each zone. This step, along with the determination of the number of block segments within a zone, represented the "weighting" of the survey sampling methodology. Essentially, this allowed the selection of the majority of the block segments from the areas of the community with the greatest number of trees, then to the second greatest number and finally to the third greatest number. By weighting the selection of block segments to inventory trees, it better represented what was characteristic of the city of Ramsey compared to a simple randomized selection process.

Pre-sample Segments

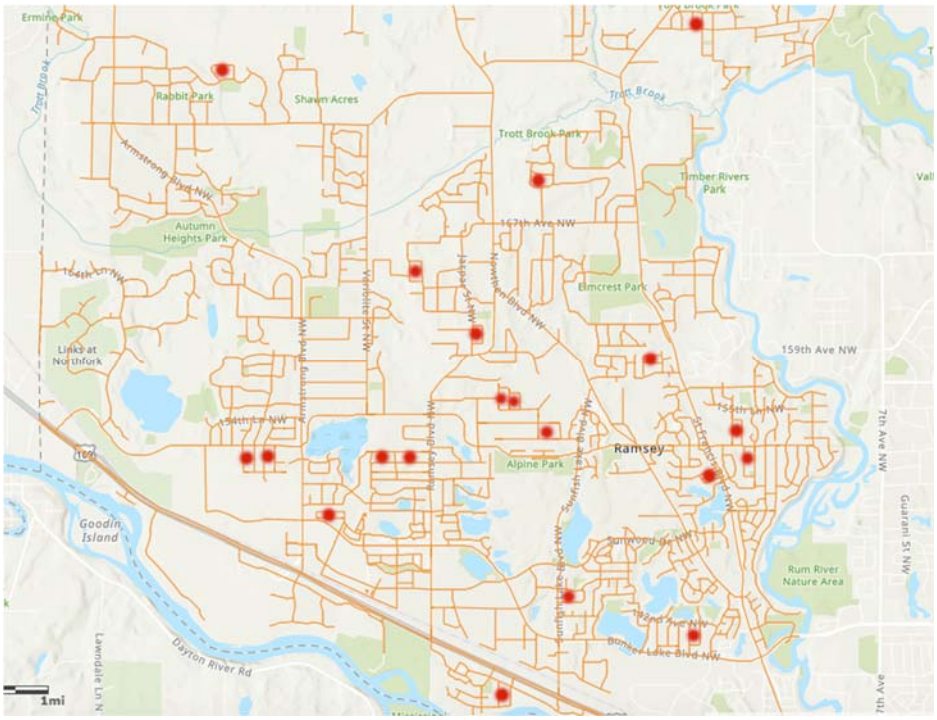


Figure 1.2

Twenty (20) segments were randomly selected from the community, as shown in Figure 1.2 above. Nine segments were selected in Zone A, 4 segments in Zone B, and 7 segments in Zone C (see fig 1.1 for zones). For each segment every public tree within 16 feet of the curb was

counted. This proved to be challenging in the City of Ramsey as the line between public and private land is blurry in many of the rural areas and many streets do not have a defined curb. A mistake was made in differentiating between public and private trees during the first pre-sample which required a return at a later date to correct the data. Areas with unmaintained forest on public land were excluded from the sample under the assumption that the city does not have a role in maintaining individual trees in these locations.

On average there are 10.44 public trees per segment in Zone A, 23.75 trees per segment in Zone B, and 7.86 trees in Zone C. It should be noted that the higher average number of public trees in Zone B could at least be partially attributed to a recent planting of maple saplings in high numbers and with narrow spacing between each individual tree.

Using the average trees per segment in each zone, the total number of public trees for each zone were estimated. Calculations are shown in Figure 1.3 below.

Estimating percent of total trees in each zone

Zone Segment	avg # of public trees per street unit	total # of street units in zone segments	Estimated total # of public trees per zone	% of total trees
A	10.44	274	2860.56	23%
B	23.75	197	4678.75	37%
C	7.86	647	5085.42	40%

Figure 1.3

Of the estimated 12,635 public trees in the city, the goal was to sample 2,000 – 2,300 trees. Jaenson et al, 1992, justifies this number in the original methods. Increasing the sample size used in a sampling procedure will increase the level of accuracy of the estimate; however, the improvement in accuracy is not substantial. The extra cost of conducting a survey with a sample of more than 2,000 – 2,300 trees, in time, personnel, and data analysis, generally seems not to be justified by the limited increase in accuracy. Additionally, sampling a known number of trees is much easier than sampling a known percentage of the total population for two reasons: 1) it is often impossible to know the population size, even approximately, before conducting the survey, and 2) percentage sampling of a very large population requires a very large sample.

The three zones were then weighted according to their different tree densities to satisfy the 2,000 – 2,300 total tree requirement. The percentage of trees in each zone was multiplied by 2,000 to get an estimate of the total number of trees that needed to be sampled in each zone. This number was then divided by the average number of trees per segment to get the total number of segments to be sampled in each zone. Calculations are shown in Figure 1.4 below.

Calculating total number of segments to be sampled

Zone	% of total public trees	Minimum required # of trees to be sampled	Avg # of trees per segment	Total # of segments to be sampled
A	23%	453.17	10.44	43
B	37%	741.20	23.75	31
C	40%	805.63	7.86	103
Totals		~2,000 trees		177

Figure 1.4

It was calculated that Zone A will require a sample of 43 segments, Zone B will require 31 segments, and Zone C will require 103 segments.

Random Selection of Street Segments

Using ArcGIS every segment was assigned a number. A random number generator was then used to identify which segments would be sampled in each zone. To aid volunteers in locating the sampling segments, each sampling segment was given a start and end address. If no start or end address was available, the GPS coordinates were used in place of an address. GPS coordinates can also be easily plugged into google maps in place of an address to locate the start and end points. In doing this it is noted that the GIS software was imperfect at distributing the segments to be exactly 1,407 ft in length. This may be due to intersections, dead ends, and irregularly shaped loops throughout the city. The sampling segments that were not 1,407 ft in length were corrected and some dangerous, impractical, or confusing segments were identified and replaced with more desirable segments that were safer and easier to for a volunteer to follow.

The location of the randomly selected segments is shown in Figure 1.5.

Tree Survey Sampling Segments

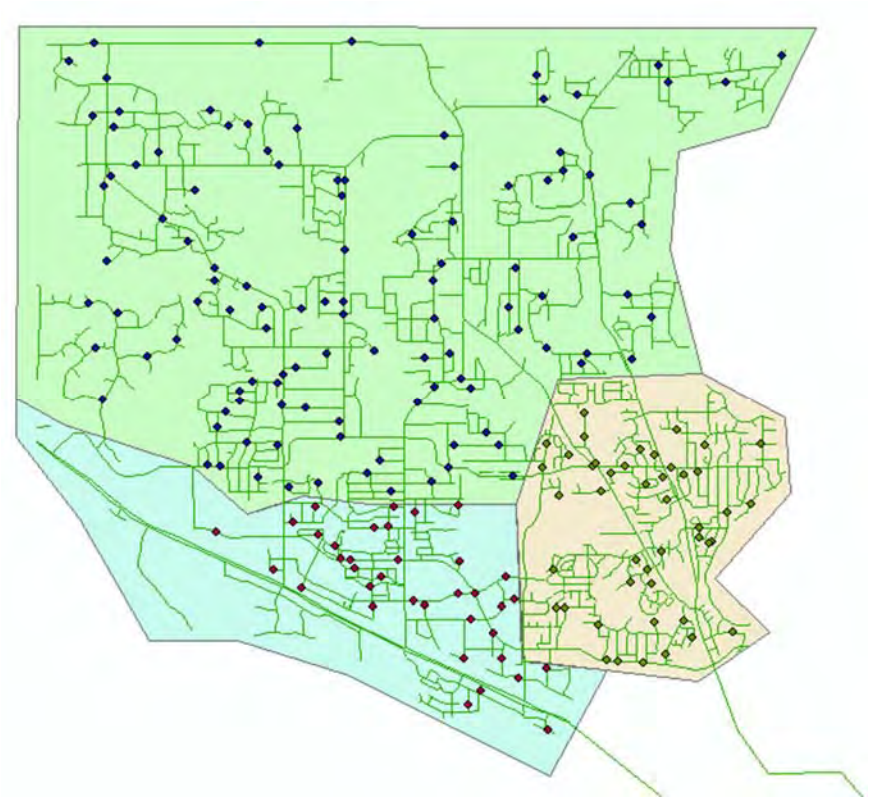


Figure 1.5

Developing Sampling Protocol

The data to be collected by the volunteers includes genus of the tree (e.g, maple), diameter at breast-height (DBH), crown width, and condition rating. The volunteers will be trained to identify some trees down to the species level (e.g. silver maple) that are particularly susceptible to certain diseases or pests as this is very useful information for the city.

The data collection form was adapted from a template online (2). A few changes were made in order to create an adequate data collection form for the Ramsey-specific tree survey. One of the changes included adjusting the administrative information. However, the main priority was to implement some changes that allowed the volunteers to enter data with greater ease and increased accuracy. To that end, the individual field sizes of the form were increased and some column headings were reworded to be more volunteer friendly (3). Instruction sheets to fill in the most complex section of the form - condition rating - were accessed from an arboriculture class at the University of Minnesota - FNRM 3501, and will be supplied to the volunteers along with the blank data collection forms.

Works Cited

(1) Jaenson, R; Bassuk, N; Schwager, S; Headley, D. (July, 1992). A Statistical Method for the Accurate and Rapid Sampling of Urban Street Tree Populations. Journal of Arboriculture. 18(4): 171.

(2) Data collection form reference: https://drive.google.com/drive/folders/10OjdQ39y6u04JVUhLz7nI129D6uehRSx

(3) Adapted data collection form: https://docs.google.com/spreadsheets/d/1F4thwx8Av9fiSU2kdYYFylBTH6B4vxWweds68ziGQQQ/edit#gid=1775893647e

Chapter 2

Training Tree Survey/Inventory Volunteers

Authors: Calli Cloutier, Alissa Cotton, Chris Titus, Gabe Cesarini, Hannah Hinrichs, Lily Johnson, Lydia Voth

Why a Tree Survey?

As a City Planner or Urban Forestry Coordinator, what do you do when a tidal wave of tree diseases or pestilence is spreading across nearby municipalities and rapidly approaching your city? The first thing you do is panic. The second thing you do is look at your city's tree inventory to get a sense of how much of your urban tree canopy is at risk. Don't have a tree inventory? Time to make one, and fast! A tree survey is essentially an abridged version of a complete tree inventory that aims to provide a picture of the number, type, age, and condition of trees in a given area within a reasonable margin of error. With this data, a city is able to get a sense for the diversity of the urban forest, assess benefits and potential risks (such as pests, disease, and structural hazards), apply for grants, and create management plans for future plantings and maintenance.

Why Ramsey?

The Minnesota Department of Natural Resources provided the City of Ramsey with a rapid tree survey in 2010, but many things can happen to a city in eight years! Development, tree planting, and tree removal can significantly alter the makeup of an urban canopy during that time. Ramsey City Planner, Chris Anderson, woke up one day and said, "Knowing just the top ten genera in Ramsey from 2010 isn't cutting it anymore. We've just *got* to know how many and what trees are in our city in 2018" (personal communication, paraphrased). After undergoing a rigorous application process, the City of Ramsey was approved for inclusion in the University of Minnesota's Resilient Communities Program, with a project aim of carrying out a tree survey in summer of 2018, to be completed entirely by volunteers.

Why Volunteers?

Besides being an excellent low-cost labor source, utilization of volunteers for city projects provides an opportunity for participants to gain new skills and build community connections. Additionally, a study comparing tree identification and condition data collected by volunteers versus professionals, showed that data from well-trained volunteers agreed with professionally-collected tree identification data 90+% of the time! (Bancks, North, & Johnson, 2018). Other studies on the accuracy of volunteer-collected data demonstrate that, when properly trained and supported, volunteers can achieve nearly identical data collection results to those collected by professional personnel (Swanson, Kosmala, Lintott, & Packer, 2016). Through their participation in this survey, volunteers will collect and provide the City of Ramsey with accurate estimates of tree species, diameter categories, condition, and total count of its public trees.

Requirements for volunteer participation in this survey include being aged to at least 18 years, or otherwise accompanied by a parent or legal guardian, and attendance in the volunteer training program. Based on the aforementioned study, completion of the volunteer training was deemed critical for ensuring accuracy in data collection, and was thus made a mandatory element of volunteer participation.

How It Was Done: Volunteer Recruitment

Lists of potential volunteers were supplied by Chris Anderson of the City of Ramsey and from the Minnesota Tree Care Advocates program (TCA) (see Appendix A for list of contacts). A selection of individuals from these lists was identified as those having "fingers on the pulse" of the volunteering community of Anoka-Ramsey. To those individuals, an initial availability survey was emailed, asking for input on days of the week and times that they thought would work best for a general volunteering audience, as well as whether they expected any volunteers to be better able or more likely to participate with certain accommodations made (see survey in Appendix B).

Volunteers were recruited through direct email, email mailing lists, Facebook messaging and posts, the City of Ramsey official media outlets, on-site flyer posting at Ramsey and Anoka businesses, and personal communications with Ramsey residents.

Email lists that posted the call for survey volunteers included Minnesota Tree Care Advocates, Minnesota Society of Arboriculture, Minnesota Shade Tree Advisory Council, Ramsey Lions Club, Anoka Lions Club, and Minnesota Master Gardeners. Additional email outreach was attempted with Elk River Lions Club, Minnesota Women of Today, and Anoka American Legion (see Appendix C).

Facebook direct messaging included outreach to Ramsey Lions Club, Anoka Lions Club, Anoka/Ramsey Outdoors, and Minnesota Women of Today. Facebook posts were made by Ramsey Lions and Anoka Lions (see Appendix D).

The City of Ramsey posted information about volunteering on the City's website, Facebook page, and outdoor community signs (Appendix E).

On-site city flyer posting was also utilized for outreach efforts. On Wednesday, April 4th, flyers were posted at the Ramsey Administrative Office, Caribou Coffee in Ramsey, Dunn Brothers Coffee in Anoka, Coburn's Superstore in Ramsey, Anoka American Legion, Anoka Technical College. As well, personal contact was made with Ramsey residents who are close family friends of one of the student curriculum developers; these residents expressed interest in participating in the survey and made copies of the flyer to distribute to approximately everyone residing on Bower's Drive. All flyer outreach materials are included in Appendix F.

As prominently displayed on all volunteer outreach materials, volunteers were directed to the mntreesource.umn.edu webpage to register for the training; City of Ramsey's city planner, Chris Anderson's, contact information was also provided. Volunteers registered for the training via a Google forms document. This registration provided volunteers with a brief summary of the

training event, event locations, and collected the following volunteer information: First and last name, email address, phone number (optional), if they planned on attending the training, and any dietary restrictions. See Appendix G for the Google form.

How It Was Done: Curriculum Development

Students in the University of Minnesota's capstone course in urban and community forestry (FNRM 4501/5501) designed survey methods, developed volunteer training curriculum, and provided training to the registered volunteers in order to deliver a qualified volunteer tree survey force to the City of Ramsey. It was determined by the city that this survey would focus only on public trees, namely on boulevards or rights-of-ways, which would include any trees planted within 16-feet of a street, as the City has the most jurisdiction over these trees. The most useful data that would be collected by volunteers was determined to be (by the City of Ramsey) the identification of the tree to the genus level (e.g. apple, dogwood, fir), with a handful of trees identified more closely down to the species level (please find the list of species-identified trees in Appendix H); the trunk diameter (a standardized measurement made at 4.5 feet above ground, A.K.A. D.B.H. which stands for diameter at breast height) which is used to place trees in an age class; and the spread of the canopy, which is used to place a relative value on the shade value of a tree and a numeric condition rating of each tree's trunk and canopy (each assessed independently).

The Volunteer Training Sessions: Content, Scheduling, and Delivery

Content

As stated above, volunteers were provided training to accurately collect data on tree identification, tree trunk and canopy size and the condition of the tree trunks and canopies. Volunteers were instructed to perform the survey in groups of three as doing so boosts data accuracy through collaboration, and enhances the safety of the participating volunteers. Additionally, volunteers were trained on proper conduct during surveying (they are, after all, representing the community) including how to handle interaction with the public and tips for maintaining safety. Each volunteer was issued a comprehensive training manual, a packet of tree identification cards, and the Minnesota Trees identification packet (see Appendices I, K, L, respectively). Each group of three is assigned a list of street segments (see Chapter One for the selection process); each assigned segment is identified by a starting and ending address. Volunteers are instructed to survey each tree independently and then confer with fellow team members in order to make the most accurate assessment of each tree. Equipment necessary for the training sessions was provided by the University of Minnesota. The City of Ramsey will provide equipment for volunteer use during survey execution.

An introduction to tree identification was provided at the indoor training. This portion of the training included a brief explanation of scientific naming and categorization of plants into family, genus, and species classifications. Basic methods used for narrowing down the identification of a tree to family and genus level were discussed, as well as a foray into botanic terms that are useful for identification and in utilizing reference tools such as a dichotomous key. The bulk of genus and species identification training is performed in the outdoor field session,

where volunteers visit each type of tree they could encounter in the survey; multiple distinguishing features for each tree are pointed out at this time, including branching habit, leaf, fruit, and bark characteristics, and form. The outdoor field session is an opportunity for volunteers to gain confidence in identifying trees while training leaders are present to answer questions and give guidance.

The method for categorizing age class of trees was presented during the indoor session with discussion on measuring diameter at breast height (D.B.H.) and the potential abnormal challenges to measuring D.B.H. that could be encountered in the field. The outdoor session offers opportunities to practice measuring D.B.H.

The tree condition rating system used in this survey was developed by the U.S. Forest Service and subsequently modified to suit urban forestry situations by the University of Minnesota's Community Engagement and Preparedness program as a means to get a sense of baseline condition of a tree, using a zero-to-four point scale (four points indicating no defects according to the rating criteria). Rating criteria include multiple features that account for both the canopy and stem condition. Details on using this method for rating tree condition are illustrated in the Ramsey Tree Survey Training manual (see Appendix I). Volunteers were introduced to the tree condition rating system during the indoor training session. The hands-on methods for rating condition and recording condition points on the data sheet are practiced during the outdoor field session.

Scheduling and Delivery

Initial training sessions were scheduled based on responses to a preliminary availability survey. Subsequent sessions will be scheduled based on feedback from confirmed participants. The first set of indoor and outdoor sessions was scheduled for Friday, April 13th, from 5:30-8:30pm, and Saturday, April 14th, from 9am-3pm, respectively.

The indoor session was hosted at the Ramsey Administrative Center, located at 7550 Sunwood Drive NW, Ramsey, Minnesota, 55303. Material was presented by University of Minnesota students using a PowerPoint™ presentation (Appendix J), the Ramsey Tree Survey Training manual, the Minnesota Trees identification packet, and the Tree ID cards packet. Twig samples were provided to illustrate botanic vocabulary and to demonstrate distinguishing characteristics among trees without leaves. Elements of the condition rating system were elucidated with examination of branch samples provided by the University of Minnesota's Urban Forestry Outreach, Research, and Extension Nursery and Lab.

Of the ten volunteers registered, five attended the training on April 13th; a few volunteers informed us earlier in the day that the weather deterred them from attending the training. Upon arriving at the training the volunteers received the Tree Survey Training manual, Tree ID Cards packet, and Minnesota Trees identification packet. The training lasted the full three hours, and covered all the training topics planned for the indoor session.

The outdoor field session was rescheduled due to inclement weather and because of the potential difficulty in providing tree identification training before the trees had leafed out. The outdoor

session will take place in May, facilitated by the Urban Forestry Outreach, Research, and Extension lab personnel in the Department of Forest Resources at the University of Minnesota - Twin Cities. The outdoor session is designed to be a hands-on and experiential learning day, where volunteers apply what they have learned in the classroom, as well as to delve into the more finely-tuned features of tree identification. The session will begin with a review discussion on tree identification features, followed by visits to each type of tree that volunteers could encounter during the survey. Ample opportunities to practice measuring D.B.H. and to assess tree condition are provided in the outdoor session. Training personnel are present to check for accuracy and to answer any questions. The outdoor session also includes details on how volunteers are to obtain their City identification badges to be worn during all surveying, as well as a reiteration of how completed data sheets are to be submitted to the City.

Next Steps

A critical "next step" that needs to occur is the recruitment of additional volunteers. This can be accomplished by conducting a second round of volunteer outreach and recruitment through media outlets, such as Facebook and the City of Ramsey's city webpage, as well as sending email chains, and posting flyers throughout the city. After a second round of recruitment, an additional indoor session can be scheduled to accommodate the new individuals interested in volunteering. This training could occur later in the spring, and would ideally occur before the rescheduled outdoor field session, allowing for a combined outdoor field session with all volunteers. Having additional trained volunteers will help decrease total time the survey will take, as well as foster community engagement with the urban forest of Ramsey.

Another step to be taken in this training series is to set a date and time for the previously cancelled outdoor field session. This training date should be scheduled for a time later in the spring once leaf-out has occurred, as the presence of leaves will greatly improve volunteer ability to identify trees. Locations for hosting the outdoor training as well as an outline for how the outdoor field session should be run is found in the appendices M and N, respectively. It will be important on this day to assign or form volunteer groups into teams of three, as they will use these groups to complete the survey.

Finally, it will be important to inform the volunteers of how they will receive or obtain their volunteer identification badge. These badges will be carried by all volunteers as they conduct their survey, and the process through which badges will be obtain will be confirmed with Chris Anderson from the City of Ramsey.

Recommendations

It is recommended that in future trainings or volunteer programs, childcare or other accommodations be made for volunteers if at all possible and practical. By providing the accommodations, the accessibility of the training improves, which may result in more individuals committing to volunteering. Obtaining a passenger van is recommended for use in the outdoor field session; the distance between tree-identification sites is not walkable. In addition to accommodations, supplying volunteers with refreshments at the trainings would contribute to volunteer enjoyment.

It is also recommended, at the completion of the survey, that volunteers be provided with an end-of-survey celebration to thank them for their work and dedication to the project; volunteer recognition is not only important for volunteer satisfaction, but for volunteer retention, as volunteers feel that they themselves, and their work, is valued.

Finally it is recommended that a news release for Ramsey or Anoka County newspaper is written after completion of the survey. This would not only aid in the volunteer recognition, but would allow the community to get involved and be made aware of what Ramsey is doing with and for its urban forest.

Works Cited

(1) Bancks, N., North, E., & Johnson, G. (2018). An analysis of agreement between volunteer- and researcher-collected urban tree inventory data. Arboriculture and Urban Forestry, 44(2), 73-86.

(2) Swanson, A., Kosmala, M., Lintott, C., & Packer, C. (2016). A generalized approach for producing quantifying, and validating citizen science data from wildlife images. Conservation Biology, 30(3), 520-531. 2010.

Chapter 2 Appendices

Appendix A: Contact List (before outreach)

Appendix B: Volunteer Pre-survey

Appendix C: Recruitment Email

- Anoka Lions Club
- Ramsey Lions Club
- Minnesota Master Gardeners
- Minnesota Shade Tree Advisory Committee (MnSTAC)
- Minnesota Society of Arboriculture (MSA)
- Elk River Lions Club
- Anoka/Ramsey Outdoors
- Anoka American Legion

Appendix D: Social media messaging

- Facebook Correspondence
  - Anoka Lions Club
  - Minnesota Women of Today
  - Ramsey Lions Club
  - Anoka/Ramsey Outdoors

Appendix E: City of Ramsey Media Outreach

- City of Ramsey Press Release
- City of Ramsey Facebook Event Page
- City of Ramsey Facebook Informational Post

Appendix F: Outreach Flyers

- Flyer 1
- Flyer 2

Appendix G: Volunteer Registration Form

Appendix H: List of trees to species

Appendix I: Tree survey training Volunteer manual

Appendix J: Powerpoint

Appendix K: Tree identification cards

Appendix L: Minnesota Trees tree identification packet

Appendix M: Map of outdoor training locations

Appendix N: Training Outline

Appendix A: Contact List (before outreach)

Below is a list of the volunteer contacts received from Chris Anderson at the City of Ramsey to be used as initial contacts in the volunteer recruitment process.

-- RAMSEY VOLUNTEER CONTACT LIST --

Amy Rager rager001@umn.edu - contact for Master Naturalist program.
MN Tree Care Advisor program – Another potential option for volunteers.
Ashley Reichard reich343@umn.edu - Volunteer Programs Coordinator
-Additionally, cc' info@mntca.org

Parks and Recreation Commission – "A good pool of potential volunteers."
mriverblood@ci.ramsey.mn.us
-Contact the Assistant Public Works Superintendent, who is the liaison to the commission.
-Put together an invitation that includes a summary of what is needed so info can be funneled through.

Environmental Policy Board members:
IMPORTANT - Please bcc the message to each of the EPB members and cc Chris Anderson.
cdanderson1213@gmail.com
jcovart@gmail.com
lucastrossen@yahoo.com
mhiatt422@gmail.com
jmvalentine@hotmail.com
reidbernard@yahoo.com
tommystodola@yahoo.com

Appendix B: Volunteer Pre-survey

See below for the google form used for the volunteer pre-survey sent to the initial contacts received from Chris Anderson, see above.

Volunteer Training Pre-Survey

As someone with experience working/volunteering in Ramsey, would you mind answering a few quick questions regarding volunteer participation?

This spring, Ramsey is hosting a citywide tree survey. In order to participate in the survey, volunteers must attend a training.

We are looking to train volunteers this spring after leaf-out occurs, but want to make sure we host the training on days that are most accessible to residents; training would take place in two parts, and on two days. The first day will include an indoor classroom session (3hrs) and the second day an outdoor field session (6hrs).

1. **Email address** *

2. **What days would work best for volunteers in your community to participate in an indoor volunteer training?**
Mark only one oval per row.

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
First Choice							
Second Choice							
Third Choice							

3. **What days would work best for volunteers in your community to participate in an outdoor volunteer training?**
Mark only one oval per row.

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
First Choice							
Second Choice							
Third Choice							

4. **What times would work best for volunteers in your community to participate in a volunteer training?**
Check all that apply.

- [ ] Morning (9am-12pm)
- [ ] Afternoon (12pm-5pm)
- [ ] Evening (5pm-9pm)

5. **Are you aware of individuals who would benefit from having childcare, translation services, or other accessibility services provided? If so, which services?**

Appendix C: Recruitment Email

Below are the recruitment emails sent to various organizations in Ramsey.

Anoka Lions Club

1. From: Alissa Cotton <and03664@umn.edu>
   Date: Sun, Mar 25, 2018 at 1:11 PM
   Subject: City of Ramsey urban forest volunteer opportunity!

   Hello there!

   Thank you for responding to my Facebook request for outreach to Anoka Lions Club. Below is some information about the project, along with a link to sign up for the volunteer training. Would it be possible to post this to Facebook as well as send an email out to members? Please let me know if you would like any additional information. Again, thanks for your collaboration! -Alissa

   Here are the details:

   There is an excellent upcoming opportunity for Lions Club members to get involved with the development plan for the future of your neighbor city, Ramsey's, urban forest! In the summer of 2018 the City of Ramsey is performing a tree inventory, taking account of the species and condition of each public tree. Taking inventory of public trees will allow the City to plan for threats such as the infamous emerald ash borer, which is devastating ash tree populations, as well as to improve the stability of the urban forest by getting a sense for how much of a given type of tree is present, and to plan future plantings and tree maintenance.

   This inventory will be performed entirely by volunteers! The time commitment is open to individual volunteer groups. After completing the initial training, volunteers will be given all the tools and equipment necessary for performing the inventory, and will be able to go out into the City to collect data as often as they are able, over the course of the summer and into the fall.

   Training will be provided by University of Minnesota students over the course of two days. The first day will be an indoor session focusing and inventory instruction and tree identification. Day two will be a hands-on, outdoor field session, where volunteers learn exactly how to measure trees and record inventory data.

   Training dates:
   Day 1: Friday April 13th 5:30pm-8:30pm (indoor session, snacks provided, childcare available upon request)
   Day 2: Saturday April 14th 9:00am-3:00pm (outdoor field session, lunch provided, childcare provided upon request)

   Interested individuals may sign up for the training by following this link:
   http://mntreesource.umn.edu/ramsey-inventory

   We would love to see some Anoka Lions represented alongside Ramsey Lions in this effort to improve Ramsey's urban forest! Besides being a first step to bolstering the City's tree canopy, it is a magnificent chance to learn valuable new skills, enjoy the outdoors, and engage with neighbors, old and new!

   Thank you in advance for considering participation in this community-building opportunity!

2. From: Alissa Cotton <and03664@umn.edu>
   Date: Tue, Mar 27, 2018 at 10:05 AM
   Subject: City of Ramsey urban forest volunteer opportunity!

   Hello all!

   I wanted to make a quick clarification- I have sent this invitation to collaborate on Ramsey's tree inventory to three Lions Clubs: Ramsey, Anoka, and Elk River. The reason for this is that it is a large project and a unique opportunity for community- and skill-building; we hope to reach as many volunteers from the surrounding areas as might be interested and able to work with us. With the Lions Club's reputation for outstanding service and community engagement, it would be excellent to see representation from multiple locations. If it seems appropriate to you all, we would welcome Lion volunteers from each of those areas; however, if this strays from the normal Lions Club outreach protocol, I sincerely apologize for the blunder.

   Please let me know if there is anything unclear about the project; we will be happy to provide additional information.

   Thank you very much for considering sharing this opportunity with your members!

   Sincerely,

   Alissa Cotton
   and03664@umn.edu
   651.219.9454

Ramsey Lions Club

From: Alissa Cotton <and03664@umn.edu>
Date: Sun, Mar 25, 2018 at 10:40 AM
Subject: City of Ramsey urban forest volunteer opportunity!

Dear _____ and _____,

There is an excellent upcoming opportunity for Lions Club members to get involved with the development plan for the future of your neighbor city, Ramsey's, urban forest! In the summer of 2018 the City of Ramsey is performing a tree inventory, taking account of the species and condition of each public tree. Taking inventory of public trees will allow the City to plan for threats such as the infamous emerald ash borer, which is devastating ash tree populations, as well as to improve the stability of the urban forest by getting a sense for how much of a given type of tree is present, and to plan future plantings and tree maintenance.

This inventory will be performed **entirely by volunteers**! The time commitment is open to individual volunteer groups. After completing the initial training, volunteers will be given all the tools and equipment necessary for performing the inventory, and will be able to go out into the City to collect data as often as they are able, over the course of the summer and into the fall.

Training will be provided by University of Minnesota students over the course of two days. The first day will be an indoor session focusing and inventory instruction and tree identification. Day two will be a hands-on, outdoor field session, where volunteers learn exactly how to measure trees and record inventory data.

Training dates:
Day 1: Friday April 13th 5:30pm-8:30pm (indoor session, snacks provided, childcare available upon request)
Day 2: Saturday April 14th 9:00am-3:00pm (outdoor field session, lunch provided, childcare provided upon request)

We would love to see some Anoka Lions represented alongside Ramsey Lions in this effort to improve Ramsey's urban forest! Besides being a first step to bolstering the City's tree canopy, it is a magnificent chance to learn valuable new skills, enjoy the outdoors, and engage with neighbors, old and new!

Interested individuals may sign up for the training by following this link:
http://mntreesource.umn.edu/ramsey-inventory

Would you consider sharing this information with your members? We are happy to answer any questions you may have. We hope to see you at the training!

Thank you in advance for considering participation in this community-building opportunity!

Minnesota Master Gardeners

On Tue, Mar 27, 2018 at 4:33 PM, GRACE ANDERSON <teagarden1@comcast.net> wrote:

I am posting this on behalf of a colleague, Alissa Cotton, at the University of MN . She would like to have Master Gardener help with an inventory of trees in Ramsey, MN. Not limited to Anoka MGs.

Here is her message with a link to sign up:

There is an excellent upcoming opportunity for Master Gardeners to get involved with the development plan for the future of Ramsey's urban forest! In the summer of 2018 the City of Ramsey is performing a tree inventory, taking account of the species and condition of each public tree. Taking inventory of Ramsey's public trees will allow the City to plan for threats such as the infamous emerald ash borer, which is devastating ash tree populations, as well as to improve the stability of the urban forest by getting a sense for how much of a given type of tree is present, and to plan future plantings and tree maintenance. This could be the first step to making Ramsey the next Tree City USA!

This inventory will be performed **entirely by volunteers**! The time commitment is open to individual volunteer groups. After completing the initial training, volunteers will be given all the tools and equipment necessary for performing the inventory, and will be able to go out into the City to collect data as often as they are able, over the course of the summer and into the fall.

Training will be provided by University of Minnesota students over the course of two days. The first day will be an indoor session focusing and inventory instruction and tree identification. Day two will be a hands-on, outdoor field session, where volunteers learn exactly how to measure trees and record inventory data.

Training dates:

Day 1: Friday April 13th 5:30pm-8:30pm(indoor session, snacks provided, childcare available upon request)

Day 2:Saturday April 14th 9:00am-3:00pm(outdoor field session, lunch provided, childcare provided upon request)

We would love to see Master Gardeners represented in this effort to improve Ramsey's urban forest! Besides being a first step to bolstering the City's tree canopy, it is a magnificent chance to engage with other citizen scientists and learn valuable tree identification and measuring skills!

Interested individuals may sign up for the training by following this link:
http://mntreesource.umn.edu/ramsey-inventory

We hope to see you at the training!

Please contact Alissa Cotton at and03664@umn.edu.

Grace Anderson
Hennepin County Master Gardener

Minnesota Shade Tree Advisory Committee (MnSTAC)

(published in weekly email on 3/26/18, 4/2/18, 4/9/18)

On Wed, Mar 21, 2018 at 1:09 PM, Alissa Cotton <and03664@umn.edu> wrote:

Hi Ryan, would you please add this to the MnSTAC volunteering opportunity section?

Opportunity to participate in a citywide tree inventory survey!

The City of Ramsey is partnering with community volunteers and students from the University of Minnesota to pilot a public tree inventory beginning in spring of 2018. Trees are an often-overlooked asset of communities, but they provide an array of economic, environmental, personal, and social benefits. As Ramsey continues to grow and develop, updated information for the current boulevard/street trees is needed to help city planners make decisions to create a healthier, more diverse urban forest. The survey will be citizen-science based, giving members of the community an exciting opportunity to engage in a project to improve the quality of the city. Volunteers will complete an indoor and and outdoor field training instructed by members of the University of Minnesota. After completion of training, volunteers will perform a citywide survey to collect information about public trees. The survey will take place over the course of the summer of 2018.

For more information, and to join this team, visit http://mntreesource.umn.edu/ramsey-inventory
or contact Chris Anderson, canderson@cityoframsey.com

Minnesota Society of Arboriculture (MSA)

(Published in weekly email sent 3/30/18, 4/13/18, 4/27/18)

On Wed, Mar 21, 2018 at 1:10 PM, Alissa Cotton <and03664@umn.edu> wrote:
Hi Danielle,

Would it be possible to include this call for volunteers in an MSA email blast? It's for a tree inventory survey for the city of Ramsey:

Opportunity to participate in a citywide tree inventory survey!

The City of Ramsey is partnering with community volunteers and students from the University of Minnesota to pilot a public tree inventory beginning in spring of 2018. Trees are an often-overlooked asset of communities, but they provide an array of economic, environmental, personal, and social benefits. As Ramsey continues to grow and develop, updated information for the current boulevard/street trees is needed to help city planners make decisions to create a healthier, more diverse urban forest. The survey will be citizen-science based, giving members of the community an exciting opportunity to engage in a project to improve the quality of the city. Volunteers will complete an indoor and and outdoor field training instructed by members of the University of Minnesota. After completion of training, volunteers will perform a citywide survey to collect information about public trees. The survey will take place over the course of the summer of 2018.

For more information, and to join this team, visit http://mntreesource.umn.edu/ramsey-inventory
or contact Chris Anderson, canderson@cityoframsey.com

Elk River Lions Club

From: Alissa Cotton <and03664@umn.edu>
Date: Sun, Mar 25, 2018 at 11:07 AM
Subject: City of Ramsey urban forest volunteer opportunity!

Dear Elk River Lions Club,

There is an excellent upcoming opportunity for Lions Club members to get involved with the development plan for the future of your neighbor city, Ramsey's, urban forest! In the summer of 2018 the City of Ramsey is performing a tree inventory, taking account of the species and condition of each public tree. Taking inventory of public trees will allow the City to plan for threats such as the infamous emerald ash borer, which is devastating ash tree populations, as well as to improve the stability of the urban forest by getting a sense for how much of a given type of tree is present, and to plan future plantings and tree maintenance.

This inventory will be performed entirely by volunteers! The time commitment is open to individual volunteer groups. After completing the initial training, volunteers will be given all the tools and equipment necessary for performing the inventory, and will be able to go out into the City to collect data as often as they are able, over the course of the summer and into the fall.

Training will be provided by University of Minnesota students over the course of two days. The first day will be an indoor session focusing and inventory instruction and tree identification. Day two will be a hands-on, outdoor field session, where volunteers learn exactly how to measure trees and record inventory data.

Training dates:
Day 1: Friday April 13th 5:30pm-8:30pm (indoor session, snacks provided, childcare available upon request)
Day 2: Saturday April 14th 9:00am-3:00pm (outdoor field session, lunch provided, childcare provided upon request)

We would love to see some Elk River Lions represented alongside Ramsey and Anoka Lions in this effort to improve Ramsey's urban forest! Besides being a first step to bolstering the City's tree canopy, it is a magnificent chance to learn valuable new skills, enjoy the outdoors, and engage with neighbors, old and new!

Interested individuals may sign up for the training by following this link:
http://mntreesource.umn.edu/ramsey-inventory

Would you consider sharing this information with your members? We are happy to answer any questions you may have. We hope to see you at the training!

Thank you in advance for considering participation in this community-building opportunity!

Anoka/Ramsey Outdoors

From: Alissa Cotton <and03664@umn.edu>
Date: Sun, Mar 25, 2018 at 11:13 AM
Subject: Re:

Hello_____, sounds great, thanks for your help! Here you go:

There is an excellent upcoming opportunity for outdoor-lovers to get involved with the development plan for the future of Ramsey's urban forest! In the summer of 2018 the City of Ramsey is performing a tree inventory, taking account of the species and condition of each public tree. Taking inventory of public trees will allow the City to plan for threats such as the infamous emerald ash borer, which is devastating ash tree populations, as well as to improve the stability of the urban forest by getting a sense for how much of a given type of tree is present, and to plan future plantings and tree maintenance. This could be the first step in making Ramsey the next Tree City USA!

This inventory will be performed entirely by volunteers! The time commitment is open to individual volunteer groups. After completing the initial training, volunteers will be given all the tools and equipment necessary for performing the inventory, and will be able to go out into the City to collect data as often as they are able, over the course of the summer and into the fall.

Training will be provided by University of Minnesota students over the course of two days. The first day will be an indoor session focusing and inventory instruction and tree identification. Day two will be a hands-on, outdoor field session, where volunteers learn exactly how to measure trees and record inventory data.

Training dates:
Day 1: Friday April 13th 5:30pm-8:30pm (indoor session, snacks provided, childcare available upon request)
Day 2: Saturday April 14th 9:00am-3:00pm (outdoor field session, lunch provided, childcare provided upon request)

We would love to see some Anoka/Ramsey Outdoors folks represented in this effort to improve Ramsey's urban forest! Besides being a first step to bolstering the City's tree canopy, it is a magnificent chance to learn valuable new skills, enjoy the outdoors, and engage with neighbors, old and new!

Interested individuals may sign up for the training by following this link:
http://mntreesource.umn.edu/ramsey-inventory

Would you consider sharing this information with your members? We are happy to answer any questions you may have. We hope to see you at the training!

Thank you in advance for considering participation in this community-building opportunity!

Anoka American Legion

From: **Alissa Cotton** <and03664@umn.edu>
Date: Sun, Mar 25, 2018 at 10:01 AM
Subject: City of Ramsey urban forest volunteer opportunity!

Dear Anoka American Legion,

There is an excellent upcoming opportunity for your friends and members to get involved with the development plan for the future of Ramsey's urban forest! In the summer of 2018 the City of Ramsey is performing a tree inventory, taking account of the species and condition of each public tree. Taking inventory of Ramsey's public trees will allow the City to plan for threats such as the infamous emerald ash borer, which is devastating ash tree populations, as well as to improve the stability of the urban forest by getting a sense for how much of a given type of tree is present, and to plan future plantings and tree maintenance. This could be the first step to making Ramsey the next Tree City USA!

This inventory will be performed **entirely by volunteers**! The time commitment is open to individual volunteer groups. After completing the initial training, volunteers will be given all the tools and equipment necessary for performing the inventory, and will be able to go out into the City to collect data as often as they are able, over the course of the summer and into the fall.

Training will be provided by University of Minnesota students over the course of two days. The first day will be an indoor session focusing and inventory instruction and tree identification. Day two will be a hands-on, outdoor field session, where volunteers learn exactly how to measure trees and record inventory data.

Training dates:
Day 1: Friday April 13th 5:30pm-8:30pm (indoor session, snacks provided, childcare available upon request)
Day 2: Saturday April 14th 9:00am-3:00pm (outdoor field session, lunch provided, childcare provided upon request)

We would love to see the Anoka American Legion represented in this effort to improve Ramsey's urban forest! Besides being a first step to bolstering the City's tree canopy, it is a magnificent chance to learn valuable new skills and engage with other community members and citizen scientists!

Interested individuals may sign up for the training by following this link:
http://mntreesource.umn.edu/ramsey-inventory

Would you consider sharing this information with your members? We are happy to answer any questions you may have. We hope to see you at the training!

Thank you in advance for considering participation in this community-building opportunity!

Appendix D: Social media messaging

Included below is the social media outreach messaging sent to various organizations in Ramsey for volunteer outreach and recruitment.

Facebook Correspondence

Anoka Lions Club

MAR 25TH, 10:43AM
Alissa Cotton: Hello there! I am a member of a University of Minnesota student group working with the City of Ramsey to perform a city-wide tree inventory completed entirely by volunteers. We thought there might be some Anoka Lions who might be interested in participating with their neighbors in Ramsey! I've sent an email to the president and vice president of the Anoka Lions Club with details and wondered if you might consider adding a blurb to your Facebook page. May I send you the information for the volunteer training to post here? Thanks in advance for considering! -Alissa Cotton and03664@umn.edu
MAR 25TH, 12:31PM

Anoka Lions Club: Send info to _____

Alissa Cotton: Will do, thanks!

Minnesota Women of Today

MAR 25TH, 9:41AM
Alissa Cotton: Hi there! I am a member of a University of Minnesota student group working with the City of Ramsey to perform a city-wide tree inventory completed entirely by volunteers. We thought there might be some ladies in Minnesota Women of Today who might be interested in participating. I've sent an email to Kathy Hansen with details and wondered if you might consider adding a blurb to your Facebook page. May I send you the information for the volunteer training to post here? Thanks in advance for considering! -Alissa
Seen Mar 25

Ramsey Lions Club

MAR 25TH, 9:50AM
Alissa Cotton: Hello there! I am a member of a University of Minnesota student group working with the City of Ramsey to perform a city-wide tree inventory completed entirely by volunteers. We thought there might be some Lions who might be interested in participating. I've sent an email to the Ramsey Lions Club general email address with details and wondered if you might consider adding a blurb to your Facebook page. May I send you the information for the volunteer training to post here? Thanks in advance for considering! -Alissa Cotton and03664@umn.edu

Ramsey Lions Club: Alissa, we can post something. Go ahead and send the info.
Alissa Cotton: Great, thanks very much! Here you go:
There is an excellent upcoming opportunity for Lions Club members to get involved with the development plan for the future of Ramsey's urban forest! In the summer of 2018 the City of Ramsey is performing a tree inventory, taking account of the species and condition of each public tree. Taking inventory of Ramsey's public trees will allow the City to plan for threats such as the infamous emerald ash borer, which

is devastating ash tree populations, as well as to improve the stability of the urban forest by getting a sense for how much of a given type of tree is present, and to plan future plantings and tree maintenance. This could be the first step to making Ramsey the next Tree City USA!

This inventory will be performed entirely by volunteers! The time commitment is open to individual volunteer groups. After completing the initial training, volunteers will be given all the tools and equipment necessary for performing the inventory, and will be able to go out into the City to collect data as often as they are able, over the course of the summer and into the fall.

Training will be provided by University of Minnesota students over the course of two days. The first day will be an indoor session focusing and inventory instruction and tree identification. Day two will be a hands-on, outdoor field session, where volunteers learn exactly how to measure trees and record inventory data.

Training dates:
Day 1: Friday April 13th 5:30pm-8:30pm (indoor session, snacks provided, childcare available upon request)
Day 2: Saturday April 14th 9:00am-3:00pm (outdoor field session, lunch provided, childcare provided upon request)

We would love to see the Ramsey Lions Club represented in this effort to improve Ramsey's urban forest! Besides being a first step to bolstering the City's tree canopy, it is a magnificent chance to engage with other citizen scientists and learn valuable tree identification and measuring skills!

Interested individuals may sign up for the training by following this link:
http://mntreesource.umn.edu/ramsey-inventory
Ramsey Inventory | Urban and Community Forestry
mntreesource.umn.edu
Seen Mar 25

Anoka/Ramsey Outdoors

MAR 25TH, 10:07AM
Alissa Cotton: Hello there! I am a member of a University of Minnesota student group working with the City of Ramsey to perform a city-wide tree inventory completed entirely by volunteers. Participation in the survey is a delightful opportunity for outdoor-loving individuals and families to gain valuable skills in tree identification, measurement, and condition assessment. We thought there might be some members of Anoka Ramsey Outdoors who would be interested in joining the crew. May I send you more information on the training and would you consider adding a blurb about this to your Facebook page? Thanks in advance for your consideration! -Alissa Cotton (and03664@umn.edu)

Anoka/Ramsey Outdoors: Please send me more info! I have a meeting tonight with the ARAA board and will discuss this tonight if possible. I'll send you an email if it's easier to pass Info via email. Thanks.
BJ Brent

Alissa Cotton: Hi there! Yes, I think it will be easiest to view in email form. Can you send me your address or an email to my address above? THANK YOU!

Anoka/Ramsey Outdoors: Email sent. Thanks.

Appendix E: City of Ramsey Media Outreach

Below is the press release, the Facebook event post, and the Facebook media post, utilized by the City of Ramsey.

City of Ramsey Press Release

Attention community members, friends, nature-lovers, and outdoor enthusiasts, there is an excellent opportunity coming up to get involved with the development plan for the future of Ramsey's urban forest! In the summer of 2018, the City of Ramsey is performing a tree inventory/ survey, taking account of the species and condition of public trees. Taking inventory of public trees will allow the City to plan for threats, such as the infamous emerald ash borer that is devastating ash tree populations. It will also improve the stability of the urban forest by getting a sense for how much of a given type of tree is present, and to plan future plantings and tree maintenance.

