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## Acorn Yield of Gambel Oak in Northern Arizona

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The acorns of Gambel oak (*Quercus gambelii* Nutt.) periodically provide quantities of food for deer, elk, squirrels, turkeys, and other wildlife in the forests of the Southwest. While the species currently has little commercial value for wood products, it is important for wildlife.

Acorn production by Gambel oak was studied cooperatively by the Arizona Game and Fish Department<sup>2</sup> and the Rocky Mountain Forest and Range Experiment Station on the Beaver Creek watersheds<sup>3</sup> in northern Arizona. The results suggest guides for acorn production in this area.

### Methods

From 1958 to 1963, acorn production was sampled annually. The sampling areas were approximately 30 miles south-southeast of

Flagstaff in the ponderosa pine type, on relatively uniform sites between 6,500 and 7,000 feet elevation. A total of 94 trees was selected within a radius of 3 miles, to represent the existing range of diameter classes (2 to 20 inches d.b.h.). Five vigor classes, based on ocular estimate of percent of live crown, were arbitrarily recognized in the field: A, 80-100; B, 60-79; C, 40-59; D, 20-39; and E, 0-19. When mean acorn yield for the 6-year period was analyzed, however, there were only three apparently different vigor classes among the original five crown-vigor categories: I, at least 80 percent of the crown alive; II, 40-79 percent live crown; and III, less than 40 percent live crown (tables 1).

Data taken on each tree included diameter, crown area (length times width), percent of live crown as an index of vigor, and occurrence of heart rot as determined from increment borings.

Prior to the acorn drop each year, one trap (a square 3.93 sq. ft. in area covered with 1-inch mesh wire) was placed under each of the 94 trees. The traps, supported with a permanent stake, were left in place until all acorns had fallen. The total number of acorns collected in each trap over the 6-year sampling period was considered representative of acorn yield from each tree.

### Results

The 6-year sample included 3 years of heavy production (1958, 1961, and 1963), 2

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<sup>2</sup>Under Federal Aid Project W-78-R; the study was initiated by Robert A. Jantzen who was formerly attached to Project W-78-R and whose efforts are gratefully acknowledged.

<sup>3</sup>A 275,000-acre watershed on the Coconino National Forest where costs and benefits of intensive multiple-use land management are being evaluated as a part of the Arizona Watershed Program.

Table 1. --Distribution of Gambel oak acorn production sample, and derivation of recognized vigor classes from field data

| Original<br>(field)<br>vigor<br>class | Live<br>crown | Trees  | Mean <sup>1</sup><br>acorn<br>yield | Final<br>vigor<br>class | Live<br>crown | Distribution of trees by size class (inches d.b.h.) |    |   |    |    |    |    |    |    |    |       |
|---------------------------------------|---------------|--------|-------------------------------------|-------------------------|---------------|-----------------------------------------------------|----|---|----|----|----|----|----|----|----|-------|
|                                       |               |        |                                     |                         |               | 2                                                   | 4  | 6 | 8  | 10 | 12 | 14 | 16 | 18 | 20 | Total |
|                                       | Percent       | Number | Number                              |                         | Percent       | Number                                              |    |   |    |    |    |    |    |    |    |       |
| A                                     | 80-100        | 37     | 29.9                                | I                       | 80-100        | 11                                                  | 7  | 2 | 5  | 5  | 3  | 2  | 1  | 1  | 0  | 37    |
| B                                     | 60- 79        | 11     | 19.5                                | II                      | 40- 79        | 3                                                   | 4  | 4 | 2  | 2  | 4  | 0  | 1  | 1  | 2  | 23    |
| C                                     | 40- 59        | 12     | 19.2                                |                         |               |                                                     |    |   |    |    |    |    |    |    |    |       |
| D                                     | 20- 39        | 12     | 8.0                                 | III                     | 0- 39         | 5                                                   | 3  | 3 | 4  | 7  | 7  | 2  | 1  | 1  | 1  | 34    |
| E                                     | 0- 20         | 22     | 8.3                                 |                         |               |                                                     |    |   |    |    |    |    |    |    |    |       |
| Total                                 |               | 94     |                                     |                         |               | 19                                                  | 14 | 9 | 11 | 14 | 14 | 4  | 3  | 3  | 3  | 94    |

<sup>1</sup> Mean of 6-year total catch of acorns per trap.

years of low production (1959 and 1962), and 1 year of no production (1960). Acorn yield was related to diameter classes within vigor classes to develop the curves shown in figure 1.

