

**WESTERN NORTH CAROLINA
HARD AND SOFT MAST
SURVEY REPORT
31st Year**

FALL 2013



North Carolina Wildlife Resources Commission

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Funding for the hard and soft mast survey was partially provided through a Pittman-Robertson Wildlife Restoration Grant. The Federal Aid in Wildlife Restoration Act, popularly known as the Pittman-Robertson Act, was approved by Congress on September 2, 1937, and began functioning July 1, 1938. The purpose of this Act was to provide funding for the selection, restoration, rehabilitation and improvement of wildlife habitat, wildlife management research, and the distribution of information produced by the projects. The Act was amended October 23, 1970, to include funding for hunter training programs and the development, operation and maintenance of public target ranges.

Funds are derived from an 11 percent Federal excise tax on sporting arms, ammunition, and archery equipment, and a 10 percent tax on handguns. These funds are collected from the manufacturers by the Department of the Treasury and are apportioned each year to the States and Territorial areas (except Puerto Rico) by the Department of the Interior on the basis of formulas set forth in the Act. Funds for hunter education and target ranges are derived from one-half of the tax on handguns and archery equipment.

Each state's apportionment is determined by a formula which considers the total area of the state and the number of licensed hunters in the state. The program is a cost-reimbursement program, where the state covers the full amount of an approved project then applies for reimbursement through Federal Aid for up to 75 percent of the project expenses. The state must provide at least 25 percent of the project costs from a non-federal source.



Introduction

North Carolina Wildlife Resources Commission (NCWRC) personnel have surveyed hard mast in the Mountain Region of North Carolina since 1983. From 1983-2005, North Carolina's hard mast surveys were conducted and reported using a method developed by Whitehead (1969) with slight modifications (Wentworth et al. 1992). This same protocol was used in whole or part by Georgia and Tennessee for many years and was adopted by South Carolina in the 1990's. In an effort to reduce costs and manpower commitments, while maintaining quality data and standard methodology among neighboring states, the member states of the Southern Appalachian Black Bear Study Group (SABBSG, Georgia, North Carolina, South Carolina, and Tennessee) have long searched for an improved technique for monitoring hard mast surveys. Beginning with the 2006 survey, we are using a new protocol and formula for determining mast indices (Greenberg and Warburton 2007). The new protocol only requires simple calculation of percent crown with acorns in the field. In order to maintain consistency with the old technique, the new technique uses statistically verified equations to convert mast index values to numbers previously used with the Whitehead (1969) method. Hard mast results reported in this document utilize the techniques described in Greenberg and Warburton (2007) and are described using the scale used by our agency since 1983. Due to small sample sizes, results will no longer be reported for individual routes for hickory and beech, but overall values for these species will be reported. Sample sizes are sufficient to allow the reporting of values for both the white oak and red oak groups by route.

Hard Mast Overall Results

The 2013 hard mast survey was conducted by WRC Game Lands and Private Lands staff on 12 routes in western North Carolina. A total of 1,378 trees were sampled including 550 from the white oak group, 653 from the red oak group, 138 hickories, and 37 beeches. Combining all groups of species, mast was rated as poor, with an overall index of 1.44 (Table 1), which is a decline from last year's fair mast crop. Since 1983, North Carolina has experienced eleven years in which the hard mast index was rated as poor.

For the third year in a row, white oak production rated as poor (1.00; Table 1) and was below the long-term average of 1.81. White oak production has been rated as poor in nineteen of thirty-one years of this survey. When the white oak group is separated by species, chestnut oak and white oak production both rated as poor (0.72 and 1.34, respectively; Table 2). Red oak production was poor (1.43; Table 1) and below the long-term average (2.77) for the species. Red oak production has been poor in nine of thirty-one years. Separated by species, black oak rated as fair (2.92), while northern red oak and scarlet oak rated as poor at 1.42 and 1.24, respectively (Table 2). Hickory production rated as fair (2.43) and slightly above the long-term average (2.32) for the species (Table 1). Beech production (4.45) was good, which was an improvement from last year's production rating and above the long-term average (4.13; Table 1).