This survey will be performed entirely by volunteers! The time commitment is open to individual volunteer groups. After completing the initial training, volunteers will be given all the tools and equipment necessary for performing the inventory, and will be able to go out into the City to collect data as often as they are able, over the course of the summer and into the fall.

Training will be provided by University of Minnesota students over the course of two days. The first day will be an indoor session focusing and inventory instruction and tree identification. Day two will be a hands-on, outdoor field session, where volunteers learn exactly how to measure trees and record inventory data.

Come and be a part of this community-building opportunity! Besides being a first step to bolstering the City's tree canopy, it is a magnificent chance to learn valuable new skills, enjoy the outdoors, and engage with neighbors and friends, old and new!

Training details:
Location: Ramsey City Hall - 7550 Sunwood Drive
Day 1: Friday April 13th 5:30pm-8:30pm (indoor session, snacks provided)
Day 2**: Saturday April 14th 9:00am-3:00pm (outdoor field session, rain or shine!**, lunch provided)

**In case of cancellation due to lightning, the field session will be held the following day, Sunday, April 15, from 9am-3pm.

Interested individuals may sign up for the training by following this link:
http://mntreesource.umn.edu/ramsey-inventory

City of Ramsey Facebook Event Page

(Event shared 4/5/18 and 4/10/18)
This summer, the City of Ramsey is performing a Tree Inventory Survey completed entirely by volunteers! The survey will take account of the species, age and condition of our public trees.

Everyone is welcome to volunteer! (Individuals younger than 18 years of age must be accompanied by a parent or legal guardian.) If you are interested in participating, this two-part volunteer training is required.

DAY 1- Friday, April 13, 5:30 - 8:30 pm
Indoor, snacks provided
DAY 2- Saturday, April 14, 9:00 am - 3:00 pm
Outdoors, rain or shine!** Lunch provided.

**In case of cancellation due to lighting, the field session will be held the following day, Sunday, April 15 from 9:00 am - 3:00 pm.

Sign-up for the training sessions at mntreesource.umn.edu/ramsey-inventory, or visit our website to learn more http://www.cityoframsey.com/CivicAlerts.aspx?AID=49

City of Ramsey Facebook Informational Post

(Posted 4/3/18)
This summer, the City of Ramsey is performing a tree inventory to take account of the species and condition of our public trees. This inventory will be performed entirely by volunteers!

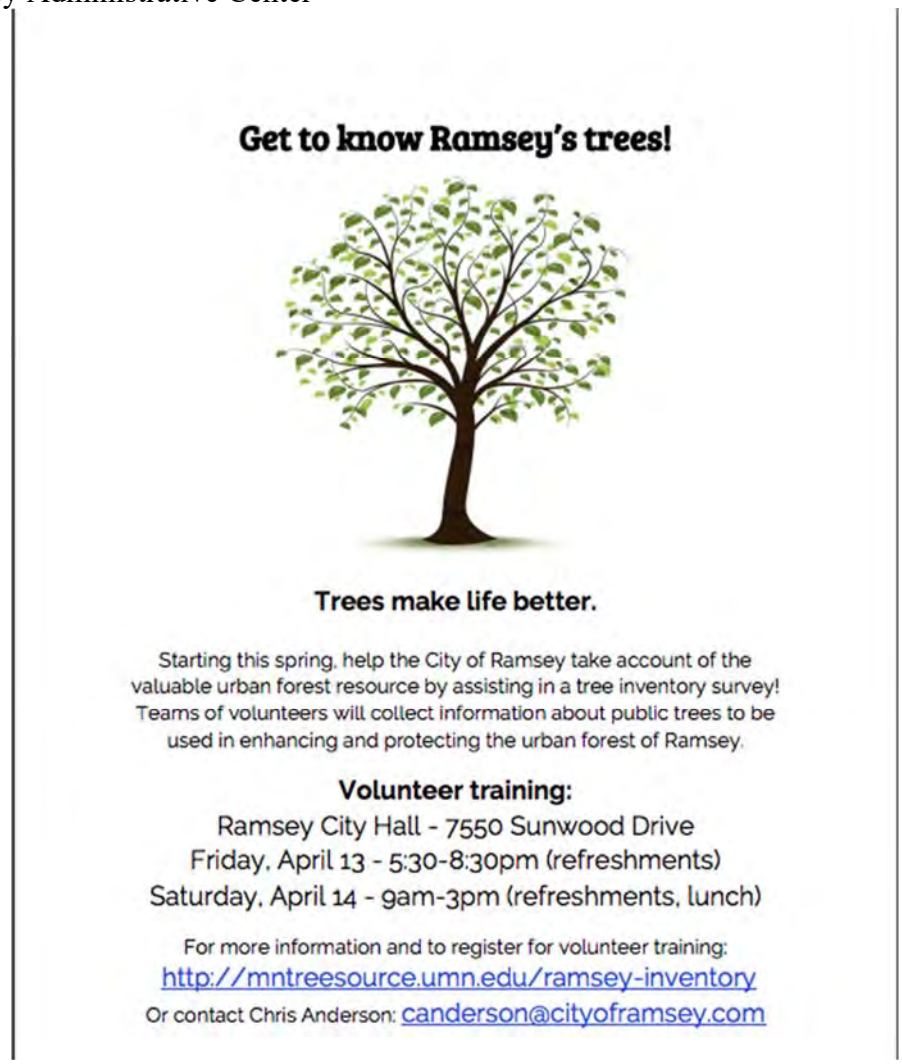
If you are interested in joining this opportunity, training will be provided by students of the Resilient Communities Project - University of Minnesota on Friday, April 13 from 5:30 - 8:30 pm and Saturday, April 14 9:00 am - 3:00 pm at Ramsey City Hall. Visit our website to sign up and learn more.

Appendix F: Outreach Flyers

Below are the flyers that were created and distributed for outreach and volunteer recruitment. For pdf versions, see the attached documents.

Flyer 1

Posted at:
Ramsey Administrative Center

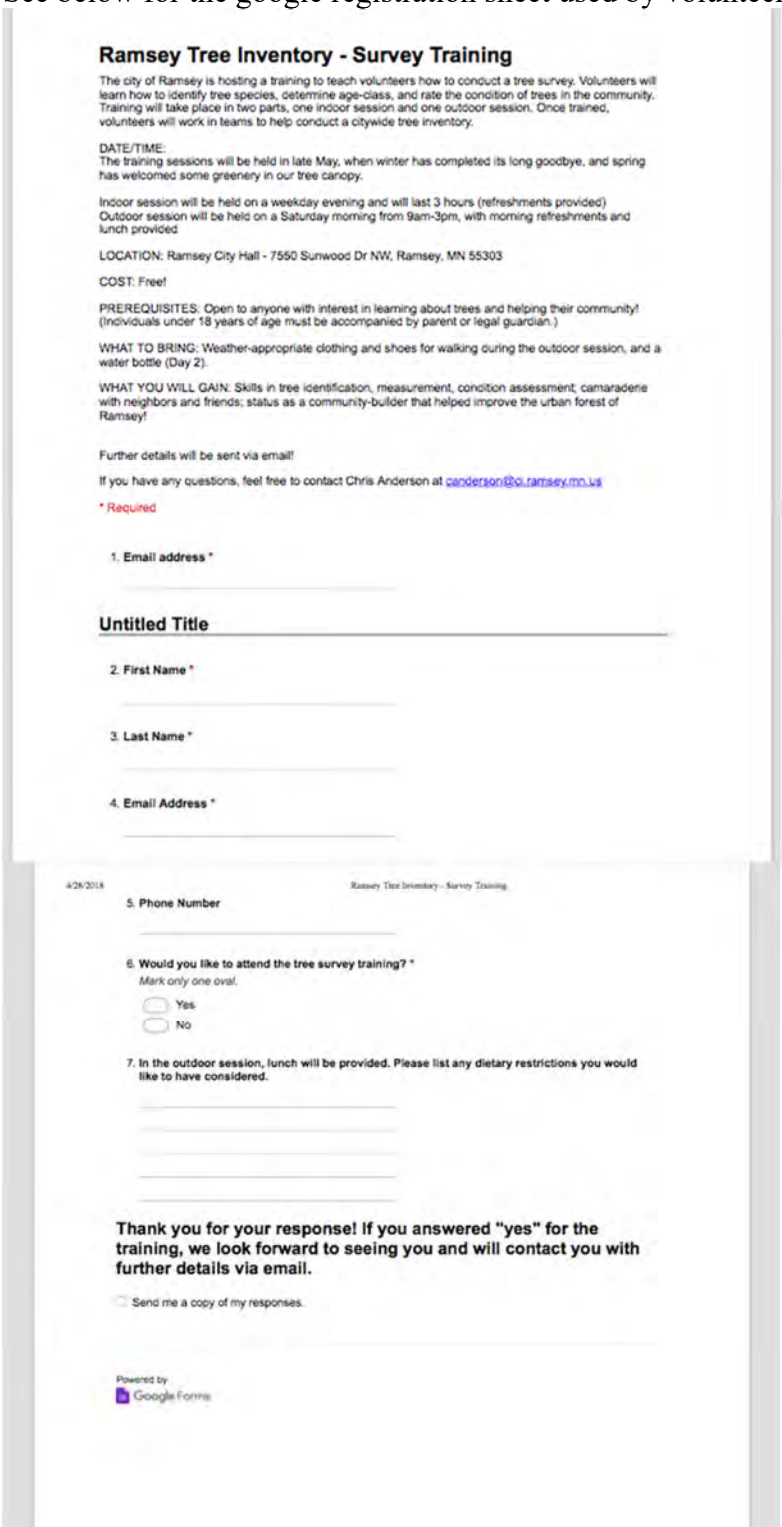


Flyer 2

Distributed/Posted at:
Ramsey Administrative Center
Caribou Coffee, Ramsey
Dunn Brothers Coffee, Anoka
Coburn's Superstore, Ramsey
Anoka American Legion
Anoka Technical College

Appendix G: Volunteer Registration Form

See below for the google registration sheet used by volunteers to register for the training.



Ramsey Tree Inventory - Survey Training

The city of Ramsey is hosting a training to teach volunteers how to conduct a tree survey. Volunteers will learn how to identify tree species, determine age-class, and rate the condition of trees in the community. Training will take place in two parts, one indoor session and one outdoor session. Once trained, volunteers will work in teams to help conduct a citywide tree inventory.

DATE/TIME:
The training sessions will be held in late May, when winter has completed its long goodbye, and spring has welcomed some greenery in our tree canopy.

Indoor session will be held on a weekday evening and will last 3 hours (refreshments provided)
Outdoor session will be held on a Saturday morning from 9am-3pm, with morning refreshments and lunch provided

LOCATION: Ramsey City Hall - 7550 Sunwood Dr NW, Ramsey, MN 55303

COST: Free!

PREREQUISITES: Open to anyone with interest in learning about trees and helping their community! (Individuals under 18 years of age must be accompanied by parent or legal guardian.)

WHAT TO BRING: Weather-appropriate clothing and shoes for walking during the outdoor session, and a water bottle (Day 2).

WHAT YOU WILL GAIN: Skills in tree identification, measurement, condition assessment; camaraderie with neighbors and friends; status as a community-builder that helped improve the urban forest of Ramsey!

Further details will be sent via email!

If you have any questions, feel free to contact Chris Anderson at canderson@ci.ramsey.mn.us

* Required

1. **Email address** *

Untitled Title

2. **First Name** *

3. **Last Name** *

4. **Email Address** *

4/26/2018 Ramsey Tree Inventory - Survey Training

5. **Phone Number**

6. **Would you like to attend the tree survey training?** *
Mark only one oval.
- Yes
- No

7. **In the outdoor session, lunch will be provided. Please list any dietary restrictions you would like to have considered.**

Thank you for your response! If you answered "yes" for the training, we look forward to seeing you and will contact you with further details via email.

Send me a copy of my responses.

Powered by Google Forms

Appendix H: List of trees to species

Below is the list of trees that are to be identified down to species by volunteers found on page 12 of the Volunteer Tree Survey Training manual.

Family	Genus	Species	Common Name	Identify to…
Betulaceae	Betula	nigra	river birch	species
Betulaceae	Betula	papyrifera	paper birch	species
Fagaceae	Quercus	alba	white oak	white oak group
Fagaceae	Quercus	bicolor	swamp white oak	white oak group
Fagaceae	Quercus	macrocarpa	bur oak	species
Fagaceae	Quercus	palustris	pin oak	red oak group
Fagaceae	Quercus	rubra	northern red oak	red group
Juglandaceae	Juglans	nigra	black walnut	species
Pinaceae	Picea	glauca	white spruce	species
Pinaceae	Picea	pungens	Colorado blue spruce	species
Pinaceae	Picea	abies	Norway spruce	species
Pinaceae	Pinus	strobus	eastern white pine	species
Pinaceae	Pinus	resinosa	red pine	species
Pinaceae	Pinus	sylvestris	Scots pine	species
Salicaceae	Populus	grandidentata	bigtooth aspen	"aspen"
Salicaceae	Populus	tremuloides	trembling/quaking aspen	"aspen"
Salicaceae	Populus	deltoides	eastern cottonwood	species
Sapindaceae	Acer	negundo	boxelder	species
Sapindaceae	Acer	rubrum	red maple	species
Sapindaceae	Acer	ginnala	Amur maple	species
Sapindaceae	Acer	platanoides	Norway maple	species
Sapindaceae	Acer	saccharum	sugar maple	species
Sapindaceae	Acer	saccharinum	silver maple	species
Ulmaceae	Ulmus	americana	American elm	species
Ulmaceae	Ulmus	pumila	Siberian elm	species
Ulmaceae	Ulmus	rubra	slippery elm/red elm	species
Ulmaceae	Ulmus	thomasii	rock elm	species

Appendix I: Tree survey training Volunteer manual

See the attached “Ramsey Tree Survey Training 2018” volunteer training manual document. All volunteers received a copy of this manual at the indoor training session; the manual is also available on the mntreesource.umn.edu webpage.

Ramsey Tree Survey Training 2018

This training manual was prepared by students at the University of Minnesota as part of the Resilient Communities Project under the unsurpassed guidance of the everwise Gary Johnson. Trees forever!

CONTENTS

5

1. Introduction

What is a Tree Survey?

Trees are an important part of any community as they provide many environmental, economic, and social benefits. In order to maximize and maintain these benefits, it is important to effectively and efficiently manage them. In order to do this, understanding what trees exist within the community is crucial. Having information on the size, type, condition, and abundance of trees allows communities to create accurate and appropriate management practices for the present and future. One way to gather information about the trees within a community is to conduct a tree inventory or tree survey. Tree inventories can be a great asset to a community as they:

- Facilitate the development of management plans
- Produce information that can be used by city officials in determining budget
- Identify trees of concern or trees susceptible to failure in severe weather
- Determine where maintenance is needed
- Provide a sense of the overall canopy health in a community
- Establish monetary value and ecosystem services of urban forest

Ramsey's Survey

For the City of Ramsey's tree survey, a stratified random sampling technique will be used, allowing for accurate estimates of tree species, diameter categories, and total trees. By participating in this tree survey you are collecting and providing your city with the means to create management plans, apply for grants, identify risks, determine benefits, and understand environmental benefits.

2. Tree Survey Volunteer Guidelines, Policies, and Procedures

Volunteer Commitment

Thank you for your willingness to volunteer your time and energy to help with this tree survey! In order to help keep data as accurate as can be, you are asked to attend both days of training. Once trained, it is expected that you and the volunteers in your team work out a time frame and time schedule to inventory your assigned sections before October 2018. Time required to complete the survey ultimately depends on the number of groups participating; the more groups, the less surveying for everyone. Additionally, in order to maintain accurate data collection practices it is recommended that surveying sessions are limited to four hours at a time.

Have fun, and remember that you are only asked to do as much as you can; any gaps or unfinished sections will be completed by other groups in the community.

Teams

At the close of the tree survey training each individual will be asked to form a team of three volunteers. Each team will then be assigned a section, and it is up to them to arrange a surveying schedule.

Remember to notify your community contact each time your group conducts a section of the survey.

Name:	**Phone:**	**Email:**
_____	_____	_____
_____	_____	_____

Survey Equipment and Materials

Each time you survey, remember to dress for the weather, wear comfortable shoes and bring:

- ❑ DBH tape
- ❑ 50' cloth measuring tape
- ❑ Data collection sheets
- ❑ Tree identification cards/guides
- ❑ Clipboard
- ❑ Pens/pencils
- ❑ Volunteer identification (card/vest/lanyard, etc.)
- ❑ Informational material for interested onlookers with project details and city contacts
- ❑ Water
- ❑ Cell Phone

Minimum Age Requirement

Participants must be 18 years or older to participate in this survey. Individuals under 18 years of age must be accompanied by parent or legal guardian.

Public vs. Private Trees

This is a survey of public trees only. Public trees include anything planted within 16' of a street.

Safety

When conducting the tree survey it is important that you remain safe, especially when working in busy areas of the community. Remember to stick with your team when in the field, looking out for one another as you survey.

You may choose to perform the survey in various types of weather. Make sure to wear proper attire for your comfort and safety. Never perform surveying if there is lightning anywhere in view.

Perform the survey only during daylight hours.

Interactions with the Public

Please remember to carry your volunteer identification every time your team goes out to survey. Additionally, make sure you have contact information for your city's contact: **Chris Anderson, 763-433-9817.**

It is natural for residents to be curious about work being done near their homes. Some residents may see you as a source of knowledge and ask you to look at certain trees or answer tree questions. Explain to them that you are a volunteer who has received tree survey training, and if they have any questions they may contact the city or an ISA-certified arborist.

You will be collecting data on public trees, however some residents may request that no information be taken on the public tree near their property. In the event that a resident asks you to leave the area, thank them for their time, make a note on your data sheet for your contact your city contact and move on to the next tree.

If you find yourself interacting with a disagreeable resident, you may explain that you are a trained volunteer authorized by the city to collect information about public trees. If there is a substantial fuss, discontinue surveying that particular tree and contact your city contact, Chris Anderson at 763-433-9817. You will be provided with a replacement tree to survey.

If at any time you feel uncomfortable or threatened, leave the area immediately and call 9-1-1 if you are in immediate danger.

Important Contacts

Chris Anderson, City planner and Community Development (canderson@cityoframsey.com)

3. Surveying Trees

Typical Trees in Ramsey

In a rapid tree survey performed by the DNR in 2010, the top ten genera were identified (Figure 1). Why complete another tree survey now? A lot can happen in eight years! Along with the growth and development of cities comes drastic change to the urban canopy.

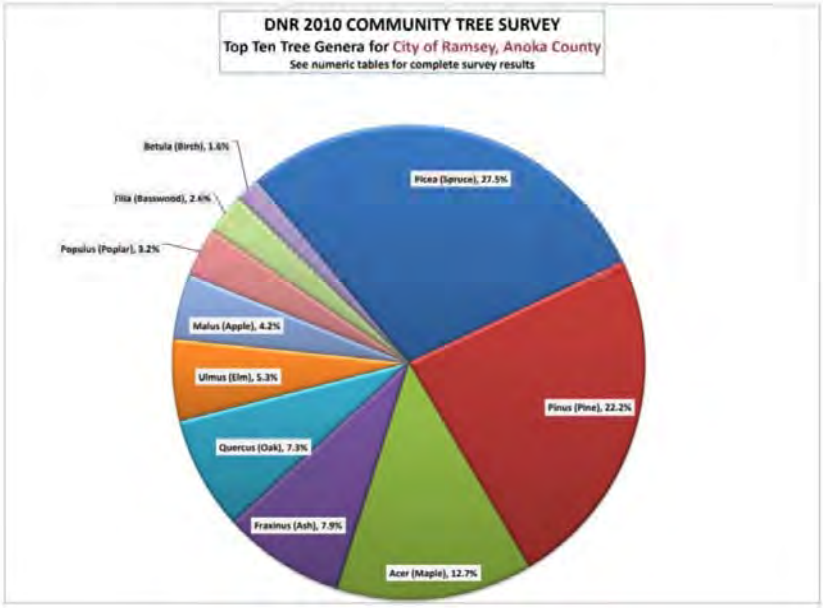


Figure 1 - 2010 DNR Rapid Survey of Ramsey, MN

Tree Identification

Classification

You may recall from a biology class that each unique plant, animal, and fungus on earth has been given a scientific name, or binomial (at least, those that have been discovered so far!). This scientific, or binomial, name includes one word for the genus and one word for the species (e.g. sugar maple = *Acer saccharum*). The genus classification (such as *Acer*) includes any number of individual species that share common characteristics. The species classification (such as *saccharum*) is unique to individuals that can freely reproduce with each other, and are distinct from other related species.

Most trees in this survey will be identified down to the genus level for simplicity. However, there are some trees for which there is value in identifying the species because different species within a genus may be at risk for certain pests or diseases. For example, you will differentiate between the white oak group and the red oak group due to the high risk of oak wilt associated with the red oak group, and the risk of bur oak blight on bur oak, which is in the white oak group.

Identification

The following trees should be identified down to the species level:

Family	Genus	Species	Common Name	Identify to…
Betulaceae	Betula	nigra	river birch	species
Betulaceae	Betula	papyrifera	paper birch	species
Fagaceae	Quercus	alba	white oak	white oak group
Fagaceae	Quercus	bicolor	swamp white oak	white oak group
Fagaceae	Quercus	macrocarpa	bur oak	species
Fagaceae	Quercus	palustris	pin oak	red oak group
Fagaceae	Quercus	rubra	northern red oak	red group
Juglandaceae	Juglans	nigra	black walnut	species
Pinaceae	Picea	glauca	white spruce	species
Pinaceae	Picea	pungens	Colorado blue spruce	species
Pinaceae	Picea	abies	Norway spruce	species
Pinaceae	Pinus	strobus	eastern white pine	species
Pinaceae	Pinus	resinosa	red pine	species
Pinaceae	Pinus	sylvestris	Scots pine	species
Salicaceae	Populus	grandidentata	bigtooth aspen	"aspen"
Salicaceae	Populus	tremuloides	trembling/quaking aspen	"aspen"
Salicaceae	Populus	deltoides	eastern cottonwood	species
Sapindaceae	Acer	negundo	boxelder	species
Sapindaceae	Acer	rubrum	red maple	species
Sapindaceae	Acer	ginnala	Amur maple	species
Sapindaceae	Acer	platanoides	Norway maple	species
Sapindaceae	Acer	saccharum	sugar maple	species
Sapindaceae	Acer	saccharinum	silver maple	species
Ulmaceae	Ulmus	americana	American elm	species
Ulmaceae	Ulmus	pumila	Siberian elm	species
Ulmaceae	Ulmus	rubra	slippery elm/red elm	species
Ulmaceae	Ulmus	thomasii	rock elm	species

For information on identification, please reference the Minnesota Trees booklet and TreeID Cards provided in the training.

Determining Age-Class

In order to assess the age-class of a tree, the diameter at breast height (DBH) and the crown width can be utilized. These measurements help in the identification of the age and the growth of a tree.

Measuring Diameter at Breast Height (DBH)

Diameter at breast height is a standardized point on a trunk, 4.5 feet from the base of the tree. This measurement is used to estimate age and volume of trees. To measure the DBH you can use a diameter tape (D-tape), or you can measure the circumference of a tree with a standard measuring tape and convert the measurement to diameter by dividing the circumference by pi (3.14).

Using a D-tape

- All breasts are not 4.5 feet off the ground! Determine breast height on your own body by measuring 4.5 feet up from the ground - remember where that point on your body is; it will make measurements in the field go quickly.
- When measuring a tree, wrap the D-tape completely around the tree at your breast height until the zero on the tape reaches the tape again. Record the number where the zero meets the tape again. If the tree is on a slope, take the measurement on the uphill side of the tree (Figure 2).
- Remember to read the correct side of the D-tape:
    - The right side: measures using distances that have been converted to diameter
    - The wrong side: measures in standard feet

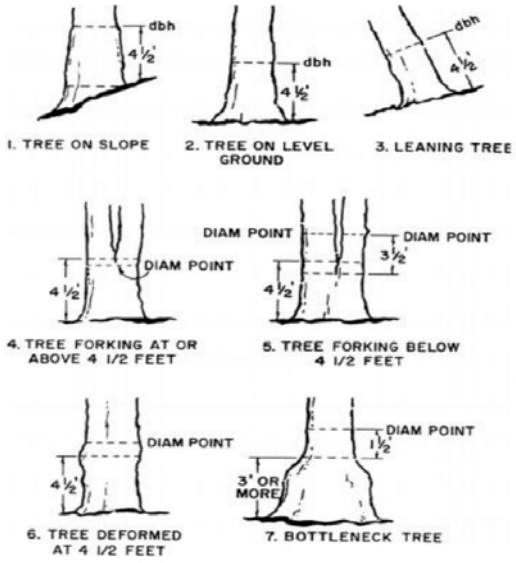


Figure 2 - Measuring DBH

Measuring Crown Width

The crown width of a tree refers to the average diameter of a tree's crown. You can approximate a tree's crown width by using a standard measuring tape. To measure crown width (Figure 3):

- One group member will stand at the edge of the canopy with one end of the tape measure
- A second member walks with the opposite end of the tape measure to the tree's trunk. They then turn 90 degrees with the tape hugging the stem around the corner and continue that path to the edge of the canopy.
    - Record this distance to the nearest foot.

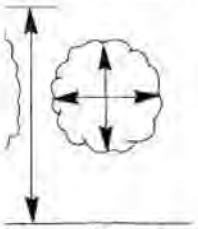


Figure 3 - Measuring Crown Width

Condition Rating

When assessing the condition of a tree, each team member present should evaluate the tree independently. Once everyone has had a chance to determine their ratings, the team should discuss how each person rated the tree. If condition ratings vary dramatically between team members, take time to discuss and resolve the differences.

For each tree surveyed, two separate condition ratings will be determined, one for the crown and one for the stem. **Numeric values for the crown and stem ratings are not lumped together or averaged.** Each rating is determined by using a zero-to-four point scale. Every tree begins with four points, and receives **reductions in quarter point increments** as the crown and as the stem are evaluated. Foliage (leaves) is not evaluated in this rating system.

Rating the Crown Condition

Stag Heading

Stagheading is a condition where an entire main branch is dead, from the tip of the branch all the way back to the main stem of another major branch (Figure 4). **Up to 1 point** may be deducted, based on the size of the dead branch and the percentage of crown affected. Larger branches that affect more of the crown will receive deductions near 1, whereas smaller dead branches that make up only a small portion of the crown will receive minor deductions.

Figure 4 - Stag Heading (Source: Gary Johnson)

Tip dieback

Tip dieback is a condition where there is significant death at the tips of the branches (Figure 5). If a tree exhibits die back, **up to 0.5 point** can be deducted from the rating. This deduction usually is typically given to trees that exhibit dieback in the entire crown of the tree.

Figure 5 - Tip Dieback

Source: (http://www.treecology-mn.com/wp-content/uploads/2012/03/construction-die-back.jpg)

Symmetry

This condition factor address symmetry of the crown; each tree is assessed in comparison to a perfectly symmetrical crown (Figure 6). **Up to 1 point** can be deducted if a portion, or portions, of the crown is missing.

- 50% crown missing: **-1.0**
- 25% crown missing: **-0.5**
- Less than 25% crown missing: **-0.25**

Figure 6 - Symmetry
(Source: https://www.tottenhamtrees.org/uploads/5/6/9/4/56947305/1360982_6_orig.jpg)

Live crown ratio (LCR)

The live crown ratio is the total potential crown of a tree. It is the ratio of the height of the crown to the total height of the tree (Figure 7 and 8). The crown begins where the first main branch on the tree is located and rises to the top of the tree. Note: The crown does not begin at the foliage but at the first main branch.

Measuring LCR

- Stand far from the tree and hold a tape measure out in front of you.
- Take the first measurement by lining up the top of the tree with the beginning of the measuring tape (at the 0) and measure the distance to the base of the tree. Record the number (N) at the tape where the base of the tree is located. This is the total height of the tree you will use to determine the LCR.
- Take the second measurement by lining up the top of the tree with the beginning of the measuring tape (at the 0) and measure the distance to the first main branch on the tree (n).
- Using the two measurements you've recorded, use the formula **n/N** to produce the percentage of LCR; divide the second measurement by the first measurement to get the live crown percentage.

LCR Standards

- Deciduous trees: LCR >/= 60% (as a general rule, **deciduous trees with less than 25% LCR should lose 2 points, with 33% LCR would lose 1 point, and with 50% LCR could lose up to 0.5 point)**
- Conifers: LCR >/= 75%

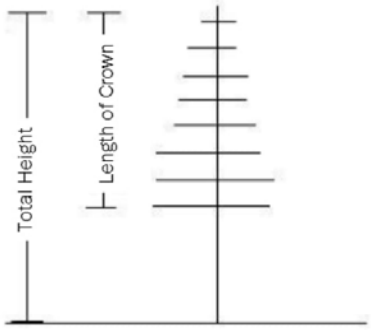


Figure 7 - LCR
(Source: https://openoregon.pressbooks.pub/forestmeasurements/chapter/5-4-live-crown-ratio/)

Figure 8: LCR (Source: Gary Johnson)

17

Rating the Stem Condition

Cambium loss

Cambium loss can be caused by pruning wounds, accidental damage, vandalism, and winter injury (Figure 9 and 10).

- **Up to 3 points can be deducted if 50% or more** of the stem's circumference is girdled; a tree that is **25% girdled would lose about 1.5 points**.
- Vertical cambium loss is not counted, only add up circumferential loss.
- Girdling refers to the removal or loss of bark and phloem from around the circumference of a branch or trunk.

Figure 9 - Cambium Loss (Source: Lydia Voth)

Figure 10 - Cambium Loss
(Source: https://www.todayshomeowner.com/how-to-deal-with-broken-branches-on-a-bradford-pear-tree/)

Exposed or decayed wood

Exposed wood requires **a deduction of 0.25 point minimum** and more if it shows obvious signs of decay (i.e. "punky" or soft rots). Judge decayed wood deduction by significance, location, and amount (Figure 11).

Figure 11: Exposed/Decayed Wood

Source: https://1.bp.blogspot.com/-MqXLLlw95hk/TupPLZ-GA6I/AAAAAAAAMVk/XiOLoZMBMXo/s1600/6.JPG

Sprouts/suckers (up to 0.5 pt deduction)

Sprouts, or water sprouts, are fast growing excess shoots that grow out of the main stem of the tree. Suckers are sprouts that develop at the base of the tree stem or off of the tree's root system (Figure 12). If **any** sprouts of suckers are present deduct a **minimum of 0.25 point**. If sprouts or suckers are excessive, **deduct 0.5 point.**

Figure 12 - Sprouts

(Source:https://extension.umd.edu/sites/default/files/_images/programs/hgic/Trees_Shrubs/EnvironmentalProblems/Water_sprouts_MG_Handbook.jpg)

Stem cracks

Stem cracks can form as a result of wounding or rapid temperature changes, exposing wood to disease and decay (Figure 13). Depending on the severity of the crack, **up to 2 points can be deducted.** Severity increases if there are multiple cracks, cracks with sap oozing out, and/or if there are indications of decay.

Figure 13 - Stem Crack
(Source: http://www.mggkc.org/wp-content/uploads/2012/11/frost_crack_initiation_point.jpg)

Included branch unions

Included branch unions occur when bark grows between where a branch and the stem, or where two branches, attach, causing a weak attachment (Figure 14 and 15). Depending on the number of inclusion present, and their severity, a **maximum of 0.5 point can be deducted.** Only the first main order branches can be considered when deducting points for this category. Do not consider anything further up in the crown of the tree for this stem condition rating.

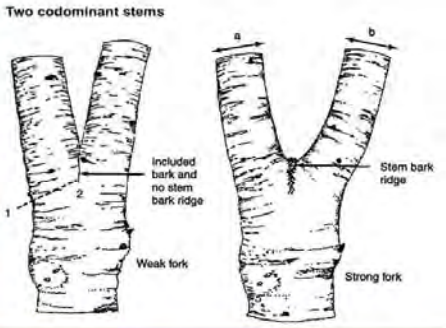


Figure 14 - Included Branch Union (Source: Lydia Voth) **Figure 15 - Included branch union examples** (Source: http://images.slideplayer.com/13/4023674/slides/slide_17.jpg)

Data Collection

Conducting the Segment Sampling

Start and end points

Each group will have a "master list" of segments to survey. Segments are denoted by starting and ending addresses. To begin surveying, travel to the starting point of a listed segment and proceed to survey each public tree from the starting address to the ending address. When all trees between the start and endpoints of a given segment are surveyed and recorded, the data sheet for that segment should be returned to Chris Anderson at Ramsey Municipal Center.

Public trees

This tree survey will include only street or boulevard trees. These trees are public trees are often situated near the road, but may be located **up to 16**' from the street. If you have any questions as to whether a tree is public or private, contact Chris Anderson.

Completing Data Sheets

Please use the guideline outlined blow when completing your survey sheets.

- **General Information:**
  - Group Member Names: Record the names of all group members present
  - Date: Record the date of the survey
  - Zone: Record the zone where the segment is located
  - Count: The number of the tree; remember no repeating numbers on a single segment
  - Segment # : The segment number as it appears on your survey map
  - Page _ of _ : Record the current page out of the total pages used for each segment.
- **Tree Information:**
  - Genus: Record the genus for each tree.
  - Species: Reference page 11 in this manual for the list of trees requiring species designation.
  - DBH (to the nearest inch): The DBH measurement taken for the tree.
  - Crown Width (to the nearest foot): The determined crown width of the tree.

For the following criteria, remember to only note the maximum deductions in each column, going in only quarter increments.

- **Crown Assessment:**
  - Stag Heading (up to 1 point): Refer to the condition rating section of the manual.
  - Tip Dieback (up to 0.5 point): Refer to the condition rating section of the manual.
  - Symmetry (up to 1 point): Refer to the condition rating section of the manual.
  - Live Crown Ratio (up to 2 points): Refer to the condition rating section of the manual.
  - Total from Canopy: The total number of points a tree canopy receives. The sum of the deductions made from the assessment are subtracted from the starting point of 4 points.

- **Stem Assessment:**
  - Cambium Loss (up to 3 points): Refer to the condition rating section of the manual.
  - Exposed or Decayed Wood: This is a **Minimum** deduction column. Take **at least** 0.25 point off if there is exposed/decayed wood. There is no maximum.
  - Sprout/Sucker (up to 0.5 point): Refer to the condition rating section of the manual.
  - Stem Cracks (up to 2 points): Refer to the condition rating section of the manual.
  - Included Branch Unions (up to 0.5 points): Refer to the condition rating section of the manual.
  - Total from Stem: The total number of points a tree stem receives. The sum of the deductions made from the assessment are subtracted from the starting point of 4 points.
- Comments/Notes: Record any comments or notes for a tree or segment.

Submitting Data Sheets

Completed data sheets can be submitted to Chris Anderson either in person at city hall, via email (canderson@cityoframsey.com), via fax (763-433-9848), or by mail (7550 Sunwood Drive NW, Ramsey, MN 55303). **Remember,** to submit data sheets after you complete each segment and/or surveying outing in order to ensure that the data sheets and important data are recorded and the survey kept up-to-date.

Glossary

Alternate leaves:
: Leaves that are attached to the branch in an alternating pattern.

Cambium Loss:
: Loss of a tree's cambium due to pruning wounds, accidental damage, vandalism, and winter injury.

Cambium:
: The thin layer of living wood tissue between the park and the inner wood of a tree.

Condition:
: An assessment of a tree's specific likelihood of structural failure.

Coniferous:
: A tree that has needles or scale-like leaves and cones.

Crown:
: The leaves and branches of a tree, excluding the trunk/stem.

Crown symmetry:
: Occurs when the general shape and condition of the crown is the same from all sides.

Decay:
: See wood decay.

Deciduous:
: Trees that lose their leaves in the fall.

Dentate:
: A leaf that has jagged edges that point upward.

Diameter at breast height (DBH)
: The diameter of the tree trunk at 4.5 feet above the ground.

Die-back:
: See tip dye-back.

Doubly serrate:
: A leaf that contains both larger and smaller serrations on its edges.

Entire (leaf):
: A leaf that has a smooth edge.

Included Bark:
: Bark that grows between where a branch and the stem, or two branches, attach, causing a weak attachment.

Live Crown Ratio:
: The ratio of living branches to the total tree height.

Opposite:
: Leaves that are attached to the branch directly opposite to each other.

Palmately Compound Leaf:
: Leaves that originate from one point; all leaflets branch out from one point

Pinnately Compound Leaf:

Leaflets form in rows along either side of the central vein.

Samara:

A type of fruit with wings found on maple and ash trees.

Serrate:

A leaf that has jagged edges pointing towards the tip of the leaf.

Simple (leaf):

Leaves that are singular; singularity attached leaves.

Species Tree Code:

The four letter code used by the U.S. Forest Service to designate trees by their genus and species.

Stag Heading:

The complete dearth and defoliation of main branches. Branches have an antler-like appearance.

Stem:

The trunk of the tree, excluding branches and leaves.

Stem Circumference:

The circular measurement around the stem of the tree.

Suckers:

Suckers are sprouts that develop at the base of the tree stem or off of the tree's root system.

Terminal Bud:

Terminal buds are the buds seen at the very tips of twigs. Note: not all species have terminal buds.

Tip Dieback:

Dieback that begins at the tip of a twig and works backward to the stem.

Tree Defects:

Any condition such as decay, cavities, included bark/weak branch attachments, cracks or cankers that occur anywhere on a tree and may cause the structural failure of part of, or the whole, tree.

Water Sprouts:

Sprouts, or water sprouts, are fast growing excess shoots that grow out of the main stem of the tree.

Whorled (leaf):

Three or more leaves that are attached to the branch opposite each other.

Winter Injury:

Injury caused by a freezing following a period of warmer weather.

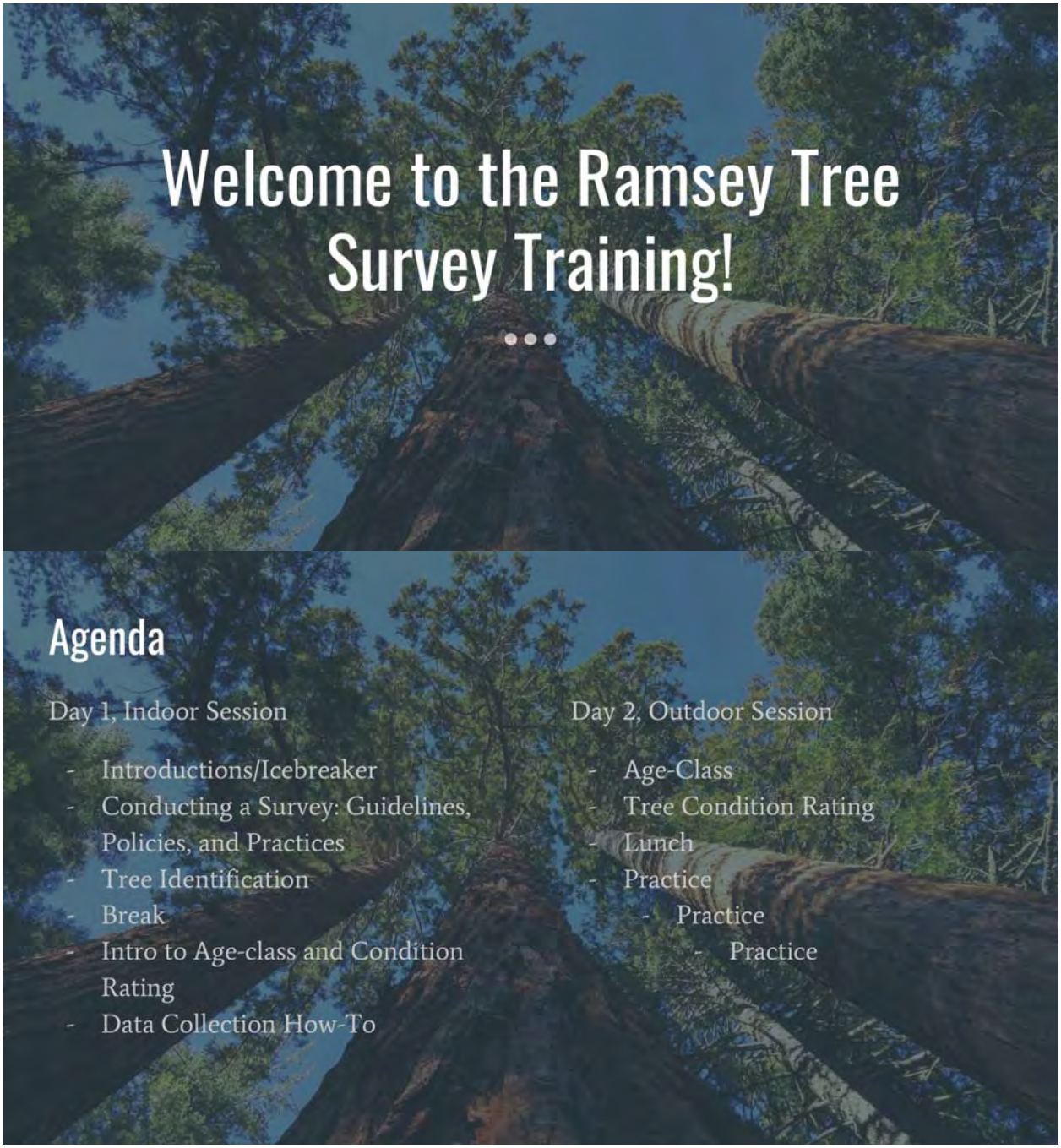
Wood Decay:

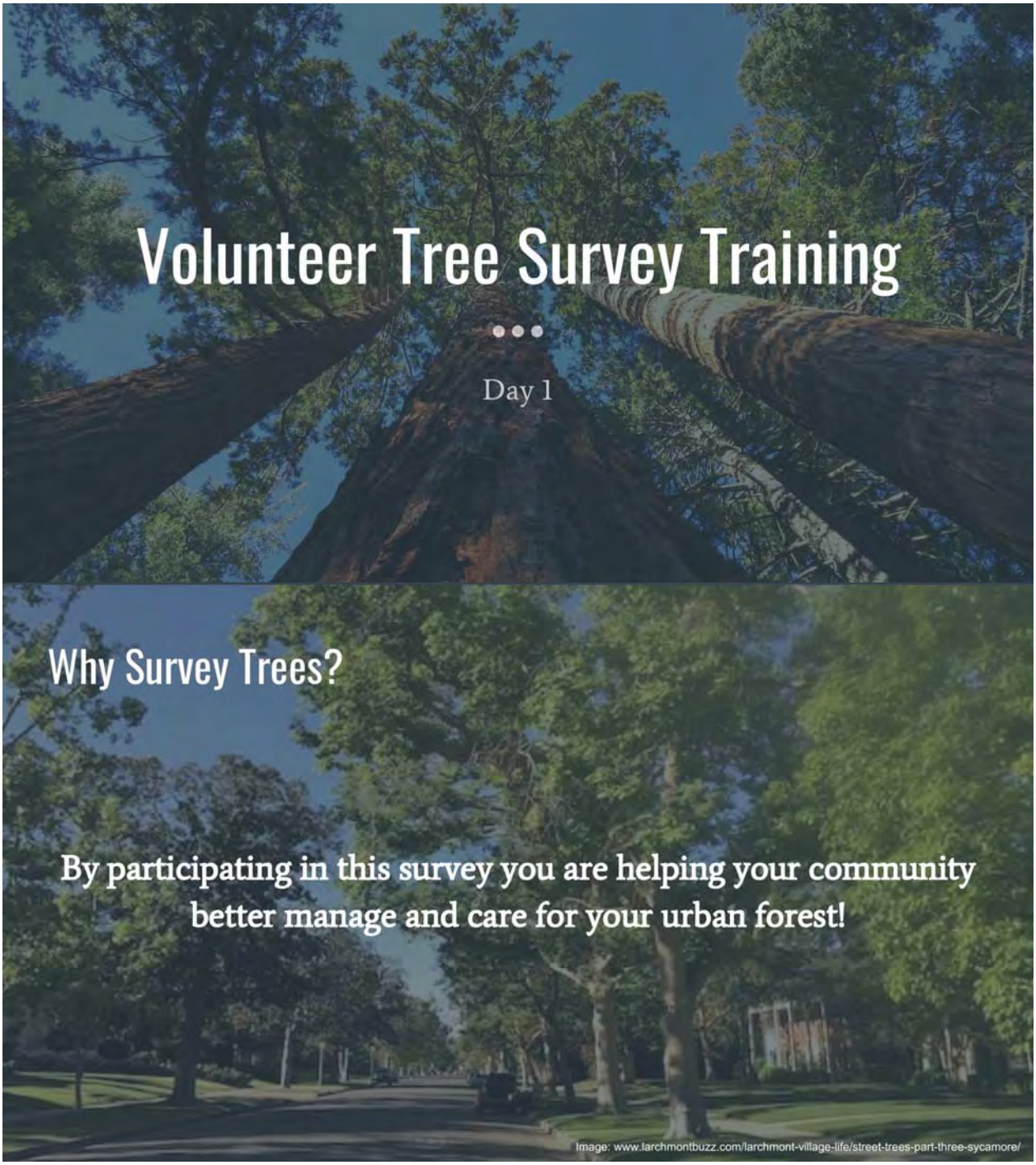
Wood that is rotting or missing due to fungus or bacteria.

