IDAHO STATE FORESTRY CONTEST

Instruction Manual for Teachers and Students

Sponsored by:

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IN DEDICATION TO RAY AND FAIRY DELAY

DELAY FARMS – CAREYWOOD, IDAHO

The Idaho State Forestry Contest began as a joint effort of the Bonner Soil and Water Conservation District, USDA Soil Conservation Service and the Idaho Department of Lands. During the formative meeting with district supervisors and agency staff, Ray and Fairy Delay offered their family property to host the first contest in May 1983.

Delay Farms, located along US Highway 95 about midway between Sandpoint and Coeur d'Alene, provided convenient access. The vast farmstead allowed convenient parking and facilities, including a Depression era outhouse. Most of all, the 1,000 acres of forestland guaranteed diverse venues for educational and competitive purposes.

In addition to operating both dairy and beef livestock operations, Delay Farms produced various agricultural crops along with forest management. The Delays received many awards including Bonner County Grassman, Woodsman of the Year and Idaho Outstanding Tree Farmer of the Year.

Ray and Fairy were active in local, state and national conservation organizations. A short list includes the Fair Board, Farm Bureau, Soil Conservation District, Idaho Dairy Products Commission, Idaho Dairyman's Association, Idaho-Washington Resources Conservation and Development Council, National Resources Conservation and Development Council, and Idaho Forest Owners Association. Ray and Fairy comprised an effective and influential conservation team while serving in leadership roles of many of these organizations.

As the contest grew, opportunities were added for younger students to participate in novice and rookie educational divisions in order to prepare them for the Junior/Senior competitive divisions. Ray and Fairy graciously accommodated this massive expansion by allowing more forestland for use and installing additional outlets in the farm buildings.

As far as Ray and Fairy were concerned, Delay Farms would be the permanent home of the Idaho State Forestry Contest, and Gene and Ray Delay Jr. carried on this legacy their parents began. However, increasing traffic on the BNSF Railroad at the farm's entrance forced the contest to seek another location. Since 2022, Farragut State Park has hosted the Idaho State Forestry Contest.

In dedicating this manual to Ray and Fairy Delay, we express our deepest appreciation to the Delay family and thank them for almost four decades of forestry and environmental education that occurred at Delay Farms.

IDAHO STATE FORESTRY CONTEST

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INTRODUCTION

HISTORY

Welcome to the Idaho State Forestry Contest! The inaugural contest was held in 1983 at Delay Farms near Careywood, Idaho. Based on its initial success, there was no question that the contest would become an annual event. The contest was jointly sponsored by the Idaho Department of Lands, the Bonner Soil and Water Conservation District, and Panhandle Lakes Resource Conservation and Development. In 2022 the contest moved to Farragut State Park in Athol and in 2023, the contest celebrated its 40th anniversary. The contest has proven to be a unique and memorable event. Many past contestants have pursued rewarding careers in forestry or resource management and come back to volunteer and help carry the legacy forward. We encourage students from around the state to be a part of this Idaho tradition!

CONTEST OBJECTIVES

The primary objective of the contest is to introduce young people to basic forestry concepts and skills. By gaining this knowledge, participants develop a higher degree of understanding and appreciation of the natural environment and Idaho's vast forest resource.

A secondary objective is to provide students the opportunity to interact with foresters and other resource management professionals. Combined with the contest, this interaction gives students a chance to explore the variety of career opportunities in the field of forestry and natural resource management.

PURPOSE OF THIS MANUAL

This manual provides instruction in ten forestry subject areas. Students can master each of the subjects by developing skills using common forestry tools and by applying associated knowledge. The skills and knowledge they develop are then tested at the contest, with prizes awarded to the top competitors.

Many of these subjects are likely new to both adults and students. Students and the adults that coach them are encouraged to spend “hands-on” time practicing under the guidance of a professional forester. Practice kits with all the necessary forestry tools are available on loan. Contact your local Idaho Department of Lands office to arrange for coaching assistance and practice kits.

HOW THE CONTEST WORKS

The contest is open to 5th through 12th grade students. Students compete in three divisions based on grade level: Rookie (5th and 6th), Junior (7th and 8th) , and Senior (9th through 12th).

The Rookie Division is tested on five manual subjects: 1) Log Scaling, 2) Timber Cruising, 3) Tree and Plant Identification, 4) Map Reading and 5) Compass and Pacing. Rookies are also introduced to Silviculture, but are not tested on this subject.

The Junior and Senior Divisions are tested on all ten manual subjects: 1) Log Scaling, 2) Timber Cruising, 3) Tree and Plant Identification, 4) Map Reading, 5) Compass and Pacing, 6) Tool Identification, 7) Soils and Water Quality, 8) Tree Health, 9) Silviculture, and 10) Noxious Weeds.

Each contestant competes for an individual score. Contestants can also choose to compete as part of a team. Teams consist of four people within the same division. The individual scores are combined into the team score. Prizes are awarded to top individuals and teams in all divisions.

This is a competitive event, and all contestants are required to complete the contest on their own. Cheating in any form will result in disqualification.

Students must be age 19 or under on contest day. Contestants may choose to “move up” and compete in a higher division. Students are not allowed to compete in a lower division.

The contest is not limited to school-sponsored teams: Home school groups, 4-H, Boy Scouts, Girl Scouts, FFA and other youth organizations are encouraged to participate.

TIE BREAKER RULES

If two teams or individuals have identical scores, a tie-breaking system has been established. The team (or individual) with the highest Plant Identification score will be declared the winner. In the event they are also tied, move on to Log Scaling, then Timber Cruising, Map Reading, Compass and Pacing, Tool Identification, Soils and Water Quality, Tree Health, and Silviculture, in that order.

The Contest Steering Committee hopes you all study hard and enjoy the upcoming

IDAHO STATE FORESTRY CONTEST!!

CHAPTER 1 - LOG SCALING

Log scaling is a system of measuring the volume of usable wood in a log before it is cut into lumber or other products. Log scaling is important to timber owners, foresters, loggers, and sawmills. This is because log volume measurements are used to help determine harvested timber values and products that can be made from it.

Throughout the United States, we use **board foot volume** to express log volume. The basic unit of measurement is one (1) board foot which is equal to a 12-inch by 12-inch board that is one (1) inch thick.

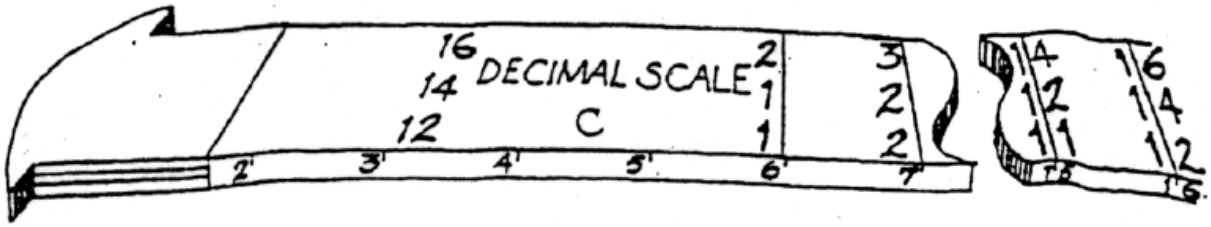
You need two measurements to determine the **gross board foot volume** of a log: **length** and **diameter**. Measure the length of a log in feet, and measure the diameter of the small end of the log in inches. You also need to determine the species of the log. You will learn about that later in this chapter.

LOG SCALING TOOLS

To determine the board foot volume of a log, you will need a **measuring tape** and either a **log scale stick** or a **log rule table**.

A log scale stick simplifies scaling because it combines both a measuring stick and a table of log volumes. Divisions on the log scale stick are to the one-half inch, so no rounding is needed.

There are different configurations of scale sticks available, and log lengths may be displayed differently, so be sure to be familiar with your tools. In the Forestry Contest, you will be using a Coconino Scribner Decimal C scale stick.

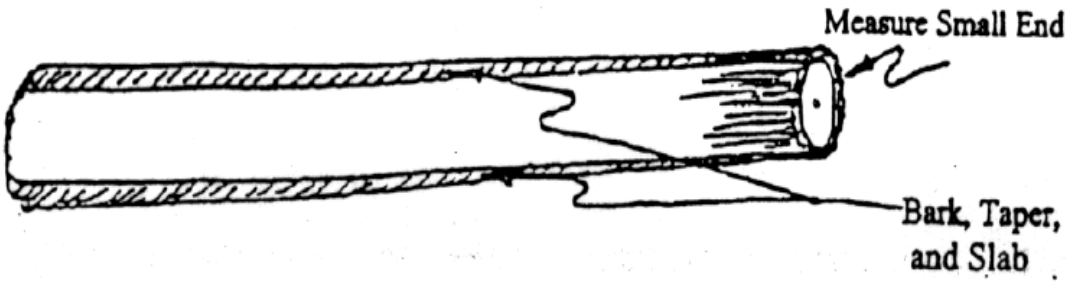


You can use any kind of measuring tape to measure log length. Professional scalers typically use logger's tape, which is a more rugged and versatile measuring tape.

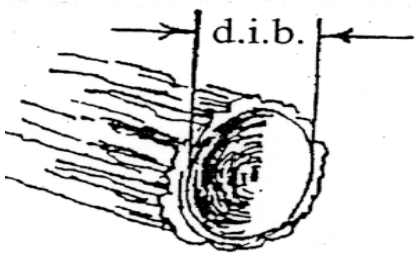
HOW TO DETERMINE BOARD FOOT VOLUME OF A LOG

Step 1: Measure The Diameter

Always measure the *diameter of the small end of the log*. Read the scale stick directly from the end of the log, not obliquely from the side.



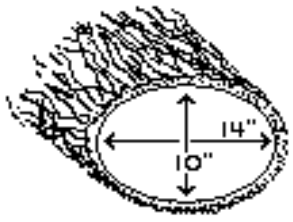
The diameter of a log is always measured inside the bark. This measurement is called "**diameter inside of bark**" or **d.i.b**. The bark is not considered in board foot volume because it is not usable wood. Use a log scale stick to measure the d.i.b. at the small end of the log.



Non-circular logs and rounding rules:

The ends of logs are not always circular, so you will determine the diameter by averaging the short measurement and long measurement, taken at 90 degrees from each other. Take both measurements through the true (geometric) center of the log, not the "center" of the log as shown by growth rings or pith.

$$\frac{10+14}{2} = 12$$



Take each diameter measurement to the nearest inch. Measurements that fall exactly on the 1/2-inch are rounded as follows:

- Round up when only one of the diameter measurements falls on the 1/2-inch.
- When both measurements fall on the 1/2-inch, round one up and the other down.
- When the average of the two diameters results in a 1/2-inch measurement, round down for the final scaling diameter.

Step 2: Measure the Length

Scaling length is always expressed in whole, one-foot increments. Measure the length of a log in feet and inches, and then round to the whole-foot increment by following these specific rules:

- Eight (8) inches or less: Round down to the next whole-foot increment.
- More than eight (8) inches: Round up to the next whole-foot increment.

Logs are usually cut a few inches longer than the scaling length specified by the sawmill to allow for minor log end damage and to square the ends of boards sawn from the log. In other words, a 16-foot log will generally be somewhat more than 16 feet long. This extra length is called **trim allowance**. Trim allowance will vary according to sawmill specifications. *Full trim allowance* is six inches, but logs often vary from this trim by up to two inches.

A log may have a *maximum of eight (8) inches of trim allowance* added to its scaling length. For example, a log measuring 16 feet 8 inches is considered to have a 16-foot scaling length when calculating volume. When a measured log length is more than 16 feet 8 inches, the scaling length is rounded up to the next higher foot, so a log that is 16 feet 9 inches in measured length has a 17-foot scaling length and the volume is calculated using that 17-foot length.

Below is a Scaling Length Determination Table used to calculate volume for all commercial log lengths up to 20 feet 8 inches. Based on this table, what scaling length would you use to calculate the volume of a log measuring 20 feet 10 inches?*

Measured Log Length	Scaling Length
8’1” – 8’8”	8
8’9” – 9’8”	9
9’9” – 10’8”	10
10’9” – 11’8”	11
11’9 – 12’8”	12
12’9” – 13’8”	13
13’9” – 14’8”	14
14’9” – 15’8”	15
15’9” – 16’8”	16
16’9” – 17’8”	17
17’9” – 18’8”	18
18’9” – 19’8”	19
19’9” – 20’8”	20

*Answer: 21 feet

Step 3: Calculate Board Foot Volume

After measuring the small end of the log's d.i.b. and log length, the **Scribner Decimal C Log Rule Table** is used to calculate its board foot volume. A portion of the Scribner Decimal C Log Rule Table used by professional Idaho scalers is on the next page. You will use this table or a **Coconino Scribner Decimal C scale stick** in the Forestry Contest to calculate board foot volumes of the logs you measure.

The Scribner Decimal C Log Rule Table is based on the "C" or third revision of an early 20th century log volume table that expresses board foot volumes in "decimal" form (the scale stick also does this). This means the actual volume figure has been rounded to the nearest 10 board feet (6 BF rounds up, 5 BF rounds down), the decimal point was moved to the left, and the zero was dropped.

For example, a log that scales at 802 BF was rounded down to 800 BF, the decimal was moved one place to the left (i.e. 80.0) and the zero was dropped, so the volume **reads** as 80 on the Scribner Decimal C Table or scale stick.

After determining the board foot volume on either tool, you must remember to multiply by ten (add the zero back) to express the **gross board foot volume** of the log (800 BF).

EXAMPLE A

To determine the board foot volume of a log using the Scribner Decimal C Log Rule Table, move your finger across the row from the d.i.b. (8 inches, for example) and down the column from the log length (18 feet, for example) to the point where they intersect (at 3).

Remember, the words "Decimal C" mean that all board foot volumes shown in the table or on the scaling stick must be multiplied by ten (10). The simplest way to calculate board foot volumes using the Scribner Decimal C Log Rule Table is to add a zero (0) to all of the board foot volumes given in the table.

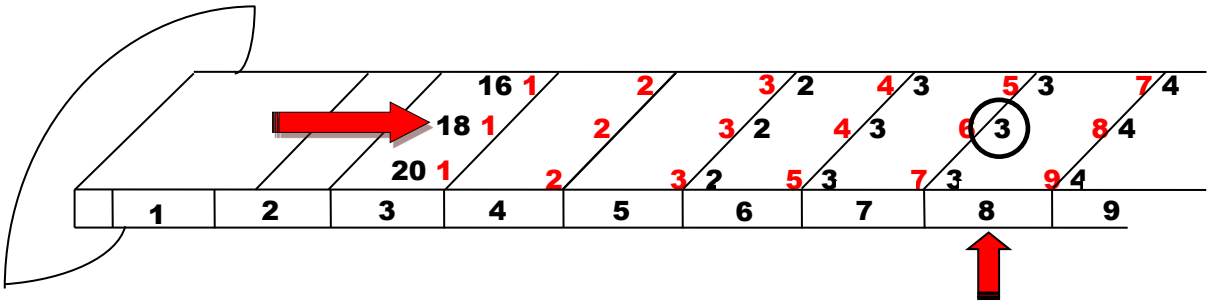
Therefore, a log measuring 8 inches d.i.b. and 18 feet in scaling length has a volume of 30 board feet (i.e., 8" d.i.b. x 18' length = 30 board feet).

LOG RULE TABLE

IDAHO SCRIBNER DECIMAL "C" LOG RULE TABLE

Diameter (inches)	Log Length (feet)																
	4	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
3										1	1	1	1	1	1	1	1
4					1	1	1	1	1	1	1	1	1	1	1	1	1
5		1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
6		1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
7	1	1	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3
8	1	1	1	1	1	1	2	2	2	2	2	2	3	3	3	3	3
9	1	1	1	2	2	2	3	3	3	3	3	3	4	4	4	4	4
10	1	1	2	2	3	3	3	3	3	4	4	5	6	6	6	6	7
11	1	2	2	2	3	3	4	4	4	5	5	6	7	7	8	8	8
12	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	10	10
13	2	3	4	4	5	5	6	7	7	8	8	9	10	10	11	12	12
14	3	4	4	5	6	6	7	8	9	9	10	11	11	12	13	14	14
15	4	4	5	6	7	8	9	10	11	12	12	13	14	15	16	17	18
16	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
17	5	6	7	8	9	10	12	13	14	15	16	17	18	20	21	22	23
18	5	7	8	9	11	12	13	15	16	17	19	20	21	23	24	26	27
19	6	8	9	10	12	13	15	16	18	19	21	22	24	25	27	28	30
20	7	9	11	12	14	16	17	19	21	23	24	26	28	30	31	33	35
21	8	10	12	13	15	17	19	21	23	25	27	28	30	32	34	36	38
22	8	10	13	15	17	19	21	23	25	27	29	31	33	35	38	40	42
23	9	12	14	16	19	21	23	26	28	31	33	35	38	40	42	44	47
24	10	13	15	18	21	23	25	28	30	33	35	38	40	43	45	48	50
25	11	14	17	20	23	26	29	31	34	37	40	43	46	49	52	54	57
26	12	16	19	22	25	28	31	34	37	41	44	47	50	53	56	59	62
27	14	17	21	24	27	31	34	38	41	44	48	51	55	58	62	65	68
28	15	18	22	25	29	33	36	40	44	47	51	54	58	62	65	69	73
29	15	19	23	27	31	35	38	42	46	49	53	57	61	65	68	72	76
30	16	21	25	29	33	37	41	45	49	53	57	62	66	70	74	78	82

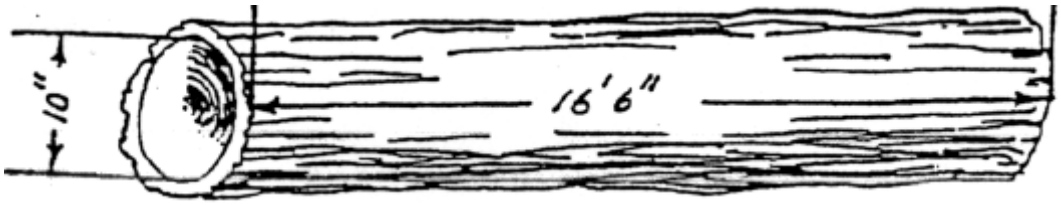
To find log volume using a scale stick, measure the d.i.b. by laying the stick across the small end of the log with the tip of the metal end at the inside edge of the bark. Read the diameter on the narrow sides of the stick. This inch-scale is designed to automatically round your d.i.b. measurement to the nearest inch. After measuring log length, find that measurement on the wide side of the stick, near the end plate (one side is for 10, 12, and 14-foot logs and the other is for 16, 18, and 20-foot logs). In the diagram below, the red arrows show how to read the volume of an 18-foot log with an 8-inch d.i.b. The volume (**3**) is circled. Remember to multiply it by 10 to determine the actual gross board foot volume.



Note: Ignore the red numbers on the scale stick for the purpose of the Forestry Contest because those are used for calculating defect and net volume, which is beyond the scope of the contest.

EXAMPLE B

Suppose that you measure the d.i.b. of a log at the small end, and it is 10 inches. The log measures 16'6" in length. What is the board foot volume of the log?



Here is the procedure to follow, using the log rule table:

Starting at the top, look down the d.i.b. column until you find the proper diameter inside of bark (d.i.b.). In this example, it is 10 inches.

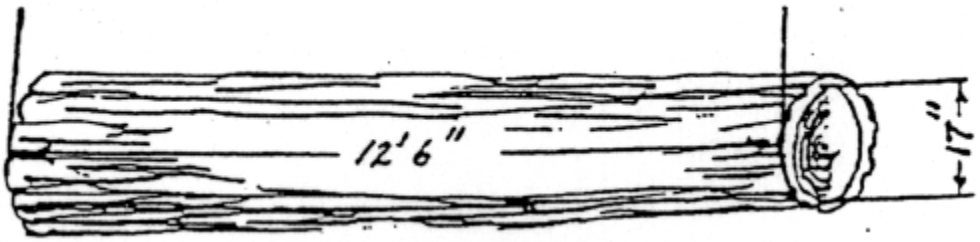
Next, move your finger across the top row of numbers until you find the proper log scaling length. In this example, it is 16 feet (with standard trim allowance).

Now, go across the row corresponding to d.i.b. 10" and down from the 16' length to the intersection of the row and column. In this case, the answer is 6.

Add a zero to that answer to get the correct log volume of **60** board feet.

EXAMPLE C

In this example, the d.i.b. measurement is 17 inches and the measured length is 12 feet 6 inches (12’6”). What is the board foot volume of this log?



Remember, although the measured length is 12 feet plus the full trim allowance of 6 inches, the log is 12 feet in scaling length.

The correct answer from the table is 17 d.i.b. x 12 ft. → 14 Decimal C volume, so it must be multiplied by 10 to give the gross board foot volume. Therefore, the correct log volume is **140** board feet.

LOG DEFECT

The procedure described above for determining the gross board foot volume assumes that the log is completely straight and the entire log can be used to manufacture lumber. In reality, logs are sometimes crooked or contain decay that makes a portion of the log unusable for lumber. This unusable portion is called defect, and it is deducted from the gross board foot volume to determine the net board foot volume in a log.

The amount of defect measured and deducted is a somewhat subjective measurement based on a scaler’s forestry training, knowledge, and experience. It is not within the scope of the Forestry Contest to be able to accurately measure defect. Therefore, students only need to be concerned about learning to measure the gross volume of logs with no defect.

DETERMINING LOG SPECIES

You must also be able to identify the species of logs. Scalers must identify species because log volumes and wood characteristics, which determine value, vary widely by species.

Log volumes differ for tree species because of variations in the amount of **taper**, i.e. the conical shape of the trunk (diameter or width at the bottom versus the small diameter at the top). White pine trees, for example, tend to be tall without much tapering of the trunk diameter towards the top in comparison to the bottom (Figure 1). By contrast, western redcedar trees tend to be wide at the bottom and fairly short, tapering quickly to the top (Figure 2). The amount of taper in a log affects the volume of lumber that can be sawn from it.

