# WESTERN NORTH CAROLINA HARD AND SOFT MAST SURVEY REPORT 30th Year

# FALL 2012

**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 2012 hard mast survey was conducted by WRC Game Lands and Private Lands staff on 12 routes in western North Carolina. A total of 1,381 trees were sampled including 553 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 fair, with an overall index of 2.29 (Table 1), which is an improvement from last year's poor mast crop. Since 1983, North Carolina has experienced nineteen years in which the hard mast index was rated as fair.

For the second year in a row, white oak production rated as poor (1.87; Table 1), but was slightly above the long-term average of 1.83. White oak production has been rated as poor in eighteen of thirty years of this survey. When the white oak group is separated by species, chestnut oak rated as poor (1.74; Table 2), while white oak production rated as fair (2.03; Table 2). Red oak production was in the fair range (2.68; Table 1), but below the long-term average (2.82) for the species. Red oak production has been fair in twenty-one of thirty years Separated by species, black oak, northern red oak, and scarlet oak all rated as fair at 2.71, 2.89, and 2.13 respectively (Table 2). Hickory production rated as fair (2.01) and below the long-term average (2.32) for the species (Table 1). Beech production (3.14) was fair, which was a decline from last year's production rating and below the long-term average (4.12; 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). Two areas surveyed had red oak productivity rated as good, five areas rated as fair, while the remaining five areas rated as poor (Table 3). The Fires Creek route (Clay County) route and the Santeetlah route (Graham County) had the highest red oak index, while Sherwood route (Haywood County) had the lowest red oak index (Table 3). White oak production in seven of twelve survey areas was rated as poor and only one area rated as having good white oak

production (Table 3; Figure 2). The Santeetlah route (Graham County) had the highest white oak index, while both the Cold Mountain route (Haywood County) and Sherwood route (Haywood County) had the lowest white oak index (Table 3) Red oak productivity was better in the mid- to upper elevations than in the lower and extreme high elevations, with productivity rated as fair between 2,000 and 4,900 feet (Table 4). White oak productivity was fair in the lower elevations and poor above 3,000 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 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 will be conducted during the summer of 2013.

Last summer's soft mast were below all overall averages (Table 5). Blueberry, huckleberry and pokeberry produced poor crops, while blackberry production was fair (3.28). 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 2012 fall soft mast survey is conducted in conjunction with the hard mast survey. Overall, soft mast production was poor and lower than 2011 and pokeberry, blackgum, cherry and grapes were below long-term averages (Table 7). Grapes were fair and had the highest index (2.92) followed by pokeberry (fair; 2.50), cherry (poor; 1.08) and blackgum (1.0, 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 nineteenth year since 1983 in which the overall hard mast index was fair. Fall hard mast productivity in 2012 was improved from the poor hard mast crop that occurred in 2011. This year, white oak production was poor, while red oak, hickory and beech production were fair. Surrounding states have reported that overall white and red oak productivity were improved from 2011 conditions. South Carolina reported good hard mast production in the lower elevations, but poor hard mast production in the mid- to upper elevations. Virginia and Cherokee National Forest both reported good hard mast productivity. Weather conditions were more favorable in 2012 than in 2011, which may have influenced this year's mast abundance. While a late frost did occur in 2012, it was of short duration, which may explain why there was poor mast productivity in the upper elevations, yet fair productivity in the mid-elevations. Reports from orchard owners indicate this late frost did negatively impact apple production.

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.

Whitehead, C.J. 1969. Oak mast yields on wildlife management areas in Tennessee. Tennessee Game and Fish Commission, Nashville, USA.