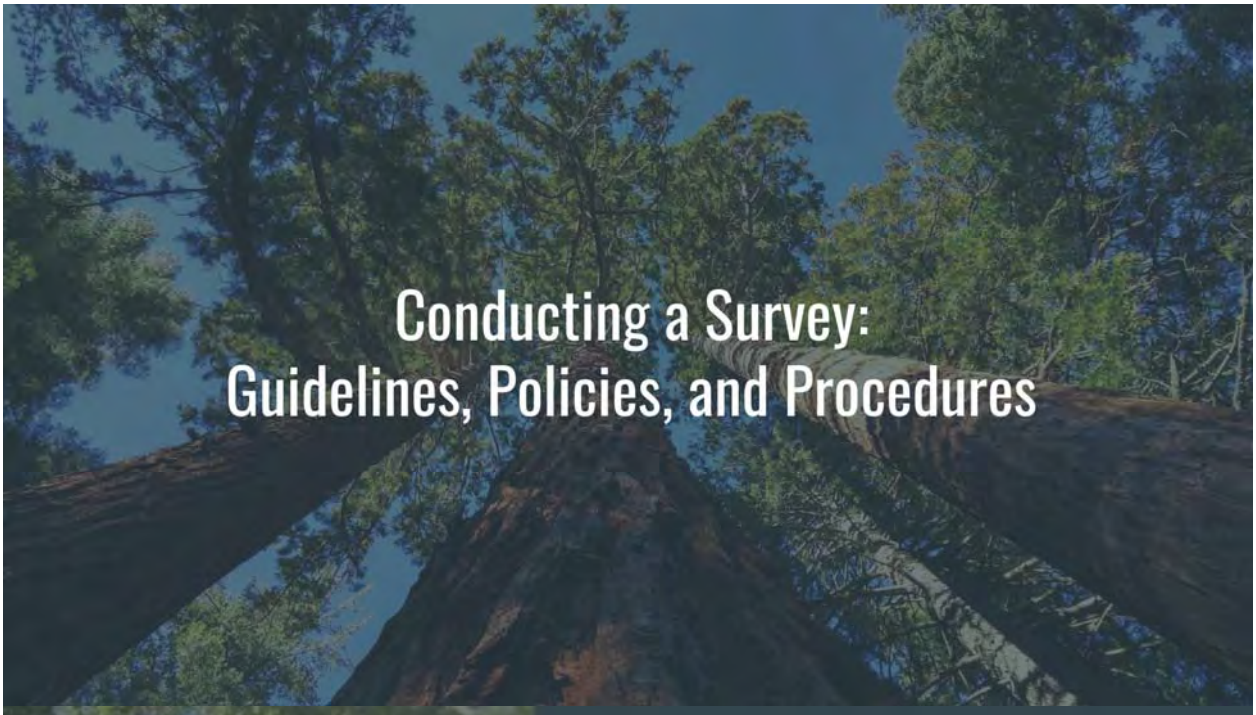
Space for Notes

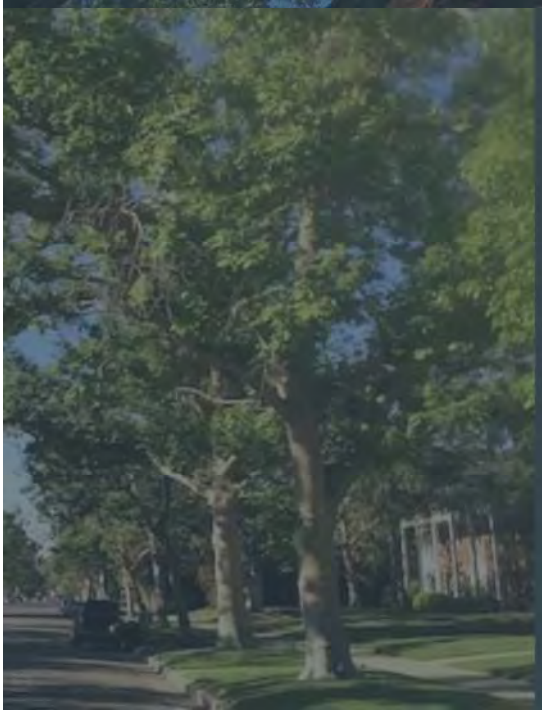
Appendix J: Powerpoint

See the attached “Volunteer Training” pdf for the powerpoint utilized in the indoor session of the volunteer training.


Welcome to the Ramsey Tree Survey Training!
Agenda
Day 1, Indoor Session
- Introductions/Icebreaker
- Conducting a Survey: Guidelines, Policies, and Practices
- Tree Identification
- Break
- Intro to Age-class and Condition Rating
- Data Collection How-To
Day 2, Outdoor Session
- Age-Class
- Tree Condition Rating
- Lunch
- Practice
- Practice
- Practice


Volunteer Tree Survey Training
Day 1
Why Survey Trees?
By participating in this survey you are helping your community better manage and care for your urban forest!
Image: www.larchmontbuzz.com/larchmont-village-life/street-trees-part-three-sycamore/





Volunteer Tree Survey Training

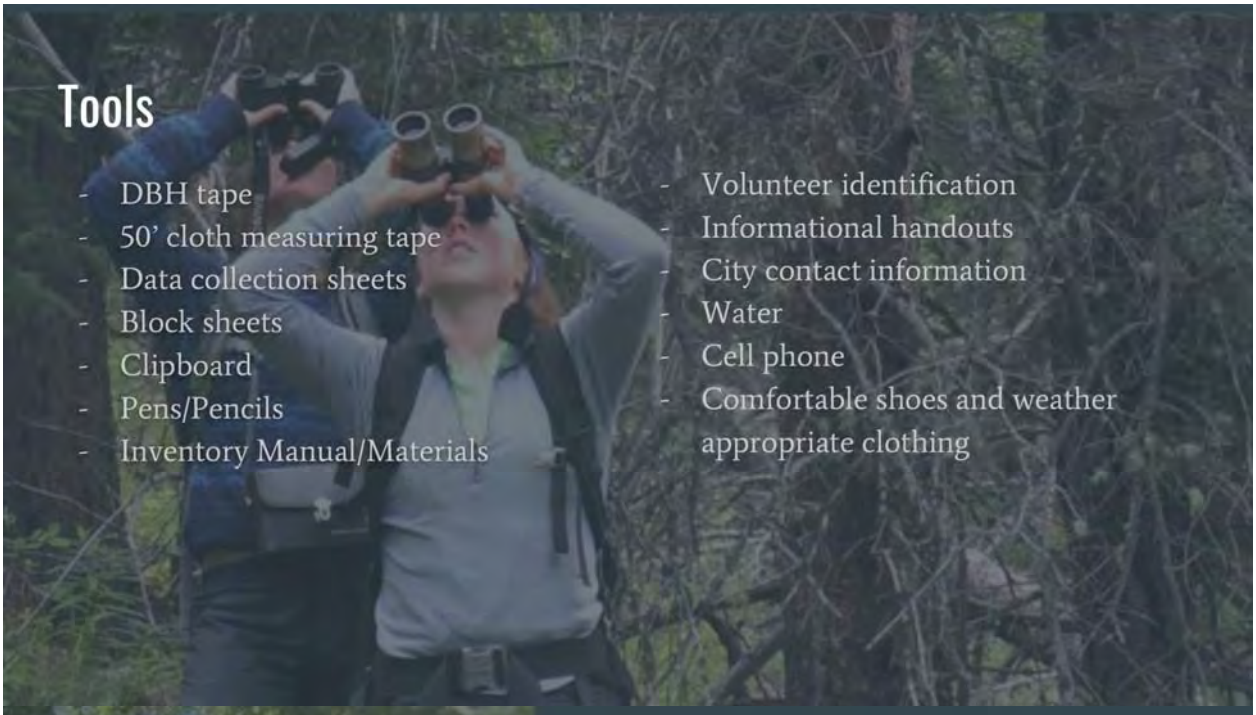
- What kind of training is given?
- Who can Volunteer?
- What does volunteering look like?

Public Vs. Private

- **Public Trees**
  - Located up to 16' from the street/curb
- **Private Trees**
  - Trees on a privately owned property
- **Street/Boulevard Tree**
  - A tree planted in the public right of way

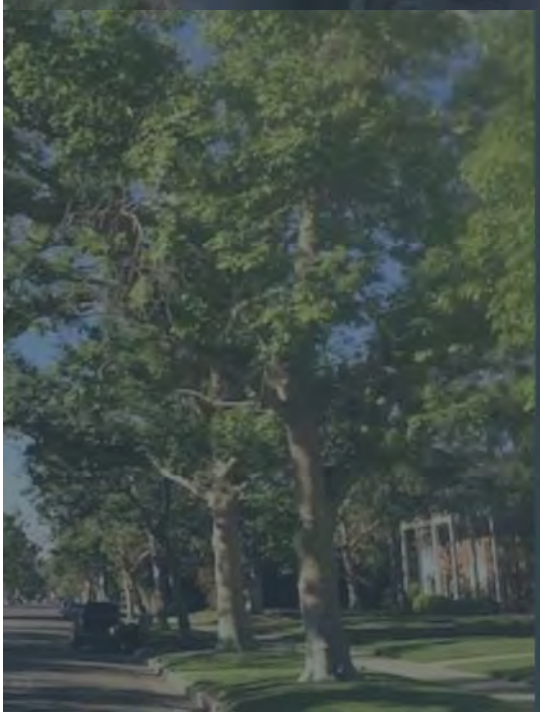
Safety

- Stay with your group
- Stay aware of your surroundings
- Check the weather
- Wear proper attire
- Carry important contact info
- Dealing with unfriendlies



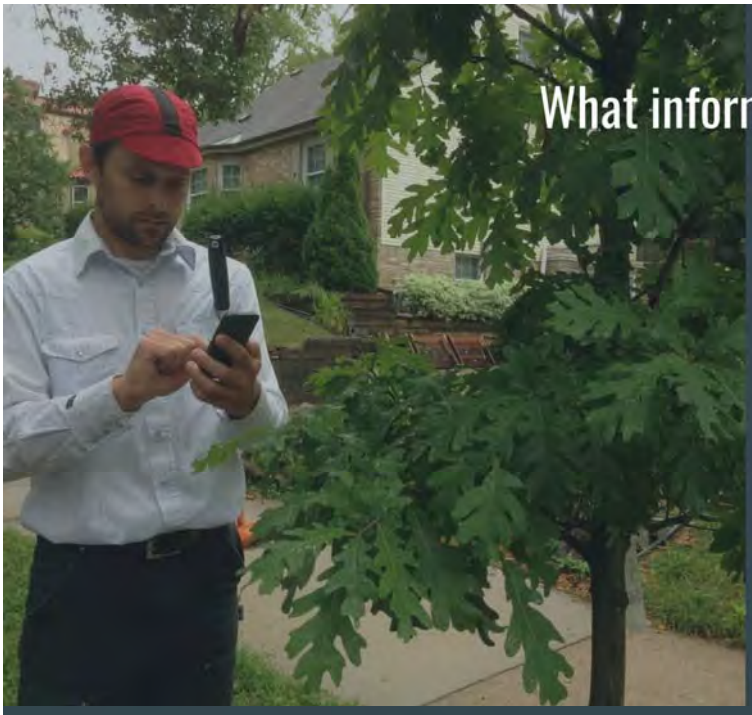
Tools

- DBH tape
- 50' cloth measuring tape
- Data collection sheets
- Block sheets
- Clipboard
- Pens/Pencils
- Inventory Manual/Materials
- Volunteer identification
- Informational handouts
- City contact information
- Water
- Cell phone
- Comfortable shoes and weather appropriate clothing



Tree Survey Breakdown

1. **Stratification**
2. **Pre-sample**
   a. Accomplished beforehand by U of M students
3. **Sample**
   a. Taken by the wonderful volunteers!
4. **Data analysis**

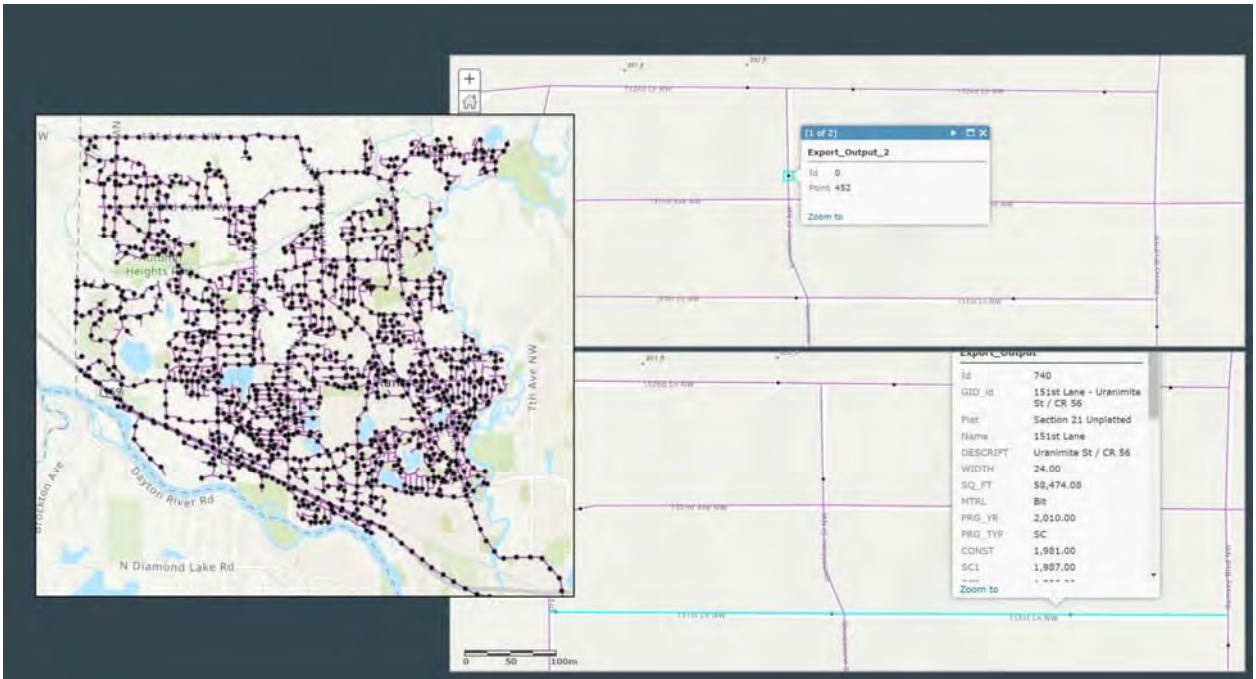


What information will you collect?

1. **Tree genus (some species)**
2. **Tree size/Age-class**
   a. Diameter of trunk
   b. Canopy spread
3. **Tree condition**
   a. Assess multiple variables to determine canopy and stem conditions
   b. Measuring DBH

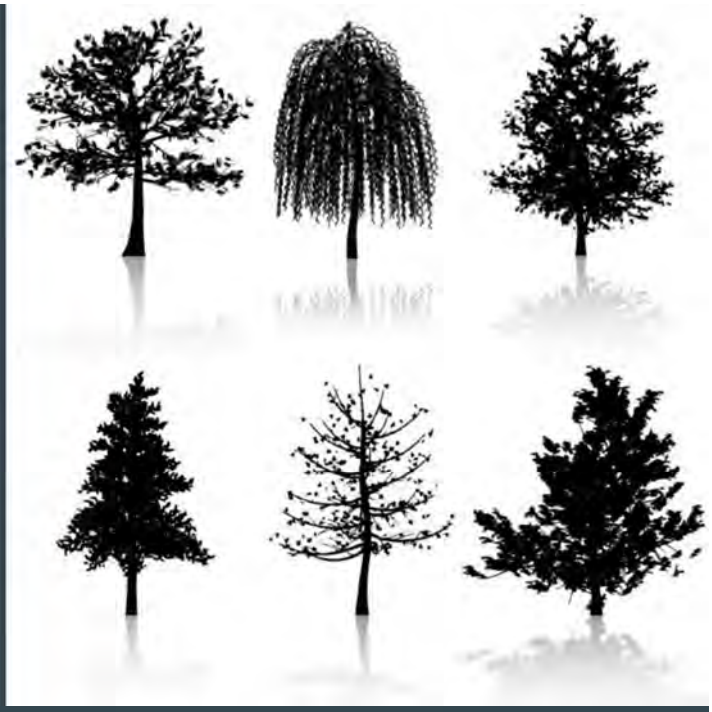
Conducting the Survey

- Surveying Segments
  - Start in the most south-western corner of the segment
  - Put an X on the segment map at your first tree and write the associated number (1) under the Trees # column
  - Work in a counterclockwise direction, giving each tree an associated number (e.g 1, 2, 3, etc.)
  - Be sure to indicate the placement of the tree on the segment map with a dot and the name label (P1, P2, etc.).
  - Continuing surveying the trees in the segment, recording the information on your survey form
- Numbers in a segment do not repeat.
- Contact Chris Anderson with any questions!



Group Member Names:						Crown Assessment					Stem Assessment						Page ____ of ____
Date:																	
Zone:																	
General Information		**Tree Information**				**Stag Heading**	**Tip Die Back**	**Symmetry**	**Live Crown Ratio**	**Total from Canopy**	**Cambium Loss**	**Exposed or Decayed Wood**	**Sprout/ Sucker**	**Stem Cracks**	**Included Branch Unions**	**Total from Stem**	**Comments/ Notes**
Count	Block #	Genus	Species	DBH (to the nearest inch)	Crown Width (to the nearest foot)	Up to 1 pt	Up to 0.5 pt	Up to 1 pt	25% or less - 2 pts 33% or less - 1 pt 50% or less - 0.5 pt	Substract the sum of the deductions from 4 pts	Up to 3 pts	Minimum 0.25 pt	Up to 0.5 pt	Up to 2 pts	Up to 1/2 pt	Substract the sum of the deductions from 4 pts	
1																	
2																	
3																	
4																	

Tree Identification



Types of Trees

Conifer

- Needles
- Cones
- "It's a pine tree!"

Image: www.mycutegraphics.com/graphics/tree/pine-tree.html

Deciduous

- Broadleaf
- Flowers/fruit
- "It's a maple!"

Image: www.clker.com/clipart-green-tree-21.html

Deciduous Leaf Characteristics

P. 20 MN Trees packet

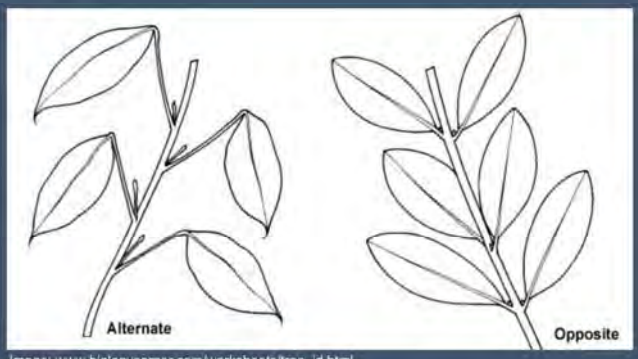


Image: www.biologycorner.com/worksheets/tree_id.html

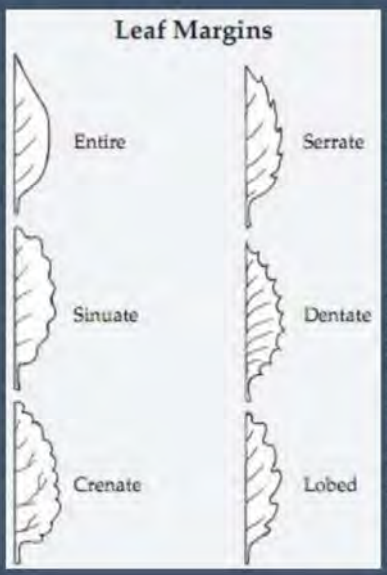
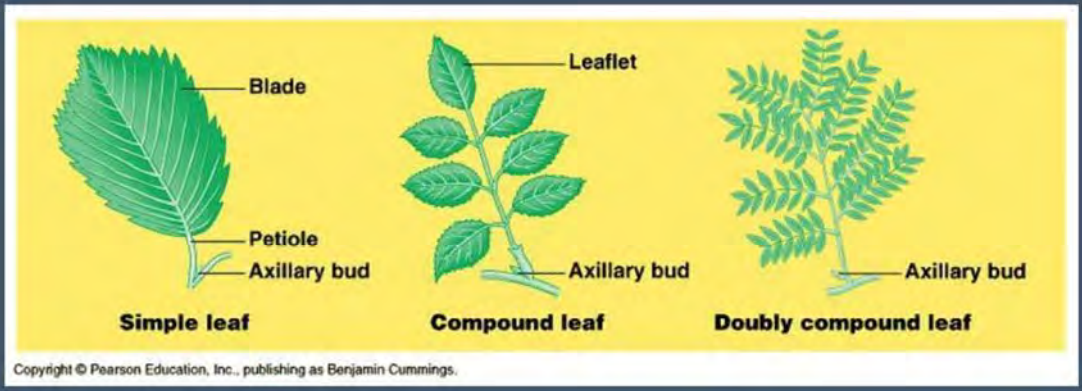


Image: lifeofplant.blogspot.com/2011/03/leaf-margins-tips-and-bases.html

Deciduous Leaf Characteristics



Deciduous Twig Characteristics

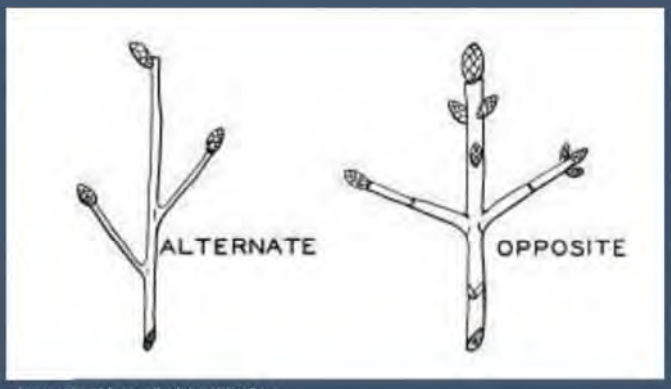


Image: bhort.bh.cornell.edu/tree/plate2.jpg

Opposite:

M.A.D.
Cap.
Hippo.

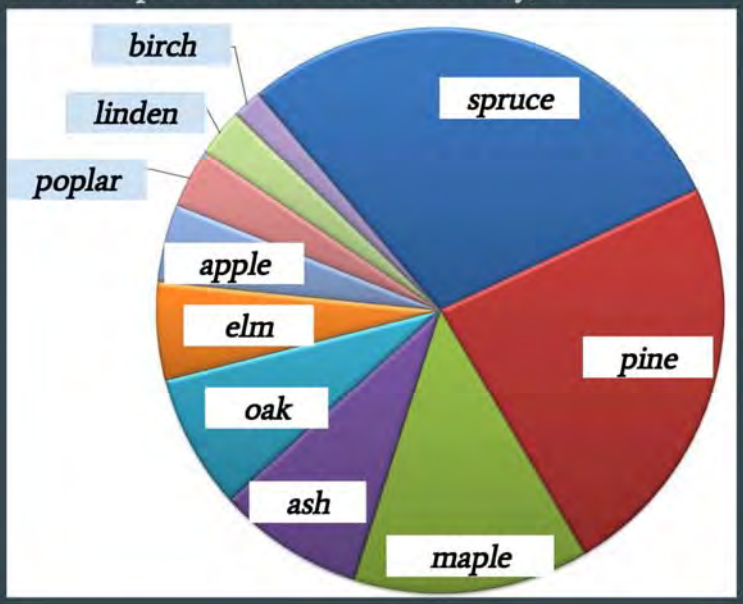
Alternate:

Everything else!

Genera to Know

Acer (maple)
Betula (birch)
Fraxinus (ash)
Malus (apple)
Picea (spruce)
Pinus (pine)
Populus (poplar)
Quercus (oak)
Tilia (linden)
Ulmus (elm)

DNR Top Ten Tree Genera in Ramsey, MN



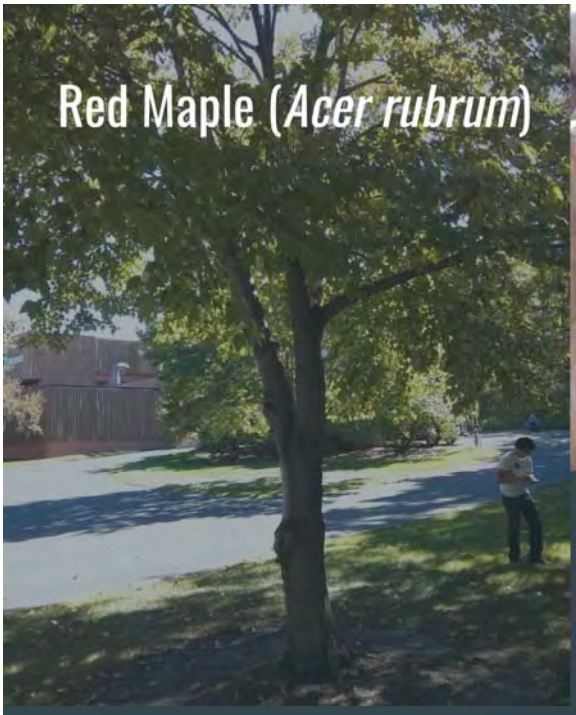
Maple (*Acer*)

Sugar Maple (*Acer saccharum*)


Silver Maple (*Acer saccharinum*)


Norway Maple (*Acer platanoides*)

Red Maple (*Acer rubrum*)



Maple (*Acer negundo*)

boxelder (note compound leaves, ash look-alike)

Ash (*Fraxinus*)

Green Ash (*Fraxinus pennsylvanica*)

Page 1 - Tree ID Cards

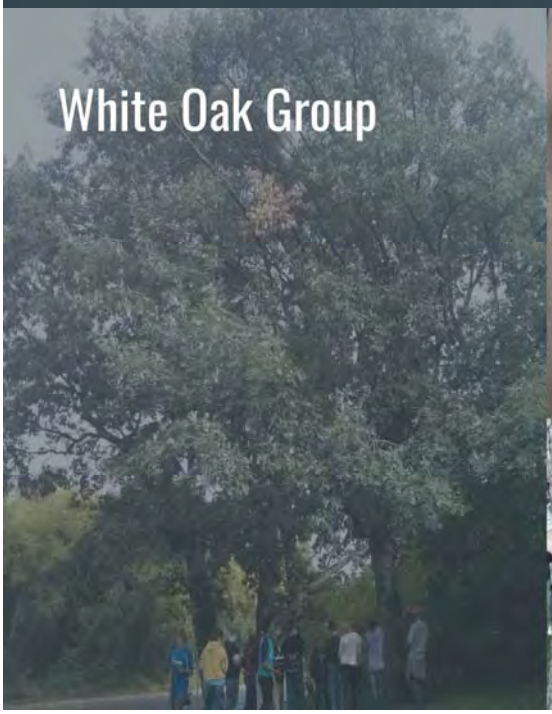
White Ash (*Fraxinus americana*)

Page 1 - Tree ID Cards

Oak (*Quercus*)

Red Oak Group

White Oak Group



Elms (*Ulmus*)

Common Conifers

- Pine
- Fir
- Spruce

Needle ID

Spruce (*Picea*)

Pine (*Pinus*)

Fir (*Abies*)

Condition Ratings

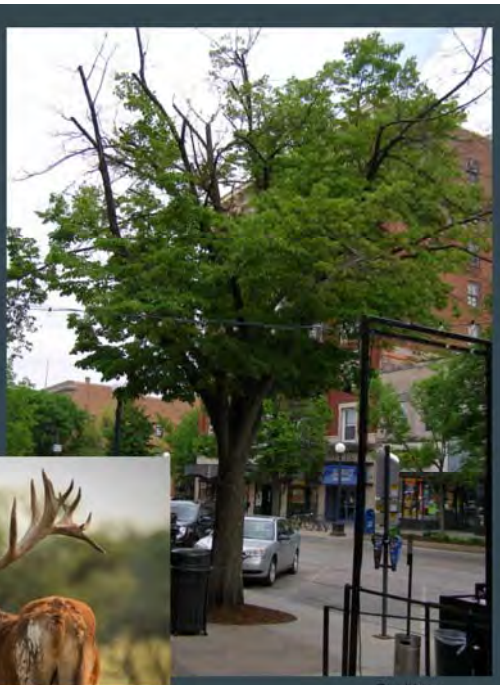
- A tool to assess the physical condition of a tree
  - Difference between health and condition
- Two separate ratings for crown and stem (not averaged or added)
  - Numerical value of 1-4
  - Tree begins with 4 total points per rating
  - Incremental points are subtracted for defects

Condition Ratings

- To measure:
  - First, each team member should assess condition separately
  - Compare with others once each person has a rating
  - Discuss differences to agree on the best number for each possible defect

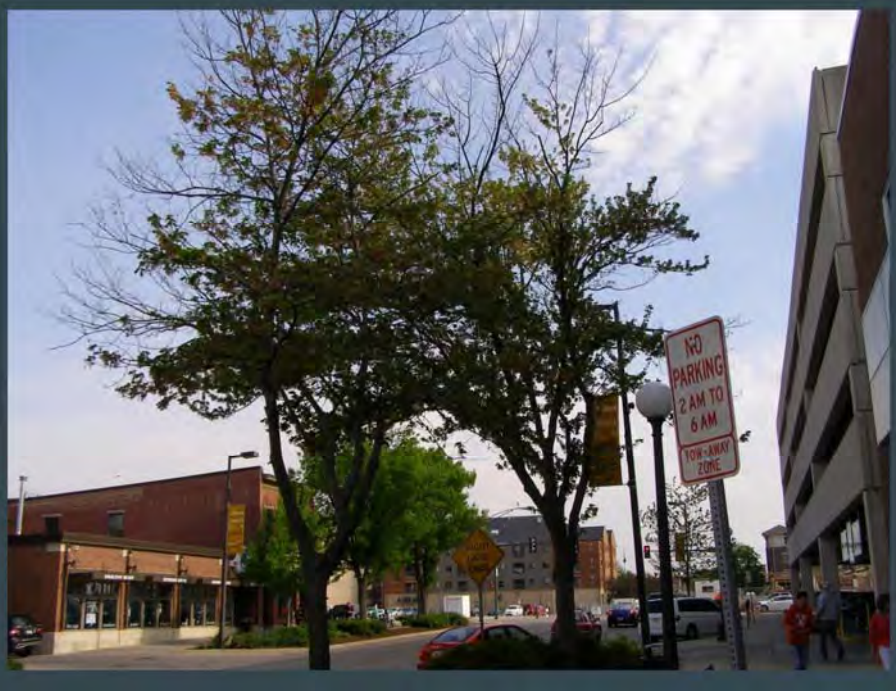
Stag Heading

- A branch is dead from the tip all the way back to the main stem
  - Looks like antler
- Deduction: up to 1 point
  - Larger vs. smaller branches



http://www.largenbsbighuntmag.com/images/news/red-stag-hunting/red-stag-back.jpg

Gary Johnson



Gary Johnson

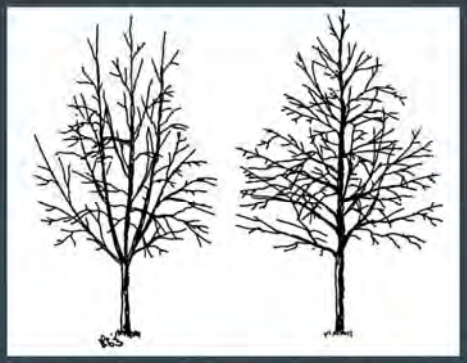
Gary Johnson

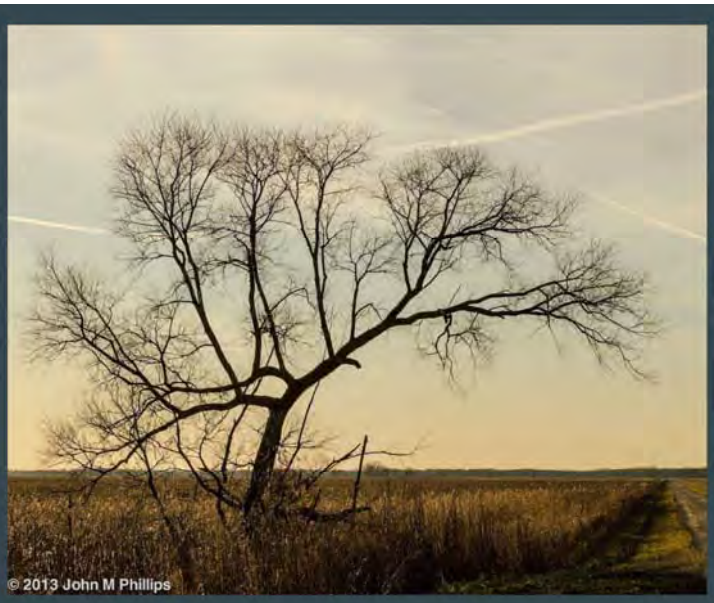
Tip Dieback

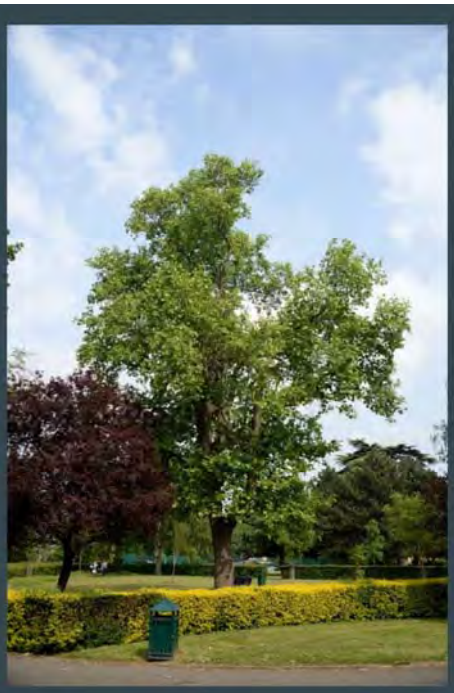
- Death at branch tips
- Deduction: up to ½ point
  - Depends on extent
  - Full deduction when trees exhibit dieback throughout crown

Symmetry

- Compare to a perfectly symmetrical crown
- Deduction: up to 1 point
  - Portion or portions of crown missing
  - Look for a central leader and full crown

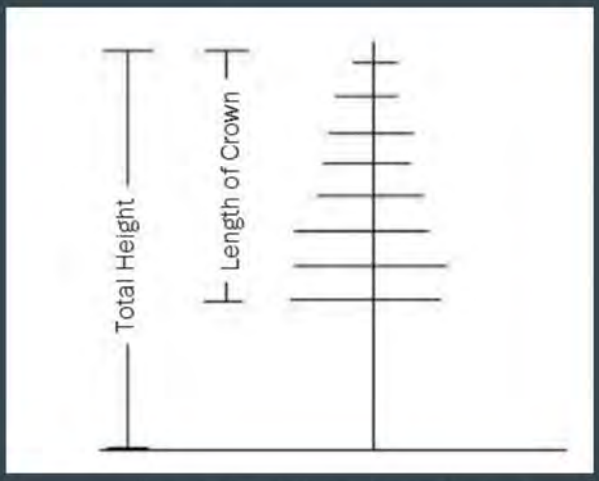






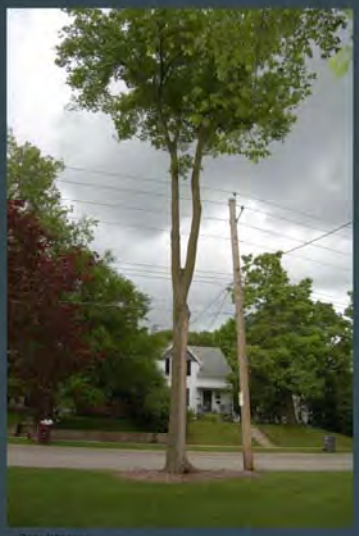
Live Crown Ratio (LCR)

- Ratio of crown height to total tree height
- Crown begins at first main branch
- Standard deciduous LCR = 60%
- Standard coniferous LCR = 75%



Live Crown Ratio (LCR)

- Deduction (deciduous trees):
  - 25% or less LCR- 2 points
  - 33% or less LCR- 1 point
  - 50% or less LCR- ½ point
- *Make sure to stand far enough back to see the tree's full form*



Gary Johnson

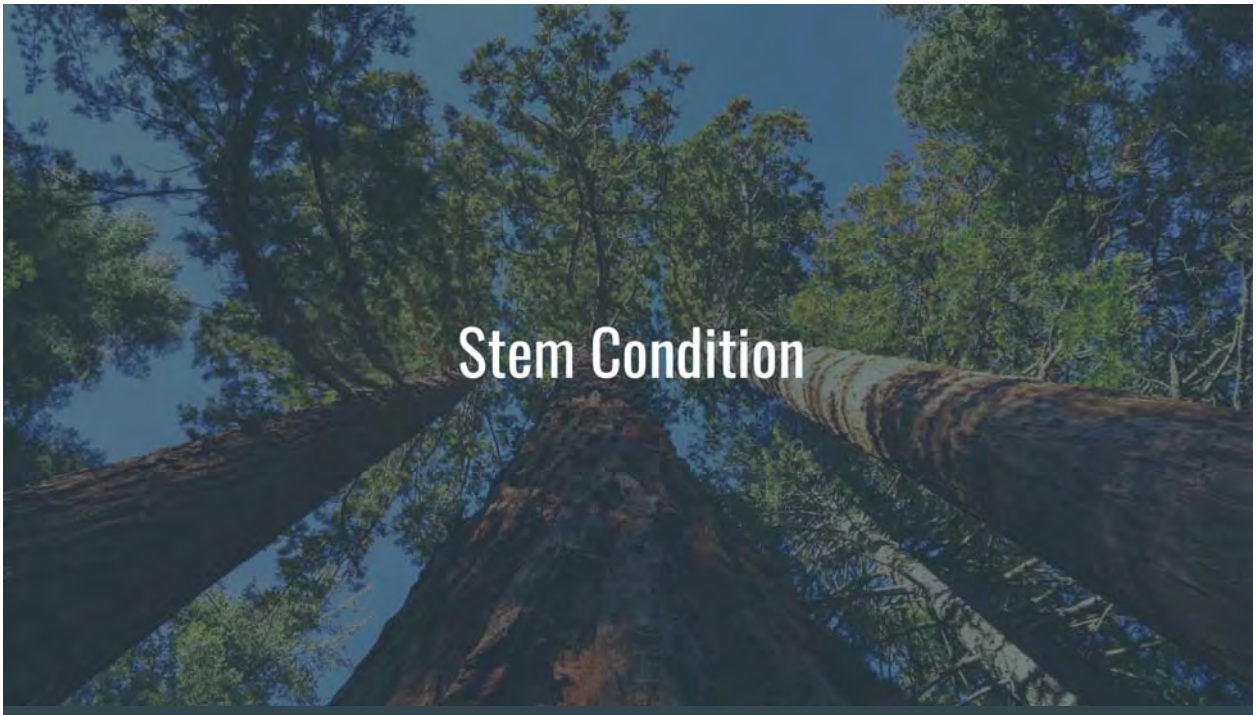
Poor LCR

vs.

Good LCR (>60%)

Gary Johnson

Gary Johnson



Cambium Loss

- Loss of outer bark / phloem
- Circumferential stem girdling (*not* vertical loss)
  - Pruning wounds
  - Accidental damage
  - Vandalism
  - Winter injury

Cambium Loss

- Add the circumferential percent loss of cambium
- Deduction: up to 3 points
  - 50% girdling - 3 points (use this to calculate lower rates of girdling)
  - 25% girdling - 1½ points

Exposed or Decayed Wood

- Significance, location, and amount
- Deductions
  - Minimum ¼ point
  - More for obvious signs of decay

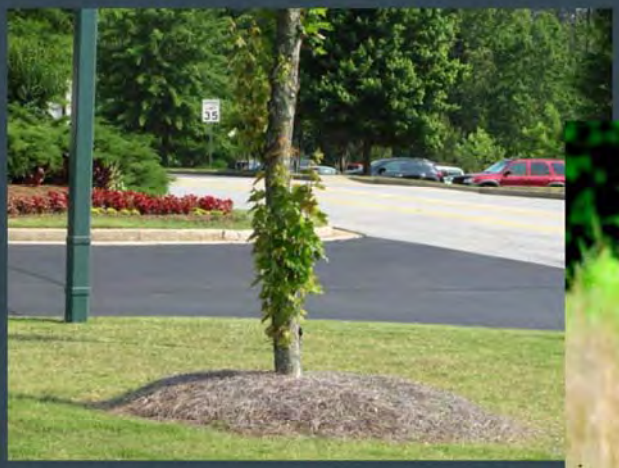

UGA1408033

Sprouts and Suckers

- Undesirable vegetative shoots, growing straight out of trunk or roots
- Deductions:
  - ¼ point- presence of any sprouts
  - ½ point- excessive sprouting

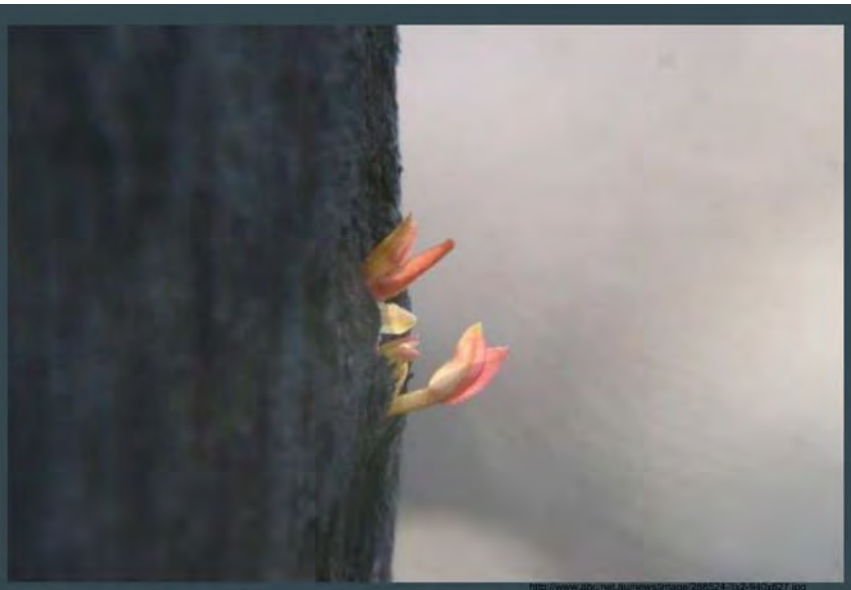
https://www.hgtv.com/outdoors/gardens/planning-and-maintenance/tree-pruning-removing-water-shoots-and-suckers

https://www.lowes.com/creative-ideas/gardening-and-outdoor/tree-pruning-basics/article



http://extension.uga.edu/publications/detail.html?number=B1031&title=Shade%20and%20Street%20Tree%20Care

https://extension.umd.edu/sites/default/files/_images/programs/hgic/Trees_Shrubs/EnvironmentalProblems/Water_sprouts_MG_Handbook.jpg



How much would you deduct?

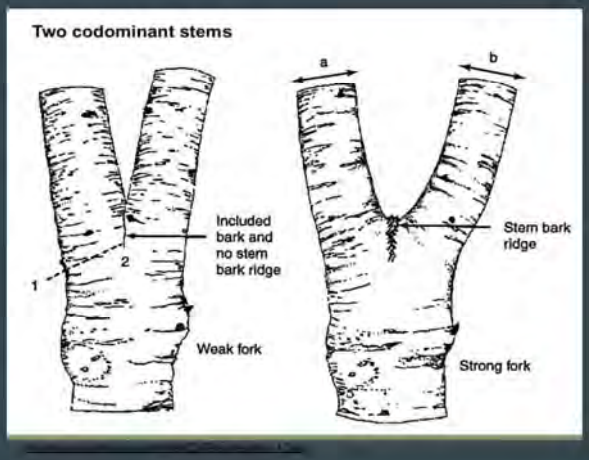
How much would you deduct?

Stem Cracks

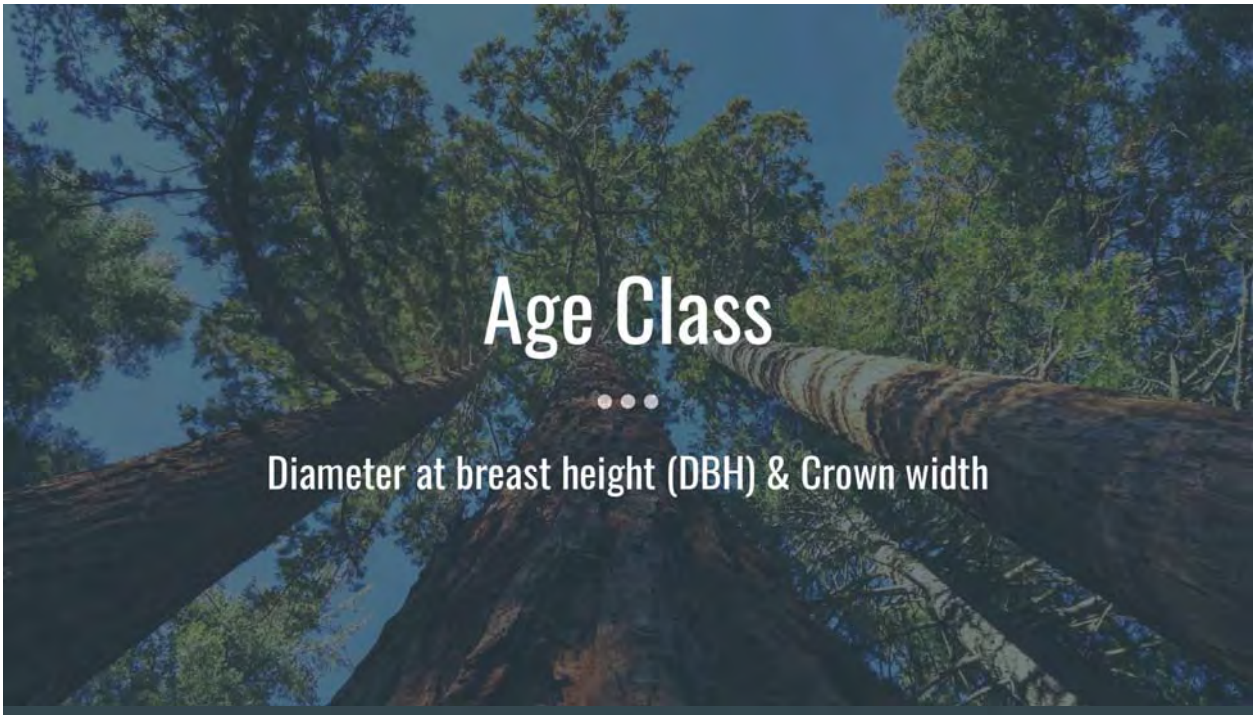
- Deductions: up to 2 points
  - Severity increases if there are multiple cracks, cracks with sap oozing out, and/or if there are indications of decay

Included Branch Unions

- Caused by bark growing into branch union, instead of in a ridge around the union
- Can compromise main stem during loading events
- Deductions: up to 1½ points
  - Based on number and severity of inclusions



Branch bark ridge (good) vs. Inclusion (bad)



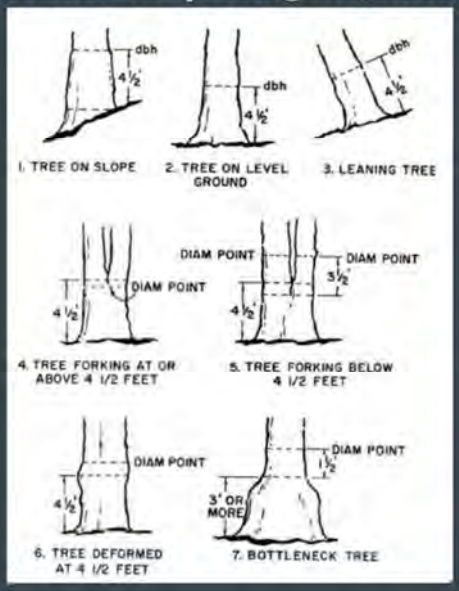
Age Class

Diameter at breast height (DBH) & Crown width

Diameter at breast height (DBH)

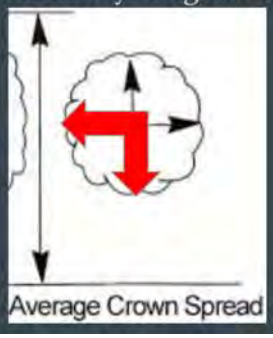
- **Breast height:** Standardized point on the trunk, 4.5 feet from its base.
- To measure DBH, a diameter tape (D-Tape) can be used. Otherwise the measurement can be taken with a standard measuring tape and converted to diameter by dividing by pi (3.14).
- To measure a tree, wrap the D-tape completely and tightly around the tree at your breast height and record the number where the zero meets the tape again.
- Take care to record the distance on the D-Tape that displays the diameter distance and to record in proper units (inches).

