

2019 Mast Survey Report

Kentucky Department of Fish and Wildlife Resources



White oak (*Quercus alba*), a vital food source for wildlife. Photo: KDFWR.



Contents

Introduction 3

 Our Agency 3

 Importance of Mast to Wildlife 3

Monitoring Mast Production: KDFWR’s Mast Survey 4

 Past Method 4

 Figure 1. Old survey card method for mast assessment across Kentucky 1982 – 2007. 4

 Figure 2a: Mast Survey results, 1982-2006. 5

 Figure 2b: Mast Survey results by species group, 1982-2006. 5

 Current Method 6

 Figure 3. White oak mast survey locations for the regional mast survey consortium, 2016. 6

 Surveyors 6

Mast Survey Results and Discussion 7

 Figure 4: Mast Survey sites, 2019. 7

 Figure 5: Percentage of trees bearing mast by species group, 2019. 8

 Figure 6. Variation in percentage of crown bearing mast (PBA) by species group within survey regions, 2019. 9

 Figure 7: Trends in percentage of trees bearing mast (PBA) by species group, 2007-2019. 10

 Table 1. Mast Survey results (PBA) by species group, statewide and region, 2019. 11

 Table 2. Mast Survey results (PBA) by survey site, 2019. 11

 Appendix 1. Percent of crown bearing mast (PCA) for surveyed trees grouped by region for the 2019 Mast Survey in Kentucky. 13

 Appendix 2. Percent of crown bearing mast (PCA) for surveyed trees grouped by site for the 2019 Mast Survey in Kentucky. 14

Closing 15

Acknowledgments 15

Introduction

Our Agency

The Kentucky Department of Fish and Wildlife Resources (KDFWR) is an agency of the Kentucky Tourism, Arts & Heritage Cabinet. KDFWR is overseen by a commission of members nominated by Kentucky's sportsmen and women from 9 districts across the state and appointed by the Governor. KDFWR employs about 500 full-time staff, including conservation officers, wildlife and fisheries biologists, conservation educators, and specialists in information technology, public relations, and administrative services. KDFWR receives no money from the state's General Fund; rather, the agency is funded through the sale of hunting and fishing licenses, boating registration fees, and federal grants based on the number of hunting and fishing licenses sold in the state.

KDFWR's Wildlife Division is responsible for the conservation and management of wildlife populations in the state to provide opportunity for hunting and viewing wildlife. Each year, KDFWR staff and partners from other agencies, universities, and non-governmental organizations conduct a mast survey in an effort to summarize mast conditions and shed light on population and harvest trends of various wildlife species. The Grouse & Turkey Program and Small Game Program coordinate the survey and prepared this report of survey findings.

Importance of Mast to Wildlife

Mast refers to the fruit of woody vegetation, many types of which provide important foods for wildlife. "Hard mast" includes acorns, hickory nuts, beechnuts, walnuts, and hazelnuts, all of which are available to wildlife beginning in late summer through fall and winter. "Soft mast" includes the many types of soft fruits produced from late spring through the summer and early fall, such as serviceberries, wild plums, wild grapes, dogwood berries, and persimmons.

Both hard and soft mast are important for Kentucky's wildlife throughout the year, but fall and winter hard mast production is of primary concern for wildlife managers because of the great influence this food resource exerts on the movements, body condition, and thus population dynamics of many forest-dwelling wildlife species. Thus, the KDFWR Mast Survey focuses on surveying oak, hickory, and American beech trees.

Deer, bears, wild turkeys, ruffed grouse, squirrels, small mammals, and other species depend on nutritious hard mast to bulk up before winter and for sustenance during winter when few other foods are available. Research has shown that in years when acorn crops are large enough to be available in March and April, female ruffed grouse enter the nesting season in better condition. The same may be true for other species. Animal movement in fall and winter is related to the availability of high-energy hard mast foods. In years when little to no mast is available from oaks, hickories, or beech trees, wildlife may move more often and/or greater distances in search of limited food supplies. Higher rates of movement may lead to more encounters with wildlife, some positive (deer and turkeys using fields to a greater degree in search of waste grains) and some negative (bear nuisance activity may be higher).

Mast production may be highly variable year to year, especially among the many oak species in our forests. Harsh spring weather may hinder flowering and pollination, reducing the fall mast crop. However, weather does not explain all the variability in mast production and all factors influencing a given year’s mast crop are unknown. Variability in production is buffered to some degree by having different hard mast species present in a forest stand, and most forests in Kentucky have multiple oak and hickory species. Some have walnuts and beech, as well.

Monitoring Mast Production: KDFWR’s Mast Survey

Since 1982, KDFWR has conducted a statewide mast production survey of important producers of wildlife foods. The KDFWR Mast Survey evaluates 4 broad groups of trees of importance to Kentucky wildlife: red oaks, white oaks, hickories, and beech. By monitoring mast production annually, we can detect trends in wildlife food availability in our forests any given year. We may also compare these metrics to the number of animals harvested or observed in a given year to determine the relationship between mast and wildlife.

