

2022 Mast Survey Report

Kentucky Department of Fish and Wildlife Resources

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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 400 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.

Methods

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.

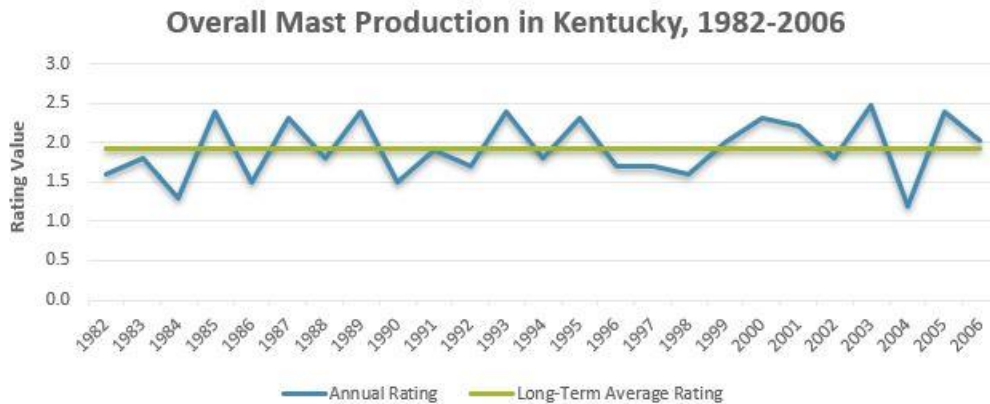


Figure 2a. Mast Survey results, 1982-2006.

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.

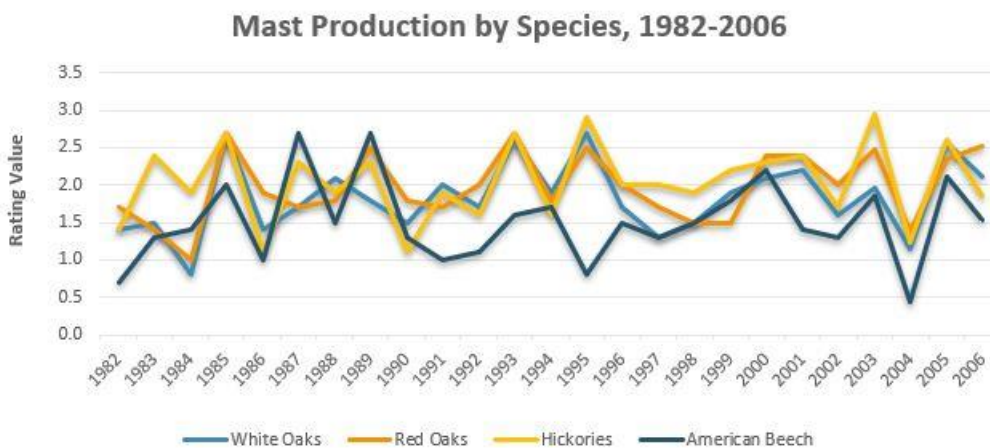


Figure 2b. Mast Survey results by species group, 1982-2006. Ratings are mast production index values averaged annually across all trees surveyed within each of 4 groups: white oak species, red oak species, hickory species, and American beech.

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. To alleviate concern that PCA is still subjective, we reclassify the PCA ratings more broadly based on presence or absence of any mast, abbreviated

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).