Adverse conditions requiring adjustments to DBH



Crown Width

- One group member will stand at the edge of the canopy holding one end of the tape measure.
- A second member walks the tape to the trunk, takes a 90° turn and continues on that path to the end of the trees drip line. Record this distance to the nearest foot, this is the Average crown spread.
- The 90° turn will account for any irregularities in crown form.



Filling in the data sheets

Group Member Names:						Crown Assessment					Stem Assessment						Page ____ of ____
Date:																	
Zone:																	
General Information		Tree Information				Stag Heading	Tip Die Back	Symmetry	Live Crown Ratio	Total from Canopy	Cambium Loss	Exposed or Decayed Wood	Sprout/ Sucker	Stem Cracks	Included Branch Unions	Total from Stem	
Count	Block #	Genus	Species	DBH (to the nearest inch)	Crown Width (to the nearest foot)	Up to 1 pt	Up to 0.5 pt	Up to 1 pt	25% or less - 2 pts 33% or less - 1 pt 50% or less - 0.5 pt	Substract the sum of the deductions from 4 pts	Up to 3 pts	Minimum 0.25 pt	Up to 0.5 pt	Up to 2 pts	Up to 1/2 pt	Substract the sum of the deductions from 4 pts	Comments/ Notes
1																	
2																	
3																	
4																	
5																	


Find a Team!
...

Appendix K: Tree identification cards

See the attached “Tree ID cards” packet for the packet of tree identification cards distributed to volunteers at the indoor training.

Ash (green & white)

Code: FR

Family: Oleaceae

Fraxinus pennsylvanica and *Fraxinus americana*

(Code: FRPE) (Code: FRAM)

Photos: Dave Hanson

Leaves: opposite, pinnately compound, leaflets have petioles (not sessile as black ash).

Fruit: 1-2" single samara, "wing" stops where seed begins, seed is round in cross-section.

Bark: Gray/brown interlacing ridges form "diamond" patterns. **Twigs**: not as stout as black ash.

Black Ash

Code: FRNI

Family: Oleaceae

Fraxinus nigra

Photos: Dave Hanson

Leaves: opposite, pinnate compound, 7-13 sessile leaflets, rust-colored hairs at leaflet base.

Fruit: 1-1¾" single samara, "wing" around seed, blunt at both ends, seed flat in cross-section.

Bark: Gray/brown soft, scaly, corky bark. **Twigs**: very stout. **Buds**: dark colored.

Prickly Ash

Code: ZAAM

Family: Rutaceae

Zanthoxylum americanum

Photos: Dave Hanson

Leaves: alternate, pinnate compound, 5-11 leaflets, prickly stalk, twig-leaf aromatic if crushed.

Fruit: small capsules, bright red becoming reddish-brown, split in half to release black seed.

Bark: Gray/brown smooth. **Twigs**: Brown to gray, paired ½" spines. **Buds**: red, fuzzy.

3

Mountain Ash

Code: SO

Family: Rosaceae

Sorbus decora Showy mountain ash and *S. americana* American mountain ash

Photos: Dave Hanson

Leaves: alternate, pinnately compound, 6-10" long, 11-17 sharp, finely-toothed leaflets.

Twigs: twig, stout gray-reddish. **Buds**: dark, pointed, resinous, hairy. **Fruit**: small red-orange "berries" in a cluster. **Bark**: grayish, smooth, lenticels in youth - ages to splitting, peeling, rough.

4

White oak family

Code: QU-AL

Quercus spp.

Photos: Dave Hanson

General Characteristics

Bark: grayish with vertical ridges, some deeply furrowed; bur oak can be corky

Leaves: alternate, simple leaf with 5-9 rounded lobes; 4-12" long

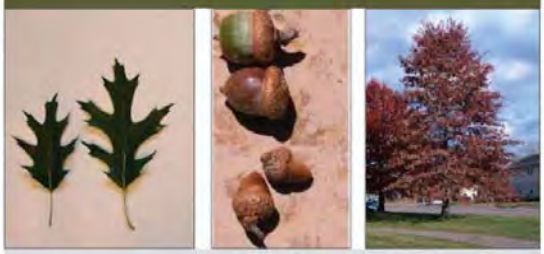
Seeds: 1/2" to 2" acorns

5

Red oak family

Code:QU-RU

Quercus spp.



Photos: Dave Hanson

General Characteristics

Bark: grayish with vertical furrows

Leaves: alternate, simple leaves with 5-9 pointed lobes; 4-9" long

Seeds: 1/2" to 1" acorns oblong to round, small cap; tree form is more slender than white oak

Bur Oak

Code: QUMA

Family: Fagaceae

Quercus macrocarpa

Photos: Dave Hanson

Leaves: alternate, simple, 4-12" long, 5-9 rounded lobes, center sinuses cut to mid-rib.

Fruit: acorn, fringed (bur) cap covers ½ or more of ¾" to 2" acorn, acorns attached direct to twig.

Bark: grayish with vertical ridges, deeply furrowed. Bur oak can have corky twigs.

7

White Oak

Code: QUAL

Family: Fagaceae

Quercus alba

Photos: Dave Hanson

Leaves: alternate, simple, 4-9" long, 5-9 rounded lobes, sinuses nearly uniform in depth.

Fruit: acorn, ⅜" to 1¼" acorns, cap covers top ¼-⅓, acorn is attached via a ¼" stalk.

Bark: Light ashy-gray, narrow vertical ridges, with age breaks into blocky, irregular shapes.

8

Swamp White Oak

Code: QUBI

Family: Fagaceae

Quercus bicolor

Photos: Dave Hanson

Leaves: alternate, simple, 4-7" long, 5-12 shallow rounded lobes, shiny green top, whitish below.

Fruit: ¾" to 1½" paired acorns, 1"-4" stalk. Acorns mature in the autumn.

Bark: light brown, papery, scales become blocky and deeply fissured with age.

9

Northern Red Oak

Code: QURU

Family: Fagaceae

Quercus rubra

Photos: Dave Hanson

Leaves: alternate, simple, 4-9" long, 7-11 bristle-tipped lobes, sinuses cut ½ way to midrib.

Fruit: ½" to 1½" acorn, shallow cap, scales pubescent, acorns mature autumn of second season.

Bark: gray to red-brown, smooth, shiny, becoming grayish flat-topped ridges, deeply furrowed.

10

Northern Pin Oak

Code: QUEL

Family: Fagaceae

Quercus ellipsoidalis

Commonly planted: Eastern Pin Oak - *Quercus palustris*

Photos: Dave Hanson

Leaves: alternate, simple, 3-5" long, 5-7 bristle-tipped lobes, sinuses cut nearly to midrib.

Fruit: acorns, cone-shaped cap, ⅜-⅝" cone-shaped (ellipsoidal) acorns.

Bark: gray to dark brown, smooth, shiny in youth, develops flat-topped ridges, shallow furrows.

Form for identification: descending lower branches, horizontal central branches, ascending upper.

11

Black Oak

Code: QUVE

Family: Fagaceae

Quercus velutina

Photos: Dave Hanson

Leaves: alternate, simple, 4-9" long, 7-9 bristle-tipped lobes, sinuses shallow cut or near midrib.

Fruit: ½" to ¾" acorn, deep cap covers ⅓, cap scales wooly, mature autumn of second season.

Bark: gray to almost black, becoming deeply furrowed with age. Yellowish inner bark.

12

Family: Juglandaceae

2 Native Hickories

Code: CA1

Carya spp.

Bitternut (*Carya cordiformis*) and shagbark (*Carya ovata*)

Photos: Dave Hanson

Leaves: alternate pinnately compound, bitternut 7-11 leaflets, shaglark 5-7 leaflets, lanceolate.
Twigs: stout, bitternut - sulfur-yellow buds, shagbark - large buds. **Fruits**: green, 4-parted husk.
Bark: gray/brown - bitternut is smooth, light furrows with age; compare to shaggy (shagbark).

13

Family: Juglandaceae

Shagbark Hickory

Code: CAOV

Carya ovata

Photos: Dave Hanson

Leaves: alternate, pinnately compound, 5-7 lance-shaped leaflets, finely toothed, ciliated margins.
Twigs: gray, red-brown, lenticels, stout, large terminal buds. **Fruit**: 1¼-2½" green 4-parted husk.
Bark: smooth and gray in youth, with age bark plates lift to become very shaggy (shagbark).

14

Family: Juglandaceae

Bitternut Hickory

Code: CACO

Carya cordiformis

Photos: Dave Hanson

Leaves: alternate, pinnately compound, 5-11 sessile leaflets, elliptic to lanceolate.
Twigs: light gray, stout, **Buds**: sulfur yellow, fuzzy. **Fruit**: ½"-1½" nut is in 4-ribbed husk.
Bark: silvery gray, smooth in youth - breaking into shallow fissures with age.

15

Family: Juglandaceae

Black Walnut

Code: JUNI

Juglans nigra

Photos: Dave Hanson

Leaves: alternate, pinnately compound, 12-24" long, 9-23 leaflets; terminal leaflet small/missing.
Twigs: stout, light brown/orange, face-like leaf scar. **Fruit**: 1½-2½" round nut, thick husk.
Bark: dark brown / grayish black, rough, deep narrow furrows. **Pith**: chambered, tan color.

16

Family: Aceraceae

Red Maple

Code: ACRU

Acer rubrum

Photos: Dave Hanson

Leaves: opposite, simple, 2-4" long, 3 up to 5 pointed lobes; "V" sinuses and toothy margins.
Twigs: reddish with red buds. **Fruit**: ⅝-1" long paired (two winged) seeds; red turning to brown.
Bark: Young trees have smooth gray bark, becoming dark gray and rough when older.

17

Family: Aceraceae

Sugar Maple

Code: ACSA2

Acer saccharum

Photos: Dave Hanson

Leaves: opposite, simple, 3-6" long, 3-5 pointed lobes; "U" sinuses, coarsely toothed margins.
Twigs: brown, pointed buds. **Fruit**: 1-1¼" long, paired; horseshoe shape, green turning brown.
Bark: Young gray/brown and smooth; Becomes dark and deeply furrowed when older.

Silver Maple

Code: ACSA1

Family: Aceraceae

Acer saccharinum

Photos: Dave Hanson

Leaves: opposite, simple, 5-7" wide, 3-5 pointed lobes, deep cut sinuses, silvery underside.
Twigs: reddish-brown, clustered reddish buds. **Fruit**: 1-3" long samaras, paired, maturing brown.
Bark: Light, silvery-gray and smooth in youth - gray/brown strips; lifting and shaggy with age.

Norway Maple

Code: ACPL

Family: Aceraceae

Acer platanoides

Non-native

Photos: Dave Hanson

Leaves: opposite, simple, 4½-7" wide, 5-7 pointed lobes, shallow "U" sinuses, wavy-toothed.
Twigs: brown, rounded buds. **Fruit**: 1½-2" long, paired, divergent mustache-shape.
Bark: In youth gray/brown and smooth. Becomes dark and deeply furrowed when older.
Many cultivars: green to purple; Emerald Lustre™, Emerald Queen, Schwedleri, & Crimson King.

20

Boxelder

Code: ACNE

Family: Aceraceae

Acer negundo

Photos: Dave Hanson

Leaves: opposite, pinnately compound, 3-7 leaflets each 2-4" long, coarsely serrate (toothed).
Twigs: green to purplish, waxy coating. **Fruit**: 1-1½" V-shaped paired samaras, persist in winter.
Bark: light brown, slightly ridged and furrowed, orangey at the bottom of the furrow.

Black Maple

Code: ACNI

Family: Aceraceae

Acer nigrum

a.k.a. black sugar maple (*Acer saccharum* subsp. *nigrum*)

Photos: Dave Hanson

Leaves: opposite, simple, compare to sugar maple: typically 3 pointed lobes (rarely 5); stipules on the petioles, drooping lateral lobes (appearance of wilt), fuzzy underside of leaf. Very similar to sugar maple; yet, considered more drought tolerant with its range further west in MN and IA.

22

Mountain Maple

Code: ACSP

Family: Aceraceae

Acer spicatum

Photos: Dave Hanson

Leaves: opposite, simple, coarsely toothed margin, underside find tufts of hair where veins meet.
Twigs: yellow-green to red-green, gray hairs. **Fruit**: ¾-1" paired samaras, U-shaped, often red.
Bark: red-brown to brown, smooth to slightly furrowed.

23

American Elm

Code: ULAM

Family: Ulmaceae

Ulmus americana

a.k.a. white elm

Photos: Dave Hanson

Leaves: alternate, simple, 3-6" long, doubly serrate edges, strongly uneven base, pointed tip.
Fruit: ¾"- ½", papery samara, oval wing, deeply notched tip, hairy. **Buds**: pointed, not hairy.
Bark: grayish, with deep furrowed ridges - in cross-section alternating layers of red and white.

24

Red Elm

Code: ULRU

Family: Ulmaceae

Ulmus rubra

a.k.a slippery elm

Photos: Dave Hanson

Leaves: alternate, simple, 3-6" long, doubly serrate edges, uneven base, pointed tip.

Fruit: ⅛" - ¼", papery samara, almost round, slightly notched tip, not hairy. **Buds** are hairy.

Bark: grayish, deep furrowed ridges - in cross-section layers of red-brown.

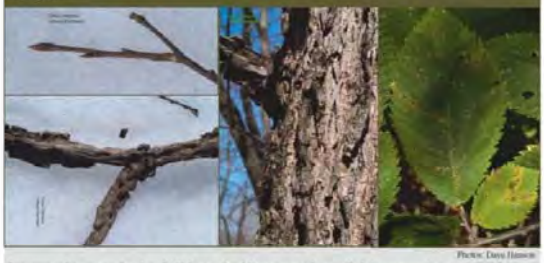
25

Rock Elm

Code: ULTH

Family: Ulmaceae

Ulmus thomasii



Photos: Dave Hanson

Leaves: alternate, simple, 3-6" long, doubly serrate edges, slightly uneven base, pointed tip.

Fruit: ⅛-¼", papery samara, egg-shaped, shallowly notched tip, hairy. **Twig**: hairy, pointed bud.

Bark: grayish, deep furrowed ridges, very coarse bark - in cross-section layers of brown/white.

26

Siberian elm

Code: ULPU

Ulmus pumila

Photos: Dave Hanson

General Characteristics

Bark: grayish, with furrowed ridges - prominent lenticels on young bark

Leaves: alternate, simple, doubly (nearly single) serrate edges, ¾-2" long, nearly equal at base.

Seeds: ½" papery samara, almost round with a deeply notched tip; Leaf is dark green, smooth.

Crabapple

Code: MA2

Family: Rosaceae

Malus spp.

Photos: Dave Hanson

Leaves: alternate, simple, 1-3" long, elliptical-ovate, finely serrated, showy white to red flowers.

Fruit: small apple or pome (< 2"), variety of colors, some persist into late winter.

Bark: gray/pink thin, scaly/flaky. **Twigs**: moderately thick, foliage/fruit on spur shoots.

28

Hawthorns

Code: CR

Family: Rosaceae

Crataegus spp.

Typically sold as thornless.

Photos: Dave Hanson

Leaves: alternate, simple, egg-shaped to oval, toothed and lobed, variable shapes within genera.

Twigs: red-brown to gray, may have sharp, stiff thorns. **Fruit**: apple-like (pome) yellow to red.

Bark: reddish brown to gray, scaly becomes fissured with age. Minnesota has 13 native species.

29

Serviceberry

Code: AM

Family: Rosaceae

Amelanchier spp.

a.k.a. Juneberry

Photos: Dave Hanson

Leaves: alternate, simple, 1-3" long, serrated, ovate. **Flowers**: showy white, early spring.

Twigs: slender, long pointed bud; **Fruit**: ½" berry - red in June maturing to purple.

Bark: grayish with thin vertical ridges. **Form**: native shrub - available as single stem small tree.

30

Chokecherry

Code: PRVI

Family: Rosaceae

Prunus virginiana

Photos: Dave Hanson

Leaves: alternate, simple, oval - finely toothed margins, prominent veins produce rough surface.

Fruit: drupes ⅛-¼" diameter, hanging in clusters, red maturing to dark purple.

Bark: brown to gray becoming slightly fissured with age.

31

Black Cherry

Code: PRSE

Family: Rosaceae

Prunus serotina

Photos: Dave Hanson

Leaves: alternate, simple, 2-4" long, lance to elliptic, serrated edge, hairs along bottom mid-rib

Fruit: drupes, ¾" diameter, hanging in clusters, maturing to reddish-purple.

Bark: shiny, scaly, typically dark, horizontal lenticels - mature bark platy, as burnt potato chips.

32

Pin Cherry

Code: PRPE

Family: Rosaceae

Prunus pensylvanica

a.k.a. Fire Cherry

Photos: Dave Hanson

Leaves: alternate, simple, lance-shaped to elliptic - finely toothed margins, long pointed tip.

Fruit: drupes ¼" diameter, not in clusters, matures bright red. **Twigs**: reddish, orange lenticels.

Bark: red-gray prominent lenticels are tan to orangey in color. Foliage and fruit on spur shoots.

33

Wild Plum

Code: PRAM

Family: Rosaceae

Prunus americana

a.k.a. American Plum

Photos: Dave Hanson

Leaves: alternate, simple, 2-3" long, doubly toothed margins, prominent veins, long pointed tip.

Fruit: ⅝-1" diameter single-seeded drupes, maturing late summer to reddish, yellow or orange.

Bark: brown to dark brown becoming slightly fissured with age. **Twigs**: Thorn-like spur shoots.

34

2 Native Birches

Code: BE

Family: Betulaceae

Betula nigra (Code: BENI) and *Betula papyrifera* (Code: BEPA)

Photos: Dave Hanson

Leaves: alternate, simple leaves, doubly toothed margins, river angular leaf base, paper rounded.

Twigs: both have reddish-brown twigs, prominent lenticels, male catkins present at twig ends.

Bark: River birch - coppery, peeling. Paper birch - white, peeling. Matures to coarse, furrowed.

35

Paper Birch

Code: BEPA

Family: Betulaceae

Betula papyrifera

Photos: Dave Hanson

Leaves: alternate, simple, coarse doubly toothed margins, leaf base - symmetrical, rounded.

Twigs: reddish-brown with prominent lenticels. Male catkins are often present at twig ends.

Bark: young reddish bark, lenticels - matures to white peeling bark at tree base dark and fissured.

36

River Birch

Code: BENI

Family: Betulaceae

Betula nigra

a.k.a. Red Birch

Photos: Dave Hanson

Leaves: alternate, simple, doubly toothed margins, triangular or wedge leaf base.

Twigs: reddish-brown twigs, prominent lenticels. Shiny male catkins are present at twig ends.

Bark: coppery to pinkish peeling bark in youth, matures to be dark gray and coarse.

37

Yellow Birch

Code: BEAL

Family: Betulaceae

Betula alleghaniensis

Photos: Dave Hanson

Leaves: alternate, simple, doubly toothed margins. Singles on long shoots, double on spur shoots.

Twigs: green to yellow-brown, lenticels, wintergreen odor. Male catkins present in winter.

Bark: yellowish-brown, prominent lines (lenticels), smooth paper-thin curly strips.

38

Blue-Beech

Code: CACA

Family: Betulaceae

Carpinus caroliniana

a.k.a. muscle-wood, hornbeam

Photos: Dave Hanson

Leaves: alternate, simple, 2-5" long, ovate/elliptic, doubly toothed margin, bluish-green.

Twigs: Slender, zigzag twigs, male catkins absent in winter. **Buds:** 4-sided in cross-section.

Bark: smooth, gray, trunk ridged resembles muscle. **Fruit**: 4-6" catkins of nutlets, 3-lobed bracts.

39

Ironwood

Code: OSVI

Family: Betulaceae

Ostrya virginiana

a.k.a. hop-hornbeam

Photos: Dave Hanson

Leaves: alternate, simple, 2-5" long, ovate to elliptic, doubly serrate with pointed tip.

Twigs: Slender twigs, pointed buds, male catkins present near twig ends.

Bark: rough, thin, loose rectangular strips. **Fruit**: clustered oval, inflated pouches covering nuts.

40

Hazel

Family: Betulaceae

Corylus americana and *C. cornuta*

American Hazel and Beaked Hazel

Photos: Dave Hanson

Leaves: alternate, simple, doubly toothed, rounded or heart shaped leaf base.

Fruit: ½" filberts, American hazel 2 leafy bracts - beaked hazel has a unique, 1½" extended husk.

Twigs: American hazel has hairy twigs, 1½-3" catkins - beaked hazel no hairs, ½-¾" catkins.

41

2 Native Poplars

Code: PO

Family: Salicaceae

Populus grandidentata and Populus tremuloides

(Code: POGR) (Code: POTR)

Photos: Dave Hanson

Leaves: alternate, simple, flat petioles, Bigtooth large teeth, Quaking - egg-shaped and fine teeth.

Twigs: star-shaped pith, lenticels. Bigtooth: stout, buds diverge. Quaking: slender, buds incurved.

Fruit: String of capsules, capsules 2-valved, split in two to release cottony seed.

Bark: Bigtooth - smooth olive-green bark. Quaking - pale green. Both deeply furrowed with age.

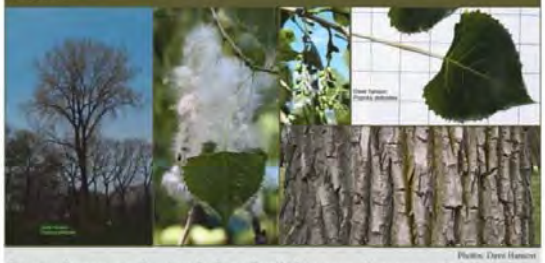
42

Eastern Cottonwood

Code: PODE

Family: Salicaceae

Populus deltoides



Photos: Dave Hanson

Leaves: alternate, simple, triangular/heart shaped, shiny green, blunt, coarse, glandular teeth.
Twigs: large resinous buds, stout twigs. **Fruit**: ¼" long, 2 to 4-valved capsules, cottony seed.
Bark: gray/brown, very thick deep furrows, tall trees can be very large in diameter.

43

Balsam Poplar

Code: POBA

Family: Salicaceae

Populus balsamifera
a.k.a. balm-of-gilead

Photos: Dave Hanson

Leaves: alternate, simple, triangular/heart shaped, blunt fine teeth, shiny green, silvery below.
Twigs: 1" long sticky buds, red balsam-scented resin. **Fruit**: ¼" long capsules, cottony seed.
Bark: greenish in youth becoming gray/brown with v-shaped furrows.

44

White Poplar

Code: POAL

Family: Salicaceae

Populus alba

Non-native

Photos: Dave Hanson

Leaves: alternate, simple, 3-5 triangular coarse-toothed lobes, dark green above, white below.
Twigs: petioles, twigs and buds covered by white cottony hairs, rubs off easily, star shaped pith.
Bark: smooth whitish to gray, deeply furrowed with age. **Fruit**: capsules 2-valved, cottony seed.

45

Northern Catalpa

Code: CASP

Family: Bignoniaceae

Catalpa speciosa

Photos: Dave Hanson

Leaves: opposite or whorled, simple, 5-12" long, "heart" shaped. **Flower**: large, showy, white.
Twigs: stout reddish brown, large leaf scars. **Fruit**: 10-18" long, skinny pod. **Pith**: solid, white.
Bark: gray reddish brown, irregular shallow fissures, scaly ridges.

46

Kentucky Coffeetree

Code: GYDI

Family: Caesalpiniaceae

Gymnocladus dioicus

Photos: Dave Hanson

Leaves: alternate, bipinnately (doubly) compound, 12-36" long with 6-15 leaflets.
Twigs: stout, inconspicuous buds. **Fruit**: 4-10" long, 1½-2" wide dark red-brown seed pod.
Bark: Gray/brown rough fissured, edges lifting/curling. **Pith**: large, soft, salmon colored.

47

Tulip Poplar

Code: LITU

Family: Magnoliaceae

Liriodendron tulipifera

Non-native

Photos: Dave Hanson

Leaves: alternate, simple, 4-6" long and wide, 4 lobed, shallow sinuses, large stipules, unique.
Fruit: 2½-3" long, cone-like, clustered samaras, erect. **Twig**: stout, brownish. **Buds**: flat, valvate.
Bark: grayish, breaking into interlacing rounded ridges. **Flower**: 1½-2" wide, yellow, tulip-like.

48

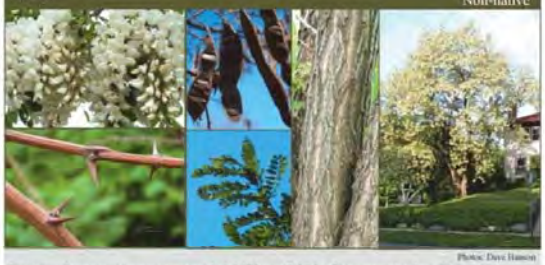
Black Locust

Code: ROPS

Family: Fabaceae

Robinia pseudoacacia

Non-native



Photos: Dave Hanson

Leaves: alternate, pinnate compound, 6-14" long, 7-19 leaflets, smooth edges, blue-green.
Twigs: brownish with paired spines near buds. **Fruit**: 2-4" long, ½" wide pod, dark brown.
Bark: grayish-brown deeply furrowed, coarse, interlacing ridges, orangish troughs.

49

Honeylocust

Code: GLTR

Family: Caesalpiniaceae

Gleditsia triacanthos

Typically sold as variety 'Inermis' (without thorns).

Photos: Dave Hanson

Leaves: alternate, compound pinnately and bipinnately, 15-30 small leaflets.
Twigs: reddish/brown and may have thorns. **Fruit**: 6-18" long, 1" wide, brown twisted pods.
Bark: reddish/brown scaly ridges, a "cracking" appearance - may have sharp, 3-branched thorns.

50

Ohio Buckeye

Code: AEGL

Family: Hippocastanaceae

Aesculus glabra

Non-native

Photos: Dave Hanson

Leaves: opposite, palmately compound, 5-7 serrate leaflets each 2-6" long, lance shaped leaflets.
Fruit: 1-2" rounded nut-like, thick husk, prickles. **Twig**: grayish. **Flower**: spikes, yellow, showy.
Bark: grayish brown, corky patches on older trees. **Buds**: light brown, dry appearance.

51

Horsechestnut

Code: AEHI

Aesculus hippocastanum

Non-native

Photos: Dave Hanson

General Characteristics

Bark: grayish brown, with corky patches on older trees. Form: med. to large, rounded crown.
Leaves: opposite, palmate compound, typically 7 leaflets, 4-10" long, obovate, serrate margin.
Twig: light gray-brown with dark, sticky, shiny buds. Seeds: 2-2¼" spiny capsule, thick husk.

52

Ginkgo

Code: GIBI

Ginkgo biloba

Photos: Dave Hanson

General Characteristics

Bark: light gray, irregular ridges, a corky appearance.
Leaves: alternate, simple fan shaped 2-3" often separated by a cleft into two lobes (biloba).
Twigs: gray with many spur shoots; Seeds: Fleshy, "stinky" fruit (female only), orangey.

Hackberry

Code: CEOC

Family: Ulmaceae

Celtis occidentalis

Photos: Dave Hanson

Leaves: alternate, simple, singly toothed, uneven base, ovate in shape, nipple gall is common.
Twigs: twigs slender, zigzagged. **Pith**: chambered. **Fruit**: ⅛-¼" single, purple berry-like drupe.
Bark: grayish, with distinct corky ridges. **Form**: medium to large tree at 40-70', rounded crown.

54

Amur Corktree

Code: PHAM

Phellodendron amurense and *P. sachalinense*

Look for seedless male cultivars.

Non-native

Photos: Dave Hanson

General Characteristics

Bark: with age becomes ridged and furrowed, light gray, inner bark is bright yellow-green.
Leaves: opposite, pinnately compound, 10-15" long, 5-11 leaflets, smooth edges.
Twigs: Stout, yellowish to yellowish-gray. Fruit: ½" drupe, greenish then black at maturity.

55

Sycamore

Code: PLOC

Family: Platanaceae

Platanus occidentalis

Non-native

Photos: Dave Hanson

Leaves: alternate, simple, 4-8" diameter, 3-5 lobed, coarsely toothed, shallow sinuses, stipules.

Fruit: ½-1½" ball, 3-6" stem, cluster of small seeds, persist into winter. **Twig**: brownish, zigzag.

Bark: Gray, rough outer bark sheds to expose "camouflage" patterns of white to grayish brown.

56

American Basswood

Code: TIAM

Family: Tiliaceae

Tilia americana

Photos: Dave Hanson

Leaves: alternate, simple, 4"-8" long, coarsely serrate edges; heart-shaped, unequal base.

Twigs: slender, round 2-scaled, reddish bud. **Fruit**: ¼-⅜", round, under leaf like bract, no ridges.

Bark: light gray when young, darkens with age, narrow/shallow flat topped ridges.

57

Little-leaf Linden

Code: TICO

Family: Tiliaceae

Tilia cordata

Non-native

Photos: Dave Hanson

Leaves: alternate, simple, 1½-3" long, ovate to heart shaped, sharp fine serrate edges.

Twigs: slender, green-brown or red-tinged, buds brownish.

Bark: gray - brown, ridged, shallow furrows. **Fruit**: round nutlets under a bract, slightly ridged.

58

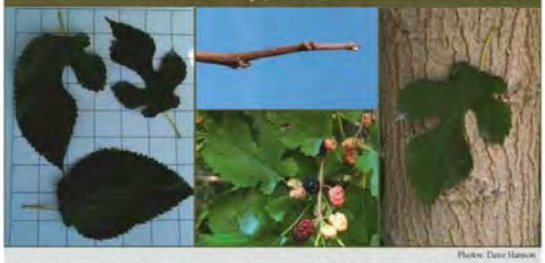
Mulberry

Code: MO

Family: Moraceae

Morus spp. Likely white mulberry (*M. alba*), native red mulberry (*M. rubra*) is not common.

Non-native



Photos: Dave Hanson

Leaves: alternate, simple, coarsely toothed margins, variety of lobe shapes, shiny green, smooth.

Twigs: greenish to red-brown, milky sap. **Fruit**: clustered drupes (raspberry-like) red to black.

Bark: Orangey-brown, scaly ridges, more orangey at the bottom of the furrows.

59

Willows

Code: SA

Family: Salicaceae

Salix spp.

Few large tree forms - numerous shrub forms

Photos: Dave Hanson

Leaves: alternate, simple, typically lance shaped, finely toothed, some have stipules.

Twigs: vary in color from reds, browns to golden yellow. **Fruit**: cottony seeds.

Bark: grayish-brown to brownish-black, larger trees the bark is deeply furrowed, fibrous.

60

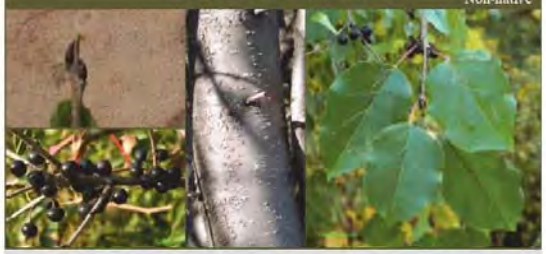
European Buckthorn

Code: RHCA

Rhamnus cathartica

a.k.a. Common buckthorn, buckthorn.

Non-native



Photos: Dave Hanson

General Characteristics

Bark: smooth, gray to reddish brown with lenticels, dark gray and scaly on older trees.
Leaves: sub-opposite, simple elliptic to oval 2-3" long, finely serrated edge, arcuate veination.
Twigs: Terminal thorn with buds on either side. Seeds: round 1/4" "berry" shiny black.

61

Spruces

Code: PI1

Family: Pinaceae

Picea spp.

Photos: Dave Hanson

Needles: single, pointed 1/2" to 2" long, typically 4-sided so roll between index finger and thumb.
Cones: black ½-1¼", white 1¼-2½", CO blue 2-4", Norway 4-6". All have layered scales.
Bark: thin gray-brown flaky/scaly. **Form**: conical, typical "Christmas Tree" shape.

62

White Spruce

Code: PIGL

Family: Pinaceae

Picea glauca

a.k.a. skunk spruce

Photos: Dave Hanson

Needles: single, 4-sided, ½-¾" long, dull points, dark bluish-green color. **Buds**: reflexed scales.
Cone: 1¼-2½" long, scales have smooth margins. **Twigs**: Gray to orange-brown, hairless.
Bark: red-brown to gray flaky, scaly. Described that crushing needles releases a skunk-like odor.

63

Colorado Spruce

Code: PIPU

Family: Pinaceae

Picea pungens

a.k.a. blue spruce

Non-native

Photos: Dave Hanson

Needles: single, 4-sided, ¾-1½" long, sharply pointed, green to silvery-blue color.
Cones: 2-4" long, papery scales, scales have irregularly toothed margins, flexible scales.
Bark: grayish-brown flaky, scaly. **Buds**: golden, reflexed scales.

64

Norway Spruce

Code: PIAB

Family: Pinaceae

Picea abies

Non-native

Photos: Dave Hanson

Needles: single, ½-1" long, 4-sided, on an orangey twig, not too sharp, dark green color.
Cones: 4-6"long with stiff, thin scales, irregular teeth, green when first forming, turning brown.
Bark: gray flaky, scaly. **Form**: large tree - 40-65', pyramidal, drooping lateral (side) branchlets.

65

Black Spruce

Code: PIMA

Family: Pinaceae

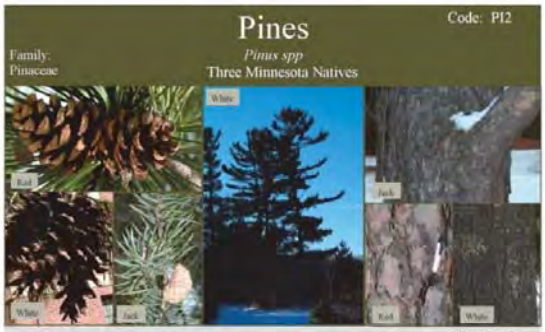
Picea mariana

a.k.a. bog or swamp spruce

Photos: Dave Hanson

Needles: single, 4-sided, ½-¾" long, dull points, blue-green color. **Twigs**: red-brown, red hairs.
Cones: ½-1¼" long, egg-shaped, clustered to interior tree top, scales rounded, rigid. persist years.
Bark: red-brown to gray flaky, scaly. **Buds**: hairy, grayish, outer scales long, slender, pointed.

66



Photos: Dave Hanson

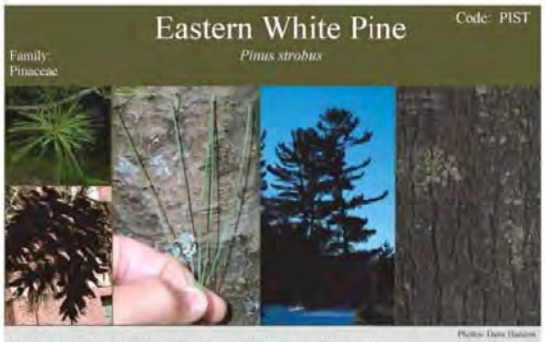
Needles per bundle: 5 for white, 2½-5" long - 2 for red, 4-6" long - 2 for jack,¾-1½" long.
Cones: white has 4-8" white tipped, red has 1½-2¼" paired, jack has 1-2" pointing to twig tip.
Bark: dark gray, small blocks on jack and white pines. Reddish-gray, large blocks on red pine.

67

Photos: Dave Hanson

Needles: 2 per bundle, 4-6" long, needles break cleanly when bent, persist to 4th or 5th year.
Cones: 1½-2¼" long, sub-sessile, typically paired, unarmed - compare to ponderosa pine.
Bark: reddish-gray large blocks. **Buds**: pointed, reddish-brown, ragged scales.

68



Photos: Dave Hanson

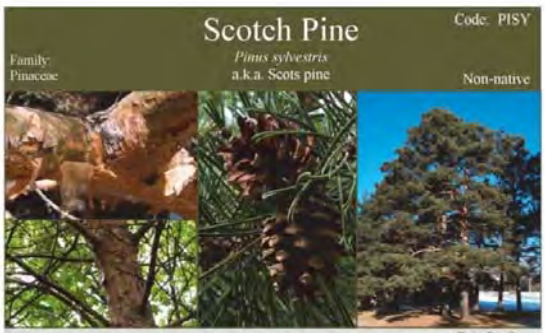
Needles: 5 per bundle, 2½-5" long, very soft, persist to end of 2nd season.
Cones: 4-8" long with white (resin) tipped scales, unarmed, cones fall during the winter.
Bark: dark, small blocks - mature trees develop characteristic stag-horn branching.

69

Photos: Dave Hanson

Needles: 2 per bundle, ¾-1½" long, often twisted, divergent or forming a "V", persist 2-3 years.
Cones: 1-2", paired, sessile, pointing to twig tip, cones are closed (serotinous), light brown.
Bark: dark, small blocky scales. Cones persist for many years.

70



Photos: Dave Hanson

Needles: 2 per bundle, 1½-3½" long, twisted, pairs not divergent - almost wrapped.
Cones: 1½-2½", single to paired, light brown, tip bent back.
Bark: upper trunk / branches papery, flaky, orangey to green, main stem grayish, scaly plates.

71

Photos: Dave Hanson

Needles: 2 or 3 per bundle, 5-8" long. Persist into 3rd season. **Buds** reddish, pointed, resin drops.
Cones: 3-6" long, sessile, 'armed' with stiff, sharp prickle (spines), light brown in color.
Bark: grayish-black becoming irregular, furrowed reddish brown scales or plates.

72

Mugo Pine

Code: PIMU

Pinus mugo

Non-native

Photos: Dave Hanson

General Characteristics

Bark: brown to gray, scaly, irregular chunks. Form: Typically a shrub in Minnesota.
Needles: 2 per bundle, 1-2" long, rigid, curved, pointing to branch tip - bottle-brush appearance.
Cones: 1-2", solitary, paired, or in 3s, short-stalked or sessile, grayish black. 73

Balsam Fir

Code: ABBA

Family: Pinaceae

Abies balsamea

Photos: Dave Hanson

Needles: evergreen, flattened, soft, 2-ranked (in rows), 2 white lines underside, persist 7-10 years.

Cones: 2-4" long, near tree top, erect on branch - cones don't persist, leaving the central stalk.

Bark: gray, resin blisters - becomes reddish-brown and scaly. **Buds**: ⅛-¼", resinous. 74

Douglas Fir

Code: PSME

Family: Pinaceae

Pseudotsuga menziesii

Non-native

Photos: Dave Hanson

Needles: fir-like, ¾-1⅛" long, flat, yellow green to blue-green, 2 white stomate lines below.

Twigs: red-brown, pale brown. **Buds**: sharp pointed. **Cones**: 2-4" long, fork-like bracts protrude.

Bark: reddish-brown, deeply furrowed. Needles persist 8 or more years. 75

Eastern Red-cedar

Code: JUVI

Family: Cupressaceae

Juniperus virginiana

Photos: Dave Hanson

Needles: evergreen, opposite, mature needles scale-like, Juvenile needles sharp, awl-like.

Cones: typically 1-2 seeds in a ⅛-½" diameter - ovoid, berry-like cone, ripe 1st season.

Bark: thin gray-brown - vertical strips. You may notice small, brown pollen cones at branch tips. 76

Northern White-cedar

Code: THOC

Family: Cupressaceae

Thuja occidentalis

a.k.a. - Arborvitae.

Photos: Dave Hanson

Needles: evergreen, scale-like, flattened and generally soft, fan-like, aromatic.

Cones: ½" long, oblong, usually upright on branch, light brown in color, typically 4 fertile scales.

Bark: thin gray-brown - vertical strips. **Form**: small to medium trees at 25-50'. 77

Common Juniper

Code: JUCO

Family: Cupressaceae

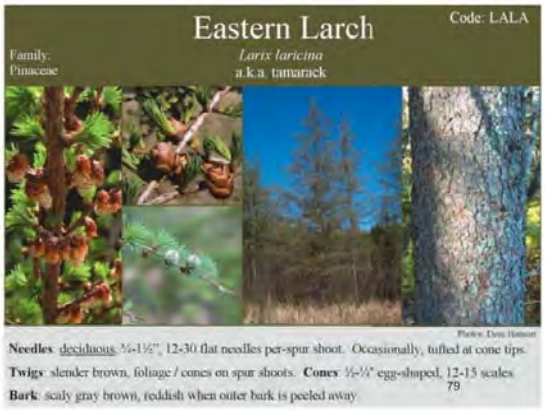
Juniperus communis

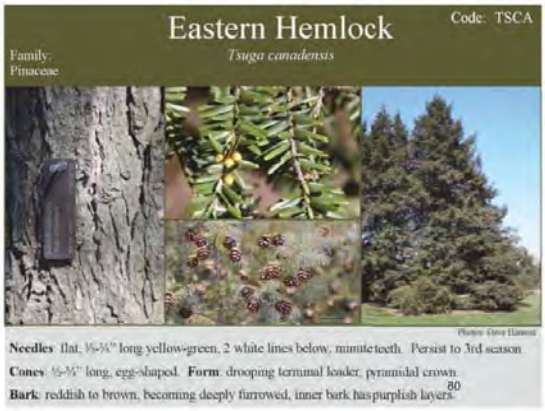
Photos: Dave Hanson

Needles: evergreen, whorled in 3s, awl-shape, sharp, concave upper surface is whitish (stomates).

Cones: ⅛-½" diameter - ovoid, berry-like appearing three-parted, ripens in 3rd season.

Bark: thin reddish-brown - vertical strips. Form: in Minnesota - most often a sprawling shrub. 78


Eastern Larch
Code: LALA
Family:
Pinaceae
Larix laricina
a.k.a. tamarack
Photos: Dave Hanson
Needles: deciduous, ¾-1½", 12-30 flat needles per-spur shoot. Occasionally, tufted at cone tips.
Twigs: slender brown, foliage / cones on spur shoots. Cones: ½-¾" egg-shaped, 12-15 scales.
Bark: scaly gray brown, reddish when outer bark is peeled away.
79


Eastern Hemlock
Code: TSCA
Family:
Pinaceae
Tsuga canadensis
Photos: Dave Hanson
Needles: flat, ½-¾" long yellow-green, 2 white lines below, minute teeth. Persist to 3rd season.
Cones: ½-¾" long, egg-shaped. Form: drooping terminal leader, pyramidal crown.
Bark: reddish to brown, becoming deeply furrowed, inner bark has purplish layers.
80

Appendix L: Minnesota Trees tree identification packet

See the attached “Minnesota Trees” dichotomous booklet. This booklet was distributed to all volunteers who attended the indoor training.

BU-00486-S
Reviewed 2001

Product Manager: Gail M. Tischler
Editor: Mary Hoff
Graphic Designer: Deb Thayer
Graphic Assistant: Jeff Davel
Illustrators: Bruce L. Fuller
John Molstad
Michael W. Rathke
USDA Forest Service (A.E. Hoyle, Leta Hughey)
Photographers: Don Breneman
Margaret Thayer

Cover Photograph: Autumn colors are one of the many treasures Minnesota's trees provide. Two Norway pines, Minnesota's state tree, are framed by the autumn fabric of smooth sumacs in the foreground and a large eastern cottonwood overhead.

Produced by Communication and Educational Technology Services, University of Minnesota Extension Service.

Beginner's Guide Available

Casual nature observers and elementary and secondary school-age youth may prefer the inexpensive, 20-page *A Beginner's Guide to Minnesota Trees*. It identifies the 35 tree species commonly found in Minnesota with easy-to-follow keying symbols. Call the University of Minnesota Extension Service Distribution Center at (800) 876-8636 or (612) 625-8173 for price and availability. Ask for item BU-06593.

MINNESOTA EXTENSION SERVICE
UNIVERSITY OF MINNESOTA

MINNESOTA TREES

David M. Rathke
Assistant Extension Specialist
Department of Forest Resources
University of Minnesota

ACKNOWLEDGMENTS

The author wishes to thank Melvin J. Baughman, Stephan P. Carlson, Jerome C. Deslen, Gary R. Johnsen, Phyllis Jenks, and Michael Zins of the University of Minnesota; and Amy J. Rathke for reviewing the publication and providing helpful assistance. While this publication could not have been produced without these individuals, the author accepts responsibility for the final product including any oversights or errors.

Minnesota Trees (formerly *Minnesota Forest Trees*) was first written in 1930 by Wilbur Mattoon and Parker Anderson. The publication was completely revised in 1970 by William R. Miles and Bruce L. Fuller, and in 1989 by Harold "Scotty" Scholten. This work largely is based on the efforts of these five individuals.

ILLUSTRATION CREDITS

Bruce L. Fuller, Minnesota Extension Service, University of Minnesota. Drawings of speckled alder (leaf), and staghorn sumac (leaf) were reproduced from the Minnesota Extension Service publication *Minnesota Forest Trees* (1972) by William R. Miles and Bruce L. Fuller.

John Molstad, University of Minnesota, Minnesota Extension Service. Drawings of coniferous tree leaves and seed cones (figure 4), deciduous tree leaves (figure 5), twig characteristics (figure 6, false terminal bud, valvate bud scales, pith shape, arrangements, male catkin), fruits (figure 7, samara, double samara, multiple of drupes, acorn), black ash (twig), green ash (twig), white ash, American mountain-ash (twig), European mountain-ash, common prickly-ash (leaf), European white birch, paper birch (twig), blue-beech (twig), buckeye (fruit), catalpa (twig), black cherry (twig, fruit), chokecherry (twig), pin cherry (twig), Kentucky coffeetree (twig, fruit), American elm (twig, bark), rock elm (twig, fruit), Siberian elm, slippery elm, douglas-fir, ginkgo (twig), hackberry (twig), bitternut hickory (twig), shagbark hickory (twig), ironwood (twig), eastern larch, European larch, basswood, black locust (twig), honeylocust (leaves), boxelder (twig, fruit), Norway maple, red maple (twig, fruit), silver maple (fruit), sugar maple (twig, fruit), Ishurian maple, black oak (twig, fruit), bur oak (twig), eastern pin oak (fruit), northern pin oak (fruit), swamp white oak (fruit), American plum, Canada plum, balsam poplar (twig), bigtooth aspen (leaf, twig), trembling aspen, jack pine (leaf), ponderosa pine (leaf), red pine (leaf), Scotch pine (leaf), white pine (leaf), black walnut, butternut (fruit,
twig), bebb willow, black willow (twig), hearthead willow, hurel willow, peachleaf willow, pussy willow, sandbar willow, shining willow, and white willow.

