WESTERN NORTH CAROLINA HARD AND SOFT MAST SURVEY REPORT 40th Year

FALL 2022

North Carolina Wildlife Resources Commission

Compiled and written by:
Colleen Olfenbuttel
Black Bear and Furbearer Biologist
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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 Bear Management Unit (MBMU) 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 2022 hard mast survey was conducted by WRC Land and Water Access staff, WRC Wildlife Management Division Operations staff, South Mountains State Park staff, and Carl Sandberg Home National Historic Site staff on 13 routes in western North Carolina. A total of 1,427 trees were sampled including 566 from the white oak group, 683 from the red oak group, 140 hickories, 31 beeches, and 3 walnuts. Of these, 18 trees were reported dead. Combining all groups of species, mast abundance was rated as poor, with an overall index of 1.93, which is a decrease from last year's mast crop index (2.55; Table 1). Since 1983, North Carolina has experienced 13 years out of 40 years in which the hard mast index was rated as poor. Including only the oak species, mast production rated as poor (1.82; Table 1).

White oak production rated as poor (1.16) and below both the long-term average (1.85) and last year's index (2.58; Table 1). When the white oak group is separated by species, chestnut oak (0.58) and white oak (1.77) production both rated as poor (Table 2). Red oak production rated as fair (2.37) and below the long-term average (2.82) and last year's index (2.38; Table 1) for the species. Separated by species, black oak (1.55) was poor, while northern red oak (2.50), and scarlet oak (2.23) rated as fair (Table 2). Hickory production rated as fair (2.32) and below the long-term average (2.38) for the species (Table 1). Beech production (4.81) was good and above the long-term average (4.09; 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). Unlike 2021 when there was much variation in white oak production by route, white oak productivity was universally poor during 2022 (Figure 1). White oak productivity rated as poor on 12 of 13 routes (Table 3; Figure 1). Only the Fires Creek route in Clay County had fair productivity (Table 3).

Red oak productivity varied a bit more than white oak productivity. Red oak productivity rated as poor on nine routes, rated as fair on two routes, and rated as good on two routes (Table 3). At the county level, 2 counties had good red oak productivity, one county had fair productivity, and seven counties experienced poor red oak productivity (Figure 2). Counties further west had better red oak productivity than counties in the eastern portion of the survey area.

Red oak productivity increased as elevation increased with fair productivity above 3,000 feet (Table 4). White oak productivity was poor across all elevations, though poorest above 5,000 feet (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 has remained consistent throughout this period including the current year. Summer soft mast surveys are 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 SBSS every other year. Because of the new schedule, the summer soft mast survey is conducted in odd years. The previous summer soft mast survey was conducted in 2019 (Table 5 and 6) and the next survey was conducted during the summer of 2021.

During the summer of 2021, 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. These are similar results to the 2017 and 2019 summer soft mast survey. 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 2022 fall soft mast survey is conducted in conjunction with the hard mast survey. Pokeberry and grapes were above long-term averages, but below productivity observed in 2021 (Table 7; Figure 3). Cherry and black gum were below long-term averages and also below productivity observed in 2021 (Table 7). Black gum productivity rated as poor, while pokeberry, cherry, and grapes rated as fair (Table 7 and 8). As observed in previous years, local areas experienced variable production of fall soft mast depending on species and area (Table 8). Although not recorded during the soft mast survey, some staff reported a good apple crop, especially at higher elevations, as well as a bumper crop of yellow jackets. The author also noted a high abundance of yellow jackets in several areas of the Mountain BMU during summer and fall 2022.