WHITE OAK MAST SURVEY SITES 2016

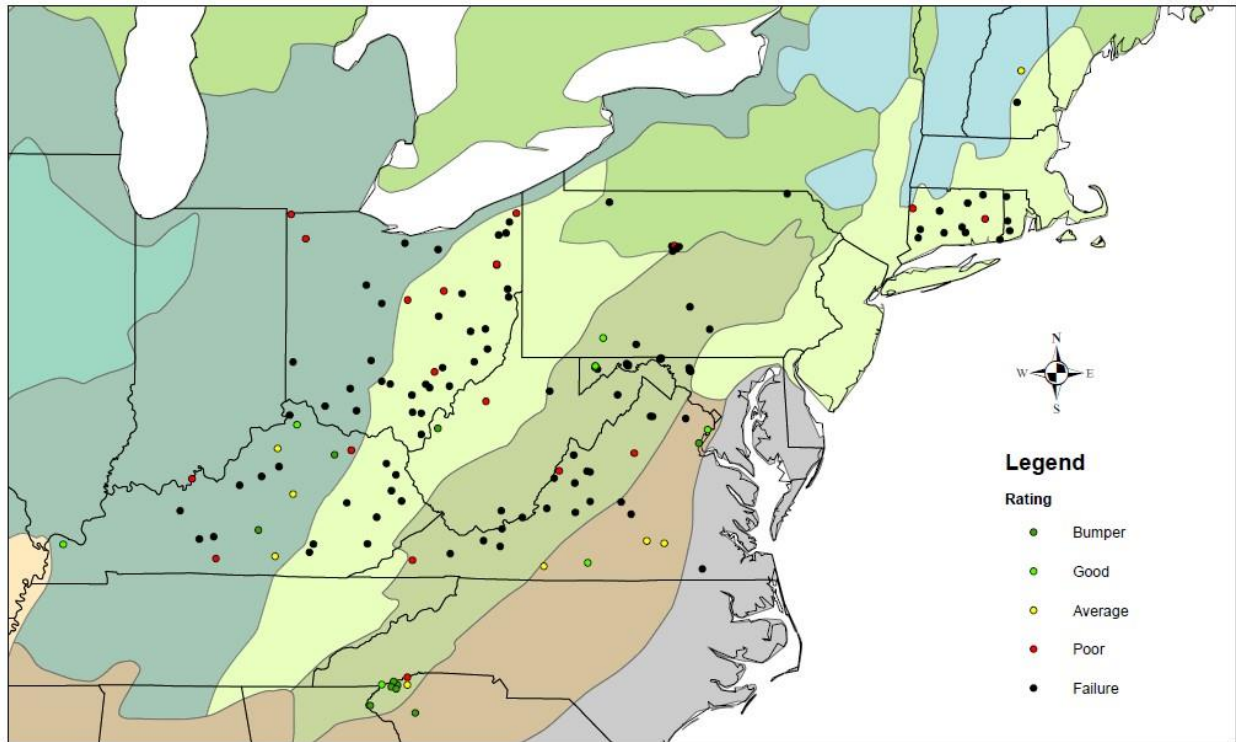


Figure 3. White oak mast survey locations for the regional mast survey consortium, 2016. Red oaks were also surveyed in all participating states, but hickory and beech surveys are unique to KY.

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.

Results and Discussion

In 2022, surveys were completed along 43 individual routes in 40 counties (Figure 4). A total of 3,555 individual trees were sampled, including 1030 white oak trees, 1041 red oak trees, 1022 hickory trees, and 462 American beech trees (Table 1).

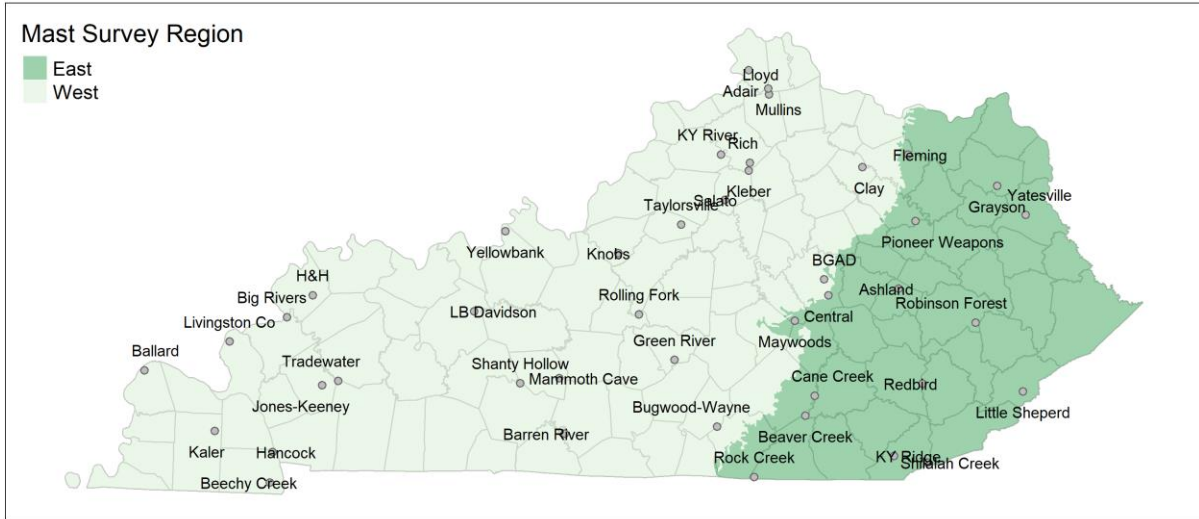


Figure 4. Mast survey sites, 2022. Location of sites surveyed. Regional division based on U.S. Forest Service ecological and forest type classifications (https://data.fs.usda.gov/geodata/rastergateway/forest_type/).

Table 1. Mast survey results overall, 2022. This table provides quantitative and qualitative measures of masting. Region indicates how data are summarized. Tree Group refers to broad categories into which various tree species are grouped. Trees Surveyed is the number of individual trees surveyed across all routes. PCA is the percentage of a tree’s crown bearing mast averaged across all survey trees. PBA is the percentage of trees bearing any mast of all survey trees and is derived from PCA. PBA Rating is the PBA value categorized into classes: “Failure” = 0 to 20%, “Poor” = 21 to 40%, “Average” = 41 to 60%, “Good” = 61 to 80%, “Bumper” = 81 to 100%.

Region	Tree Group	Trees Surveyed	PCA	PBA	PBA Rating
Statewide	Beech	462	3.5	21.0	Poor
	Hickory	1,011	7.2	35.7	Poor
	Red Oak	1,041	10.5	43.8	Average
	White Oak	1,030	10.3	47.3	Average
East	Beech	238	3.8	19.7	Failure
	Hickory	345	11.2	38.8	Poor
	Red Oak	328	9.5	43.3	Average
	White Oak	353	14.5	56.9	Average
West	Beech	224	3.2	22.3	Poor
	Hickory	666	5.1	34.1	Poor
	Red Oak	713	10.9	44.0	Average
	White Oak	677	8.1	42.2	Average

Across the state, mast production rated Average for white oaks, Average for red oaks, Poor for hickories, and Poor for beech (Figure 5, Figure 6). At eastern sites, mast production rated Average for white oaks, Average for red oaks, Poor for hickories, and Failure for beech. At western sites, mast production rated Average for white oaks, Average for red oaks, Poor for hickories, and Poor for beech.