Past Method

Beginning in 1982 the Mast Survey took the form of a survey card sent out to area biologists for completion on 3 separate areas in their respective regions. The survey card had 4 categories for each tree and shrub group: Heavy, Moderate, Light, and None. These subjective categories reflected the surveyor’s personal evaluation of the amount of hard or soft mast occurring on each group of trees and shrubs in September and October (Figure 1). The trends observed from these data cannot be assimilated in the current survey method, but are valuable metrics in a historical context (Figure 2).

ANNUAL MAST SURVEY CARD		G-PR(44)		
County _____	Observer _____	Year <u>2005</u>		
	Heavy	Moderate	Light	None
The Hickories				
The Red Oaks				
The White Oaks				
Black Walnut				
American Beech				
Flowering Dogwood				
Other				

Figure 1. Old survey card method for mast assessment across Kentucky 1982 – 2007.

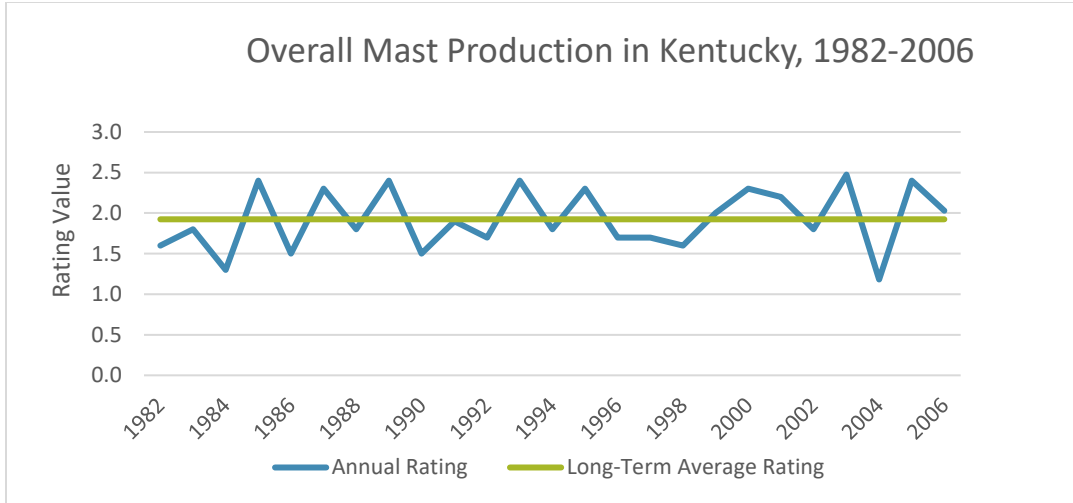


Figure 2a: Mast Survey results, 1982-2006.

Ratings are mast production index values averaged annually across all trees surveyed. Species survey included various white oak, red oak, and hickory species, American beech, black walnut, and flowering dogwood.

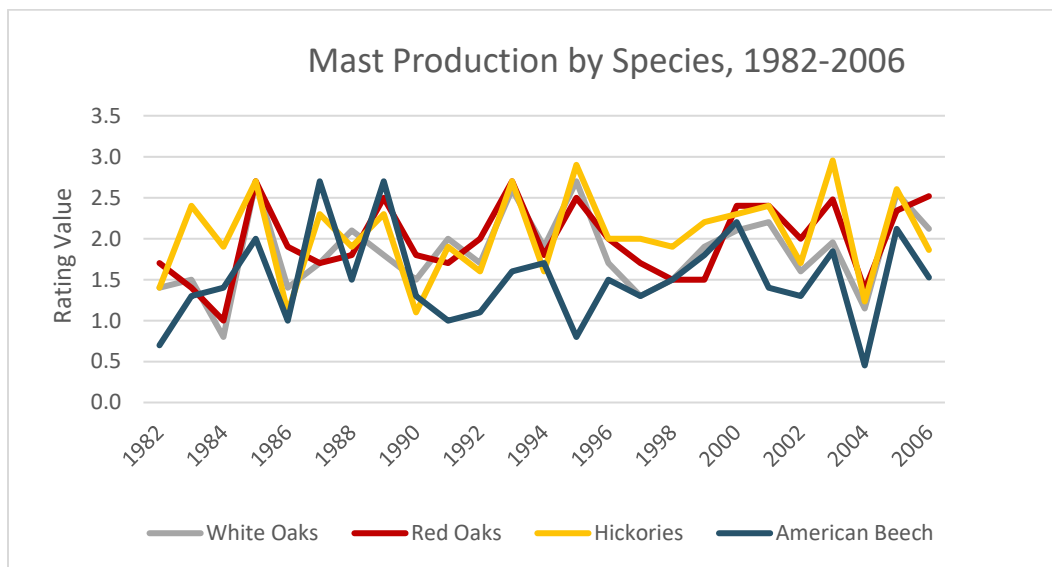


Figure 2b: Mast Survey results by species group, 1982-2006.

Ratings are mast production index values averaged annually across all trees surveyed within each of 4 groups: white oak species, red oak species, hickory species, and American beech.

Current Method

Beginning in 2007 the Mast Survey changed to a more quantitative method of data collection. This change was motivated by the formation of a coordinated hard mast survey by several eastern states in 2007 based on recent research. The goal was to allow comparison of mast conditions regionally (**Figure 3**).

