Bark Texture as an Indicator of Tree Vigor in Three Bottomland Oak Species

Tamara Bennett, Hollis Gregory, Jeremy Stovall, John Lanham, and Brian Oswald

Arthur Temple College of Forestry and Agriculture, Stephen F. Austin State University

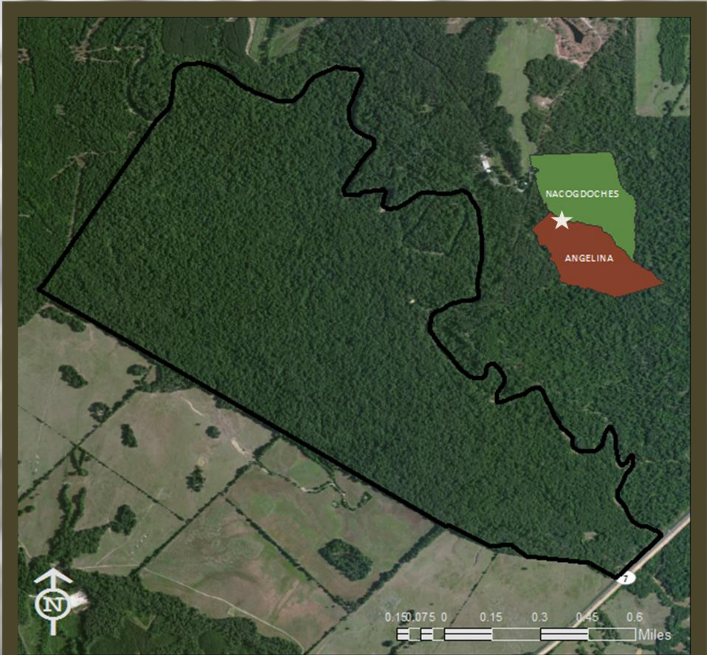
Scanned image of an overcup oak core from winDENDRO showing tree rings

INTRODUCTION

Visually examining bark texture has been proposed as a method of differentiating between high and low vigor trees in bottomland oak species. Generally, faster growing, more vigorous trees have smoother bark than slower growing, less vigorous trees. Bark texture also differs between red and white oaks. Bark traits can be rapidly assessed while cruising and marking timber, while growth rates require more labor-intensive, invasive measurements, like increment boring, that degrade timber quality and increase costs. The objective of this project was to test whether observed patterns in bark roughness were correlated to growth rates in cherrybark oak (*Quercus pagoda*), willow oak (*Q. phellos*), and overcup oak (*Q. lyrata)*.

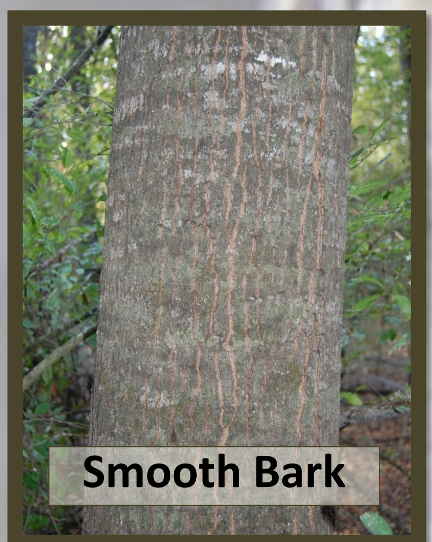
STUDY AREA

On November 10, 2012, the 860 acre Naconiche Mitigation Area (NMA) in Angelina County, Texas was sampled. The NMA, located on the floodplain of the Angelina River, is dominated by 55-year-old bottomland oaks mixed with other hardwoods.