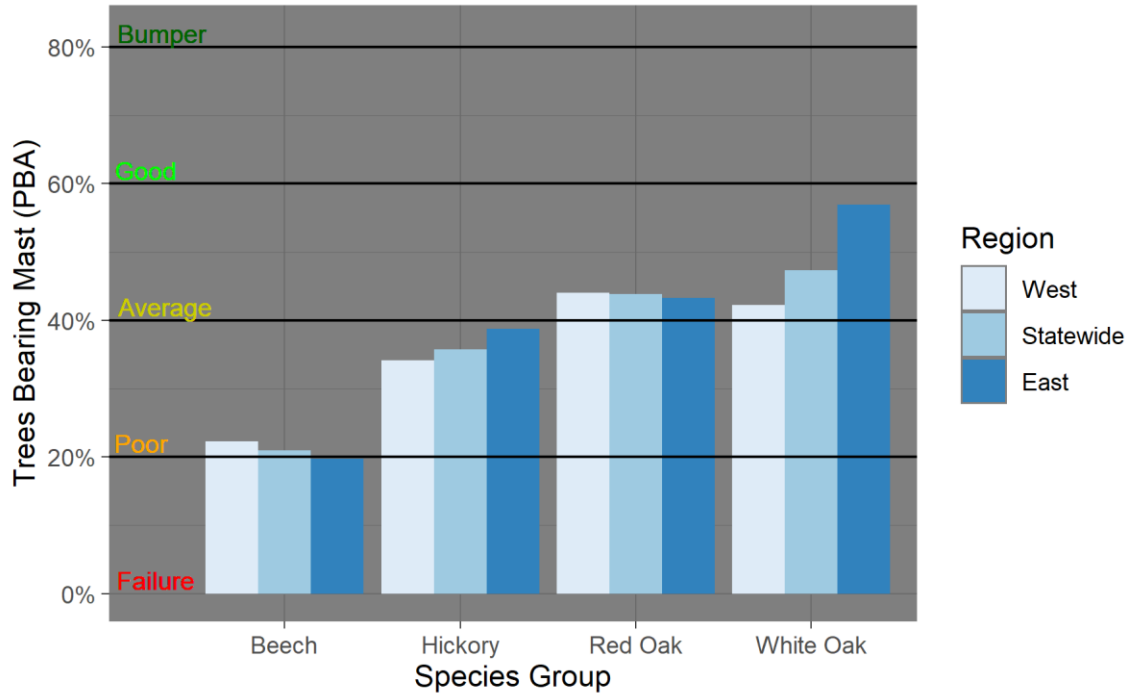


Figure 5. Percentage of trees bearing mast (PBA), 2022. This bar plot shows the distribution of PBA values when sampled trees are grouped by species group and survey region. PBA is presence or absence of mast derived from estimates of the percentage of each tree crown area bearing mast (PCA).