Conclusion

This season’s hard mast crop was the thirteenth year since 1983 in which the overall hard mast index was poor. The 2022 fall hard mast index was lower than in 2019 through 2021, and below long-term averages (Table 1). There is a weak correlation of red oak productivity declining as one moves from western to eastern counties within the Mountain BMU, with eastern counties all experiencing poor oak productivity (Figures 2). Conversely, the two far western

counties experienced good red oak productivity (Figures 2). There was also a slight increase in red oak productivity as elevation increased (Table 4). No regional or elevational pattern was found with white oak productivity (Figure 1, Table 4). It should be noted that the Mountain BMU, and most of North Carolina, experienced a very dry and hot year during 2022. Several Commission staff noted that while initially it appeared that the Mountain BMU would experience a robust summer and fall soft mast, that by August, many berries had dried up on the shrubs, lending to the poor productivity noted during our annual fall soft mast survey. The exception during the summer was Clay County, which was one of the wettest counties; this may have contributed to oak productivity being higher here than in other counties (Figures 1 and 2). Another exception that deserves mention is an area where the Commission does not have mast routes; Commission staff reported heavy white oak productivity on Sandy Mush Game Land (Buncombe and Madison counties). The stark difference in white oak productivity between Sandy Mush and the other areas surveyed may be due to habitat management that occurs on this game land.

Comparing our results with near-by states and regions, the Great Smokey Mountains National Park and Cherokee National Forest in Tennessee, anecdotally reported that white oak appeared good this year, but patchy. Georgia reported that white and red oak productivity were poor (1.59 and 1.38, respectively) and below oak productivity from 2021. South Carolina reported fair red oak (3.9) and white oak (2.9) productivity, but still below 2021 productivity. Both Georgia and South Carolina suspected that the hot and dry year could have impacted productivity. While mast surveys are not conducted outside the Mountain BMU, anecdotally, hard mast productivity in the Piedmont region appeared to be fair, but lower than the "bumper" crop reported in some Piedmont areas in 2020. The overall trend in hard mast production shows a very slight declining trend since surveys were initiated in 1983 (Figure 4). The 2022 fall soft mast results were fair to poor, depending on species, and productivity was lower than observed in 2021 for all four soft mast species (Table 7; Figure 3).

This report and previous annual mast reports (2003 to present) can be found at: http://www.ncwildlife.org/bear and click on "Surveys and Reports" tab, then the "Hard and Soft Mast Surveys" link.

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, 1983-2022.

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
2018	0.94	2.14	1.61	1.58	1.11	1.58
2019	1.97	2.84	2.45	3.35	5.54	2.63
2020	1.42	3.23	2.43	2.26	4.67	2.47
2021	2.58	2.38	2.47	3.21	2.63	2.55
2022	1.16	2.37	1.82	2.32	4.81	1.93
Average	**1.87**	**2.83**	**2.33**	**2.38**	**4.07**	**2.48**

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, 2022.

Grouping	Species	Index	Number of Trees Sampled
Hickories	MH, PH, SH, GH[1]	2.32	140
Beech	Beech	4.81	31
Red Oaks	Black Oak	1.55	32
	Northern Red Oak	2.50	475
	Scarlet Oak	2.23	173
White Oaks	Chestnut Oak	0.58	296
	White Oak	1.77	270

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, 2022.

County	Area	White Oak	Red Oak	All Oaks
Transylvania	Avery Creek	0.7	0.8	0.7
Henderson	Carl Sandberg	0.7	0.4	0.7
Haywood	Cold Mountain	0.6	1.4	1.1
Avery & Caldwell	Edgemont	0.6	1.8	1.2
Clay	Fires Creek	2.4	5.5	3.9
Haywood	Harmon Den	0.9	1.6	1.3
Burke & McDowell	Linville Mtn.	1.3	0.6	1.0
Macon	Nantahala	0.4	1.4	1.0
Mitchell	Poplar	1.0	2.8	2.2
Graham	Santeetlah	1.4	5.0	3.4
Haywood	Sherwood	0.4	1.6	1.3
Burke	South Mountains	2.0	1.2	1.7
Macon	Standing Indian	0.6	2.5	1.7