Hard Mast Survey Area Results

As in previous years, hard mast production varied by location and species (Table 3; Figures 1 and 2). Nine areas surveyed had red oak productivity rated as poor, one area rated as fair, while the remaining two areas rated as good (Table 3). The Nantahala (Macon County) route and the Standing Indian route (Macon County) both had good productivity and had the highest red oak index (Table 3). White oak production in ten of twelve survey areas was rated as poor, one area rated as fair, and one area rated as having good white oak production (Table 3;

Figure 2). The Nantahala route (Macon County) had the highest white oak index (4.74), while the Cold Mountain route (Haywood County), Linville Mountain route (Burke/McDowell counties) and Sherwood route (Haywood County) had the lowest white oak index (Table 3). Red and white oak productivity was poor from <1,900 feet through 4,900 feet. Above 5,000 feet, red oak was good, but white oak was poor (Table 4).

Summer Soft Mast Survey Results

A soft mast survey was implemented during the summer and fall of 1993 to document berry production and abundance. The technique used for evaluating the soft mast survey has remained consistent throughout this period including the current year. Summer soft mast surveys have been conducted in conjunction with the Sardine Bait Station Survey (SBSS). During summer 2006, based on an agreement with the member states of the SABBSG, we did not conduct the SBSS. Review of data from the SBSS indicates that we can obtain long-term bear population trend information by conducting the survey every other year. Because of the new schedule, the summer soft mast survey will be conducted in odd years. The previous survey was conducted in 2011 and the next survey was conducted during the summer of 2013.

This year's summer blackberry and pokeberry were above the long-term average, while blueberry and huckleberry were below all overall averages (Table 5). Blueberry, huckleberry and pokeberry produced poor crops, while blackberry production was fair (3.7). Summer soft mast production varied on a local basis with some areas failing to produce any significant fruit of certain species while producing "fair" to "good" crops of others (Table 6).

Fall Soft Mast Survey Results

The 2013 fall soft mast survey is conducted in conjunction with the hard mast survey. Overall, soft mast production was slightly above production observed in 2012 poor; cherry was above long-term average, while pokeberry, blackgum, and grapes were below long-term averages (Table 7). Cherry and grapes were fair (2.75), followed by pokeberry (fair; 2.00), and blackgum (1.08, poor; Table 7). As observed in previous years, local areas experienced variable production of fall soft mast with levels from 0 to 6 depending on species and area (Table 8).

Conclusion

This season's hard mast crop was the eleventh year since 1983 in which the overall hard mast index was poor. Fall hard mast productivity declined in 2013 from the fair hard mast crop that occurred in 2012. This year, both red and white oak production were poor, while hickory was fair and beech was good. Except for Great Smoky Mountains National Park (GSMNP), surrounding states reported that overall white and red oak productivity was poor. GSMNP reported that white and red oak production was average to good. Extreme wet weather may have influenced the poor mast production observed in North Carolina. During 2013, western North Carolina experienced record rainfall. By July 2013, most areas in western North Carolina had experienced the wettest year on record. For example, Brevard, NC was 29 inches above normal by July 2013.

LITERATURE CITED

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Table 1. Hard Mast Survey Results for Western North Carolina, 1983-2013.

Year	White Oak	Red Oak	All Oaks	Hickory	Beech	Total
1983	1.43	2.59		1.99	5.51	2.25
1984	1.08	2.73		3.05	4.28	2.30
1985	2.01	3.66		0.80	3.06	2.80
1986	1.32	1.98		2.25	5.22	1.90
1987	1.16	0.56		3.57	5.75	1.31
1988	3.16	4.07		2.04	4.25	3.57
1989	0.43	4.89		2.78	6.44	3.14
1990	1.85	2.62		1.20	1.89	2.17
1991	2.38	1.93		3.75	6.89	2.43
1992	1.07	2.45		0.72	1.17	1.78
1993	0.65	3.58		2.43	4.77	2.48
1994	2.06	3.48		2.02	6.20	2.85
1995	2.80	5.60		2.48	0.36	4.22
1996	3.70	1.99		2.81	4.31	2.72
1997	0.53	1.79		1.17	2.35	1.29
1998	2.26	4.68		3.27	4.70	3.69
1999	3.28	2.76		2.80	6.22	3.05
2000	0.50	2.11		2.73	5.71	1.82
2001	2.83	4.92		2.88	3.97	3.98
2002	1.90	3.01		1.75	3.44	2.47
2003	1.24	0.68		3.58	5.42	1.33
2004	3.99	2.93		1.32	1.65	3.09
2005	0.70	3.11		1.86	4.30	2.14
2006	1.70	1.40	1.50*	3.20	4.10	1.80
2007	3.02	1.19	2.04	0.73	2.71	1.90
2008	1.01	2.40	1.76	3.82	4.34	2.06
2009	0.48	2.47	1.55	1.72	5.58	1.67
2010	3.46	3.97	3.75	3.50	0.87	3.66
2011	1.17	2.22	1.74	1.30	4.96	1.76
2012	1.87	2.68	2.31	2.01	3.14	2.29
2013	1.00	1.43	1.23	2.43	4.45	1.44
Average	1.81	2.77	1.99	2.32	4.13	2.43