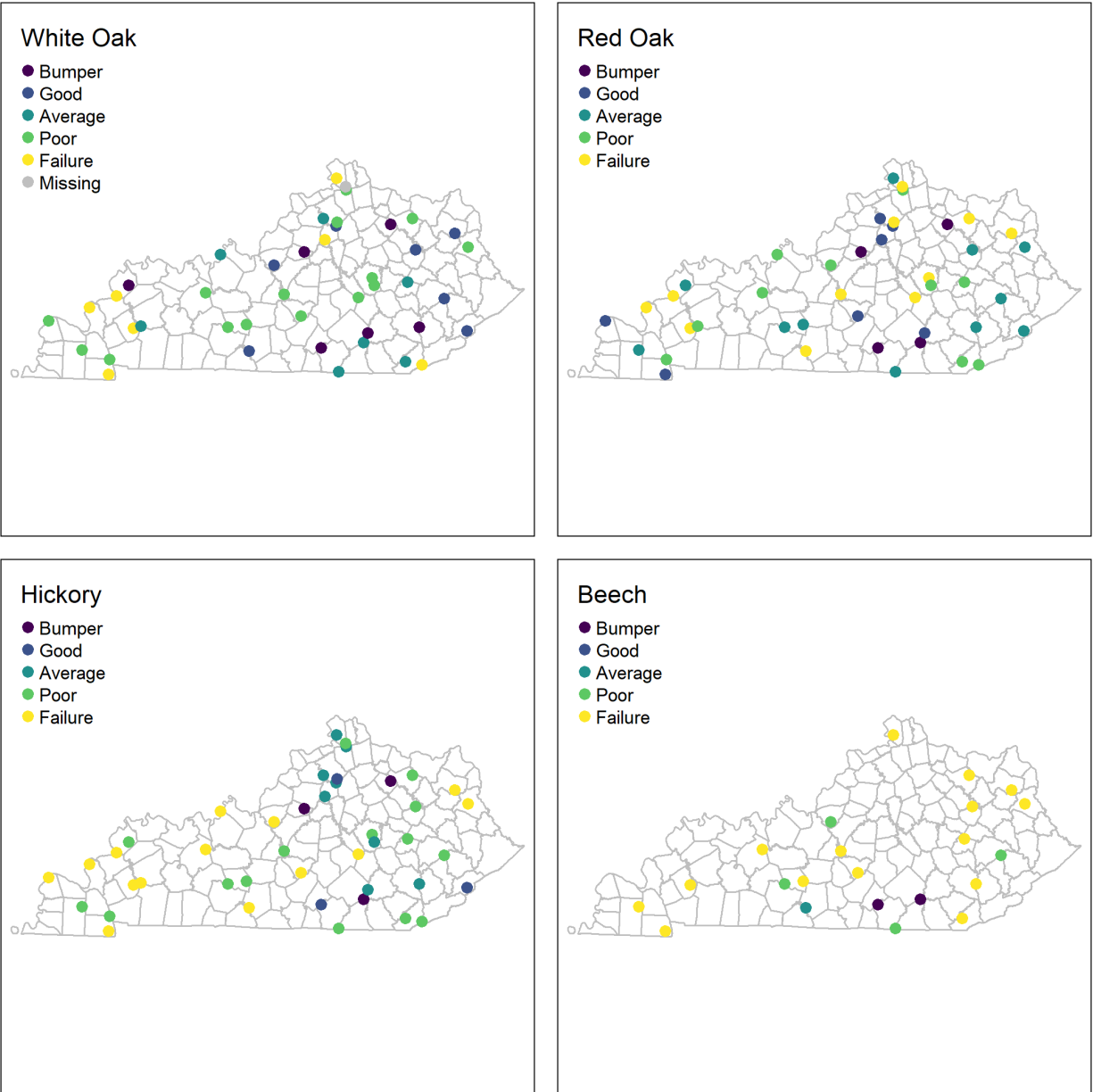


Figure 6. Mast survey ratings by site for tree species groups, 2022. Ratings categorize the percentage of trees bearing any mast (PBA). At each site: “Failure” = 0 to 20%, “Poor” = 21 to 40%, “Average” = 41 to 60%, “Good” = 61 to 80%, “Bumper” = 81 to 100%. White Oak, Red Oak, Hickory, and Beech are 4 broad groupings of the various mast-producing tree species surveyed. Not all tree group were surveyed at each site.

Red oak acorn crops were good to bumper at 2 of 14 (14%) eastern sites and 9 of 29 (31%) western sites (Tables 2 and 3). White oak acorn crops were good to bumper at 6/14 (43%) eastern sites and 7 of 28 (25%) western sites. Hickory nut crops were good to bumper at 2 of 14 (14%) eastern sites and 4 of 29 (14%) western sites. Beechnut crops were good to bumper at 1

of 10 east sites (10%) and 1 of 12 west sites (8%). However, beechnut production values are questionable because we do not check for nut viability via float tests.

Table 2. Mast ratings by tree group, 2022. This table provides the average number (and percentage) of survey routes in each region in each of 5 mast rating categories for each of 4 tree species groups. Region indicates how data are summarized. Tree Group refers to broad categories into which various tree species are grouped. PBA Rating refers to categories for the percentage of trees bearing any mast: “Failure” = 0 to 20%, “Poor” = 21 to 40%, “Average” = 41 to 60%, “Good” = 61 to 80%, “Bumper” = 81 to 100%. White Oak, Red Oak, Hickory, and Beech are broad categories into which various tree species are grouped.

Region	PBA Rating	Beech	Hickory	Red Oak	White Oak
Statewide	Bumper	2 (9%)	3 (7%)	4 (9%)	6 (14%)
	Good	0 (0%)	3 (7%)	7 (16%)	7 (17%)
	Average	1 (5%)	8 (19%)	11 (26%)	7 (17%)
	Poor	4 (18%)	15 (35%)	10 (23%)	15 (36%)
	Failure	15 (68%)	14 (33%)	11 (26%)	7 (17%)
East	Bumper	1 (10%)	1 (7%)	1 (7%)	2 (14%)
	Good	0 (0%)	1 (7%)	1 (7%)	4 (29%)
	Average	0 (0%)	2 (14%)	6 (43%)	4 (29%)
	Poor	2 (20%)	7 (50%)	3 (21%)	3 (21%)
	Failure	7 (70%)	3 (21%)	3 (21%)	1 (7%)
West	Bumper	1 (8%)	2 (7%)	3 (10%)	4 (14%)
	Good	0 (0%)	2 (7%)	6 (21%)	3 (11%)
	Average	1 (8%)	6 (21%)	5 (17%)	3 (11%)
	Poor	2 (17%)	8 (28%)	7 (24%)	12 (43%)
	Failure	8 (67%)	11 (38%)	8 (28%)	6 (21%)

Table 3. Mast ratings by survey site, 2022. This table provides mast ratings for every site surveyed. Sites are ordered alphabetically within regions. PBA Rating refers to categories for the percentage of trees bearing any mast: “Failure” = 0 to 20%, “Poor” = 21 to 40%, “Average” = 41 to 60%, “Good” = 61 to 80%, “Bumper” = 81 to 100%. White Oak, Red Oak, Hickory, and Beech are broad categories into which various tree species are grouped. Blanks indicate that a tree group was not surveyed at a site.

