WESTERN NORTH CAROLINA HARD AND SOFT MAST SURVEY REPORT 35th Year

FALL 2017

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 2016 hard mast survey was conducted by WRC Land and Water Access staff, WRC Wildlife Management Division Private Lands staff, and South Mountains State Park staff on 11 routes in western North Carolina; the Avery Creek route was not conducted in 2017. A total of 1,211 trees were sampled including 479 from the white oak group, 579 from the red oak group, 118 hickories, and 35 beeches. Combining all groups of species, mast was rated as fair, with an overall index of 3.44, which is a slight increase from last year's mast crop index (2.67) and the third year in a row that the mast index was rated as fair (Table 1). Since 1983, North Carolina has experienced 22 years out of 35 years in which the hard mast index was rated as fair. Including only the oak species, mast production rated as fair (3.40; Table 1).

White oak production rated as fair (2.13; Table 1) and was above the long-term average of 1.88. but lower than last year's index. When the white oak group is separated by species, chestnut oak rated as poor and white oak production rated as fair (1.69 and 2.63, respectively; Table 2). Red oak production rated as good (4.42; Table 1) and above the long-term average (2.85) for the species. Separated by species, black oak, northern red oak and scarlet oak all rated as good (4.70, 4.52, and 4.19, respectively; Table 2). Hickory production rated as fair (3.20) and above the long-term average (2.36) for the species (Table 1). Beech production (5.69) was good, above the long-term average (4.14; 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). Seven areas surveyed had red oak productivity rated as good and 4 areas were rated as fair (Table 3; Figure 1). The Nantahala route (Macon County) had the highest red oak index (6.3; Table 3). White oak production in 4 areas rated as poor, 5 areas rated as fair, and 2 areas rated as good (Table 3; Figure 2). The Nantahala route (Macon County) had the highest

white oak index (6.0), followed by the Poplar route (Mitchell County; Table 3; Figure 2). Though they do not conduct mast surveys, US Forest Service staff from Nantahala National Forest noted that white and red oak mast was abundant, which matches the results of that survey route. Red oak productivity ranked highest at 3,000-3,900 feet, and were lowest in the upper and lower elevations (Table 4). White oak productivity ranked highest (2.34, fair) at <1,900 feet and was variable across elevations gradients. At 5,000+ feet, white oak production was poorest (1.36; Table 4). Differences in white oak productivity across all elevation gradients were similar to 2016.

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 2015 (Table 5 and 6) and the next survey was conducted during the summer of 2017.

This year's all four summer soft mast species surveyed (blueberry, huckleberry, blackberry, and pokeberry) were below the long-term averages (Table 5). Blueberry, huckleberry, and pokeberry production rated as poor, while blackberry rated as fair. 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 "excellent" crops of others (Table 6). Field observations of summer soft mast noted that several berry species dried up soon after nearing ripeness.

Fall Soft Mast Survey Results

The 2017 fall soft mast survey is conducted in conjunction with the hard mast survey. Overall, soft mast production was below the production observed in 2016; pokeberry was above the long-term average while cherry, grapes, and blackgum were below long-term averages (Table 7; Figure 3). Pokeberry and grapes rated as fair, while blackgum and cherry produced poor crops (Table 7). As observed in previous years, local areas experienced variable production of fall soft mast depending on species and area (Table 8).

Conclusion

This season's hard mast crop was the twenty-second year since 1983 in which the overall hard mast index was fair. While the fall hard mast index was higher in 2017 than in 2016, this year's hard mast production was uneven and extremely variable based on location, with some areas experiencing poor production while other areas experienced good to excellent production. For example, several areas experienced very poor production of white oaks (Table 3; Figures 1 and 2). In addition, we suspect that hard mast productivity in 2016 was higher than what the index reflected. This year, red oak and beech rated as good, while white oak and hickory production rated as fair. Surrounding states reported variability in hard and soft mast production. South Carolina reported low soft mast abundance and fair white oak and red oak productivity

(2.9 and 2.7, respectively) with mast scattered at all elevations. Georgia reported that soft mast was on the "low side of fair", but that hard mast abundance appeared good. Virginia reported poor summer soft mast, red oak abundance better at higher elevations and a total failure of white oaks. The overall trend in hard mast production shows no change since surveys were initiated in 1983 (Figure 4).

LITERATURE CITED

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Wentworth, J.M., A.S. Johnson, P.E. Hale, and K.E. Kammermeyer. 1992. Relationship of Acorn abundance and deer herd characteristics in the southern Appalachians. Southern Journal of Applied Forestry 16:5-8.