Healthy Gambel oak (vigor class I) attained maximum acorn yield in the range of 12 to 14 inches d.b.h., after which productivity fell rapidly. Maximum yield of trees with 40-70 percent live crown (vigor class II) occurred at 11 to 13 inches d.b.h., but was only equivalent to the yield of more vigorous trees at 6 to 7 inches d.b.h. Maximum yield of trees with less than 40 percent live crown (vigor class III) occurred at 8 to 10 inches d.b.h., but was only equal to the yield of vigor class I and II at 3 to 4 inches d.b.h.

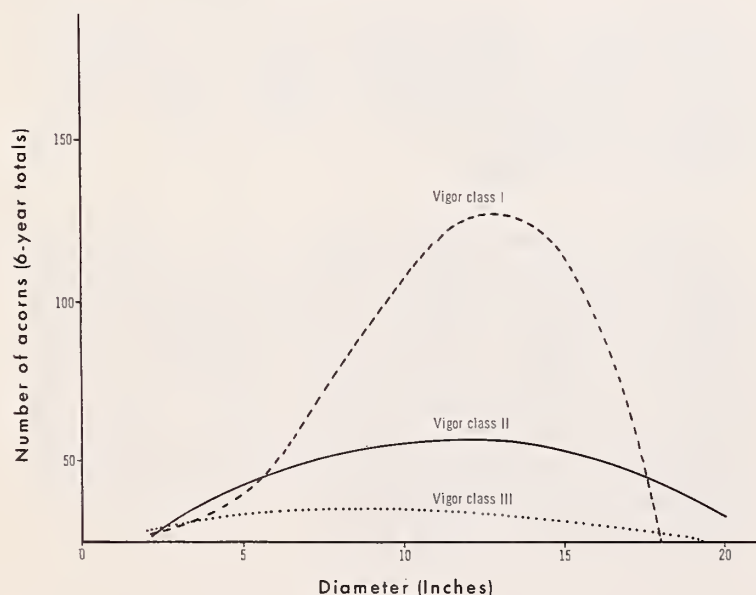


Figure 1.--Gambel oak mast production by vigor class and diameter (based on the average number of acorns caught per trap for a diameter class).

While it might be expected that larger trees in vigor class I would be high producers of acorns, few trees live to large size in a vigorous condition in this area. Perhaps the larger trees in the sample were decadent, although it was not apparent in the condition of the crown.

Heart rot caused by *Polyporus dryophilus* is common in Gambel oak in the Southwest,<sup>4</sup> but no relationship between incidence of heart rot and acorn yield was found in the area where this study was conducted.

### Conclusions

For wildlife benefits, forest management practices should aim at maximum acorn production, but in the interest of timber benefits, unproductive Gambel oak trees should be eliminated.

If removal of Gambel oak is necessary to meet other objectives of forest management, sacrifice trees with less than 80 percent of the crown alive (vigor classes II and III) and trees over 15 inches in diameter regardless of vigor. Save all Gambel oak trees with 80 percent or more of the crown alive (vigor class I) up to 15 inches d.b.h.; smaller diameter classes will provide growing stock to maintain acorn yield.

<sup>4</sup>Hedgcock, G. G., and Long, W. H. Heart-rot in oaks and poplars caused by *Polyporus dryophilus*. Jour. Agr. Res. 3: 65-77. 1914.