Figure 1. White pine trunk shape

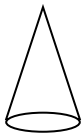


Figure 2. Cedar trunk shape

Wood characteristics are very important because they determine the products that can be manufactured and, therefore, the value of the wood. Log values vary tremendously depending on species.

The following attached **Appendix A-1** from the Idaho Board of Scaling Practices Manual provides excellent guidance for learning how to identify logs of the following **nine Idaho commercial species**:

- western redcedar
- Douglas-fir
- western hemlock
- western larch
- lodgepole pine
- ponderosa pine
- western white pine
- Engelmann spruce
- grand fir

APPENDIX A-1 – SPECIES IDENTIFICATION

A-1.1 GENERAL

The ability to identify logs by species is extremely important to the scaler because of the wide differences in value of the various species; for example, a Cedar log may be worth significantly more than a Grand fir log of equal volume. Consequently, errors in species identification by a scaler may result in considerable financial loss to the buyer or the seller. Through study and properly supervised experience, however, the scaler should develop the skills required for accurate species identification in a short time.

The problem of species identification in Idaho is somewhat involved because of the number of commercial species that occur in the state. In any given area or operation the number of species that the scaler must identify may be half a dozen or more. Most of the commercial species in Idaho are conifers, with the following eleven considered to be those of major importance:

C	Cedar.....	*Thuja plicata*
DF	Douglas Fir.....	*Pseudotsuga menziesii*
H	Western Hemlock.....	*Tsuga heterophylla*
L	Larch.....	*Larix occidentalis*
LP	Lodgepole Pine.....	*Pinus contorta*
PP	Ponderosa Pine.....	*Pinus ponderosa*
WP	White Pine.....	*Pinus monticola*
S	Engelmann Spruce.....	*Picea engelmanni*
AF	Alpine Fir.....	*Abies lasiocarpa*
GF	Grand Fir & White Fir.....	*Abies grandis & Abies concolor*

It is generally not necessary for a scaler to distinguish between Grand fir and White fir, but occasionally a scaler may be required to separately identify Western Hemlock and Mountain Hemlock. Conifers of lesser commercial importance because of their scrubby growth characteristic, inaccessibility, or widely scattered distribution include:

MH	Mountain Hemlock.....	*Tsuga mertensiana*
WB	Whitebark Pine & Limber Pine....	*Pinus albicaulis & Pinus flexilis*

Hardwoods are usually of little importance as timber trees in Idaho. Black cottonwood and Quaking aspen have occasionally been commercially harvested.

CW	Black Cottonwood.....	*Populus trichocarpa*
QA	Quaking Aspen.....	*Populus tremuloides*

Rarely, some other tree or shrub species not previously mentioned may be presented for scaling. They may be classified as "Other" using species abbreviation "O".

Generally speaking, a scaler depends largely on bark characteristics, and color and amounts of sapwood and heartwood for identification purposes. Scalers must also be able to accurately identify species of dead or barked logs. Especially in the spring and early summer, bark can slough off easily during the logging process. Under these

conditions a scaler depends largely on things such as color and amounts of sapwood and heartwood, presence of pitch, and the size, color, and distribution of knots as the basis for identification.

In using bark characteristics for identification of logs, a scaler must keep in mind that in many species, the bark on young trees may be very different in color and texture from the bark on older or mature trees. Logs cut from the lower boles of older trees may also have different bark characteristics than those cut from the upper boles. These differences are pointed out in the descriptions given in this chapter.

The descriptions of species that follow are designed to give the features of greatest value in scaling practice. An effort has been made to list all printable common names in use in Idaho for each species.

A-1.2 MAJOR COMMERCIAL SPECIES

A-1.21 Cedar

Species. (*Thuja plicata*) Common name is Cedar, also called red cedar or western red cedar.

Bark. The bark, light reddish-brown on young trees and grayish-brown on old trunks, is thin (1 to 3 inches thick), and forms a network of long, thin, fibrous strips. The stringy shreds of bark adhering to logs are one of the most identifiable characteristics.

Sapwood. The sapwood is thin, nearly white, and non-resinous.

Heartwood. The heartwood is soft and brittle, reddish-brown to pinkish-brown, and has a pungent, distinctive odor. The contrast between heartwood and sapwood is pronounced.

Knots. Knots are generally scattered around the tree with a dark brown center surrounded by lighter brown or tan colored wood.

Foliage. The leaves of Cedar, borne in flattened groups of four, are very small and scale-like. The branch-lets have a "fern- like" appearance and are dark, glossy green on the upper surface.

A-1.22 Douglas Fir

Species. (*Pseudotsuga menziesii* variety *glauca*) Common name is Douglas Fir, also called red fir or simply “Doug” fir.

Bark. On young trees the bark is smooth, gray-brown, and broken by pitch blisters. On mature trees it gradually becomes corky and deeply furrowed. Mature bark, dark red-brown to a very light gray, usually shows a lighter, almost orange color deep in the furrows. The mature bark is 2 to 6 inches thick. Second growth bark is usually 1/2 inch to 2 inches thick.

Sapwood. The sapwood is a pale yellow or off white to a reddish-cream color, rather narrow, and pitchy.

Heartwood. The heartwood is hard and yellowish-brown to deep reddish-brown in color. The contrast between heartwood and sapwood is usually very distinct.

Knots. Douglas fir knots are usually reddish brown in the center surrounded by a darker brown wood and will generally be pitchy.

Foliage. Douglas fir needles -- medium green to blue-green in color, 3/4 inch to 1 inch long, flexible, and with rounded ends are borne singly and are arranged all around the twig. The most notable feature of foliage is the pointed, red-brown buds.

A-1.23 Hemlock

Species. (*Tsuga heterophylla*) Common name is Hemlock, also called western hemlock. Similar in appearance to mountain hemlock, it is usually not necessary to separately identify "western" and "mountain" hemlock when scaling in Idaho.

Bark. On young trees the bark is dark reddish-brown to purple-brown and is broken into small, rounded scales; on mature trees, the bark has deep furrows between flat ridges, which are covered with close-set, dark brown to purple-gray scales. The underbark on Hemlock of all ages is a bright red streaked with purple when cut lengthwise. Inner-bark on Hemlock is a dark cocoa-brown compared to a lighter brown inner-bark on grand fir.

Close-up showing difference of inner-bark between Hemlock and Grand fir *Hemlock (left) and Grand fir (right)*

Sapwood. The sapwood is quite thin. The last few outer rings, sometimes almost white, are the only portion of the sapwood, which may show any contrast to the heartwood. A slightly dented or wavy surface is common in areas where the bark is missing on the outside of the log.

Heartwood. The heartwood is hard, tough, and closely-grained, usually pale tan or cream colored; but occasionally it may have a reddish or purplish cast, especially in the summerwood portion of the annual rings. Usually there is little or no contrast between heartwood and sapwood. The absence of resin and lack of contrast between the cream colored heartwood and sapwood are typical of both western and mountain hemlocks.

Knots. The larger knots are hard, dark cream colored and may be surrounded by a black ring on the outside edge. Smaller knots are usually black and may show a black stain in the bark.

Foliage. The needles are small and flat, 1/4 inch to 1 inch long, and irregular in length. They are dark green on top and pale green with two white bands beneath.

A-1.24 Larch

Species. (*Larix occidentalis*) Common name is Larch, also called western larch or tamarack.

Bark. On young trees the bark is scaly and reddish-brown to purplish-brown. On older trees, it is deeply furrowed and broken into irregularly shaped plates, usually purple-gray in color, but sometimes brown to reddish-brown. Bark is relatively thick at all ages, being 4 to 6 inches thick on mature butt trunks. Larch bark, which may be confused with that of Ponderosa pine, has a reddish-purple color under the scales in contrast to the yellow patches under the scales of Ponderosa pine.

Sapwood. The sapwood is thin (1/4 inch to 1 inch thick), nearly white to light pale brown, and may be slightly pitchy. One of the most distinguishable features is the sharp color contrast between the narrow band of sapwood and the heartwood.

Heartwood. The heartwood is hard, reddish-brown to dull brown in color. The contrast between heartwood and sapwood is distinct. At times the log end may resemble a "target" with distinct bands of light and dark colored rings.

Knots. Knots are scattered, light reddish-brown in the center, surrounded by light tan or pale brown wood. Larch knots have a tendency to be clustered with several knots forming small bunions or bulges on the side of the log.

Foliage. Needles are borne in dense clusters on small raised bumps on the twigs. They are 1 to 1 1/2 inches long, thin, flexible, and light green in color. In the fall they turn bright yellow and then drop off. This is the only conifer in Idaho that loses its needles.

A-1.25 Lodgepole Pine

Species. (*Pinus contorta*) Common name is Lodgepole Pine, also called jack pine, black pine, or simply “lodgepole”.

Bark. The bark on young trees is dark gray to almost black and very scaly. Bark on mature Lodgepole pine differs in northern and southern parts of the state. In northern Idaho the mature bark is made up of narrow ridges, broken into almost square or rectangular plates with the ridges separated by deep furrows. The overall color is almost black to dark gray. Cutting length-wise into the bark reveals numerous, small white specks of pitch. In the southern part of Idaho mature Lodgepole pine bark is light brown or orange-brown to almost gray and is covered by thin, loose scales. Knocked-off scales reveal a greenish color where the scales were attached.

Sapwood. The sapwood is narrow, nearly white to pale yellow in color. Often there is no easily discernible difference between heartwood and sapwood, though the sapwood is usually somewhat lighter in color. Pitch exudation is conspicuous on the sapwood.

Heartwood. The heartwood is light yellowish white to pale yellow and may have a slight pink hue.

Knots. These are scattered and often have a dimpled appearance with small catfaces surrounding them.

Foliage. The yellow-green to light green needles are borne in bundles of two and are 1 to 3 1/2 inches long.

A-1.26 Ponderosa Pine

Species. (*Pinus ponderosa*) Common name is Ponderosa Pine, also called “P” pine, bull pine, yellow pine, and western yellow pine.

Bark. The bark on young trees (80 to 100 years old) is broken into ridges covered with small, thin platelets, dark reddish-brown to nearly black, and from 1/2 inch to 1 1/2 inches thick. Young trees with this dark bark are often called bull pine. On older trees the bark is often from 2 to 4 inches thick, divided into deep and irregular plates, sometimes 4 to 5 feet long and 12 to 18 inches wide. These larger plates are covered with thick, yellow-brown to orange-brown irregular platelets.

Sapwood. Young Ponderosa pine is 80 to 100 percent sapwood. In older growth, the sapwood is usually 2 to 12 inches thick. This sapwood is cream-colored, and pitch exudation on the sapwood is usually conspicuous.

Heartwood. The heartwood is yellowish to light reddish-brown and usually has a conspicuous brown center or pith. There is a definite pitchy odor.

Knots. Are scattered, bulging, and can be quite large. The knots are usually reddish-brown to a dark brown in color surrounded by cream colored wood. The center of the knot is often hard and brittle.

Foliage. The needles of Ponderosa pine are usually borne in bundles of three (sometimes two to five), 5 to 11 inches long, and dark green in color.

A-1.27 White Pine

Species. (*Pinus monticola*) Common name is White Pine, also called Idaho white pine or western white pine.

Bark. The bark on young trees is usually smooth and light gray-green in color. On old trees it is 3/4 inch to 1 1/2 inches thick, and is divided into small, nearly square plates by deep lengthwise and crosswise fissures covered by small, thin or closely oppressed purplish-gray scales.

Sapwood. The sapwood is whitish to a light cream in color, soft, and from 1/2 inch to 3 inches thick. A conspicuous exudation of pitch (resin) is generally visible in the sapwood on the log ends. In older decked logs the sapwood may be almost white in color.

Heartwood. The heartwood is usually an off white but may have a pale pink to light reddish-brown hue. The wood is soft, straight-grained, and has a slightly pitchy or resinous odor.

Knots. Knots are usually whorled around the tree in a single row with large areas in between the whorls containing no knots. The centers of the knots are pink in color; this is especially visible in the smaller knots.

Foliage. Needles are borne in bundles of five, 2 to 4 inches long, and blue-green in color.

A-1.28 Spruce

Species. (*Picea engelmanni*) Common name is Spruce, also called Engelmann spruce.

Bark. The bark is from 1/4 to 1/2-inch thick, usually light purplish-gray to orange-brown in color, and broken into larger, thin, loose scales.

Sapwood. The sapwood is 2 to 4 inches thick, pale yellow to pale yellow-brown in color, and may be slightly pitchy.

Heartwood. The heartwood is usually about the same color as the sapwood, sometimes slightly darker. As a rule, it is extremely difficult to differentiate between heartwood and sapwood.

Knots. Knots are generally scattered around the log and are about the same color as the heartwood on Spruce logs.

Foliage. The blue-green needles are borne singly and are usually about 1 inch long. They are moderately stiff and sharp-pointed; crushed needles have a pungent odor.

A-1.29 Grand Fir

Species. *(Abies grandis)* Common name is Grand Fi r, also called white fir (the common name "white fir" is also used for *Abies concofor* whose native range in Idaho is the southeast corner of the state; for commercial scaling in Idaho, species identification as "grand fir" or "white fir" is used interchangeably for either species).

Bark. Young trees have smooth, gray-green bark with numerous pitch blisters. Older trees begin to develop a furrowed, rough bark , which is up to 2 inches thick and is dark gray-brown to purple-gray i n color on mature trees. I n southern Idaho trees, the bark is corky i n texture and resembles Douglas fir bark.

Sapwood. The narrow sapwood, light cream to pale yellowish-brown, is not resinous; although some pitch from the inner bark may be present on the sapwood. It may be difficult to distinguish the sapwood from the heartwood.

Heartwood. The soft heartwood of Grand fir is not distinctively different in color from the sapwood, although it may be slightly darker. The summerwood portion of the annual rings may be faintly pinkish i n color.

Knots. The absence of resin exudation from the sapwood on ends of logs and the similarity in color of sapwood and heartwood are marked features. A dark water core is sometimes present and growth rings are conspicuous.

Foliage. Grand fir needles are borne singly and those of the lower crown are arranged in flat rows along each side of the twig. They are about I to 2 inches long and are dark glossy green on the upper side with whitish streaks on the underside. Crushed needles give off a pleasant aromatic odor.

A-1.4 SPECIES IDENTIFICATION CHART

Some general characteristics to aid in the process of species identification are shown in the chart below.

Log Species Identification Chart / Species	Bark - scaly or plated (on mature trees)	Bark - deeply furrowed (on mature trees)	Bark - stringy & fibrous	Heartwood / Sapwood light-color, little contrast	Heartwood / Sapwood dark color, strong contrast	Knots – pinkish color	Knots – yellowish color	Pith - large & distinct	Pitchy sapwood	No pitch, sap or heartwood
White Pine	X			X		X			X	
Ponderosa Pine	X			X				X	X	
Lodgepole Pine	X			X					X	
Douglas Fir		X			X				X	
Larch	X				X				X	
Grand Fir		X		X						X
Hemlock		X		X						X
Spruce	X			X					X	
Cedar			X		X					

IDAHO STATE FORESTRY CONTEST

CHAPTER 2 - TIMBER CRUISING

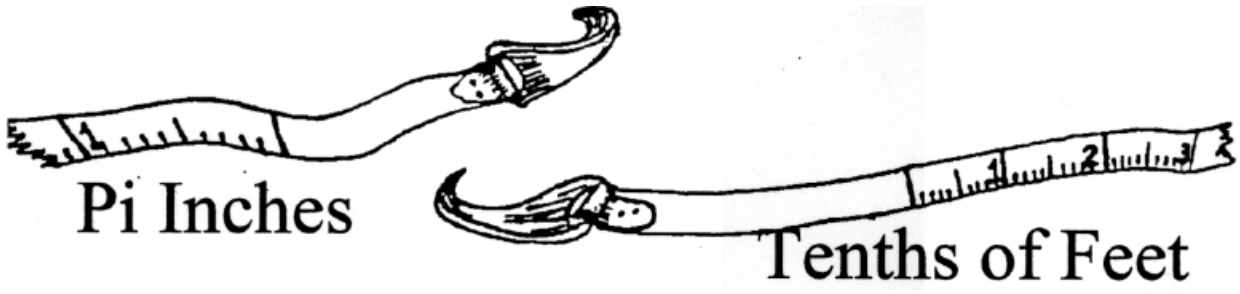
Timber cruising is the method that foresters use to determine the board foot volume of a standing tree and the amount of timber in a forested tract.

Two basic tree measurements are required in order to measure the board foot content of a standing tree. The diameter of the tree is *measured at 4½ feet above the ground*. This is called the "**diameter at breast height**" and is commonly referred to as **d.b.h**. The height of a tree includes the total height from ground level to the top of the tree. After determining the diameter at breast height and the total height of the tree, a **Board Foot Volume Table** is used to compute the board foot volume. A board foot is the volume of a board measuring 12 inches by 12 inches by 1 inch.

Let's take a closer look at the three steps involved in calculating the board foot volume of a tree:

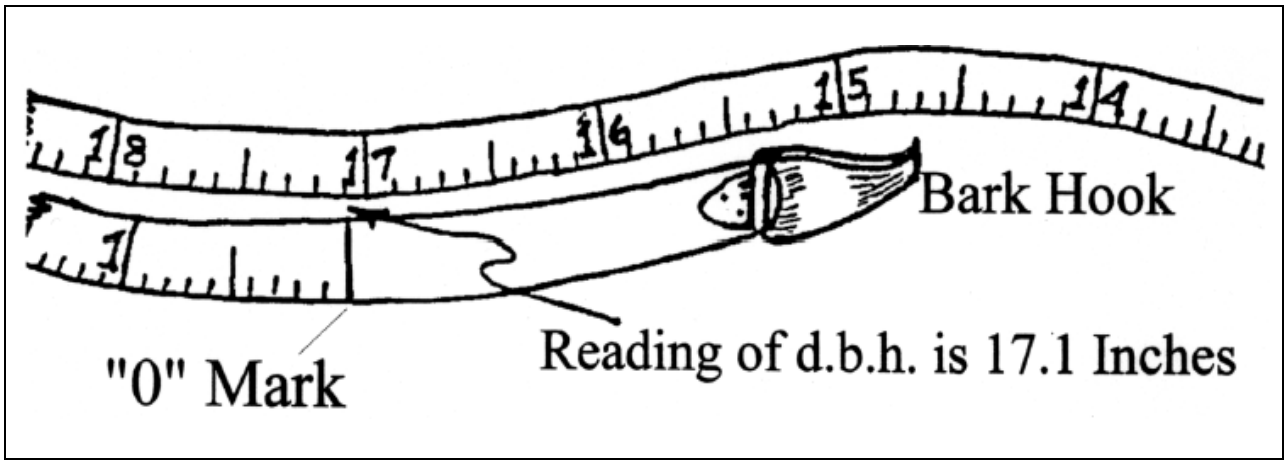
TREE DIAMETER AT BREAST HEIGHT

A **diameter tape** is a commonly used tool for measuring d.b.h. A **D-tape** usually has a hook on the end to help attach it to the bark so the tape can be more easily wrapped around the circumference of the tree. A diameter tape differs from a normal measuring tape (calibrated to 12 inches/foot or tenths of feet) because it is calibrated in "Diameter Equivalents of Circumference in Terms of Inches" (a.k.a "**Pi Inches**"). This diameter tape scale allows the user to determine the diameter of a tree simply by measuring the circumference, since measuring with Pi Inches calibration eliminates the need to divide a "tenths of feet" circumference measurement by Pi (3.1416) to calculate the diameter.



Note: A **logger's tape** is often used by foresters to measure both d.b.h. and tree height because one side is calibrated in Pi Inches while the other side is calibrated in feet and tenths of a foot (for measuring distance from the tree or other distances).

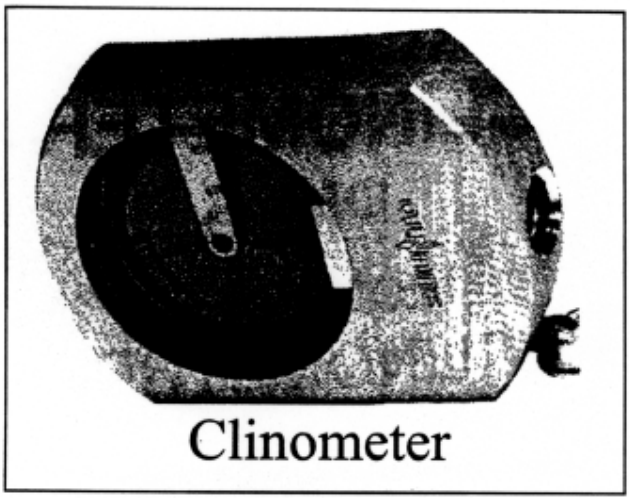
To measure d.b.h., first measure 4½ feet up the tree from the ground line (i.e. to "breast height"). Next, place the diameter tape's hook into the bark at that height and extend the tape counterclockwise around the tree, making sure to keep the tape level. Finally, read the tree diameter where the tape crosses the "zero" line (located on the tape next to the hook), as illustrated below.



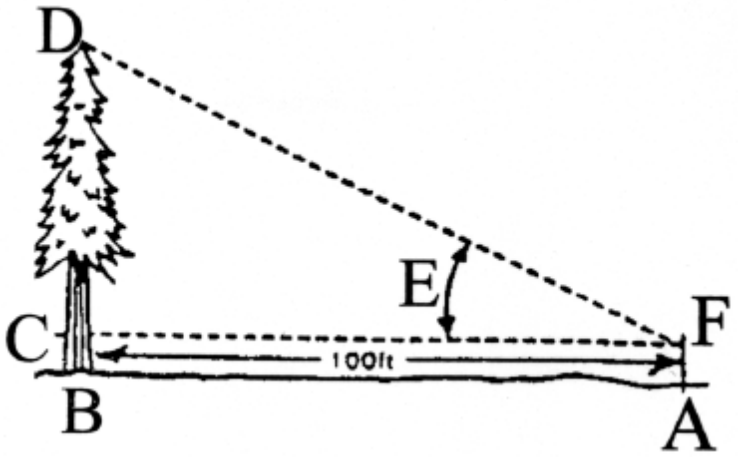
Example of diameter tape in use on a tree

MEASURING TOTAL TREE HEIGHT

A **clinometer** is a tool used to measure total tree height. With a little practice, you will be able to accurately determine the height of a tree. To use the clinometer, hold it up to your eye (with the lanyard ring below the lens opening). Keeping both eyes open, simultaneously look through the lens and alongside the clinometer's housing to the target. By an optical illusion, the horizontal sighting line will appear to project outside the clinometer's housing. Place the projected sighting line on your target and read the adjacent scale.