PBA Rating					
Region	Site	White Oak	Red Oak	Hickory	Beech
East	Ashland	Average	Poor	Poor	Failure
East	Beaver Creek	Average	Bumper	Bumper	Bumper
East	Cane Creek	Bumper	Good	Average	
East	Fleming	Poor	Failure	Poor	Failure
East	Grayson	Good	Failure	Failure	Failure
East	KY Ridge	Average	Poor	Poor	Failure
East	Little Sheperd	Good	Average	Good	
East	Maywoods	Poor	Failure	Failure	
East	Pioneer Weapons	Good	Average	Poor	Failure
East	Redbird	Bumper	Average	Average	Failure
East	Robinson Forest	Good	Average	Poor	Poor
East	Rock Creek	Average	Average	Poor	Poor
East	Shilalah Creek	Failure	Poor	Poor	
East	Yatesville	Poor	Average	Failure	Failure
West	Adair	Failure	Average	Average	Failure
West	Ballard	Poor	Good	Failure	
West	Barren River	Good	Failure	Failure	Average
West	Beechy Creek	Failure	Good	Failure	Failure
West	BGAD	Poor	Failure	Poor	
West	Big Rivers	Failure	Failure	Failure	
West	Bugwood-Wayne	Bumper	Bumper	Good	Bumper
West	Central	Poor	Poor	Average	
West	Clay	Bumper	Bumper	Bumper	
West	Green River	Poor	Good	Failure	Failure
West	H&H	Bumper	Average	Poor	

Region	Site	PBA Rating			
		White Oak	Red Oak	Hickory	Beech
West	Hancock	Poor	Poor	Poor	
West	Jones-Keeney	Failure	Failure	Failure	Failure
West	Kaler	Poor	Average	Poor	Failure
West	Kleber	Good	Good	Average	
West	Knobs	Good	Poor	Failure	Poor
West	KY River	Average	Good	Average	
West	LB Davidson	Poor	Poor	Failure	Failure
West	Livingston Co	Failure	Failure	Failure	
West	Lloyd	Poor	Poor	Average	
West	Mammoth Cave	Poor	Average	Poor	Failure
West	Mullins		Failure	Poor	
West	Rich	Poor	Failure	Good	
West	Rolling Fork	Poor	Failure	Poor	Failure
West	Salato	Failure	Good	Average	
West	Shanty Hollow	Poor	Average	Poor	Poor
West	Taylorville	Bumper	Bumper	Bumper	
West	Tradewater	Average	Poor	Failure	
West	Yellowbank	Average	Poor	Failure	

As is typical and confounding to managers, mast production was highly variable (Table 3, Figure 7). Based on the inter-quartile range (i.e., the width of boxes in Figure 7), variability was higher at western Kentucky sites than in the east (6% more for red oaks, 3% more for hickories, and 2% more for beech). As an example of how two nearby sites can vary, red oak mast rated as Failure at Rich WMA but as Good at nearby Kleber WMA. In contrast, red oak rated as Bumper at Beaver Creek WMA in southern KY and at Clay WMA in northern KY.

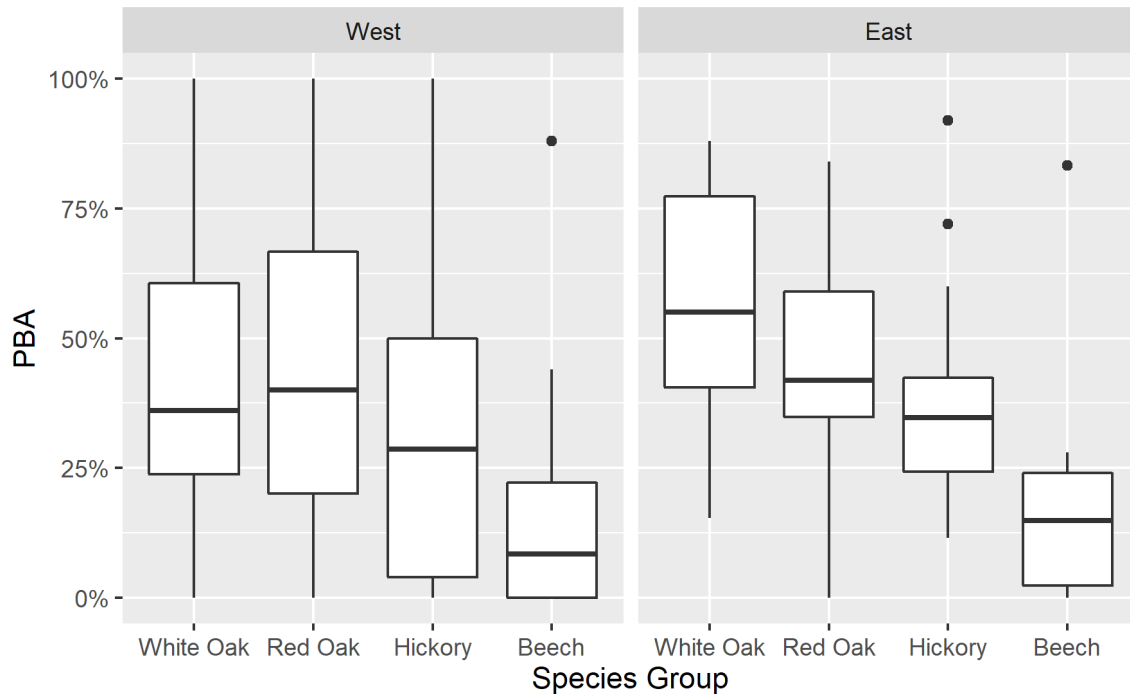


Figure 7. Variation in percentage of trees bearing mast (PBA), 2022

Distribution of PBA values summarized by tree species group and region. The horizontal line inside each box represents median PBA (50% of values across all sites in the region are below this value). The lower bound of each box is the lower quartile (25% of values are below this value). The upper bound is the upper quartile (75% of values are below this value). The “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.