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Table 1. Hard Mast Survey Results for Western North Carolina, 1983-2017.

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
2014	4.43	4.36	4.42	2.33	1.23	4.10
2015	1.07	2.65	1.92	2.64	5.77	2.09
2016	2.71	2.60	2.66	2.45	4.08	2.67
2017	2.13	4.42	3.40	3.20	5.69	3.44
Average	**1.88**	**2.85**	**2.36**	**2.36**	**4.14**	**2.50**

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, 2017.

Grouping	Species	Index	Number of Trees Sampled
Hickories	MH, PH, SH, GH[1]	3.20	118
Beech	Beech	5.69	35
Red Oaks	Black Oak	4.70	31
	Northern Red Oak	4.52	378
	Scarlet Oak	4.19	166
White Oaks	Chestnut Oak	1.69	258
	White Oak	2.63	221

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

[1]MH,SH, PH, GH: Mockernut Hickory, Pignut Hickory, Shagbark Hickory

Table 3. Hard Mast Survey Results by Area, 2017.

County	Area	White Oak	Red Oak	All Oaks
Transylvania	Avery Creek[1]	N/A	N/A	N/A
Haywood	Cold Mountain	0.4	3.3	1.90
Avery & Caldwell	Edgemont	0.9	4.2	2.60
Clay	Fires Creek	2.9	5.7	4.20
Haywood	Harmon Den	1.5	2.7	2.10
Burke & McDowell	Linville Mtn.	1.0	3.3	2.00
Macon	Nantahala	6.0	6.3	6.30
Mitchell	Poplar	5.0	4.9	5.00
Graham	Santeetlah	2.7	5.0	3.90
Haywood	Sherwood	2.4	4.3	3.80
Burke	South Mountains	2.4	3.1	2.70
Macon	Standing Indian	2.1	5.1	3.90

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

[1] Survey of the Avery Creek route was not conducted in 2017

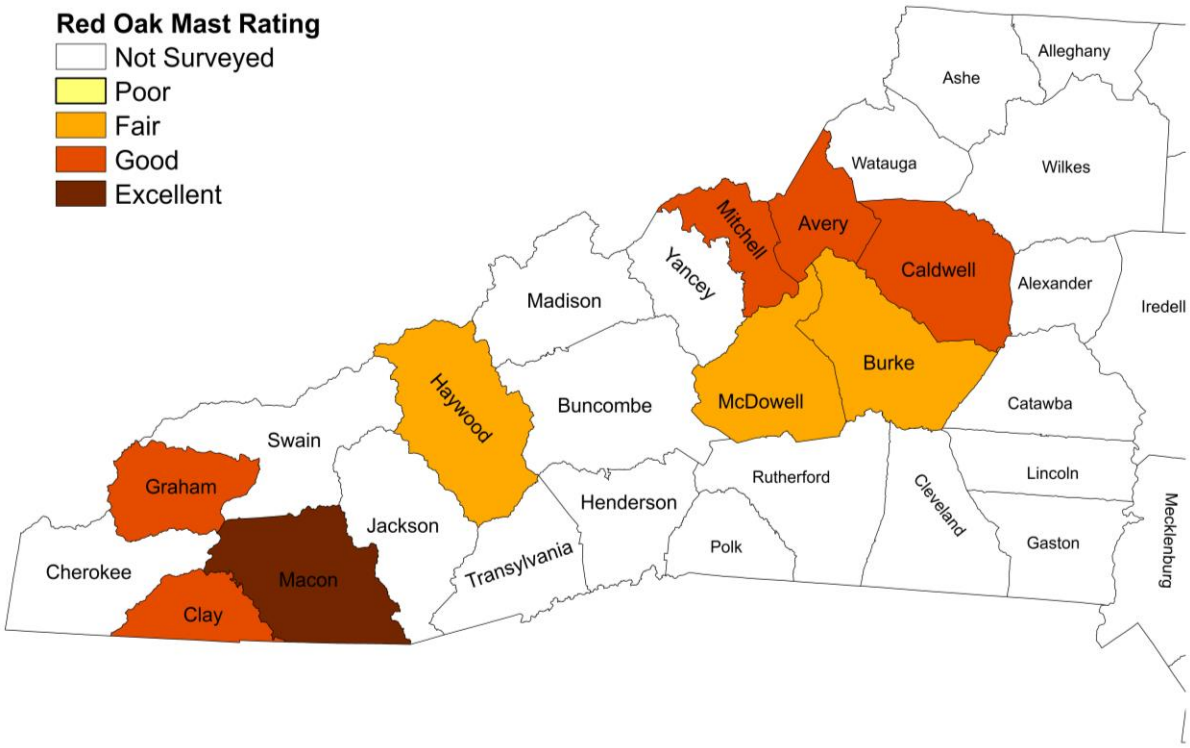

Figure 1. Red Oak Index by County in western North Carolina, 2017.