Numerical Rating = Crop Quality

0.0 to 2.0 = Poor

2.1 to 4.0 = Fair

4.1 to 6.0 = Good

6.1 to 8.0 = Excellent

* Not reported for prior years.

Table 2. Hard Mast Survey Results by Species, 2013.

Grouping	Species	Index	Number of Trees Sampled
Hickories	MH, SH, PH, GH ¹	2.43	138
Beech	Beech	4.45	37
Red Oaks	Black Oak	2.92	30
	Northern Red Oak	1.42	435
	Scarlet Oak	1.24	184
White Oaks	Chestnut Oak	0.72	299
	White Oak	1.34	251

Numerical Rating = Crop Quality

0.0 to 2.0 = Poor 2.1 to 4.0 = Fair

4.1 to 6.0 = Good 6.1 to 8.0 = Excellent

¹MH,SH, PH, GH: Mockernut Hickory, Shellbark Hickory, Pignut Hickory, Shagbark Hickory

Table 3. Hard Mast Survey Results by Area, 2013.

County	Area	White Oak	Red Oak	All Oaks
Transylvania	Avery Creek	0.62	0.76	0.69
Haywood	Cold Mountain	0.38	0.44	0.40
Avery & Caldwell	Edgemont	0.48	0.44	0.45
Clay	Fires Creek	0.98	0.83	0.91
Haywood	Harmon Den	1.20	0.57	0.87
Burke & McDowell	Linville Mtn.	0.38	0.44	0.40
Macon	Nantahala	4.74	5.65	5.36
Mitchell	Poplar	1.56	0.44	0.80
Graham	Santeetlah	0.49	1.71	1.16
Haywood	Sherwood	0.38	1.48	1.17
Burke	South Mountains	2.72	3.86	3.28
Macon	Standing Indian	1.99	4.51	3.47