Table 1. Hard Mast Survey Results for Western North Carolina, 1983-2012.

| 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 |
| **Average** | **1.83** | **2.82** | **2.09** | **2.32** | **4.12** | **2.46** |

| 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, 2012.

| Grouping | Species | Index | Number of Trees Sampled |
|---|---|---|---|
| Hickories | MH, SH, PH, GH[1] | 2.01 | 138 |
| Beech | Beech | 3.14 | 37 |
| Red Oaks | Black Oak | 2.71 | 30 |
| | Northern Red Oak | 2.89 | 437 |
| | Scarlet Oak | 2.13 | 180 |
| White Oaks | Chestnut Oak | 1.74 | 303 |
| | White Oak | 2.03 | 250 |

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, Shellbark Hickory, Pignut Hickory, Shagbark Hickory

Table 3. Hard Mast Survey Results by Area, 2012.

| County | Area | White Oak | Red Oak | All Oaks |
|---|---|---|---|---|
| Transylvania | Avery Creek | 0.75 | 2.44 | 1.66 |
| Haywood | Cold Mountain | 0.38 | 3.29 | 1.90 |
| Avery & Caldwell | Edgemont | 0.85 | 2.37 | 1.64 |
| Clay | Fires Creek | 1.41 | 4.45 | 2.84 |
| Haywood | Harmon Den | 0.52 | 1.84 | 1.21 |
| Burke & McDowell | Linville Mtn. | 3.00 | 1.50 | 2.36 |
| Macon | Nantahala | 2.87 | 3.86 | 3.54 |
| Mitchell | Poplar | 2.15 | 1.98 | 2.03 |
| Graham | Santeetlah | 4.12 | 4.86 | 4.56 |
| Haywood | Sherwood | 0.38 | 0.97 | 0.79 |
| Burke | South Mountains | 3.48 | 1.05 | 2.40 |
| Macon | Standing Indian | 1.83 | 2.92 | 2.47 |