Numerical Rating = Crop Quality

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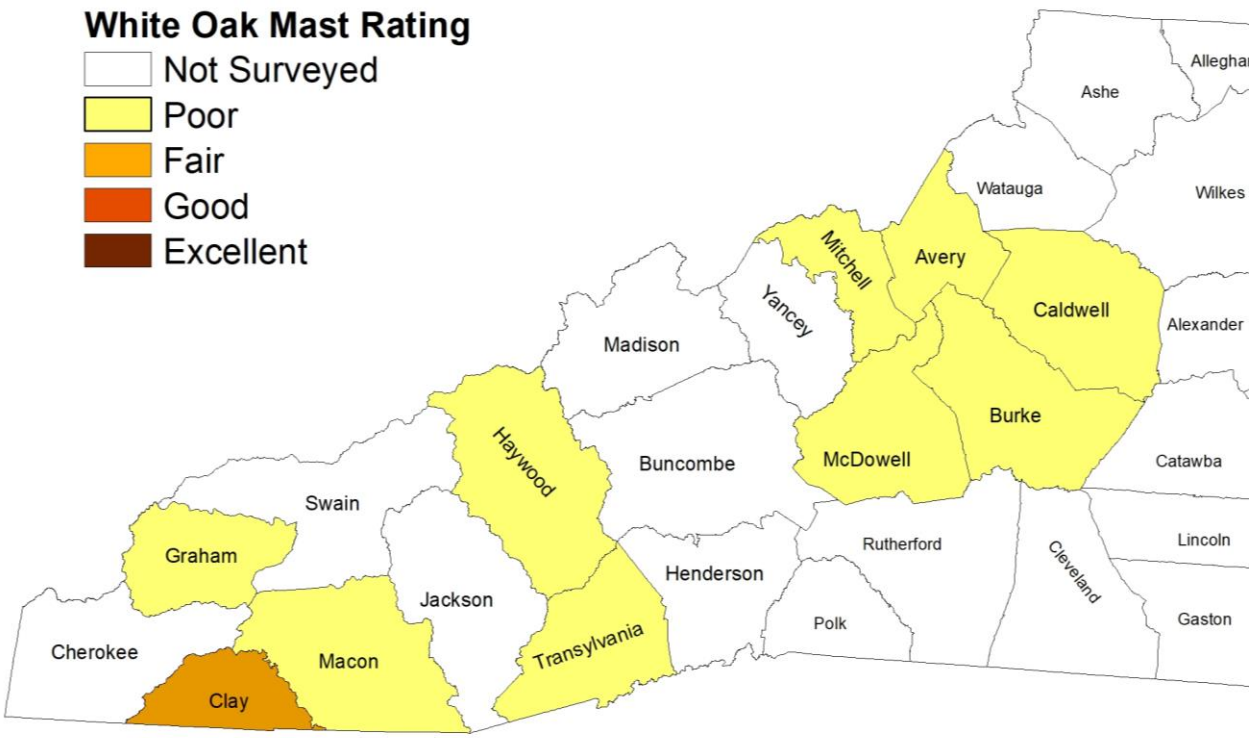

Figure 1. White Oak Index by County in western North Carolina, 2022.

