A PRELIMINARY REPORT ON THE EFFECT OF MAST ABUNDANCE ON THE WEIGHT AND REPRODUCTION OF DEER IN CENTRAL FLORIDA

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The importance of mast to the diet of deer, in the South, has been recognized as indicated by the following observations:

> "A poor crop of palmetto berries and acorns could cause deer to pass the winter in poor shape so that parasites and disease may become a serious threat. Apparently the nutritive value of both acorns and palmetto berries is high." Strode (1954).
>
> "Reproduction of a deer herd falls off as the quality of nutrition declines. Normal productivity in a well fed herd is about one fawn per doe. Any loss of mast and fruit production on a deer range may be expected to seriously affect its carrying capacity." Lay (1957).
>
> "Evidence on the Ocala National Forest indicates the average legal deer weight would decrease in relation to the acorn crop. Therefore, increased populations and decreased areas suitable for acorn production would tend to lower the average weight of harvested bucks." Tyson (1958).

Evidence indicating that the above statements are reasonable has been obtained from data collected on the Tomoka and Farmton Wildlife Management Areas in Volusia County and from the Ocala National Forest Wildlife Management Area in Marion County. Scrub oak acorn mast on Chapman's oak (*Quercus Chapmanii*), scrub live oak (*Q. geminata*), myrtle oak (*Q. myrtifolia*), saw palmetto (*Serenoa repens*) berry production, deer weights and age classes have been collected from 1952-58. These data have been compared and correlations computed.

The Tomoka and Farmton Areas are located in the east coast flatwoods region. The principal plant communities are pine flatwoods (53.5%), cypress swamps and bayheads (43.0%), scrub oak ridge (2.0%), and hardwood hydric hammocks (1.5%). The Ocala Area is composed principally of sand pine-scrub oak ridge which makes up approximately 70% of the area. Other types included in Ocala are longleaf pine-turkey oak (10%), swamps (7.0%), flatwoods (5.0%), prairies (3.0%), and open water (5.0%).

Saw palmetto is the most abundant mast producing plant in the east coast flatwoods occurring in 90% of eighty plots (each plot 9.61 square feet in size). In scrub oak habitat myrtle oak occurred in 88% of 207 plots while Chapman's oak occurred 37% of the time and scrub live oak 42% of the time. Based on percent occurrence of these plants their importance to the communities in which they appear is evident.

Deer populations on the two Volusia County areas are estimated at approximately one deer for every 70-90 acres and on the Ocala Area one deer to 45 acres. Populations were derived from deer tracks and annual kill data records.

To census annual acorn production, scrub oak acorn shrubs were taken at random and all acorns counted. From these data the average number of acorns per scrub were computed for each species (bearing and non-bearing). The same areas and the same time of year were selected for study annually. For adequate sample size shrubs were counted until at least 100 shrubs of each species were taken. If the number of acorns on a shrub was fifteen or less, it

was considered bearing light, 16-25 medium, and over 25 heavy. Shrub sizes ranged from four to fifteen feet in height.

The line transect method was employed to measure saw palmetto berry production. At every ten feet along a 100-foot tape all vegetation underlying the following twenty-five inches was tabulated as to percent coverage of plants and the quantity of fruit produced. This gives a total of 20.8 linear feet for every hundred linear feet of vegetation. The number of inches a plant registers along the twenty-five inch plot is multiplied by four to give the percent coverage of that particular species. The unit of measure designated to fruit abundance is 0-30% indicated by "15" which stands for scarce, 31-60% indicated by "45" moderately abundant, 61-100% indicated by "80" abundant. Reducing these figures to fit the actual abundance of saw palmetto mast recorded, 0-5% indicates low production, 6-10% moderately abundant, above 10% abundant. Percent fruit production on each transect line was arrived at by dividing the total percent production by the number of times the plant bore. Percent fruit production for the total number of plots taken annually was determined by adding percent berry production of each line and dividing by the total number of lines run. Two hundred plots (twenty transect lines) were run annually. Saw palmetta occurred in over 70% of plots taken each year by the line transect method of sampling.

