Learning Objective: Following this lab students will be able to differentiate hardwood crown classes in the field, classify trees to meet specific management objectives, and rationally justify these decisions.

Introduction

To properly mark a stand that will be thinned by any method other than a geometric thinning, or regenerated by shelterwood or selection methods, it is necessary to classify individual trees to differentiate those to be left from those to be removed. A number of methods of tree and log classification or grading exist. These methods vary by region, stand type, and the product class that is being managed. In this lab you will work with one crown classification system and one tree classification system that can be used in hardwood stands in East Texas.

Kraft Crown Classification System

The Kraft Crown Classification System describes the effects on crown morphology of intense density dependent competition typical to the stem exclusion stage of stand dynamics (Oliver and Larson 1996, Smith et al. 1997). This system is intended for use only in even aged stands, and only in pure stands or mixed stands with species that grow at approximately the same rate. Thus, this system is ideal for application in pine plantations. In the Kraft Crown Classification, trees are placed into one of the following classes based on visual evidence assessed in the field by a forester:

- **Dominant:** Crowns are well developed, extend above surrounding trees, and receive light from above and partly from the side. Crowns may be somewhat crowded on the sides. Trees are larger than average. These trees are usually retained in a low thinning or in the establishment cut of a shelterwood system.
- **Codominant:** Crowns are medium sized, at the same height as surrounding trees, and receive full light from above but little from the sides. Crowns are more or less crowded on the sides. Trees are average size. Many of these trees are often retained in a low thinning or in the establishment cut of a shelterwood system.
- **Intermediate:** Crowns are small, shorter than dom/codom but extend into the same canopy strata, and receive little light from above and none from the side. Crowns are very crowded on the sides. Trees are smaller than average. These trees are often removed with a low thinning, and are not usually retained as overwood in a shelterwood system.
- **Overtopped:** Crowns are small, usually unhealthy or sparse, below the level of surrounding trees, and receive no direct light from either above or the sides. Trees are small, often unhealthy, and are also referred to as *suppressed.* These trees are cut in most low thinnings or regeneration harvests.
- **Cull:** The tree is dead or of such poor form that it is not merchantable even for pulp. A tree severely infected with fusiform rust would be an example. Cull trees are knocked down during either harvest activities or subsequent site preparation, unless they are intentionally left for other values (habitat).

Meadows Hardwood **Crown** Classification System

While the Kraft system works well for most pine stands in East Texas, it is more difficult to quantify crown morphology and competitive interactions among hardwood species. Southern hardwoods typically have broader more structurally complex crowns, and are often also more shade tolerant than

southern pines. A hardwood crown class system primarily intended for use in southern bottomland hardwood stands was developed by Meadows et al. (2001). This system places trees into the same classes as the Kraft Crown Classification System. However, rather than relying on a holistic subjective assessment, the forester instead assigns values to four categories, sums them, and uses the total points to more objectively identify the crown class. The four variables assessed on each tree are:

- Amount of direct sunlight from above
    - One point is given for every 10% of crown surface, as viewed from above, that receives direct sunlight.
- Amount of direct sunlight from the side
    - One point is given for every 10% of crown surface that, as viewed from the sides, receives direct sunlight from above the crowns of adjacent trees or from canopy openings. Only the upper 50% of the live crown length is considered.
- Crown balance
    - The crown is divided into four horizontal quadrants. One point is given for each quadrant that is occupied by more than 20% of the total crown volume.
- Relative crown size
    - Total crown size, in terms of both lateral spread and density, is assessed in relation to the diameter (dbh) and species of the tree. Values of 1 to 4 are assigned depending on whether the size is judged to be *severely limiting* to growth (1 point); *limiting* to growth (2 points); *somewhat limiting* to growth (3 points); or *not limiting* to growth (4 points).