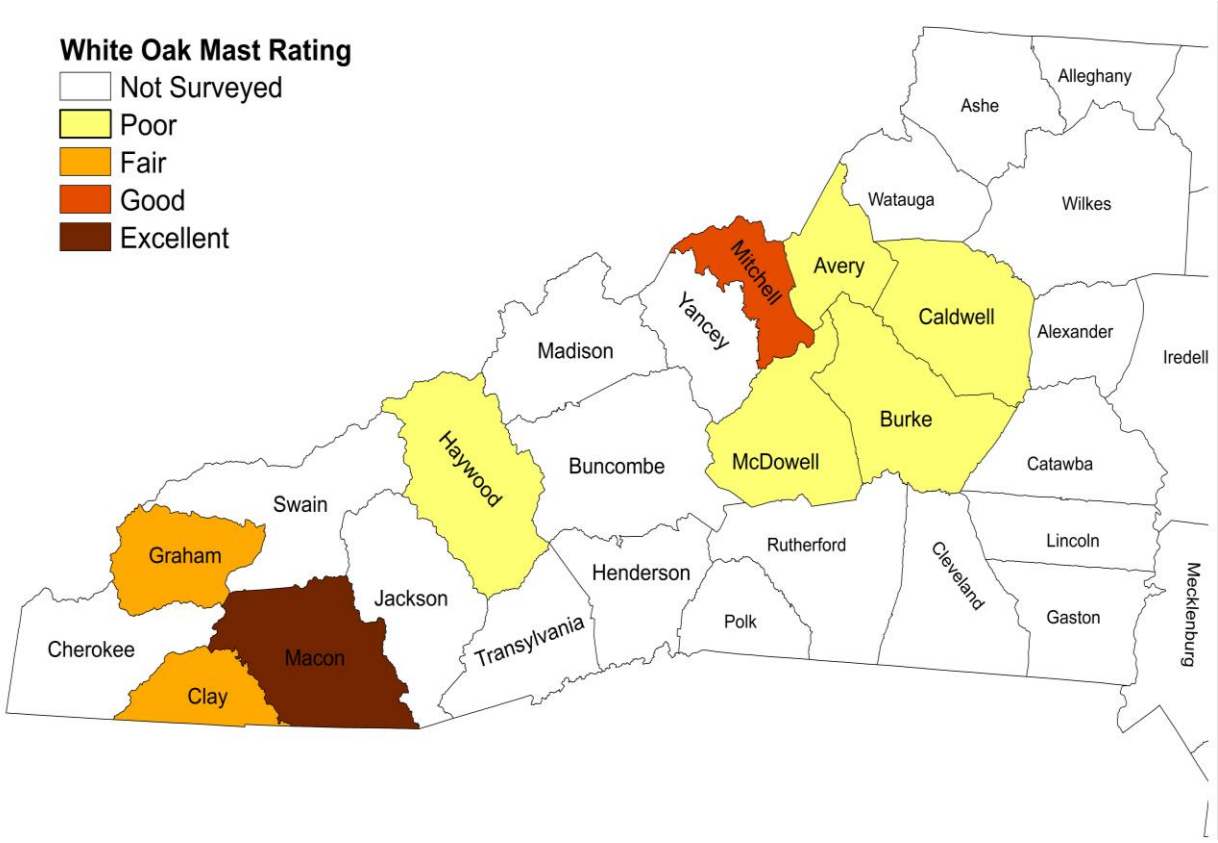

Figure 2. White Oak Index by County in western North Carolina, 2017.

Table 4. Hard Mast Survey Results by Elevation, 2017.

Elevation (ft.)	Red Oak	White Oak
<1900	1.15	2.34
2000-2900	4.70	2.30
3000-3900	5.23	1.93
4000-4900	3.69	2.17
5000+	1.93	1.36

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, 1993-2017[1].

Year	Blueberry	Huckleberry	Blackberry	Pokeberry
1993	3.24	3.56	3.81	2.44
1994	3.17	3.54	3.53	1.44
1995	1.92	2.46	3.12	1.20
1996	2.02	1.97	3.39	1.51
1997	2.84	2.95	3.78	1.96
1998	1.73	1.09	3.00	2.10
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
2015	2.14	1.38	3.97	2.28
2017	1.64	1.15	2.74	1.04
Average	**2.18**	**2.10**	**3.34**	**1.56**

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

Table 6. Mountain Summer Soft Mast Survey Results by Area, 2017.