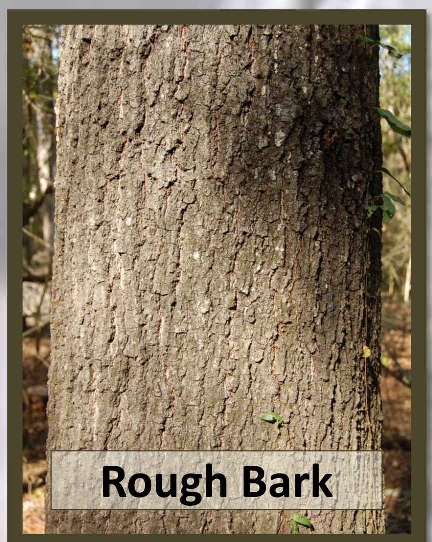


Naconiche Mitigation Area in Angelina County, Texas

Willow Oak

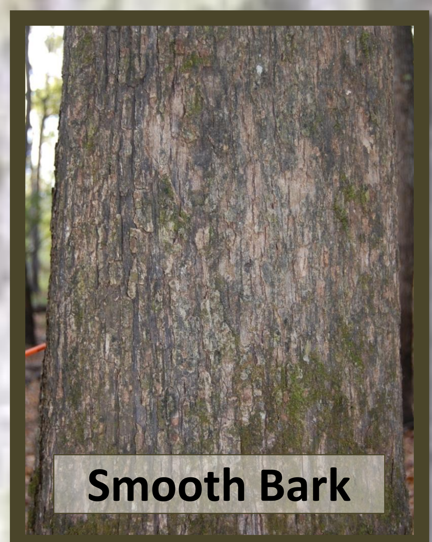


Smooth Bark

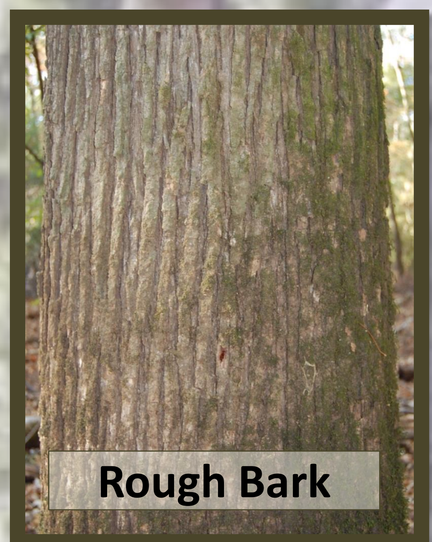


Rough Bark

Overcup Oak

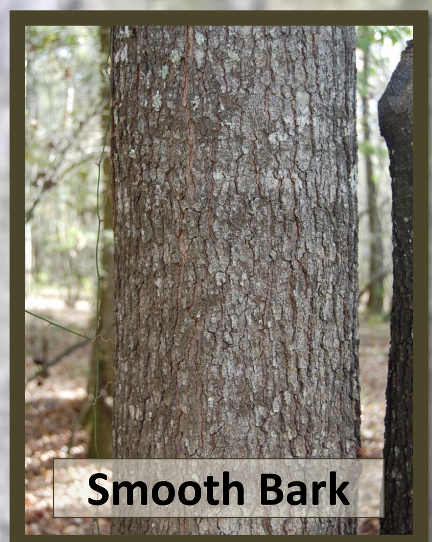


Smooth Bark

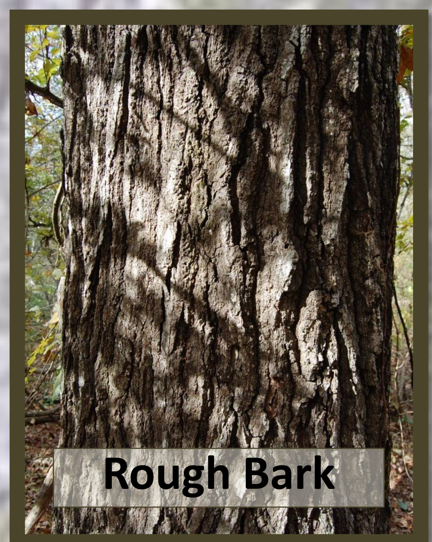


Rough Bark

Cherrybark Oak



Smooth Bark



Rough Bark

Estimating tree height

Increment boring to obtain core

Wrapping wire at breast height

Measuring bark thickness

METHODS

A total of 39 trees from the NMA, 13 of each species, were selected. Trees were chosen based on subjective criteria including a high quality butt log with minimal apparent defects or disease that could then or would in the future be capable of producing high-quality sawtimber. Measurements in the field included total height, diameter at breast height (dbh), bark thickness, and crown class. Crown class was quantified using an index developed by Meadows et al. (2001). To assess bark roughness a 17 gauge wire was wrapped around each tree at dbh. Wires were pressed into each fissure in the bark, clipped to length, and stored. A regression between wire weight and length ($R^2 > 0.99$, $p < 0.05$) was used to convert wire weights to straightened lengths. These lengths were used with tree circumference calculated from dbh to create a Bark Roughness Index (BRI) per Glitzenstein and Harcombe (1979). An increment core (bark to pith) was obtained by boring each tree. Cores were sanded and analyzed with winDENDRO to determine age at dbh height, average radial growth per year, and radial growth for the past 5 and 10 year periods.