The current method requires individuals to scan the crown of each survey tree for 30 seconds and estimate the percentage of the crown bearing mast. This percentage, abbreviated as “PCA” (the “A” originally meant “acorns” but here denotes “any” mast) is quantitative, which is preferable to the old qualitative method but is still subjective. To alleviate this concern, we reclassify the PCA ratings more broadly based on presence or absence of any mast, which abbreviate as “PBA”. We group PBA ratings into categories: failure (0-19% PCA), poor (20-39% PCA), average (40-59% PCA), good (60-79% PCA), and bumper (80-100% PCA).

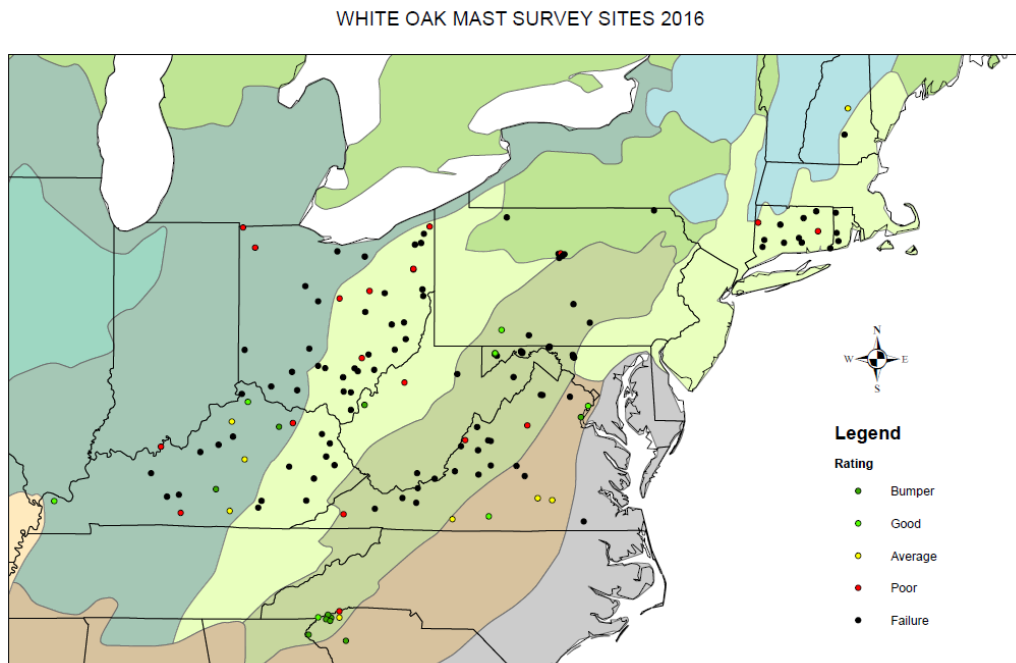


Figure 3. White oak mast survey locations for the regional mast survey consortium, 2016.

Red oaks were also surveyed in all participating states, but hickory and beech surveys are unique to KY.

Surveyors

The Mast Survey in Kentucky takes place across the state. The number of surveys conducted each year has varied but typically has included about 25 individual survey routes. Most routes include 100 trees per route, with 25 each in the white oak group, red oak group, hickory group, and American beech. Historically, KDFWR biologists completed surveys but the list of surveyors now includes volunteers from other natural resource agencies, universities, and non-governmental organizations.

Mast Survey Results and Discussion

In 2019, surveys were completed along 41 individual routes in **35** counties (**Figure 4**). Averaged statewide, mast by red oaks and beech rated “good” while white oaks and hickories rated “average” (**Figure 5**). Sites in the west region showed greater variability in masting by red and white oaks and beech, but not hickory (**Figure 6**). White oak acorn mast production was the most variable tree group across sites in both regions, with the east region rating “average” and the west region rating “poor” (**Figure 5**). Red oak acorn crops were good to bumper at 14 of 17 (82%) eastern sites and 14 of 23 (61%) western sites (**Table 2**). White oak acorn crops were good to bumper at 6 of 17 (35%) eastern sites and 4 of 22 (18%) western sites (**Table 2**). Hickory nut crops were good to bumper at 4 of 19 (21%) eastern sites and 5 of 22 (23%) western sites (**Table 2**). Beechnut crops were good to bumper at 9 of 12 east sites (75%) and 7 of 11 west sites (64%). (Note however, beechnut production values are questionable because we do not check for viability via float tests.)