Numerical Rating = Crop Quality

0.0 to 2.0 = Poor 2.1 to 4.0 = Fair

4.1 to 6.0 = Good 6.1 to 8.0 = Excellent

Red Oak Mast Rating

- Not Surveyed
- Poor
- Fair
- Good
- Excellent

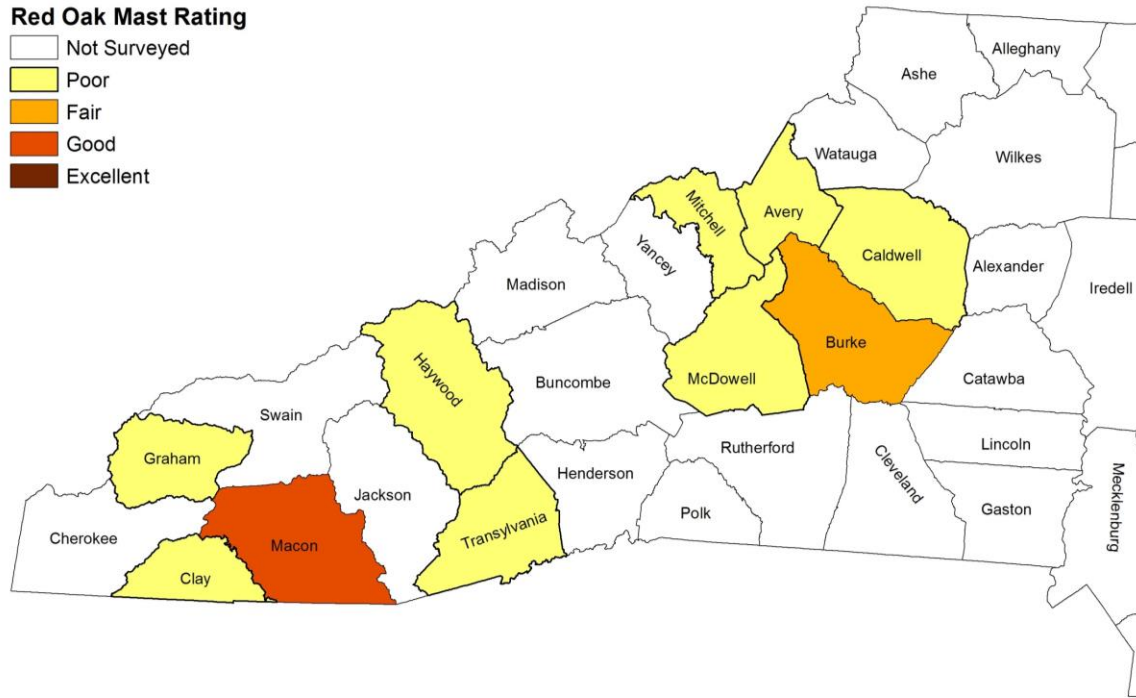


Figure 1. Red Oak Index by County in western North Carolina, 2013.

White Oak Mast Rating

- Not Surveyed
- Poor
- Fair
- Good
- Excellent

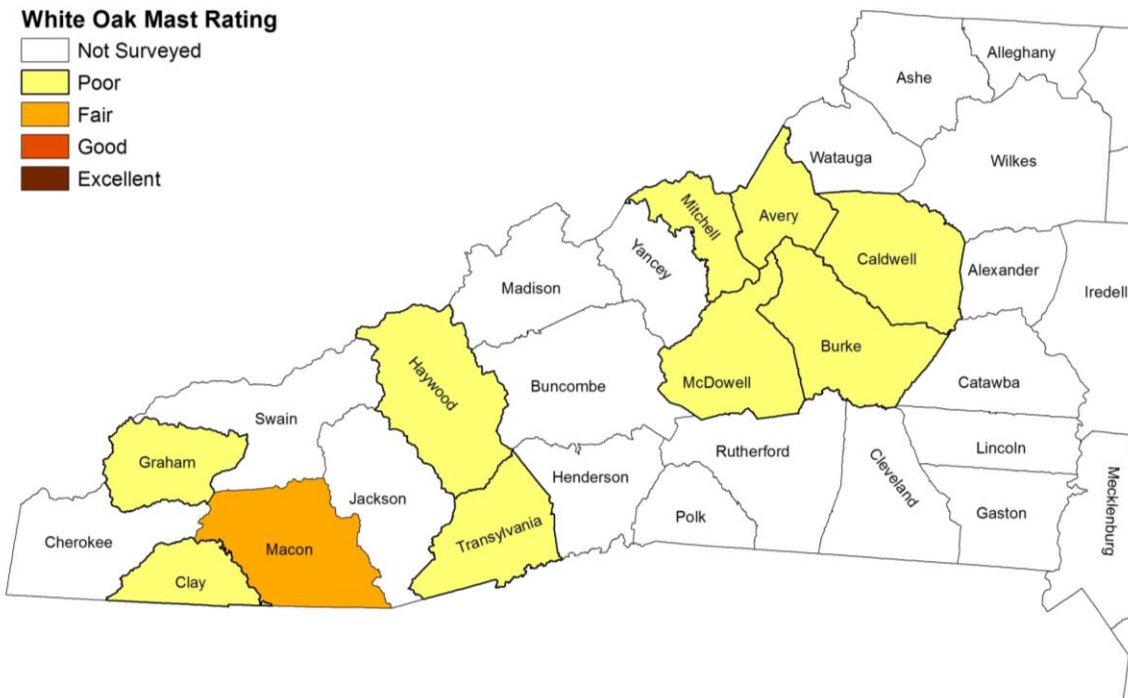


Figure 2. White Oak Index by County in western North Carolina, 2013.

Table 4. Hard Mast Survey Results by Elevation, 2013.

Elevation (ft.)	Red Oak	White Oak
<1900	1.36	0.38
2000-2900	1.76	1.23
3000-3900	0.84	0.66
4000-4900	1.62	1.33
5000+	4.30	1.40

Numerical Rating = Crop Quality

0.0 to 2.0 = Poor	2.1 to 4.0 = Fair
4.1 to 6.0 = Good	6.1 to 8.0 = Excellent

Table 5. Results of Mountain Summer Soft Mast Surveys, 1993-2013¹.