Long-term trends in PBA show substantial fluctuations year-to-year at the statewide level (Figure 8). However, white oak PBA has been stable since rebounding to the long-term average in 2018. Red oak PBA increased steadily between 2015 and 2020 but decreased sharply this year. Though not strongly, hickory and beech PBA decreased this year. Causes of variability in mast production are not well understood, particularly at local levels.

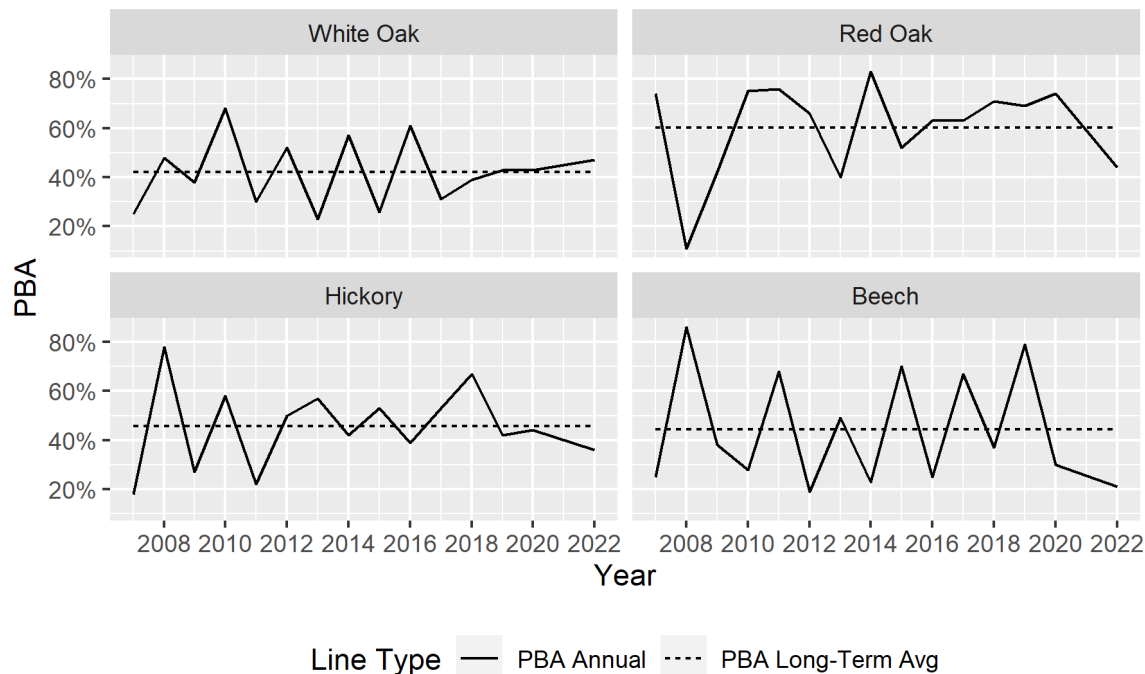


Figure 8. Trends in percentage of trees bearing mast (PBA) by species group, 2007-2021. PBA is presence or absence of mast derived from estimates of the percentage of crown area bearing mast [PCA] greater than 0. NOTE: Percentages for beech are suspect because we do not routinely assess soundness of beechnuts by floating the nuts (sound nuts sink), which is important since beech mast is known to be highly irregular.

So far we have reported on PBA, a presence-absence metric. In terms of PBA, a white oak tree with 1 acorn rates the same as another white oak tree with 1,000 acorns, despite the large difference in acorn abundance (i.e., PCA) between trees. Trees commonly have low PCA values and PCA can be highly variable. Both conditions were observed this year (Figure 9, Figure 10). PBA and PCA are not related linearly in a 1-to-1 relationship (Figure 11). PBA tends to be higher at a given PCA, so slight changes in PCA can bump the PBA rating to a higher category (Figure 11A). At statewide and regional levels, the PBA-PCA relationship varies somewhat by tree group (Figure 11B). And across sites, the median and variance for PCA (4%, 10%) are much lower than for PBA (33%, 42%).