EXAMPLE:
Measuring tree height on level ground using a **clinometer percent (%) scale**:



100 feet is the most convenient baseline distance if you are using the percent scale on the clinometer. Back away from the tree 100 feet (from C to F or B to A on the diagram above). Sight the top of the tree (D) and read the percent (%) scale. This reading represents the height of the tree from eye level (0% slope) to the top of the tree (i.e. from C to D). Now, sight on the base of the tree and read the percent scale again. This reading represents the height from eye level down to the base of the tree (B to C). Add this reading to the first reading you took. This will give you the total tree height (i.e. the distance from B to D).

If you are measuring a tree in dense underbrush where it is difficult or impossible to see the top or base of the tree at 100 feet, you might want to use the **topo scale** (the other scale on the clinometer, which is labeled **1/66**). To measure tree height using this scale, you use the same procedure described in the example above, except that you will stand only 66 feet away from the tree (instead of 100 ft.) and you will read the topo scale (1/66 feet) on the clinometer instead of the percent scale.

DETERMINING BOARD FOOT VOLUME

A volume table gives the number of board feet in a tree. This is an estimate of the amount of lumber that can be cut from an individual tree. On the next page is a board foot volume table similar to the one used at the Forestry Contest.

SCRIBNER BOARD FOOT VOLUME TABLE

	TOTAL HEIGHT (feet)										
DBH	50	60	70	80	90	100	110	120	130	140	150
8	11	18	27	36	44	53	58	67			
10	21	32	43	54	65	76	87	93	102		
12	33	50	69	88	105	124	140	155	176	196	225
14	47	74	101	129	156	175	201	224	252	282	318
16	92	102	136	170	205	235	265	296	330	368	410
18	127	154	174	215	257	294	329	367	411	460	510
20	148	177	213	262	311	355	397	440	494	558	618
22	203	221	275	319	366	420	470	520	584	658	732
24	232	286	332	374	425	489	545	607	676	758	848
26			353	436	492	562	626	692	770	866	971
28				498	578	638	708	782	870	975	1096
30				597	652	712	792	876	972	1088	1228
32					672	756	884	980	1102	1234	1286

To use the table, look down the d.b.h. column (on the left side) to find the d.b.h. to the nearest inch of the tree you measured. Then look across the tree height line to find the height to the nearest ten feet of the tree you measured. Look down that column – the point where it intersects with the d.b.h. row is the board foot volume of your tree.

Contest Tip #1: Rounding Tree Heights

Tree heights are listed in 10-foot increments in the volume table

Therefore, round your tree height measurement to the nearest 10-foot increment. For example, a tree measuring 85 to 90 feet tall must be rounded up to 90 feet and you will use the 90 column to determine its volume from the table. A 90 to 94-ft. tree should be rounded down to 90. For a second example, if you measure a tree that is 78-ft tall, you will round up to 80 ft tree height to determine its volume using the volume table.

Contest Tip #2: Rounding Diameters

D.B.H. is given in 2-inch increments in the volume table

The standard practice for rounding diameters at the Forestry Contest is as follows: All trees between 11.1 inches and 13.0 inches d.b.h. are considered to be in the 12-inch diameter class. The 14-inch diameter class includes trees between 13.1 inches and 15.0 inches d.b.h. A 16-inch diameter class includes trees 15.1 to 17.0 inches (and so on).

Use these sample questions to practice using the volume table [correct answers are given at the bottom of the page]:

1) A tree has a d.b.h. of 20.0 inches and a total height of 100 feet. Read down the d.b.h. column to "20" and then read across the tree height row to "100." What is the board foot volume of this tree?

2) How many board feet would be contained in a tree that measures 14.8 inches d.b.h. and 73 feet tall?

3) What is the board foot volume of a tree that is 85 feet tall and 15.2 inches d.b.h.?

4) You measure a tree that is 25.5 inches d.b.h. and 99 feet tall. What is the board foot volume of this tree?

5) How many board feet are in a tree that measures 9.3 inches d.b.h. and 64 feet tall?

Answer 1 = 355 board feet. The d.b.h. and height do not need to be rounded, so the volume can simply be read from the table by running your finger across from row "20" to the answer in column 100 (go down column "100" to row "20")

Answer 2 = 101 board feet. The d.b.h. is rounded down to 14 (because it's less than 15.0 and more than 13.1). The height is rounded down to 70 (the nearest 10-ft increment). Read across row "14" and down column "70" to find the answer.

Answer 3 = 205 board feet. The tree height is rounded up to 90 feet (it measures between 85 and 94 feet, so the nearest 10-ft increment is 90 ft.). The diameter is rounded up to 16 d.b.h. (because it is greater than 15.1 inches and less than 17.0 inches).

Answer 4 = 562 board feet. The diameter of 25.5 inches rounds up to 26 (the nearest 2-inch diameter class) and the height rounds up to 100 feet (the nearest 10-ft increment).

Answer 5=32 bf. The 9.3-inch d.b.h. rounds up to 10 inches d.b.h. and the 64-ft height rounds down to 60.

IDAHO STATE FORESTRY CONTEST

CHAPTER 3 - TREE AND PLANT IDENTIFICATION

The most basic skill that a forester must possess is the ability to recognize the trees and plants in an area. After a little practice, tree and plant identification becomes second nature: A quick glimpse of a tree's bark or a plant's leaf is often all that is needed to correctly identify the specimen.

The best way to learn the native tree and plant species is to spend some time with a forester or other knowledgeable person. Tree and plant identification is a skill that is difficult to learn out of a book. If no one is available to teach you how to identify trees and plants, perhaps you can hike on a nature trail that has plant species identified with labels. Many parks and recreation areas have excellent nature trails.

CONTEST TIP: There is often more than one commonly used name for a single type of tree or shrub. For example, Ponderosa pine is sometimes referred to as bull pine or yellow pine. Lodgepole pine may be called jack pine, black pine or red pine. Douglas-fir may be called red fir. Grand fir may be called white fir. With so many common names being used in different areas, it's important to know the most accepted local names **and** the scientific names used by professional foresters and botanists throughout the world. In addition, scientists may revise scientific names as more knowledge about a plant's genetics becomes available.*

At the Forestry Contest, you should use the plant names given in this chapter.

The Idaho native plants you must be able to identify for the Forestry Contest are:

CONIFER TREES

Douglas-fir (*Pseudotsuga menziesii*)
Engelmann spruce (*Picea engelmannii*)
Grand fir (*Abies grandis*)
Lodgepole pine (*Pinus contorta*)
Ponderosa pine (*Pinus ponderosa*)
Subalpine fir (*Abies lasiocarpa*)
Western hemlock (*Tsuga heterophylla*)
Western larch (*Larix occidentalis*)
Western Redcedar (*Thuja plicata*)
Western white pine (*Pinus monticola*)

DECIDUOUS TREES

Black cottonwood (*Populus trichocarpa)*
Quaking aspen (*Populus tremuloides*)
Paper birch (*Betula papyrifera*)

SHRUBS

Blue huckleberry (*Vaccinium globulare*)
Buffaloberry (*Shepherdia canadensis*)
Kinnickinnick (*Arctostaphylos uva-ursi*)
Mountain maple (*Acer glabrum*)
Ocean spray (*Holodiscus discolor*)
Oregon grape (*Berberis repens*)
Pachistima (*Pachistima myrsinites*)
Ninebark (*Physocarpus malvaceus*)
Red-osier dogwood (*Cornus stolonifera*)
Serviceberry (*Amelanchier alnifolia)*
Shiny-leaf spiraea (*Spiraea betulifolia*)
Snowberry (*Symphoricarpos albus*)
Syringa (*Philadelphus lewisii*)
Twinflower (*Linnaea borealis*)
Wild rose (*Rosa gymnocarpa*)

Reference: Patterson, P.A., Neiman, K. E., & Tonn, J. R. (1985). *Field guide to forest plants of northern Idaho.* Odgen, UT: USDA Forest Service, Intermountain Research Station.

* *For example:* ***Berberis repens*** *was recently changed to* ***Mahonia repens; Pachistima*** *was changed to* ***Paxistima****; and* ***Populus trichocarpa*** *is changing to* ***Populus balsamifera*** *var.* ***trichocarpa.***

TREE PLANTING

It is important to be able to tell if a tree seedling has been planted correctly or not. The picture below shows a correctly planted tree seedling. The next page shows a variety of incorrectly planted tree seedlings.

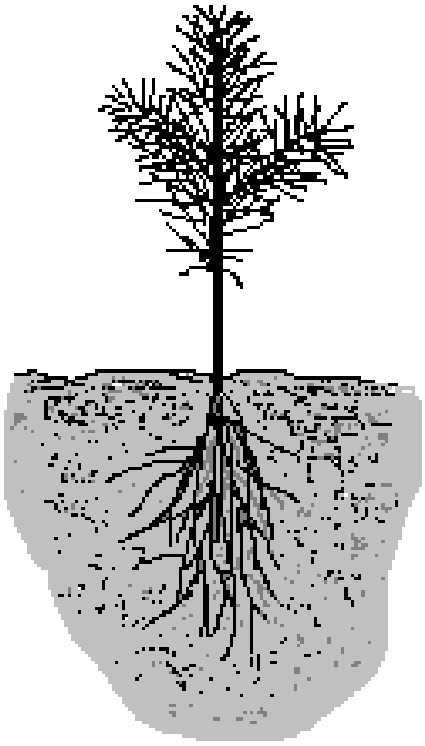
1. Before planting, a two to three-foot area is "**scalped**" using a Hoedad, Pulaski or shovel to remove vegetation (grass, etc.) that would otherwise compete with the seedling for moisture and nutrients.

2. The tree seedling is **oriented vertically** in **mineral soil** with its roots spread outward and down.

3. There are **no large air pockets or loose soil** around the roots.

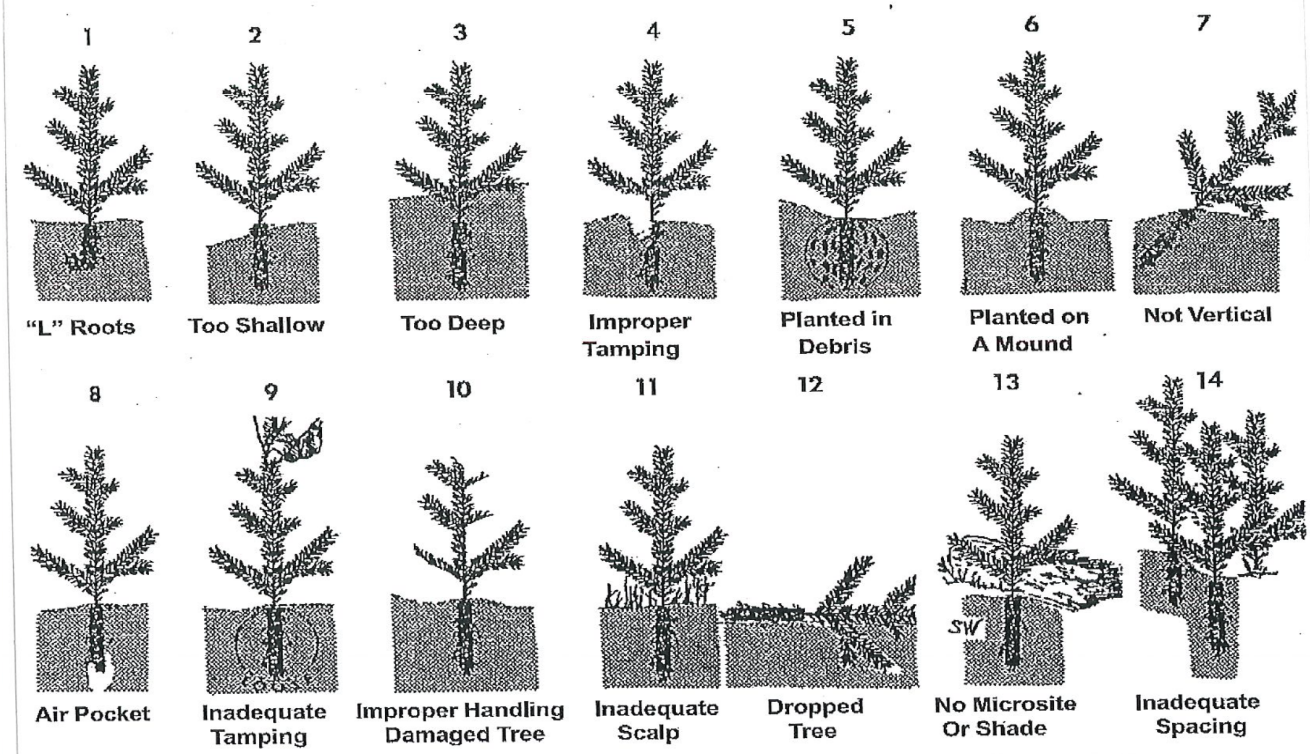
4. The soil is even with the **root collar** (the line on the stem showing where the soil level was when the seedling was grown in the nursery).

5. **Shade**, such as a log, rock, or cedar shingle, is provided on the southwest side of the tree.



Correctly Planted Tree Seedling

Unacceptably Planted Trees



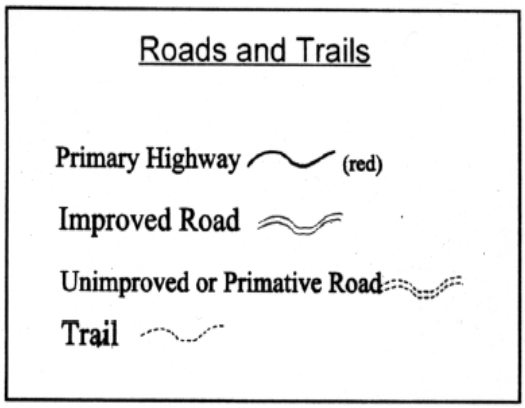
CHAPTER 4 - MAP READING

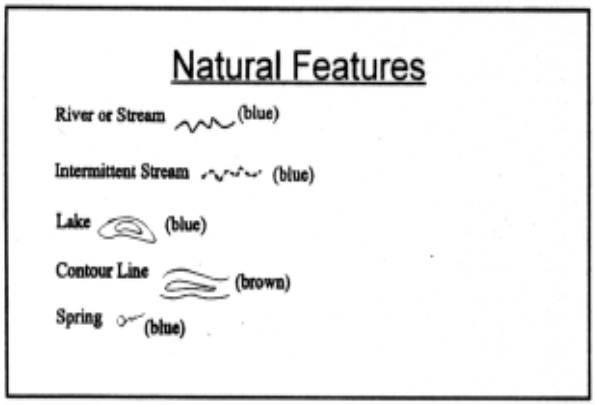
Foresters use various maps while planning and carrying out their daily activities. The map reading portion of the Forestry Contest will involve learning the following map skills:

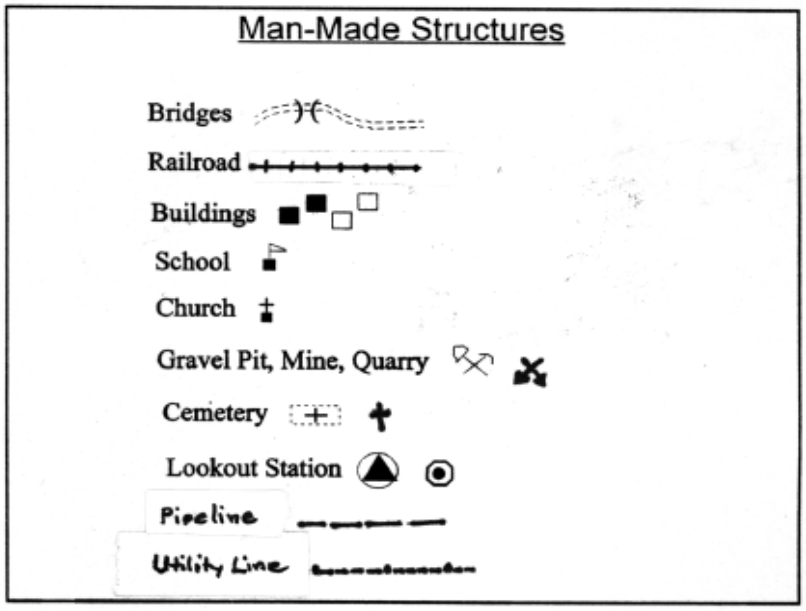
- Identifying standard map symbols
- Finding your location from locations markers and legal descriptions
- Identifying features on a topographic map
- Giving legal descriptions of map features

MAP SYMBOLS

The student will be expected to identify standard map symbols on a United States Geological map. The symbols will be selected from the following list:







TYPES OF MAPS

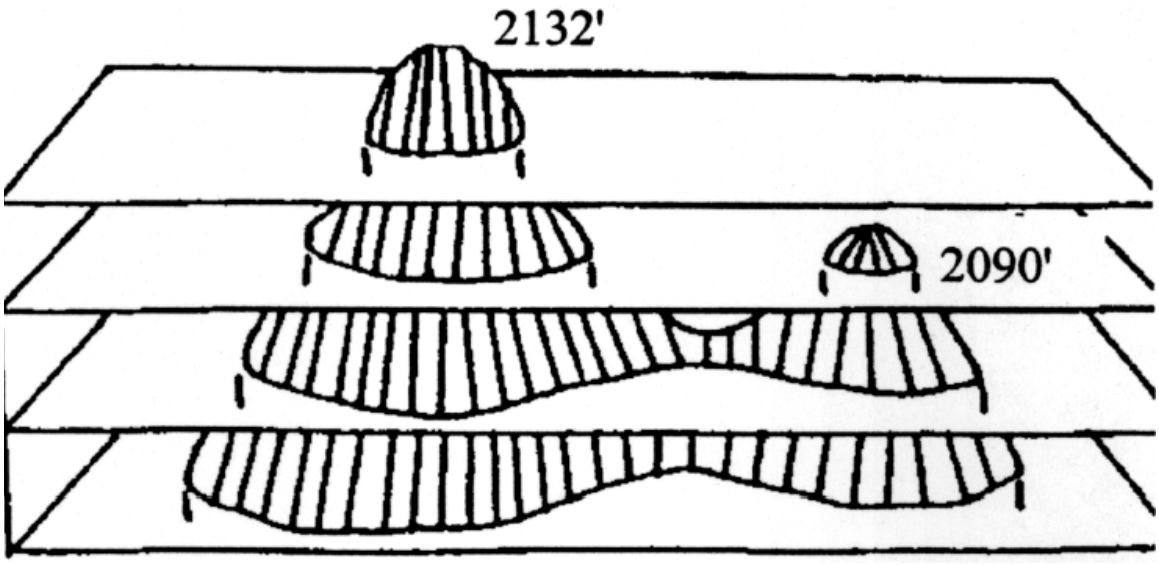
The two types of maps most frequently used by foresters are **planimetric maps** and **topographic maps**. Planimetric maps show detail in a flat, 2-dimensional plane. The United States Forest Service Visitors Map is a good example of a planimetric map. It is scaled at ½ inch per mile and shows features such as streams, mountain peaks, roads and trails. It is usually color-coded to show various ownerships.

The **United States Geological Survey (USGS) maps** are topographic maps. The usual scale is 2½ inches per mile. They show the third dimension (3-D), or depth, as well as showing a high degree of detail in the flat (2-D) plane. Differences in **elevation** are shown by the use of contour lines.

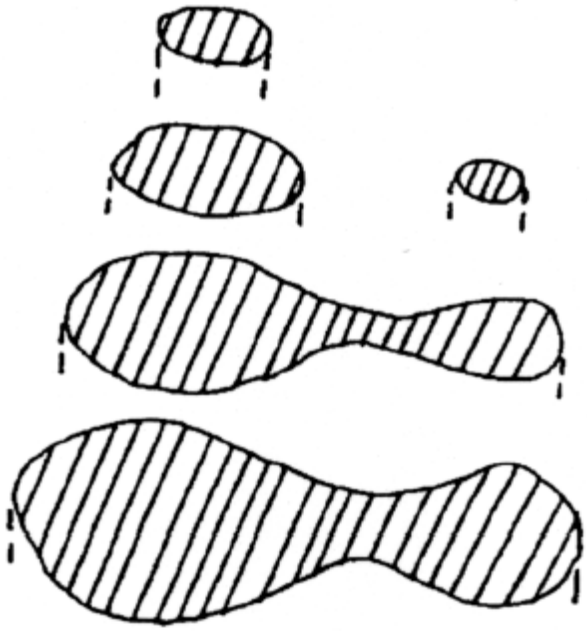
A **contour line** is an imaginary level line on the ground that connects all points of equal elevation. A contour line on a map indicates the elevation of that line above sea level. The *vertical* distance between two adjacent contours is known as the **contour interval**. Contour intervals that are commonly used on maps are 20, 40, 80, or 100 feet.