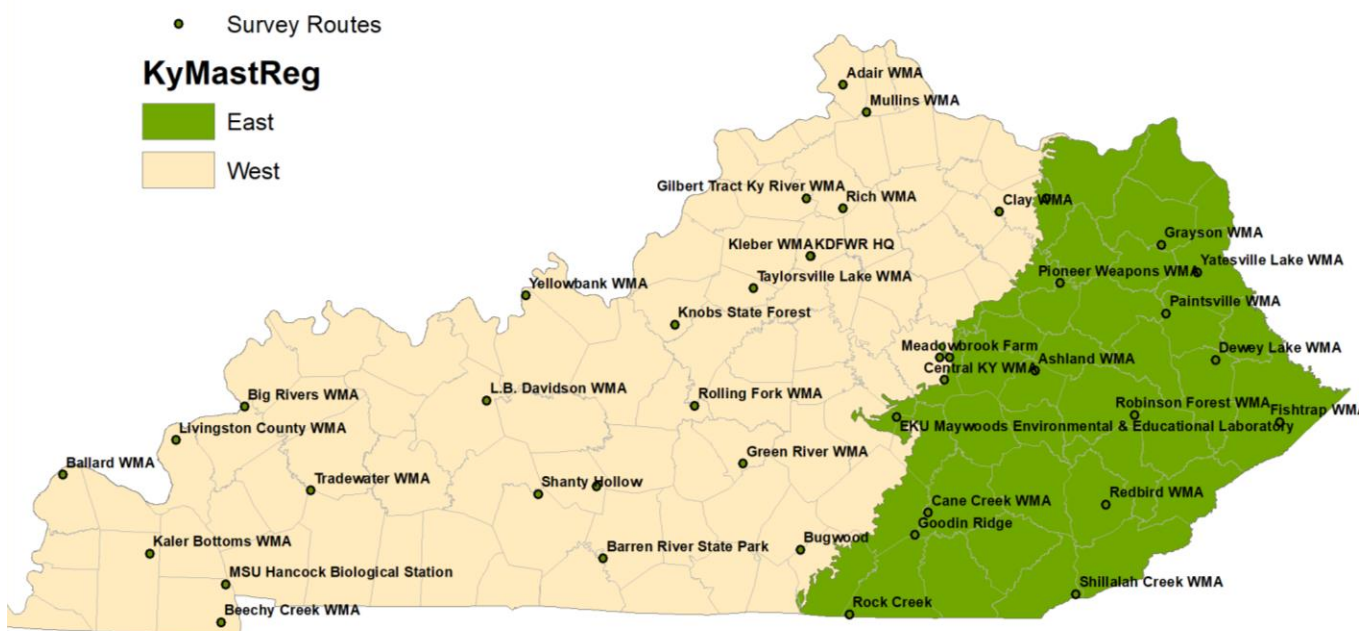


Figure 4: Mast Survey sites, 2019.

East-West regional division based on the U.S. Forest Service ecological province classification.

As is typical and confounding to managers, mast production varied highly at both region and site levels (**Figure 6, Table 2**). As an example at the site level, white oak mast rated poor at the Gilbert Tract of KY River WMA but rated bumper at Rich WMA, which was nearest site. In contrast, Kaler Bottoms WMA in far western KY showed the same rating for white oak mast as Grayson Lake WMA in northeastern KY. With such variability, check the survey site nearest to your location (**Table 2**). Despite high variation, wildlife in Kentucky appear to have access to at least some mast in a majority of sites surveyed.

Speaking of variability, many surveyors have commented on the subjective nature of the current “quantitative” survey method; that is, they question the validity of their own visual estimates of the percent of crown area covered by mast. After all, it is difficult to see the entire crown of most survey trees along our routes because they are located within the forest. This is why we collapse PCA values to PBA values by region and statewide. PBA is essentially a presence-absence metric, which we have more confidence in as an annual index of masting.

Based on long-term trends at the statewide level (**Figure 7**), we could speculate that red oak and beech will decline next year while white oak and hickory will increase. However, causes of variability in mast production are not well understood, particularly at local levels.