Michael W. Rathke with assistance from Daniel M. Rathke. Drawings of twig characteristics (figure 6, twig, flower), fruits (figure 7, capsule, drupe, legume, pome), prairie crabapple, common buckthorn, alternate-leaf dogwood, hawthorn, amur maple, nannyberry, roundleaf serviceberry, Saskatoon serviceberry, staghorn sumac (twig, fruit), and wahoo.

A. E. Hoyle, U.S. Department of Agriculture, Forest Service. Drawings of black ash (leaf, fruit), green ash (leaf, fruit), American mountain-ash (leaf, fruit), paper birch (leaf, fruit), yellow birch, river birch, blue-beech (leaf, fruit), northern white-cedar, black cherry (leaf), chokecherry (leaf, fruit), pin cherry (leaf, fruit), American elm (leaf, fruit), rock elm (leaf), balsam fir, hackberry (leaf, fruit), eastern hemlock, bitternut hickory (leaf, fruit), shagbark hickory (leaf), ironwood (leaf, fruit), eastern redcedar, honeylocust (thorn, fruit), boxelder (leaf), sugar maple (leaf), black oak (leaf), red oak (leaf), swamp white oak (leaf), white oak (leaf, fruit), balsam poplar (fruit), bigtooth aspen (fruit), eastern cottonwood, jack pine (twig, seed cone), red pine (closed seed cone), white pine (seed cone), downy serviceberry (leaf), black spruce, white spruce, butternut (leaf), and black willow (leaf, fruit) were reproduced from the University of Minnesota, Department of Agriculture, Extension Division publication *Common Forest Trees of Minnesota* (1910) by Wilbur Mattoon and Parker Anderson.

Lela Hughey, U.S. Department of Agriculture, Forest Service. Drawings of sweet birch, Ohio buckeye (leaf), northern catalpa (leaf, fruit), Kentucky coffeetree (leaf), amur corktree, Fraser fir, ginkgo (leaf, fruit), shagbark hickory (fruit), black locust (leaf, fruit), black maple, red maple (leaf), silver maple (leaf), red mulberry, white mulberry, chinkapin oak, eastern pin oak (leaf), Austrian pine, ponderosa pine (seed cone), Scotch pine (seed cone), red pine (open seed cone), balsam poplar (leaf), white poplar, Russian-olive, blue spruce, and Norway spruce were reproduced from "Important Forest Trees of the United States" by Elbert Little in *The Yearbook of Agriculture 1949*.

University of Minnesota, Minnesota Extension Service. Drawings of poison ivy (page 24), poison sumac (page 24), and common prickly-ash (twig, fruit) (page 42) were reproduced with permission of the Minnesota Extension Service from the publication *Perky Plants* (1989) by T. Kommedahl.

CONTENTS

The Witch Tree, precariously perched on a granite rock at the edge of Lake Superior near Grand Portage, is deeply rooted in Minnesota's history. The centuries-old white-cedar holds a special place in American Indian spirituality. People of all backgrounds and traditions respect it as a symbol of strength and endurance.

INTRODUCTION

Trees contribute much to the quality of life enjoyed in Minnesota, so we naturally are interested in knowing more about them. This book introduces you to more than 100 trees found in Minnesota forests and backyards.

The book is divided into four sections: (1) background information, (2) descriptions of coniferous trees and their identifying characteristics, (3) descriptions of deciduous trees and their identifying characteristics, and (4) projects to help you enjoy learning about trees.

With this book in hand, you'll make many new friends—the trees growing in Minnesota. With pride, you'll be able to say, "That's a sugar maple, and the tree to the left is a basswood."

What Is a Tree?

For our purposes, a tree is defined as a woody plant usually having a single, upright stem growing to a height of at least 15 feet with a defined crown developing at least two or more feet above the ground. Shrubs, in contrast, usually have several upright or spreading stems branching from the base and grow less than 15 feet tall. Plants that commonly develop into trees are included in this book.

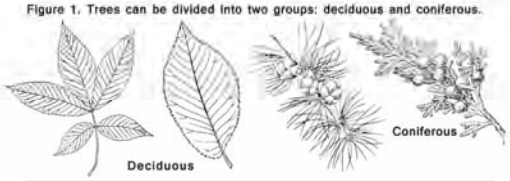
Identifying Trees

When we try to identify things, whether rocks, animals, or trees, we begin by connecting them with groups of things with similar characteristics. Trees can be classified into two broad groups: *coniferous* and *deciduous*. Coniferous trees bear their seeds in cones and have very narrow or overlapping leaves. All of our coniferous trees except the larches are evergreens, meaning that they maintain their leaves throughout the year. Deciduous trees, in contrast, do not bear their seeds in cones and have broad leaves that drop in autumn. Figure 1 shows the basic differences between coniferous trees and deciduous trees.

If you know whether a tree is coniferous or deciduous, you are ready to begin. If the tree is coniferous, turn to Section Two. If it is deciduous (or without leaves), turn to Section Three.

The introductions to both sections describe features commonly used to identify trees in each group. They also contain keys for identifying trees by genus (e.g., maple, pine). If you are unsure about how to use an identification key, read "How to Use a Key" on page 2.

Figure 1. Trees can be divided into two groups: deciduous and coniferous.



How to Use a Key

A key is a tool that reduces the process of identifying something to a series of steps.

If you are trying to identify a tree and think you know its name or genus (e.g., maple, pine), find that tree's description using the species index at the back of this book, then check its characteristics with those provided in the text. To assist your identification, species with similar characteristics are grouped together in the text. If you are unsure of what it is, use the keys to help narrow the possibilities.

Three keys are provided: (1) coniferous trees (page 8); (2) deciduous trees with leaves (page 25); and (3) trees without leaves, including larches (page 75). The keys are based on differences in leaves, twigs, fruits, and bark.

Each step in the key has two alternative descriptions (labeled *a* and *b*) with the same number and indentation on the page. Select the one of the pair that best describes the tree you are examining. Proceed to the next pair of descriptions directly below and indented closest to your choice. Continue this process until you get to the name of the genus or species. (If both choices seem reasonable at any step, try going both ways.) Finally, read the species descriptions to confirm your identification.

For example, suppose that the unknown tree you are examining is an imaginary coniferous tree known as blue pine. It has 6- to 8-inch long, bluish-green, needlelike leaves, and 8- to 12-inch long seed cones. The correct steps for identifying the tree are highlighted in the example key below.

Example Key

(correct steps for identifying blue pine are highlighted)

1a. Seeds borne in woody (rarely fleshy) cones; leaves needlelike or overlapping (like fish scales), persistent in winter (coniferous tree).
- 2a. Leaves brownish-green, less than 2" long.
  - 3a. Cones fleshy; leaves overlapping ..... Brown cedar
  - 3b. Cones woody; leaves needlelike ..... Brown pine

2b. Leaves bluish-green, 2" long or greater.
- 4a. Cones less than 8" long, leaves 3" - 4" long ..... False blue pine
- **4b. Cones 8" - 12" long; leaves greater than 6" long** ..... Blue pine

1b. Seeds not borne in cones; leaves broad and flat absent in winter (deciduous tree).

Section One: BACKGROUND

Common and Scientific Names

Each species has a common and a scientific name. Common names usually are based on characteristics or uses of the tree (e.g., swamp white oak, bitternut hickory, paper birch, Kentucky coffeetree). Despite efforts to standardize them, common names tend to vary from location to location. Scientific names, on the other hand, are the same worldwide and describe one and only one species. For example, our state tree often is called Norway pine in Minnesota and red pine in other parts of the country. However, the scientific name of this tree is *Pinus resinosa* throughout the world.

Scientific names are written in Latin and composed of two words. The first word is the name of the genus, and the second is the species expression (or epithet). For red pine, the complete scientific name is *Pinus resinosa*; the genus is *Pinus*, and the species expression is *resinosa*. Note that scientific names are written in italics (or underlined) and the first letter of the genus name is capitalized. Although it is important to recognize scientific names, you will want to remember the common names.

Size and Shape

A tree's size and shape can help you identify it and select appropriate species to plant in different locations. Small trees grow to a mature height of 25 feet or less. Medium-sized trees reach a mature height of 26 to 50 feet, while large trees commonly exceed 50 feet at maturity. As a general rule, you should only plant small trees near power lines.

Height estimates given in the tree descriptions that follow are for mature trees under average conditions in the Upper Midwest. Heights in parentheses are for older trees or for trees growing under very favorable conditions in Minnesota.

Some species show distinctive branching patterns and trunk forms. An open-grown American elm, for example, easily can be identified at a distance by its vase-shaped crown composed of several upright stems forking off the main trunk and drooping at their ends. Kentucky coffeetree tends to develop a narrow, pyramid-shaped or rounded crown of crooked branches, while basswood tends to have a broad, rounded crown of spreading branches. With a little practice, you can become quite proficient at identifying open-grown trees from a distance.

A tree's trunk also can offer some identification clues. Some trees, such as the black willow, often develop a twisted or leaning trunk. Others, such as eastern white pine, tend to develop a tall, straight trunk that is flared (buttressed) at the base. Basic trunk descriptions are given along with the typical mature trunk diameter. Trunk diameter is expressed as the diameter 4½ feet above the ground, known as the diameter at breast height (dbh).

Other Characteristics

Leaves, twigs, fruits (or seed cones), and bark are described for each tree. Key identifying characteristics are italicized in the text. Definitions of the features needed to identify trees are provided in the introduction to the section.

Like people, trees are unique individuals that are influenced by many genetic and environmental factors. Genetic factors are passed from one generation to the next. Environmental factors that can influence a tree's characteristics include soil nutrients, water, light, competition, climate, and disturbance. Although genetic factors may influence almost any characteristic of the tree, environmental factors tend to influence tree size, crown form, and the size and number of leaves, branches, and fruits. Because genetic and environmental factors affect the appearance of a tree, you should carefully examine several characteristics to make an accurate identification.

Range: Native and Introduced Trees

Each species is described as native or introduced to Minnesota and its general geographic range and hardiness zone is identified. Many native species occur outside the identified range because of outlying populations or, more often, because people planted them there. In nature, species survival is based on an ability to outcompete or coexist with others and reproduce in a specific habitat type, known as a *niche*. When we plant and care for trees, however, we eliminate (or greatly reduce) competition, allowing many species to survive outside their natural niche. In these cases climate, soil nutrients, and landscape patterns become the primary limiting factors.

Hardiness Zones

When selecting trees for planting, it is important to select plants that can survive in the area. The best technique usually is to use species native to the area. The U.S. Department of Agriculture (USDA) plant hardiness zones also can provide assistance. Figure 2 shows the different hardiness zones in Minnesota based on minimum winter temperatures. Note that each zone is divided into two parts, with (*a*) being the colder half. While hardiness ratings are useful, they only are general references; many factors can influence a tree's ability to survive in a specific area.

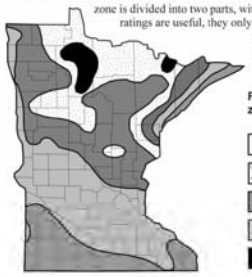


Figure 2. USDA plant hardiness zone map of Minnesota.

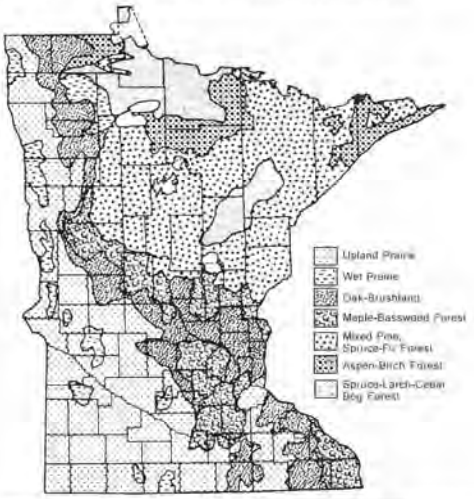
- Zone 2b (-40° to -45° F)
- Zone 3a (-35° to -40° F)
- Zone 3b (-30° to -35° F)
- Zone 4a (-25° to -30° F)
- Zone 4b (-20° to -25° F)

Natural Vegetation

Minnesota is uniquely situated at the edge of three major ecological communities—eastern deciduous forest, western tall grass prairie, and northern coniferous forest. Thus, many species have only a small portion of their geographic range within the boundary of the state.

The occurrence of these ecological communities largely has been determined by climate, soils, and landscape patterns. Within each community, different vegetative types can occur because of natural disturbances (e.g., fire, drought, windstorm, ice damage, and insect and disease outbreaks), soil types, topography, and microclimates. Figure 3 shows the vegetative types present in Minnesota prior to European settlement.

Figure 3. Original vegetation of Minnesota prior to European settlement.



Minnesota Forests

The acreage of Minnesota's forests has greatly decreased since the first European settlers arrived. Then, about 31.5 million acres of our state's 51.2 million acres were forested. With the development of agriculture, roads, and cities, forests now cover only about 16.7 million acres. Fortunately, tree planting and natural succession are restoring some of the previously forested areas.

Minnesota's forests have immense economic and environmental importance. The production and processing of wood and wood fiber is the second largest manufacturing industry in Minnesota. Millions of tourists and recreational users are attracted to the beauty and solitude of our forests. Forests also provide habitat for wildlife, protect soils, and renew water resources. And they enhance the appearance of communities and promote health by reducing noise, cutting energy costs, screening unsightly views, and attracting songbirds and other wildlife.

Your interest in learning more about trees is a major step toward protecting and enhancing these values.

Shade Tolerance, Growth Rate, and Life Span

The tree descriptions in this book include remarks about tree uses, habitat, landscape limitations, and unique characteristics. They also note shade tolerance, height growth rate prior to maturity, and typical life span.

Shade Tolerance

Shade tolerance describes the species' ability to establish and survive in various degrees of shade. Shade-intolerant species require full sunlight. Intermediate species can survive in partial shade. Shade-tolerant species can survive in dense shade. These classes not only provide important species selection information for planting, they also can help you differentiate species growing in a shaded forest from those growing in full sunlight.

Growth Rate

Growth rates are based on the height increase of a tree growing under average conditions in the Upper Midwest prior to maturity. Slow-growing is defined as 12 inches or less per year; moderate-growing, 13 to 24 inches per year; and fast-growing, 25 inches or more per year. Trees grow continuously, but growth usually slows after maturity.

Life Span

Trees are described as short-lived (less than 76 years), intermediate (76 to 150 years), or long-lived (longer than 150 years). A tree's life span is influenced by many factors (e.g., disease, damage). Downtown urban trees, for example, on average live only 10 percent as long as trees in rural areas. Therefore, the classes provided should only be viewed as potential ages.

Section Two:
CONIFEROUS TREES

So your tree is coniferous! It belongs to one of the most ancient group of plants living today. This group includes some of the most valuable trees in the world. It also includes the largest of all living plants, the redwoods and giant sequoias.

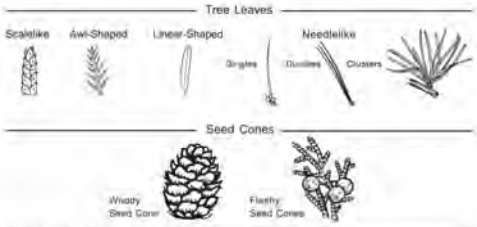
Identifying Coniferous Trees

Since coniferous trees (except larch) maintain their leaves and most of their identifying features throughout the year, we can use the same characteristics to identify them during both summer and winter. Begin by examining the shape of the leaves. Coniferous tree leaves may be needlelike, linear-shaped, scalelike, or awl-shaped (Figure 4). If the leaves are needlelike or linear-shaped, measure them using the ruler on the back cover of this book and determine if they are arranged in singles, clusters or tufts of 12 or more, or held together in bundles of 2 to 5.

Next try to locate a few seed cones on the tree (Figure 4). Coniferous tree seeds are borne on the scales of a woody (rarely fleshy) cone. The seeds are mature in autumn unless otherwise stated. Note the location and position of the cones on the tree and branches. Measure the length of the cone and examine the cone's scales. Most coniferous trees have smooth cone scale tips, but some are armed with sharp points. On others a small, winglike bract extends beyond the scales.

Finally, examine the color and texture of the twigs and bark. Twigs, located at the ends of the branches, represent the newest growth. The texture, color, and size of the twigs and their buds can offer important identification clues. Bark is the outer protective layer on the main trunk of a tree. It is difficult to describe, but offers important identification clues. This especially is true for tall trees in which leaves and cones may be out of reach.

Figure 4. Coniferous tree leaves and seed cones.

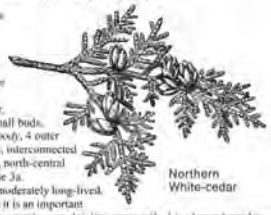


2a. Twigs flattened; cones woody, brown; leaves entirely scalelike ..... **White-cedar, p. 9**
2b. Twigs 4-sided; cones fleshy (berrylike), bluish; leaves awl-shaped and scalelike ..... **Junipers, p. 9**
1b. Leaves linear-shaped (flattened in cross section) or needlelike.
3a. Leaves borne in clusters or bundles (2 or more)
4a. Leaves borne in clusters of 12 or more on stubby spur shoots, singly at twig ends ..... **Larches, p. 10**
4b. Leaves borne in bundles of 2 - 5 ..... **Pines, p. 11-13**
3b. Leaves borne singly, never in clusters or bundles.
5a. Leaves needlelike, 4-sided, stiff (not flexible), often sharply pointed ..... **Spruces, p. 14-15**
5b. Leaves linear-shaped, flattened, soft, relatively flexible, usually blunt.
6a. Leaves borne on small, peglike stalks; scattered teeth on leaf margins; rough leaf scars (stalks) on twigs ..... **Hemlock, p. 16**
6b. Leaves borne on whitish cushions or flush with twig; smooth leaf margins; slightly raised leaf scars (smooth) on twigs.
7a. Buds relatively large, sharply pointed, not sticky; cones hang down, scales persistent, scattered on tree, forklike bracts extend beyond cone scales ..... **Douglas-fir, p. 16**
7b. Buds small, blunt, sticky; cones erect, scales deciduous, occur near top of tree, bracts rarely extend beyond scales ..... **True Firs, p. 17**

Coniferous Tree Descriptions

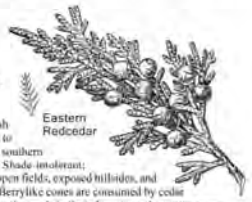
Trees with Scalelike or Awl-shaped Leaves (Cedars, Junipers)

NORTHERN WHITE-CEDAR or arborvitae
(Thuja occidentalis)
Small to medium tree, 25' - 50' (60') tall; columnar to pyramidal crown; trunk often twisted or leaning, fluted, up to 36" diameter. **Leaves:** *Scalelike, aromatic when crushed*, green to yellowish-green. **Twigs:** Yellowish-green to light red, slender, *flattened (forming fanlike sprays)*, very small buds. **Seed cones:** ⅜" - ½" long, *light brown, woody*, 4 outer scales. **Bark:** Reddish-brown with shallow, interconnected fissures and fibrous ridges. **Range:** Native, north-central and northeastern Minnesota; hardy to Zone 3a.



Remarks: Shade-tolerant; slow-growing; moderately long-lived. Typically found in northern swamps where it is an important winter food source for deer and rabbits. Also survives on dry, limestone soils. Live lower branches sprout roots and form new trees when covered by soil or plant litter. Rot-resistant wood often is used for fence posts, roof shingles, and fire-by-friction kits. The name *arborvitae*, meaning "tree of life," is traced to the early French explorer Jacques Cartier whose crew was saved from scurvy by a tea brewed from the tree's vitamin C-rich foliage and twigs.

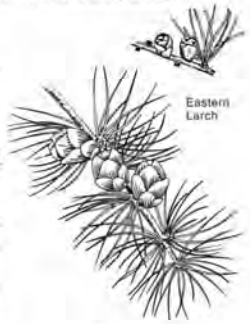
EASTERN REDCEDAR or juniper
(Juniperus virginiana)
Small to medium tree, 25' - 50' tall; columnar to pyramidal crown; trunk up to 24" diameter. **Leaves:** *Scalelike and awl-shaped*, dark green, reddish-brown in winter. **Twigs:** Brown, *4-sided*, slender; buds very small, covered by leaves. **Seed cones:** Round, ⅛" - ¼" diameter, *fleshy (berrylike)*, pale green to dark blue with a whitish film, *matured in one year*. **Bark:** Reddish-brown to gray with narrow, fibrous strips. **Range:** Native, southern half of Minnesota; hardy to Zone 3b. **Remarks:** Shade-intolerant; slow-growing; long-lived. Commonly found in open fields, exposed hillsides, and rocky ledges. Also inhabits low, swampy areas. Berrylike cones are consumed by cedar waxwings and other animals, which then disperse the seeds in their droppings. Aromatic, rose-colored wood is strong, light, and durable; prized for use in cabinets, chests, and pencils.



ROCKY MOUNTAIN JUNIPER *(Juniperus scopulorum)*
Small to medium tree, very similar to eastern redcedar.
Leaves: Scalelike leaves rarely overlap the ones directly above them when mature; do not change color in winter. **Seed cones:** Berrylike cones take two years to mature.
Range: Introduced from the Rocky Mountains; hardy to Zone 3b.

Trees with Needlelike Leaves Grouped in Clusters of 12 or More (Larches)

EASTERN LARCH or tamarack
(Larix laricina)
Medium to large tree, 40' - 70' tall; narrow, pyramidal crown; trunk up to 24" in diameter. **Leaves:** Needlelike, 3-sided in cross section, ½" - 1½" long, *deciduous, borne singly or clustered on wartlike (short) spur shoots in groups of 12 - 30*; soft, light green; yellow in autumn. **Twigs:** Orangish-brown to gray, dark red buds. **Seed cones:** ½" - ¾" long, *usually 12 - 15 scales*. **Bark:** Dark reddish-brown with small scales (flaky appearance); reddish-purple inner bark. **Range:** Native, northern and eastern Minnesota; hardy throughout.



Remarks: Shade-intolerant; moderately fast-growing; moderately short-lived. Common bog species that may develop on soils too mucky to support a person. In shallow muck overlaying hard clay, larch roots often develop a sharp bend or angle. Pioneers used these angled roots in the construction of small boat frames. The hard, durable wood also is used for poles, pulp, and framing houses. Eastern larch is the only deciduous conifer native to Minnesota.

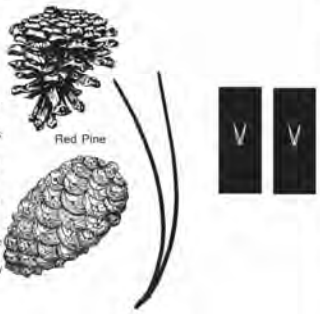
EUROPEAN LARCH *(Larix decidua)*
Large tree. **Leaves:** ½" - 1½" long, borne singly or clustered in groups of 30 - 40. **Twigs:** Yellowish-gray. **Seed cones:** ½" - 1½" long with 40 - 50 hairy scales. **Range:** Introduced from northern and central Europe; hardy to Zone 3a.

SIBERIAN LARCH *(Larix sibirica)*
Large tree. **Leaves:** 1" - 2" long, borne singly or clustered in groups of 30 - 40. **Twigs:** Yellowish-green. **Seed cones:** ¾" - 1½" long with 20 - 30 hairy scales. **Range:** Introduced from Russia; hardy throughout.

JAPANESE LARCH *(Larix kaempferi)*
Large tree. **Leaves:** Can be distinguished from other larches by bluish-green leaves that have two conspicuous white bands below. **Twigs:** Reddish-brown. **Seed cones:** Cone scales curve downward near the tip. **Range:** Introduced from Japan; hardy to Zone 4a.

Trees with Needlelike Leaves Grouped in Bundles of 2 to 5 (Pines)

RED PINE or Norway pine *(Pinus resinosa)*
Large tree, 40' - 60' (100') tall; symmetric, rounded crown with stout, horizontal branches spaced in annual whorls along the trunk; trunk, buttressed when mature, up to 36" diameter. **Leaves:** Needlelike, *4" - 6" long*, 2 per bundle, *break cleanly when bent*, dark green. **Twigs:** Reddish-brown; buds, orangish-brown to reddish-brown, with loose scales. **Seed cone:** 1½" - 2¼" long, *scale tips unarmed*, pairs usually stick on at right angles from branch. **Bark:** *Reddish-brown to gray*, flaky; becoming shallowly furrowed with thin, scaly plates (resembling jigsaw *puzzle* pieces). **Range:** Native, north-central and northeastern Minnesota; hardy throughout. **Remarks:** Shade-intolerant; moderately fast-growing; long-lived; Minnesota's state tree. Important timber tree naturally found on dry, highly acidic, sandy soils. Commonly used in reforestation projects and Christmas tree plantations. Fire dependent; seeds rapidly germinate on exposed soil. Thick bark protects mature trees. Sometimes called "Norway pine," probably because early settlers confused the tree with the Norway spruce of Europe.

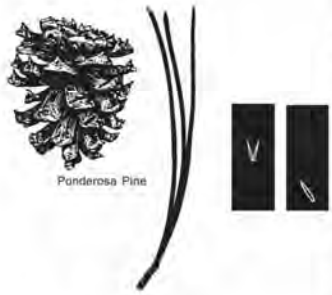


EASTERN WHITE PINE *(Pinus strobus)*
Large tree, 40' - 70' (100') tall; oval or irregular crown with horizontal branches spaced in annual whorls along the trunk (plumelike outline); trunk, buttressed when mature, up to 42" diameter. **Leaves:** Needlelike, 2½" - 5" long, *5 per bundle, soft, flexible*, bluish-green. **Twigs:** Greenish-gray to orangish-brown; buds, reddish or yellowish-brown, pointed tip. **Seed cones:** *4" - 8" long, flexible*, resin-coated scale tips (white). **Bark:** Greenish-gray, smooth; becoming grayish-brown and deeply furrowed with scaly ridges. **Range:** Native, northern and eastern Minnesota; hardy to *Zone 3a*. **Remarks:** Intermediate in shade tolerance; fast-growing; long-lived. Once called the "Monarch of the North," eastern white pine is the largest coniferous tree in Minnesota and was the most important timber species in the United States from about 1700 to 1920. British attempts to control white pine harvesting for use in the Royal Navy contributed to the American Revolution. Reestablishment efforts have been slowed by white pine blister rust (a disease) and heavy deer browsing. Attractive Christmas tree and ornamental species that survives on a wide variety of well-drained sites.

JACK PINE *(Pinus banksiana)*
Medium tree, 25' - 40' (50') tall; spreading, cone-shaped to irregular crown, often containing several dead lower limbs; trunk, often crooked, up to 15" diameter. **Leaves:** Narrowly linear-shaped, *¾" - 1½" long*, 2 per bundle, *widely forked tufts*, often twisted, dark green to yellowish-green. **Twigs:** Reddish- to purplish-brown, scaly; buds, pale brown, resinous, blunt tip. **Seed cones:** 1" - 2" long, *curved toward twig*, open or *closed scales*. **Bark:** Grayish-brown, scaly; becoming blackish- to reddish-gray and shallowly fissured with loose, scaly ridges (rugged appearance). **Range:** Native, northern and eastern Minnesota south along Mississippi River to Winona; hardy in Zone 3a. **Remarks:** Very shade-intolerant; fast-growing when young, then moderate to slow; short-lived. Survives on extremely dry, sterile, sandy soils where other pines perish. Considered a pioneer species, it has resin-closed (serotinous) cones that open and disperse seeds following fire. Trees in some areas produce heavy numbers of serotinous cones while others produce large numbers of open cones. The trait may be related to the fire history of the area.

AUSTRIAN PINE or black pine
(Pinus nigra)
Large tree, 40' - 60' (100') tall; flat- to round-topped crown with stout horizontal branches spaced in whorls along the trunk; trunk, *distinct curves or waves between branch whorls*, up to 36" diameter. **Leaves:** Needlelike, *3" - 6" long*, 2 per bundle, sharply pointed, *very stiff (break cleanly when twisted)*, dark green. **Twigs:** Yellowish- to greenish-brown, fuzzy; buds, *silvery-white*, sharply pointed. **Seed cones:** 2" - 3" long, *scale tips armed with a small spine*. **Bark:** Pinkish-gray to dark gray; becoming deeply fissured with irregular, scaly plates. **Range:** Introduced from central and southern Europe; hardy to Zone 3b. **Remarks:** Shade-intolerant; moderately fast-growing; moderately long-lived. Popular ornamental tree that adapts to urban conditions better than most pines.

PONDEROSA PINE *(Pinus ponderosa)*
Large tree, 40' - 70' (100') tall, may exceed 200' in native range; large, conical or flat-topped crown; trunk up to 48" diameter. **Leaves:** Needlelike, *5" - 8" long, 2 or 3 per bundle (rarely 5), stiff* (difficult to break), dark green. **Twigs:** Orange-brown, turpentine smell when scraped; buds, *reddish, sharply pointed,* usually covered with resin droplets. **Seed cones:** 3" - 6" long, *scale tips armed with a sharp spine.* **Bark:** Grayish-black; becoming reddish-brown and irregularly furrowed with flat, scaly plates. **Range:** Introduced from western North America; hardy to Zone 3b. **Remarks:** Shade-intolerant; moderately fast-growing; long-lived. Most widely distributed pine in North America. Wide variation in hardiness among seed sources.


Ponderosa Pine

SCOTCH PINE or Scots pine
(Pinus sylvestris)
Medium to large tree, 30' - 50' (100') tall; spreading, irregular to rounded crown; trunk up to 24" diameter. **Leaves:** Needlelike, *1½" - 3½" long,* 2 per bundle, *pairs not forked,* twisted, *bluish-green (sometimes silvery).* **Twigs:** Reddish- to orangish-brown, scaly; buds, reddish-brown, pointed. **Seed cones:** 1½" - 2½" long, short-stalked, *tip bent back.* **Bark:** Orangish-brown, flaky; becoming reddish-gray and furrowed with scaly ridges; *bright orange and flaky on upper trunk.* **Range:** Introduced from Europe and Asia; naturalized in Minnesota; hardy to Zone 3a. **Remarks:** Shade-intolerant; moderately fast-growing; moderately long-lived. Attractive ornamental and Christmas tree species that prefers sandy, well-drained soils.


Scotch Pine

MUGO PINE *(Pinus mugo)*
Broad shrub or small tree. **Leaves:** Narrowly linear-shaped, short (1" - 2"), dark green, 2 per bundle. **Seed cones:** ½" - 2½" long, borne flush with twig. **Bark:** Grayish-black. **Range:** Introduced from central and southern Europe; hardy to Zone 3a.

Trees with Four-sided, Needlelike Leaves (Spruces)

BLACK SPRUCE or bog spruce
(Picea mariana)
Small to medium tree, 25' - 30' (50') tall; slender, pyramidal crown, often with dead lower branches; trunk up to 12" diameter. **Leaves:** Needlelike, ½" - ¾" long, blunt tips, blue-green. **Twigs:** *Reddish-brown with scattered reddish hairs,* rough leaf scars; buds, reddish brown, *extended scale tips.* **Seed cones:** Egg-shaped to *nearly round, ½" - 1½" long, purple* (brown when ripe), irregularly toothed scale margins, open or closed scales. **Bark:** Grayish- to reddish-brown, thin, flaky scales, olive-green inner bark. **Range:** Native, north-central and northeastern Minnesota; hardy throughout. **Remarks:** Shade-tolerant; moderately slow-growing; moderately long-lived. Common marsh or bog species that often relies on fire to open seed cones and expose mineral soil. Live lower branches sprout roots and form new trees when covered by soil or plant litter. Twigs and leaves once used to brew spruce beer. Transcontinental range, reaching north to the limit of tree growth in Canada and Alaska.


Black Spruce

WHITE SPRUCE or skunk spruce
(Picea glauca)
Large tree, 40' - 60' (100') tall; dense, pyramidal crown; trunk up to 24" diameter. **Leaves:** Needlelike, ½" - ¾" *long (rarely ⅓"), blunt tips, skunklike smell when crushed,* dark bluish-green. **Twigs:** *Orangish-brown to gray, hairless,* rough needle scars; buds, light brown, pointed scales. **Seed cones:** *1½" - 2½" long,* brown, smooth scale margins. **Bark:** Reddish-brown to gray, flaky scales, silvery inner bark. **Range:** Native, northeastern Minnesota; hardy throughout. **Remarks:** Shade-tolerant; moderately slow-growing; moderately long-lived. Bog species also found along streams, rivers, and lakes. Fibrous roots of white spruce and eastern larch were used by American Indians to lace together birchbark canoes and baskets. Principal pulpwood and sawtimber species in Canada. Valuable wildlife habitat, Christmas tree, and shelterbelt species in Minnesota. Transcontinental range reaches north to the limit of tree growth in Canada and Alaska. Black Hills spruce (*Picea glauca* var. *densata*) is among the most commonly planted varieties of white spruce. The variety is desired for its dense, cone-shaped crown of bright bluish-green foliage and drought tolerance.


White Spruce

COLORADO SPRUCE or blue spruce
(Picea pungens)
Medium to large tree, 30' - 60' tall; dense, pyramidal crown often reaching the ground in open areas; trunk, often forked, up to 36" diameter. **Leaves:** Needlelike, ½" - 1½" *long, very sharp tips*, variable color (green to *bluish-green or silver-blue*). **Twigs:** Orangish-brown to light brown, rough leaf scars; buds, yellowish-brown, curled scale tips.
Seed cones: 2" - 4" *long, straw-colored, papery scales with irregularly toothed margins*. **Bark:** Grayish-brown, flaky scales, becoming deeply furrowed. **Range:** Introduced from central and southern Rocky Mountains; hardy to Zone 3a. **Remarks:** Shade-tolerant, slow-growing, long-lived. Heavily planted ornamental, Christmas tree, and shelterbelt species that prefers moist, well-drained soils. Fairly drought resistant. Mature trees often are disfigured or killed by cytospora canker or rhizosphaera needlecast fungi.


Colorado Spruce

NORWAY SPRUCE *(Picea abies)*
Large tree, 40' - 65' (100') tall; spreading, pyramidal crown with *drooping or weeping lower branchlets*, trunk up to 36" diameter.
Leaves: Needlelike, ½" - 1" long, *balsam-smell when crushed, slightly pointed tips, shiny, deep green*. **Twigs:** Reddish- to orangish-brown, rough leaf scars; buds, orangish- to reddish-brown, spreading scales. **Seed cones:** 4" - 7" *long*, brown, *stiff scales* with fine, irregularly toothed margins.
Bark: Reddish- to grayish-brown, flaky scales. **Range:** Introduced from northern and central Europe; hardy to Zone 3b.
Remarks: Shade-tolerant; moderately fast-growing; long-lived. Widely planted ornamental and shelterbelt tree that does best on moist, cool, slightly acidic soils. Wide variation in traits among varieties.


Norway Spruce

Trees with Linear-shaped (Flattened) Leaves (Hemlock, Douglas-fir, True Firs)

CANADIAN HEMLOCK or eastern hemlock
(Tsuga canadensis)
Medium to large tree, 40' - 60' tall; large, pyramidal crown, *drooping terminal leader* straightens out during the growing season; trunk up to 36" diameter. **Leaves:** Linear-shaped, ½" - ¾" *long, fine irregularly toothed margins, borne on pulvinus projections*, dark yellowish-green (two white lines below). **Twigs:** Light brown to grayish-brown with *rough, reddish-brown leaf scars*; buds, small and reddish brown.
Seed cones: Oval or round, ½" - ¾" long, borne at twig ends. **Bark:** Reddish- to purplish-brown, scaly; becoming deeply furrowed with scaly ridges, *inner bark with purplish layers*.
Range: Native; rare and localized; Carlton, St. Louis, and Aitkin counties; hardy to Zone 3b.
Remarks: Very shade-tolerant; moderate-growing; very long-lived. Bark rich in tannic acids used by pioneers to tan hides. Foliage and twigs may be used to brew a tea (don't worry—not the same hemlock as the poisonous herb Socrates used to brew his final drink!). Few plants survive beneath a mature hemlock's dense foliage or in the highly acidic soil created by its fallen needles.


Canadian Hemlock

DOUGLAS-FIR or Oregon-pine
(Pseudotsuga menziesii)
Medium to large tree, 40' - 70' tall, may exceed 300' in native range; dense, pyramidal crown; trunk up to 24" diameter. **Leaves:** Linear-shaped, ½"–1½" long, *borne on slightly raised cushions*, yellow-green to blue-green (two white lines below).
Twigs: Reddish-brown to pale brown with *whitish leaf scars*; buds, reddish-brown, *shiny, sharply pointed*. **Seed cones:** 2" - 4" long, *fuzzlike bracts extend beyond cone scales*. **Bark:** Gray-brown, smooth with scattered resin blisters; becoming reddish-brown and deeply furrowed. **Range:** Introduced from Rocky Mountains and Pacific Coast (coastal sources not hardy in Minnesota); hardy to Zone 3b. **Remarks:** Moderately shade-tolerant; fast-growing; long-lived. Principal timber species in United States. Excellent Christmas tree and ornamental species when not grown in dry, windy areas.


Douglas-fir

BALSAM FIR (*Abies balsamea*)
Medium tree, 40' - 75' tall; narrow, pyramidal crown; trunk up to 18" diameter. **Leaves:** Linear-shaped, ½" - 1" long, shiny green (two silvery lines below). **Twigs:** Grayish, smooth, circular leaf scars; buds, yellowish-brown, blunt, *sticky, clustered*. **Seed cones:** 2" - 4" long, erect, borne near top of tree; *cone scales fall off, leaving a persistent candlelike central stalk*, purple to purplish-brown.
Bark: Light gray with *numerous blisters (pitch pockets)*, smooth; becoming reddish-brown and scaly.
Range: Native, northeastern and southeastern Minnesota; hardy to Zone 3a (grows best in native range).
Remarks: Very shade-tolerant; slow-growing; intermediate-lived. Popular Christmas tree that has excellent needle retention and aroma. Resins collected from trunk blisters formerly used for mounting specimens on microscope slides, cementing lenses, making varnishes, and sealing birchbark canoes. Typically found in moist, shaded forests.

Balsam Fir

FRASER FIR (*Abies fraseri*)
Medium tree; very similar to balsam fir.
Seed cones: Yellowish-green bracts extending beyond the cone scales and curling downward. **Range:** Introduced from the Smoky Mountains; hardy to Zone 4a.
Remarks: Considered the Cadillac of Christmas trees, but not always winter hardy in Minnesota.

Fraser Fir

WHITE FIR (*Abies concolor*)
Medium tree. **Leaves:** Linear-shaped, 2" - 3" long, silvery blue to silvery green, distinctly curved upward. **Range:** Introduced from western United States; hardy to Zone 4a.

Section Three:
DECIDUOUS TREES

So your tree is deciduous! It belongs to one of the most highly developed and diverse group of plants living today, the flowering plants. In tropical regions of the world flowering trees often retain their leaves year-round (evergreen), but here in Minnesota all of our flowering trees lose their leaves in autumn (deciduous).

Identifying Deciduous Trees

Most deciduous trees can be identified in summer by their leaves alone, with twigs, fruits, and bark as added clues to their identification. In winter, when deciduous trees have lost their leaves, we must identify them by twigs, buds, bark, and in some cases, fruits. The previous year's dead leaves also can help confirm your winter identification. They often can be found on the branches or on the ground directly below the tree.

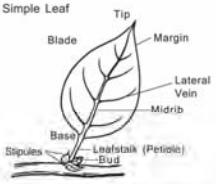
Regardless of the season, begin by examining the arrangement of leaves or leaf scars on the branches or twigs. Determine if the arrangement is whorled, opposite, or alternate (Figure 5). Whorled trees have three (or more) leaves or leaf scars attached to the branches at the same distance from the end; opposite trees have two; and alternate trees have only one. If you cannot reach branches, examine the arrangement of twigs on the branches; this will follow the same pattern as the leaves. Sometimes a twig breaks off or fails to develop, so be sure to look at several areas of the tree.

After examining the tree's leaf or branch arrangement, look at the tree's leaves, or, if it's winter, look at its buds, twigs, bark, and fruits.

Leaves

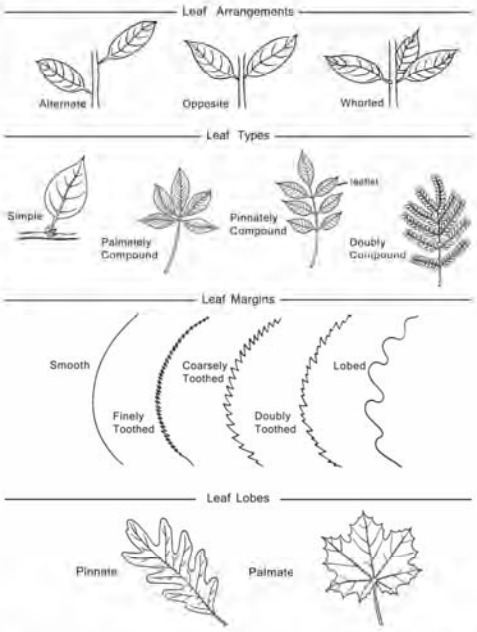
If leaves are present, check to see if they are simple or compound (Figure 5) by following a leaf from its tip to the base of the leafstalk. If you find a distinct swelling at its base and a bud, it is a simple leaf. (You will need to pick off the leaf since some trees have hidden buds.) You will not find buds at the base of *leaflet stalks* on compound leaves.

If the leaf is compound, count the number of leaflets and examine its pattern to determine if it is palmately compound, pinnately compound, or doubly compound. One tree, honeylocust, will have both pinnately compound and doubly compound leaves.



Next, examine the shape and features of the leaf or leaflet. Determine if the margins (edges) of the leaf or leaflet are smooth, toothed, lobed, or some combination (Figure 5). Most deciduous trees in Minnesota will have toothed leaf margins. Some have doubly toothed margins where you will see both long and short teeth. Trees with lobed leaves often will have a distinct pattern, such as pinnately lobed or palmately lobed (Figure 5).

Figure 5. Leaf characteristics.



Branches, Twigs, and Buds

Branches, twigs, and buds tend to offer the best winter identification clues because, unlike fruits, they are consistently available.

Branches are composed of several years' growth. Twigs are at the ends of branches and represent the newest growth. They can be identified by locating the end of a branch and tracing it back (usually 6 to 12 inches) to a series of encircling scars left by the previous years' bud scales. Branchlets are older sections of branch with a diameter similar to the twigs.

Twigs vary in size, shape, and other characteristics. Walnuts and ashes have stout twigs, while birches and ironwood have slender twigs. When some twigs are broken or scraped, they have a distinct odor—for example, the disagreeable odor of boxelder, the pleasant wintergreen odor of yellow birch, and the bitter almond smell of cherries and plums. Odor can be an excellent identification characteristic, but it can be lost or greatly reduced in cold weather.

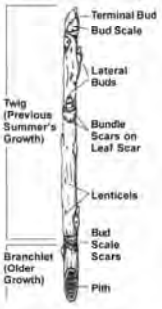
Some twigs or branchlets are armed with spines or thorns, or have prominent stubby, spur shoots (Figure 6). Spur shoots are dwarf branchlets that grow very slowly but retain the same number of leaves as normal (long) branchlets, resulting in a stubby, wartlike appearance. Other twigs exude a milky sap when broken. Still others have a very distinctive pith (core) color or cross-sectional shape that can be examined when cut with a knife (Figure 6). The pith on most trees will be solid throughout, but walnuts and huckleberries have a chambered pith in which the tissue has hollow pockets between narrow plates.

Features such as lenticels and bundle scars can be very useful but often can only be observed with a magnifying glass. Lenticels are small pores on the twigs or bark that appear as dots of various sizes and shapes. Some trees (e.g., birches and cherries) have very prominent, horizontally elongated lenticels. Bundle scars are the sealed ends of vascular tissues that once transported water and nutrients to and from the leaf. Bundle scars will appears as dots of various sizes and shapes on a leaf scar. Most trees have three prominent bundle scars, but some have numerous scars that are scattered or arranged in distinct patterns.

Buds are immature twigs bearing leaves, flowers, or both (Figure 6). The buds on most Minnesota trees are covered with scales to protect the immature tissues from damage (e.g., insects, drying). Buds forming along the sides of the twig or branchlet are called lateral buds, while those at the end of a twig are called terminal buds. Some trees have true terminal buds (e.g., hickories, maples, ashes), while others have false or absent terminal buds (e.g., linden, elms, birches). False terminal buds are a little below and to the side of a leaf scar on the end of the twig.

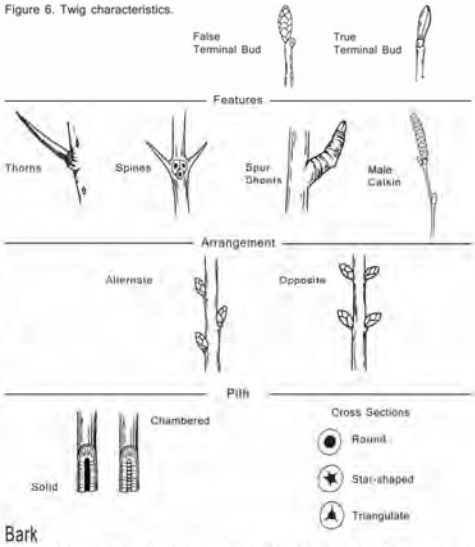
The color, size, and shape of buds offer important clues for identifying most tree species. For example, a slender, bright yellow bud easily identifies bitternut hickory, while a sharply pointed, sticky, aromatic bud identifies balsam poplar.

Some twigs have slender, cigar-shaped male catkins (flowers) that are present in winter (Figure 6). Catkins are compact flowering structures composed of several inconspicuous flowers surrounding an elongated axis. The term *catkin* also is used to describe the grouped arrangement of some fruits (Figure 7).



Twig Characteristics

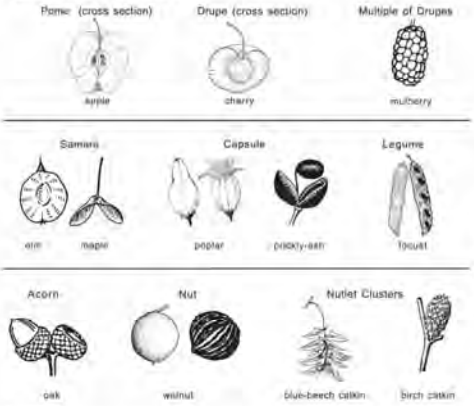
Figure 6. Twig characteristics.