Based on the point total from all four components, the tree is then assigned to a crown class:

- **Dominant**: 24–28 points
- **Codominant**: 17–23 points
- **Intermediate**: 10–16 points
- **Suppressed**: 2–9 points

<u>Meadows & Skojac Hardwood **Tree** Classification System</u>

While crown classification provides useful information about the future growth potential and health of trees, more comprehensive **tree** classification systems are often used prior to thinning or regeneration treatments to assess not only growth potential and health, but also value. Tree classification systems are typically used in selection systems and crown thinnings to choose which trees to remove at harvest. Trees are often classified as

- **Acceptable Growing Stock (AGS):** Merchantable trees that are not large enough to be mature, but are of a desirable species, form, and quality and would be satisfactory as crop trees in a final stand on the site or have potential to be grown for a future harvest.
- **Unacceptable Growing Stock (UGS):** Merchantable trees that are not mature for the site, not desired in the stand because of species, defect, poor form or are in decline.

Meadows and Skojac (2008) have modified the southern bottomland hardwood tree classification system originally developed by Putnam et al. (1960). This modified system can be applied as part of a selection regeneration method, or can be used to mark a stand for a thinning. An advantage of this system is its flexibility to meet different management objectives depending upon how it is applied. For example, the list of desired species could include species tailored to manage for either timber (cherrybark oak, green ash) or wildlife (swamp chestnut oak, hickories) as the primary objective. This revised tree classification system uses five different variables to classify trees:

- Species (desirable or undesirable for management objective)
- Crown class (dominant, codominant, intermediate, suppressed)
- Condition (excellent, good, fair, poor)
- Butt log grade and length
- Value trend and risk of degradation

Sawtimber sized trees are classified into one of five classes, each with a recommendation for whether it should be harvested in the current cutting cycle or thinning treatment, or should be left on the site to grow until a subsequent harvest operation:

- **Preferred growing stock:** Best trees that will be retained to grow for a future harvest.
- **Desirable growing stock:** Very good trees that will be retained to grow for a future harvest.
- **Acceptable growing stock:** Not desirable, but trees that can be retained to the next harvest and are consistent with management goals. Most, some, or none of these trees may be cut to achieve a target thinning or harvest level.
- **Cutting stock:** An unwanted component in the stand to be removed in the current operation.
- **Cull stock:** Unmerchantable or dead trees that are inconsistent with management objectives.

As part of this system, it is necessary to grade the butt log of each tree. Log grading evaluates the timber quality of a cut log. Logs with fewer knots and no defects receive better grades than logs with knots and defects. Grade 1 is given to the best, highest value logs, followed by grades 2, 3, and 4. Grading logs requires trees to be cut. However, there are many systems that have been developed to estimate log grades in standing trees. For this lab, we will use a “quick and dirty” method for grading hardwood logs developed by a procurement forester. The steps in this grading method are:

1. Divide the first 16-foot log into 4 faces.
2. Walk around the tree and grade each of the four faces as “clear” or “not clear” based on the presence of knots, limbs, seams, etc. Do not bother with length of cuts.
3. Determine the tree grade based on the following table:

	Number of clear Faces			
	3+	2	1	0
Minimum DBH	Grade			
16	1	2	3	4
14	2	2	3	4
10	3	3	3	4

Procedure

Methods

You'll practice the Meadows Crown Classification System and the Meadows and Skojac Tree Classification System in a mixed mesophytic hardwood stand as directed.

Literature Cited

Meadows, J. S., E. C. Burkhardt, R. L. Johnson, and J. D. Hodges. 2001. A numerical rating system for crown classes of southern hardwoods. Southern Journal of Applied Forestry **25**:154-158. https://doi.org/10.1093/sjaf/25.4.154

Meadows, J. S., and D. A. Skojac Jr. 2008. A new tree classification system for southern hardwoods. Southern Journal of Applied Forestry **32**:69-79.

Oliver, C. D., and B. C. Larson. 1996. Forest Stand Dynamics, update edition. John Wiley and Sons Inc., New York, NY. pp: 520.

Putnam, J. A., G. Furnival, M., and J. S. McKnight. 1960. Management and inventory of southern hardwoods. U.S. Department of Agriculture Forest Service. Agriculture Handbook No. 181:108 pp.