Year	Blueberry	Huckleberry	Blackberry	Pokeberry
1993	3.20	3.60	3.80	2.40
1994	3.20	3.50	3.50	1.40
1995	1.90	2.50	3.10	1.20
1996	2.00	2.00	3.40	1.50
1997	2.80	3.00	3.80	2.00
1998	1.90	1.20	3.30	2.33
1999	2.72	2.45	2.90	1.78
2000	2.70	2.72	2.99	1.64
2001	2.27	2.73	2.87	0.87
2002	1.87	2.22	3.55	1.32
2003	2.27	2.74	3.20	1.02
2004	1.67	1.61	4.25	1.41
2005	1.57	1.41	4.07	1.48
2007	2.11	1.23	2.48	1.84
2009	2.08	2.06	2.78	1.09
2011	1.69	1.53	3.28	1.37
2013	1.87	1.07	3.73	1.89
Average	2.24	2.27	3.31	1.53

¹ After 2005, summer soft mast surveys are conducted every two years.

Table 6. Mountain Summer Soft Mast Survey Results by Area, 2013.

Area	Blueberry	Huckleberry	Blackberry	Pokeberry
Daniel Boone	1.60	1.20	0.40	0.20
Fires Creek/Santeetlah	1.20	1.80	1.80	1.40
Flattop	0.00	0.00	6.00	0.00
Harmon Den Area	0.67	0.00	1.33	1.00
Mt. Mitchell	3.33	1.33	4.67	0.33
Pisgah Area	2.40	2.20	2.20	0.00
Rich Mountain	1.00	1.00	0.00	0.00
Standing Indian	0.00	0.57	2.71	0.29
T. Chatham	3.75	2.00	2.00	2.00
Cheoah	1.00	1.00	1.50	3.00
South Mountains	2.00	1.00	4.00	4.00
Highlands	1.00	1.00	2.00	1.00
Gorges State Park	9.00	1.00	9.00	4.00
Lake James State Park	1.00	1.00	4.00	1.00
Sandy Mush	1.00	1.00	9.00	6.00
Green River	1.00	1.00	9.00	6.00
Average	2.22	2.20	3.34	1.55

Numerical Rating = Crop Quality

0.0 to 2.0 = Poor

2.1 to 4.0 = Fair

4.1 to 6.0 = Good

6.1 to 8.0 = Excellent

Table 7. Results of Mountain Fall Soft Mast Surveys, 1993-2013.

Year	Pokeberry	Cherry	Grapes	Blackgum
1993	2.00	2.71	2.14	0.43
1994	3.11	2.00	3.78	1.71
1995	2.67	5.00	2.22	1.78
1996	2.40	1.63	3.25	1.75
1997	4.20	1.25	3.14	0.75
1998	4.63	2.67	2.80	1.50
1999	2.40	2.70	3.25	1.10
2000	2.20	2.70	3.30	1.00
2001	2.80	3.30	4.18	2.33
2002	1.10	2.45	2.73	1.27
2003	2.33	3.00	2.55	2.22
2004	1.67	2.70	3.00	1.44
2005	2.45	2.09	1.36	1.55
2006	3.73	2.00	3.17	2.50
2007	2.08	1.58	2.73	0.67
2008	2.91	4.64	4.08	2.58
2009	1.92	1.82	2.33	1.83
2010	2.90	5.80	4.80	1.40
2011	2.50	1.67	2.33	1.42
2012	2.50	1.08	2.92	1.00
2013	2.00	2.75	2.75	1.08
Average	2.60	2.64	2.99	1.49

Numerical Rating = Crop Quality

0.0 to 2.0 = Poor	2.1 to 4.0 = Fair
4.1 to 6.0 = Good	6.1 to 8.0 = Excellent

Table 8. Local Results of Mountain Fall Soft Mast Surveys, 2013.

County	Area	Pokeberry	Cherry	Grapes	Blackgum
Transylvania	Avery Creek	0	1	4	0
Haywood	Cold Mountain	1	3	6	3
Avery & Caldwell	Edgemont	2	0	0	0
Clay	Fires Creek	2	6	6	1
Haywood	Harmon Den	0	4	4	1
Burke & McDowell	Linville Mtn.	2	2	1	3
Macon	Nantahala	2	1	0	0
Mitchell	Poplar	2	0	0	0
Graham	Santeetlah	2	6	6	1
Haywood	Sherwood	1	6	6	4
Burke	South Mountains	4	0	0	0
Macon	Standing Indian	6	4	0	0
Average:		2.00	2.75	2.75	1.08

Numerical Rating = Crop Quality

0.0 to 2.0 = Poor

2.1 to 4.0 = Fair

4.1 to 6.0 = Good

6.1 to 8.0 = Excellent