

Feeding Response of Wild Turkeys to Chestnuts and Other Hard Mast

William G. Minser, *Department of Forestry, Wildlife, and Fisheries, The University of Tennessee, Box 1071, Knoxville, TN 37901*

Todd Allen, *Department of Forestry, Wildlife, and Fisheries, The University of Tennessee, Box 1071, Knoxville, TN 37901*

Brian Ellsperman, *Department of Forestry, Wildlife, and Fisheries, The University of Tennessee, Box 1071, Knoxville, TN 37901*

S. E. Schlarbaum, *Department of Forestry, Wildlife, and Fisheries, The University of Tennessee, Box 1071, Knoxville, TN 37901*

Abstract: Disease eliminated American chestnut (*Catenea dentata*), mast production from most North America forests before objective data could be collected on its use by wild turkeys (*Meleagris gallopavo*). This study evaluated wild turkey use of American chestnut, chestnut hybrids, and other selected hard mast. Feeding responses of free-ranging wild turkeys to American and Chinese chestnuts was compared to 22 other mast species during winters 1993 and 1994. Turkeys were presented measured amounts of mast during 20 feeding trials. Chestnuts were readily accepted as a food. There were no differences ($P = 0.0001$) in preferences for 11 oak species, 4 pine species, and small Chinese chestnuts. Turkeys showed no preference ($P = 0.0001$) among 5 diameter classes of Chinese chestnuts presented alone, selected ($P = 0.0001$) corn, American chestnuts, and chinkapins, over chestnut cultivars and selected ($P = 0.0001$) corn, American chestnuts, red oak and white oak to Chinese chestnuts. Turkeys ate most nuts and seeds regardless of species or size when preferred foods were unavailable. Managing forests for mast diversity was suggested for improving mast production consistency for wild turkeys.

Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 49:488-497

Historically, the American chestnut was a dominant species in upland hardwood forests in eastern North America. Martin et al. (1951) speculated that American chestnuts had been a primary and dependable mast producer for wildlife. However, mature American chestnut trees are now nearly absent in eastern North American forests due to the chestnut blight fungus [(*Cryphonectria* (= *Endothia*) *parisitica*)] which occurred from about 1904 to the present. Although consumption of American chestnuts by wildlife can be assumed, use of

chestnuts by wild turkeys and impact of its loss on wild turkey populations are unknown: monitoring of wild turkey populations did not occur until after the American chestnut had disappeared from eastern deciduous forests.

Horticulturists have been importing chestnut species and chestnut varieties from Europe and eastern Asia since the late 1800s (Anagnostakis 1990) to produce nuts for human consumption, as the fruit size could be much larger compared to the native American chestnut. After the chestnut blight began to ravage eastern forests, tree breeders and pathologists used existing unaffected Asian chestnuts to hybridize with American chestnut for blight resistance (cf. Burnham et al. 1986). In addition to breeding projects, experimental plantations of Asian and hybrid chestnuts were established throughout eastern North America (Diller and Clapper 1965). A recent survey of these plantations revealed that some Asian and hybrid genotypes can survive 50 years in forest conditions if competition is controlled when trees are young (Schlarbaum et al. 1994). Restoring chestnut trees to eastern forests has the potential to again provide a dependable fall food item for wild turkeys (Schlarbaum 1989*a,b*). It is uncertain, however, if wild turkeys accept chestnuts as food. Native chestnut mast has been absent from eastern forests for over 4 decades. Moreover, nut size from Asian and hybrid trees are generally larger than American chestnut, and it is unknown what size nuts would be accepted by turkeys.

Wild turkeys are considered opportunistic feeders taking advantage of the most available food, plant, or animal (Hurst 1992). Hard and soft mast comprise the bulk of fall foods for wild turkeys (Bailey and Rinell 1967, Korschgen 1967). Although it is known that wild turkeys consume a wide variety of mast species, little has been documented about preference. This study was initiated to determine if: 1) chestnuts are recognized and accepted as food by wild turkeys, 2) there is a limit or preference for chestnut size, and 3) there are preferences for chestnuts compared with other hard mast species. Data on mast preference of wild turkeys could provide managers information necessary to manipulate forest for the more important mast producers (Dickson 1992).