A contour map is made by drawing around the edges of sections of the ground where those edges intersect with imaginary parallel planes at a given contour interval. The drawings below illustrate how this works:

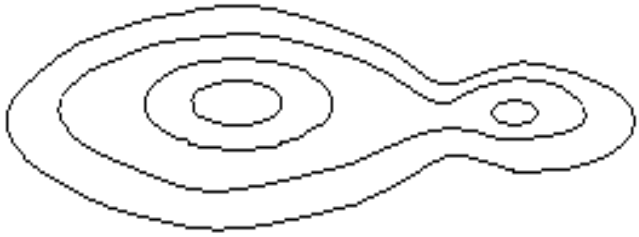
1) **Parallel planes intersecting terrain at a 40 ft. contour interval**



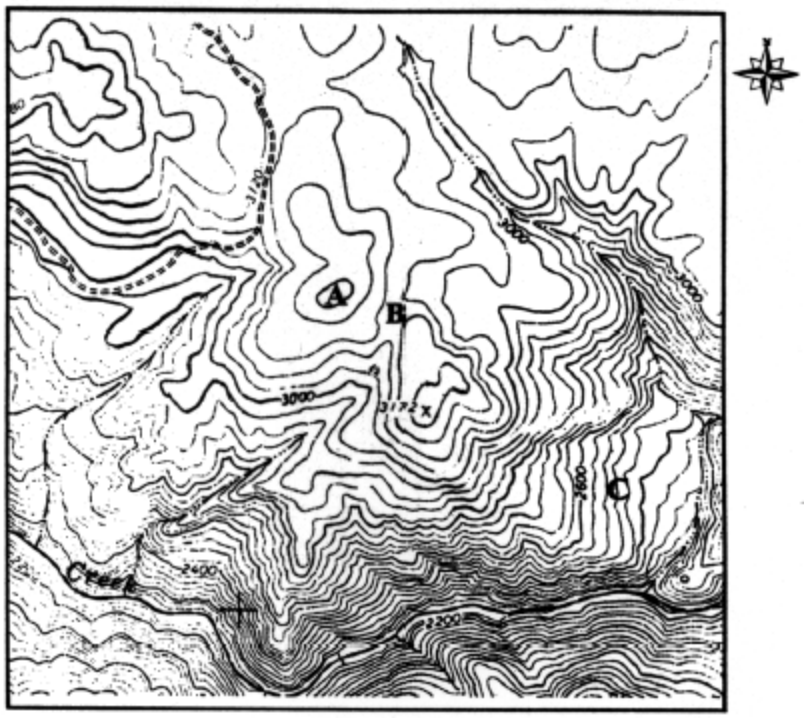
2) Sections cut by parallel planes, as seen from the top



3) Contour map of terrain (the sections are overlying each other)



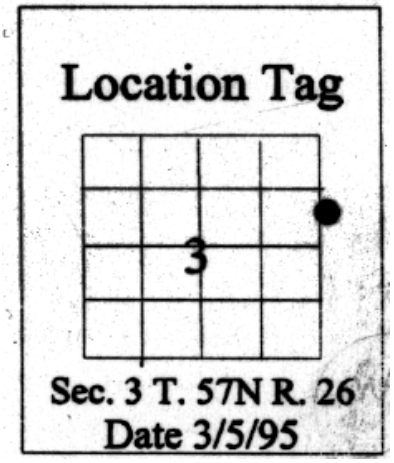
Characteristics of Contours:
The following map illustration gives examples of the characteristics of contours described below.

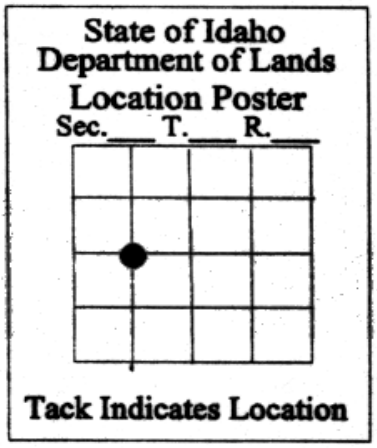


- All points on any contour line have the same elevation.
- Summits are indicated by closed contours, with no contour lines inside. Point **A** on the map is a summit.
- The depressions between summits are called saddles. Point **B** on the map is a saddle.
- In valleys and draws, the contour lines point uphill.
- On ridges, the contour lines point downhill.
- Contours never split or branch.
- The closer together the contour lines are to each other, the steeper the slope. The further apart the contours are, the flatter the slope.
- **Aspect** is the compass direction a slope is facing. Point **C** is on a slope with an east-facing aspect.

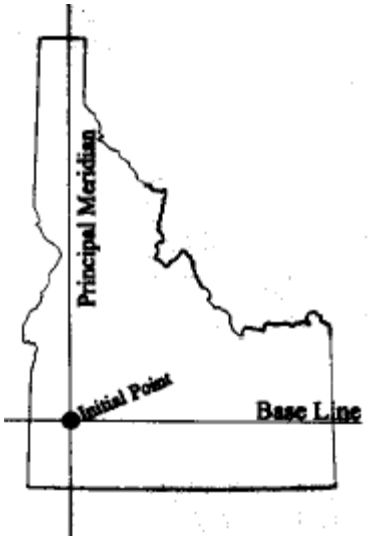
FINDING YOUR LOCATION

Foresters and surveyors establish location markers in the forest to help them locate exact position quickly and easily. Location markers are usually four- to six-inch metal signs, painted yellow, showing a simple map. These markers or "**tags**" are often situated alongside roads and are nailed to a tree or post. A small nail or tack indicates the exact location of the marker. Therefore, it is easy to pinpoint your exact position by comparing the tag location to a map of the area. The following illustrations show two typical location tags:

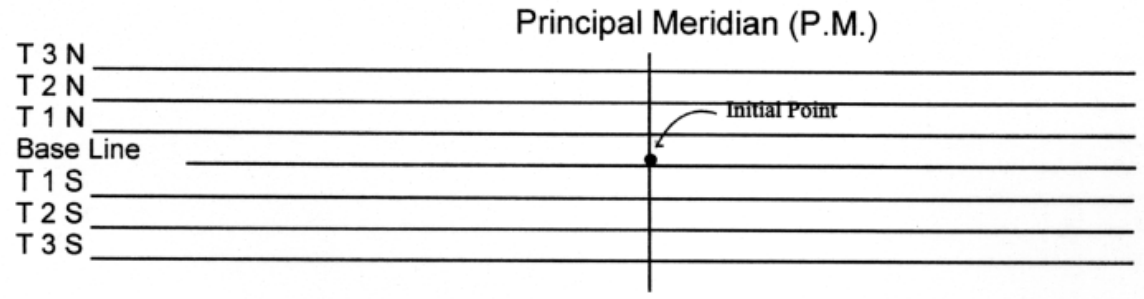




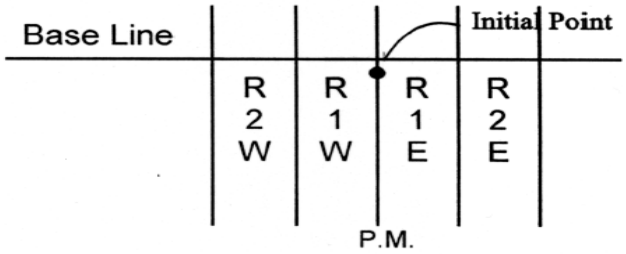
To better understand the use of location tags, a brief explanation of land surveying is necessary. A land survey consists of a series of parallel lines that form a grid over the state. The land survey starts at a point called the "initial point." An east-west line is established from this point and is called the "**Base Line**." The north-south line is established and is called the "**Principal Meridian**." The illustration below shows the initial point, the Base Line, the Principal Meridian and their relative position in the State of Idaho.



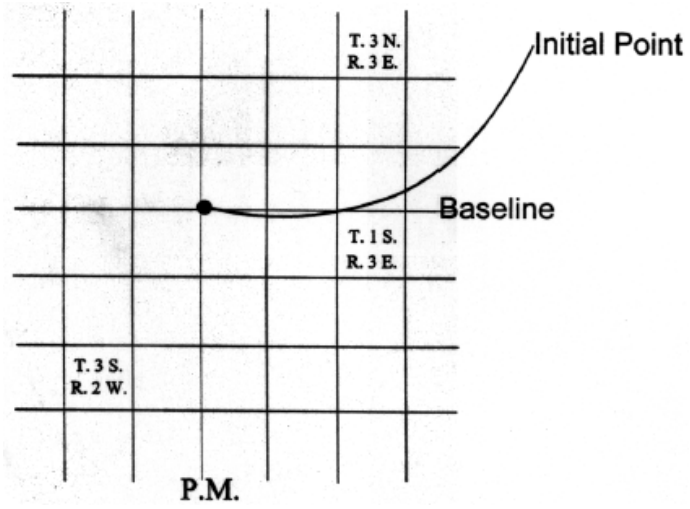
The state is subdivided by lines running at six-mile intervals, both parallel to the Base Line and to the Principal Meridian. The lines running east-west are called **Township (T)** lines and are numbered consecutively **North (N)** and **South (S)** of the Base Line. The first line north of the Base Line is *Township 1 North (T. 1 N.)* and the first line south of the Base Line is *Township 1 South (T. 1 S.)*, as illustrated below:



The lines running north-south at six-mile intervals are called **Range (R)** lines and are numbered consecutively **East (E)** and **West (W)** of the Principal Meridian (PM). *Range 1 East* is the first column to the right (east) of the PM. *Range 1 West* is the first column to the left of the PM, as illustrated below:



When you combine township lines and range lines on the same map, it makes a grid of squares that are each six miles square. Each square is called a **township** and its position can be identified as shown in the examples below:



Townships (which have 6 miles per side) are further subdivided into 36 square miles called **sections**. Each section is one square mile and contains 640 acres. The following system is used to number the individual sections in a township:

R. 3 W.

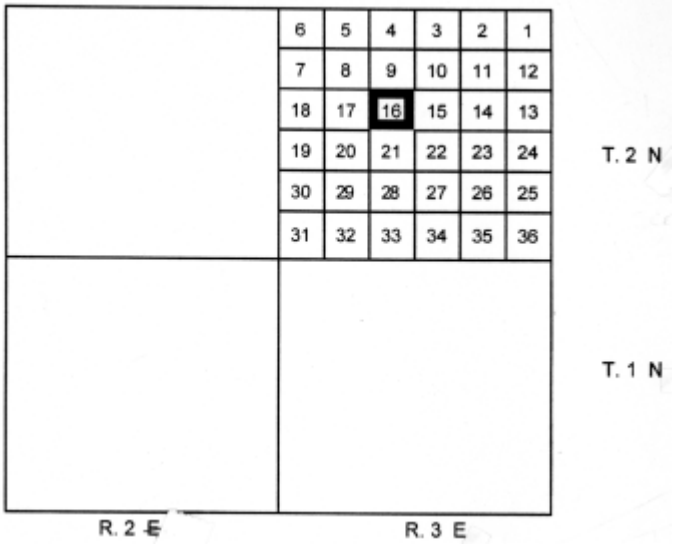
6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

T. 3 S.

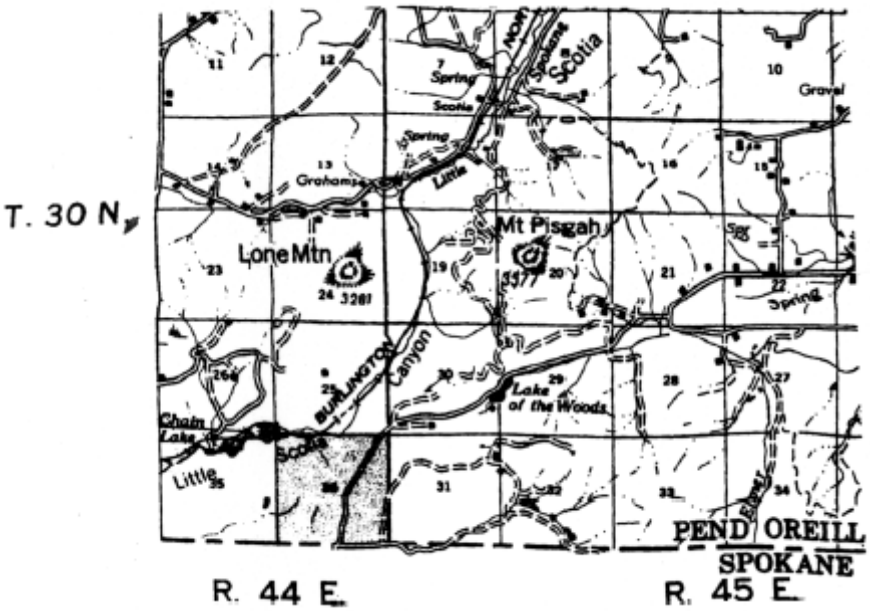
Legal descriptions are used to describe the exact location of townships, sections and even features such as mountain peaks or roads. The example below gives the legal description for a section of land as shown on the accompanying map:

Example:

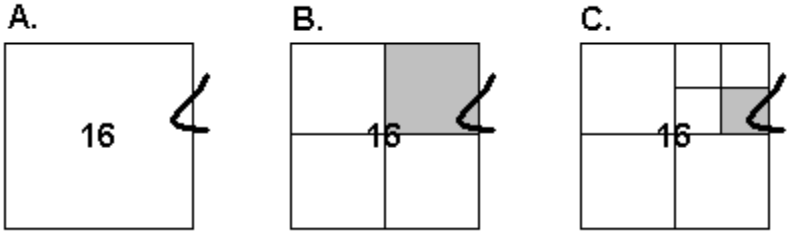
Section 16, Township 2 North, Range 3 East



If you look closely at either a U.S. Forest Service map or a USGS map, you will notice a superimposed grid of sections and townships. (It is sometimes difficult to see these lines due to physical features, names, and ownership lines.) Section numbers (1 through 36) are usually found in the middle of a section, while township numbers are listed vertically along the map's margin and range numbers are listed horizontally across the top and bottom margins of the map.



To give a legal description of the location of a feature within a section, you can subdivide the section into halves or quarters. For example, suppose you want to pinpoint the location of a loop of road in **Section 16, T. 2 N., R. 3 E.** (Diagram A).



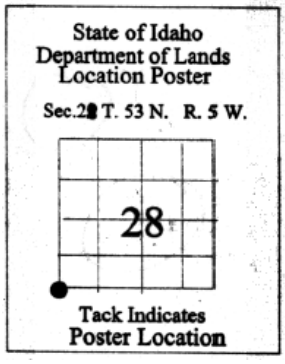
If you divide Section 16 into quarters, you will see that the road is located in the *northeast quarter* of the section (Diagram B). Next, if you divide that northeast quarter into quarters, you will see that the road is located in the *southeast quarter of the northeast quarter* of the section (Diagram C). The legal description of the road loop would be written:

Southeast quarter of the Northeast quarter, Section 16,
Township 2 North, Range 3 East

This can be abbreviated to: **SE1/4 NE1/4 Sec. 16 T2N R3E**

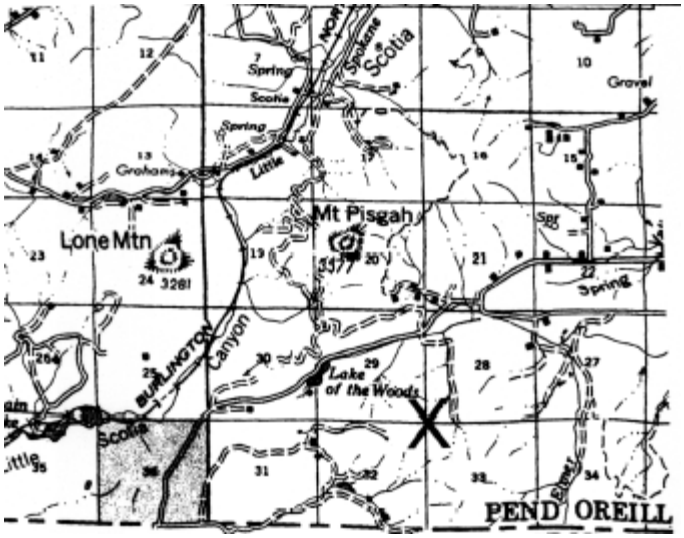
Now, let's return to the location marker and see how we can use it to determine our exact location in the forest.

EXAMPLE:
Suppose you are driving along a forest road and see a location tag like this:



Next, by looking at your map, you can determine that your location is on the section corner between sections 28, 29, 32, and 33 (see **X** on the map below).

T 53 N



R 4 W **R 5 W**

With practice, you will easily be able to determine your exact location if you have a map of the area and find a location marker. It is suggested that you obtain a U.S. Forest Service Visitor Map and familiarize yourself with the layout of the sections and townships, and practice writing legal descriptions for map features.

IDAHO STATE FORESTRY CONTEST

CHAPTER 5 - COMPASS READING & PACING

Using a compass and pacing are two basic forestry skills that are practiced almost daily by professional foresters to navigate in the woods.

COMPASS READING

The three essential **parts of a compass** include a magnetic **needle** balanced on a jeweled bearing or pivot and a **graduated dial.** The dial is divided into 360 degrees (360º) of azimuth. These parts are housed in a **base plate** or frame that has a sighting device for aiming at your direction of travel. All compasses contain these three basic parts. Because of the wide variety of uses for a compass, there are many different compass designs.

The **three** basic parts of the compass:

1. **Compass Needle.** The magnetic needle is attracted by the magnetic North Pole of the earth. The red end points North and the white end points South.

2. **Compass Housing or Dial.** The compass housing is a dial that is graduated into the 360° of a circle. The compass housing rotates on the base plate. Each mark on the housing represents 2°. The azimuth is read in degrees at the index pointer. The four principal directions are also indicated: North (0° and 360°), South (180°), East (90°), and West (270°). The orienting arrow is the black arrow that appears on the bottom of the housing.

3. **Base Plate.** The base plate points out the line of travel.

Foresters use compasses in many ways, such as obtaining azimuths from a map, taking azimuths on the ground, giving directions, reporting the location of a forest fire, plotting locations on a map, and laying out timber sale boundaries or roads.

The compass portion of the Forestry Contest will involve determining an azimuth from one object to another object. Therefore, taking an azimuth will be the only procedure discussed in this text. You may want to refer to one of the compass publications to learn the other procedures.

DEFINITION: An **azimuth** is the direction or degree reading from one station to another. For example, to go from Point A to Point B at an azimuth of 90º means that starting at Point A, you must travel due East (90º) to reach Point B.

DEFINITION: Declination is the variation between true north and magnetic north. Declination changes gradually over time because the earth wobbles slightly as it spins on its axis. The declination of the compass arrow can be adjusted to permit running compass lines on “true north” azimuth or “magnetic” north.

Note: *To use most compasses correctly, you must be familiar with the concept of declination, but you will not be asked about it at the Forestry Contest.*

There are two different types of compasses used at the contest. Rookies will use a baseplate compass and Juniors and Seniors will use a mirror sighting compass.

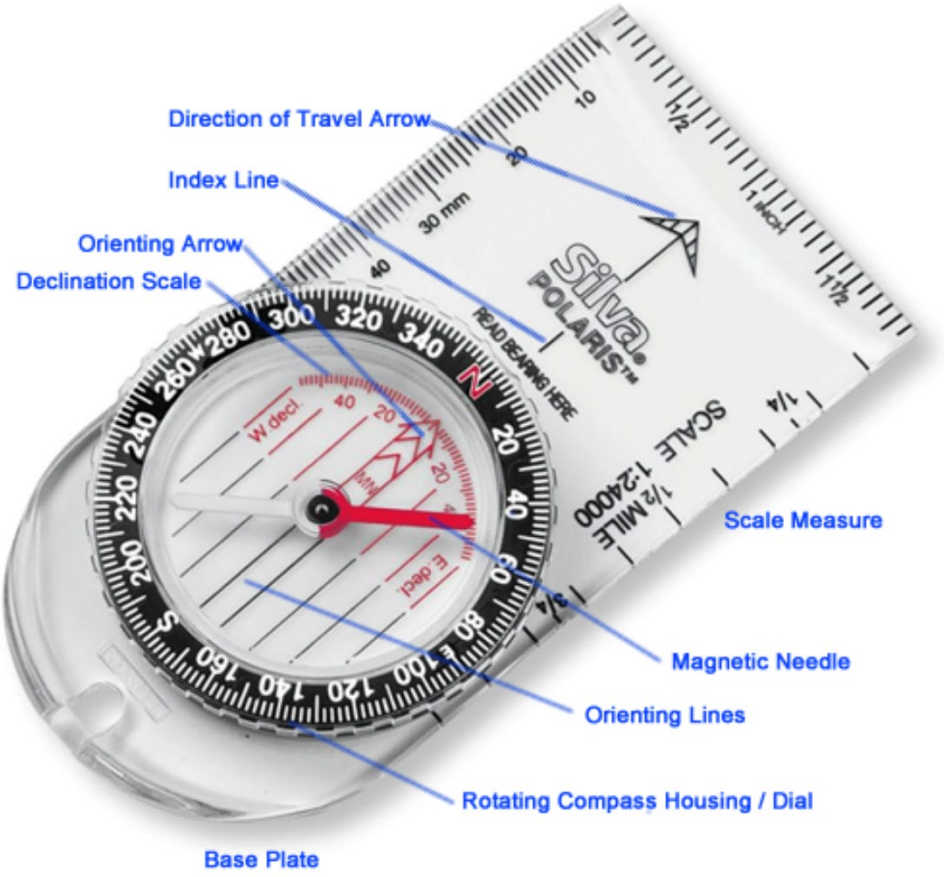
TAKING AN AZIMUTH WITH A BASEPLATE COMPASS (ROOKIES)

Rookies will be asked to find the azimuths and distances to two stations (survey stakes) using an **Orienting** or **Baseplate Compass** as shown below.

To use this compass to take an azimuth:

1. Hold the **Baseplate** at your waist positioned directly perpendicular to your body with the **Direction of Travel Arrow** pointing toward the object that you are siting (a survey stake will be used at the contest).

2. Holding the compass level, *turn* the **Housing** or **Dial** until the red **Orienting Arrow** lines up under the **Magnetic Needle**. Notice the magnetic needle always points in the same direction, which is called magnetic north.



3. Read the **Azimuth** found on the dial just below the **Index Line**. (*Every little hash mark on the dial equals 2 degrees.)* Be sure to keep the compass level in your hand and the magnetic needle directly above the orienting arrow.

4. Record this azimuth and pace toward the object of your destination (the survey stake). Follow the pacing instructions described later in this chapter.

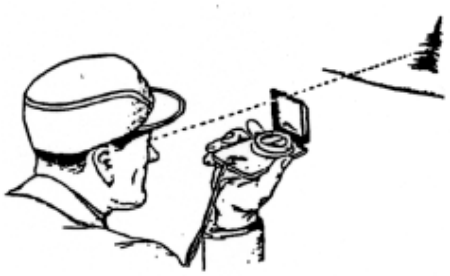
5. Once you have calculated and recorded your paced distance repeat this procedure to the next destination (the next survey stake).