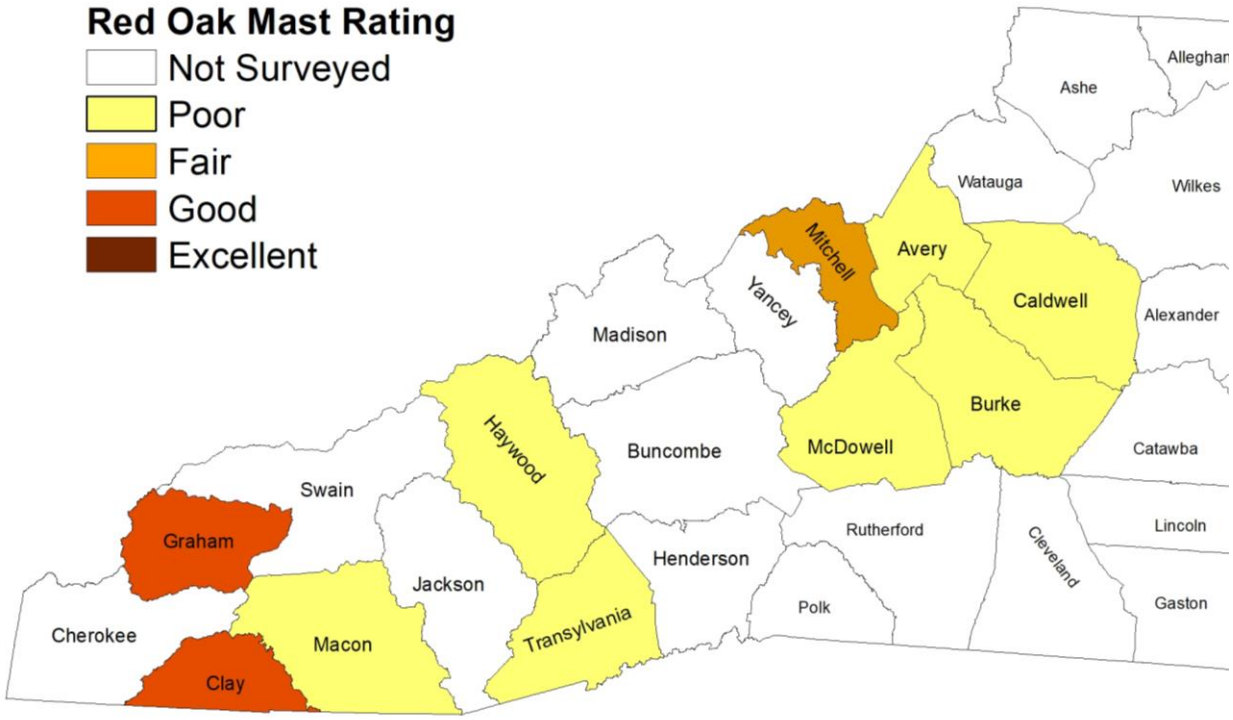

Figure 2. Red Oak Index by County in western North Carolina, 2022.

Table 4. Hard Mast Survey Results by Elevation, 2022.

Elevation (ft.)	Red Oak	White Oak
<1900	1.9	1.4
2000-2900	1.9	1.2
3000-3900	2.5	1.0
4000-4900	2.7	1.7
5000+	3.1	0.4

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, 1993-2021[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
2019	1.65	1.60	3.47	1.20
2021	1.08	0.72	2.82	1.68
Average	**2.10**	**2.01**	**3.32**	**1.55**

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

Table 6. Mountain Summer Soft Mast Survey Results by Area, 2021.

Area	Blueberry	Huckleberry	Blackberry	Pokeberry
Daniel Boone	1.50	0.00	2.00	1.25
Fires Creek/Santeetlah	1.60	1.00	1.60	1.60
Flattop	0.00	0.00	6.00	2.00
Harmon Den Area	3.67	2.00	1.33	0.67
Mt. Mitchell	1.33	0.67	3.33	0.67
Pisgah Area	1.60	0.60	1.60	0.40
Rich Mountain	2.00	0.50	0.50	0.00
Standing Indian	0.00	0.75	0.25	0.00
T. Chatham	1.50	1.00	1.00	0.75
Cheoah	1.00	1.00	1.50	1.50
South Mountains	0.00	0.00	1.00	0.00
Highlands	0.00	0.00	4.00	2.00
Gorges State Park	1.00	2.00	2.00	2.00
Johns River	0.00	0.00	4.00	4.00
Sandy Mush	2.00	2.00	9.00	6.00
Green River	0.00	0.00	6.00	4.00
Average	**1.08**	**0.72**	**2.82**	**1.68**

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, 1993-2022.