Methods

The study area was a mixture of hayfields and pine-hardwood forests on a private, 40-ha farm in Blount County, Tennessee, adjoining a state wildlife management area. Hard mast production around the study area was very poor in fall/winter 1992–93, but was excellent during 1993–94 (Tenn. Wildl. Resour. Agency, unpubl. mast survey data). No hunting had been allowed on the property for 10 years. A flock of free-ranging wild turkeys, 11 females and 5 males in 1993 and 29 females and 14 males in 1994, were used to evaluate acceptance and preferences of selected mast species. Resident turkeys were attracted by the homeowner who distributed corn for wildlife. The flock routinely fed around the home site prior to sunset and then flew 75 m to roost in a grove of mixed white and Virginia pines 25–50 m from the residence. At dawn, the turkeys flew

to the feeding site and fed before leaving to forage in adjoining pastures. A silver-phase hen and/or a constant number of hens and jakes indicated the same flock was present throughout the study in 1993. Tests were conducted at the same site in 1994, and the flock was believed to consist of turkeys and offspring from the 1993 flock.

Feeding Tests

Feeding tests were conducted in winters 1993 and 1994 with different combinations of mast species presented during each tests. We tested 24 mast species (Tables 1–5). A 3 × 5 m area of compacted bare clay soil was selected for distribution of mast samples. Absence of vegetation aided in collection of uneaten seeds following feeding trials. The site was observed throughout each feeding

Table 1. Preference^a and consumption of 21 mast species by wild turkeys in Tennessee, February 1993 (Test 93-1).

Mast species ^b	Weight (g)/percentage eaten						\bar{x}
	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	
Oaks							
Northern red AB	39/65 ¹	55/92	38/63	60/100	60/100	60/100	87
Southern red A	60/100	60/100	60/100	60/100	60/100	60/100	100
White A	60/100	60/100	60/100	60/100	60/100	60/100	100
Swamp white BCD	40/67	10/17	19/32	44/73	60/100	60/100	65
Sawtooth A	60/100	60/100	60/100	60/100	60/100	60/100	100
Nuttall A	60/100	44/73	60/100	60/100	60/100	60/100	96
Water A	60/100	60/100	60/100	60/100	60/100	60/100	100
Willow A	59/98	60/100	60/100	60/100	60/100	60/100	99
Pin A	60/100	60/100	60/100	60/100	60/100	60/100	100
Turkey A	60/100	53/88	60/100	60/100	60/100	60/100	95
Shumard A	60/100	60/100	60/100	60/100	60/100	60/100	100
Cherrybark A	60/100	60/100	60/100	60/100	60/100	60/100	100
Mockernut hickory G	60/00	60/00	60/00	60/00	60/00	60/00	0
Black walnut G	60/00	60/00	60/00	60/00	60/00	60/00	0
Pecan BCD	60/00	31/52	45/75	60/100	57/95	51/85	68
Persimmon ABCD	15/25	20/33	60/100	60/100	60/100	60/100	76
Dogwood ^c F	15/25	25/42	14/23	19/32	19/32	11/18	29
White pine A	50/83	60/100	60/100	60/100	60/100	60/100	97
Virginia pine A	54/90	60/100	60/100	60/100	60/100	60/100	98
Loblolly pine A	51/85	60/100	60/100	60/100	60/100	60/100	98
Shortleaf pine A	54/90	60/100	60/100	60/100	60/100	60/100	98
Chinese chestnut diameter classes							
20 mm A	56/93	54/90	57/95	60/100	58/97	60/100	96
22 mm ABC	40/67	31/52	57/95	57/95	58/97	60/100	84
23.5 mm DE	60/00	18/30	19/32	60/100	52/87	60/100	58
25 mm EF	60/00	60/00	60/00	60/100	25/42	60/100	24
28 mm CD	28/47	10/17	17/28	60/100	50/83	60/100	46

^aMost (A) to least (G) preferred (Duncan's Multiple Range Test). Groups that have the same letter(s) did not differ in preference.