TAKING AN AZIMUTH WITH A MIRROR SIGHTING COMPASS (JR/SR)

The Silva Ranger (or similar styles of compass made by different brands) is the most common type of mirror sighting compass used by foresters. It has a rectangular baseplate with a graduated dial that houses the needle and can be rotated. The mirror, line, and peep sight on the hinged cover help with sighting the compass. The graduated dial is filled with liquid to dampen the quivering of the needle. This compass is fast to use, particularly on straight cruise lines, and is accurate enough for most forestry applications.

1. Face the object you are aiming at.

2. Holding the compass ***level*** at eye level and at arm's length, look at the dial of the compass in the mirror reflection.



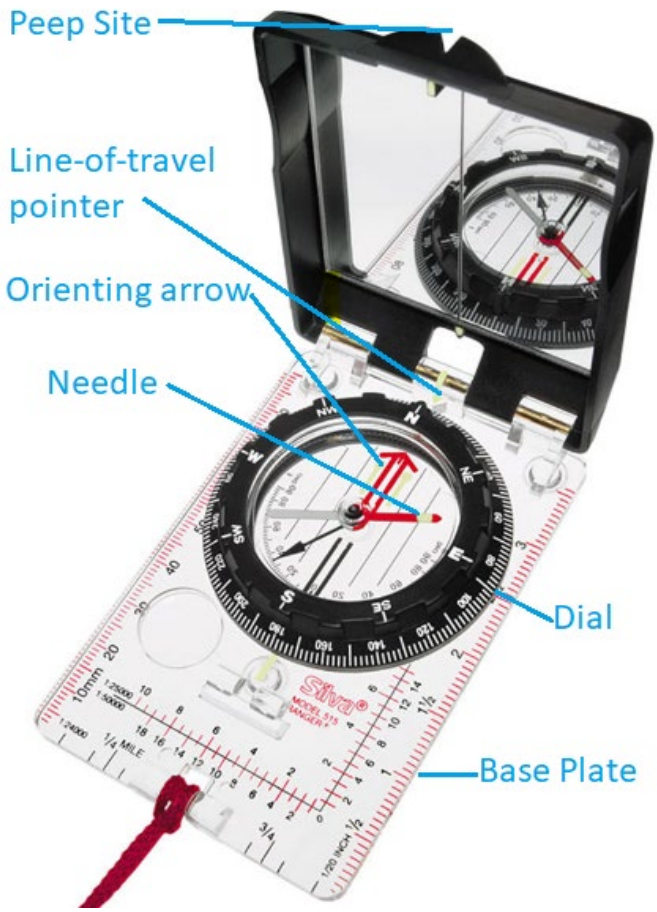
3. Next, line up your objective through the peep sight on the compass.

4. While continuing to hold the compass level, look at the compass dial in the mirror reflection and turn the dial until the orienting arrow (the arrow on the bottom of the dial) is lined up with the compass needle and the red part of the needle is underneath the orienting arrow.

5. Make sure you keep the compass baseplate level throughout this operation. You are still sighting on the objective through the peep sight, keeping the needle and the orienting arrow lined up exactly.

6. Adjust as necessary and keep double-checking that everything is lined up.

7. Finally, read the **azimuth** at the **line-of-travel pointer** (the little triangle or mark on the baseplate by the hinge). The markings on the dial are graduated to 2º. Estimate the azimuth to the nearest 1º.



PACING

Pacing is the technique of measuring distances by knowing the length of your pace and counting the number of paces you take. Each two steps is called a **pace**. It is easier and more accurate to count the number of paces rather than individual steps.

DETERMINING THE LENGTH OF PACE

People's average length of pace differs. To determine your own average length of pace, measure 100 feet on level ground using a tape measure. Using a normal stride, walk the 100-foot distance, counting the number of paces (i.e. if you started pacing with your right foot, count every time your left foot touches the ground as one pace.) Walk the 100-foot distance two more times, then take the average of the three pace counts. That is your average number of paces for 100 feet.

Now, divide your average number of paces into 100 feet to determine your average length of pace.

EXAMPLE A

You paced the 100-foot line three separate times. The walks resulted in 21 paces, 19 paces and 20 paces, respectively. Your average number of paces for 100 feet is

21 + 19 + 20 = 60 divided by 3 = <u>20 paces for 100 ft.</u>

Now determine your average length of pace:

100 feet divided by 20 paces = <u>5 feet per pace</u>

Once you know your average length of pace, you can calculate the distance from one point to another by pacing. To determine the distance between points, count the number of paces and multiply by the length of your pace.

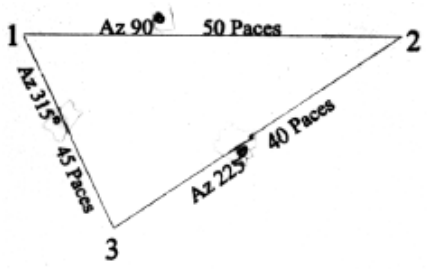
EXAMPLE B

A ← 25 paces → B

25 paces x 5 feet/pace = 125 feet from Point A to Point B

COMBINING COMPASS READING AND PACING

The compass reading and pacing portion of the forestry contest will combine both skills. Here is a sample layout of a compass course:



(Assuming your average pace is 5 feet)

Stations	Compass Azimuth	Measured Distance
1 - 2	90°	250 feet (50 paces X 5 feet)
2 - 3	225°	200 feet (40 paces X 5 feet)
3 - 1	315°	225 feet (45 paces X 5 feet)

CHAPTER 6 - TOOL IDENTIFICATION

The objective of this section is to familiarize students with some of the basic and commonly used tools and instruments in the forestry profession. The best way to learn to identify the tools is through 'hands on" demonstration or display by a forester. Pictures provided by three forestry supply catalog companies* are included at the end of this chapter as another study aid. For the contest, these tools are divided into the following categories according to their purpose:

a) Timber cruising and/or log scaling
b) Measuring distance and direction
c) Tree planting and site preparation
d) Safety
e) Cutting wood and brush
f) Fighting wildfires
g) Miscellaneous

For the contest, contestants should be able to identify the following tools and their uses:

- Tools used for **timber cruising and/or log scaling**:

  Relaskop
  Clinometer
  Prism
  Logger's tape (a double-sided tape with Pi inches on one side for measuring circumference and tenths of feet on the other for measuring distance)
  Diameter tape (a single-sided tape with Pi inches, only for measuring circumference; usually has a hook on the end for attaching to tree bark)
  Increment borer
  Log scaling stick
  Cruiser's vest
  Tatum

- Tools used for **measuring distance and/or direction**:

  GPS unit
  Hand compass
  Hip chain
  Steel chain
  Logger's Tape (also used for cruising and scaling)

- Tools used for **tree planting and/or site preparation**:

  Planting bag
  Hoedad
  Planting bar
  Planting spade/shovel

- Tools used for **safety**:

  Caulk (Cork) Boots
  Chaps
  Hard Hat
  Leather gloves
  Safety glasses

- Tools used for **cutting wood and brush**:

  Cruiser's axe or hatchet
  Chainsaw
  Pulaski

- Tools used for **fighting wildfires**:

  Backpack pump
  Chainsaw (also used for cutting wood and brush)
  Gated 'Y' (comes in several sizes)
  Hose clamp
  Hose connector (comes in various sizes)
  Forester nozzle
  Mop-up nozzle
  Pulaski (also used for cutting wood and brush)

- **Miscellaneous** tools:

  Computer
  Drip Torch
  Plastic flagging
  Pocket Stereoscope
  Map
  Aerial Photos
  Tree Marking Gun

*Forestry supply catalogs used as sources for all pictures except wildfire fighting tools:

Ben Meadows Co. Second Edition 2004
1-800-241-6401
www.benmeadows.com

Terra Tech, Inc. Catalog 23 (2000)
1-800-321-1037
www.terratech.com

Forestry Suppliers, Inc. Catalog 55 (2004-2005)
1-800-647-5368
www.forestry-suppliers.com

TOOLS USED FOR TIMBER CRUISING and/or LOG SCALING

(*Logger's Tape shown on page 6.4)

Cruiser's vest

Tatum

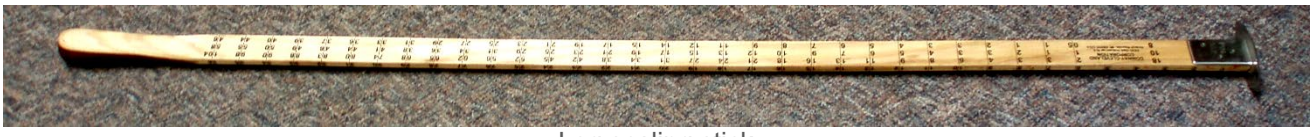
Clinometer

Increment borer

Relaskop

Prism

Diameter tape



Log scaling stick

TOOLS USED FOR MEASURING DISTANCE and/or DIRECTION

Hand compass

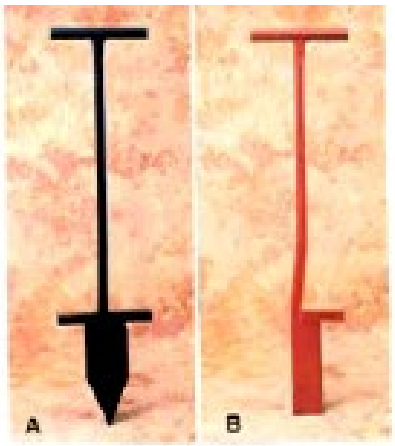
Logger's Tape

GPS unit

Steel chain

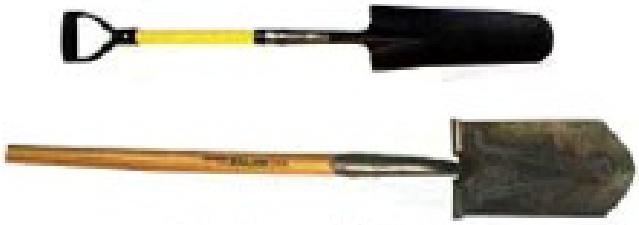
Hip chain

TOOLS USED FOR PLANTING and/or SITE PREPARATION



Planting bar

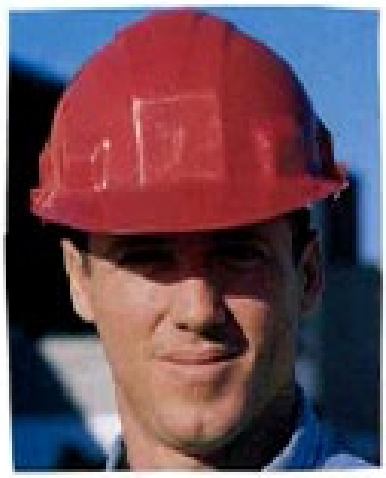
Planting bag



Planting spade/shovel

Hoedad

TOOLS USED FOR SAFETY



Hard Hat

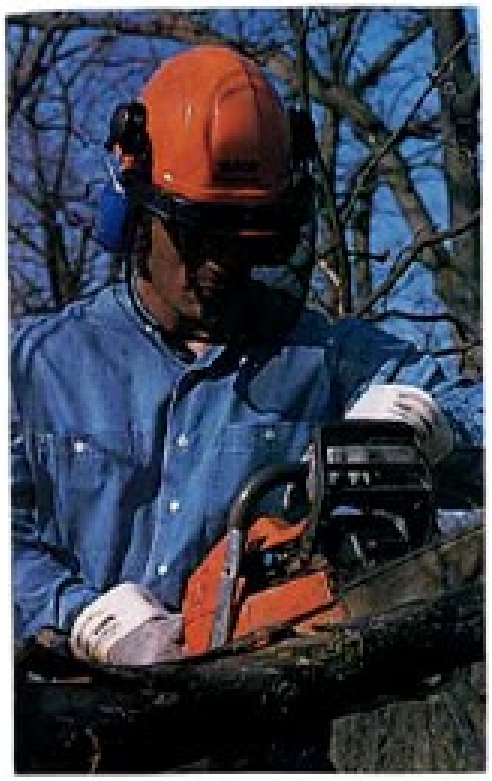
Leather gloves

Safety glasses

Chaps

Caulk (Cork) Boots

TOOLS USED FOR CUTTING WOOD and BRUSH

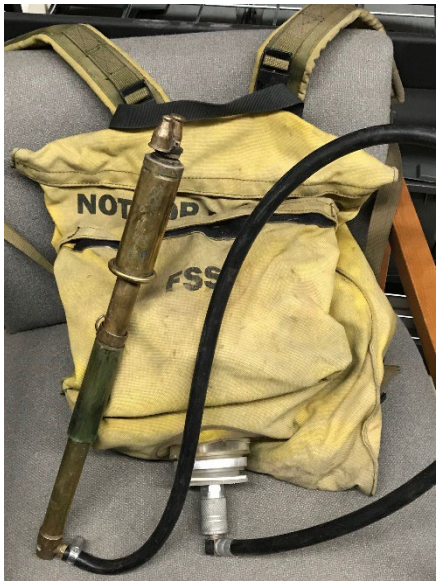


Chainsaw

Cruiser's Axe

Pulaski

TOOLS USED FOR FIGHTING WILDFIRES



Backpack pump

Gated ‘Y’ (large)

Gated ‘Y’ (small, for mop-up)

Hose clamp

Hose connector

Forester nozzle

Mop-up nozzle

MISCELLANEOUS TOOLS

Plastic flagging

Tree Marking Gun

Drip Torch

Computer

Maps & Aerial Photos

Pocket Stereoscope

IDAHO STATE FORESTRY CONTEST

CHAPTER 7 - SOILS and WATER QUALITY

SOILS

Soil can be defined as a natural body developed from a mixture of broken and weathered mineral material (rocks) and decaying organic material (remains of living organisms). Soil covers the earth in a relatively thin layer. It supplies air, water and nutrients for plant growth. Soil also provides mechanical support for plants, buildings and other types of construction.

Plants and animals derive support and nutrients directly or indirectly from the soil. As plants and animals live and die, their waste products and remains are returned to the earth to form the organic fraction of the soil. The development of *one (1) inch of soil* may require many *hundreds* of years under natural conditions.

Soils differ in their potential to produce food and fiber and in their usefulness for construction sites and other nonagricultural uses. Knowledge of soil characteristics is necessary to determine the appropriate uses, management practices and conservation measures needed to ensure appropriate land use. The best use and management of any given plot of land is based upon the specific characteristics of the soil there.

Soil engineering properties and interpretations also may be determined using soil characteristics and potential problems as a basis. These properties and interpretations may be used for selecting suitable sites for building houses, locating roads, planning parks and playgrounds, and many other construction uses of soil.

SOIL PROFILE

Each soil is unique and made up of distinctive layers called **soil horizons**. The various horizons or sequence of horizons make up a **soil profile**. The soil profile develops as the result of the interaction of five soil-forming factors: *climate, organisms, parent material, topography and time*. The soil profile is usually not over 5 feet thick because this is as deep as weathering processes generally go.

Types of Soil Horizons

A soil horizon is a layer of soil usually lying parallel to the surface. It has a unique set of physical, chemical and biological properties. The properties of soil horizons are the results of soil-forming processes. Variations in these properties cause each horizon to be distinct from adjacent horizons.

Soil horizons are named using combinations of letters and numbers. Six general kinds of horizons, called **master horizons**, may occur in soil profiles. These master horizons are named with capital letters: **O**, **A**, **E**, **B**, **C**, and **R**. A single soil probably never contains all six master horizons. Most Idaho soils have A, B, and C horizons. Other Idaho soils have an A horizon resting directly on a C horizon, or an A-E-B-C horizon sequence, or even an O-E-B-C sequence. The illustration below shows a theoretical soil profile with all 6 master horizons:

O Litter layer

A Mineral surface horizon, dark colored, granular structure

E Strongly leached horizon, light colored, platy structure

B Subsoil horizon of maximum development, “brown”, blocky structure

C Weathered “parent material”, “brown”, massive structure

R Hard bedrock

Each master horizon has a distinct set of properties, which are described on the next page.

O Horizon – An O horizon is composed of organic material (**litter**). It does not have to be 100 percent organic material, but most are nearly so. Forest soils usually have thin organic horizons at the surface. They consist of leaves, twigs, and other plant materials in various stages of decay. Wet soils in bogs or drained swamps often have only O horizons.

A Horizon – The A horizon is the surface horizon of a mineral soil. It has a **granular** structure. The unique characteristic of an A horizon is the dark color formed by the **humus** (decomposed organic) content. The thickness of A horizons ranges from a few inches in low precipitation (desert) rangeland soils, to 20 inches or more in the Palouse area of northern Idaho.

The A horizons play an extremely important role in maintaining soil fertility and providing a favorable environment for root growth. They should be protected from erosion or compaction. A horizons are usually the horizons that are referred to as "**topsoil**" although topsoil is a less definitive term than A horizon: It usually refers to the top 6 to 12 inches of the profile and may actually include no A horizon, as in the case of severely eroded or scraped areas.

E Horizon – This horizon has a light gray or whitish color. It is present only in areas with relatively high precipitation. It usually occurs immediately beneath an O or A horizon.

E horizons are light colored because nearly all the iron and organic matter has been removed or **leached** (washed) out. (**Contest Hint:** *Think of "E" for "Exit" or leaching.*) E horizons exhibit a "**platy**" structure.

B Horizon – The B horizon has the brightest yellowish-brown or reddish-brown color and a "**blocky**" structure. Many B horizons have more clay than any other horizons in the profile and show evidence of clay accumulation. B horizons are part of the subsoil. They are the subsoil horizon with the maximum amount of development.

In cases where the A horizons have been completely lost by erosion or for some other (usually) man-caused reason, the B horizon may be at the surface and thus constitutes the "topsoil."

C Horizon – The C horizon is composed of weathered geologic or **parent material** found below the A or B horizon. It is "brown" in color and has a massive structure. Any material that is loose enough to be dug with a shovel but has not been changed appreciably by soil forming processes is considered to be a C horizon. The C horizon is also considered to be part of the subsoil. The sand and gravel deposits of glacial outwash and till in northern Idaho are examples of a C horizon.

R Horizon – The R horizon designation is used for **bedrock**. Bedrock consists of hard, relatively unweathered rock material. Depending on the depth to bedrock, the R horizon may occur directly beneath any of the other master horizons.

SOIL TEXTURE (Surface and Subsoil)

Texture is the proportion of sand, silt and clay-sized soil particles making up the soil minerals. Texture is an important soil property because it is closely related to many aspects of soil behavior. The ease of tilling the soil and the ease of plant root development within the soil are both influenced by soil texture. Texture affects the amount or air and water a soil will hold and the rate of water movement into and through the soil.

Plant nutrients are also related to soil texture. Tiny silt and clay particles provide more mineral nutrients to plants than large sand grains. The productivity of sandy soils can be improved through proper management but these soils require more fertilizer and more frequent irrigation (watering) than soils with higher percentages of silts and clays.

There are three **size classes of soil particles**:

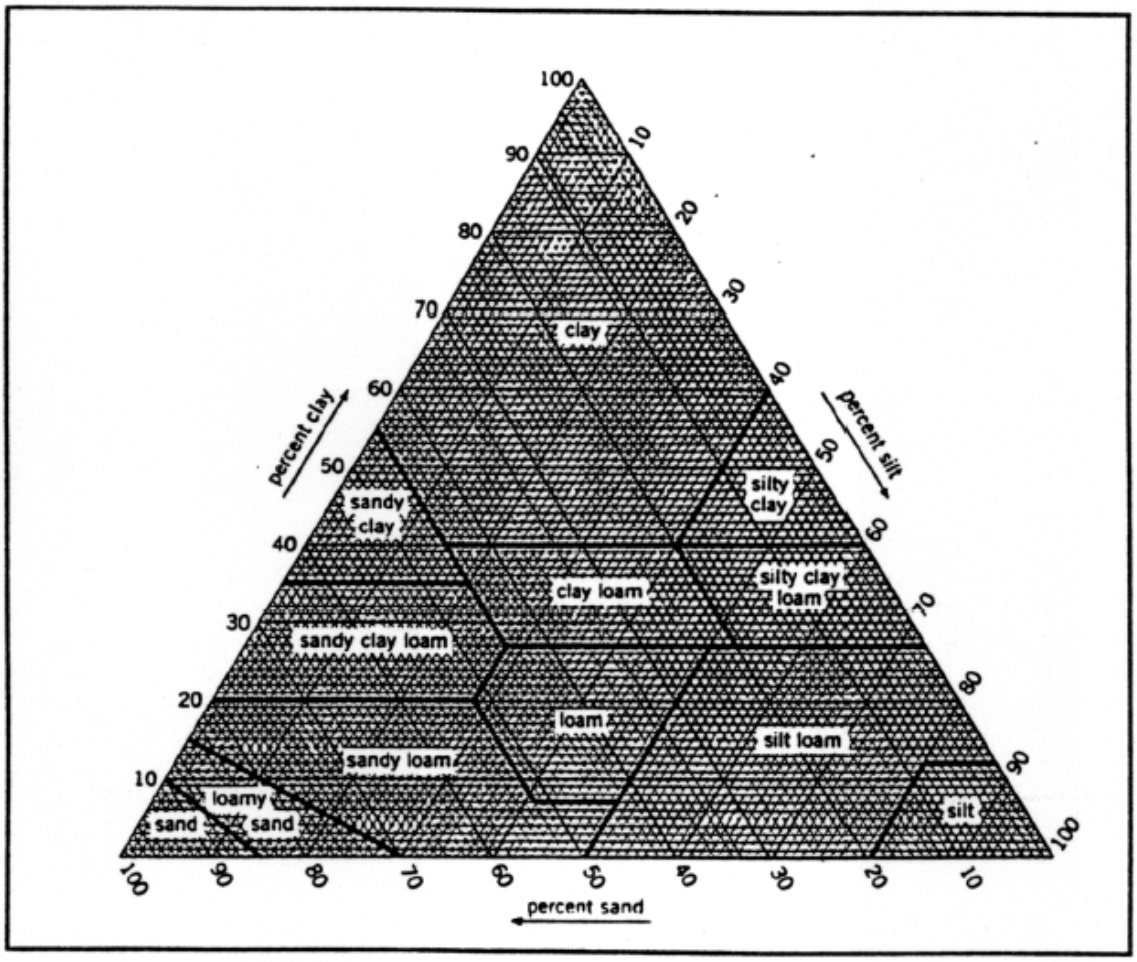
- **Sand** particles provide more mineral nutrients to plants than large sand grains. Sand particles range in size from 0.05 mm to 2 mm. They are large enough to see with the naked eye, and they feel gritty.