The formula used for determining the correlation coefficients (relationships) is:

$$r = \frac{N\ (S\,xy) - (S\,x)\ (S\,y)}{\sqrt{[N\ (S\,x^2) - S\,(x)^2]\ \ [N\ (S\,y^2) - (y)^2]}}$$

To determine the significance of the correlations the following "T" test formula was applied:

$$t = r\sqrt{\frac{N-2}{1-r^2}}$$

CORRELATIONS

TABLE I

AVERAGE NUMBER OF ACORNS PER SHRUB (ALL THREE SPECIES) CORRELATED WITH DEER WEIGHTS (ALL AGE CLASSES), VOLUSIA COUNTY

Year	*Avg. No. Acorns Per Shrub*	*Deer Weights*
1954	9.8	111.0
1955	13.7	113.3
1956	7.1	110.7
1957	5.0	101.2
1958	16.9	108.5

$r = +0.51$
$t =$ 1.02 significant at the 65% level

TABLE II

AVERAGE NUMBER OF ACORNS PER SHRUB (ALL THREE SPECIES) CORRELATED WITH DEER WEIGHTS (ALL AGE CLASSES), MARION COUNTY

Year	*Avg. No. Acorns Per Shrub*	*Deer Weights*
1952	6.4	110
1953	6.0	116
1954	5.6	118
1955	10.9	114
1956	8.7	111
1957	2.2	105
1958	7.8	112

$r = +0.37$
$t =$ 0.88 significant at the 55% level

TABLE III

PERCENT OF SHRUBS BEARING ACORNS (ALL THREE SPECIES) CORRELATED WITH DEER WEIGHTS (ALL AGE CLASSES), MARION COUNTY

Year	*Percent Oaks Bearing Acrons*	*Deer Weights*
1952	70	110
1953	75	116
1954	61	118
1955	72	114
1956	73	111
1957	28	105
1958	50	112

$r = +0.57$

$t = 1.55$ significant at the 80% level

The relationships between scrub oak acorn mast production and deer weights in the Volusia and Marion County study areas, while not statistically significant (55-65% levels) show a definite correlation. The number of years the study has been in operation is few. If the relationships should remain at their present levels of significance the 90% confidence limits would be reached in Volusia County in seven more years and in Marion County in ten years. When the percent of shrubs bearing acorns on the Ocala Area is substituted for average number of acorns per shrub the level of significance increased to 80%. The same substitution on the Volusia Area did not show an increase in significance.

TABLE IV

AVERAGE NUMBER OF ACORNS PER SHRUB (ALL SPECIES) CORRELATED WITH PERCENT 1½-YEAR-OLD BUCKS HARVESTED TWO YEARS LATER, VOLUSIA COUNTY

Year	*Avg. No. Acorns Per Shrub*	*Percent 1½-Year-Old Bucks Harvested*	*Year*
1954	9.8	28.5	1956
1955	13.7	37.3	1957
1956	7.1	21.7	1958

$r = +0.99$

$t = 7.00$ significant at the 90% level

TABLE V

AVERAGE NUMBER OF ACORNS PER SHRUB (ALL SPECIES) CORRELATED WITH PERCENT 1½-YEAR-OLD BUCKS HARVESTED TWO YEARS LATER, MARION COUNTY

Year	*Avg. No. Acorns Per Shrub*	*Percent 1½-Year-Old Bucks Harvested*	*Year*
1952	6.4	24.0	1954
1953	6.0	26.0	1955
1954	5.6	40.0	1956
1955	10.9	56.0	1957
1956	8.7	35.0	1958

$r = +0.76$

$t = 2.00$ significant at the 85% level

When annual scrub oak acorn crop (number acorns per shrub, all three species) is compared to percent 1½ year year old bucks harvested two years later on the study areas significant correlations appear. On the Volusia County Areas the correlation was significant at the 90% level and on the Marion County Area at the 85% level. This close relationship, should it continue at the same magnitude, will clearly demonstrate the importance of acorns to the diet of deer. If deer reproduction is influenced to the degree this relationship indicates,

then the eradication of oaks for pine will seriously reduce the carrying capacity of deer habitat in Florida.