^bNorthern red oak, *Quercus rubra*; southern red oak, *Q. falcata*; white oak, *Q. alba*; swamp white oak, *Q. bicolor*; sawtooth, *Q. altissima*; nuttalloak, *Q. mutallii*; water oak, *Q. nigra*; willow oak, *Q. phellos*; pin oak, *Q. palustris*; turkey oak, *Q. laevis*; shumard oak, *Q. shumardii*; cherrybark oak, *Q. paegodifolia* var.; mockernut hickory, *Carya tomentosa*; black walnut, *Juglans nigra*; pecan, *C. illinoensis*; persimmon, *Di-spyros virginiana*; dogwood, *Cornus florida*; white pine, *Pinus Arobus*; Virginia pine, *P. virginiana*; loblolly pine, *P. taeda*; shortleaf pine, *P. echinata*; and Chinese chestnut, *Catanea mollissima*.

^cDefleshed seeds.

Table 2. Preference^a and consumption of 5 diameter size classes of Chinese chestnuts by wild turkeys in February 1993 (Test 93-2).

Chinese chestnut diameter class	Weight (g)/percentage eaten				\bar{x}
	Trial 1	Trial 2	Trial 3	Trial 4	
20 mm	145/91 ²	160/100	158/99	160/100	97.5
22 mm	122/76	160/100	160/100	160/100	94.0
23.5 mm	83/52	160/100	160/100	138/86	84.5
25 mm	60/38	160/100	160/100	133/83	80.0
28 mm	160/0	148/93	160/100	89/56	62.0

^aThere was no preference among diameter classes in this test.

Table 3. Consumption of remaining mast from Test 93-1 and 93-2 by wild turkeys in February 1993 (Test 93-3).

Mast species	Weight (g)/percentage eaten	
	Trial 1	Trial 2
Turkey	7/100	—
Nuttall	16/100	—
Swamp white	127/0	127/0
Northern red	48/75	12/100
Willow	1/100	—
Chinese chestnut ^b	1049/49	535/96 ^a
Walnut	60/0	60/0
Mockernut	60/0	60/0
Pecan	116/73	31/90 ^a
Pine ^b	34/100	—
Persimmon	85/37	57/100
Dogwood	—	186/0

^aUneaten nuts were found later to be rotten.

^bAll size combined.

^cLoblolly, Virginia, shortleaf and white pine.

trial from a distance of 100 m. The observer frightened away other wildlife to prevent them from feeding on the mast samples when turkeys were absent. Feeding trials were conducted twice daily by placing mast at the site 1 hour before sunrise and again 3 hours before sunset. Acorns and chestnuts were marked with an indelible pen for identification. Following each trial, after the turkeys left the site, any remaining seeds were collected, identified, and weighed. A portable vacuum was used to collect uneaten pine and dogwood seeds. A trial was recorded for analysis only if wild turkeys visited the feeding site. All uneaten mast from all trials per test were combined and presented in additional trials (Table 3). Each mast species was measured on an electronic balance and was presented in equal weights during each trial. Weights were more representative of preference than number of seeds consumed because of weight differences in seeds of different species.

Total weight of all mast presented per test varied (800–1,600 g) based on

Table 4. Preference^a and consumption of chestnut varieties consumed by wild turkeys in February 1994 (Test 94-1).

Species/cultivar ^b	Nut diameter	Weight (g)/percentage eaten				\bar{x}
		Trial 1	Trial 2	Trial 3	Trial 4	
American chestnut AB	18	140/56	206/82	247/99	218/85	80.5
Chinese chestnut						
Small BC	21	53/22	117/47	245/98	186/74	60.2
Medium C	24	29/12	78/31	222/89	114/46	44.5
Large D	31	4/2	11/4	32/9	5/2	4.2
Sleeping giant D	34	27/13	29/14	80/40	20/10	19.2
Crane D	33	40/20	52/16	0/0	62/31	16.8
Cropper D	35	0/0	10/6	48/28	13/8	10.5
Eaton D	34	16/8	0/0	23/11	7/3	5.5
Carolina D	31	50/20	36/14	11/4	13/5	10.8
Willamette D	38	0/0	11/4	0/0	3/1	1.2
Revival D	30	15/6	37/15	0/0	18/7	7
Chinkapin A	12	218/100	131/52	250/100	241/96	83.8
Corn A		120/100	120/100	120/100	120/100	100

^aMost (A) to least (D) preferred (Duncan's Multiple Range Test). Groups that have the same letter(s) did not differ in preference.