- **Silt** particles cannot be seen without a hand lens or microscope. Silt feels smooth, like flour or corn starch. It is not sticky.

- **Clay** particles are less than 0.002 mm in size. They can be seen only with extremely high-powered microscopes. Clay feels sticky when wet and can be molded into “ribbons” or “wires” or other forms much like modeling clay.

FORESTRY CONTEST TIP: A sample of soil material taken from the profile at the contest site will be placed in a container to be used for judging textures. You will be asked to name the soil texture (i.e. sandy loam, clay loam, silt loam, etc.), as determined by the relative amounts of sand, silt or clay that are present.

The Textural Triangle



Every soil contains a mixture of various amounts of sand, silt and clay. Since there are three size classes of particles, a three-sided **textural triangle** is used to show all the possible combinations.

Precise boundaries between **textural classes** are shown in the textural triangle diagram above. Each side of the triangle is the base line or "zero point" for the particle size in the opposite corner. If we know how much sand, silt, and clay a soil has, we can easily plot that soil's location on the triangle and see which textural class it falls into.

A soil that is composed of primarily sand-sized particles would lie very close to the sand corner of the triangle. Its *textural class* name would simply be "*sand.*" Similarly, a soil dominated by clay would lie near the clay corner of the triangle and would be called "clay."

Now, consider a soil with a mixture of sand, silt and clay. All three are present, but not in exactly equal proportions (and it actually takes less clay to "balance" the mixture than either sand or silt). This type of soil will fall into the lower central part of the triangle and would be called a **loam**.

Determining Soil Texture using the Textural Triangle

Suppose we have a soil that contains 40 percent sand, 45 percent silt, and 15 percent clay.

1. *Start with the clay content*: Find the midpoint of the base line that lies between sand and silt (i.e. the base line at the bottom of the triangle). From there, go vertically up to the 15 percent clay line (the percent of clay is shown on the left side of the triangle). *Every soil on this (horizontal) line contains 15 percent (15%) clay.*

2. *Next, locate the 40 percent (40%) sand line* (the percent of sand is shown on the base line at the bottom of the triangle, opposite the clay corner). The 40% sand line runs diagonally up and to the left (i.e. parallel to the right side of the triangle). Find the point where the 15% clay line and the 40% sand line intersect. Mark that point.

3. *Now, if you wish, you can find the 45% silt line* (on the base line between silt and clay) and follow it diagonally down and to the left until it intersects with the 15% line. However, *it takes only two points to determine the soil texture*. This sample is a *loam*.

Determining Soil Texture in the Field

Soil scientists recognize 12 soil textural classes, as seen in the textural triangle. For the purpose of the Forestry Contest, the soil texture will be identified as one of only the three basic textural classes: **sandy**, **silty/loamy**, or **clayey.**

Basic Soil Textural Classes

	Sand		
Clay	**>50%**	**20-50%**	**<20%**
>40%	sandy or clayey	clayey	clayey
27-40%	sandy	silty/loamy	silty/loamy
<27%	sandy	silty/loamy	silty/loamy

Determining Soil Texture by Feel

1. Fill the palm of your hand with dry soil.

2. **Moisten the soil** enough so that it sticks together and can be worked with the fingers. Don't saturate it into runny mud. If the soil sticks to your fingers, it's too wet to tell texture. Add more dry soil.

3. **Knead the soil** between your thumb and fingers. Take out the pebbles and crush all the soil aggregates. You may need to add a little more water. Continue working the soil until you crush all the aggregates.

4. **Estimate the sand content** by the amount of textural grittiness you feel.

   a. More than 50% = sand dominates. The textural name is probably *sandy*.

   b. 20 – 50% = sand is noticeably present but not dominant. The texture is most likely *silty/loamy.*

   c. Less than 20% = silt and clay dominate. The textural name is either *silty/loamy* or *clayey.*

5. **Estimate the clay content** by pushing the sample up between your thumb and index finger to form a ribbon.

   a. Less then 27% = the ribbon is less than 1 inch long. The textural name is either *sandy* or *silty/loamy.*

   b. 27 – 40% = the ribbon is 1 to 2½ inches long. The textural name is either *silty/loamy* or *clayey*.

   c. More than 40% = clay dominates and the ribbon will be more than 2½ long. The textural name is *clayey*.

6. **Combine your estimates** of sand and clay to determine the textural name.

Soil Depth

The depth of soil includes the total thickness of the soil horizons readily penetrated by plant roots, water and air. A restrictive layer may be dense clay, hardpan or bedrock. There are *five classes of soil depths*:

1) Very Shallow = soils less than 10 inches deep
2) Shallow = soils 10 to 20 inches deep
3) Moderately Deep = soils 20 to 40 inches deep
4) Deep = soils 40 to 60 inches deep
5) Very Deep = soils more than 60 inches deep

CONTEST TIP: You will be expected to be able to identify the:

→ Texture of the A horizon

→ Thickness of the A and B horizon

→ Percent of rock fragments in the whole soil by volume

FORESTRY INTERPRETATIONS for SOILS

By identifying the properties of a soil, a user can make predictions about the success of various uses. Foresters, for example, can use the knowledge of soil properties to help determine how difficult reforestation will be or how severe the hazard of windthrow is. The two forestry interpretation charts on the next page can be used to determine the **limitations ratings** (i.e. the expected difficulties or risks) for *reforestation* and *windthrow*.

Reforestation is the planting or natural regeneration (growth) of tree seedlings. Soil factors that influence tree seedling survival are:

- Rooting depth (depth that roots are able to penetrate through the soil)
- Texture (as related to water-holding capacity)
- Thickness of the A horizon

The chart below shows how variations in effective rooting depth, soil texture, and soil thickness affect tree survival (*Rating*). This chart predicts the likelihood of tree seedling survival in each soil type (for planting site-adapted tree species and for naturally regenerating seedlings).

Effective Rooting Depth	Texture of A Horizon	Thickness of A horizon	Rating
>40 inches	Sandy	0-10”	moderate
		>10”	slight
	Silty/loamy, Clayey	any	slight
20-40 inches	Sandy	0-10”	severe
		>10”	moderate
	Silty/loamy, Clayey	0-10”	moderate
		>10”	slight
<20 inches	Sandy	any	severe
	Silty/loamy, Clayey	0-10”	severe
		>10”	moderate

Windthrow Hazard is an estimate of how susceptible mature trees are to being blown over during strong winds. The soil factors that influence windthrow hazard are *effective rooting depth* and *texture*. The chart below shows the effect these two factors have on windthrow hazard.

Effective Rooting Depth	Surface Texture	Rating
>40 inches	Silty/loamy, Clayey	slight
	Sandy	moderate
20 to 40 inches	Silty/loamy, Clayey	moderate
	Sandy	severe
<20 inches	any	severe

WATER QUALITY

We hear a lot of talk about “water quality,” but what does it really mean? How do we know if our water is clean?

Water contains many substances besides “H20.” Minerals, for example, give water its taste and are necessary for health. They are found naturally in water, as are many other substances. But when these substances become too plentiful, they can change from being harmless materials to “**pollutants**.”

The amount of a substance that is *safe* to allow in water depends on the use of the water. The water from the tap at home should be crystal clear and free of bacteria, right? But what about the water used for livestock or for irrigating the garden? Water used for various activities requires different levels of purity and protection. In Idaho, **safety levels of pollutants** have been established for the following activities or uses:

- Domestic Water (drinking and other household activities)
- Cold Water Fisheries (trout and their cousins)
- Warm Water Fisheries (sunfish, bass, and their relatives)
- Trout Spawning
- Swimming
- Wading and Boating
- Irrigation
- Livestock Watering

The **quality of water** is determined by its chemical and physical characteristics. If these are outside the safe range, the water is considered polluted. Here are ten important factors that we look at to determine water quality:

1. Suspended Solids

Suspended solids are materials carried in streams and rivers that can be filtered out of the water. They include particles of sewage and animal wastes, decaying plants, industrial wastes, and soil particles. Soil particles in water are called **sediment**. *Suspended* sediment gets into water through the process of erosion. This occurs when water runs over land not covered with vegetation. Suspended sediment reduces water clarity, fills in reservoirs, increases treatment costs of drinking water, reduces habitat for aquatic organisms, and interferes with irrigation by decreasing pump life and increasing ditch-cleaning costs.

2. Dissolved Oxygen

Creatures that live in water need oxygen that is dissolved in water to survive. Oxygen gets into water from the air or is released by aquatic plants.

Some of the factors that affect the amount of oxygen dissolved in water include:

- **Temperature** – Cold water holds more oxygen
- **Altitude** – Air is thinner at higher altitudes
- **Plants in water** – Photosynthesis releases oxygen into the water
- **Decaying materials in water** – The decomposition of dead algae, leaves, and wastes uses up oxygen
- **Turbulence** – Rocky stream bottoms increase oxygen
- **Depth** – The greater the surface area, the more oxygen is absorbed
- **Velocity** – Moving water absorbs more oxygen
- **Shading** – Affects temperature and photosynthesis
- **Ice Cover** – Prevents contact between air and water

Dissolved oxygen normally ranges between 8 and 15 parts per million (*ppm*). Since oxygen requirements vary among aquatic organisms, Idaho has set a minimum level of 5 ppm for warm water fish, and 6 ppm for cold water fish (except below dams).

3. Parts Per Million

Most pollutants are harmful at very low levels, so their quantity is reported in **parts per million** (abbreviated to **ppm**). One drop of a substance in 26 gallons of water is about 1 ppm. You will also see pollutants reported in **milligrams per liter** (**mg/l**), but this still means parts per million. For **toxic materials**, the units are often **parts per billion** (**ppb**). **Micrograms per liter** (**µg/l**) also means ppb.

4. Temperature

There is an ideal temperature range for each creature that lives in water. Cold water fish, like trout, do best at temperatures between 50º and 58º F. Water temperatures over 70º F can cause problems for them. Warm water fish, like sunfish and bass, can survive in 92º F water. Temperatures outside fishes' ideal range may not kill them but can cause a lot of stress. At high temperatures, fish can't reproduce, they grow less, and they are more susceptible to disease and harm from pollutants. Creatures that fish eat are sensitive to temperature changes, so warmer water may also cause a reduction in the food supply.

5. pH

pH is a measurement of acidity - in this case, it measures whether water is **acidic, basic or neutral**. Specifically, pH is a measure of hydrogen ion activity in water. It is measured on a scale from 0 to 14, with 7 representing the neutral point. Values below 7 are acidic (like vinegar or soda pop) and values above 7 are basic (like soap or lye). Most natural waters are buffered by minerals like bicarbonates (the active ingredient in baking soda, for example) that keep pH values in the 6.5 to 9.0 range.

pH is important because it affects most chemical processes that occur in water. For example, in water with a high pH, metals are not toxic but at low pH, metals are actively toxic. pH also affects the makeup and size of communities of creatures in water. Generally, low pH (acidic) waters have fewer species and a much lower rate of

productivity, so they support a smaller fish population than waters with higher pH (basic or alkaline) values.

6. Bacteria

Bacteria are measured in water to see if disease-causing organisms are present. It is impossible to test for all the disease-bearing organisms that can occur in water, so tests are done to see if one particular bacterial group, called **fecal coliform**, is present. This bacterial group consists of beneficial bacteria that exist in the intestines of warm-blooded animals. If fecal coliform bacteria are found in water, it's likely that other organisms that cause health problems are also present.

In Idaho, maximum safety levels for fecal coliform are:

- Wading or Boating: 200 bacteria colonies per 100 ml
- Swimming: 50 bacteria colonies per 100 ml
- Drinking: 1 bacteria colony

7. Nutrients

Nutrients stimulate plant growth in water in the same way they stimulate growth of house plants in a flower pot or crops in a field. Microscopic plant life called **algae** causes a green scum on rocks or, as a floating form, causes a "pea soup" color in lakes and ponds. Larger aquatic plants are called "tules" or "seaweed" in lakes and are known as "mosses" when found in irrigation ditches. When aquatic plant growth is excessive, it can interfere with recreational uses such as boating and swimming. It can also cause odors when it decays, clog pipes and ditches, and it reduces oxygen to levels that are harmful to fish. Too many nutrients speed up the natural aging of lakes, a process in which lakes are filled with plant growth and become swamps or bogs.

The most common nutrients in water are nitrogen and phosphorus, the same nutrients that are used on farms and gardens as fertilizer. Nitrogen gets into water from the air (80% of air is nitrogen gas), sewage, animal waste, fertilizer, and soil that washes into the water. Phosphorus does not become a gas. It is leached by rain or irrigation from soil and bedrock into water sources. Generally, concentrations of inorganic nitrogen above 0.3 ppm and concentrations of phosphorus above 0.1 ppm are considered unacceptable.

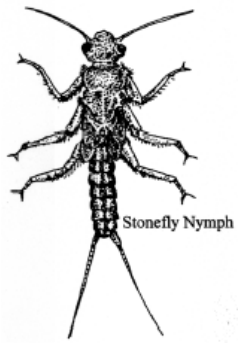
8. Turbidity

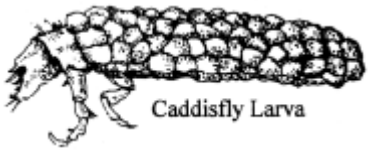
Turbidity refers to the murkiness of water, with zero turbidity indicating clear water. Turbidity is determined by shining a beam of light through a water sample and measuring the amount of light that is reflected off the particles in suspension. Water with turbidity higher than 25 units looks dirty and is considered to be harmful to fish and other aquatic organisms.

9. Biological Indicators

One way to determine if a body of water is healthy is to look at the creatures living in the water. We can see what kind of **macroinvertebrates** live in a stream. “Macro” means big enough to be seen with the naked eye. “Invertebrates” means animals without backbones. Insects, small crustaceans and snails are all macroinvertebrates that live in water.

A healthy stream has a wide variety of macroinvertebrates including some that are sensitive to pollution such as *caddisflies, mayflies and stoneflies*. These creatures are the primary source of food for trout. In a polluted stream, this variety is reduced to only a few species that are more tolerant of pollution. These species often multiply quickly and, in some cases, become nuisances.





10. Toxicity

Many toxic materials are **soluble** (i.e. they dissolve) in water. Among the most common are organic compounds (like pesticides and herbicides) and heavy metals such as lead, mercury and cadmium. These compounds may be lethal to fish and other aquatic organisms or may cause more subtle effects such as reduced growth or failure to reproduce.

WATER QUALITY and FORESTRY

Forestry practices such as timber harvest, road construction, skidding, and log hauling can have a positive or a negative effect on water quality. Poor road construction and/or poor skidding practices can account for up to 90% of the soil erosion entering streams. Intermittent streams can contribute a significant amount of sediment to year-round streams. Thus, both intermittent and year-round streams need to be protected.

We can protect our streams by using a set of stream protection guidelines that have been developed for forest practices called **Best Management Practices** (**BMPs**). BMPs address such items as soil protection, drainage systems, and road maintenance. BMPs prescribe the most effective and practical means of preventing or reducing the amount of “**non-point source pollution**” generated by forest practices.

BMP Requirements & Streams

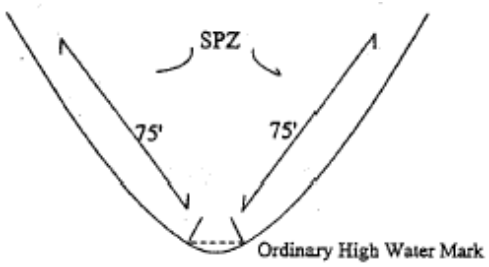
For forest practice purposes, streams are divided into two categories: Class I and Class II. Each category has its own set of BMP requirements.

Class I streams are important for spawning, rearing, or migration of fish.

Class II streams are usually minor drainages or headwater streams that do not support fish.

Class I Stream Protection Zone

Class I streams have a **Stream Protection Zone (SPZ)** of **75 feet** on each side of the "**Ordinary High Water Mark**".



For example, one of the BMPs for Class I streams says that logging can occur inside the Class I stream protection zone (75 feet on either side), but a certain number of trees must be maintained to maintain shade. Shade is important because it helps to maintain the cooler water temperatures needed by fish.

Class II Stream Protection Zones

Class II streams have a stream protection zone (SPZ) of **30 feet** on either side of the "Ordinary High Water Mark." There are no tree retention requirements for Class II streams as long as the SPZ is promptly reforested.

Here are two more examples of stream-related BMPs:

1. When streams must be crossed, temporary structures must be installed that are adequate to carry stream flows. Skidding logs in or through streams is not permitted. This rule applies to both tracked and wheeled skidders.

2. **Large organic debris** (referred to as **LOD**) must be provided and maintained along a stream. LOD is defined as large, living or dead trees and parts of trees that are buried in the stream bank or bed. LOD is important because it creates diverse fish habitat and stable stream channels by reducing water velocity, trapping stream gravel, and allowing scour pools and side channels to form.

BMPs & Soil Protection

To keep **sediment** (dirt) out of streams, the soil must be protected from *erosion* and other damage. To minimize soil erosion during logging, the harvesting method and the type of equipment used must be carefully chosen to suit the conditions of the site (such as slope, landscape, and soil properties).

Specific BMPs have been developed for all aspects of forest management including timber harvest, maintenance of productivity, road specifications and plans, road construction, road maintenance, minimum tree seedling stocking levels, use of chemicals, and slash management. These BMPs can be found in the Idaho Department of Lands publication Rules and Regulations Pertaining to the Idaho Forest Practices Act, Title 38, Chapter 13, Idaho Code.

The following are examples of BMPs that have been developed for tractor **skidding** and line skidding:

→ Tracked or wheeled skidders should not be used on geologically unstable, saturated, or easily compacted soils. (Unstable and erosive soils are generally the sands and silts. Clays, loams or soils high in organic matter tend to be less erosive.)

→ Line skidding is usually required on steep slopes, especially adjacent to Class I or Class II streams. Line skidding is required if the slope exceeds 45%.

In the end, the condition of our streams is a reflection of how well we are managing our natural resources. With the proper application of BMPs, our streams will be protected.

CHAPTER 8 - TREE HEALTH

Determining a tree's health is an important part of caring for a forest. Some tree health problems may be confined to an individual tree but problems that occur on many trees within a forest may indicate an unhealthy forest. An understanding of the relationship between tree health and forest health is important in making management decisions because, to permanently improve forest health, a broad range of management actions over a long period of time is often necessary.

To assess the health of a tree, use a logical, three-step approach. Start by looking for abnormalities and damage. If anything is found, look for additional signs and symptoms, and then use all these clues to help you determine the type of damage, and finally, identify a specific causal agent.

A. Locate Any Damage

Look over the tree for damage such as scars, holes, discolored needles, missing bark, fine sawdust in bark crevices or around the base of the tree, unusual swellings or growths, or pitch flow. It's very important to stand back and look at the top of the tree. Is it thinning, dead, off-color or fading? Is there an unusual crop of small cones? Compare the growth of the top leader to nearby trees of the same size and species to assess current growth. Short growth or other crown problems are evidence that the tree is not getting sufficient nutrients to maintain normal health.

Look for a pattern of damage. Does the damage involve the whole tree or only one side or at a certain height or age of needles? Check adjacent trees and elsewhere in the stand for similar problems. Is the damage only on certain types, sizes, or ages of trees? Are other species damaged, too? Look at the surrounding environment. Is the damage limited to depressions, ridge tops, southern exposures, etc.?

B. Determine the Type of Damage

There are five general causes of damage, including:

1. **Insects** – Insects can be identified by their presence on or in trees but are more often identified by the damage they cause. Look for fine sawdust in bark crevices or around the tree base, small holes in the bark, grooves or tunnels under the bark or in the trunk of the tree, small masses of pitch (**"pitch tubes"**) on the trunk, and chewing or webbing on the needles.

2. **Diseases** – Diseases are sometimes harder to identify than insects. Look for discoloration or browning of foliage, pitch flow or sap oozing from the bark, unusual growths, swellings, decay, or the fruiting bodies of fungi (**conks**).

3. **Animals** – Animals may damage trees by chewing, rubbing or breaking branches. Woodpeckers sometimes peck holes in tree trunks or branches.

4. **Mechanical** – Mechanical damage is the result of equipment use or other human-caused injuries to trees in a forest. Look for torn or missing bark and broken or scraped trunks and/or branches.

5. **Environmental** – Environmental damage is the result of weather, fire, or chemicals in the environment. Look for damage across a broad area on many trees of different sizes and often on many different species including shrubs.

NOTE: Trees are often damaged by one of these five factors and subsequently attacked by insects or disease, which may mask the original cause of damage. It is common to find multiple problems on the same tree, because an already weakened tree is more susceptible to insects and diseases.

C. Identifying the Specific Agent that Caused the Damage

Insects – Three major types of insects damage trees, including:

1. **Bark beetles** bore through the bark of trees where adults lay their eggs and larvae feed, grow and mature in the inner bark. This activity girdles the tree, which usually kills it, although some trees may survive if the attacks are limited (e.g. "**strip attacks**"). Each type of bark beetle has a distinctive egg gallery. Look for galleries under the bark on the trunks of dying and dead trees. Look for sawdust and/or pitch tubes in bark crevices or on the ground around affected trees. Sometimes only the tops of trees are killed.

2. **Defoliators** feed on the leaves or underside of needles. Some larvae mine buds and old needles of trees. After several years of severe defoliation, branches may die back, and top kill may occur. When defoliator populations are high, tree mortality can occur or trees can become susceptible to other insects or diseases. Look for chewed needles or leaves. Look for larvae, pupae, webbing and cocoons or egg masses.