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
2018	1.83	1.58	3.00	1.17
2019	2.08	1.69	2.15	1.85
2020	1.83	2.00	2.25	1.50
2021	3.09	4.08	3.92	2.75
2022	2.70	2.50	3.60	1.20
Average	**2.55**	**2.62**	**2.99**	**1.56**

Numerical Rating = Crop Quality

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4.1 to 6.0 = Good 6.1 to 8.0 = Excellent

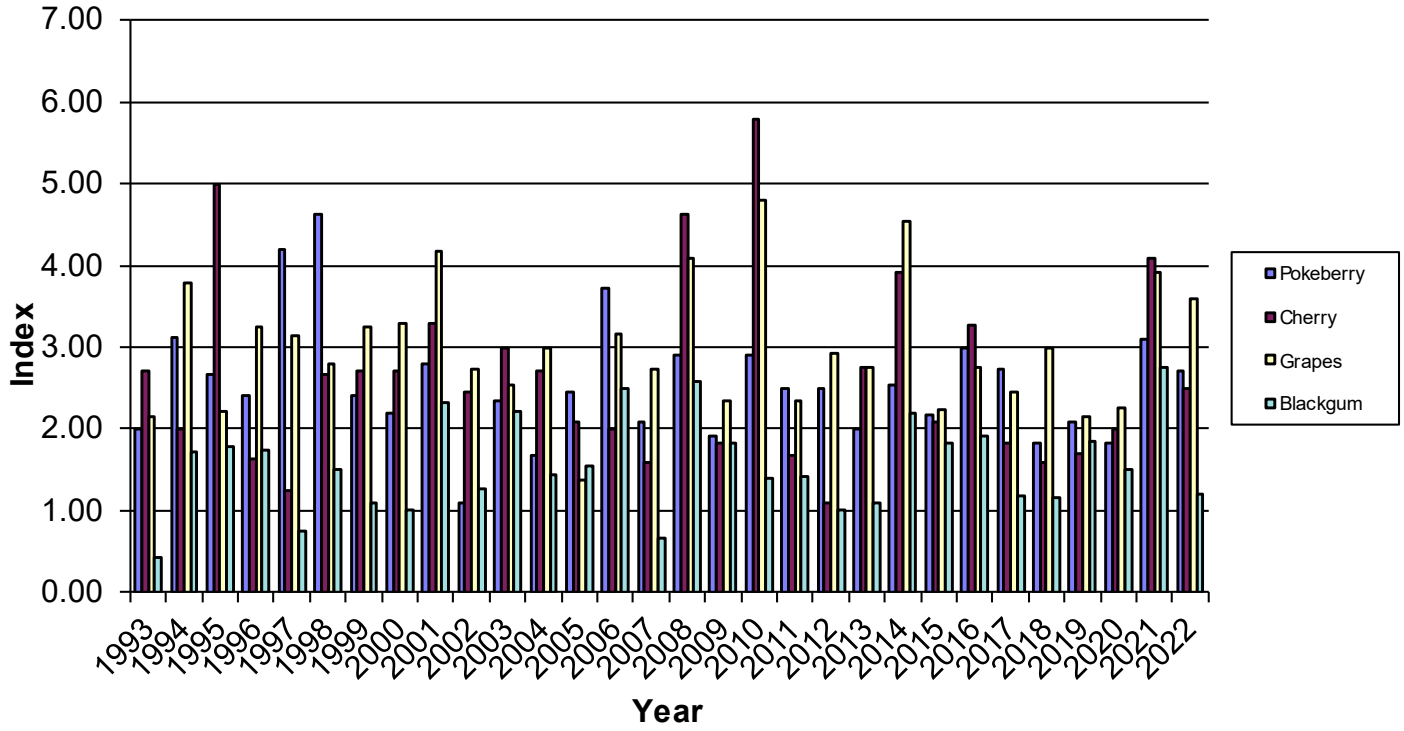

Figure 3. Results of Mountain Fall Soft Mast Surveys by species, 1993-2022.

Table 8. Local Results of Mountain Fall Soft Mast Surveys, 2022.