^bAmerican chestnut, *Catenea deutata* and chinkapin chestnut, *C. pumila*.

Table 5. Preferences^a and consumption of mast by wild turkeys during February 1994 (Test 94-2).

Species presented	Weight (g)/percentage eaten				\bar{x}
	Trial 1	Trial 2	Trial 3	Trial 4	
American chestnut A	112/72 ²	96/64	111/74	109/72	71.2
White oak AB	82/55	76/51	91/62	93/67	58.7
Northern red oak A	141/94	115/77	79/53	71/48	68
Chinese chestnut					
Small CD	75/50	75/52	75/39	75/52	48.2
Medium D	75/4	75/0	75/12	75/12	7
Corn A	120/100	120/100	120/100	120/100	100

^aMost (A) to least (D) preferred (Duncan's Multiple Range Test). Some preference groups overlap (have more than 1 letter).

availability to the authors, but weight per trial per test was equal. We attempted to present a volume of mast sufficient to keep turkeys returning to the feeding site. Six trials were completed for Test 93-1; only 4 trials each were completed for Test 93-2, 94-1, and 94-2 due to mast shortage. Only 2 trials were required for Test 93-3 evaluating leftover foods because turkeys ate nearly all mast in 2 trials.

1993 Feeding Tests

Three separate feeding tests were conducted in February 1993. Prior to the feeding trials, amount of corn fed daily by the landowner was gradually dimin-

ished during 3 days and replaced with samples of all mast species used in the study. This allowed turkeys time to become familiar with the mast used.

The 93-1 test compared preferences for 21 mast species (Table 1). A bulked seedlot of pure Chinese chestnuts and Chinese X Japanese hybrid chestnuts from a commercial orchard were used. Chestnuts were divided into 5 diameter classes: 20 mm, 22 mm, 23.5 mm, 25 mm, and 28 mm. Whole pecans were collected in an urban area in western Tennessee and were likely from a planted cultivar. Flowering dogwood fruits were obtained from a nursery and had been defleshed prior to the study.

Sixty grams of each species were mixed and scattered at the feeding site. Test 93-1 consisted of 6 feeding trials, 3 mornings and 3 afternoons on 3 consecutive days. Acorns from each oak species and chestnuts from different size classes were marked to identify remaining fruits after each feeding trial. Each of 4 pine species (Table 1) was placed at a designated spot at the site instead of being mixed due to difficulty in distinguishing seeds of different species.

The 93-2 test consisted only of chestnuts of different size classes (as above) presented at each feeding trial (Table 2). Each size class contained 160 g of chestnuts. The chestnuts were distributed and collected in the same manner as in Test 93-1 in 4 trials on 2 consecutive days.

All foods not eaten in Tests 93-1 and 93-2 were distributed again in Test 93-3 during 2 trials on 1 day (Table 3). Foods not eaten in the morning trial were presented again in the afternoon trial.

1994 Feeding Tests

Mast was placed at the test site for 2 tests from 6 February to 12 March 1994. Whole kernel corn (120 g) was included in each feeding trial as an enticement. Without corn, the turkeys ignored the feeding site for 2–3 consecutive days probably because of abundant native mast in the surrounding forest.

The 94-1 test consisted of different chestnut species, Allegheny chinkapin, chestnut cultivars, and pure American chestnuts from an isolated stand in New York unaffected by the chestnut blight (Table 4). Allegheny chinkapins, a bulked seedlot of pure Chinese chestnuts and Chinese X Japanese hybrid chestnuts, came from a commercial orchard. The bulked Asian chestnuts were sorted into 3 diameter classes: small (20–23 mm), medium (25 mm), and large (28 mm). Open-pollinated Chinese or hybrid chestnuts from 7 cultivars were collected by commercial growers. Chestnuts were marked for identification, weighed, mixed, and presented to turkeys during 4 feeding trials.