Smith, D. M., B. C. Larson, M. J. Kelty, and P. M. S. Ashton. 1997. The Practice of Silviculture: Applied Forest Ecology, Ninth edition. John Wiley & Sons, Inc., New York, New York. pp: 537.

MEADOWS & SKOJAC TREE CLASSIFICATION SYSTEM FOR HARDWOODS (2008)

SAWTIMBER-SIZED TREES

Preferred growing stock

1. Is a desirable species for the site and for management objectives
2. Has a dominant or codominant crown
3. Is currently in excellent condition and is likely to remain so indefinitely (to the end of the rotation) with very low risk of mortality or degradation in merchantability
4. Currently contains a grade 1 log at least 10 ft in length, entirely within the 16-ft butt log section of the bole
5. Is expected to increase in value at a satisfactory rate if left in the stand for one or more cutting cycles

Desirable growing stock

1. Is a desirable or an acceptable species for the site and for management objectives
2. Has a dominant or codominant crown
3. Is currently in good condition and is likely to remain so indefinitely (to the end of the rotation) with low risk of mortality or degradation in merchantability
4. Currently contains a grade 2 or better log at least 10 ft in length, entirely within the 16-ft butt log section of the bole
5. Is expected to increase in value at a satisfactory rate if left in the stand for one or more cutting cycles

Acceptable growing stock

1. Is a desirable or an acceptable species for the site and for management objectives
2. Has a dominant, codominant, or intermediate crown (may have an overtopped crown if a shade-tolerant species)
3. Is currently in fair condition and is likely to remain so for one or more cutting cycles with moderate risk of mortality or degradation in merchantability
4. Currently contains a grade 3 or better log at least 8 ft in length, entirely within the 16-ft butt log section of the bole
5. Is expected to neither increase nor decrease in value if left in the stand for one or more cutting cycles

Cutting stock

1. Must be cut during the next cutting cycle if any of the following are true:
   a. Is an undesirable species for management objectives or is a species unsuitable for the site
   b. Has an overtopped crown (except if a shade-tolerant species)
   c. Is currently in poor condition with significant risk of mortality or degradation in merchantability
2. Currently contains a grade 3 or better log at least 8 ft in length within the merchantable bole
3. Is expected to significantly decrease in value if left in the stand for one or more cutting cycles

Cull stock

1. Is incapable of meeting the desired product goals or is an unmerchantable species

POLETIMBER-SIZED TREES

Superior poletimber stock

1. Is a desirable or an acceptable species for the site and for management objectives
2. Is currently in good condition and is likely to remain so for one or more cutting cycles with moderately low risk of mortality or degradation in potential merchantability
3. Has the potential to contain a grade 2 or better log at least 10 ft in length, entirely within the 16-ft butt log section of the bole, when minimum diameter requirements are reached

Inferior poletimber stock

1. Must be cut during the next cutting cycle if any of the following are true:
   a. Is an undesirable or unmerchantable species for management objectives or is a species unsuitable for the site
   b. Is currently in poor condition with significant risk of mortality or degradation in potential merchantability
   c. Is diseased, damaged, or exhibits poor form
2. Is incapable, because of poor bole quality, of producing a grade 2 or better log at least 10 ft in length, entirely within the 16-ft butt log section of the bole, when minimum diameter requirements are reached

MEADOWS HARDWOOD CROWN CLASSIFICATION RATING SYSTEM (2001)

Direct Light Received From				**Crown Morphology**			
Above	*Points*	**Sides**	*Points*	**Balance**	*Points*	**Size**	*Points*
0%	0	0%	0	1 Quad	1	Severely Limiting	1
10%	1	10%	1	2 Quad	2	Limiting Growth	2
20%	2	20%	2	3 Quad	3	Slightly Limiting	3
30%	3	30%	3	4 Quad	4	Not limiting	4
40%	4	40%	4	↑ Count each quadrant with >20% of crown			
50%	5	50%	5	← Consider only upper 50% of crown for sides			
60%	6	60%	6	**Crown Class**	*Points*		
70%	7	70%	7	Dominant	24-28		
80%	8	80%	8	Codominant	17-23		
90%	9	90%	9	Intermediate	10-16		
100%	10	100%	10	Suppressed	2-9		