TABLE VI

NUMBER OF ACORNS PER SHRUB (ALL THREE SPECIES), VOLUSIA COUNTY, CORRELATED WITH NUMBER ACORNS PER SHRUB, MARION COUNTY, 1954-58

Year	*Acorn Crop Volusia County*	*Acorn Crop Marion County*
1954	9.8	5.6
1955	13.7	10.9
1956	7.1	8.7
1957	5.0	2.2
1958	16.9	7.8

$r = +0.61$

$t =$ 1.32 significant at the 70% level

Although the relationship is only significant at the 70% level, the close trend of the widely separate acorn crops is striking. This close correlation existed even though the studies were conducted separately and by different technicians.

The shrub myrtle oak consistently raises the largest acorn crop of the three scrub oaks annually on both areas. It also occurs in much greater abundance in scrub oak habitat than either scrub live or Chapman's oak. Because of its abundance and bearing qualities, relationships were computed between myrtle oak acorn crop, deer weights, and 1½ year old bucks harvested two years later.

TABLE VII

MYRTLE OAK ACORN CROP (NUMBER OF ACORNS PER SHRUB) CORRELATED WITH DEER WEIGHTS, VOLUSIA COUNTY

Year	*Avg. No. Acorns Per Shrub*	*Deer Weights*
1954	16.8	111.0
1955	37.6	113.3
1956	19.2	110.7
1957	8.6	101.2
1958	27.8	108.5

$r = +0.75$

$t =$ 1.95 significant over the 80% level

TABLE VIII

MYRTLE OAK ACORN CROP CORRELATED WITH DEER WEIGHTS, MARION COUNTY

Year	*Avg. No. Acorns Per Shrub*	*Deer Weights*
1952	9.6	110.0
1953	8.8	116.0
1954	10.2	118.0
1955	25.1	114.0
1956	16.2	111.0
1957	1.6	105.0
1958	11.1	112.0

$r = +0.42$

$t =$ 1.02 significant at the 65% level

In both study areas a stronger relationship existed between myrtle oak acorn crop and the weight of deer than between the combined acorn crop abundance figures and deer weights.

TABLE IX

AVERAGE NUMBER OF ACORNS PER SHRUB (MYRTLE OAK) CORRELATED WITH PERCENT 1½-YEAR-OLD BUCKS HARVESTED TWO YEARS LATER, VOLUSIA COUNTY

Year	*Myrtle Oak Acorn Abundance*	*Percent 1½-Year-Old Bucks Harvested*	*Year*
1954	16.8	28.5	1956
1955	37.6	37.3	1957
1956	19.2	21.7	1958

r = + 0.85
t = 1.60 significant at the 65% level

TABLE X

AVERAGE NUMBER OF ACORNS PER SHRUB (MYRTLE OAK) CORRELATED WITH PERCENT 1½-YEAR-OLD BUCKS HARVESTED TWO YEARS LATER, MARION COUNTY

Year	*Myrtle Oak Acorn Abundance*	*Percent 1½-Year-Old Bucks Harvested*	*Year*
1952	9.6	24.0	1954
1953	8.8	26.0	1955
1954	10.2	40.0	1956
1955	25.1	56.0	1957
1956	16.2	35.0	1958

r = + 0.87
t = 3.04 significant at the 94% level

The relationship between myrtle oak acorn crop and percent of 1½ year old bucks harvested in Volusia County was high (0.85) but the correlation was significant at the 65% level. If the relationship should stay at the same magnitude for two more years the level of significance would increase to 90%. In Marion County the myrtle oak acorn crop and 1½ year old bucks harvested two years later showed a relationship significant at the 94% level. This correlation was stronger than between the three scrub oak acorn crops combined and 1½ year old bucks harvested.

TABLE XI

MYRTLE OAK ACORN CROP IN MARION COUNTY CORRELATED WITH MYRTLE OAK ACORN CROP IN VOLUSIA COUNTY

Year	*Acorn Crop Marion County Marion County*	*Acorn Crop Volusia County Volusia County*
1954	10.2	16.8
1955	25.1	37.6
1956	16.2	19.2
1957	1.6	8.6
1958	11.1	27.8

r = + 0.81
t = 2.39 significant at the 90% level

The myrtle oak acorn crop on both study areas increased and decreased together annually with a surprisingly close relationship. The Marion County study area was over forty miles distance away from the Volusia County study area.

