The Yearling Disadvantage in Alabama Deer: Effect of Birth Date on Development

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Abstract: Male white-tailed deer are subjected to a variety of factors that influence body and antler development when they are yearlings. Nutrition and genetics have received considerable attention as factors that influence this development; however, date of birth has yet to be adequately investigated and theoretically could dramatically influence development in later years. To determine how date of birth influences development of antler and body characteristics at 1.5 years of age, we collected data from yearling male white-tailed deer *(Odocoileus virginianus)* harvested on 23 Alabama Wildlife management Areas (WMAs) during the 1998–99 and 1999–2000 hunting seasons. We found that early born males had greater body mass, number of antler points, antler beam length, and antler beam circumference than their late born counterparts. Mean birth date of fork-antlered yearlings was earlier (26 Jun) than spike-antlered yearlings (23 July). Yearling males from the Lower Coastal Plain had shorter main beam lengths and less antler points that those from the Appalachian Plateau, Piedmont Plateau, and Upper Coastal plain, but body mass and main beam circumference did not differ. There was also a lower proportion of fork-antlered yearlings harvested on the Lower Coastal Plain than in other physiographic regions. Antler development in the yearling age class has been proposed as a predictor of an animal's potential for antler quality. Because of variability of fawning periods in Alabama and subsequent effects on physical development, as well as differences in physical development among physiographic regions, selective harvest programs based on physical characteristics of yearling males may not be suitable as a means to improve genetic quality of deer populations.

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Most white-tailed deer *(Odocoileus virginianus)* populations across North America breed in late fall (Nov–Dec) and give birth in May and June (Verme and Ullrey 1984). In Alabama, peak breeding for most deer populations occurs in January. However, summary data from statewide reproductive surveys indicate nearly onefifth (16.8%) of conceptions occur in February (Gray, unpubl. data). These breeding patterns result in fawns being born during late summer/early fall (Leuth 1955, 1967). In extreme cases, breeding may be extended as late as March and fawning as late as October (Leuth 1967). Late breeding and fawning periods also have been documented for other Gulf Coast deer populations including Mississippi (Jacobson et al. 1979), Louisiana (Roberson and Dennett 1966), and Florida (Morgan, pers. commun.).

Excessive harvest of males and inadequate harvest of females in many areas of Alabama have resulted in deer populations with a very young male age structure and biased adult sex ratios heavily skewed towards females. These unnatural herd structures have been reported to delay and prolong breeding and fawning periods (Gruver et al 1984). Further protraction of an already late fawning period in much of Alabama has resulted in a high variability of age (e.g., several months' difference) among fawns. Consequently, when many male deer enter the hunting season in their second year, they may only be 15–16 months of age.

Differences in body mass and antler development among yearling male deer are attributed to differences among subspecies, nutrition, and genetic potential (French et al. 1956, Harmel 1982, Sauer 1984). However, late and extended fawning periods likely are as important as well, but their effects have been poorly researched. Data collected in northwest Florida suggested later-born yearlings had less antler development than earlier-born yearlings (Shea et al. 1991). Similarly, Vanderhoof (1991) found that later-born yearlings in northwest Florida had smaller antler characteristics than earlier-born yearlings from the Everglades region of Florida, a smaller subspecies. In South Carolina, Knox et al. (1991) reported differences in both weight and antler development between yearlings ≤17 months and yearlings ≥19 months. Jacobson (1995) reported that deer raised in captivity showed a relationship between birth month and antler size when they were yearlings. In contrast, Causey (1990) found that earlier born captive fawns fed ad libitum did not have greater body mass or antler characteristics than late born fawns at 16 months of age.

Prohibiting harvest of yearling males is commonly prescribed in management strategies designed to improve age structure among male deer. However, in some regions, yearling bucks with small antlers (e.g., spikes) or other "undesirable" antler characteristics may be harvested as part of the management approach. Such management schemes are based on the belief that yearling antler development is a strong indicator of genetic potential for antler production (Brothers and Ray 1975, Harmel 1982). Many Alabama hunters and landowners selectively "cull" spike-antlered yearlings on areas where the efficacy of such a strategy may be questionable. Because many factors such as birth date may influence physical development of yearling male deer, selective harvest of yearling males in Alabama may not be appropriate. Considering that in many areas of Alabama over 85% of all yearling bucks may be spike-antlered (Cook 2001), such an approach could further compound problems associated with poor age structures resulting from over-harvest of young males. Thus, the goal of our study was to determine if birth date influenced body mass and antler development of yearling male white-tailed deer.