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

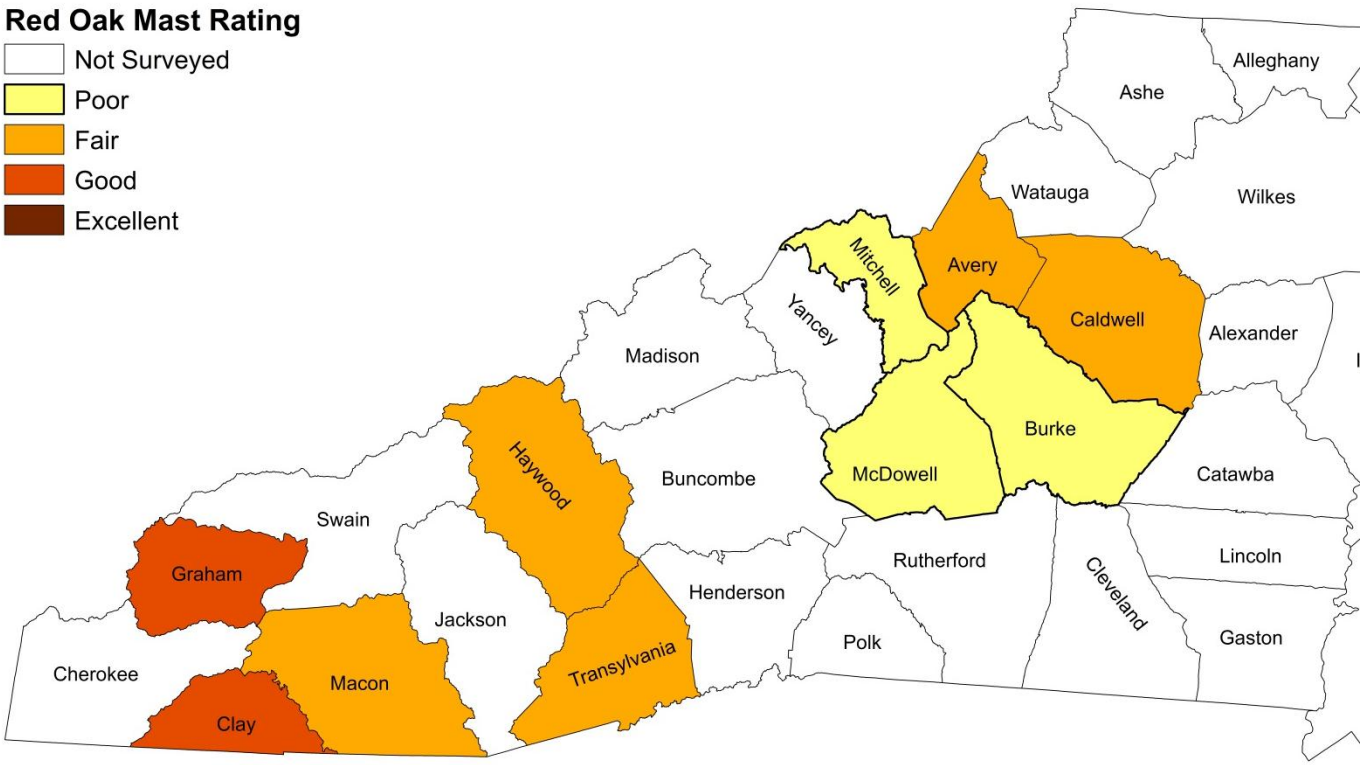


Figure 1. Red Oak Index by County in western North Carolina, 2012.