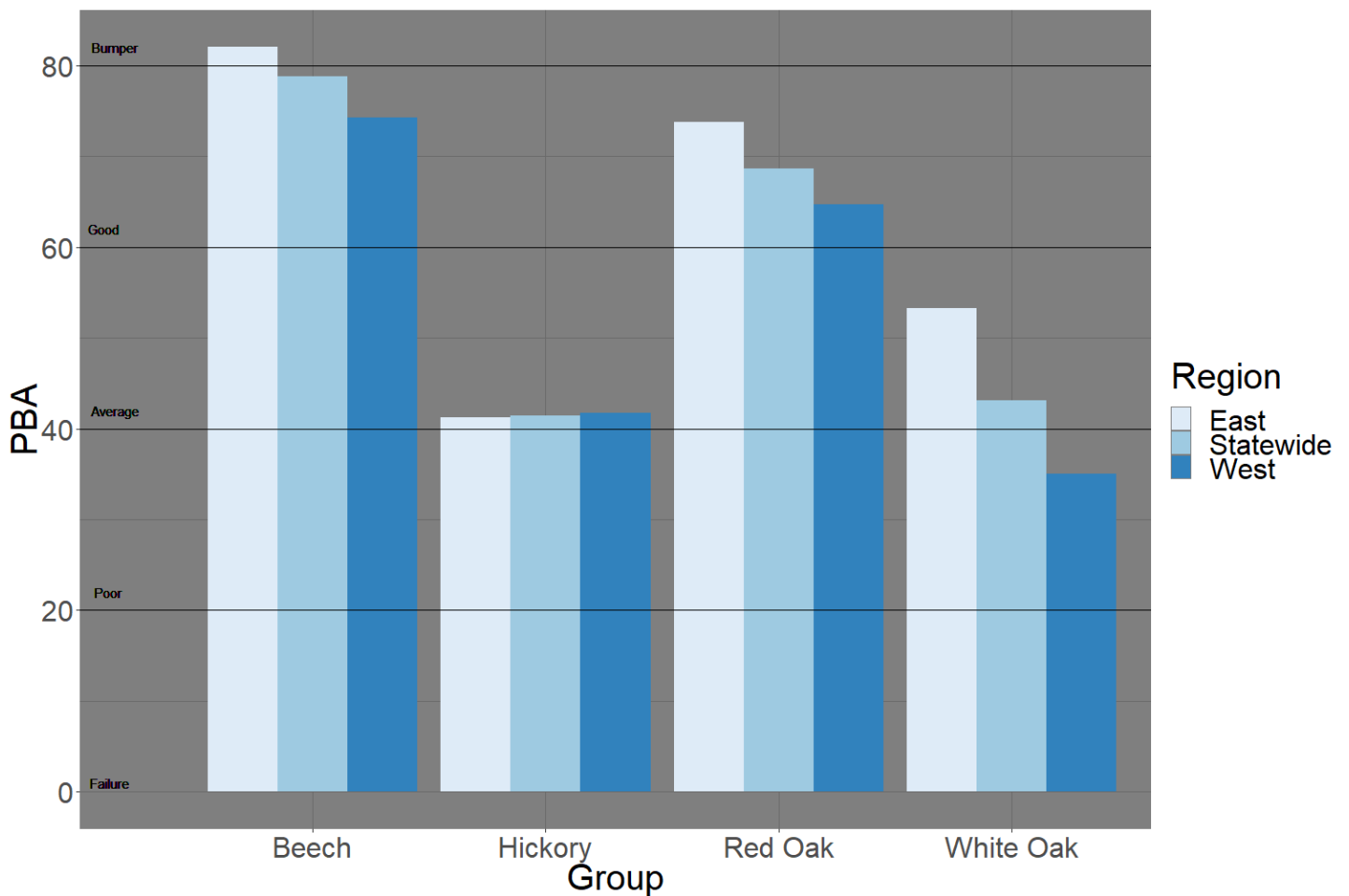


Figure 5: Percentage of trees bearing mast by species group, 2019.

PBA is presence or absence of mast derived from estimates of the percentage of crown area bearing mast [PCA] greater than 0.