ACKNOWLEDGEMENTS

Funding for this research was provided by the McIntire-Stennis Cooperative Forestry Research Program.

RESULTS AND DISCUSSION

Linear regression showed that the BRI was not significantly ($p > 0.05$) influenced for any of the three species by tree age, height, dbh, crown class, bark thickness, or radial growth based on average annual and 5 or 10 year periods (**Table 1**). This may have been due to difficulty in accurately assessing the BRI. Despite careful measurements made in the field, the wire length was slightly less than the diameter tape length for 17 of the 39 sampled trees by a mean of 4.7% ± 1.7 (standard error) . Examination of photos taken of each tree revealed that these were generally trees with the smoothest bark and the least obvious ridges or fissures. Despite problems with BRI, bark thickness was also unrelated to growth variables ($R^2 < 0.03$, $p > 0.05$). Bark roughness and thickness were not useful indicators of tree vigor based on the population sampled in this study. Further work developing a better BRI and evaluating greater sample sizes across a broader range of stand ages, site qualities, and oak species is required before broadly inferring bark roughness or thickness as predictors of vigor.

Table 1: Effects of growth, tree size, and crown classification on bark traits in three bottomland oak species. Results that are weakly significant at an alpha of 0.10 are shown in bold font. Only one bolded value was significant at the 0.05 level.

				Bark Roughness Index			Bark Thickness		
Dependent Variable	**Species**	**Mean**	**SE**	β_1	**P-Value**	R^2	β_1	**P-Value**	R^2
Bark thickness (inches)	Cherrybark	0.21	0.025	0.001	0.49	0.04			
	Overcup	0.27	0.039	-0.001	0.54	0.04			
	Willow	0.11	0.018	0.000	0.50	0.04			
Growth last 5 years (inches)	Cherrybark	0.62	0.086	0.002	0.63	0.02	0.11	0.92	0.00
	Overcup	0.41	0.049	0.000	0.85	0.00	0.04	0.92	0.00
	Willow	0.50	0.075	***-0.002***	***0.05***	***0.30***	0.28	0.83	0.00
Growth last 10 years (inches)	Cherrybark	1.36	0.172	0.008	0.39	0.07	-0.20	0.93	0.00
	Overcup	0.95	0.096	0.001	0.66	0.02	-0.20	0.79	0.01
	Willow	1.10	0.158	-0.003	0.12	0.20	-0.36	0.89	0.00
Average growth (inches / year)	Cherrybark	0.20	0.022	0.001	0.34	0.08	0.09	0.74	0.01
	Overcup	0.15	0.014	***0.001***	***0.08***	***0.25***	0.03	0.82	0.01
	Willow	0.14	0.016	0.000	0.37	0.07	-0.14	0.62	0.02
Age at 4.5 feet (years)	Cherrybark	40.69	4.520	-0.033	0.75	0.01	11.27	0.61	0.02
	Overcup	52.54	6.735	-0.075	0.22	0.13	8.88	0.67	0.02
	Willow	70.00	10.047	-0.017	0.75	0.01	34.33	0.61	0.02
Diameter at 4.5 feet (inches)	Cherrybark	17.99	2.100	0.030	0.81	0.01	***59.77***	***0.01***	***0.50***
	Overcup	18.17	0.992	0.006	0.80	0.01	11.06	0.14	0.19
	Willow	19.14	1.429	-0.025	0.19	0.15	2.84	0.91	0.00
Total height (feet)	Cherrybark	81.14	5.499	-0.004	0.93	0.00	***14.00***	***0.07***	***0.28***
	Overcup	83.41	3.517	-0.014	0.14	0.19	***5.30***	***0.09***	***0.24***
	Willow	90.79	4.467	0.002	0.83	0.00	-3.46	0.71	0.01
Crown class score (unitless)	Cherrybark	17.31	1.022	0.008	0.74	0.01	***12.19***	***0.00***	***0.56***
	Overcup	15.38	1.159	-0.014	0.17	0.16	0.40	0.91	0.00
	Willow	18.23	1.285	-0.005	0.47	0.05	1.57	0.86	0.00

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.

Glitzenstein, J. and P. Harcombe. 1979. Site-specific changes in the bark texture of *Quercus falcata* Michx. (southern red oak). *American Journal of Botany* **66**:668-672