Bark

Bark is the outer protective layer on the main trunk of a tree. Bark varies widely among species in texture and color. For example, black cherry has a black, scaly bark that looks like burned potato chips; bur oak has a thick, deeply furrowed bark; bitternut hickory has a smooth, shallowly fissured bark with interlacing ridges (like chains); paper birch has a thin, papery, curling bark; and a shallow cut into black oak reveals a bright yellow or orange inner bark. Bark is extremely difficult to describe and illustrate, but with experience you will quickly discover its identification value. This especially is true for large trees in which leaves and twigs are not easily accessible.

Figure 7. Fruits of Minnesota trees.



Fruits

Deciduous trees vary in fruit size, shape, and color (Figure 7). Fruits of Minnesota trees include legumes, samaras, acorns, nuts, nutlets, capsules, pomes, and drupes.

Fleshy fruits that do not split to release their seeds include the *drupe*, which has a thin coat protecting a fleshy, often juicy, middle usually containing one seed surrounded by a very hard cover (e.g., cherries, plums); and the *pome*, which has a leathery or hard core containing several seeds (e.g., apples, hawthorns). *Nuts* are single-seeded fruits with hard shells (e.g., walnuts, hickories). *Nutlets* are similar to nuts, but much smaller (e.g., birches, ironwood, blue-beech). *Acorns*, another type of nut, have a moderately hard shell that is partially enclosed by a scaly or warty cup (e.g., oaks). *Samaras* also contain a single seed, but it is attached to a thin, papery wing (e.g., maples, ashes, elms). *Capsules* are dry pods containing two or more chambers that split along sutures to release their seeds (e.g., willows, poplars). *Legumes* are dry, beanlike fruits that split along two sutures (e.g., locusts).

Fruits may occur singly, in close clusters (e.g., birch) or in fused multiples (e.g., mulberry). Persistent fruits are extremely helpful for winter identification.

Words of Caution: Poison Ivy and Poison Sumac

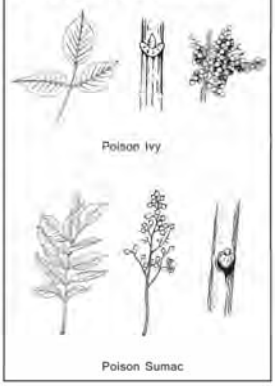
Every outdoor activity has a few safety concerns, and tree identification is no exception. Before learning to identify deciduous trees, you should know how to identify two plants that are poisonous to touch (even in winter) — poison ivy *(Rhus radicans)* and poison sumac *(Rhus vernix)* (Figure 8). Both have alternate arrangements and compound leaves.

Poison ivy commonly is found in open forests, pastures, fence rows, thickets, and dry, rocky fields. It may occur as a herbaceous plant, vine, or upright shrub. It usually has three leaflets with smooth or wavy-lobed margins. The fruit is a green to grayish-white drupe appearing late in summer. Poison ivy has brownish twigs that are covered with conspicuous dots (lenticels) and large, *V*- or *U*-shaped leaf scars with numerous bundle scars. The main stem may be quite stout and will be covered with numerous hairlike aerial roots.

Poison sumac most commonly is found in swamps and bogs of southeastern and east-central Minnesota. It usually occurs as a shrub or small tree, 5 to 25 feet tall. Its leaves have 7 to 13 leaflets arranged in pairs with a single end leaflet. The leaflets are dark green and shiny with smooth margins. The fruit is a green to ivory-white drupe grouped in loose clusters that may be 10 to 12 inches long. Twigs are moderately stout, yellowish-brown and covered with conspicuous dark dots or blotches.

Touching these plants causes painful skin irritations (redness, swelling, blisters, itching). If you come in contact with poison ivy or poison sumac, immediately wash infected areas with soap and water to remove excess poison. Symptoms usually appear within 24 hours. Contact your doctor or pharmacist for treatment advice.

Figure 8. Poison ivy and poison sumac.



Key to Deciduous Trees with Leaves

(if leaves are absent, see page 75)

1a. Leaves opposite or whorled.
- 2a. Leaves compound.
  - 3a. Leaves pinnately compound.
    - 4a. Fruit a single samara or drupe; leaflets 5 - 13, smooth or finely toothed margins, nearly uniform in shape; twigs not covered with whitish film
      - 5a. Twigs green, gray, purple, or light brown; leaf scars shield-shaped, not encircling buds; fruit a samara ..... **Ashes, p. 30-31**
      - 5b. Twigs orangish-yellow or yellowish-gray; leaf scars horseshoe-shaped, nearly to entirely encircling bud; fruit a drupe; turpentine smell when crushed ..... **Cork-tree, p. 32**
    - 4b. Fruit a double samara; leaflets 3 - 5 (rarely 7), margins toothed or 3-lobed, often irregular in shape; twigs covered with whitish film (easily rubbed off) ..... **Boxelder, p. 32**
  - 3b. Leaves palmately compound ..... **Buckeye, p. 33**
- 2b. Leaves simple.
  - 6a. Leaf margins palmately lobed or doubly toothed; fruit a samara ..... **Maples, p. 34-37**
  - 6b. Leaf margins smooth or singly toothed; fruit a capsule or drupe.
    - 7a. Fruit a cigar-shaped capsule 8" - 18" long; leaves heart-shaped, 6" - 12" long, often whorled in groups of 3 ..... **Catalpa, p. 38**
    - 7b. Fruit a drupe or a 4-celled capsule; leaves not heart-shaped less than 6" long, always opposite.
      - 8a. Twig tips often armed with a small spine; leaves sometimes alternate near twig ends ..... **Buckthorn, p. 38**
      - 8b. Twig tips not armed with spines; leaves always opposite.
        - 9a. Twigs or branchlets with 4 corky lines or wings; fruit a 4-celled capsule ..... **Wahoo, p. 39**
        - 9b. Twigs or branchlets without corky lines or wings; fruit a drupe.
          - 10a. Leaf margins finely toothed, lateral veins terminate near margins; leafstalk winged or grooved ..... **Nannyberry, p. 39**
          - 10b. Leaf margins smooth, lateral veins nearly parallel leaf margins; leafstalk nearly round **Dogwood, p. 73**

1b. Leaves alternate, never opposite or whorled.
- 11a. Leaves compound.
  - 12a. Leaves doubly compound or pinnately compound and doubly compound.
    - 13a. Twigs stout, pith salmon-colored; leaves doubly compound, up to 36" long; leaflets 1" - 3" long; thornless ..... **Coffeetree, p. 40**
    - 13b. Twigs slender, pith white; leaves pinnately compound and doubly compound; leaflets ¾" - 1¼" long; often thorny **Honeylocust, p. 41**
  - 12b. Leaves pinnately compound, never doubly compound.

(continued on next page)

- 14a. Branchlets (or twigs) armed with sharp spines paired at the leaf scars.
  - 15a. Leaves have lemonlike smell when crushed; fruit a capsule; bark fairly smooth ..... **Prickly-ash, p. 42**
  - 15b. Leaves not lemon smelling; fruit a legume; bark deeply furrowed ..... **Black Locust, p. 42**
- 14b. Branchlets (or twigs) not armed with spines.
  - 16a. Fruit a husked nut; bark usually rough with inconspicuous lenticels.
    - 17a. Twig pith solid, 5 - 11 leaflets; nut smooth, husk splits into 4 segments ..... **Hickories, p. 43-44**
    - 17b. Twig pith chambered; 14 - 23 leaflets; nut rough, husk not split into segments ..... **Walnuts, p. 44-45**
  - 16b. Fruit fleshy, orange or red; trunk bark smooth with conspicuous horizontal lines or raised dots (lenticels).
    - 18a. Twig and leaf sap clear; fruit a pome ..... **Mountain-ashes, p. 46-47**
    - 18b. Twig and leaf sap milky; fruit a cone-shaped multiple of drupes, covered with numerous hairs ..... **Sumacs, p. 47**

11b. Leaves simple.
- 19a. Leaves fan-shaped with parallel veins, often notched at the tip ..... **Ginkgo, p. 48**
- 19b. Leaves not fan-shaped.
  - 20a. Leaf margins lobed or notched.
    - 21a. Branchlets (or twigs) do not have thorns or thornlike shoots; fruit not a pome
      - 22a. Leaves pinnately lobed; buds clustered at twig ends; fruit an acorn.
        - 23a. Lobes often rounded (rarely pointed), without bristle tips ..... **White Oak Group, p. 49-51**
        - 23b. Lobes pointed with bristle tips . **Red Oak Group, p. 52-53**
      - 22b. Leaves palmately lobed or irregularly lobed; buds not clustered at twig ends; fruit not an acorn.
        - 24a. Fruit a capsule; leaves white and very fuzzy below, sap clear ..... **White Poplar, p. 54**
        - 24b. Fruit a multiple of drupes; leaves smooth or hairy below, sap milky ..... **Mulberries, p. 54**
    - 21b. Branchlets (or twigs) armed with thorns or thornlike shoots; fruit a pome.
      - 25a. Thorns smooth, very sharp; pome core hard; spurshoots absent on branchlets ..... **Hawthorn, p. 55**
      - 25b. Thorns rough with buds or leaves often attached; pome core leathery or papery; numerous spur shoots on branchlets ..... **Apples, Pears, p. 55-56**
  - 20b. Leaf margins toothed or smooth, never lobed.

26a. Leaf margins doubly toothed.
27a. Branchlets or trunk armed with thorns.
28a. Thorns smooth without buds or leaves attached, very sharp; spur shoots absent ..... **Hawthorn, p. 55**
28b. Thorns rough with buds or leaves often attached; stubby spur shoots present.
29a. Fruit a drupe; twigs with a bitter almond smell or taste when broken; thorns less than 1" long ..... **Plums, p. 56**
29b. Fruit a pome; twigs lack bitter smell or taste; thorns often greater than 1" long ..... **Apples, Pears, p. 55-56**
27b. Branchlets or trunk not armed with thorns.
30a. Leaf base distinctly lopsided (uneven); fruit a waferlike samara ..... **Elms, p. 57-58**
30b. Leaf base not lopsided (nearly even); fruit a nutlet.
31a. Nutlets grouped in a nonwoody catkin (often absent), slender male catkins also may be present; leaves papery; buds covered with 3 or more overlapping scales.
32a. Trunk bark marked with dark horizontal lines (lenticels), usually peeling in papery strips; leaves attached to branchlets or twigs in 5 rows or more ..... **Birches, p. 59-61**
32b. Trunk bark not marked with dark lines, smooth or peeling in vertical strips; leaves attached to branchlets or twigs in 2 parallel rows.
33a. Trunk grayish-brown, scaly or peeling in vertical strips, nearly round in cross section; nutlet enclosed in an inflated papery sac ..... **Ironwood, p. 62**
33b. Trunk gray, smooth with musclelike ridges, fluted in cross section; nutlet attached to 3-lobed, leaflike bract ..... **Blue-beech, p. 63**
31b. Nutlets grouped in a woody, pineconelike catkin (often present), slender male catkins also may be present; leaves leathery; buds covered with 2 (or 3) outer scales meeting at their edges ..... **Alder, p. 63**
26b. Leaf margins singly toothed or smooth, never doubly toothed.
34a. Leaf and twig sap milky; fruit a joined multiple of drupes ..... **Mulberries, p. 54**
34b. Leaf and twig sap clear; fruit not a joined multiple.

(continued on next page)

35a. Leaf base distinctly lopsided (uneven), heart-shaped.
36a. Leaves 2" - 7" long, nearly as wide; trunk bark smooth or vertically fissured with smooth ridges; fruit stalk attached to a leaflike wing ..... **Lindens, p. 64**
36b. Leaves 2" - 5" long, about half as wide; trunk bark smooth with corky warts or raised ridges; fruit stalk attached to twig ..... **Hackberry, p. 65**
35b. Leaf base nearly symmetric (even), rarely heart-shaped.
37a. Leaves 3 times (or more) as long as wide (not including leafstalk).
38a. Twigs silvery, often thorny; leaves grayish-green above, silvery and scaly below; margins nearly smooth ..... **Russian-olive, p. 65**
38b. Twigs not silvery; thornless; leaves green above, not silvery or scaly below.
39a. Branchlets often brittle at base, pith star-shaped in cross section, smell unlike bitter almonds when broken; buds covered by single scale (or sheath) ..... **Willows, p. 66-67**
39b. Branchlets firm at base, pith nearly round in cross section, bitter almond smell when broken; buds covered with several overlapping scales ..... **Cherries, p. 68-69**
37b. Leaves less than 3 times as long as wide (not including leafstalk).
40a. Twigs distinct bitter almond smell when broken ..... **Cherries, p. 68-69**
40b. Twigs smell unlike bitter almond.
41a. Leaves often thick and waxy, leafstalk often flattened; twig pith star-shaped in cross section; buds often sticky, lowest scale on lateral buds centered directly over leafstalk; fruit a capsule ..... **Poplars, p. 70-72**
41b. Leaves thin and smooth, leaf stalk round; twig pith round in cross section, buds not sticky, lowest scale of lateral buds not centered over leafstalk; fruit not a capsule.

42a. Leaves clustered at ends of upturned twigs, margins smooth, lateral veins nearly parallel margins; fruit a drupe
..... **Alternate-leaf Dogwood, p. 73**

42b. Leaves not clustered at ends of upturned twigs, margins finely toothed, lateral veins terminate near margins; fruit a pome.

43a. Branchlets with scattered short, stubby spur shoots; trunk or large branches gray to reddish-brown, scaly
..... **Apples, Pears, p. 55-56**

43b. Branchlets without spur shoots; trunk and large branches gray or brown, marked with vertical stripes
..... **Serviceberries, p. 74**

Deciduous Tree Descriptions

Opposite-branching Trees with Pinnately Compound Leaves (Ashes, Boxelder, Cork-tree)

BLACK ASH *(Fraxinus nigra)*
Medium tree, 30' - 50' (80') tall; narrow, rounded crown of upright branches; trunk often leaning or crooked, up to 18" diameter. **Leaves:** Opposite, pinnately compound, 9" - 16" long; *leaflets 7 - 11 (lush with leaflets)*, 4" - 5½" long, 1" - 2" wide, finely toothed margins, light yellowish-green; yellow to brown in autumn. **Twigs:** Light green to gray with *light brown dots (lenticels)*; blunt, blackish-black buds. **Fruit:** Samara, 1" - 1½" long, *blunt at both ends, notched wing tip*, mature in late summer. **Bark:** Light gray with orangish streaks, smooth; becoming scaly or corky (rubs off easily). **Range:** Native, eastern and northern Minnesota; hardy to Zone 3a. **Remarks:** Moderately shade-intolerant; moderately slow-growing; moderately short-lived. Common bottomland species found in deciduous floodplain forests and borders of coniferous swamps and bogs. Sometimes called hoop ash because when pounded, the green wood splits along annual growth rings into tough, flexible strips. American Indians used these strips to construct baskets, mats, and fish traps.

GREEN ASH or red ash *(Fraxinus pennsylvanica)*
Medium tree, 40' - 60' tall; dense, rounded or irregular crown of upright branches; trunk up to 24" diameter. **Leaves:** Opposite, pinnately compound, 6" - 12" long; *leaflets, 5 - 9 (usually 7)*, 2½" - 5" long, 1" - 1½" wide, *leaflet stalk narrowly winged*, toothed or smooth margins, yellowish-green; yellow in autumn. **Twigs:** Greenish-gray to reddish-brown with light-colored dots (lenticels), *often hairy, leaf scars straight or slightly notched at top*; reddish-brown to dark brown buds. **Fruit:** Samara, 1" - 2" long, *notched or pointed wing tip*, mature in early autumn. **Bark:** Brown to dark gray, smooth or slightly flaky; becoming deeply furrowed with narrow, interlacing ridges (diamond-shaped appearance). **Range:** Native and hardy throughout Minnesota. **Remarks:** Moderately shade-tolerant, fast-growing, moderately long-lived. Naturally found in wet lowland forests, but tolerant of dry site conditions. Extensively planted urban shade tree; also used in farm shelterbelts and field windbreaks. Hard, tough wood used for interior trim, oars, baseball bats, tennis rackets, tool handles, furniture, and snowshoes.

WHITE ASH *(Fraxinus americana)*
Large tree, 40' - 70' tall; dense, rounded to pyramidal crown; trunk up to 24" diameter. **Leaves:** Opposite, pinnately compound, 8" - 12" long; *leaflets, 5 - 9 (usually 7), 2½" - 5" long, 1" - 2" wide, toothed or smooth margins, dark green (distinctly paler or white below)*; yellow or purple in autumn. **Twigs:** Green or purplish with *scattered white dots (lenticels), leaf scars deeply notched or U-shaped at the top*, dark brown buds. **Fruit:** Samara, 1" - 2" long, *notched or rounded wing tip*, mature in late summer. **Bark:** Greenish-gray; becoming dark gray, deeply furrowed with narrow, interlacing ridges (diamond-shaped appearance). **Range:** Native, scattered and rare, southeastern and east-central Minnesota; hardy to Zone 4a. **Remarks:** Intermediate in shade tolerance; moderately fast-growing; moderately long-lived. Similar to green ash, but naturally found in dry upland forests and moist, well-drained forests. Like all ashes, white ash sprouts vigorously from the trunk when injured.

BOXELDER or Canadian maple
(Acer negundo)
Medium tree, 30' - 50' tall, broad, rounded crown; trunk often divided low, up to 36" diameter. **Leaves:** Opposite, pinnately compound, 4" - 9" long; *leaflets, 3 - 5 (rarely 7 - 9), 2" - 4" long, 1" - 2½" wide*, irregularly toothed margins *(often 3-lobed)*, pale green; yellow in autumn. **Twigs:** *Green to purple with a whitish film (rubs off easily), very smooth, disagreeable odor when broken*; buds, white with reddish scales (usually 4), fuzzy. **Fruit:** Samara, 1" - 1½" long, V-shaped pairs, mature in autumn. **Bark:** Yellowish-tan to grayish-brown, blocky; becoming deeply furrowed with irregular troughs and warty ridges. **Range:** Native and hardy throughout Minnesota, but scattered or absent in northeast. **Remarks:** Shade-tolerant; fast-growing; moderately short-lived. Commonly found in floodplains and disturbed sites. Hardy ornamental that survives in extreme site conditions, but subject to limb breakage. Female trees often attacked by annoying boxelder bugs. Occasionally used for maple syrup.

AMUR CORK-TREE
(Phellodendron amurense)
Medium tree, 30' - 50' tall, broad, rounded crown with low spreading branches; trunk up to 24" diameter. **Leaves:** Opposite; pinnately compound; 6" - 12" long; *leaflets, 5 - 13, oval, long pointed tips, 2" - 4" long, smooth margins, aromatic when crushed*, shiny dark green; yellow in autumn. **Twigs:** *Orangish-yellow to yellowish-gray, horseshoe-shaped leaf scars nearly to entirely encircling buds*, velvety buds. **Fruit:** *Drupe*, ½" diameter, black, drupes grouped in 2" - 8" long clusters, *5-seeded, turpentine odor when crushed*, mature in autumn. **Bark:** Light gray, *soft, corky*, becoming deeply fissured. **Range:** Introduced from northern China; hardy to Zone 3b. **Remarks:** Moderately shade-intolerant; moderate-growing; moderately long-lived. Attractive ornamental tree that prefers moist, well-drained soils.

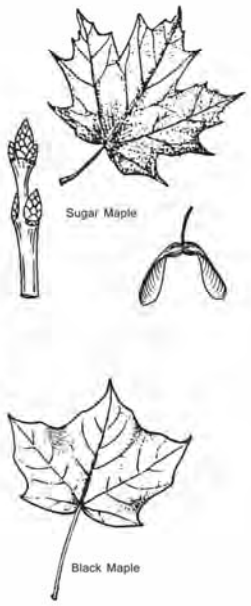
Opposite-branching Trees with Palmately Compound Leaves (Buckeye)

OHIO BUCKEYE *(Aesculus glabra)*
Small to medium tree, 20'- 40' tall; broad, rounded crown; trunk up to 24" diameter. **Leaves:** Opposite, *palmately compound*, 4" - 15" long; leaflets, 5 (rarely 7), 3" - 6" long, 1"- 2½" wide, fine irregularly toothed margins, yellowish-green; orange, or yellow in autumn. **Twigs:** Reddish-brown to ashy-gray, stout, *disagreeable odor when broken*, shield-shaped leaf scars; *terminal buds*, ½"- ¾" *long, reddish-brown, scales fidged down the center* **Fruit:** Capsule, 1" - 2" diameter; round or *pear-shaped, prickly or warty husk, containing 1 - 2 brown seeds with white caps*, mature in mid-autumn. **Bark:** Ash-gray, smooth; becoming deeply furrowed with thick, scaly plates (alligator hide appearance). **Range:** Introduced from east-central United States, hardy to Zone 3b. **Remarks:** Intermediate in shade tolerance, moderately slow-growing, moderately long-lived. Ornamental tree with attractive autumn foliage. Some superstitious people carry buckeye seeds in their pockets to ward off rheumatism or to bring good luck.

Opposite-branching Trees with Simple, Palmately Lobed or Doubly Toothed Leaves (Maples)

SUGAR MAPLE or hard maple
(Acer saccharum)
Large tree, 40' - 70' (80') tall; broad, round or oval crown; trunk up to 36" diameter. **Leaves:** Opposite, simple, 3½" - 5½" long, nearly as wide, palmately lobed; *lobes 5 (rarely 3), rounded crotches, smooth or wavy margins*; light green; yellow, orange, or deep red in autumn. **Twigs:** Reddish-brown to gray with scattered whitish dots (lenticels); buds, *reddish-brown to dark brown, cone-shaped, pointed tip, numerous scales*. **Fruit:** Samara, ¾"- 1¼" long, U-shaped pairs with nearly parallel wings, mature in autumn. **Bark:** Light gray, smooth or warty, becoming dark gray to nearly black with deep, irregular furrows and narrow plates that curl at the edges, sometimes scaly. **Range:** Native, eastern Minnesota; hardy to Zone 3b. **Remarks:** Very shade-tolerant; slow-growing, long-lived. Attractive, widely planted ornamental tree naturally found on moist, fertile soils. Primary source of maple syrup and maple sugar. Principal timber species; its hard, closely grained, light brown wood is used in furniture, flooring, cabinets, cutting boards, veneer, and musical instruments. Occasionally develops unique wood grain pattern known as bird's eye, curly, tiger, or blister maple.

BLACK MAPLE *(Acer nigrum)*
Large tree, nearly identical to sugar maple. **Leaves:** 3-lobed (rarely 5), smooth or wavy margins, abruptly pointed lobes, drooping sides, dark green. **Range:** Native, southeastern and south-central Minnesota; hardy to Zone 4a.

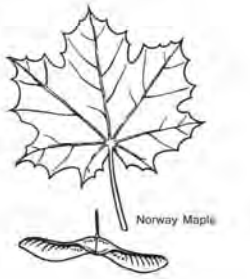


RED MAPLE *or* soft maple *(Acer rubrum)*
Medium to large tree, 40'- 70' tall; dense, rounded crown; trunk up to 24" diameter. **Leaves:** Opposite, simple, 2½" - 4" long, nearly as wide, palmately lobed; *lobes, 3 or 5 (usually 3), relatively shallow crotches (often pointed), doubly toothed margins;* light green; scarlet red, orange, or yellow in autumn; red leafstalk. **Twigs:** Bright red to reddish-brown with white dots (lenticels); buds, green or dark red, blunt.
Fruit: Samara, ½" - 1" long, U-shaped pairs with slightly divergent wings, mature in spring.
Bark: Silvery gray, smooth, scaly limb scars; breaking up into *large, vertical strips with scaly ridges*
Range: Native and hardy throughout Minnesota except along western and southern border. **Remarks:** Intermediate in shade-tolerance; moderately fast-growing; moderately long-lived. Attractive, hardy tree found on a broad range of site conditions. Tannins boiled from the bark formerly used to produce inks and cinnamon-colored dyes. Important ornamental species that also is sometimes used for maple syrup. Common name, red maple, is based on the color of the tree's flowers, not on its leaves.

SILVER MAPLE *or* soft maple *(Acer saccharinum)*
Large tree, 40'- 70' tall; massive, round-topped crown; trunk, often divided low, up to 42" diameter.
Leaves: Opposite, simple, 4" - 6" long, nearly as wide, palmately lobed; lobes, 5, *2 deeply cut crotches come to sharp point, doubly toothed margins;* dull green *(white or silvery below);* pale yellow to orange in autumn.
Twigs: Yellowish-gray to reddish-brown, *disagreeable odor when broken;* buds, dark red, blunt. **Fruit:** Samara, 1½" - 2½" long, V-shaped pairs with *widely divergent wings,* mature in spring. **Bark:** Gray; smooth; becoming furrowed with *long, scaly, narrow strips that often curl at the ends.* **Range:** Native, southern and east-central Minnesota, north to Duluth and west to upper Mississippi River; hardy to Zone 3b. **Remarks:** Moderately shade-intolerant; *fast-growing,* moderately short-lived. Prolific seed producer commonly found in moist bottomland forests. Sprouts vigorously when injured. Extensively planted as a fast-growing street tree that is somewhat tolerant of extreme site conditions, but has brittle branches and roots that may damage sidewalks, sewers, and drains. Occasionally used for maple syrup.

MOUNTAIN MAPLE *(Acer spicatum)*
Shrub or small tree, 10'- 20' (30') tall; small, irregular crown of upright branches; trunk, often crooked and divided, up to 7" diameter.
Leaves: Opposite, simple, 2½" - 4½" long, two-thirds as wide, palmately lobed; *lobes, 3 (rarely 5), shallow crotches, coarsely toothed margins;* light green; deep red or orange in autumn. **Twigs:** Yellowish-green to reddish-green with *velvety, gray hairs; terminal bud, red, perched on a small stalk, 2 scales*
Fruit: Samara, ½" - 1" long, U-shaped pairs with divergent wings, mature in autumn. **Bark:** Reddish-brown to brown, thin, smooth or slightly furrowed. **Range:** Native, northeastern and east-central Minnesota; hardy throughout. **Remarks:** Shade-tolerant; slow-growing; short-lived. Understory species found in moist, cool, often rocky forests.
Live lower branches sprout roots and form new trees when covered by soil or plant litter.

NORWAY MAPLE *(Acer platanoides)*
Medium tree, 40'- 60' tall; dense, round crown; trunk up to 24" diameter. **Leaves:** Opposite, simple, 4½" - 7" wide, nearly as long, *exudes milky sap when cut,* palmately lobed; lobes, 5, *shallow crotches, sharp ways-toothed margins;* shiny green; bright yellow or orange-brown in autumn. **Twigs:** Greenish-brown to brown; buds, yellowish-green to brownish-red, *exude milky sap when cut.* **Fruit:** Samara, 1½" - 2" long, V-shaped pairs with *extreme(l) divergent wings,* flat, mature in autumn. **Bark:** Dark gray, smooth; becoming closely fissured with narrow, interlacing ridges. **Range:** Introduced from Europe and western Asia; hardy to Zone 4a. **Remarks:** Shade-tolerant, moderate-growing, moderately long-lived. Extensively planted ornamental street tree. Varieties with *red or purple foliage* often are planted, but are not always winter hardy in Minnesota.



AMUR MAPLE *(Acer ginnala)*
Shrub or small tree, 15' - 18' tall; round to irregular crown; trunk, often multistemmed, up to 12". **Leaves:** Opposite, simple, 1½" - 3" long, *usually less than one-third as wide*, palmately lobed with doubly toothed margins, middle lobe much larger than lateral lobes; dark green; bright red or orange in autumn. **Twigs:** Yellowish-brown, *slightly angled*; buds, reddish-brown, *small (¼" long)*. **Fruit:** Samara, 1" long, U-shaped pairs with nearly parallel wings, mature in autumn. **Bark:** Grayish-brown, smooth; becoming vertically striped. **Range:** Introduced from China and Japan; hardy to Zone 3a. **Remarks:** Shade-tolerant; moderate growth rate; moderately long-lived. Attractive ornamental that requires a well-drained soil. Commonly planted in above-ground containers.

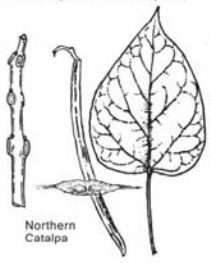

Amur Maple

TATARIAN MAPLE *(Acer tataricum)*
Shrub or small tree, very similar to amur maple. **Leaves:** Doubly toothed or obscurely lobed margins. **Fruit:** Samara, 1½" - 1½" long. **Range:** Introduced from Europe; hardy to Zone 3a.


Tatarian Maple

Opposite- or Whorled-branching Trees with Simple and Finely Toothed or Smooth Leaves (Catalpa, Buckthorn, Nannyberry, Wahoo, Most Dogwoods - See Page 73)

NORTHERN CATALPA or hardy catalpa
(Catalpa speciosa)
Large tree, 50' - 80' tall; conical or rounded crown; trunk up to 24" diameter. **Leaves:** *Opposite or whorled in threes*, simple, *heart-shaped, 6" - 12" long, 4" - 8" wide*, smooth margins, dull green, blackish in autumn. **Twigs:** Brown, *round or shield-shaped leaf scars (distinctly raised)*; dark brown to black buds. **Fruit:** Capsule, *8" - 18" long*, beanlike, splits into 2 parts, *feathery winged seed pairs*, present through winter, mature in spring. **Bark:** Brown, deeply furrowed with scaly, vertical ridges. **Range:** Introduced from Mississippi and Ohio river valleys; hardy to Zone 4b. **Remarks:** Shade-intolerant; moderately fast-growing; moderately short-lived. Attractive ornamental tree with showy flowers. Should not be planted on dry, exposed sites.


Northern Catalpa

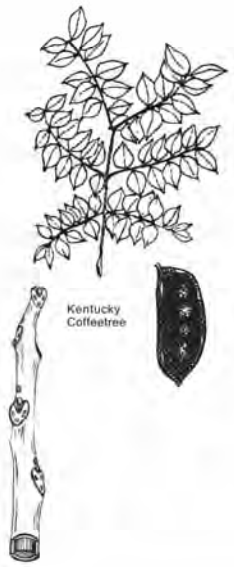
COMMON BUCKTHORN
(Rhamnus cathartica)
Shrub or small tree, 8' - 20' (30') tall; rounded crown; up to 5" diameter. **Leaves:** *Opposite (occasionally alternate)*, simple, 1" - 2½" long, ¾" - 2" wide, round to pointed tip, finely toothed margins, *distinctly curved lateral veins (slightly sunken in surface)*, dark green, greenish-yellow in autumn. **Twigs:** Gray, stubby-spur shoots, *usually spine tipped*; buds, brown, fuzzy scale tips. **Fruit:** Drupe, ¼" diameter, bluish-black, *containing 3 or 4 seeds*, mature in early autumn. **Bark:** Brown, peeling, *yellow inner bark*. **Range:** Introduced from Europe, naturalized in southern Minnesota; hardy throughout. **Remarks:** Moderately shade-tolerant; moderately fast-growing; short-lived. Considered a nuisance species that has escaped from cultivation. Widely spread by birds that consume large numbers of the berrylike fruits and pass the undamaged seeds in their droppings.


Common Buckthorn

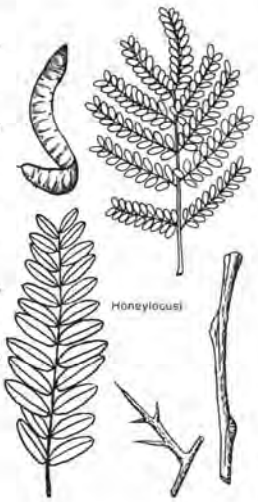
NANNYBERRY *(Viburnum lentago)*
Shrub or small tree, 8' - 25' tall; dense, rounded crown of drooping branches; trunk, often divided low, up to 7" diameter. **Leaves:** Opposite, simple, 2" - 5" long, 1" - 2½" wide, finely toothed margins, shiny green; red or reddish-purple in autumn; *winged or grooved leafstalk.* **Twigs:** Light green to gray-brown; *terminal buds, brownish-gray; 2 scales, often fat and bulb-shaped at base, long pointed tip.* **Fruit:** Drupe, ½" diameter, bluish-black, *containing one seed (flat),* clustered, mature in early autumn. **Bark:** Reddish-brown to brownish-gray; furrowed with irregular, scaly plates; skunklike odor when broken. **Range:** Native and hardy throughout Minnesota, but scattered or absent in southwest. **Remarks:** Moderately shade-tolerant; moderate-growing; short-lived. Common understory species found on rocky hillsides and near woodland edges, stream banks, and wetlands. Edible fruits develop a *sweet* datelike flavor after the first frost.

WAHOO or eastern burningbush
(Euonymus atropurpureus)
Shrub or small tree, 12' - 20' tall; broad, flat-topped crown; trunk up to 4" diameter. **Leaves:** Opposite, simple, 2" - 4½" long, half as wide, finely toothed margins, dull green (hairy below); yellow to scarlet red in autumn. **Twigs:** *Green to purplish-brown with 4 corky lines or wings, often 4-sided;* buds, small, green (reddish tinge). **Fruit:** Capsule, ½" wide, *4-celled, red to purple seeds (fleshy),* clustered, mature in autumn. **Bark:** Gray, smooth; becoming shallowly fissured. **Range:** Native, scattered, southern half of Minnesota; hardy to Zone 4a. **Remarks:** Shade-tolerant; moderately fast-growing; short-lived. Commonly found in thickets, hillsides, woodland edges, and stream banks. Prefers rich, moist soils that are well drained.

KENTUCKY COFFEETREE
(Gymnocladus dioica)
Large tree, 50' - 70' tall; open, rounded or pyramidal crown of crooked branches (witch's fingers); trunk, often divided low, up to 24" diameter. **Leaves:** Alternate, *doubly compound, 12" - 36" long; leaflets, often 40 or more,* 2" - 2½" long, ¼" - 1½" wide; smooth margins, bluish-green; yellow in autumn. **Twigs:** Brownish-gray, *very stout, capped leaf scars, salmon-colored pith; lateral buds, brown, sunken in craters, hairy.* **Fruit:** Legume, 6" *long,* 1½" *wide, purplish-brown,* mature in autumn. **Bark:** Brownish-gray, *smooth; becoming scaly or blocky with vertical strips that curve outward at the edges (cupped).* **Range:** Native, rare, southeastern Minnesota in Mississippi River Valley to St. Paul and Minnesota River Valley to New Ulm; hardy to Zone 3b. **Remarks:** Shade-intolerant; moderate-growing; moderately long-lived. Floodplain species. Distribution in Minnesota may be correlated with former American Indian villages whose inhabitants apparently grew the trees for their seeds. The seeds were used in a dice game or roasted and eaten like chestnuts. Common name, Kentucky coffeetree, derives from the seeds, which were roasted, pulverized, and boiled into a bitter, black, coffeelike beverage. Uncooked, however, the seeds and surrounding pulp are poisonous. Kentucky Coffeetree is a popular ornamental tree that prefers fertile, moist soils.



HONEYLOCUST *(Gleditsia triacanthos)*
Medium tree, 40' - 60' (80') tall; open, often flat-topped crown; trunk, often divided low, up to 36" diameter. **Leaves:** Alternate, *doubly compound (usually at twig tips) and pinnately compound*; leaflets, ½" - 1½" long, narrowly egg-shaped, very finely toothed margins, deep green; yellow in autumn. **Twigs:** *Reddish-brown, shiny, zigzags, often thorny; thorns, 1"- 3" long, stiff, often three-forked*; lateral buds, brownish, *small, 3 or more sunken in leaf scar.* **Fruit:** Legume, 8" - 18" long, 1" wide, *twisted, purplish-brown*, mature in late fall. **Bark:** Grayish-brown with *dark lines (lenticels)*, smooth, becoming blackish with irregularly shaped, platelike, vertical ridges; *often thorny (2"- 8" long).* **Range:** Native, scattered and rare, southeastern Minnesota (native populations probably extinct); hardy to Zone 3b (variable). **Remarks:** Shade-intolerant; fast-growing; moderately long-lived. Naturally found in moist lowlands and limestone-derived soils, but also tolerates dry sites. Common name, honeylocust, is based on the immature fruits that contain a sweet pulp that tastes like a mixture of honey and castor oil. The pulp is relished by wildlife and cattle, and formerly was fermented into a beerlike beverage. Thornless and seedless varieties commonly are used in ornamental plantings.



Alternate-branching Trees with Pinnately Compound Leaves and Thorns
(Prickly-ash, Black Locust, Honeylocust - See Page 41)

COMMON PRICKLY-ASH
(Zanthoxylum americanum)
Shrub or small tree, 4' - 15' (25') tall; rounded crown; trunk up to 6" diameter. **Leaves:** Alternate, pinnately compound, 5" - 10" long; leaflets, 5 - 11, 1"- 2" long, one-half as wide, egg-shaped, *lemonlike smell when crushed*, smooth margins, dull green; yellow in autumn. **Twigs:** Brown or gray, *zigzags, lemonlike smell when broken, paired spines (½" long), lateral buds, red, fuzzy, small.* **Fruit:** Capsule, reddish-brown, clustered, black seeds, mature in late summer. **Bark:** Gray to brown, often with darker lines (lenticels), smooth. **Range:** Native throughout Minnesota; often absent in north; hardy in Zone 3a. **Remarks:** Moderately shade-tolerant; fast-growing; short-lived. Forms dense thickets in forest edges, and open, often grazed, woodlands. Often considered a nuisance tree. Leaves, bark, and fruits contain xanthoxylin, a lemon-smelling oil used in some drug preparations. Inner bark and fruits formerly were chewed to relieve toothaches.

BLACK LOCUST *(Robinia pseudoacacia)*
Medium tree, 30' - 60' tall; open, irregular crown; trunk, often crooked, up to 24" diameter. **Leaves:** Alternate, *pinnately compound*, 6" - 14" long; leaflets, 7 - 19, 1½" - 2" long, ½" - ¾" wide, smooth margins, blue-green; yellow in autumn. **Twigs:** Brown, *paired spines (½" - 1" long)*; lateral buds, reddish-brown, 3 or more sunken in leaf scar, hairy. **Fruit:** Legume, 2" - 4" long, ½" wide, *dark brown, containing 4 - 8 seeds*, mature in late autumn. **Bark:** Grayish-brown; deeply furrowed with *interlacing ridges and orangish troughs.* **Range:** Introduced from eastern United States; naturalized in Minnesota; hardy in Zone 3b. **Remarks:** Shade-intolerant; fast-growing; short-lived. Commonly planted erosion-control species that rapidly spreads from root suckers. Often considered a nuisance species. Bacteria in the roots fix nitrogen, improving soil fertility. Durable, rot-resistant wood is used for fence posts, mine timbers, dowels, and firewood. During the War of 1812, the British credited American naval successes to the use of black locust timber in their ships. Although several factors contributed to British losses, the perception started a black locust planting craze in Europe.

Alternate-branching, Nut-producing Trees with Pinnately Compound Leaves (Hickories, Walnuts)

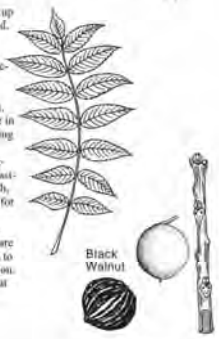
BITTERNUT HICKORY
(Carya cordiformis)
Medium to large tree, 40' - 80' tall; broad, rounded crown with upright branches; trunk up to 24" diameter. **Leaves:** Alternate, pinnately compound, 6" - 10" long; leaflets, 7 - 11, finely toothed margins, bright green; golden yellow in autumn. **Twigs:** Greenish-brown to gray-brown with whitish hairs, bundle scars scattered on leaf scar or arranged in a monkey-face pattern, star-shaped pith; *buds, bright yellow,* flattened. **Fruit:** *Nut, ½" - 1½" diameter, rounded, sharply pointed tip;* thin, 4-ribbed husk (*splitting halfway down from tip*); mature in autumn.
Bark: Grayish, *smooth with shallow interlacing ridges*; becoming shallowly furrowed.
Range: Native, southeastern and east-central Minnesota, occasionally found along upper Mississippi River and tributaries of the St. Louis River; hardy to Zone 4a.
Remarks: Moderately shade-tolerant; moderately slow growing; moderately long-lived. Common species found on variety of sites, from moist lowlands to dry uplands. Bitter nuts are unpalatable to humans and many wildlife species. Oils extracted from the boiled nuts formerly used for lamp fuel and rheumatism medicine. Heavy, hard wood used for tool handles, firewood, and smoking meats (reportedly the best hickory flavor).

Bitternut Hickory

SHAGBARK HICKORY *(Carya ovata)*
Medium to large tree, 40' - 80' (80') tall; narrow, irregular crown; trunk up to 24" diameter. **Leaves:** Alternate, pinnately compound, 8" - 14" long; leaflets, 5 - 7 (usually 5), *upper 3 larger than lower 2*, finely toothed margins, dark yellowish-green; golden yellow in autumn. **Twigs:** Gray to reddish-brown with whitish hairs, stout, bundle scars scattered on leaf scar or arranged in a monkey-face pattern, star-shaped pith; *terminal buds, large, egg-shaped, loose scales.* **Fruit:** Nut, 1" - 1½" diameter, oval; thick, 4-ribbed husk (splitting from tip to base); mature in autumn. **Bark:** Gray, smooth; *breaking up into long, curved strips that are loosely attached (shaggy appearance).* **Range:** Native, southeastern corner of Minnesota; hardy to Zone 4b. **Remarks:** Shade tolerant when young, moderately shade-intolerant when mature; slow growing; long-lived. Heavy, strong wood makes an excellent charcoal; also used for tool handles, wagon wheels, skis, and baskets. Delicious nuts are consumed by humans and wildlife. American Indians formerly crushed and boiled the nuts to produce a sweet oil (hickory milk) used in corn cakes and grits.

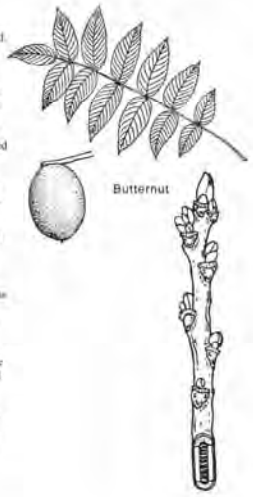
Shagbark Hickory

BLACK WALNUT *(Juglans nigra)*
Large tree, 50' - 70' (100') tall; large, open crown; trunk up to 36" diameter. **Leaves:** Alternate, pinnately compound, 12" - 24" long; leaflets, 14 - 23, terminal leaflet often smaller or absent, finely toothed margins, yellowish-green; yellow in autumn. **Twigs:** Light brown to orange-brown, stout, *chambered pith (light brown),* hairy, bundle scars in 3 U-shaped clusters (monkey-face pattern); *buds, tan to white, ½" long, fuzzy.* **Fruit:** Nut, 2" diameter, *round, aromatic husk (not sticky),* mature in autumn. **Bark:** Brownish-black, slightly scaly; becoming darker and deeply furrowed with scaly ridges.
Range: Native, southeastern and south-central Minnesota; hardy to Zone 4a. **Remarks:** Shade-intolerant; fast-growing; moderately long-lived. Typically found in rich, well-drained lowland sites. Prized timber species used for furniture, cabinets, caskets, gun stocks, and veneer. Individual trees suitable for high quality veneer occasionally sell for several thousand dollars. Nut kernels are sweet and delicious, but woody seed cover is difficult to crack and wildlife often consume them prior to collection. Roots exude a natural herbicide, known as juglone, that is toxic to many plants including tomatoes.



Black Walnut

BUTTERNUT or white walnut
(Juglans cinerea)
Medium tree, 40' - 60' tall; flat or round-topped, open crown with ascending branches, trunk often divided, up to 24" diameter. **Leaves:** Alternate, pinnately compound, 15"–25" long; leaflets, 11 –17, finely toothed margins, yellowish-green; yellow or brown in autumn. **Twigs:** Greenish-gray to reddish-brown, rough, hairy, stout, *finely chambered pith (dark brown)*, bundle scars in 3:1)–shaped clusters on leaf scar (monkey-face pattern); buds, *brownish, ⅛"–½" long, fuzzy*. **Fruit:** Nut, 2"–3" diameter, *egg-shaped, sticky husk (stains your fingers)*, mature in autumn. **Bark:** *Whitish-gray*, smooth; becoming narrowly fissured with *broad, flat ridges*. **Range:** Native, southeastern and east-central Minnesota; hardy in Zone 4a. **Remarks:** Shade-intolerant; fast growing; moderately long lived. Uncommon species being destroyed by butternut canker, a fungus first reported in 1967. A search currently is underway to identify disease-resistant trees. Common name, butternut, refers to the butterlike oil that American Indians extracted from the tree's edible nut kernels. Confederate troops in the Civil War sometimes were called "butternuts" because their homemade uniforms were colored with dyes obtained from the tree's inner bark and nut husks. The sap can be boiled to produce a sweet syrup, and the wood is a favorite among carvers.



Alternate-branching Trees with Pinnately Compound Leaves and Fleshy, Orange or Red Fruits (Mountain-Ashes, Sumacs)

AMERICAN MOUNTAIN-ASH
(Sorbus americana)
Small tree, 15' - 30' tall; open, rounded crown; trunk up to 12" diameter. **Leaves:** Alternate, pinnately compound, 6" - 9" long; *leaflets, 11 –17, sharp finely toothed margins, ½"–4" long, one-third to one-half as wide*, dark yellowish-green; yellow in autumn. **Twigs:** Reddish-brown, spur shoots on branchlets; *terminal buds, dark red, hairy, pointed, exude a gummy sap*. **Fruit:** *Pome, bright orange or red*, ¼" diameter, clustered, mature in autumn. **Bark:** Light grayish-brown with dark lines or dots (lenticels), smooth or slightly scaly. **Range:** Native, northeastern Minnesota; hardy throughout. **Remarks:** Moderately shade-intolerant; slow-growing; short-lived. Attractive ornamental, but very susceptible to fire blight (bacterial disease) and sunscald. Concoctions extracted from the mountain-ash's inner bark reportedly were used in colonial times to exorcise people falsely convicted of being witches.

EUROPEAN MOUNTAIN-ASH or
Rowan tree *(Sorbus aucuparia)*
Small tree, 15' - 30' tall; rounded crown; trunk up to 12" diameter. **Leaves:** Alternate, pinnately compound, 4" - 8" long; leaflets, 9 - 17, finely toothed margins, ½" - 2" long, about one-third as wide, dull green (*whitish hairs below*); yellow in autumn. **Twigs:** Reddish-brown, *white hairs (velvety)*, spur shoots on branchlets; *terminal buds, ⅛" long, white-woolly*. **Fruit:** Pome, bright orange or red, ⅜" diameter, clustered, mature in autumn. **Bark:** Dark gray with dark lines or dots (lenticels), smooth or slightly scaly, *aromatic*. **Range:** Introduced from Europe and Asia; naturalized in some areas; hardy throughout. **Remarks:** Moderately shade-intolerant; moderate-growing; short-lived. Most commonly planted mountain-ash. The fruits are an important winter food source for many birds and formerly were used to bait bird traps. The Latin species expression, *aucuparia*, is derived from the root words *avis* and *capere*, meaning "to catch birds."