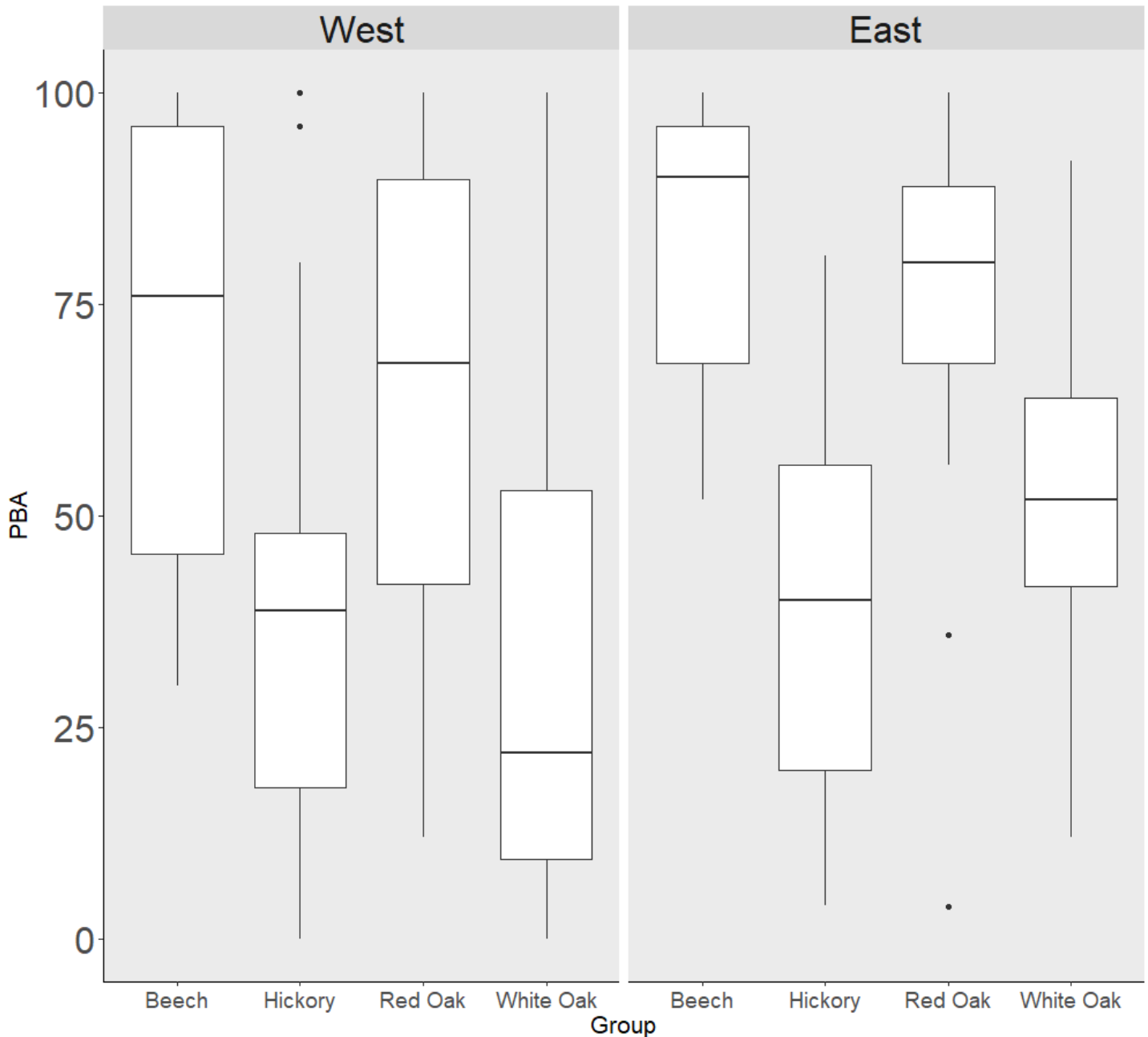


Figure 6. Variation in percentage of crown bearing mast (PBA) by species group within survey regions, 2019.

The horizontal line inside each box represents median PBA (50% of values across all sites in the region are below this value). Lower bound of each box is 25th-percentile (25% of values below this value); upper bound is the 75th-percentile (75% of values below this value). “Whiskers” show maximum and minimum values, excluding outliers. Outliers, represented by individual dots, are 1.5 times greater than the upper quartile or lower than the lower quartile.



Figure 7: Trends in percentage of trees bearing mast (PBA) by species group, 2007-2019.

PBA is presence or absence of mast derived from estimates of the percentage of crown area bearing mast [PCA] greater than 0. NOTE: Percentages for beech are suspect because we do not routinely assess soundness of beechnuts by floating the nuts (sound nuts sink), which is important since beech mast is known to be highly irregular.

Table 1. Mast Survey results (PBA) by species group, statewide and region, 2019.

Color scheme represents mast rating categories (failure, poor, average, good, bumper). PBA = percent of all trees bearing any mast (0 to 100%).

Grouping	Number of Trees Sampled	PBA	Rating
<i>Statewide</i>			
Red Oak	994	68.6%	Good
White Oak	955	43.1%	Average
Hickory	921	41.5%	Average
Beech	514	78.8%	Good
<i>East</i>			
Red Oak	427	73.8%	Good
White Oak	424	53.3%	Average
Hickory	427	41.2%	Average
Beech	300	82%	Bumper
<i>West</i>			
Red Oak	567	64.7%	Good
White Oak	531	35%	Poor
Hickory	494	41.7%	Average
Beech	214	74.3%	Good

Table 2. Mast Survey results (PBA) by survey site, 2019.

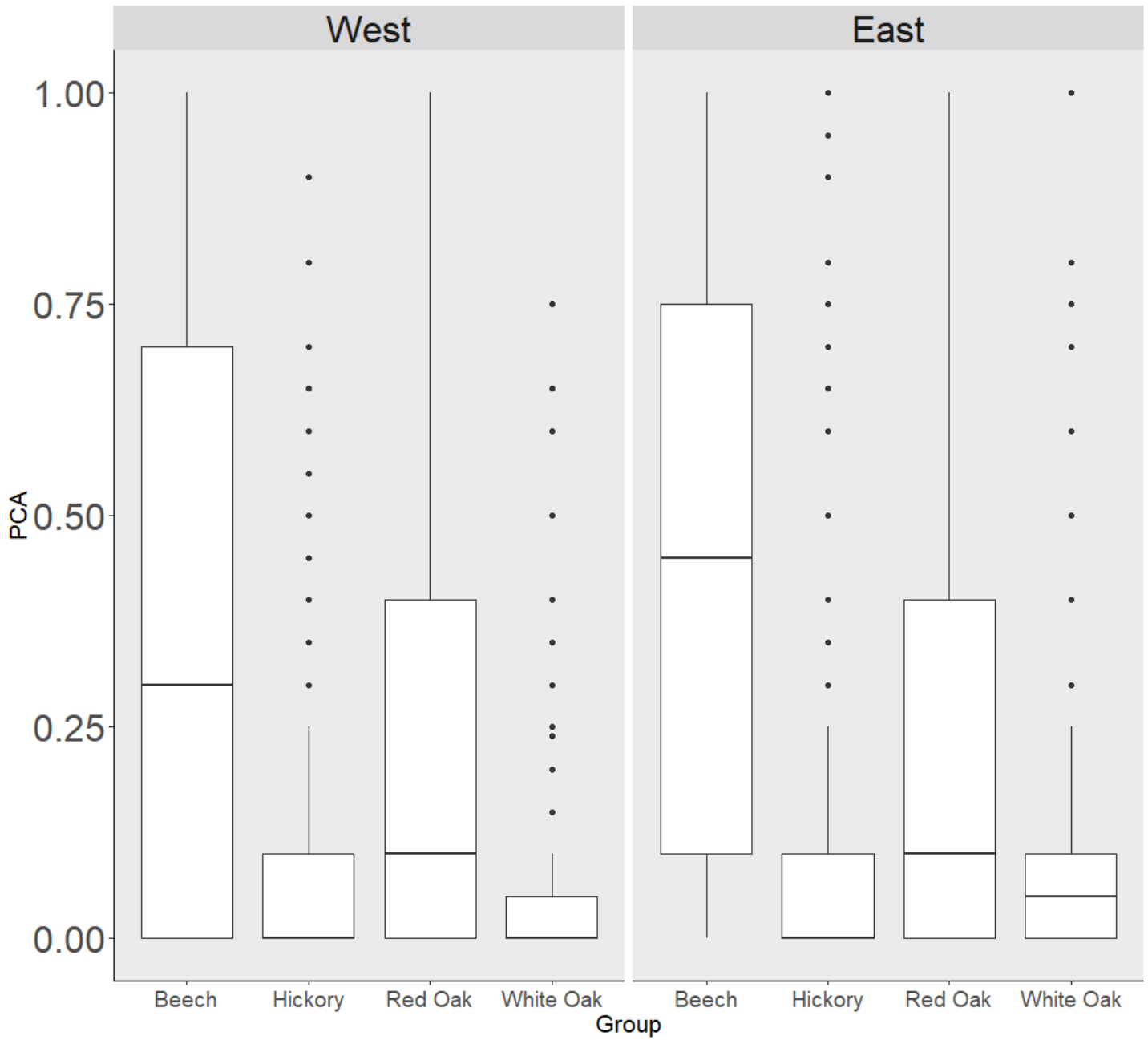
Color scheme represents mast rating categories (failure, poor, average, good, bumper). PBA = percent of all trees bearing any mast (0 to 100%).