Area	Blueberry	Huckleberry	Blackberry	Pokeberry
Daniel Boone	0.75	0.25	1.25	0.25
Fires Creek/Santeetlah	1.20	1.00	1.60	1.40
Flattop	0.00	0.00	6.00	0.00
Harmon Den Area	3.33	3.33	1.00	1.00
Mt. Mitchell	1.33	0.67	2.00	0.33
Pisgah Area	1.80	1.00	2.00	0.40
Rich Mountain	1.50	1.00	3.00	1.00
Standing Indian	0.00	0.43	0.29	0.00
T. Chatham	2.25	1.75	1.75	0.75
Cheoah	1.00	1.00	1.00	1.50
South Mountains	4.00	2.00	4.00	1.00
Highlands	0.00	0.00	0.00	0.00
Gorges State Park	6.00	3.00	4.00	2.00
Lake James State Park	1.00	1.00	1.00	1.00
Sandy Mush	1.00	2.00	9.00	6.00
Green River	1.00	0.00	6.00	0.00
Average	**1.64**	**1.15**	**2.74**	**1.04**

NA[1]=No summer soft mast data provided for this route.

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 9.0 = Excellent

Table 7. Results of Mountain Fall Soft Mast Surveys, 1993-2017.

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
2014	2.55	3.91	4.55	2.18
2015	2.17	2.09	2.23	1.82
2016	3.00	3.27	2.75	1.92
2017	2.73	1.82	2.45	1.18
Average	**2.60**	**2.67**	**2.99**	**1.54**

Numerical Rating = Crop Quality

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4.1 to 6.0 = Good 6.1 to 8.0 = Excellent

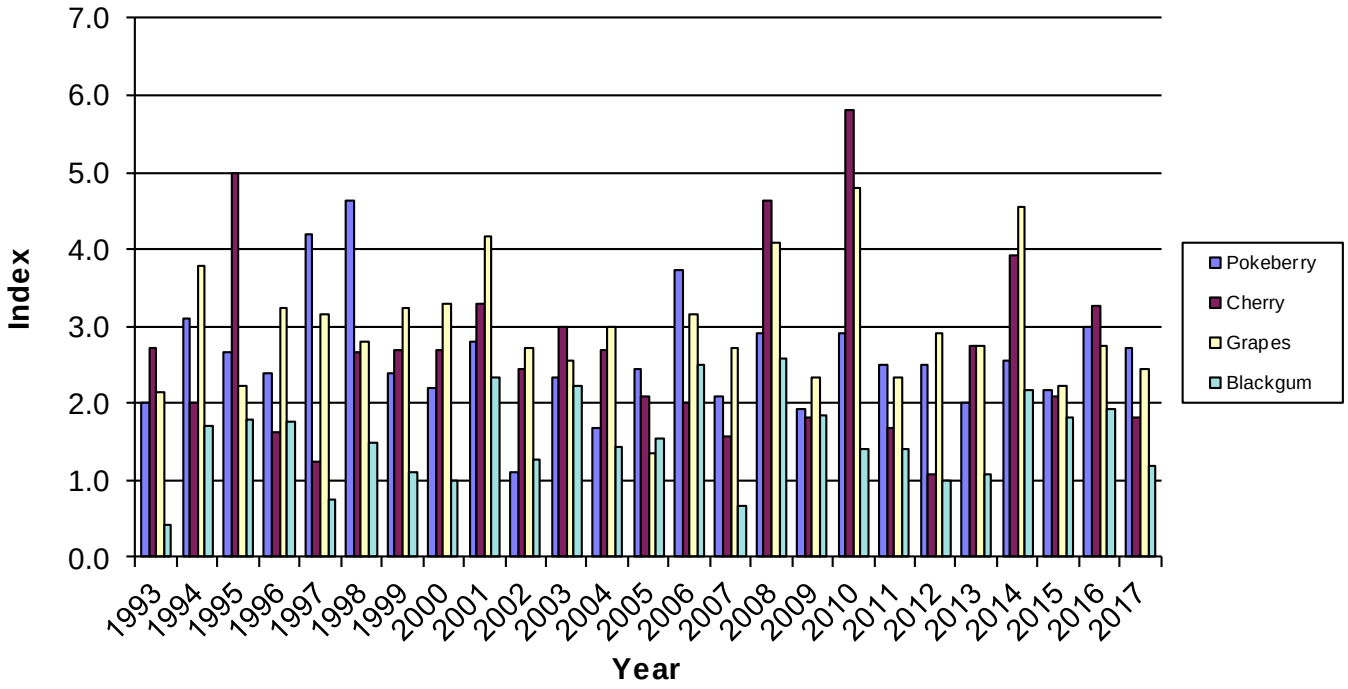

Figure 3. Results of Mountain Fall Soft Mast Surveys by species, 1993-2017.