TABLE XII

SAW PALMETTO CROPS (PERCENT PRODUCTION) CORRELATED WITH DEER WEIGHTS (ALL AGE CLASSES), VOLUSIA COUNTY

Year	*Palmetto Berries*	*Deer Weights*
1954	0	111.0
1955	12.3	113.3
1956	4.5	110.7
1957	0.7	101.2
1958	16.5	108.5

$r = +0.36$

$t =$ 0.67 significant at the 45% level

TABLE XIII

SAW PALMETTO CROP CORRELATED WITH PERCENT OF 1½-YEAR-OLD BUCKS HARVESTED TWO YEARS LATER, VOLUSIA COUNTY

Year	*Percent Production Palmetto Berries*	*Percent 1½-Year-Old Bucks Harvested*	*Year*
1954	0	28.5	1956
1955	12.3	37.3	1957
1956	4.5	21.7	1958

$r = +0.68$

$t =$ 0.93 significant at the 45% level

Correlations between saw palmetto crop production and deer weights and 1½ year old bucks harvested two years later were not statistically significant. Notice that a stronger relationship occurred between saw palmetto berry production and 1½ year old bucks harvested than between the palmetto crop and deer weights.

TABLE XIV

PERCENT TIMES SAW PALMETTO PLANTS BORE FRUIT CORRELATED WITH PERCENT PRODUCTION OF PALMETTO BERRIES, VOLUSIA COUNTY

Year	*Percent Times Bore Fruit*	*Percent Fruit Production*
1954	0	0
1955	17.1	12.3
1956	0.03	4.5
1957	0.006	0.75
1958	19.1	16.5

$r = +0.96$

$t =$ 5.90 significant at the 99% level

Note the strong relationship between percent of times saw palmetto plants bore fruit and the percent fruit production of those plants bearing. Since a relationship of this magnitude exists, it would probably be sufficient to measure the palmetto crop abundance by merely recording the percent of palmetto plants bearing fruit.

TABLE XV

SAW PALMETTO CROP (PERCENT PRODUCTION) CORRELATED WITH SCRUB OAK ACORN CROP (ALL THREE SPECIES), VOLUSIA COUNTY

Year	*Palmetto Crop*	*Acorn Crop*
1954	0	9.8
1955	12.3	13.7
1956	4.5	7.1
1957	0.7	5.0
1958	16.5	16.9

$r = +0.89$

$t =$ 3.37 significant at the 95% level

A statistically significant correlation existed between the abundance of saw palmetto berries and scrub oak acorns. This strong relationship is not a desirable one for deer. The two mast producing crops increasing and decreasing together in abundance may possibly intensify the degree to which deer fluctuate in weight and reproduction.

TABLE XVI

DEER WEIGHTS (ALL AGE CLASSES), MARION COUNTY, CORRELATED WITH DEER WEIGHTS, VOLUSIA COUNTY, 1954-58

Year	*Deer Weights Volusia County*	*Deer Weights Marion County*
1954	111.0	118.0
1955	113.3	114.0
1956	110.7	111.0
1957	101.2	105.0
1958	108.5	112.0

$r = +0.93$

$t = 2.58$ significant at the 90% level

A statistically significant correlation existed between annual weight trends of deer on the two study areas. Deer on both areas were low in weight during the 1957 hunting season.

TABLE XVII

WOODS DRESSED DEER WEIGHTS FROM 1954-58, FARMTON AND TOMOKA AREA, VOLUSIA COUNTY

Year	*No. in Sample*	*1½ Years*	*No. in Sample*	*2½ to 4½ Yrs.*	*No. in Sample*	*2½ Yrs. and Over*	*No. in Sample*	*Avg. Wt. All Age Classes*
1954	23	97.7	33	114.0	40	118.7	63	111.0
1955	18	93.1	64	112.7	76	118.1	94	113.3
1956	34	94.3	69	111.7	86	117.2	120	110.7
1957	40	87.6	58	104.6	67	109.3	107	101.2
1958	15	90.6	52	112.4	54	113.4	69	108.5

In comparing the 1955 and 1957 deer weights (all age classes), a statistically significant difference was found with $t = 3.87$. $P < 0.001$. Probability greater than at the 0.1% level.