The 94-2 test consisted of white oak and northern red oak acorns and American chestnut and small and medium Chinese chestnuts, all of which were marked, weighed, mixed, and presented to wild turkeys during 4 trials (Table 5).

Effects of species and trial on percent consumed were analyzed using 2-way analysis of variance (ANOVA). Duncan's Multiple Range Test was used to test for differences among species if ANOVA was significant at $\alpha = 0.05$ (SAS 1989).

Results

1993 Feeding Tests

Turkeys visited and fed at the site during 12 of 13 trials (92%) in 1993. ANOVA of turkey preference for 22 mast species and 5 diameter classes of Chinese chestnuts presented during 6 trials (Test 93-1) (Table 1) showed significant differences ($F_{25,125} = 17.7$, $P < 0.001$) between species and trials. Duncan's Multiple Range Test found significant differences between groups. Eleven of the 12 oaks, the 4 pine species, and the smaller Chinese chestnuts were most preferred; hickory and walnut were least preferred. ANOVA of turkey preference for 5 diameter classes of Chinese chestnuts presented alone (Test 93-2) (Table 2) revealed no significant differences ($F_{4,12} = 1.07$, $P = 0.4132$). In Test 93-3, turkeys were presented leftover foods from Tests 93-1 and 93-2. No statistical analysis was done for this test because amounts of each food item were not equal and replicate trials were not possible. Turkeys consumed 90% to 100% of 11 species presented and none of 4 mast species presented (Table 3).

1994 Feeding Tests

Number of turkeys visiting the site in 1994 varied from 29 to 43. The flock fed at the site an average of 24 minutes. Food items were presented both morning and afternoon for a total of 16 times, with turkeys visiting the feeding site 8 times (50%).

ANOVA of turkey preference for chestnut species, chestnut cultivars, Chinese chestnut diameter classes and corn (Test 94-1) indicated significant differences ($F_{12,36} = 20.86$, $P < 0.001$) (Table 4). Duncan's Multiple Range Test showed that American chestnuts, chinkapins, and corn were preferred over all others. Next preferred as a group were small and medium Chinese chestnuts, and least preferred were all chestnut cultivars and large Chinese chestnuts. Analysis also indicated differences in trials; some species were consumed at different rates in different trials.

ANOVA of turkey preference for American chestnuts compared to other mast (test 94-2) showed significant differences ($F_{5,15} = 33.64$, $P < 0.001$) (Table 5). Duncan's Multiple Range Test showed corn was preferred to other groups. American chestnuts, northern red oak, and white oak were next in preference and were not different. American chestnut and northern red oak were preferred to small and medium Chinese chestnuts.

Discussion

This study showed that wild turkeys identify and utilize unfamiliar mast as food. Although these individual turkeys had no prior exposure to chestnuts, turkeys readily accepted chestnuts as food and selected chestnuts over certain other mast species. Eleven other species in test 93-1 not natural to the study area, also were readily eaten. Pecans were the most often eaten food of wild

turkeys in Mississippi bottomland hardwood forests (Kenamer and Arner 1967), but pecans are not native to our study area, so the oblong nut shape probably was unfamiliar to the turkeys in the 1993 tests. Pecans were totally avoided in the first trial of test 93-1, but consumption increased to 85%–100% in the last 4 trials.

The broad range of turkey food preferences (Test 93-1) (Table 1) was demonstrated by 17 mast species which were in the most preferred category. This group included all acorns (except swamp white oak), all pines, smaller Chinese chestnuts, and persimmons, which overlapped with a less preferred group. This supports the description by Hurst (1992) of the diversity of foods eaten by the wild turkey.