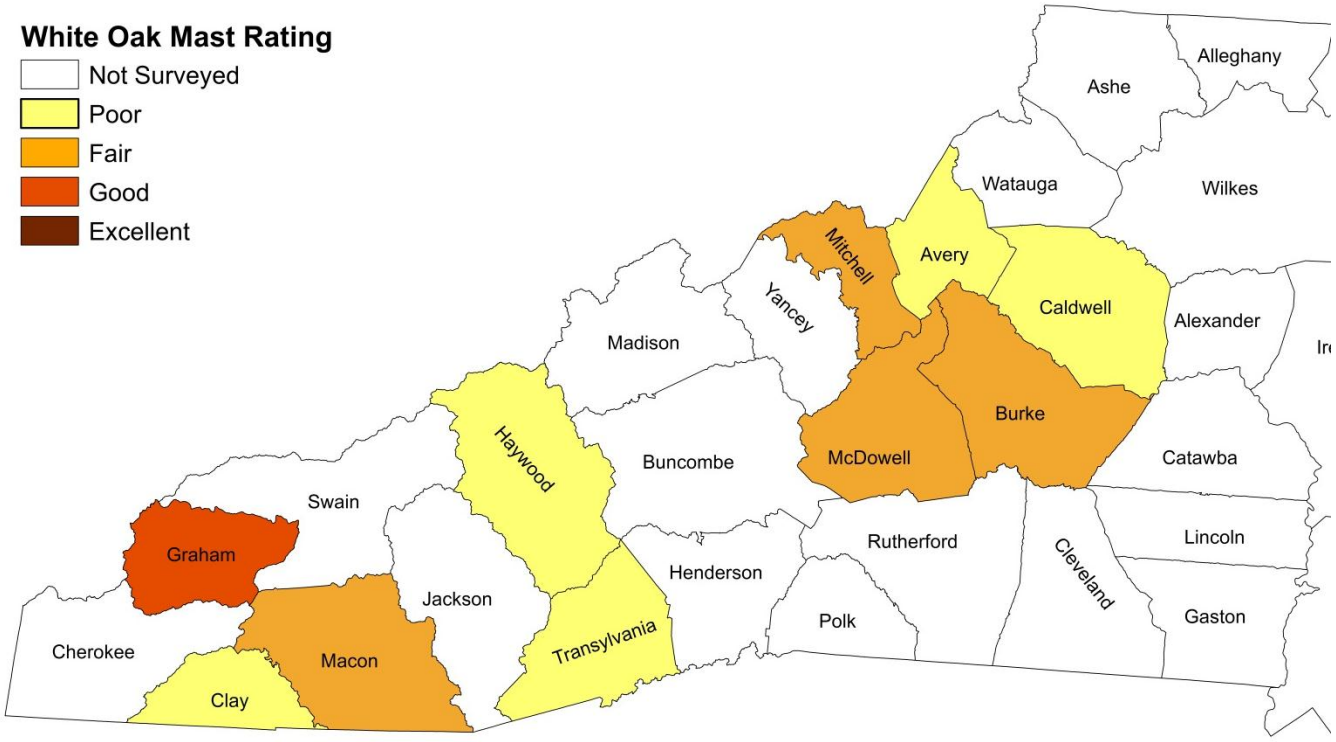


Figure 2. White Oak Index by County in western North Carolina, 2012.

Table 4. Hard Mast Survey Results by Elevation, 2012.

| Elevation (ft.) | Red Oak | White Oak |
|---|---|---|
| <1900 | 1.77 | 2.90 |
| 2000-2900 | 2.47 | 2.62 |
| 3000-3900 | 2.46 | 1.07 |
| 4000-4900 | 3.86 | 1.62 |
| 5000+ | 1.04 | 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, 1993-2011[1].

| 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 |
| **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, 2011.

| Area | Blueberry | Huckleberry | Blackberry | Pokeberry |
|---|---|---|---|---|
| Daniel Boone | 0.75 | 1.00 | 1.50 | 0.25 |
| Fires Creek/Santeetlah | 1.20 | 1.80 | 2.20 | 1.80 |
| Flattop | 0.00 | 0.00 | 3.00 | 1.00 |
| Harmon Den Area | 0.33 | 0.00 | 3.33 | 1.33 |
| Mt. Mitchell | 1.00 | 1.00 | 3.75 | 0.00 |
| Pisgah Area | 2.00 | 1.60 | 1.67 | 0.33 |
| Rich Mountain | 0.00 | 0.00 | 2.00 | 2.00 |
| Standing Indian | 0.00 | 0.57 | 3.17 | 0.40 |
| T. Chatham | 3.33 | 2.00 | 0.33 | 0.00 |
| Cheoah | 1.00 | 1.00 | 3.00 | 1.50 |
| South Mountains | 2.00 | 1.00 | 6.00 | 6.00 |
| Highlands | 2.00 | 1.50 | 3.00 | 1.50 |
| Gorges State Park | 9.00 | 9.00 | 9.00 | 2.00 |
| Lake James State Park | 1.00 | 1.00 | 4.00 | 1.00 |
| **Average** | **2.08** | **2.06** | **2.78** | **1.09** |

| 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, 1993-2012.

| 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 |
| **Average** | **2.62** | **2.64** | **3.00** | **1.51** |

| 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, 2012.

| County | Area | Pokeberry | Cherry | Grapes | Blackgum |
|---|---|---|---|---|---|
| Transylvania | Avery Creek | 2 | 0 | 4 | 0 |
| Haywood | Cold Mountain | 4 | 3 | 2 | 2 |
| Avery & Caldwell | Edgemont | 4 | 0 | 2 | 0 |
| Clay | Fires Creek | 2 | 6 | 6 | 1 |
| Haywood | Harmon Den | 2 | 0 | 6 | 1 |
| Burke & McDowell | Linville Mtn. | 4 | 2 | 1 | 6 |
| Macon | Nantahala | 0 | 0 | 0 | 0 |
| Mitchell | Poplar | 2 | 2 | 4 | 1 |
| Graham | Santeetlah | 2 | 0 | 0 | 1 |
| Haywood | Sherwood | 4 | 0 | 6 | 0 |
| Burke | South Mountains | 4 | 0 | 4 | 0 |
| Macon | Standing Indian | 0 | 0 | 0 | 0 |
| | **Average:** | **2.50** | **1.08** | **2.92** | **1.00** |

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 |