Meadows Crown Classification Rating System Data Sheet

Tree #	**Species**	**Above Points**	**Side Points**	**Balance Points**	**Size Points**	**Total Points**	**Crown Class**
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

MEADOWS & SKOJAC TREE CLASSIFICATION SYSTEM FOR HARDWOODS (2008)

Sawtimber-sized trees

	Species	Crown	Condition	Log Grade	Value
Preferred	Desirable	Dom or Codom	Excellent w/ low risk of degrading	Grade 1 (10 feet)	Increase
Desirable	Desirable or Acceptable	Dom or Codom	Good w/ low risk of degrading	Grade 2 (10 feet)	Increase
Acceptable	Desirable or Acceptable	Dom, Codom, or Int	Fair w/ mod risk of degrading	Grade 3 (8 feet)	Stable
Cutting*	Undesirable	Overtopped	Poor w/ sign. risk of degrading	Grade 3 (8 feet)	Decrease
Cull	Unmerchantable species or tree incapable of meeting product goals				

*May meet any one of species, crown, or condition requirements to be cutting stock.

Poletimber-sized trees

	Species	Condition	Log Grade
Superior	Desirable or Acceptable	Good w/ low risk of	Potential for Grade 2 (10 feet)
Inferior*	Undesirable, unmerchantable, or unsuitable for site	Poor, diseased, or damaged w/ risk of degrade	Incapable of producing at least Grade 2 (10 feet)

*May meet any one of species or condition requirements to be inferior.

	Number of clear Faces			
	3+	2	1	0
Minimum DBH	Log Grade			
16	1	2	3	4
14	2	2	3	4
10	3	3	3	4

Meadows & Skojac Tree Classification Rating System Data Sheet

Tree #	Species	Species Group	Crown Position	Condition	Log Grade	Value Trend	Tree Class
1							
2							
3							
4							
5							
6							
7							
8							

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Your Name: Stand Name: Date:

Stand Description

Timeline for silvicultural prescription with narrative notes

Year	Age	Action	Narrative Notes

Silvicultural Prescriptions Grading Key

Annotation	Explanation
1	**Terminology** is incorrect or imprecise. Be sure to use correct silvicultural terminology in all prescriptions.
2	Prescribed action is too **vague**. You need more detail (e.g. marking instructions, removal percentage).
3	Prescribed action does not meet **landowner objectives**, or some of the constraints we discussed for this stand.
4	Prescribed action is **incorrectly timed**. Is your rotation is too short or long based on growth rates of your species or landowner objectives? Are you applying herbicide too late compared to planting (herbaceous control spring after planting, hardwood control fall before planting)?
5	Prescribed action is not **ecologically** feasible. Does your regeneration method match with the shade tolerance of your crop species? Did you prescribe a burn that will likely kill all your crop trees?
6	Prescribed action is not **operationally** feasible. Is the stand too small? Are you removing too little volume per acre for a logger to take the contract? Are you operating when the site is too wet?
7	Prescribed action is **unnecessary**. Are you fixing something that is not actually a problem (e.g. mechanical site preparation on a site with no soil limitations, herbicide on a site with no competition problems, fertilizer on a droughty site, thinning a stand that's at an appropriate density)?
8	An additional prescribed **action needed**. Did you forget to apply herbicides when planting? Was slash management not prescribed on a high-slash site? Was bedding not prescribed on a wet site?
9	Prescribed action will not achieve the **density** you state. Did your planting spacing and density match? Did your row thinning intensity and post-thinning density match?
10	More than one treatments are **combined** on a single line. Be particularly careful with this for establishment of stands, when multiple treatments may be used in within one or two years. Each should go on its own line.