SHOWY MOUNTAIN-ASH *(Sorbus decora)*
Small tree, similar to American mountain-ash. **Leaves:** Pinnately compound; leaflets, 11 - 15, 1½" - 2½" long, more than one-third as wide, bluish-green. **Fruit:** ¼" - ⅜" diameter, bright red. **Range:** Native to northeastern Minnesota and scattered interior locations; hardy throughout.

STAGHORN SUMAC *(Rhus typhina)*
Tall shrub or small tree, 10' - 20' tall; open, irregular, flat-topped crown; trunk up to 6" diameter. **Leaves:** Alternate, pinnately compound, 12" - 24" long; *leaflets, 11 - 31,* 2" - 4½" long, ⅞" - 1½" wide, sharply toothed margins, dark green (often with red hairs below); bright orange, red, or purple in autumn; reddish, hairy leafstalk. **Twigs:** Brown, *dense velvety-brown hairs, very stout;* lateral buds, small, cone-shaped, *surrounded by horseshoe-shaped leaf scar.* **Fruit:** *Multiple of drupes, cone-shaped, dark red with long hairs,* mature in autumn. **Bark:** Dark brown to yellowish-brown, smooth or slightly scaly. **Range:** Native, southeastern and east-central Minnesota; hardy to Zone 4a. **Remarks:** Shade-intolerant; fast-growing; short-lived. Forms dense thickets in abandoned fields or at forest edges. Berrylike fruits can be used to brew a sour lemon-tasting drink. Common name, staghorn, is based on the fuzzy twigs, which feel like the velvety antlers on a buck deer.

SMOOTH SUMAC *(Rhus glabra)*
Tall shrub or small tree, similar to staghorn sumac; distinguished by its hairless twigs and leafstalks. **Range:** Native throughout Minnesota; hardy to Zone 3a.

Alternate-branching Trees with Simple, Fan-shaped Leaves (Ginkgo)

GINKGO or maidenhair tree *(Ginkgo biloba).* Medium tree, 40' - 60' tall; pyramid-shaped crown; trunk, distinctly tapered, up to 30" diameter. **Leaves:** Alternate, *fan-shaped,* 1" - 2" long, 1½" - 3" wide, borne singly or *clustered on wartlike spur shoots,* often notched at the tip, light green; yellow in autumn. **Twigs:** Yellowish-green to gray, *numerous wartlike spur shoots, leaf scars with 2 bundle scars,* buds, reddish-brown, small. **Seeds:** Drupelike (exposed), fleshy, 1" long, yellowish, stalked, fleshy, vomitlike smell when overripe, mature in early autumn. **Bark:** Gray, slightly rough; becoming deeply furrowed. **Range:** Introduced from eastern China; hardy to Zone 4a. **Remarks:** Shade-intolerant; moderately slow-growing; long-lived. Durable ornamental tree that is the sole survivor of an ancient plant family. Since female trees produce ill-smelling fruits, nurseries primarily sell male tree selections.

Alternate-branching, Acorn-producing Trees with Simple, Pinnately Lobed Leaves with Rounded Tips (White Oak Group)

BUR OAK *(Quercus macrocarpa)*
Large tree, 50' - 80' tall; broad, rounded crown with stout, spreading branches (rugged appearance); trunk up to 48" diameter. **Leaves:** Alternate, simple, 4" - 12" long, 3" - 6" wide, pinnately lobed (sometimes wavy-toothed); lobes, 5 - 9, *center pair cut almost to the midrib*, rounded tips, shiny, dark green; yellow or brown in autumn. **Twigs:** *Yellowish- to grayish-brown*, slightly hairy, *often with corky ridges or wings*; buds, reddish-brown, clustered at twig ends. **Fruit:** Acorn, ¾" - 2" long; *very deep cup (covering top one-half or more) with hairy margins*; mature in autumn. **Bark:** Dark grayish-brown, furrowed, rough; becoming *deeply furrowed with thick, vertical ridges*. **Range:** Native throughout Minnesota; hardy to Zone 3a. **Remarks:** Intermediate shade tolerance; slow-growing; long-lived. Extremely hardy species; its thick bark and deep root system protect it from fire and drought. Commonly found on dry hillsides and prairie borders, but grows best on well-drained lowland sites. Attractive shade tree tolerant to urban pollution and root disturbance, but requires considerable space.

WHITE OAK *(Quercus alba)*
Large tree, 50' - 70' (100') tall; broad, open crown with stout, rugged-looking branches; trunk up to 48" diameter. **Leaves:** Alternate, simple, 4" - 9" long, 2" - 4" wide, pinnately lobed; *lobes, 5 - 9, rounded tips, crotches nearly uniform in depth (fingerlike)*; bright green; red or brown in autumn. **Twigs:** Reddish-green to reddish-gray; *buds dark reddish-brown*, clustered at twig ends. **Fruit:** Acorn, ½" - 1¼" long, *bowl-shaped cup (covering top one-third)*, mature in autumn. **Bark:** Light ashy gray; breaking up into irregularly shaped, scaly blocks or shallow furrows with narrow, vertical ridges; *large branches often scaly*. **Range:** Native, southeastern and east-central Minnesota; hardy to Zone 3b. **Remarks:** Intermediate in shade tolerance; moderately slow-growing, very long-lived. Typically found on moist, well-drained soils. Valuable timber species; its tough, close-grained wood is used for support timbers, paneling, flooring, furniture, tobacco pipes, and whiskey barrels. Prior to the use of steel, it was heavily used in ship construction. The USS *Constitution* ("Old Ironsides") and several of the mine sweepers used in World War II were constructed with white oak timber. Attractive urban shade tree when space permits. White oak acorns are a valuable fall food source for many wildlife species, notably squirrels, deer, mallards, wood ducks, and blue jays.

SWAMP WHITE OAK *or bicolor oak*
(Quercus bicolor)
Medium to large tree, 50' - 60' tall; narrow, open, round-topped crown often with drooping branches; trunk up to 36" diameter. **Leaves:** Alternate, simple, 4" - 7" long, 2" - 4½" wide, pinnately lobed *(sometimes wavy-toothed); lobes, 5 - 12, broadly rounded tips, shallow crotches;* shiny green *(whitish-green below);* red or brownish-orange in autumn. **Twigs:** *Light brown to reddish-orange;* buds, light brown to orangish-brown, cluster at twig ends. **Fruit:** Acorn, ½" - 1½" long, *pair often attached to a 1" - 4" stalk,* bowl-shaped cup (covering top one-third) with *a slightly hairy margin;* mature in autumn. **Bark:** Light brown with *papery scales;* becoming grayish-brown and deeply fissured with blocky plates. **Range:** Native, southeastern Minnesota along Mississippi River and west along Minnesota River to Le Sueur County, scattered locations in Yellow Medicine County; hardy to Zone 4a. **Remarks:** Intermediate in shade tolerance; slow-growing; long-lived. Lowland species that tolerates poor drainage and drought. Wood is similar to white oak but more knotty. Latin species expression, *bicolor,* refers to the leaves, which are shiny green above and whitish-green below.

CHINKAPIN OAK *(Quercus muehlenbergii)*
Medium tree. **Leaves:** Pinnately toothed (rarely lobed) with pointed tips, shiny green. **Bark:** Ash-gray and flaky or blocky (not furrowed or ridged). **Range:** Native to Houston County (native populations probably extinct).

Alternate-branching, Acorn-producing Trees with Simple, Pinnately Lobed Leaves with Pointed Tips (Red Oak Group)

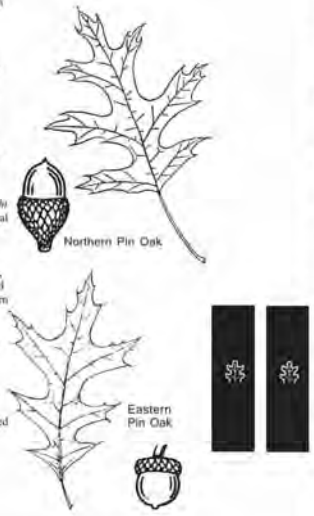
NORTHERN RED OAK *(Quercus rubra)*
Large tree, 60' - 70' tall; broad, rounded crown with spreading branches; trunk up to 36" diameter. **Leaves:** Alternate, simple, 4" - 9" long, 3" - 6" wide, pinnately lobed; *lobes 7 - 11, bristle-tipped, wavy crotches cut halfway to midrib;* dull green; brown or dark red in autumn. **Twigs:** Reddish-brown; buds, reddish-brown, pointed, hairy scales, clustered at twig ends. **Fruit:** Acorn, ½" - 1½" long, *saucerlike cup (very shallow),* mature in autumn. **Bark:** Gray to reddish-brown, smooth, somewhat shiny; becoming dark gray to blackish and shallowly furrowed with *long, whitish-gray, flat ridges (ski trail appearance); reddish inner bark.* **Range:** Native throughout Minnesota, except in northwest; hardy to Zone 3b. **Remarks:** Moderately shade-tolerant; fast-growing; long-lived. Fire-dependent species with thick bark and deep roots to protect mature trees; young trees sprout back from the stump. Produces a very valuable wood that is used for flooring, veneer, furniture, railroad ties, and numerous other products. Red oak acorns are an important winter food source for squirrels, deer, wild turkeys, and several songbirds. Oaks are susceptible to oak wilt disease, a deadly, native fungus spread overland by picnic beetles and underground through adjoining roots.

BLACK OAK or yellow oak
(Quercus velutina)
Medium to large tree, 40' - 60' tall; open, spreading, irregular, round-topped crown; trunk up to 30" diameter. **Leaves:** Alternate, simple, 4" - 9" long, 3" - 6" wide, pinnately lobed; lobes, 7 - 9, *bristle-tipped, shallow or deep crotches;* dark green (paler below with *scruffy brown hairs);* dull red or orangish-brown in autumn. **Twigs:** Reddish brown, often shiny, angled; buds, grayish, woolly, clustered at twig ends, angled terminal buds. **Fruit:** Acorn, ½" long, *bowl-shaped cup (covering top one-third),*

mature in autumn. **Bark:** *Ash-gray to nearly black with shallow, often orangish fissures; becoming deeply furrowed with blocky ridges; bright orange or yellow inner bark.* **Range:** Native, southeastern Minnesota; hardy in Zone 4b. **Remarks:** Moderately shade-intolerant; moderately fast-growing; long-lived. Often found on dry, sandy upland soils and rocky ridges. Except for the bright orange or yellow inner bark, black oak is difficult to distinguish from northern red oak. Cross-pollinates with northern red oak or northern pin oak to form hybrids that are lumped into groups known as the "red oak complex." Bark once an important source of leather tannin and yellow dyes.

NORTHERN PIN OAK or Hill's oak *(Quercus ellipsoidalis)*
Medium tree, 40' - 60' tall; irregular crown with many small drooping branches; trunk up to 18" diameter. **Leaves:** Alternate, simple, 3" - 5" long, 2½" - 4" wide, pinnately lobed; lobes, 5 - 7, *long bristle-tips, deep cuts cut nearly to midrib*; shiny green (*often with white hairy below*); deep red, yellow, brown, or purple in autumn. **Twigs:** Reddish-brown; buds, reddish-brown, clustered at twig ends. **Fruit:** Acorn, ½" - ¾" *long; cone-shaped cup (covers up one-third to one-half)*; mature in autumn. **Bark:** Dark brown to grayish-black, smooth; becoming shallowly fissured with *rough, slightly blocky ridges; light yellow inner bark.* **Range:** Native, southeastern and central Minnesota, spreading north to Beltrami County; hardy to Zone 3b. **Remarks:** Shade-intolerant; moderately fast-growing; moderately long-lived. Often found on dry uplands and sandy soils. Excellent wildlife habitat species, producing both food and nesting cavities. Often described as scarlet oak *(Quercus coccinea)*, an eastern and southern United States species not native to Minnesota, in early state records. Not recognized as a separate species until 1899, when it was described by pioneer botanist E. J. Hill, hence the alternative name "Hill's oak."

EASTERN PIN OAK *(Quercus palustris)*
Large tree, very similar to northern pin oak, distinguished by its symmetric, pyramidal crown and its nearly round acorn that has a shallow, saucerlike cup. **Range:** Introduced from the eastern United States; hardy to Zone 4a. **Remarks:** Pin oak suffers from iron chlorosis that can be avoided only by planting on slightly acidic soils.



Alternate-branching Trees with Simple, Palmately or Irregularly Lobed Leaves
(White Poplar, Mulberries, Hawthorn - See Page 55, Apple - See Pages 55-56)

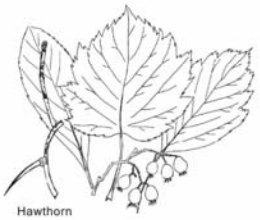
WHITE POPLAR or European poplar *(Populus alba)*
Large tree, 40' - 70' tall; rounded or irregular crown of many stout, crooked branches; trunk, often crooked and forked low, up to 24" diameter. **Leaves:** Alternate, simple, 2½" - 4" long, nearly as wide, *palmately lobed* (often toothed), *dark green (white-woolly hairs below)*; reddish-yellow in autumn. **Twigs:** Light green with *white hairs*; buds, white, fuzzy. **Fruit:** Capsule, splitting into 2 parts, containing numerous seeds with cottony hairs, capsules grouped in 1½" - 3" long catkins, mature in late spring. **Bark:** Creamy white or gray, smooth, thin; becoming dark greenish-gray and furrowed. **Range:** Introduced from Europe and western Asia; hardy to Zone 3a. **Remarks:** Shade-intolerant; fast-growing; short-lived. Attractive ornamental tree with many undesirable characteristics including roots that damage drains, sewers, and sidewalks.

RED MULBERRY *(Morus rubra)*
Small tree, 18' tall; open, rounded crown; trunk, often divided low, up to 18" diameter. **Leaves:** Alternate, simple, 4" - 7" long, 2½" - 5" wide, *base often uneven*, sharp coarsely toothed margins, *sometimes with 2 or 3+ lobes, milky sap when crushed, rough surface (hairy below)*, dark bluish-green; yellow in autumn. **Twigs:** Green to orange-brown, zigzags, *milky sap when broken*; buds, light brown, *dark brown scale margins*. **Fruit:** *Multiple of drupes*, reddish-black, mature in midsummer. **Bark:** Orange-brown, deeply fissured with scaly ridges. **Range:** Native, scattered and rare, southeastern Minnesota in the Mississippi and Minnesota River valleys (native populations probably extinct); hardy to Zone 4b. **Remarks:** Moderately shade-tolerant; moderately fast-growing; short-lived. Mulberries are an important food source for many birds, which disperse the seeds in their dropping. Often used in wildlife plantings.

RUSSIAN MULBERRY
(Morus alba var. tatarica)
Small tree, similar to red mulberry. **Leaves:** Coarsely toothed margins, often irregularly lobed, smooth surface, shiny green (hairy tufts below). **Twigs:** Buds are reddish-brown with uniformly colored scale margins. **Range:** Introduced from Russia; hardy to Zone 3b.

Alternate-branching Trees with Simple, Doubly Toothed Leaves and Thorns (Hawthorn, Apples, Plums)

HAWTHORN or thornapple
(*Crataegus* species)
Shrub or small tree, 15' - 30' tall; dense, broad, rounded or flat-topped crown; trunk, usually stout. **Leaves:** Alternate, simple, oval to egg-shaped, doubly toothed margins (often shallowly lobed), slightly hairy, variable color; red or orange in autumn. **Twigs:** Reddish-brown to gray, often much branched, zigzags slightly; *thorns, stiff, sharp, shiny*; buds, rounded, dark brown. **Fruit:** *Pome, small, applelike, yellow to red, fleshy, containing 1 - 5 hard pits*, mature in autumn. **Bark:** Reddish-brown to gray, scaly or shallowly fissured with narrow-shredded ridges. **Range:** 13 native species and numerous introduced species scattered throughout Minnesota; hardiness varies widely. **Remarks:** The hawthorn genus is poorly described because of the large number of species and the tremendous amount of variation within each species. Hawthorns usually are found on old fields, open or cutover forests, stream banks, and roadsides. They provide important escape cover and winter food (fruits) for wildlife. Shrikes, also known as butcher birds, store excess food (insects, small birds, mice) on the thorns. Thornless individuals or varieties exist.

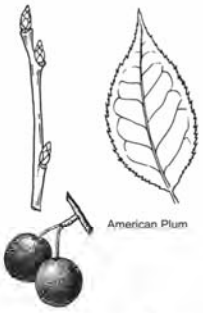

Hawthorn

PRAIRIE CRABAPPLE or Iowa crab
(Malus iowensis)
Shrub or small tree, 10' - 30' tall; open, rounded crown with spreading branches; trunk up to 12" diameter. **Leaves:** Alternate, simple, 2½" - 4" long, 1" - 1½" wide, *doubly toothed margins (often shallowly lobed)*, dark green *(often hairy below)*; yellow in autumn; *stalk often hairy*. **Twigs:** Reddish-brown, often hairy, *thornlike spur shoots usually present on branchlets, thorns are rough with leaves or buds attached*; buds, reddish-brown, hairy. **Fruit:** Pome, 1" - 1½" diameter, yellow-green, *clustered on short spur shoots*, leathery core, mature in late summer. **Bark:** Reddish-brown, scaly. **Range:** Native, southeastern and east-central Minnesota; hardy to Zone 3b. **Remarks:** Moderately shade-intolerant; slow-growing; moderately short-lived. Forms dense thickets along streams, forest edges, and prairie borders. Bitter fruits are an important food source for rabbits, squirrels, and several birds.


Prairie Crabapple

FLOWERING CRABAPPLES, APPLES, AND PEARS (*Malus* species)
Shrubs or small trees; round, open crowns; trunk, short, often stocky. **Leaves:** Doubly or singly toothed, sometimes shallowly lobed, variable color (bright green to deep maroon or silvery-red). **Twigs:** Branchlets with stubby, occasionally thornlike, spur shoots with leaves, buds and fruits attached. **Fruit:** Pome, round or pear-shaped, ⅜" - 3½" diameter, leathery core. **Remarks:** Numerous species and varieties have been introduced to Minnesota. Varieties with white or light pink to rosy red flowers are available. The most common types are described by Dirr (1990) and Pellett et al. (1991) (see p. 84).

AMERICAN PLUM or wild plum
(Prunus americana)
Shrub or small tree, 15' - 25' tall; broad, spreading crown; trunk up to 10" diameter.
Leaves: Alternate, simple, 2" - 5" long, 1¼" - 2" wide; *long narrow tip, sharp doubly toothed margins;* dark green (often hairy below); golden yellow in autumn. **Twigs:** Green to light brown, often hairy, *bitter almond smell when broken, thornlike spur shoots usually present on branchlets, thorns are rough with leaves or buds attached*, reddish-brown buds. **Fruit:** Drupe, ¾" - 1" diameter; red, yellow, or orange; mature in late summer. **Bark:** Reddish-brown to dark brown, smooth; breaking into scales or thin plates.
Range: Native, southern, central, and northwestern Minnesota; hardy to Zone 3a. **Remarks:** Shade-intolerant; fast-growing, short-lived. Forms dense thickets from root sprouts following fire or clearing. Attractive ornamental with beautiful white flowers. Fruits prized for jellies and preserves.


American Plum

CANADA PLUM *(Prunus nigra)*
Shrub or small tree similar to American plum.
Leaves: Light green, doubly toothed; 2 small, red swellings (glands) on leafstalk (usually missing on American plum). **Twigs:** Green to black with dark brown or gray buds. **Range:** Native to northern and eastern Minnesota; hardy throughout.

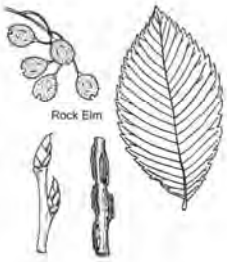

Canada Plum

Alternate-branching Trees with Simple, Doubly Toothed Leaves That Are Lopsided at the Base (Elms)

AMERICAN ELM or white elm *(Ulmus americana)* Large tree, 50' - 70' (100') tall; broad, rounded or *vase-shaped crown* with branches drooping at the ends; buttressed trunk, often divided low, up to 48" diameter. **Leaves:** Alternate, simple, 3" - 6" long, 1" - 3" wide, doubly toothed margins, *uneven base, smooth or slightly rough above (often fuzzy below)*; dark green; yellow in autumn. **Twigs:** *Brown*, often slightly fuzzy; *buds, reddish-brown, pointed tip.* **Fruit:** Samara, ½" - ¾" diameter, oval wing, deeply notched tip, mature in spring. **Bark:** Brownish-gray, corky; becoming ash-gray and deeply furrowed with flat, interlacing ridges (sometimes scaly); *outer bark layers alternating white and reddish-brown in cross section.* **Range:** Native and hardy throughout Minnesota. **Remarks:** Moderately shade-tolerant, fast-growing; long-lived. This once dominant shade-tree species is being destroyed by Dutch elm disease, a vascular wilt introduced to the United States prior to 1930 on elm logs from Europe. Although large trees are becoming scarce, elms are not in danger of extinction because they are aggressive colonizers that produce seeds at an early age. Commonly found in moist, deciduous forests and floodplains.

SLIPPERY ELM or red elm, water elm *(Ulmus rubra)* Medium to large tree, 50' - 70' tall; broad, open, flat-topped crown with ascending (not drooping) branches; trunk up to 30" diameter. **Leaves:** Alternate, simple, 4" - 7" long, 2" - 3" wide, doubly toothed margins, *uneven base, very rough above (rough or fuzzy below)*; dark green; yellow in autumn. **Twigs:** *Brownish-gray to dark gray*, hairy, *slimy when chewed; buds, dark reddish-brown with conspicuous orange hairs.* **Fruit:** Samara, ½" - ¾" diameter, *round wing, slight notched tip*, mature in spring. **Bark:** Reddish-brown and shallowly fissured with flat, nearly vertical ridges; *outer bark layers entirely reddish-brown in cross section.* **Range:** Native, southern and central Minnesota; hardy to Zone 3a. **Remarks:** Shade-tolerant; fast-growing; moderately long-lived. Common name derived from the species' slimy inner bark that was once chewed to quench thirst, soothe sore throats, and medicate minor wounds. Inhabits floodplain borders and dry, upland deciduous forests.

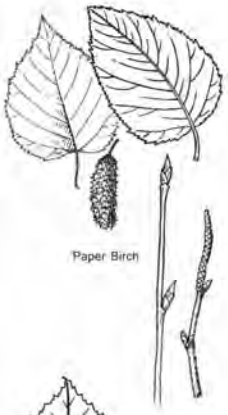
ROCK ELM or cork elm *(Ulmus thomasii)* Medium to large tree, 40' - 60' tall; cylindrical crown with drooping branches; trunk up to 48" diameter. **Leaves:** Alternate, simple, 2" - 4" long, ¾" - 2" wide, doubly toothed margins, *base usually uneven*, deep green; yellow in autumn. **Twigs:** Reddish-brown to brown, slightly hairy, *corky wings (ridges)*; buds, brown, *sharply pointed tips.* **Fruit:** Samara, ¼" - ½" diameter, *indistinct seed cavity, egg-shaped wing, shallowly notched tip*, mature in spring. **Bark:** Dark reddish-gray, rough; becoming dark gray and very deeply furrowed with broad, scaly, irregular or interlacing ridges (very rough); outer bark layers alternating white and brown in cross section. **Range:** Native, eastern (north to Duluth) and south-central Minnesota; scattered in Clearwater, Lake of the Woods, Beltrami, Cass, and Crow Wing counties; hardy to Zone 3a. **Remarks:** Moderately shade-tolerant; fast-growing; moderately long-lived. Common name, rock elm, may refer to rocky ridges and limestone bluffs the tree often inhabits or, more likely, to its rocklike wood formerly used to construct agricultural tools, wagon wheels, wheelchairs, and battleships.



SIBERIAN ELM *(Ulmus pumila)* Small to medium tree. **Leaves:** ½" - 2" long, ⅓" - 1" wide, doubly (nearly singly) toothed margins, dark green. **Twigs:** Whitish-gray with reddish-brown buds. **Range:** Introduced from eastern Siberia and northern China; hardy throughout. **Remarks:** Tolerates many extreme site conditions and highly resistant to Dutch elm disease. Otherwise an undesirable tree that is subject to limb breakage and insect attack.

Alternate-branching Trees with Simple, Doubly Toothed Leaves (Birches, Ironwood, Blue-beech, Alder)

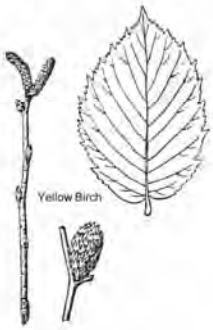
PAPER BIRCH or canoe birch
(Betula papyrifera)
Medium to large tree, 40' - 60' tall; narrow, open, often conical crown with drooping or horizontal branches; trunk, 12" - 24" diameter. **Leaves:** Alternate, simple, 2" - 5" long, 1" - 2" wide, doubly toothed margins, tapered or rounded base, dull green; light yellow in autumn. **Twigs:** Reddish-brown with white or orange dots (lenticels), spur shoots on branchlets, slender male catkins often present in winter; buds, *dull reddish-brown*, ⅛" long, slender, pointed, often slightly resinous. **Fruit:** Nutlet, winged; nutlets tightly grouped in a 1" - 1½" long catkin, mature in late summer. **Bark:** Reddish-brown, smooth; becoming *chalky white with prominent dark lines (lenticels) and peeling papery strips that often reveal an orange inner bark*; old branch scars often black and scaly. **Range:** Native, northern and eastern Minnesota; hardy throughout. **Remarks:** Shade-intolerant; fast-growing; short-lived. Fire dependent species; its profuse windblown seeds rapidly germinate on exposed soils. Bark used by American Indians to construct canoes, wigwam covers, utensils, baskets, moose-calling horns, and snow goggles. Strong, lightweight wood used for toothpicks, spools, snowshoe frames, and veneer. The tree's sap can be boiled to produce a dark molasses-like syrup. Birches are attractive ornamental trees, but they should be planted in cool, moist sites. Stressed trees are susceptible to deadly bronze birch borer (insect) attack.


Paper Birch

EUROPEAN WHITE BIRCH
(Betula pendula)
Medium tree, very similar to paper birch. **Leaves:** Doubly toothed (sometimes lobed). **Twigs:** Reddish-brown with tiny, resin-bearing glands and shiny, resinous buds. **Bark:** Usually very clean looking, flaky and white. **Range:** Introduced from Europe and Asia Minor; hardy to Zone 3a.


European White Birch

YELLOW BIRCH *(Betula alleghaniensis)*
Medium to large tree, 50' - 75' tall; broad, irregular, round-topped crown; trunk up to 36" diameter. **Leaves:** Alternate, simple, 3" - 5" long, 1½" - 2" wide, often hairy, doubly toothed margins, dull green; bright yellow in autumn. **Twigs:** Greenish-brown to yellow brown with raised, whitish dots (lenticels); *wintergreen odor when broken*, spur shoots on branchlets, slender male catkins often present in winter; buds, light reddish-brown, sharply pointed, hairy. **Fruit:** Nutlet, winged; nutlets tightly grouped in an erect, ½" - 1" long catkin; mature in early autumn. **Bark:** *Bronze to yellowish-brown with prominent dark lines (lenticels)* and smooth, paper-thin, curly strips; later breaking up into reddish-brown plates. **Range:** Native, north-central and northeastern Minnesota; hardy throughout. **Remarks:** Moderately shade-tolerant; moderately fast-growing; moderately long-lived. Yellow birch seeds germinate on moist, exposed areas, including rotting stumps and logs, and moss-covered rocks. Attractive wood often used for flooring, paneling, furniture, and veneer. Twigs and leaves can be used to brew a wintergreen-tasting tea.


Yellow Birch

SWEET BIRCH *(Betula lenta)*
Medium tree. **Twigs:** Dark brown, wintergreen odor when broken. **Bark:** Smooth, shiny brownish-red to black, later breaking up into scaly plates (like black cherry). **Range:** Introduced from the eastern United States; hardy to Zone 3b.


Sweet Birch

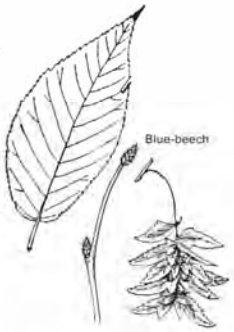
RIVER BIRCH *or* red birch *(Betula nigra)*
Medium tree, 40' - 60' tall; broad, spreading, irregular to pyramidal crown; trunk up to 24" diameter. **Leaves:** Alternate, simple, 1½" - 3" long, 1" - 2½" wide, *tapered base*, doubly toothed margins, yellowish-green (whitish and hairy below); yellow in autumn. **Twigs:** Reddish-brown with white dots (lenticels), shiny, slender male catkins often present in winter; buds, bright reddish-brown, hairy. **Fruit:** Nutlet, winged, clustered in an erect, 1" - 1½" long catkin; mature in early summer. **Bark:** *Light reddish-brown to salmon pink* with shaggy, papery curls. **Range:** Native, southeastern Minnesota in Mississippi and Root River valleys; hardy to Zone 3b. **Remarks:** Shade-intolerant; moderately fast-growing; short-lived. Common name, river birch, refers to its principal habitat, which also includes lakeshores, streams, and floodplains. Desirable species used in erosion control projects and ornamental plantings. Only native birch resistant to the bronze birch borer.

River Birch

IRONWOOD *or hop hornbeam (Ostrya virginiana)*
Small tree, 25' - 45' tall; broad, rounded or conical crown of slender, spreading branches; trunk up to 12" diameter. **Leaves:** Alternate, simple, 2" - 5" long, 1" - 2" wide, thin; *sharp, doubly toothed margins*, dark yellowish-green; dull yellow in autumn. **Twigs:** Light brown to reddish-brown, *very slender*, zigzags, slender male catkins often present in winter; buds, rounded, *brown, green scale tips*. **Fruit:** Nutlet, *enclosed in a swollen papery sac*; 4 - 10 nutlets loosely grouped in a 2" - 4" *long, cone-shaped catkin (resembles hops)*; mature in early autumn. **Bark:** Grayish-brown; *becoming fibrous with narrow ridges or strips that sometimes spiral around trunk*. **Range:** Native throughout Minnesota, but scattered in absent near western border; hardy in Zone 3b. **Remarks:** Very shade-tolerant; slow-growing; moderately long-lived. Common understory tree found in upland deciduous forests. Attractive ornamental tree, but limited availability and difficult to transplant. Common name, ironwood, refers to its extremely tough wood, which is used for tool handles, wedges, fence posts, and tent poles.

Ironwood

BLUE-BEECH or muscle-wood or hornbeam *(Carpinus caroliniana)*
Small tree, 15' - 25' tall; rounded or flat-topped crown of slender, spreading branches; trunk, *fluted in cross section*, up to 12" diameter. **Leaves:** Alternate, simple, 2" - 5" long, 1" - 2½" wide, *thin, sharp doubly toothed margins*, dark blue-green; red or orange in autumn. **Twigs:** Reddish-brown, *very slender, zigzags, slender male catkins absent in winter*; buds, reddish-brown, whitish scale tips, *4-sided in cross section*. **Fruit:** Nutlet; attached to a 1" long, 3-lobed, leaflike bract; nutlets loosely grouped in 4" - 6" long catkins, mature in late summer. **Bark:** *Bluish-gray, smooth with muscle-like ridges*. **Range:** Native, southeastern and east-central Minnesota, scattered in Clearwater and Becker counties; hardy to Zone 3b. **Remarks:** Very shade-tolerant; slow-growing; moderately short-lived. Understory tree found in rich, lowland deciduous forests. Attractive ornamental used in screening or background plantings. Wood has uses similar to ironwood, but decays quickly in a moist environment.



SPECKLED ALDER *(Alnus rugosa)*
Shrub or small tree, 15' - 25' tall; sparse, irregular crown often with several stems rising from the base; trunk, often bent or curved, up to 6" diameter. **Leaves:** Alternate, simple, 2" - 5" long, 1½" - 3" wide, doubly toothed margins, *leathery, veins sunken in surface*, dull green (paler below and often hairy); yellowish-brown in autumn. **Twigs:** Reddish-brown with whitish spots (lenticels), *triangle-shaped pith*, slender male catkins often present in winter; buds, reddish-brown, perched on a small stalk, 2 (rarely 3) scales. **Fruit:** Nutlet; *borne in a woody, pinecone-like* ½" - ¾" *long catkin*; mature in autumn. **Bark:** Dark reddish-brown or gray with *whitish or slightly orange lenticels, smooth*. **Range:** Native, northern and eastern Minnesota; hardy throughout. **Remarks:** Shade-tolerant; moderately fast-growing; short-lived. Common lowland species often forming dense thickets along lakes, streams, and rivers. Desirable species for wildlife cover, erosion control, and shading cold-water trout streams in summer. Bacteria in the roots fix nitrogen, improving soil fertility.

Alternate-branching Trees with Simple, Singly Toothed, Heart-shaped Leaves That Are Lopsided at the Base (Lindens, Hackberry)

AMERICAN BASSWOOD or American linden *(Tilia americana)*
Large tree, 50' - 75' (90') tall; dense, broad, oval or round crown often with drooping branches; trunk, *often with two or more stems, sounds hollow when struck lightly with a tool handle*, up to 36" diameter. **Leaves:** Alternate, simple, *heart-shaped, uneven base*, 3" - 7" long, *nearly as wide*, sharp coarsely toothed margins, yellowish-green; yellow to orange in autumn. **Twigs:** Reddish-gray to dark gray, zigzags; *buds, red or green, fat, slimy when chewed*. **Fruit:** Drupe (nutletlike), pea-shaped, *clusters attached to a narrow leaflike wing*, mature in autumn. **Bark:** Light gray, smooth; becoming dark gray and deeply fissured with narrow, often flat, vertical ridges. **Range:** Native throughout Minnesota; hardy to Zone 2a. **Remarks:** Shade-tolerant; moderately slow-growing; long-lived. Common deciduous forest tree that is widely planted in urban locations. Soft, lightweight wood used for carvings, crates, pulp, interior trim, and yardsticks. Fibrous inner bark formerly woven by American Indians into ropes and mats. Nectar from basswood flowers produces a high-grade bee honey.

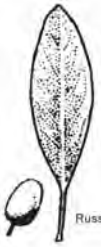
LITTLE-LEAF LINDEN *(Tilia cordata)*
Medium tree similar to American basswood but crown more compact and cone-shaped. **Leaves:** 1½" - 2½" long. **Range:** Introduced from Europe; hardy to Zone 3b.

HACKBERRY *(Celtis occidentalis)*
Medium to large tree, 40' - 60' (75') tall; rounded crown of spreading, slightly drooping branches, *large U-shaped branch crotches*; trunk up to 30" diameter. **Leaves:** Alternate, simple, 2" - 5" long, 1½" - 2½" wide, *uneven base*, sharply toothed margins, pale green; yellow in autumn; *wartlike mite galls often present*. **Twigs:** Reddish-brown, *zigzags; pith white, finely chambered throughout or only below the buds*; buds, dark brown, hairy. **Fruit:** Drupe, ¼"- ⅜" diameter, green to dark purple (often wrinkled), mature in autumn. **Bark:** Light gray or tan with *corky warts or deep, narrow ridges*. **Range:** Native, southern and central Minnesota; hardy to Zone 3a. **Remarks:** Moderately shade-tolerant; moderately fast-growing; moderately long-lived. Commonly planted ornamental naturally found in floodplains, but also survives on dry sites. Fruit is an important winter food for several wildlife species. Rapidly sprouts from the stump or root collar following fire or harvesting. Edible fruits can be dried, ground, and boiled into a coffeelike beverage.


Hackberry

Alternate-branching Trees with Simple, Narrow Leaves (Russian-olive, Willows)

RUSSIAN-OLIVE *(Elaeagnus angustifolia)*
Shrub or small tree, 15' - 20' (30') tall; low, open crown with several erect branches; trunk, often crooked or leaning, up to 6" diameter. **Leaves:** Alternate, simple, 1½" - 3½" long, ¾" - ½" wide, pointed or blunt tip, *nearly smooth margins, grayish-green (silvery below with brown dots)*; brown in autumn. **Twigs:** *Silvery to brown, scaly*, often thorny, salmon-colored pith; buds, grayish-brown with silvery scales. **Fruit:** Drupe, ⅜" - ½" long, *olive-shaped, yellow to brown with silvery scales*, mature in early autumn. **Bark:** Dark brownish-gray with shallow, orangish fissures that *often spiral around trunk*. **Range:** Introduced from Europe and Asia; hardy to Zone 3b. **Remarks:** Moderately shade-intolerant; moderate- to fast-growing; short-lived. Popular ornamental also used in farm shelterbelts. Grows well on most soils that are well drained.


Russian-olive

BLACK WILLOW *(Salix nigra)*
Small to medium tree, 30' - 60' (80') tall; broad, irregular crown; trunk, often twisted and leaning, up to 30" diameter. **Leaves:** Alternate, simple, *3" - 6" long, ½" - ¼" wide; finely toothed margins, shiny green on both sides;* light yellow in autumn; *short leafstalk, often with conspicuous leaflike appendages (stipules) at base*. **Twigs:** Reddish-brown to yellowish-green, *brittle at base (easily detached)*; buds, small, *single scale*. **Fruit:** Capsule, ¼" long, containing numerous seeds with cottony hairs; capsules grouped in 1½" - 3" long catkins. **Bark:** Grayish-brown to brownish-black, fibrous, deeply furrowed with slightly scaly ridges. **Range:** Native, southeastern and east-central Minnesota; hardy to Zone 4a. **Remarks:** Very shade-intolerant; fast-growing; short-lived. Lowland species often growing near the water's edge. Broken branches, carried by wind or water, develop roots when caught in a muddy shoreline. Wood is used for boxes, crates, charcoal, toys, and artificial limbs.

PEACHLEAF WILLOW *(Salix amygdaloides)*
Small to medium tree. **Leaves:** 5½" long, ¾" - 1½" wide, finely toothed margins, often curved at tip, light green (whitish below). **Twigs:** Yellow to orangish-brown, hairless, somewhat drooping. **Range:** Native, southern and western Minnesota; hardy throughout.

PUSSY WILLOW *(Salix discolor)*
Shrub or small tree. **Leaves:** 2" - 5" long, ¾" - 1½" wide, irregularly toothed margins, shiny green (bluish-white below), often with conspicuous leaflike appendages (stipules) at leafstalk base. **Twigs:** Dark reddish-purple with scattered orange dots (lenticels). **Range:** Native, eastern and west-central Minnesota; hardy to Zone 3a.

BEBB WILLOW *(Salix bebbiana)*
Shrub or small tree. **Leaves:** 1" - 3" long, ½"– 1" wide, irregularly toothed (or smooth) margins, dull green (bluish-white below with distinctly meshed veins and wooly hairs). **Twigs:** Reddish-purple to orangish-brown with green or gray hairs.
Range: Native, eastern and northwestern Minnesota.

SANDBAR WILLOW *(Salix exigua)*

Shrub or small tree. **Leaves:** 2" - 6" long, ¼" - ¾" wide, irregularly toothed (or smooth) margins, teeth widely spaced, yellowish-green (lighter below). **Twigs:** Yellowish- to reddish-brown, sometimes hairy. **Range:** Native and hardy throughout Minnesota.

SHINING WILLOW *(Salix lucida)*
Shrub or small tree. **Leaves:** 2" - 8" long, ½" - 1½" wide, finely toothed margins, shiny green, two distinct swellings (glands) on leafstalk, leaflike appendages (stipules) at the leafstalk base. **Twigs:** Dark orangish-brown, shiny, brittle at the base (easily detached). **Range:** Native; northern and east-central Minnesota.

HEARTLEAF WILLOW
(Salix eriocephala)
Small tree. **Leaves:** 2½" - 6" long, ½" - 1½" wide, base often heart-shaped, finely toothed margins, dark green (whitish below), scattered hairs on both sides, conspicuous leaflike appendages (stipules) at the leafstalk base. **Twigs:** Reddish-brown to brown, often with white or gray hairs. **Range:** Native throughout Minnesota, except in the northeast.

LAUREL WILLOW *(Salix pentandra)*
Medium tree. **Leaves:** 1½" - 5" long, ¾" - 2" wide, finely toothed margins, very shiny, dark green (duller below), yellow midrib (aromatic when crushed). **Twigs:** Brownish-green, shiny, hairless. **Range:** Introduced from Europe; hardy to Zone 3a.

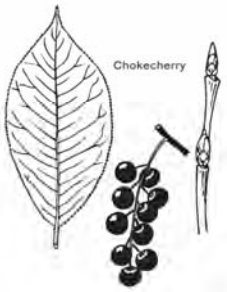
WHITE WILLOW *(Salix alba)*
Large tree. **Leaves:** 1½" - 4" long, ½" - ¾" wide, toothed margins, bright green (whitish below), fuzzy on both sides. **Twigs:** Yellowish-green, smooth, slightly drooping. **Range:** Introduced from Africa and Asia; hardy to Zone 3a. **Remarks:** Golden weeping willow (*Salix alba* "Tristis") is among the most commonly seen varieties of white willow. It can be identified by its golden yellow, drooping branchlets.

Alternate-branching Trees with Simple, Singly Toothed Leaves and Bitter Almond Smelling Twigs when Broken (Cherries, Plums - See Page 56)

BLACK CHERRY or wild cherry
(Prunus serotina)
Medium to large tree, 40' - 60' (80') tall; rounded crown; trunk, often crooked, up to 24" diameter.
Leaves: Alternate, simple, 2" - 6" long, 1" to 1½" wide, finely toothed margins, shiny, deep green *(white or brown hairs often on veins below)*, yellow to yellowish-red in autumn; usually 1 or 2 reddish-black dots (glands) near leaf base. **Twigs:** Reddish-brown with *white dots (lenticels), bitter almond smell when broken*; buds, bright reddish-brown, pointed scales, blunt or pointed tip. **Fruit:** Drupe, ¼" diameter, reddish-purple, mature in late summer. **Bark:** Reddish-brown to black with prominent horizontal lines (lenticels), smooth; breaking up into *scaly plates (burned potato chip appearance)*. **Range:** Native, southern and central Minnesota, often absent near western border; hardy to Zone 3b.
Remarks: Shade-tolerant when young, shade-intolerant when mature; moderately fast-growing; moderately long-lived. Edible fruit, though somewhat tart, is used in jellies and wines, and consumed in large numbers by many birds and small mammals. Beautiful, reddish-brown wood, used for furniture and veneer, makes an excellent, fragrant firewood. Sprouts rapidly from the stump or root collar following fire or timber harvesting. Hydrogen cyanide in the wilted leaves and twigs is poisonous to livestock.

FLOWERING CHERRIES, APRICOTS, AND PLUMS (*Prunus* species)
Shrubs, small to medium trees. **Leaves:** Doubly or singly toothed. **Twigs:** Often with a bitter almond smell when broken; branchlets occasionally with stubby or thornlike spur shoots. **Fruits:** Drupe, often juicy, containing one relatively large stone or pit (seed is inside pit). **Bark:** Marked with prominent horizontal lines (lenticels), smooth or scaly, often peeling in horizontal strips. **Remarks:** Numerous species and varieties have been introduced to Minnesota. Varieties with white or light to dark pink flowers are available. Some varieties produce double flowers with two rings of petals instead of one. Descriptions of the most common types are given by Dirr (1990) and Pellett et al. (1991) (see p. 84).

CHOKECHERRY *(Prunus virginiana)*
Shrub or small tree, 15' - 20' (35') tall; irregular to rounded crown; trunk, often crooked or leaning, up to 8" diameter. **Leaves:** Alternate, simple, *oval*, 2" - 4" long, 1" - 2" wide, finely toothed margins, shiny dark green; yellow in autumn; *leafstalk often with 2 small, wartlike swelling (glands) near leaf base.* **Twigs:** Reddish-brown, *strong bitter almond smell when broken;* buds, pale brown, brownish-black scale tips, pointed tip. **Fruit:** Drupe, ¼" - ½" diameter, *dark purple*, mature in mid- to late-summer. **Bark:** Dark brown to gray, smooth; becoming scaly or slightly fissured. **Range:** Native and hardy throughout Minnesota. **Remarks:** Intermediate in shade tolerance; moderately fast-growing; short-lived. Widespread species with a transcontinental range, found in clearings, open forests, and along streams and forest edges. Once pitted, bitter fruits often are used in jellies, preserves, and syrups.



PIN CHERRY or fire cherry
(Prunus pennsylvanica)
Small tree, 10' - 30' (45') tall; rounded crown; trunk up to 8" diameter. **Leaves:** Alternate, simple, *clustered at twig ends, long pointed tips.* 2" - 5" long, ½" - 1½" wide, finely toothed margins, shiny yellowish-green or green; bright yellow in autumn; *leafstalks often with 2 small, wartlike swellings (glands) near leaf-base.* **Twigs:** Shiny red with *orange dots (lenticels), spur shoots often present on branchlets, bitter almond smell when broken;* buds, reddish-brown, *clustered at twig ends.* **Fruit:** Drupe, ¼" diameter, *bright red*, smooth, mature in mid- to late-summer. **Bark:** *Reddish-gray with prominent orange lines (lenticels);* breaking into thin, gray, papery layers. **Range:** Native and hardy throughout Minnesota except southwestern corner. **Remarks:** Shade-intolerant; fast-growing, short-lived. Sometimes called fire cherry because the tree sprouts back vigorously from the roots to form dense thickets following fire or clearing. Fruits are used in jellies and preserves, and provide important food for several songbirds.

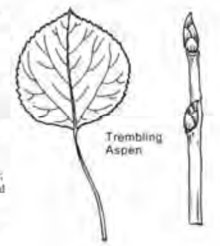
Alternate-branching Trees with Simple, Singly Toothed Leaves with Flattened Leafstalks or Sticky Buds (Poplars, White Poplar - See Page 54)

BALSAM POPLAR or balm of Gilead
(Populus balsamifera)
Medium to large tree, 40' - 70+' tall; open crown of ascending branches; trunk up to 24" diameter. **Leaves:** Alternate, simple, 3" - 6" long, half as wide, blunt finely toothed margins, *shiny green (silvery green below with rusty blotches);* yellow in autumn; *leafstalk round.* **Twigs:** Reddish-brown with bright orange dots (lenticels), star-shaped pith; *terminal buds, reddish-brown, 1" long, pointed, sticky, strong balsam odor.* **Fruit:** Capsule, splits into 2 parts, contains numerous seeds with cottony hairs; capsules grouped in 4" - 6" long catkins, mature in late spring. **Bark:** Greenish-brown to light brown, smooth; becoming grayish-black and deeply furrowed with flat ridges. **Range:** Native, northern and central Minnesota; hardy throughout. **Remarks:** Shade-intolerant; fast-growing; short-lived. Common lowland species in northern areas where it often forms dense stands. Transcontinental range extends above the Arctic Circle to become the northernmost deciduous tree in North America. Alternative common name, balm of Gilead, refers to the alleged medicinal properties of the species' resinous buds.