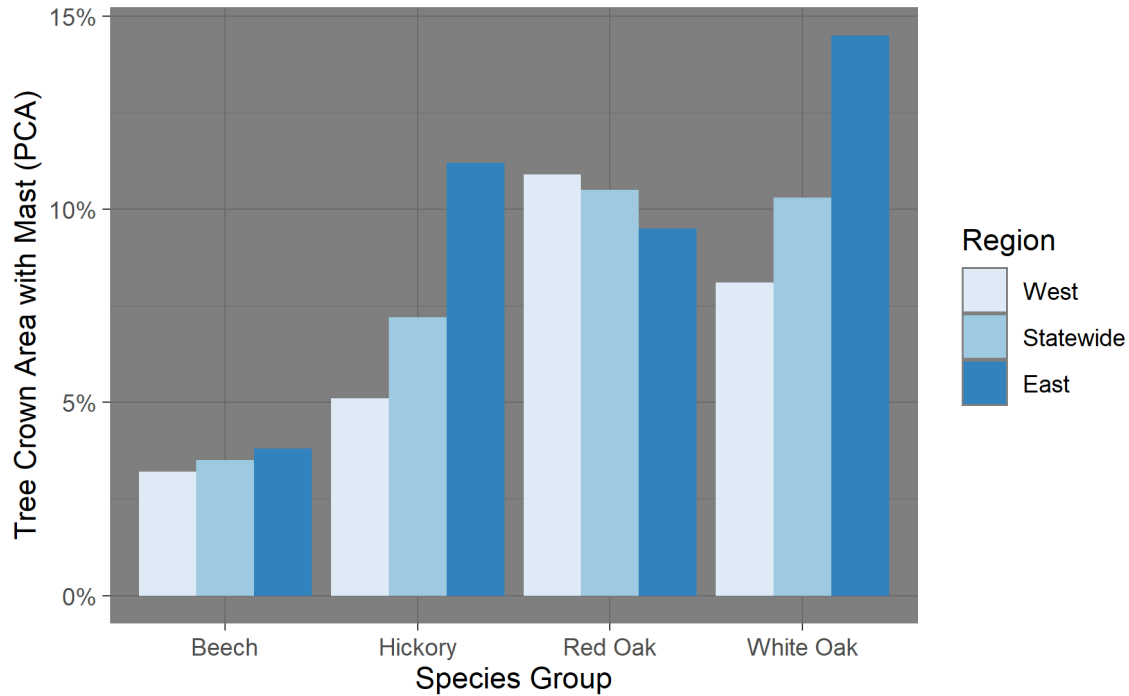


Figure 9. Percentage of tree crown area bearing mast (PCA), 2022. This barplot shows PCA values of surveyed trees averaged statewide and in each of the 2 survey regions.

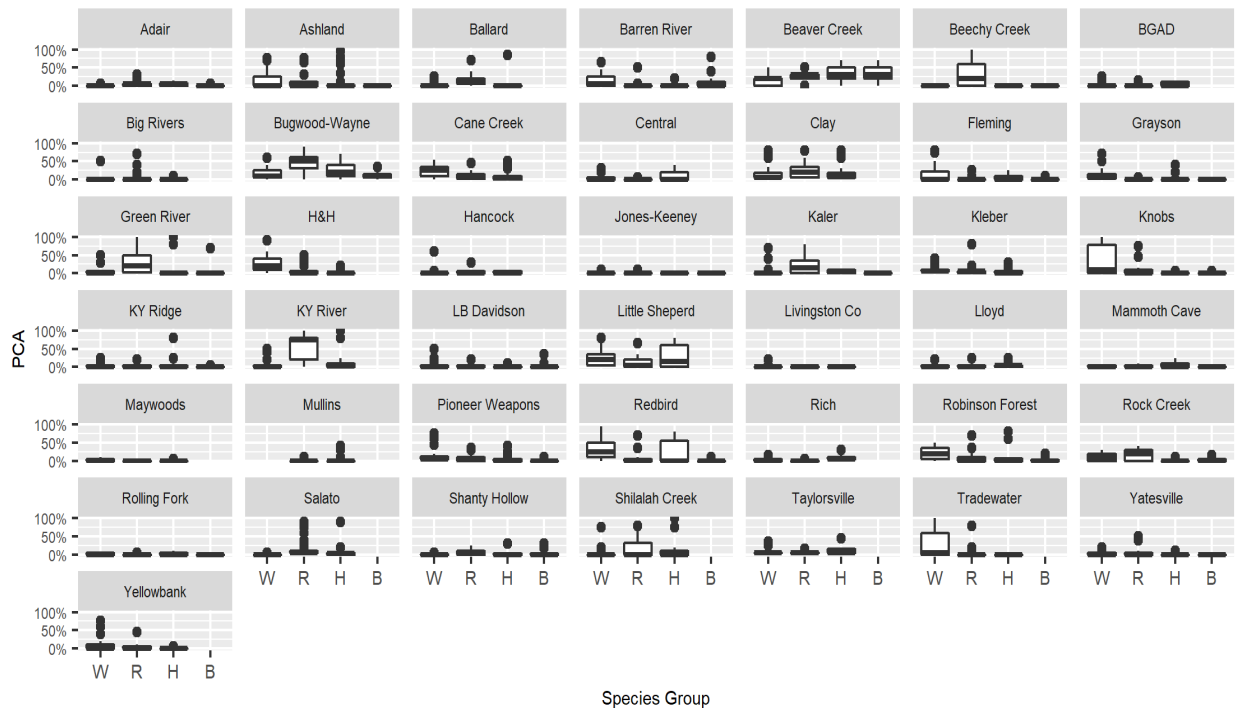


Figure 10. Percentage of tree crown area bearing mast (PCA) by site, 2022. Plots show the distribution of PCA values among individual trees at each survey site. Tree species group are abbreviated (W = white oak, R = red oak, H = hickory, B = beech).