County	Area	Pokeberry	Cherry	Grapes	Blackgum
Transylvania	Avery Creek	2	4	4	4
Henderson	Carl Sandburg	n/a	n/a	n/a	n/a
Haywood	Cold Mountain	n/a	n/a	n/a	n/a
Avery & Caldwell	Edgemont	2	0	4	2
Clay	Fires Creek	1	6	9	1
Haywood	Harmon Den	4	2	2	1
Burke & McDowell	Linville Mtn.	1	1	4	3
Macon	Nantahala	9	2	2	0
Mitchell	Poplar	2	0	4	0
Graham	Santeetlah	0	4	4	0
Haywood	Sherwood	0	4	1	1
Burke	South Mountains	n/a	n/a	n/a	n/a
Macon	Standing Indian	6	2	2	0
	Average:	**2.70**	**2.50**	**3.60**	**1.20**

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

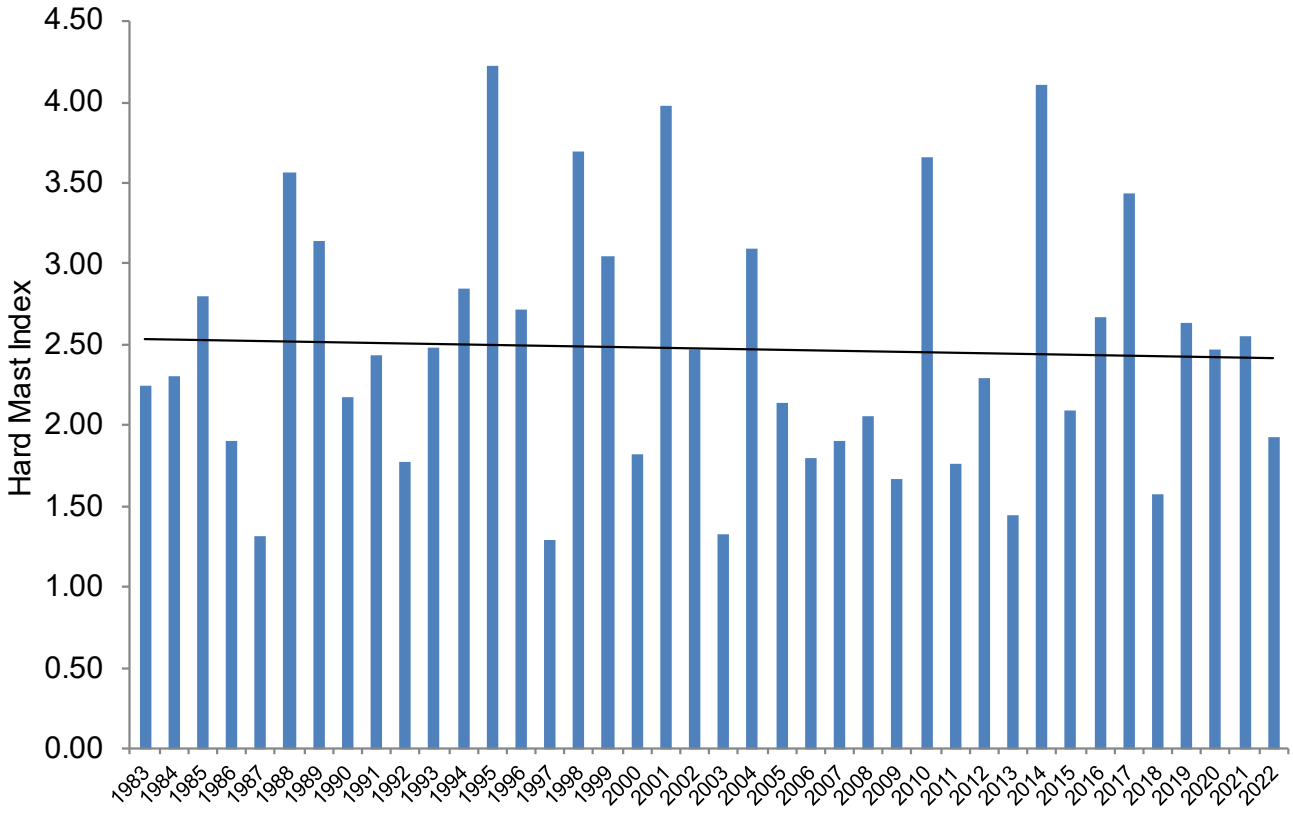

Figure 4. Annual hard mast index in western North Carolina, 1983 through 2022.