BIGTOOTH ASPEN *(Populus grandidentata)*
Medium to large tree, 40' - 60' (90') tall; open, rounded crown; trunk up to 24" diameter. **Leaves:** Alternate, simple, 2" - 6" long, 1" - 3" wide, firm, wavy, *coarsely toothed margins, teeth often distinctly curved*, yellow-green; yellow in autumn; leafstalk flattened.
Twigs: Greenish-gray to orangish-brown with scattered orange dots (lenticels); hairy, star-shaped pith; buds, gray, slightly pointed, *hairy, lateral buds point away from twig.* **Fruit:** Capsule, splits into 2 parts; contains numerous seeds with cottony hairs; capsules grouped in 3" - 6" long catkins, mature in late spring. **Bark:** Olive-green, smooth; becoming bronze-green to gray and deeply furrowed with broad, flat ridges; upper trunk smooth and *olive-green.*

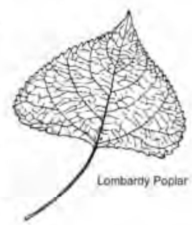
Range: Native and hardy throughout Minnesota except near western border. **Remarks:** Shade-intolerant; very fast-growing; short-lived. Pioneer species; its numerous windblown seeds and root sprouts allow the tree to quickly colonize cut-over and burned-over sites. Important Minnesota timber species used for pulp and paper, waferboard, and oriented-strandboard. Foliage, bark, twigs, and buds are an important food source for many wildlife species including grouse, deer, moose, rabbits, and beavers.

TREMBLING ASPEN or quaking aspen
(Populus tremuloides)
Medium to large tree, 40' - 60' (90') tall; open, rounded crown; trunk up to 24" diameter. **Leaves:** Alternate, simple, *round or egg-shaped*, 2" - 6" long, 1" - 2 1/2" wide, wavy; *very finely toothed margins*; yellow-green to blue-green; bright yellow in autumn; leafstalk flattened. **Twigs:** Reddish-brown with scattered light orange dots (lenticels), *very shiny*; star-shaped pith; terminal buds, reddish-brown, slender, pointed, *lateral buds often hug twig*. **Fruit:** Capsule, splits into 2 parts; contains numerous seeds with cottony hairs; capsules grouped in 3" - 4" long catkins, mature in late spring. **Bark:** Pale green to cream-colored, smooth; becoming grayish and warty or deeply furrowed; grayish-white on upper trunk. **Range:** Native and hardy throughout Minnesota except near western border. **Remarks:** Shade-intolerant; fast-growing; short-lived. Most widely distrib-uted tree species in North America. Pioneer species that sprouts from the roots following a fire or timber harvest. One aspen grove in Utah occupied 107 acres and contained 47,000 trees originating from the same root system. Common name, trembling aspen, refers to the tree's small leaves, which flutter in the breeze. Wood products are similar to bigtooth aspen. Leaves and bark of aspen (and some willows) contain salicin, the chemical compound in aspirin.



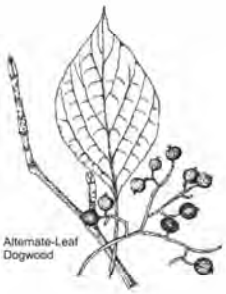
EASTERN COTTONWOOD
(Populus deltoides)
Large tree, 60' - 80' tall; broad, symmetric crown; trunk up to 96" diameter. **Leaves:** Alternate, simple, *triangle-shaped*, 3" - 7" long, nearly as wide, thick, waxy, coarsely toothed margins, *teeth distinctly curved*, shiny green; yellow to yellowish-orange in autumn; leafstalk flattened. **Twigs:** Yellowish-brown with pale dots (lenticels), often 4-sided, star-shaped pith; terminal buds, *red to yellowish-brown*, 1/4" long, angled, sharply pointed, slightly sticky, *not aromatic*, lateral buds point away from twig. **Fruit:** Capsule, *splits into 3 or 4 parts*; contains numerous seeds with cottony hairs; capsules grouped in 4" - 8" long catkins, mature in late spring. **Bark:** Yellowish-gray, smooth; becoming ashy-gray and *deeply furrowed with whitish troughs*. **Range:** Native, southern, central, and north-western Minnesota; hardy to Zone 3a. **Remarks:** Shade-intolerant; very fast-growing; short-lived. Floodplain species that also survives on dry sites once established. Extensively planted ornamental with many undesirable characteristics including the huge number of cottony seeds the tree produces. Several seedless or columnar-shaped varieties are available. Fast-growing hybrids often are used in farm shelterbelts and biomass planta-tions.

LOMBARDY POPLAR
(*Populus nigra* 'Italica')
Large to medium tree with a narrow, columnar crown of upright branches. **Leaves:** 2" - 4" long, often wider, finely toothed margins, dark green (paler below). **Twigs:** Yellowish-brown with 1/2" long, shiny brown terminal buds. **Range:** Introduced from Italy; hardy to Zone 3a. **Remarks:** Although commonly planted, better columnar poplar varieties exist; this one is very short-lived and subject to canker diseases.



Miscellaneous Alternate-branching Trees with Simple, Singly Toothed or Smooth Leaves (Dogwood, Serviceberries, Some Apples - See Page 55)

ALTERNATE-LEAF DOGWOOD or pagoda dogwood *(Cornus alternifolia)*
Shrub or small tree, 8' - 25' tall; broad, flat-topped crown of horizontal branches *arranged in irregular whorls*; trunk up to 6" diameter. **Leaves:** Alternate, simple, *clustered at twig ends*, 2½" - 4½" long, 2" - 3" wide, wavy or smooth margins, dark green (paler and hairy below); reddish-purple to reddish-yellow in autumn; *5 or 6 lateral veins on each side, distinctly curved, nearly parallel the margin at the ends.* **Twigs:** Yellowish- to purplish-green, smooth, *tips curved upward*; terminal buds, light brown, *2 scales*, pointed tip. **Fruit:** Drupe, ¼" diameter, bluish-black, red stalk, mature in mid-autumn. **Bark:** Dark gray to brown, smooth or divided with shallow fissures. **Range:** Native, eastern and central Minnesota; hardy to Zone 3a. **Remarks:** Shade-tolerant; slow to moderately slow growing; short-lived. Common understory species usually found in association with maples and basswoods. With the exception of alternate-leaf dogwood, all other dogwoods (*Cornus* species) found in Minnesota have opposite arrangements and tend to be shrubs, rarely trees. Other dogwoods can be identified by their leaves, which have distinctly curved lateral veins that tend to parallel the margins, and by their opposite buds, which have two scales.


Alternate-Leaf Dogwood

DOWNY SERVICEBERRY or Juneberry
(Amelanchier arborea)
Shrub or small tree, 6' - 25' tall; narrow, rounded crown; trunk up to 10" diameter. **Leaves:** Alternate, simple, 1½" - 4" long, 1" - 2" wide; *pointed tip*, tapered or heart-shaped base, sharp finely toothed margins, *11 - 17 lateral veins on each side*; dark green (*silvery-white hairs below*); yellow to red in autumn. **Twigs:** Reddish-brown, often hairy; *terminal buds, yellowish-green to pinkish-brown (tip often black), ½" - ¾" long, slender, sharply pointed.* **Fruit:** Pome, ¼" - ⅜" diameter, bright red to dark purple, mature in summer. **Bark:** *Light gray* to brown, smooth; becoming darker and shallowly fissured with *narrow, vertical, whitish stripes (ridges).*
Range: Native, eastern and central Minnesota; hardy to Zone 3a. **Remarks:** Shade-tolerant; slow-growing; moderately long-lived. Common understory tree. Edible fruits are an important wildlife food. Serviceberry is a corruption of the Roman name *sarvis* (or sorbus) describing the tree's fruit. During pioneer times, the name *serviceberry* may have become associated with the tree's beautiful spring flowers that marked the time when soils could be dug to bury people who died during the winter. Several serviceberries are native to Minnesota, but the genus is poorly described due to natural variations and crossbreeding between species.


Downy Serviceberry

ROUNDLEAF SERVICEBERRY
(Amelanchier sanguinea)
Shrub or small tree. **Leaves:** Dull green (hairy when young), coarsely toothed, broadly oval, blunt to rounded tips, 12 - 15 lateral veins on each side. **Twigs:** Bright red to reddish-brown. **Range:** Native to northeastern, north-central, and southeastern Minnesota; hardy to Zone 3a.

SASKATOON SERVICEBERRY
(Amelanchier alnifolia)
Shrub or small tree. **Leaves:** Dull green (hairy when young), oval, round or nearly square tips, 7 - 9 lateral veins on each side, sharp coarsely toothed margins above the middle (smooth below). **Twigs:** Reddish-brown. **Range:** Native to western Minnesota; hardy throughout.


Roundleaf Serviceberry

Saskatoon Serviceberry

Key to Trees without Leaves

1a. Branches, buds, or leaf scars opposite or whorled.
  2a. Terminal buds false or absent.
    3a. Twigs slender, tips often armed with a small spine; leaf scars occasionally alternate near twig ends ..... **Buckthorn, p. 38**
    3b. Twigs stout (usually ½" diameter or more), tips not armed with a small spine; leaf scars always opposite or whorled.
      4a. Leaf scars opposite or whorled in groups of 3; buds perched above leaf scar; twig pith white ..... **Catalpa, p. 38**
      4b. Leaf scars opposite, nearly to entirely encircling buds; twig pith brown ..... **Corktree, p. 32**
  2b. Terminal buds true.
    5a. Terminal buds covered with 2 visible scales.
      6a. Leaf scars narrow, much raised ..... **Dogwoods, p. 73**
      6b. Leaf scars U- or V-shaped, barely raised.
        7a. Twigs and buds covered with numerous velvety hairs; terminal buds red, about ¼" long ..... **Mountain Maple, p. 36**
        7b. Twigs and buds slightly hairy or hairless; terminal buds yellowish- to brownish-gray, usually more than ½" long, base often bulb-shaped ..... **Nannyberry, p. 39**
    5b. Terminal buds covered with 4 or more visible scales.
      8a. Terminal buds ½" - 1½" long ..... **Buckeye, p. 33**
      8b. Terminal buds less than ½" long.
        9a. Twigs or branchlets 4-sided or 4-lined; leaf scars with 1 bundle scar; fruit a 4-celled, pinkish capsule with red seeds ..... **Wahoo, p. 39**
        9b. Twigs or branchlets nearly round; leaf scars with 3 or more bundle scars; fruit a samara (often absent).
          10a. Buds woolly-brown or black; leaf scars with numerous tiny bundle scars arranged in a U- or O-shape ..... **Ashes, p. 30-31**
          10b. Buds whitish, scaly-brown, green or bright red; leaf scars with 3 (rarely 5) bundle scars ..... **Maples, Including Boxelder, p. 32, 34-37**

1b. Branches, buds or leaf scars alternate, never opposite or whorled.
  11a. Trunk or branchlets armed with thorns or spines. (11b on p.76
    12a. Thorns or spines paired at leaf scars.
      13a. Buds conspicuous, fuzzy, red; twigs lemonlike smell when broken ..... **Prickly-ash, p. 42**
      13b. Bud inconspicuous (sunken in leaf scar), reddish-brown; twigs do not smell lemonlike ..... **Black Locust, p. 42**
    12b. Thorns or spines scattered, never paired at leaf scar.

(continued on next page)

14a. Thorns smooth, shiny, without buds or leaf scars.
  15a. Buds inconspicuous (3 or more sunken in leaf scar), brownish; thorns often 3-forked; fruit a legume ..... **Honeylocust, p. 41**
  15b. Bud conspicuous, rounded, dark brown or red; thorns not forked; fruit a pome **Hawthorn p. 55**
14b. Thorns rough, often with leaf scars or buds attached.
  16a. Twigs silvery, scaly; fruit a yellow to brown, olive-shaped drupe with silvery scales ..... **Russian-olive, p. 65**
  16b. Twigs reddish-brown to black; fruits lack silvery scales.
    17a. Fruit a drupe (usually absent); twigs bitter almond smell when broken; thorns less than 1" long ..... **Plums, p. 56**
    17b. Fruit a pome (often present); twigs lack bitter almond smell; thorns often greater than 1" long ..... **Apples, Pears, p. 55-56**

11b. Trunk or branchlets not armed with thorns or spines.
  18a. Branchlets with stubby or wartlike spur shoots covered with several leaf scars.
    19a. Spur shoots numerous, wartlike; leaf scars nearly joined and clustered at the tip, fewer than 3 bundle scars; seeds borne exposed in a drupelike structure or cone.
      20a. Seeds borne in woody cones (often present); previous year's dead leaves are needlelike and often present on ground; leaf scars with 1 bundle scar ..... **Larches, p. 10**
      20b. Seeds borne in a drupelike structure (usually absent); previous year's dead leaves are fan-shaped and rarely present on the ground; leaf scars with 2 bundle scars ..... **Ginkgo, p. 48**
    19b. Spur shoots scattered, narrow; leaf scars separated, 3 or more bundle scars; fruit a pome, drupe, or nutlet.
      21a. Terminal buds absent or false (except on spur branchlets); slender male catkins often present; twigs with or without a distinct wintergreen smell when broken ..... **Birches, p. 59-61**
      21b. Terminal buds true; slender male catkins absent; twigs lack wintergreen smell when broken.
        22a. Twigs smell bitter almond when broken; fruit a drupe (often absent) ..... **Cherries, p. 68-69**
        22b. Twigs smell otherwise; fruit a pome (often present).
          23a. Leaf scars narrow and curved, 4 or more bundle scars; trunk bark marked with horizontal lines (lenticels) ..... **Mountain-ashes, p. 46-47**
          23b. Leaf scars with 3 bundle scars; trunk bark marked with or without dots (lenticels) ..... **Apples, Pears, p. 55-56**
  18b. Branchlets without stubby or wartlike spur shoots.

24a. Twig pith chambered (look carefully below the buds if the pith is white).
25a. Twigs zigzag, slender, small leaf scars, false terminal bud ..... **Hackberry, p. 65**
25b. Twigs straight, stout, large monkey-face leaf scars, true terminal bud ..... **Walnuts, p. 44-45**
24b. Twig pith solid or spongy, never chambered.
26a. Lateral buds sunken in twig or nearly to entirely encircled by U-shaped leaf scar.
27a. Twig sap milky, pith light brown; fruit a cone-shaped multiple of red drupes, covered with numerous hairs ..... **Sumacs, p. 47**
27b. Twig sap clear, pith otherwise colored; fruit a legume, hairless.
28a. Twigs slender, reddish-brown, shiny, pith white; legume thin, or appearing scaleless.
28b. Twigs stout, grayish, dull, pith salmon-colored; legume thick, never twisted ..... **Coffeetree, p. 40**
26b. Lateral buds not sunken in twig or encircled by leaf scar.
29a. Buds covered with 1-3 exposed scales or appearing scaleless.
30a. Buds covered with a single caplike scale or sheath ..... **Willows, p. 66-67**
30b. Buds covered with 2 - 3 scales.
31a. Leaf scars with 3 or fewer bundle scars or bundle scar groups.
32a. Leaf scars clustered at ends of upturned twigs; fruit a drupe; slender male catkins absent ..... **Alternate-leaf dogwood, p. 73**
32b. Leaf scars not clustered at ends of upturned twigs; fruit a nutlet; slender male catkins often present.
33a. Nutlets grouped in a woody, pinecone-like catkin (often present); buds with 2 scales meeting at their edges, perched on a small stalk; twig pith triangular in cross section, lacks wintergreen odor **Alder, p. 63**
33b. Nutlets grouped in a nonwoody catkin (usually absent); buds with 2 - 3 overlapping scales, flush with twig; twig pith round or flattened in cross section, with or without wintergreen odor when broken ..... **Birches, p. 59-61**

(continued on next page)

31b. Leaf scars with 4 or more bundle scars or bundle scar groups.
34a. Buds yellow, slender; fruit a husked nut ..... **Bitternut Hickory, p. 43**
34b. Buds red or green, fat, slimy when chewed; fruit a nutletlike drupe attached to a leaflike wing ..... **Lindens, p. 64**
29b. Buds covered with 4, 6, or more overlapping scales.
35a. Leaf scars with 4 or more bundle scars.
36a. Bundle scars arranged in a U-shaped line or a narrow curved line.
37a. Fruit a red or orange pome (often present); buds fuzzy, white or red, and gummy, true terminal bud; leaf scars narrow and curved ..... **Mountain-ashes, p. 46-47**
37b. Fruit a samara (usually absent); buds brown and not gummy, false terminal bud; leaf scars nearly as wide as long **Elms, pp. 57-58**
36b. Bundle scars scattered or otherwise grouped.
38a. Buds clustered at twig tips; fruit an acorn.
39a. Terminal bud tip pointed; inner surface of acorn shell is fuzzy ..... **Red Oak Group, p. 52-53**
39b. Terminal bud tip blunt or nearly blunt; inner surface of acorn shell is hairless ..... **White Oak Group, p. 49-51**
38b. Buds not clustered at twig tips; fruit not an acorn.
40a. Twig sap milky; false terminal bud, often absent ..... **Mulberries, p. 54**
40b. Twig sap clear; true terminal bud, greater than ½" long ..... **Shagbark Hickory, p. 44**
35b. Leaf scars with 3 or fewer bundle scars.
41a. Slender, cigar-shaped male catkins present.
42a. Trunk bark white, yellow, black, gray, or pinkish with prominent horizontal lines (lenticels), often peeling in horizontal paperlike curls ..... **Birches, p. 59-61**
42b. Trunk bark grayish-brown with inconspicuous lenticels, vertically fissured ..... with narrow ridges, ridges sometimes curl at ends ..... **Ironwood, p. 62**

41b. Male catkins absent.
43b. Terminal buds false (often absent).
44a. Trunk fluted in cross section, bark smooth and gray with musclelike ridges; buds angled or 4-sided in cross section, 10 or more scales in 4 rows ..... **Blue-beech, p. 63**
44b. Trunk nearly round in cross section, bark often deeply furrowed; buds nearly round, 4 to 8 scales in 2 rows ..... **Elms, p. 57-58**
43a. Terminal buds true.
45a. Twig pith star-shaped in cross section; lowest scale of lateral buds centered directly over leaf scar ..... **Poplars, p. 70-72, 54**
45b. Twig pith round in cross section; lowest scale of lateral buds not centered over leaf scar.
46a. Buds egg- or cone-shaped, sometimes clustered at twig ends; twigs distinct bitter almond smell when broken; trunk bark with horizontal lines (lenticels) or scaly ..... **Cherries, p. 68-69**
46b. Buds long and slender, sharply pointed; twigs smell otherwise; trunk bark marked with vertical stripes ..... **Serviceberries, p. 74**

?

Section Four:
YOUTH PROJECTS

The following activities provide opportunities to practice identification skills and share knowledge with others. The activities were designed for elementary-age children, but can be easily adapted for use with younger or older learners.

Activities

1. During the summer, collect leaves from 25 different Minnesota trees; identify and mount according to instructions.
2. Collect fruits or seed cones from 10 different Minnesota trees. Identify the fruits or seed cones, label them, and make a case in which they may be attractively displayed.
3. Select a large tree near your home that you can study. Keep records on its appearance and growth during the year.
4. Exhibit your leaf collection, fruit collection, project report, and record of activities at a 4-H club meeting, a community exhibit, or a county fair. Use a scrapbook or display box.
5. During the winter, collect, identify, and mount twigs from 12 Minnesota trees. Exhibit these with your leaf collection.
6. Make an educational forestry exhibit and display it in a local store window, county fair, or community exhibit. Exhibits encouraging forest protection, tree planting, or forest management are recommended.
7. Make a collection of 15 leaf prints of Minnesota trees and shrubs. Identify and label them.
8. Certain trees have characteristic leaf colors in the fall. List at least 15 trees and indicate the fall color of each tree.
9. Write an essay on a subject of interest to you that might be used as a newspaper article or a talk. You might want to write about our state tree and how it was chosen, or about your favorite tree and why you selected it as your favorite.

Suggested Presentations

1. Identifying trees by leaf characteristics.
2. Collecting, pressing, and mounting tree leaves.
3. Making leaf prints.
4. Using a plant key to identify trees.
5. Making a display box for exhibiting fruits.

Leaf Collection

When you go out to collect leaves, take along a newspaper or a large magazine. Put the leaves between the pages to keep them from drying out too fast and to protect them from being torn or broken. Press the leaves as soon as you can. If you need to, ask for help in identifying leaves. But before you ask for help, try to do it yourself using the keys in this book. Remember, there is great satisfaction in doing a good job by yourself.

Tips on Collecting Leaves

1. Do your collecting in early to mid summer so you will get mature leaves.
2. Collect leaves mainly from native forest trees rather than introduced species.
3. Select good leaves. Avoid insect-eaten or torn leaves.
4. Most important: Make sure you have the whole leaf and not just a leaflet when collecting specimens from trees such as walnut, honeylocust, or others that have compound leaves.
5. When collecting leaves, carry a newspaper with you and slip the leaves you collect between the pages. Be sure they are flat. This will prevent the leaves from curling and becoming difficult to press.

Instructions for Pressing Leaves

1. Lay your leaves flat between sheets of newspaper or other porous paper.
2. Place heavy weights such as bricks on top so your leaves are pressed flat. Don't try to press too many leaves at one time.
3. Change the papers every two days and use plenty of dry newspapers. Otherwise your leaves may mildew.
4. While drying, place your collection in an area where there is good air circulation.

Mounting Tree Leaves

After pressing, mount leaves on cardboard and label each to show: (1) common name, (2) scientific name, (3) where it was found, (4) date collected, and (5) name of the collector. Be careful when mounting the leaves to prevent damage. Use rubber cement or another appropriate adhesive to fasten the leaves to the cardboard. Make your arrangements neat and attractive.

Example:
Common name: American Elm
Scientific name: *Ulmus americana*
Where found: University of Minnesota, St. Paul Campus
Date: October 28, 1995
Collected by: Carrie Turner

Leaf Prints

You can make a permanent collection of leaf shapes by making leaf prints. All that you need are an ink pad (the larger the better), white paper (typewriter paper is fine), newspapers, and your leaves.

Press the leaves for an hour between newspapers. This will flatten them and make them easier to print. Then place each leaf, undersurface down, on the ink pad. Cover the leaf with one thickness of newspaper and rub it firmly to get ink on the margin, the stem, and the veins. If the leaf is larger than the ink pad, you will have to move the leaf around to get ink over the entire undersurface.

Place the inked leaf on your paper. Cover the leaf with one thickness of clean newspaper and rub thoroughly. Be sure to rub the entire leaf and do not let it slip or you will spoil the print. When you remove the leaf from your paper, the ink print will remain. Label your pages neatly and bind them into a notebook.

You also can make leaf prints on fabric for tablecloths or t-shirts. Paint the underside of the leaf with fabric paint using a small ink roller or sponge. Use more than one color for depth if you wish. Carefully place the leaf paint side down on the cloth and cover it with one thickness of clean newspaper. Use a roller to evenly press the leaf paint onto the fabric. Remove the leaf from the cloth, being careful not to smudge the ink.

Fruit and Seed Cone Display Box

Tree fruits and seed cones are very irregular in size and are best mounted in a display box. Use a shoe box, or a box of similar size, cut to a depth of about 2 inches. Place a layer of cotton in the box and arrange the fruits neatly on the cotton. Any number of fruits or seed cones may be put in the box as long as they are arranged neatly and are not too crowded. Place a name tag near each specimen for identification (see the example above under "Mounting Tree Leaves"). The appearance of your box may be greatly improved by covering the outside with cloth, wallpaper, or a similar attractive material. Its strength may be increased by reinforcing the corners with tape. Cover the box with plastic wrap or another clear material.

REFERENCES

The sources listed were used in development of this book. Sources shown in bold type are likely to be found in local bookstores or libraries and may be useful as additional teaching material.

Bailey, L. H. 1977. *Manual of Cultivated Plants.* New York: MacMillan Publishing Co., Inc. 1,116 pp.

Barnes, B. V., and W. H. Wagner. 1981. *Michigan Trees.* Ann Arbor: University of Michigan Press. 383 pp.

Dirr, M. A. 1990. *Manual of Woody Landscape Plants: Their Identification, Ornamental Characteristics, Culture, Propagation and Uses.* Champaign, Ill.: Stipes Publishing Company. 1,007 pp.

Eisel, M. C. 1990. *Trees, Shrubs & Vines for Minnesota Landscapes (AG-BU-0545).* St. Paul: University of Minnesota, Minnesota Extension Service. 35 pp.

Elias, T. S. 1987. *The Complete Trees of North America.* New York: Gramercy Publishing Company. 948 pp.

Gibson, H. H. 1913. *American Forest Trees.* Chicago, Ill.: Hardwood Record. 708 pp.

Harlow, W. M., E. S. Harrar, J. W. Hardin, and F. M. White. 1991. *Textbook of Dendrology.* New York: McGraw-Hill, Inc. 501 pp.

Johnson, A. G., and S. S. Pauley. 1967. "Rare Native Trees of Minnesota," *Minnesota Science* 23(4): 27-31.

Little, E. L. 1980. *The Audubon Society Field Guide to North American Trees (Eastern Region).* New York: Alfred A. Knopf, Inc. 714 pp.

Minnesota Association of Soil and Water Conservation Districts—Forestry Committee. 1986. *Minnesota Tree Handbook.* Staples, Minn.: Adventure Publications. 408 pp.

Minnesota Department of Natural Resources. 1986. *Trees of Minnesota.* St. Paul: Division of Forestry. 64 pp.

Ownbey, G. B., and T. Morley. 1991. *Vascular Plants of Minnesota: A Checklist and Atlas.* Minneapolis: University of Minnesota Press. 307 pp.

Peattie, D. 1950. *A Natural History of Trees of Eastern and Central North America.* Boston: Houghton Mifflin Co. 606 pp.

Pellett, H., N. Rose, and M. Eisel. 1991. *The Right Tree Handbook.* St. Paul: University of Minnesota, Department of Horticulture, Minnesota Extension Service and Minnesota Landscape Arboretum. 256 pp.

Petrides, G. A. 1988. *A Field Guide to Eastern Trees.* Peterson Field Guide Series. Boston: Houghton Mifflin Co. 272 pp.

Rosendahl, C. O. 1955. *Trees and Shrubs of the Upper Midwest.* Minneapolis: University of Minnesota Press. 411 pp.

SPECIES INDEX AND CHECKLIST

* denotes species native to Minnesota

☐ White Fir
where: _____
when: _____

GINKGO (*Ginkgo*) 48
☐ Ginkgo
where: _____
when: _____

HACKBERRY (*Celtis*) 65
☐ Hackberry*
where: _____
when: _____

HAWTHORN (*Crataegus*) 55
☐ Hawthorn (thornapple) species*
where: _____
when: _____

HEMLOCK (*Tsuga*) 16
☐ Canadian Hemlock (eastern hemlock)*
where: _____
when: _____

HICKORIES (*Carya*) 43-44
☐ Bitternut Hickory*
where: _____
when: _____

☐ Shagbark Hickory*
where: _____
when: _____

IRONWOOD (*Ostrya*) 62
☐ Ironwood (hop-hornbeam)*
where: _____
when: _____

JUNIPERS (*Juniperus*) 9
☐ Redcedar, Eastern (juniper)*
where: _____
when: _____

☐ Rocky Mountain Juniper
where: _____
when: _____

LARCHES (*Larix*) 10
☐ Eastern Larch (tamarack)*
where: _____
when: _____

☐ European Larch
where: _____
when: _____

☐ Japanese Larch
where: _____
when: _____

☐ Siberian Larch
where: _____
when: _____

LINDENS (*Tilia*) 64
☐ Basswood, American (American linden)*
where: _____
when: _____

☐ Little-leaf Linden
where: _____
when: _____

LOCUSTS 41-42
☐ Black Locust (*Robinia*)
where: _____
when: _____

☐ Honeylocust (*Gleditsia*)*
where: _____
when: _____

MAPLES (*Acer*) 32, 34-37
☐ Amur Maple
where: _____
when: _____

☐ Black Maple*
where: _____
when: _____

☐ Boxelder (Canadian maple)*
where: _____
when: _____

☐ Mountain Maple*
where: _____
when: _____

☐ Norway Maple
where: _____
when: _____

☐ Red Maple (soft maple)*
where: _____
when: _____

☐ Silver Maple (soft maple)*
where: _____
when: _____

☐ Sugar Maple (hard maple)*
where: _____
when: _____

☐ Tatarian Maple
where: _____
when: _____

MULBERRIES (*Morus*) 54
☐ Red Mulberry*
where: _____
when: _____

☐ Russian Mulberry
where: _____
when: _____

NANNYBERRY (*Viburnum*) 39
☐ Nannyberry*
where: _____
when: _____

OAKS (*Quercus*) 49-53
☐ Black Oak (yellow oak)*
where: _____
when: _____

☐ Bur Oak*
where: _____
when: _____

☐ Chinkapin Oak*
where: _____
when: _____

☐ Pin Oak, Eastern
where: _____
when: _____

☐ Pin Oak, Northern (Hill's oak)*
where: _____
when: _____

☐ Red Oak, Northern*
where: _____
when: _____

☐ Swamp White Oak (bicolor oak)*
where: _____
when: _____

☐ White Oak*
where: _____
when: _____

POPLARS (*Populus*) 54, 70-72

☐ Balsam Poplar (balm of Gilead)*
where: _____
when: _____

☐ Bigtooth Aspen*
where: _____
when: _____

☐ Cottonwood, Eastern*
where: _____
when: _____

☐ Lombardy Poplar
where: _____
when: _____

☐ Trembling Aspen (quaking aspen)*
where: _____
when: _____

☐ White Poplar
(European poplar)
where: _____
when: _____

PINES (*Pinus*) 11-13

☐ Austrian Pine (black pine)
where: _____
when: _____

☐ Jack Pine*
where: _____
when: _____

☐ Mugo Pine
where: _____
when: _____

☐ Ponderosa Pine
where: _____
when: _____

☐ Red Pine (Norway pine)*
where: _____
when: _____

☐ Scotch Pine (Scots pine)
where: _____
when: _____

☐ White Pine, Eastern*
where: _____
when: _____

PLUMS (*Prunus*) 56

☐ American Plum (wild plum)*
where: _____
when: _____

☐ Canada Plum*
where: _____
when: _____

RUSSIAN-OLIVE (*Elaeagnus*) 65

☐ Russian-olive
where: _____
when: _____

SERVICEBERRIES (*Amelanchier*) 74

☐ Downy Serviceberry (Juneberry)
where: _____
when: _____

☐ Roundleaf Serviceberry
where: _____
when: _____

☐ Saskatoon Serviceberry
where: _____
when: _____

SPRUCES (*Picea*) 14-15

☐ Black Spruce (bog spruce)*
where: _____
when: _____

☐ Colorado Spruce (blue spruce)
where: _____
when: _____

☐ Norway Spruce
where: _____
when: _____

☐ White Spruce (skunk spruce)*
where: _____
when: _____

SUMACS (*Rhus*) 24, 47

☐ Poison Sumac*
where: _____
when: _____

☐ Smooth Sumac*
where: _____
when: _____

☐ Staghorn Sumac*
where: _____
when: _____

tamarack (see Larches)

WAHOO (*Euonymus*) 39

☐ Wahoo (eastern burningbush)*
where: _____
when: _____

WALNUTS (*Juglans*) 44-45

☐ Black Walnut*
where: _____
when: _____

☐ Butternut (white walnut)*
where: _____
when: _____

WILLOWS (*Salix*) 66-67

☐ Bebb Willow*
where: _____
when: _____

☐ Black Willow*
where: _____
when: _____

☐ Heartleaf Willow*
where: _____
when: _____

☐ Laurel Willow
where: _____
when: _____

☐ Peachleaf Willow*
where: _____
when: _____

☐ Pussy Willow*
where: _____
when: _____

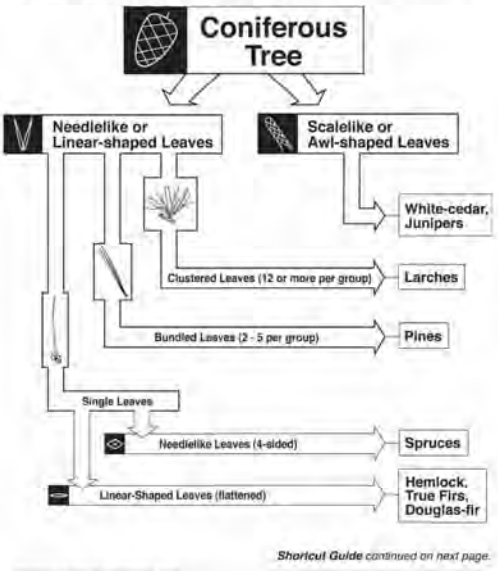
☐ Sandbar Willow*
where: _____
when: _____

☐ Shining Willow*
where: _____
when: _____

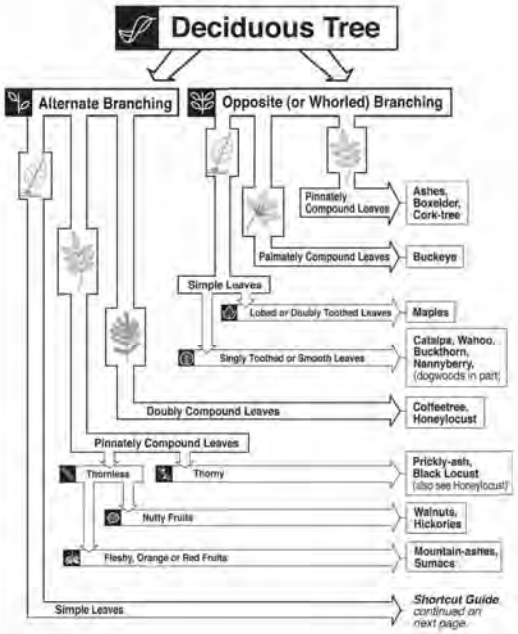
☐ White Willow
where: _____
when: _____

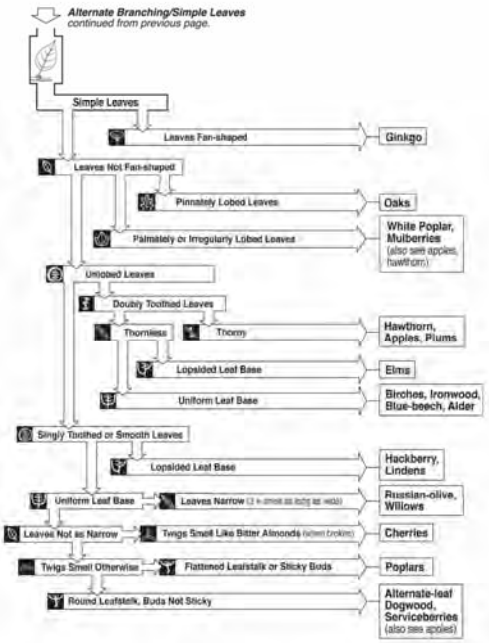
Shortcut Guide to Minnesota Trees

You can use the following chart as a guide when identifying trees. Begin with the coniferous or deciduous page, then follow the arrows, branching as appropriate according to the characteristics of the tree in question. Please note, however, that this brief guide does not cover all identifying traits or options. Refer to the keys on pages 8, 25, and 75 and to the individual species descriptions to confirm and complete your "shortcut" identification.



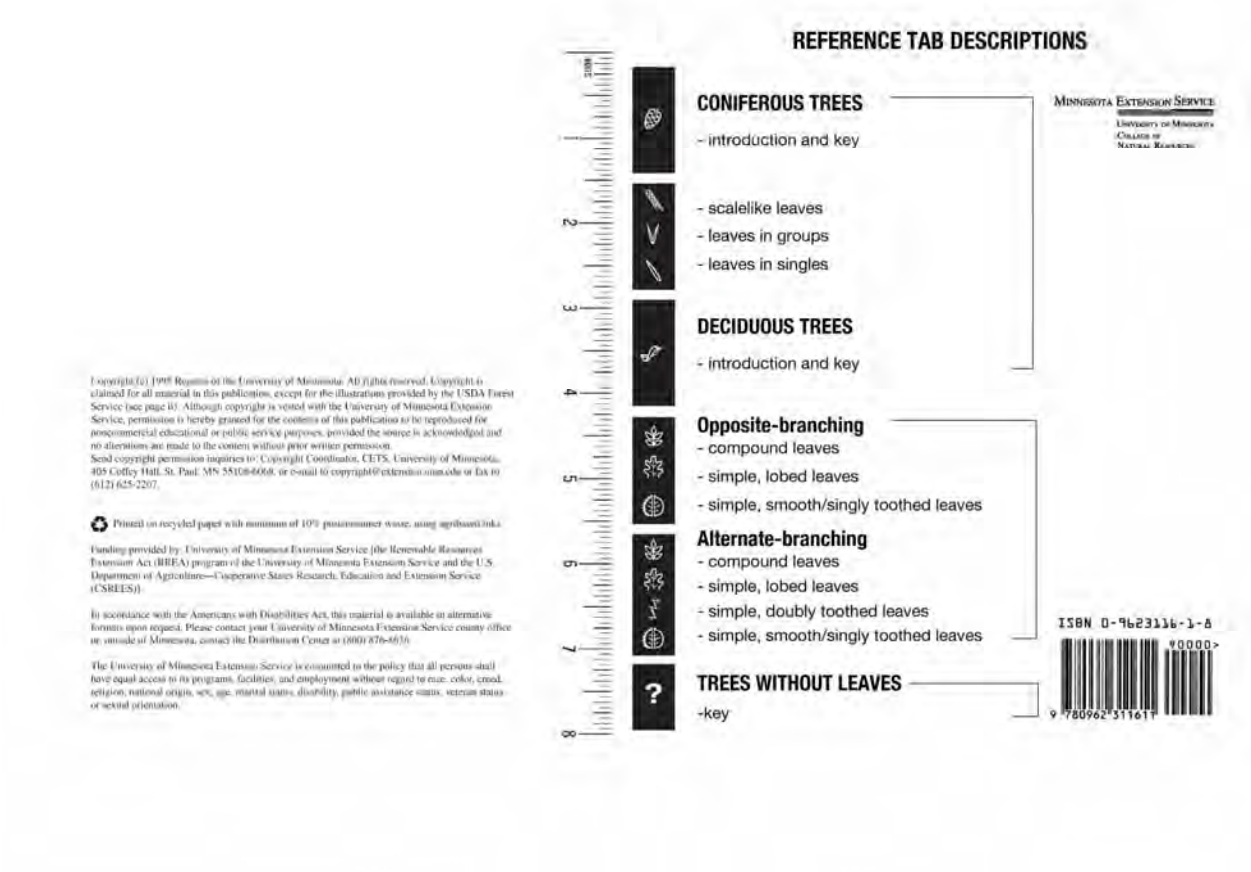
Shortcut Guide *continued on next page.*





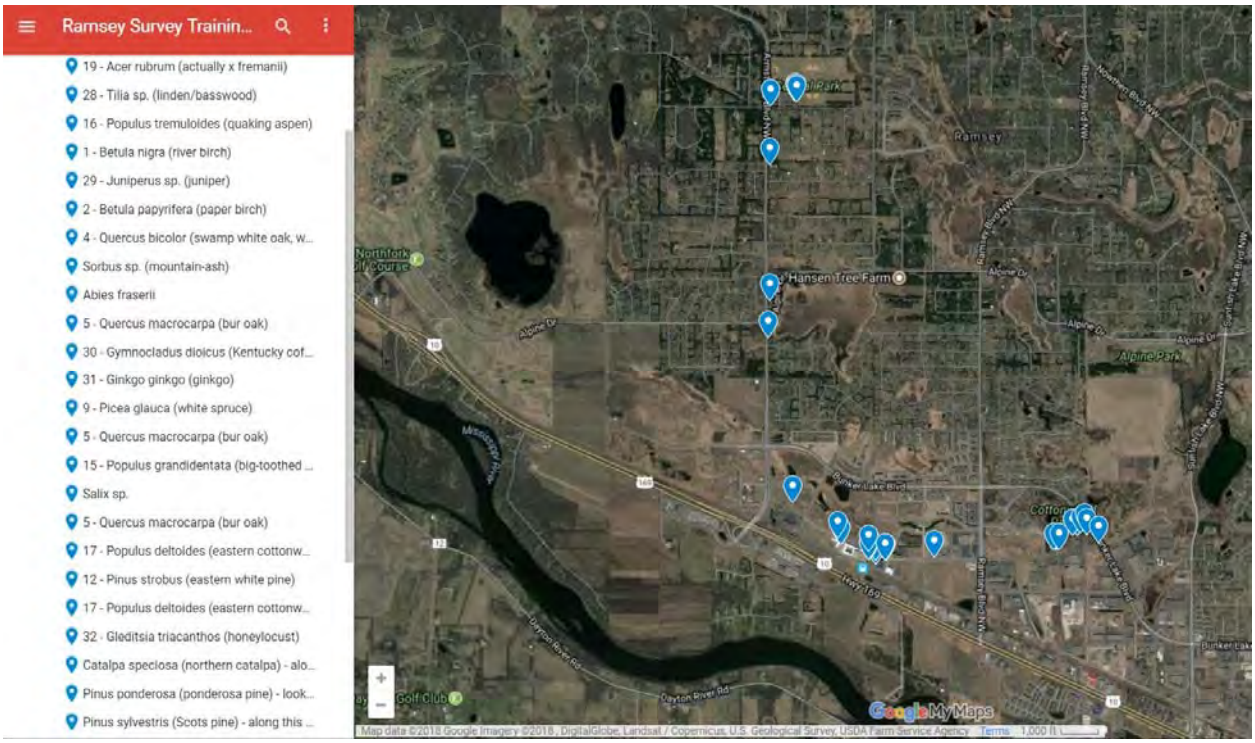
Shortcut Guide to Minnesota Trees

NOTES



Appendix M: Map of outdoor training locations

Below is a map of the location where the outdoor training session will occur. Trees that will be utilized to help teach genus and species identification have been marked. The interactive map is located here:
https://drive.google.com/open?id=1J5Ai7EmjLqQsp0lBoZs94rVcU2Y7DVfO&usp=sharing



Appendix N: Training Outline

Below is an outline of the materials, schedule, and methods used to conduct the volunteer training sessions, both indoor (day 1) and outdoor, (day 2).

<u>Indoor Training Session (Day 1) - 3 hours</u>
Room: AV setup capability, seating with tables, kitchenette

PowerPoint Presentation:

- Intro to the survey
- Tree ID
- Age class
- Condition Rating

Materials:

- DBH tape
- 50’ cloth measuring tape
- Data collection sheets
- Tree ID samples/ Riker mounts
- Condition samples such as branch unions, from UFORE lab
- Printed manuals for each volunteer:
    - Volunteer Manual
    - Tree ID cards packet
    - Minnesota Trees packet

- Volunteer sign in sheet for both days
- Volunteer ID tags
- Refreshments for the volunteers

Outdoor Field Session (Day 2), 6 hours

- Establish volunteer teams/groups (these teams will be used throughout the survey)
- Tree identification, d.b.h. Measurements, condition ratings
- Data collection how-to
    - How to fill out the data sheets
    - Where to start in a block
    - Where to submit data sheets

Conducting the training:

Indoor Day 1, 3hr session (5:30pm-8:30pm):

- Set up AV equipment, refreshments, volunteer sign in, and volunteer materials
- Volunteer sign in and materials pickup
    - Each volunteer receives: a volunteer manual, a tree ID packet, a volunteer ID tag
- Beginning the training
    - Welcome and icebreaker
    - Day 1 presentations
        - Introduction to the tree survey ppt
        - Tree ID ppt
        - 5-10 minute break
        - Condition Rating ppt
    - Wrapping up
        - Go over day 2 location for field session
        - Answer any final questions

Outdoor Day 2, 6hr session (9am-3pm):

- Welcome in volunteers; volunteer sign in; refreshments distributed
    - Pass out the data collection sheets
    - Pass out the tree segments packets
- Have people establish teams **(this will be their future collection team!)**
- Tree ID
    - Teach identification of all the trees listed on the trees to be identified to species list (manual page 12)
    - Have volunteers practice identification
- Age-class (interactive, participatory, learning)
    - Teach and practice DBH and canopy measurements
    - Have volunteers lead the group through example trees
- Tree Condition Rating (interactive, participatory, learning)

        - Teach and practice condition rating scales
            - Teach and practice condition rating
            - Have volunteers identify trees and rate conditions as a group
                - If possible, and if enough instructors present, break into smaller groups for practice session
- 1-hour lunch **(lunch to be provided to volunteers)**
- Remainder of session spent outside on tree ID, age-class, condition rating, and practice taking survey data
    - Volunteers will work in their groups
        - Staff/trainers will rotate between groups to check for accuracy and answer questions
- Training Conclusion
    - Collect materials and answer any remaining questions
    - Explain volunteers next steps
        - Remind volunteers to establish times to survey and to turn in data forms upon each completed segment

Chapter Three
Technical Assistance/ Website

Authors: Luke Bailey, Amelia Kreiter, Nam Nguyen, Dan Wattenhofer

The primary focus of this section is to outline online information and resources regarding the project that is posted on the website *mntreesource.umn.edu*, hosted by the University of Minnesota. Posting information and resources online will keep everyone informed about the state of the project, and help volunteers conduct surveys faster, more accurately, and more conveniently. The website will also provide resources to volunteers who may not be confident about their tree identification skills.

On the *mntreesource.umn.edu* website, information on this project is contained in a tab titled "Ramsey Tree Survey" on the green bar near the top. This tab has a drop-down menu containing the following sub-tabs:
Training Sign-up: information and announcements related to volunteer training sessions and training sign-up forms.
Training Materials: Additional resources provided by the survey setup and volunteer training groups and compiled for the user's convenience.
Data Collection Resources: Data collection worksheets available for printout or download, as well as a list of all street segments that will be sampled in the survey.
Tree Identification Resources: Tree identification cards provided by the University of Minnesota that will help with field ID of various species likely to be encountered during the survey.

Additional training materials that were made available during the in-person training sessions, space for volunteers to report their data include:
Frequently Answered Questions (FAQ) section.
Contact Us section, where anyone can leave feedback and ask questions not found in the FAQ section to the organizers of the project.

This space on mntreesource.umn.edu will serve both as an archive where methodology and findings can be found, as well as an active and dynamic space where those seeking more information regarding the City of Ramsey Tree Survey may be able to find the resources needed to stay informed and answer any question they have on the project.