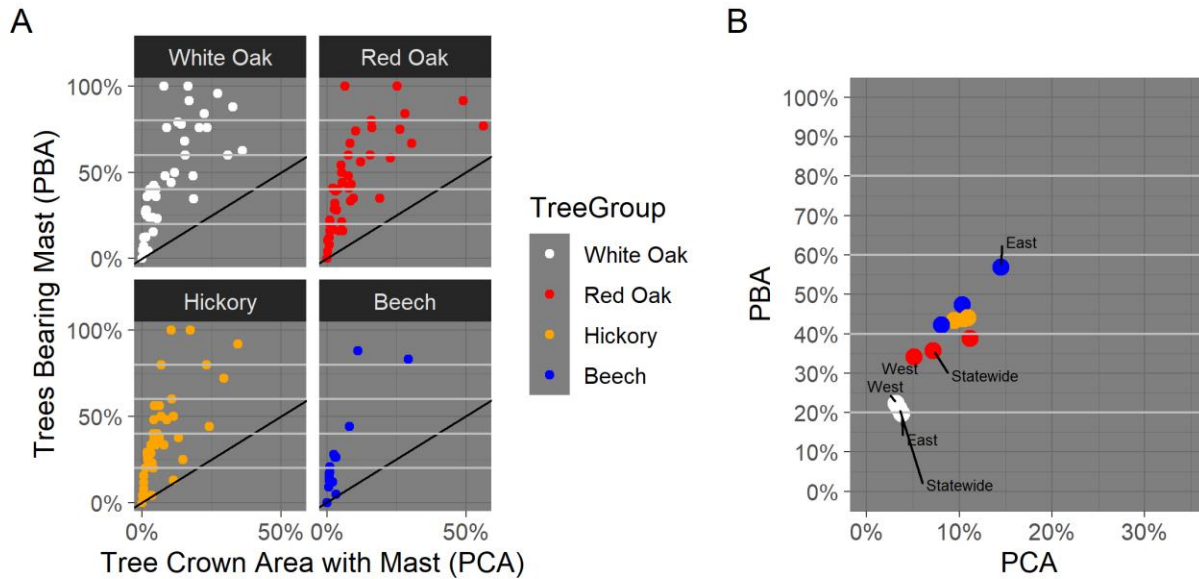


Figure 11. Relationship of PCA and PBA, 2022. Plot A shows the correlation of PCA values with PBA values by tree group across all survey sites. Each dot is a site and colors represent tree species groups. The black diagonal line in each subplot is a reference for what would be a perfectly linear relationship; however, for each tree group, the relationship is not linear, with PBA values being higher for a given PCA level. Plot B shows the PCA-PBA correlation summarized statewide and regionally. Colors represent tree groups and dots are statewide or regionally summarized values of PCA and PBA. For (A) and (B), the white horizontal lines denote the PBA ratings described above (“Failure” = 0 to 20%, “Poor” = 21 to 40%, “Average” = 41 to 60%, “Good” = 61 to 80%, “Bumper” = 81 to 100%).

In summary, masting was poor to average overall across the Commonwealth but hunters should expect variation from place to place. Where mast production was good, deer, turkeys, bears, squirrels and other animals will be keyed in to those resources. Hunters should plan hunting strategies accordingly.

Disease Spotlight

The Kentucky Division of Forestry (KDF) handles the health and sustainability of Kentucky’s forests. The Division of Forestry’s health program utilizes aerial and ground surveys to identify and monitor diseases, invasive and exotic plants issues, and insects that could impact Kentucky’s forests. In 2018 and 2019, the health program ground-surveyed over 12,000 acres and aerial-surveyed more than one million acres monitoring for various insect and disease issues across the state. Species such as the Emerald Ash Borer, Hemlock Woolly Adelgid, and many others have seriously impacted the health of common, native trees throughout Kentucky.

In 2021, KDF foresters began noticing premature browning of oak trees in a few select counties of Kentucky (Franklin, Owen, Carroll, Gallatin, Boone, Jefferson, and Shelby). After completing ground surveys and collecting samples, they determined that the damage is the result of a native insect known as the oak lace bug (*Corythucha arcuata*) (Figure 12).



Figure 12. Adult oak lace bug (Photo by Joseph Berger, bugwood.org)

The oak lace bug is a small fly (1/8" long as adults) and are equipped with piercing and sucking mouthparts that they use to feed on the sap of oak trees. Their feeding will cause the oaks' leaves to turn a brown color (Figure 13), and in severe cases, may cause the tree to prematurely drop its leaves. While this pest does not appear to have any long-term detrimental effects, infestation of this insect may make affected oak trees more susceptible to infestation by other pests. In 2022, KDF has reported a much wider distribution of damage caused by the oak lace bug throughout Kentucky.



Figure 13. Oak leaf browning caused by oak lace bug (picture by Whitney Cranshaw, bugwood.org)

If you encounter damaged trees along your route, make sure to make a note in Collector and contact the Kentucky Department of Forestry or Mast Survey coordinators.

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.

The Department of Fish and Wildlife Resources is funded through the sale of hunting and fishing licenses. It receives no general fund tax dollars.