RESULTS

The abundance of the scrub oak acorn crop showed a definite correlation with annual weight differences of buck deer harvested in both counties. Although the relationships were not significant at a high level, should they continue at the same magnitude highly significant levels would be reached in seven to ten years.

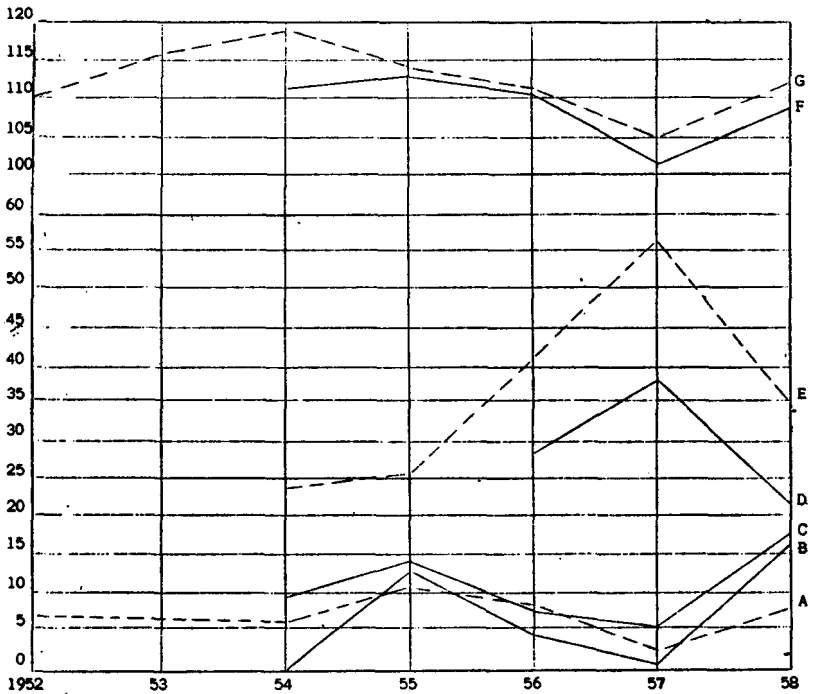
Statistically significant correlations existed on both study areas between the annual scrub oak acorn crop and the percent of 1½ year old bucks harvested two years later.

Stronger relationships were found between the abundance of myrtle oak acorns and average weight and numbers of 1½ year old bucks harvested than between the combined average of the three scrub oak acorn mast and deer weights and reproduction. Myrtle oak occurs in greater abundance than either Chapman's or scrub live oak and bears acorns more abundantly than the other two combined. Chapman's and scrub live oaks tend to weaken deer weight and reproduction correlations.

Correlations between saw palmetto berries and deer were weaker than those between acorns and deer.

The annual abundance and scarcity of saw palmetto berries and scrub oak acorns when compared shows a significant correlation. When the acorn mast is low the palmetto crop cannot always be counted upon to carry the deer through the winter in good condition as it may also be low.

Figure 1. Comparisons Between Acorns, Palmetto Berry Production, Deer Weights and Bucks Harvested on the Two Study Areas, 1952-58.



A Average Number of Acorns Per Shrub Marion County (Ocala Area).

B Percent Production Saw Palmetto Berries Volusia County (Tomoka Area).

C Average Number Acorns Per Shrub Volusia County (Tomoka Area).

D Percent 1½ Year Old Bucks Harvested Volusia County (Tomoka and Farmton Areas).

E Percent 1½ Year Old Bucks Harvested Marion County (Ocala Area).

F Weight of Deer In Pounds (woods dressed weights) - All Age Classes Volusia County (Tomoka and Farmton Areas).

G Woods Dressed Weights of Deer (all age classes) Marion County (Ocala Area).

Both study areas (Marion and Volusia Counties) showed strong similarities in acorn crop abundances, deer weights, and harvest of 1½ year old bucks even though the work was carried out independently and by different technicians.

The present relationships, although not in all cases significant, supports and strengthens the opinion that acorns and palmetto berries constitute an important part of the deer's diet and that elimination of oak for pine over extensive areas would be extremely detrimental to deer range.

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