County	Site	PBA			
		Red Oak	White Oak	Hickory	Beech
Boone	Adair WMA	66%	8%	24%	80%
Lee	Ashland WMA	80%	12%	68%	52%
Ballard	Ballard WMA	36%	12%	48%	
Barren	Barren River State Park	100%	76%	100%	100%
Calloway	Beechy Creek WMA	12%	0%	0%	50%
Crittenden	Big Rivers WMA	80%	9%	48%	
Madison	BGAD	96%	16%	16%	
Wayne	Bugwood	96%	100%	96%	100%
Laurel	Cane Creek WMA	92%	72%	80%	
Madison	Central KY WMA	84%	20%	8%	
Fleming	Clay WMA	96%	85%	80%	
Floyd	Dewey Lake WMA	76%	48%	20%	88%
Pike	Fishtrap WMA	84%	64%	52%	100%
Fleming	Fleming WMA	76%	44%	20%	96%
Owen	Gilbert Tract Kentucky River WMA	95%	33%	9%	96%
McCreary	Goodin Ridge	100%	92%	32%	96%

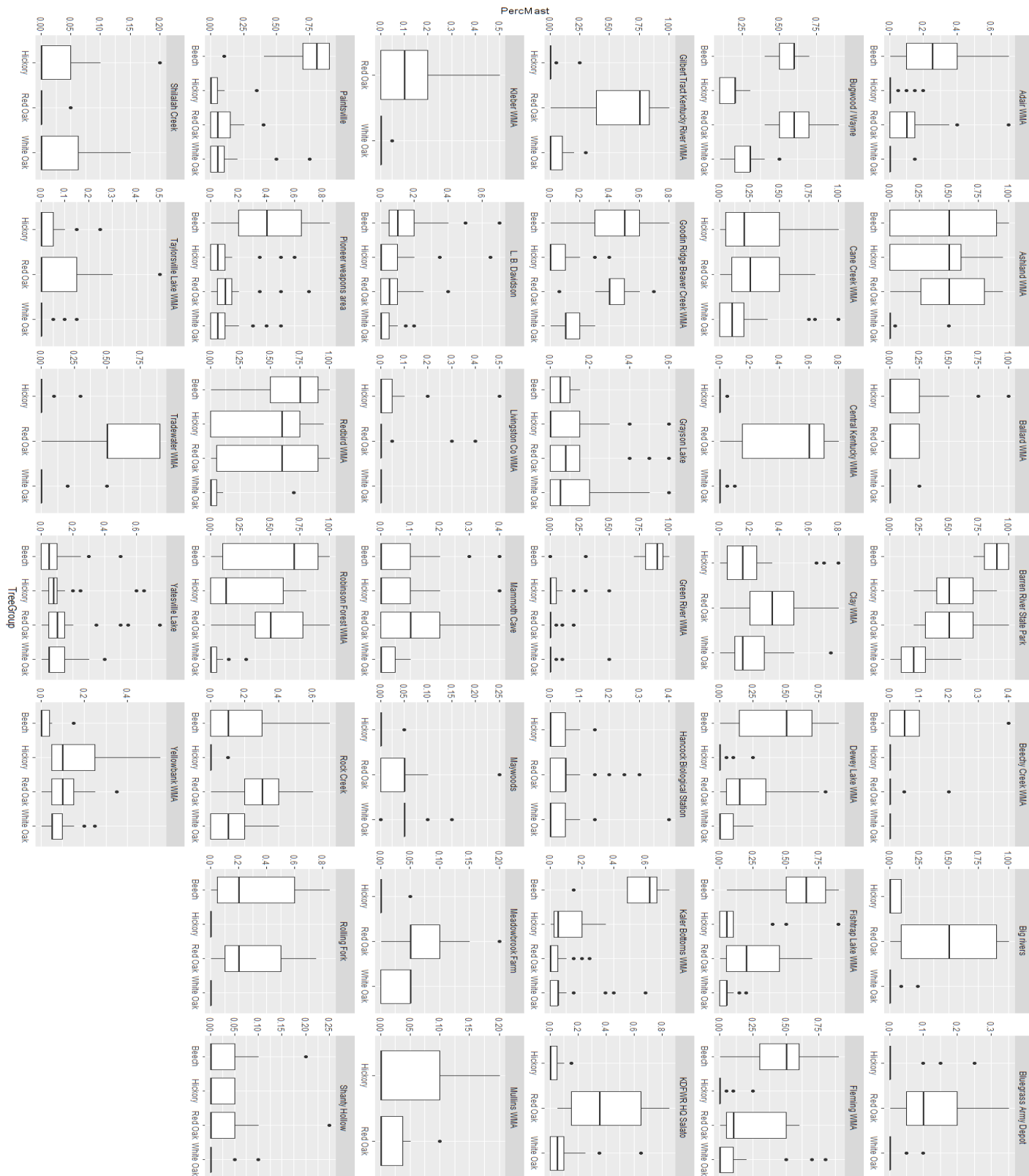
Table 2 con't.