Nut size was important concerning preference in early trials (93-1, 93-2, and 93-3). Chinese chestnuts and Chinese chestnut cultivars with smaller diameters were preferred over larger chestnuts in tests 93-1 and 93-2 in 1993. During the first 3 trials in test 93-1, turkeys fed on the smaller chestnuts, but by the sixth trial, all chestnuts were eaten, regardless of size. Among chestnuts, the Chinese chestnut and cultivar seedlots, the smaller diameter nuts were preferred. The American chestnuts and Allegheny chinkapins, smaller than any of the Chinese chestnuts, were consumed more readily than any of the larger Chinese chestnuts or chestnut cultivars. Cultivar Willamette had the largest nuts included in the test and correspondingly was the least consumed. Seed size was apparently a factor for acorn selection as well. Acorns with the smallest diameter, i.e., southern red, willow, water, pin, cherrybark, nuttall, shumard, sawtooth, and white oaks, were totally consumed in nearly every trial. The larger acorns of northern red and swamp white oaks were totally eaten in $\leq 50\%$ of the trials.

Food availability is undoubtedly a factor in food selection by wild turkeys. Wild turkeys probably eat first what they like best regardless of size or species, but will eat less preferred items when other mast is scarce or absent. When mast was scarce in 1993, turkeys came to the feeding site more consistently than in 1994 when mast was abundant. They fed longer and consumed most or all mast presented regardless of size. During mast abundance in 1994 turkeys were more selective showing a preference for American chestnuts and smaller size Chinese chestnuts.

Flowering dogwood seeds in 1993 were consumed less than we expected. Importance of dogwood mast to wild turkeys has been previously reported (Mosby and Handley 1943, Kenamer et al. 1980, Exum et al. 1987). However, defleshed dogwood seeds were evaluated in our 1993 tests, a condition in which dogwood berries are more likely to be found in the leaf litter in late winter or early spring. When whole dogwood fruits were presented in separate tests, all were consumed in 4 consecutive trials, indicating a preference for the complete fruit over the plain seeds.

Pine often is assigned a low value to wildlife, but previous studies have demonstrated the importance of pine mast to wild turkeys (Schemnitz 1956, Korschgen 1967, Kenamer et al. 1980). Pine seeds in tests 93-1 and 93-3 were

readily consumed and preference was equal to acorns. During each feeding trial, 1 or 2 turkeys would feed primarily on pine seed concentrations. When those turkeys gave up their feeding spot and began feeding on other mast, other turkeys would consume pine seeds. In test 93-1, 100% of all 4 pine species were consumed in 5 of 6 trials. In the leftover test (93-3), the remaining pine seeds were totally consumed in the first trial.

All corn was eaten in every trial. Use of corn by turkeys in every month, but particularly late winter, was reported by Korschgen (1967). These findings demonstrate the value of corn as a supplemental late winter food item. Supplemental feeding of grain from feeding stations, however, is not recommended; concentrating wild turkeys at feeding stations in West Virginia may have resulted in turkey mortality from blackhead disease (C. I. Taylor W.V. Dep. Nat. Resour. unpubl. data). Providing corn in a supplemental field planting would be a better option.

Turkeys in this study quickly identified chestnuts as food and consumed them as readily as oak mast. Historically, loss of the American chestnut from the forest as a food for turkeys was partially offset by oaks and other mast producers, although there probably was an annual net loss of hard mast. Restoration of the chestnut has management potential in forests and associated lands for increasing the carrying capacity for wild turkeys. Development of disease resistant strains of the American chestnut would allow for successful restoration of this once important mast producer. In the interim, planting of Asian and hybrid chestnuts in orchards as a supplement could provide an acceptable hard mast supply for wild turkeys and other wildlife on a local basis. Orchard planting, however, should not be expected to cause significant changes in local turkey populations.

Because of the wide diversity of mast consumed by turkeys as shown in this and other studies, we suggest that management for forest diversity would help provide for more consistent mast production and would be beneficial to wild turkeys. For example, managing for both red and white oak families helps avoid complete mast failures in years of late spring frosts (Dickson 1990). Inclusion of mixed pine-hardwood stands or scattered pine plantation in hardwood stands, hardwood streamside management zones in pine plantations (Burk et al. 1990), or hardwood corridors between pine plantations (Holbrook et al. 1985) are other techniques which could be used to provide for mast diversity and consistency.

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