Table 8. Local Results of Mountain Fall Soft Mast Surveys, 2017.

County	Area	Pokeberry	Cherry	Grapes	Blackgum
Transylvania	Avery Creek	--	--	--	--
Haywood	Cold Mountain	0	1	1	1
Avery & Caldwell	Edgemont	2	0	2	2
Clay	Fires Creek	2	3	6	1
Haywood	Harmon Den	2	2	2	1
Burke & McDowell	Linville Mtn.	4	1	2	3
Macon	Nantahala	4	0	2	0
Mitchell	Poplar	2	2	2	0
Graham	Santeetlah	4	1	4	0
Haywood	Sherwood	0	6	4	1
Burke	South Mountains	6	2	1	4
Macon	Standing Indian	4	2	1	0
	Average:	**2.73**	**1.82**	**2.45**	**1.18**

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

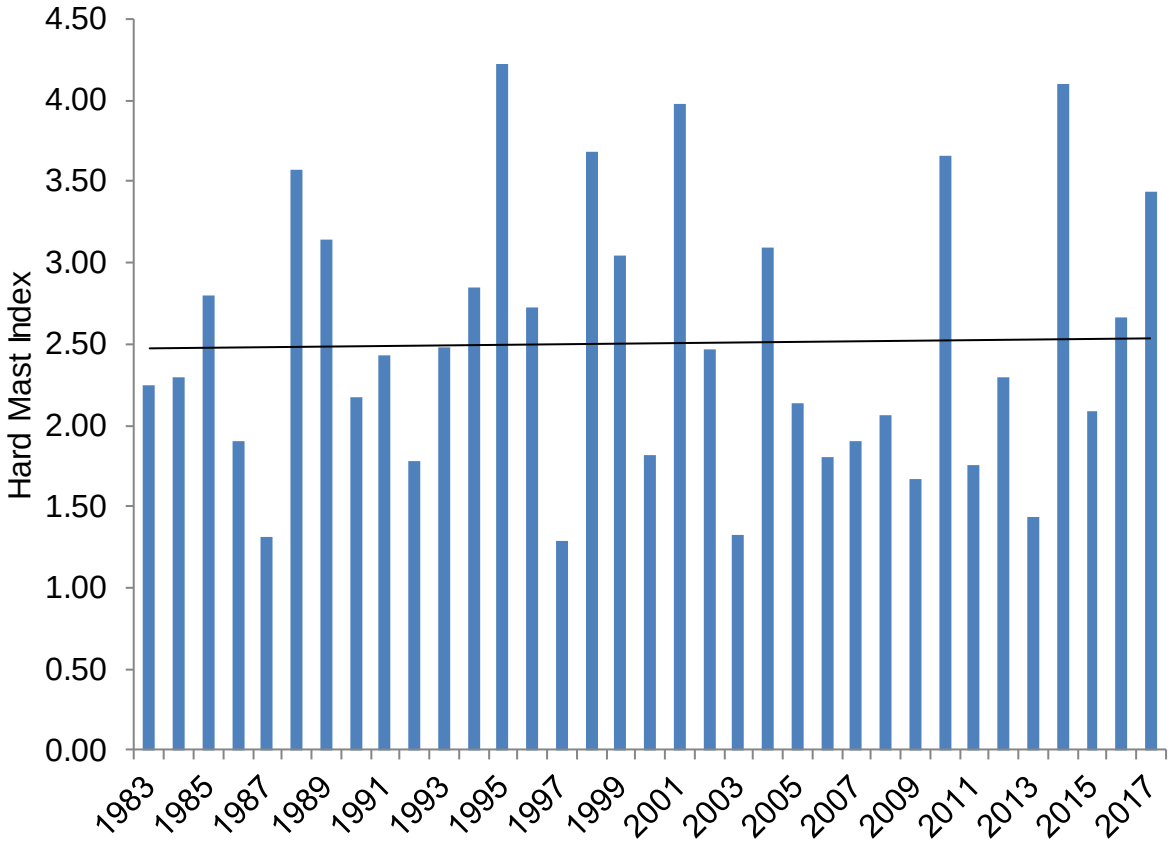

Figure 4. Annual hard mast index in western North Carolina, 1983 through 2017.