County	Site	PBA			
		Red Oak	White Oak	Hickory	Beech
<i>Carter</i>	Grayson WMA	63%	56%	40%	56%
<i>Taylor</i>	Green River WMA	20%	24%	28%	92%
<i>Calloway</i>	Hancock	64%	44%	44%	
<i>Franklin</i>	HQ Salato Habitrak	100%	60%	44%	
<i>Graves</i>	Kaler Bottoms WMA	48%	56%	67%	100%
<i>Franklin</i>	Kleber WMA	68%	4%		
<i>Ohio</i>	L.B. Davidson	56%	44%	48%	76%
<i>Livingston</i>	Livingston County WMA	12%	0%	36%	
<i>Edmonson</i>	Mammoth Cave	56%	28%	36%	38%
<i>Lincoln</i>	Maywoods	56%	88%	8%	
<i>Madison</i>	Meadowbrook Farm	96%	52%	4%	
<i>Kenton</i>	Mullins WMA	27%	52%		
<i>Johnson</i>	Paintsville WMA	68%	60%	40%	100%
<i>Menifee</i>	Pioneer Weapons Area	88%	64%	56%	96%
<i>Leslie</i>	Redbird WMA	76%	28%	64%	92%
<i>Owen</i>	Rich WMA	100%	100%	96%	
<i>Breathitt</i>	Robinson Forest WMA	80%	32%	48%	80%
<i>McCreary</i>	Rock Creek	92%	52%	12%	72%
<i>Nelson</i>	Rolling Fork	80%	0%	0%	76%
<i>Warren</i>	Shanty Hollow	36%	16%	42%	41%
<i>Bell</i>	Shillalah Creek WMA	4%	42%	28%	
<i>Spencer</i>	Taylorville Lake WMA	32%	20%	32%	
<i>Christian</i>	Tradewater WMA	80%	12%	8%	
<i>Lawrence</i>	Yatesville Lake WMA	89%	88%	81%	56%
<i>Breckinridge</i>	Yellowbank WMA	80%	92%	100%	30%

Appendix 1. Percent of crown bearing mast (PCA) for surveyed trees grouped by region for the 2019 Mast Survey in Kentucky.



Appendix 2. Percent of crown bearing mast (PCA) for surveyed trees grouped by site for the 2019 Mast Survey in Kentucky.



Closing

In addition to monitoring current mast production, wildlife and natural resource managers should be concerned with the ability of eastern forest ecosystems to produce hard mast, and thus to support the wildlife populations we manage and cherish. Future hard mast production, particularly of acorns, is in jeopardy due to changes in the composition (and structure) of our forests.

Analyses of forest inventory data collected by the U.S. Forest Service and state forestry agencies indicate that oaks are losing their foothold as a dominant species group. McShea and others (2007) found that most oaks are in the overstory (i.e., in dominant and co-dominant canopy classes) and the proportion of oak among the intermediate-aged trees in our forests has declined significantly since the late 1980s. Thus, a major concern is that there will not be sufficient young oaks to replace aging mature oaks. Also, the density of maple trees (all size classes) nearly doubled between 1989 and 2000 forest inventories; this is disconcerting because species like red maple do not produce quality food for forest wildlife. These changes have been perpetuated by poor forest management, such as high-grading (cutting only the best trees, often oaks, while leaving the rest) and a lack of pro-active management practices that reduce shade to allow sunlight to reach the young oaks in the forest understory. Examples of such practices include mid-story removal, crop-tree release, and commercial timber harvest design to thin or perpetuate oak.

Forest managers must work to keep quality mast trees in Kentucky forests. Our hope is that results of the Mast Survey can help them plan forest management practices (such as mid-story removal) that foster oak and hickory regeneration in our forests.

Acknowledgments

Survey coordinators Cody Rhoden and Zak Danks thank the many staff and partner surveyors from across the state who battled bugs, briars, and poison ivy to collect mast data for this year's survey.



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