3. **Wood Borers** infest weakened, dead, or recently felled trees. Wood borers can (occasionally) kill live trees when populations are high. The larvae mine first into the cambium of the trunk, branches or roots of the tree, then bore into the wood. Look for round or oval-shaped holes and tunnels through the wood. These may be either tightly packed with fine boring dust or loosely packed with coarse boring dust.

Diseases – There are five broad categories of diseases:

1. **Root Diseases** are caused by fungi that can be recognized by the distinctive decay or fruiting bodies they produce. Young trees of all species can be attacked and killed. Douglas-fir and grand fir trees remain highly susceptible for life but many species become less susceptible with age. Trees of all sizes may be attacked.

As root disease spreads through the root system, it slowly starves the tree (this usually takes several years for large trees). Root diseases generally spread from tree to tree via direct root contacts, which often results in a "**pocket**" or "**center**" of dead and dying trees.

Trees with root disease often have shortened terminal growth, with rounded crowns. They may also have thin, off-color (yellowish) crowns and a stress cone crop. Often, pitch will ooze through the bark at the base of the tree. Roots on **windthrown** trees may appear stubbed or callused over.

2. **Dwarf Mistletoes** are small parasitic plants that attack live trees. They produce small plants on infected branches that vary in size from one to several inches and may be yellow to purple to brown or olive green in color. Infections are most common in the lower portion of trees and often stimulate unusual branch growth, resulting in dense clusters of branches called "**witches brooms.**"

   Top kill or "**dieback**" is common as the nutrients are siphoned off by infections in the lower crown. Severe infections will reduce tree height and diameter growth. Trees are rarely killed but may be seriously deformed. Bark beetles sometimes attack trees weakened by dwarf mistletoe infections.

   Look for witches brooms, swelling on stems and branches, and small dwarf mistletoe plants in the branches.

> **CONTEST TIP:** Only Douglas-fir, western larch, ponderosa pine, and lodgepole pine are attacked by dwarf mistletoes in northern Idaho.

3. **Decays** are fungi that recycle wood. They are usually identified by the kind of decay they produce or by the fruiting bodies ("**conks**") produced on the trunk of infected trees. Most decays can be found on several different tree species, although some have a very narrow host range. They are extremely important in recycling dead and down trees, but some decays become a problem in live trees because can they cause defects and weaknesses in the trunk that predispose trees to breakage or windthrow. Trees with decay are used as nesting sites by many animal species, including birds, bats and many small mammals.

4. **Cankers** are caused by fungal diseases that attack the cambium layer and cause deformity in the trunk or branches. Most canker-causing fungi occur only on a very limited number of hosts. As cankers grow, they can girdle and kill trees or branches, or weaken trunks, predisposing them to breakage at the weakened spot. Look for **flagging** (dead branches with brown or red needles on them), deformities in the trunk or branches, or areas of severe pitching.

5. **Foliage Blights** or **Needlecasts** are diseases caused by a group of fungi that attack the foliage of live trees. Most of these fungi are very **host-specific** (i.e. each fungus attacks only one kind of tree). They usually attack either the current season of foliage or older foliage, but not both, so trees are rarely killed. Since most of these diseases are strongly favored by moist climatic conditions, some trees in a stand may be severely infected while adjacent trees have little or no infection, due to minor differences in site conditions. Look for yellowing, browning, or loss of foliage, especially in the lower crown, where moisture conditions are generally more favorable for these fungi.

Animals

Animals can cause various kinds of damage to trees, depending on the type of animal that caused the damage. For example, many browsing animals, such as deer or moose, will chew the top or branches off. Bears sometimes damage or even girdle cedar and larch trees by peeling off strips of bark to feed on the underlying cambium. Elk and other antlered big game severely damage or girdle small saplings by using them to rub the velvet off their antlers in the fall.

Woodpeckers are generally considered to be beneficial to trees because they can help to control bark beetles or other destructive insect outbreaks. Woodpeckers may flake the bark off tree trunks to reach the insects underneath but this causes little, if any, damage compared to the insect infestation. Woodpeckers also excavate nesting holes in the boles of trees but, again, the "damage" is secondary to the decay that was already present.

Mechanical

Mechanical damage is physical injury to trees that is man-caused. Examples of mechanical damage include bark injuries, broken branches, broken tops and boles on small trees, scraped branches, or other injuries caused by logging equipment such as skidders, saws, and log trucks, by vehicles scraping or bumping tree trunks along narrow forest roads, or even by people gathering firewood, chopping branches or carving into tree trunks in campgrounds. Mechanical damage can provide an entry point for diseases or insects into the damaged trees or forest stands.

Environmental

Environmental damage includes snow or wind breakage, lightning, frost injury, winter desiccation, and drought. It can be difficult to distinguish environmental damage from other kinds of damage. Determining environmental damage will often amount to eliminating other possible causes of damage by the lack of symptoms (e.g. no cankers, no insects, no galleries, no decay, and no mechanical damage).

IDAHO STATE FORESTRY CONTEST

CHAPTER 9 - SILVICULTURE[1]

Silviculture, according to the Society of American Foresters dictionary, is "The art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands to meet diverse needs and values of landowners and society on a sustainable basis."

Foresters practice silviculture to improve tree growth, forest health, timber quality, economic return and other values over the long term. The primary silvicultural tool for managing forests is cutting trees, whether through a **stand regeneration cut**, where trees are left as seed sources or where seedlings are planted afterward, or a **thinning**, where trees are cut to make more room for the remaining trees. A thinning may be **commercial**, where logs are taken to the mill, or "**precommercial**" where sapling trees are cut.

If silvicultural treatments are done properly, they can:

- Reduce insect, disease and other forest health problems
- Improve the genetic quality of natural regeneration
- Shorten the time until next harvest
- Produce higher value trees in the next harvest
- Improve wildlife habitat and other forest values

In planning a stand regeneration cut or thinning, people sometimes focus mainly on the dollar value of the trees removed but to plan for the future forest, the quality of trees left in the stand must be the foremost consideration. The choice of individual **leave trees** depends somewhat on the desired spacing and which species are best adapted to the site. However, many other factors must also be considered, including the following:

Forest Genetics

Choosing high quality leave trees is critical to the future health and quality of a forest stand. Foresters use three guiding principles to select the best quality leave trees:

1. Trees that will be structurally stronger and produce the highest quality of wood before the next harvest
2. Trees that will produce the most wood before the next harvest
3. Trees that will pass on desirable genetic characteristics to their offspring (naturally regenerating seedlings)

1 Adapted from Leave Tree Selection, by Chris Schnepf, Area Extension Forester, University of Idaho Extension

Successive partial harvests made without considering leave tree quality often erode the genetic quality of forest trees.

Trees are distinguished by their **genotype** (their "DNA") and their **phenotype** (the combined expression of genotype and environment, which results in a tree's observable characteristics). It is often difficult to determine whether a tree's characteristics are due to genotype or environment. For example, a tree may have a forked top because of genetics or porcupines, or both.

We can only choose leave trees on the basis of what we can see – their phenotype. It doesn't necessarily matter whether the characteristics are primarily due to environment or to genotype. Even if a tree has poor characteristics due primarily to its environment, we would want cut it to create more space to allow the growth of adjacent superior trees to increase.

Tree Health

Many insects, diseases and animals can damage trees. Most are a natural part of the forest, at least to some degree, but sometimes these organisms damage more trees than we would like.

Unfortunately, we have often inadvertently created a favorable environment for these damaging organisms that allows them to increase in population beyond normal levels. For example, forest fire *exclusion* is one of the primary underlying causes of forest insect and disease epidemics. This is because ground fires tend to kill understory tree species that are susceptible to these damaging organisms. Stand replacing fires also help to regenerate species that are more resistant to insects and disease.

Removing trees with evidence of insect or disease damage can sometimes help to "disinfect" a forest by reducing the abundance of a detrimental organism (such as dwarf mistletoe). Even if harvesting is unlikely to reduce infection or infestation, removing damaged trees creates more growing space for the healthier, more desirable trees. Also, since we are leaving trees which were not as affected by damaging organisms, we may be promoting genetically inherited pest resistance.

Trees with these problems should be selected to remove:

- Witches brooms from dwarf mistletoe
- Conks, seams and other evidence of stem decay fungi
- Tops broken by porcupines, wind or other causes
- Excessive bark scarring or other mechanical damage
- Thin crowns, flat tops or other indicators of poor growth and vigor

Growth Rate

Leaving high quality trees (relative to phenotype) in a forest stand will provide for the best growth rates and quality possible and higher value timber for future harvests. These trees will also pass on their desirable *inherited* traits to their seedling offspring.

To pick the most robust leave trees, you should favor trees with:

- **40-60% crown ratio** – The crown ratio is the portion of the tree with living branches. A 50% crown ratio means that fifty percent of the tree's total height has living branches coming from it. Trees with smaller crowns are less able to take advantage of the growing space provided in thinnings.

- **Healthy foliage** – Leave trees should have abundant needles with good color in their needles.

- **Long leader or internodes** – Every year, pines and fir grow a new set of horizontal branches called a **whorl**. The places these branches emanate from are called **nodes**, and the distance between them is referred to an **internode**. An internode usually represents one year of height growth. Longer internodes indicate better height growth.

- **Pointy tops** – If you can see the top of the tree, is it "pointy" or rounded in shape? Trees with pointy tops are generally more actively growing in height. As a conifer gets older, height growth slows and the top becomes rounded or flat.

- **Bark characteristics** – Tree diameter does not necessarily indicate age. A small diameter tree with bark that looks like one of its 100+ year old cousins is likely to be a slow-growing tree. For example, old ponderosa pine bark is platy and yellow, while younger ponderosa bark tends to be black.

Growth Quality

Favoring trees with better form promotes a higher return for the next harvest, because logs will have more merchantable volume. These trees also pass on these characteristics (to the degree that they were inherited) to the new tree seedlings (their offspring).

Favor trees with the following growth form characteristics[2]:

BRANCHES	BOLE (TRUNK)
Medium sized	Straight
Not too dense (broomed) or thin crown	No forks
Not too heavy branching (e.g. open grown)	No crook
No ramicorn branching	No sweep
No sharp branch angles	No major doglegs

[2] **Adapted from Plus Tree Selection Guidelines, provided by Lauren Fins, Inland Empire Tree Improvement Cooperative**

Instructor's Guide: Practicing Silviculture for the Forestry Contest

Foresters use an almost artistic weighing of all the criteria given above when choosing leave trees. They make thousands of side-by-side comparisons between adjacent trees to decide which trees best satisfy the most critical criteria for the site.

Use the booklet *Logging Selectively* by Chris Schnepf (publication PNW 534) as a supplemental reference for this section of the contest manual. A companion video titled "I want to log selectively" is also available for checkout from UI Extension Offices, IDL Offices, or purchase from the University of Idaho Educational Communications.

The following exercise provides contestants a good opportunity to practice evaluating and rating four trees of varying quality (based *only* on form, not defect). The instructor chooses and flags out sets of four trees that:

- *Are visible from one location*

- *Are all the same species*
  At first, rating criteria should be limited to individual tree characteristics, rather than site or stand characteristics. For advanced groups, multiple tree species may be chosen to integrate species site adaptation into this exercise.

- *Are all the same age class*
  The purpose of limiting practice to even-aged stands is to help contestants to focus on individual characteristics of trees that have been competing in an even-aged stand. Many forest stands in Idaho are even-aged, having regenerated after fires. [**Note:** As an enrichment activity for advanced groups, stands with multiple age-classes could be selected, and the relative ability of different species to "release", given their silvics and the site, etc., could be discussed. However, this level is beyond the scope of the Forestry Contest]

- *Provide a diversity of individual tree characteristics to consider* based on all criteria discussed in this chapter. Try to include a range of tree quality in each set. Consider flagging a number of different sets of trees to allow for practice on specific characteristics, especially those that may be difficult to understand. For example, one set could be composed of relatively equal, high quality trees except for a degree of sweep or some other individual characteristic.

Rank the four trees in a set from "best" to "worst" **leave** trees, then discuss together why some trees are better than others.

CHAPTER 10 - NOXIOUS WEEDS

A **"Noxious Weed"** is defined by the Idaho State Department of Agriculture as any plant having the potential to cause injury to public health, crops, livestock, land or other property; and which is designated as noxious by the director of the Department of Agriculture.

Noxious weeds are almost always plants that have been introduced (either accidentally or purposely) into areas where they were not originally found. Since noxious weeds are not native to these areas, there are few natural controls present, and so they tend to spread rapidly, crowd out native plants, and be very difficult to control.

NOXIOUS WEED CONTROL

Developing a basic weed control strategy begins with:

1. Identifying the weed.

2. Determining what makes it a problem. For example:

   Toxicity to Humans and Livestock is one of the most common problems. Poisonous plants can cause loss of life, serious health problems, and costly animal care services. Toxic weeds in feeds are an animal's nightmare.

   Allelopathy: Some noxious weeds produce chemicals that inhibit growth or even kill adjacent plants. Weeds with this ability are said to be **allelopathic**.

3. Determining why it's hard to control. The reasons can include:

   → **Life Cycle** – It's important to know whether the weed is **perennial**, **biennial** or **annual**. A perennial weed is likely to be the most difficult and costly to manage. Biennial and annual weeds have a shorter life, making them vulnerable to more control options than perennials.

   → **Ability to Reproduce and Spread** by seeds, rhizomes, roots or other parts. The quantity of seeds produced annually per plant and the life of those seeds in the environment are very important factors. Weeds that produce hundreds or thousands of seeds per plant each year create the need for years of expensive management. Some weeds produce a few seeds that may survive in the environment for 60 years or more, making it nearly impossible to totally eliminate them.

   Some perennial weeds can sprout from cut-up plant parts, so cultivating, mowing or pulling can actually increase their populations and rate of spread. Cutting or burning some weeds stimulates the roots to sprout more seed producing stalks.

CONTROL METHODS

All the factors listed above must be considered when developing a management plan for weed control. In addition, we must keep in mind that each plant species will express its own particular characteristics in relation to its environment. Much like people, the reactions of individual plants of a single species will vary under various conditions. Thus, depending on climate or other variations in growing conditions, the same weeds often must be managed in different ways in different areas.

A best weed control plan involves using more than one strategy and more than one control method. The control methods selected must be affordable while preserving or helping to create the desired environment. The most common methods for weed control include:

- → **Prevention:** Keep weeds from occurring or increasing by identifying and controlling them before they become a problem. Some prevention methods include scrubbing boots after hiking, washing equipment before/after use, and using weed free seeds for plantings.

- → **Cultural Methods:** Improve desirable plant growth to resist weed invasion. Methods include planting, fertilizing, and irrigating crops to compete with the weeds.

- → **Mechanical Methods:** Physically slow or kill weed growth by mowing, tilling, hoeing, pulling, burning, or mulching.

- → **Biological Control Methods:** Use of living organisms, such as insects that are a natural enemy of the weed, or targeted grazing with animals that are resistant to toxic weeds, such as goats.

- → **Chemical Methods:** Use herbicides to kill or slow weed growth. Always read and follow the label directions and warnings before using chemicals.

CONTEST TIP - At the Forestry Contest, you will be expected to be able to:

1) **Define the term "noxious weed"**

2) **Identify the 14 weeds listed on the chart (see next page) and their impacts on people, animals and/or the environment**

3) **Know the 5 common types of control methods and give examples of each type**

4) **Know the best control methods for weeds**

NOXIOUS WEEDS TO KNOW

The following chart lists 14 of Idaho's noxious weeds. You can learn more about these noxious weeds, their effects, and their control in the reference listed below. Download it from the Idaho Department of Lands website on the Forestry Contest page, or obtain it at local IDL area offices, the IDL Forestry Assistance office in Coeur d'Alene, the U.S. Forest Service IPNF offices in Coeur d'Alene or Sandpoint, or the Boundary and Bonner County weed superintendents.

IDAHO NOXIOUS WEEDS

WEED NAME	LIFE CYCLE	TOXIC OR HAZARD TO	ECONOMIC THREAT	CONTROL PROBLEMS
Hawkweeds	P	-	Rapid spread	A, C, D
Leafy Spurge	P	H, L	Resists herbicides	B, C
Large Knotweed	P	-	Rapid spread	C, E
Oxeye daisy	P	-	Rapid Spread	A
Scotch Broom	P	H, L	Long-term seed life	B, C
Canada Thistle	P	-	Rapid spread	A, C, D
Scotch Thistle	B	-	Rapid spread	A, B, D
Dalmatian Toadflax	P	L	Resists herbicides	B, C
Yellow Toadflax	P	L	Resists herbicides	B, C
Rush Skeletonweed	P	-	Resists herbicides	A, D
Eurasian Watermilfoil	P	H, L	Clogs boat props, drowning hazard	C, E
Knapweeds	B & P	H, L	Rapid spread	A, C, D
Houndstongue	B	L	Attaches to animals, rapid spread	A
Yellow Star Thistle	A	L	Rapid spread	A

Life cycle	P = perennial; B = biennial; A = annual
Toxic or Hazard to	H = humans; L = livestock;
Economic Threat	Why it's so costly to control, e.g., "Resists herbicides" means there are few choices of chemicals that will work & these are very costly to use
Control Problems	A = mass seed production; B = seed life exceeds 15 years; C = plant parts & cut roots re-grow; D = wind carries seed, E = control methods limited

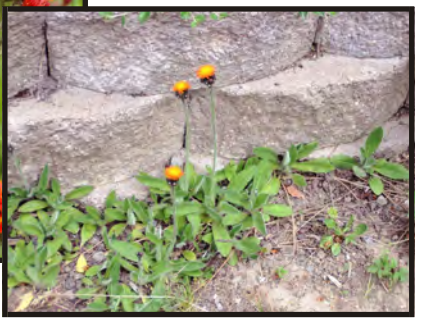
References

Goodnow, V., Frymire, K., Dingman, M. R., Hargrave, W., Ely, L. (Eds.) (n.d.) *Idaho Panhandle Noxious Weed Handbook*. Multiple agencies, counties, donors, and programs contributed to publication. Printing by Kootenai County Reprographics Center. (Free copies are available by contacting the Bonner Soil and Water Conservation District office (208-263-5310) or IDL Pend Oreille Area office (208-263-5104) in Sandpoint.)

Prather, T., Robins, S., and Morishita, D., 2004. *Idaho's Noxious Weeds, 4th Edition.* Bulletin 816. University of Idaho Extension, Moscow, Idaho. First edition 1994.

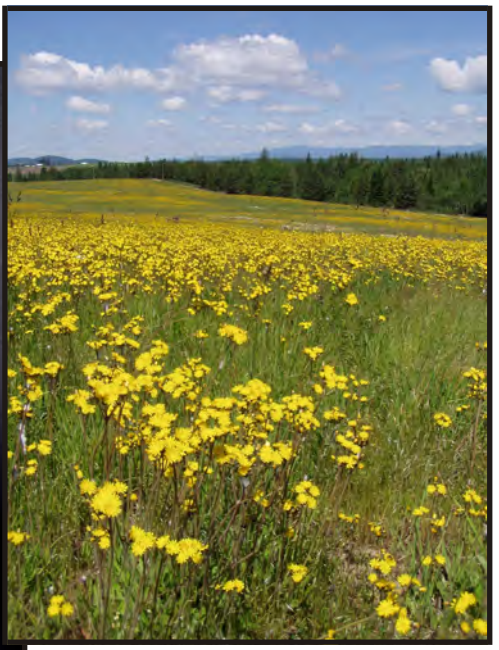
HAWKWEED

Orange Hawkweed



Hawkweed Rosette

Yellow Hawkweed



Field of Hawkweed

Source: Idaho Panhandle Noxious Weed Handbook

HAWKWEED

YELLOW *(Hieracium caespitosum)*

ORANGE *(Hieracium aurantiacum)*

- A **perennial** that spreads by root, above ground stolon and by feathery, airborne seeds.
- Grows 1 to 3 feet tall.
- The single stalk and leaves are hairy.
- Flowers are **yellow/orange**, look similar to a dandelion flower, but slightly smaller and in clusters. They bloom late May to mid June.
- Found in moist pastures, forest meadows, abandoned fields, clear cuts and roadsides.

Other Hawkweeds of Concern:

Tall Hawkweed *(Hieracium piloselloides)* There are no stolons on this hawkweed. Upper and lower leaf surfaces are smooth or with only few simple hairs. Yellow flowers bloom June through September.

Yellow Devil Hawkweed *(Hieracium glomeratum)* upper and lower leaf surfaces are covered with short stiff hairs giving the plant a rough texture. Stolons are absent in this hawkweed.

Note: There are native hawkweeds that grow in our region. These hawkweeds are **not** invasive. If you are unsure, please call your Noxious Weed Control Office for assistance.

CONTROL METHODS

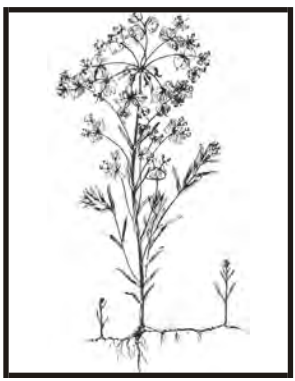
Chemical: Treat with Milestone® (aminopyralid), Curtail® (clopyralid + 2,4-D), Chaparral® (aminopyralid + metsulfuron), Brazen® (clopyralid + triclopyr) or Hi-Dep® (2,4-D) before bloom. **These products not recommended for home landscapes.**

Non-Chemical:

- Pasturelands must be healthy to recover from infestations and treatments, so fertilization is important.

Biological: There are no biological controls available in Idaho at this time. Hawkweeds are unpalatable, although sheep or goats may eat the plant.

LEAFY SPURGE



Source: Idaho Panhandle Noxious Weed Handbook

LEAFY SPURGE

LEAFY SPURGE *(Euphorbia esula)*

Because of the ability to store nutrients in its root system for several years, leafy spurge is a difficult plant to control.

- An aggressive **perennial** that spreads by rootstalks and seeds.
- Grows 1 to 3 feet tall.
- Narrow **bluish-green** leaves are up to 4 inches long.
- Flowers are small and enclosed by **yellowish-green, heart-shaped bracts** and bloom from May into the fall.
- Stems, leaves and flowers contain a **toxic milky latex sap**.
- It can be found in any type of soil and is commonly found in rangeland, pastures, roadsides, waste areas and wetland sites.

Caution: Horses and cattle should not graze the plants; the toxic sap causes blisters or ulcerations.

CONTROL METHODS

Chemical: Tordon® (picloram) applied in late spring or fall will give season-long suppression of leafy spurge. Hi-Dep® (2,4-D), Weedmaster® (dicamba + 2,4-D) or Crossbow® (triclopyr + 2,4-D) will provide some control, but must be applied 2 to 4 times each growing season. **These products not recommended for home landscapes.**

Non-Chemical:

- Fertilization and pasture health are extremely important.
- Mow and pull to prevent seed production. The sap of leafy spurge is **toxic**; skin and eye protection are needed when handling this plant.
- DO NOT CULTIVATE; new plants can begin from the cut root segments.

Biological: Several insect biological control agents are available for this plant and may be present in North Idaho infestations including flea beetles whose adults feed on leaves and flowers and the larvae feed on root hairs or roots. Sheep, goats, and hogs will graze leafy spurge. It is not only satisfactory forage for these animals, but they actually prefer it. Constant grazing slows the weed's spread and starves out the root system.

LARGE KNOTWEEDS

Giant

Giant

Japanese

Bohemian

Bohemian

LARGE KNOTWEEDS

Because of knotweeds extensive root system, once this weed is established it is difficult to control.

- Woody, upright **perennial** that spreads from long creeping roots and stem pieces.
- Found along roadsides, ditch banks, waste areas and pastures.
- Grows from 4 to 9 feet tall.
- **Bamboo-like stems** are green with **red or purple** spots.
- Small **greenish-white flowers** in early autumn.

➢ **JAPANESE KNOTWEED** *(Polygonum cuspidatum)*
- Small, greenish-white to cream colored drooping flower clusters appear at the end of stems and in leaf axils.

➢ **GIANT KNOTWEED** *(Polygonum sachalinense)*
- Distinguished by large heart-shaped leaves up to 12 inches long.

➢ **BOHEMIAN KNOTWEED** *(Polygonum X bohemicum)*
- A hybrid of Japanese and giant knotweed.
- Greenish-white to cream upright flower clusters.

CONTROL METHODS

Chemical: Garlon 4® (triclopyr), Arsenal® (imazapyr) or Banvel® (dicamba) can be applied when the knotweeds are actively growing and have reached the bud to early flowering stage of growth. **These products not recommended for home landscapes.**

Non- Chemical:

- Never transplant pieces of knotweed into your home landscape.
- Digging is a good option when the plant is small.
- Cutting it back to the ground at least twice a month during the growing season for several years may control it. It is best to remove, rake or carefully dry all knotweed vegetation you cut because stems or stem fragments can sprout creating new plants.

Biological: No effective biological control is available at this time.

OXEYE DAISY

OXEYE DAISY

OXEYE DAISY *(Leucanthemum vulgare)*

Also known as Field daisy, Marguerite daisy and Poverty weed.

- A short-lived **perennial** that spreads from seeds (2,000 to 4,000 per plant) and from the spreading roots.
- Grows 1 to 3 feet tall.
- The **glossy green** leaves get smaller as they grow up the stem.
- Daisy-like flowers are made up of **white petals** with a golden center and blooms appear June through September.
- Likes to grow in abandoned meadows and overgrazed pastures.

CONTROL METHODS

Chemical: Milestone® (aminopyralid), Escort® (metsulfuron) or Curtail® (clopyralid + 2,4-D) are effective before bloom. **These products not recommended for home landscapes.**

Non-Chemical:

- Dig plants when the soil is moist.
- Grazing - sheep, goats and horses may eat oxeye daisy.
- Applications of nitrogen fertilizer are effective in encouraging strong grass growth leaving no room for oxeye daisy seeds to germinate.

Biological: There are no known biological control methods being used at this time.

SCOTCH BROOM

Source: Idaho Panhandle Noxious Weed Handbook

SCOTCH BROOM

SCOTCH BROOM *(Cytisus scoparius)*

Seed pods resemble pea pods, which snap open at maturity and throw seeds for some distance.

- A **perennial** shrub that spreads by seed. It has an average life span of 17 years.
- Grows to 10 feet tall
- Stems are erect, woody, **green to brownish green and five-angled**. Leaves are small (1/2 inch) and fall off in times of stress.
- Pea-like flowers are **bright yellow** and bloom in June.
- Found in pastures, waterways and along roadsides.

Caution: Goats will browse the plants with no ill effect; however, it has been reported as toxic to other livestock.

CONTROL METHODS

Chemical: Spray with Garlon 4® (triclopyr), Milestone VM Plus® (aminopyralid + triclopyr), or Crossbow® (triclopyr + 2,4-D) any time the plants are actively growing. Basal bark application is an effective control method. **These products not recommended for home landscapes.**

Non-Chemical:

- Plant crowns can be dug out.
- Repeated cultivation will destroy seedlings.
- Mowing and burning are not effective.

Biological: Biological control agents are available for this plant and may already be present in North Idaho infestations including the gorse or broom tip moth, Scotch broom seed weevil and the Scotch broom twig miner.

THISTLE, CANADA

Source: Idaho Panhandle Noxious Weed Handbook

THISTLE, CANADA *(Cirsium arvense)*

This plant is difficult to control due to its extensive root system which may extend up to 20 feet across and 15 feet deep.

- A **perennial** that spreads by horizontal roots and by seed. Each plant is capable of producing more than 40,000 wind-borne seeds.
- Grows 1 to 5 feet tall.
- **Hollow stems** branch near the top. Leaves are wavy, **dark green** and shiny with sharp spines.
- Flowers are **light lavender** to **rose-purple** and bloom June through August.
- Can be found in cultivated fields, meadows, pastures and waste areas.

CONTROL METHODS

Chemical: Spray while plants are actively growing but before development of buds with Brazen® (clopyralid + triclopyr), Milestone® (aminopyralid), Curtail® (clopyralid + 2,4-D) or Banvel® (dicamba). Fall application to green leaves before a killing frost gives good control. **These products not recommended for home landscapes.**

Non-Chemical:

- Cultivation should occur every 10 days through the growing season for two years. Remove flower heads to prevent seed production.
- Tilling or mowing will stress Canada thistle and force it to draw upon stored root nutrients. The key to control perennials is to exhaust stored up nutrients in the roots, regardless of the control procedure used.
- Improve fertility to favor grass or other desirable plant growth.

Biological: Biological control agents are available for this plant and may already be present in North Idaho infestations including a stem weevil, a bud weevil and a stem gallfly. Most animals will not graze thistles, although some will occasionally consume flower heads.

THISTLE, SCOTCH

Source: Idaho Panhandle Noxious Weed Handbook

THISTLE, SCOTCH *(Onopordum acanthium)*

Also known as cotton thistle.

- A **biennial** that has a thick, fleshy taproot that may extend down 1 foot or more. Scotch thistle reproduces only by seed.
- Grows to 12 feet tall
- Leaves are large (up to 2 feet long and 1 foot wide), spiny, and covered on both sides with fine woolly hairs, giving the plant a **silvery-gray look**.
- **Purple** flowers appear July through September.
- Thrives in sunny, moist areas along rivers and streams but can also be found in pastures, fields, and along roadsides. It prefers light, well-drained, sandy or stony soils.

CONTROL METHODS

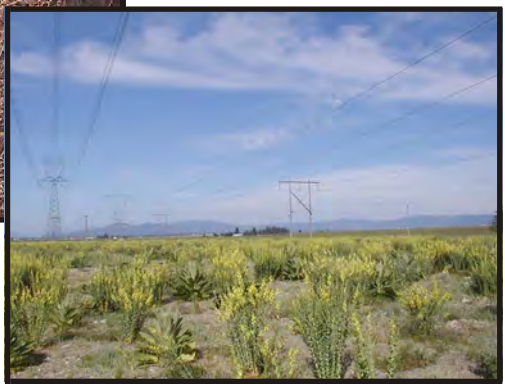
Chemical: Spray with Milestone® (aminopyralid), Banvel® (dicamba), Brazen® (clopyralid + triclopyr), or Curtail® (clopyralid + 2,4-D) in the spring before flower stalks lengthen or in the fall on rosettes. **These products not recommended for home landscapes.**

Non-Chemical: This thistle is biennial. The key to successful management is to prevent seed formation.

- Digging up or tilling the rosettes are effective methods, however, it is important to remove the entire crown.
- Mowing is not a good option and may actually add a year to their life span.
- Plants that are cut or pulled while flowering must be removed from the site to prevent the seeds from reintroducing new plants.
- Fertilize pastures to keep them in optimum condition so grasses can compete.

Biological: Biological control agents are available for this plant and may already be present in North Idaho infestations including the thistle seed head weevil. Most animals will not graze thistles, although some will occasionally consume flower heads.

TOADFLAX, DALMATIAN



TOADFLAX, DALMATIAN *(Linaria dalmatica)* ☠

It is difficult to control due to its extensive root system.

- A perennial plant that spreads by **creeping roots** and by **seed.**
- Grows to 4 feet tall.
- Leaves are **thick and waxy**, have no stems and are **blue-green**.
- The **yellow snapdragon-like flowers** are often tinged with orange or red and are located along the flower spikes at the top of the plant. Plants flower from midsummer to fall.
- An aggressive weed of pastures, roadsides and abandoned lots.

Caution: Toadflaxes contain cyanogenic glucosides which can cause cyanide poisoning if grazed, although large amounts must be ingested in a short period of time.

CONTROL METHODS

Chemical: Escort® (metsulfuron), Banvel® (dicamba), Tordon® (picloram), or Telar® (chlorsulfuron) gives control when applied before bloom. **These products not recommended for home landscapes.**

Non-Chemical:

- Cultivation at 10-day intervals can be a viable control method.
- Small infestations can be pulled and the root systems dug out.

Biological: Biological control agents are available for this plant and may already be present in North Idaho infestations including the toadflax flower-feeding beetle; the defoliating toadflax moth; the toadflax capsule weevil and the toadflax stem mining weevil.

TOADFLAX, YELLOW

Source: Idaho Panhandle Noxious Weed Handbook

TOADFLAX, YELLOW *(Linaria vulgaris)* ☠

This plant is difficult to control due to its extensive root system.

- A **perennial** plant that spreads by **creeping roots** and by **seed**.
- Grows to 3 feet tall.
- Leaves are **long, narrow** and **pale green** in color.
- **Snapdragon-like flowers** are **yellow** with an orange throat, clustered at the top of the stem. The plant flowers June through August.
- An aggressive weed of pastures and roadsides.

Caution: The toadflaxes contain cyanogenic glucosides which can cause cyanide poisoning if grazed, although large amounts must be ingested in a short period of time

CONTROL METHODS

Chemical: Escort® (metsulfuron), Banvel® (dicamba), Tordon® (picloram), or Telar® (chlorsulfuron) gives good control when applied before bloom. **These products not recommended for home landscapes.**

Non-Chemical:

- Cultivation at 10-day intervals can be a viable control method.
- Small infestations can be pulled and the root systems dug out.

Biological: Biological control agents are available for this plant and may already be present in North Idaho infestations including the toadflax flower-feeding beetle, the toadflax moth and the toadflax capsule weevil.

RUSH SKELETONWEED

Source: Idaho Panhandle Noxious Weed Handbook

RUSH SKELETONWEED

RUSH SKELETONWEED *(Chondrilla juncea)*

The large, deep root system makes skeletonweed difficult to control.

- A **perennial** which spreads primarily by seed, but also by creeping roots.
- Grows 1 to 4 feet tall.
- Leaves at the base look like a dandelion rosette. Stems are bare, except the lower 4 to 6 inches which is covered with **coarse brown hairs**. Stems and leaves produce a **milky latex juice**.
- Flower heads are **yellow** and scattered among the branches.
- Found in disturbed areas.

CONTROL METHODS

Chemical: Spray with Milestone® (aminopyralid), Chaparral® (aminopyralid + metsulfuron), Escort® (metsulfuron) or Brazen® (clopyralid + triclopyr) preferably to rosettes in spring or fall. **These products not recommended for home landscapes.**

Non-Chemical:

- Constant hand pulling or digging two to three times per year for 6 to 10 years can be effective for small infestations.
- Mowing and cultivation are ineffective; mowing does not prevent root spread and cultivation actually spreads root fragments.
- High nitrogen fertilizer assists in minimizing the effects of rush skeletonweed.
- Competitive legume plantings, such as alfalfa, may reduce rush skeletonweed through increased soil fertility and competition for soil moisture, as well as shading the rush skeletonweed plants.

Biological: Control agents may already be present in North Idaho infestations including the skeletonweed gall midge, which feed on leaves and stems. The skeleton gall mites feed on auxiliary and terminal buds. Rush skeletonweed rust attacks the leaves, stems, buds, and flowers of these plants. Continuous moderate grazing by sheep can reduce densities.

WATERWEEDS, SUBMERGED

EURASIAN WATERMILFOIL *(Myriophyllum spicatum)*

An aquatic, underwater plant that can be confused with native milfoils. The time to identify Eurasian watermilfoil is mid-June through September.

- A **perennial** plant that grows 35 feet, creating mats of floating vegetation. It reproduces by **roots, seed and fragment** (the fragmentation occurs in late summer and fall).
- Leaves are **feather-like** and tend to collapse around stem if removed from the water (native milfoil leaves do not collapse when removed from the water).
- Small flowers appear on leafless, **reddish spikes** that stand above the water surface by a few inches.
- Found in water shallower than 25 feet deep, depending upon light penetration.

CONTROL METHODS

Chemical: Chemical control is limited to herbicides labeled for aquatic use. Report any suspected infestation in a public waterway to your County Noxious Weed Department. **Aquatic herbicides can only be applied to public waterways by government agencies with permits.**

Non-Chemical:

- All water weeds can be raked, pulled or cut and disposed of on dry land.

Biological: No effective biological control is available at this time.

KNAPWEEDS

Spotted Knapweed

Diffuse Knapweed

Meadow Knapweed

Knapweed Rosette

KNAPWEEDS

SPOTTED *(Centaurea stoebe)*

- A perennial plant that spreads by seed.
- Grows 3 to 5 feet tall
- **Pink to purple flowers** and blooms from June to October.
- Each flower head has stiff bracts, which are **black tipped**, giving the flower head its 'spotted' appearance.
- Found on any disturbed site and thrives under a wide range of environmental conditions.

OTHER KNAPWEEDS OF CONCERN:

DIFFUSE KNAPWEED *(Centaurea diffusa)* Sometimes called tumble knapweed, it is spread by the tumbling of windblown mature plants.

MEADOW KNAPWEED *(Centaurea pratenis)* Flowers are large pink to purplish-red heads at the end of the branches.

Caution: Animals will not typically graze the plant due to the unpleasant taste. Horses may develop brain, respiratory, or liver damage due to carcinogenic compounds.

CONTROL METHODS

Chemical: Spray with Milestone® (aminopyralid), Curtail® (clopyralid + 2,4-D), Brazen® (clopyralid + triclopyr) or Hi-Dep® (2,4-D) in the spring when the plant is actively growing but before flower heads form. In the fall, spray newly emerging rosettes before a killing frost. **These products not recommended for home landscapes.**

Non-Chemical:

- Mowing or cutting plants will produce low-growing flowers, although the potential seed production is reduced.
- Knapweed does not survive cultivation at regular intervals.
- The plant may be pulled ***(be sure to wear gloves)*** to remove most of the taproot; it is easiest after a soaking rain.

Biological: Biological control agents are available for this plant and may already be present in North Idaho infestations including seed head flies, weevils and moths and root feeding weevils.

HOUNDSTONGUE

HOUNDSTONGUE

HOUNDSTONGUE *(Cynoglossum officinale)*

☠ The Velcro™-like seeds easily attach to animals and are spread to new sites.

- A **biennial** plant that spreads by seed.
- Grows 1 to 4 feet tall the second year.
- Leaves are **hairy**, have distinct veins and are shaped like a hound's tongue.
- **Reddish-purple** flowers are small and develop a Velcro™-like seed that sticks to almost anything it touches.
- Found in pastures, disturbed areas and roadsides.

Caution: Houndstongue is toxic to animals. It contains pyrrolizidine alkaloids, causing liver cells to slowly die. Animals may live for six months or longer after consuming a lethal dose. Sheep are more resistant to houndstongue poisoning than are cattle or horses.

CONTROL METHODS

Chemical: Apply Milestone® (aminopyralid), Chaparral® (aminopyralid + metsulfuron), or Escort® (metsulfuron) in early spring while plants are actively growing but before bloom stage. A surfactant is recommended to increase the effectiveness of any of the herbicides used. **These products not recommended for home landscapes.**

Non-Chemical:

- Hand pulling can be done on small sites in the spring before the plants produce their seeds. Always wear gloves.
- Mowing will reduce seed production. Make sure to mow before the plant blooms.
- Pasturelands must be healthy to recover from infestations and treatments, so fertilization is important.

Biological: No effective biological control is available at this time.

Source: Idaho Panhandle Noxious Weed Handbook

YELLOW STARTHISTLE

Source: Idaho Panhandle Noxious Weed Handbook

YELLOW STARTHISTLE *(Centaurea solstitialis)*

- An **annual** that reproduces by seed.
- Grows 2 to 3 feet tall.
- Very rigid branches covered with fine, soft hairs.
- Flower heads are **yellow**, located singly on the ends of branches and armed with outwardly pointed **stiff yellow spines** up to 1 inch long.
- Found along roadsides and in waste areas.

Caution: Plant causes "chewing disease" in horses and may also cause liver and brain damage due to carcinogenic compounds

CONTROL METHODS

Chemical: Spray in the rosette stage or before bud formation with Milestone® (aminopyralid), Chaparral® (aminopyralid + metsulfuron), Brazen® (clopyralid + triclopyr),or Curtail® (clopyralid + 2,4-D). **These products not recommended for home landscapes.**

Non-Chemical:

- It is possible to control small infestations by hand pulling and cultivation. This weed is difficult to handle, so good gloves and tools will make this task easier.
- Mowing can help stop seed spread over a wide area, but it usually has a negative effect. When mowed, yellow starthistle becomes denser.

Biological: Biological control agents are available for this plant and may already be present in North Idaho infestations including the yellow starthistle bud weevil, the yellow starthistle peacock fly, the yellow starthistle hairy weevil, the yellow starthistle flower weevil and the yellow starthistle gall flies.

Source: Idaho Panhandle Noxious Weed Handbook

APPENDIX

One of the objectives of the Idaho State Forestry Contest is to provide opportunities for students to meet with and learn from professional foresters and other natural resource management professionals. Often, these people are very willing to help a team prepare and train for the contest.

Help is readily available, so don't hesitate to ask. Excellent sources of assistance include the nearest offices of Idaho Department of Lands, Natural Resources Conservation Service, University of Idaho Cooperative Extension, and USDA Forest Service Ranger Districts. IDL Private Forestry Specialists, District Conservationists, and Extension Agents are often happy to volunteer some of their time to help out. Foresters who work with local forest products industries are another possible source of assistance.

RESOURCES

Forestry Contest websites:

BSWCD Forestry Contest web page: www.bonnerswcd.org

IDL Forestry Contest web page: https://www.idl.idaho.gov/idaho-state-forestry-contest/

IDL Facebook page (must have account to access): https://www.facebook.com/IdahoDepartmentofLands

IDL Twitter page (must have account to access): https://twitter.com/IdahoLands

Books:

Silva, Inc. (n.d.). *Ranger Model compass – Instruction manual*. La Porte, IN.

Kjellstrom, B. (2011 edition). *Be expert with map and compass*. ISBN 978144654413

Schnepf, C. (2000). *Logging selectively* (PNW 534). Pacific Northwest Extension - Idaho, Oregon, Washington.

Selkirk Cooperative Weed Management Area (2005). *Regional noxious weeds: What they are… how to kill them*. Sandpoint and Bonners Ferry, ID: Spud Press Printing.

Prather, T., Robins, S., and Morishita, D (2008). *Idaho's Noxious Weeds* (4th Edition). Moscow, ID: University of Idaho Extension.

Equipment Catalogs:

Forestry Supplies Inc. Catalog
P.O. Box 83847, Jackson, MS 39284-8397
Phone: 800-647-5368
Website: www.forestry-suppliers.com

Ben Meadows Company Inc. Catalog
P.O. Box 5277, Janesville, WI 53547-5277
Phone: 800-241-6401
Website: www.benmeadows.com

TerraTech, Inc.
P.O. Box 5547, Eugene, OR 97405-0547
Phone: 800-321-1037
Website: www.terratech.net

Other publications or videos

These publications or videos are available through agency websites (IDL, USFS, the Pacific Northwest Extension [PNW]), or local Cooperative Extension offices from University of Idaho [UI], Oregon State University [OSU], and Washington State University [WSU]). Publications include:

- Terminology For Forest Landowners (WSU) – EB 1353
- Measuring Timber Products Harvested From Your Woodland (OSU) – EC 1127
- Tools for Measuring Your Forest (OSU) – EC 1129
- Measuring Trees – PNW 31
- How to Plan, Plant, and Care for Windbreak, Reforestation, and Conservation Plantings (UI) – MISC 13
- Diameter Limit Cutting: A Questionable Practice (UI) CIS 654
- Thinning: An Important Management Tool – PNW 184
- Logging Selectively – PNW 534
- Soil and Water Conservation: An Introduction for Woodland Owners (OSU) – EC 1143
- Compaction of Forest Soils – PNW 217
- Idaho Forestry BMPs: Forest Stewardship Guidelines for Water Quality (UI) – EXT 745
- Forest Water Quality (UI) – video

To order from the university publication offices, write or call:

1. Ag Publications Building
   Building J40, Idaho St.
   University of Idaho
   Moscow, ID 83843-4196
   (208) 885-7082

2. Bulletin Office
   Cooperative Extension
   Cooper Publications Building
   Washington State University
   Pullman, WA 99164-5912
   (509) 335-2857

3. Agricultural Communications
   Oregon State University
   Administrative Services A422
   Corvallis, OR 97331-2119
   (503) 737-2513