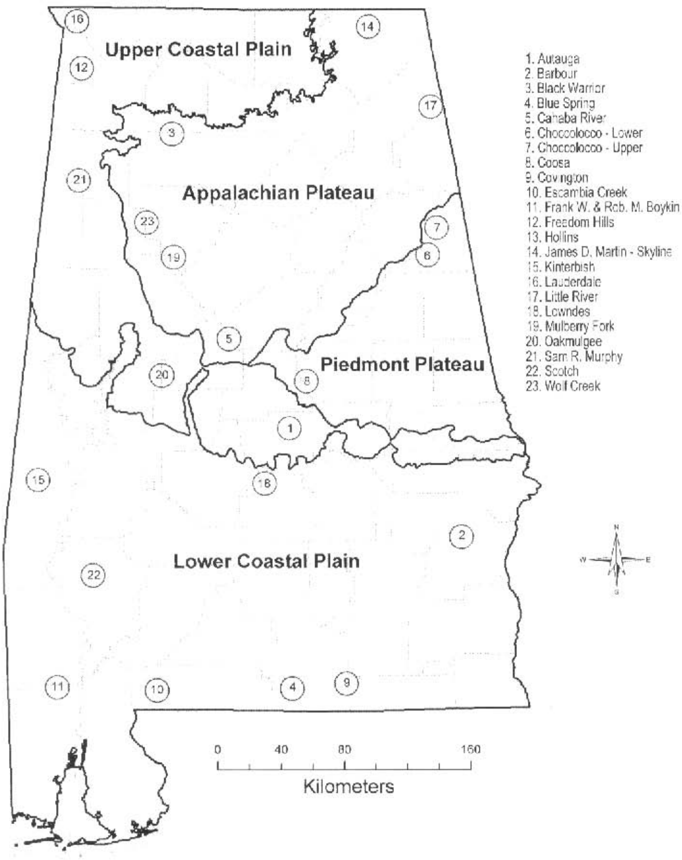

Figure 1. Map of Alabama depicting locations of 23 wildlife management areas where data on growth and development were collected from hunter-harvested yearling male white-tailed deer during 1998–99 and 1999–2000.

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Methods

During the 1998–1999 and 1999–2000 hunting seasons, we collected lower mandibles and morphological data from all yearling males ($N = 677$; Fig. 1) harvested on Alabama WMAs. Morphological data consisted of harvest date and body mass, and antler measurements consisted of number of points, basal circumference, and main beam length. We classified antlers as either forked or non-forked: if a deer had an antler with more than one point (e.g., spike) it was classified as a forked antler.

Using the aging technique of Shea et al. (2002), deer were assigned to 1 of 8 birth months ranging from April (birth month 4) through November (birth month 11). Using captive, known-age yearling white-tailed deer, Shea et al. (2002) found that the length of dentition from the front of the first erupted premolar to the furthest point of eruption of the last molar was associated with birth date in yearling deer. They found that eruption of the last molar occurs in a predictable pattern from the front to the back of the tooth—eruption of this molar influences length of total erupted dentition. However, this technique has yet to be tested with free-ranging white-tailed deer. As has been demonstrated with other deer aging techniques using dentition (Gee et al. 2002), there may be some variability of accuracy of the Shea et al. (2002) technique. As a result, we grouped our deer into age classes including several birth months for all statistical analyses and feel confident in the results.

Once deer had been assigned to birth months, there were then divided into 3 groups. Those born in April and May were considered to have early birth dates (Group 1), those born in June–August were considered to have mid-season birth dates (Group 2), and those born in September–November were considered to have late birth dates (Group 3). We used a modification of the ecoregion classification system of (Griffith et al. 2001) to classify our 23 wildlife management areas into 4 different physiographic regions. The Appalachian Plateau contained 6 management areas (Black Warrior, Cahaba River, Little River, Mulberry Fork, James D. Martin-Skyline, and Wolf Creek), the Lower Coastal Plain contained 8 areas (Barbour, Blue Spring, Frank W. and Rob M. Boykin, Covington, Escambia Creek, Kinterbish, Lowndes, and Scotch), the Piedmont Plateau contained 4 areas (Choccolocco-Upper, Choccolocco-Lower, Coosa, and Hollins), and the Upper Coastal Plain contained 5 areas (Autauga, Freedom Hills, Lauderdale, Oakmulgee, and Sam R. Murphy).

We tested for differences in mean body mass and antler characteristics among groups using analysis of variance (ANOVA; PROC GLM; SAS Inst. 1988). We tested for normality of body mass, antler point, main beam length, and beam circumference data using a Wilk-Shapiro test (PROC UNIVARIATE; SAS inst. 1988) and homogeneity of variance using Levene's test (PROC GLM; SAS Inst. 1988) by comparing mean values of the residuals. All data conformed to assumptions of normality and homogeneity of variance except antler point data which we transformed using a square root transformation (Zar 1984). Multiple comparisons were conducted when main effects were significant ($P < 0.05$) using Fischer's least square differences procedure (Hicks 1993). To test for morphometric and birth date differences in deer from management areas in different physiographic regions, we used a nested ANOVA with management area nested within physiographic region (PROC GLM; SAS Inst. 1988): area within region was used as the error term to test for regional effects. We used a Bonferroni correction for all multiple comparisons to keep the experiment-wise error rate at a statistical significance level of $\alpha = 0.05$. A chi-square test was used to compare proportions of deer with forked antlers among groups and among physiographic regions (PROC FREQ; SAS Inst. 1988), and a t-test was used to compare mean date of birth between fork- and spike-antlered deer (PROC TTEST; SAS Inst. 1988).

Results

Approximately 25% of the deer in our sample were in Group 1, 51% were in Group 2, and 24% were in Group 3 based upon birth dates as described earlier. Mean birth date was estimated to be 19 July. Because we did not detect year effects ($P >$ 0.05), we pooled data across the 2 years of collection for all analyses. Mean body mass decreased ($F_{2,674}$ = 34.55; P = < 0.001) as birth date became later and was greater (P < 0.05) in Group 1 ($\bar{x}$ = 50.7 ± 0.5 kg) than Group 2 ($\bar{x}$ = 47.3 ± 0.4 kg) or Group 3 ($\bar{x}$ = 44.8 ± 0.5 kg): body mass was also greater (P > 0.05) in Group 2 than Group 3 (Fig. 2A). Length of the main beams decreased ($F_{2,622}$ = 34.93; P = < 0.001) as birth date became later and was greater (P < 0.05) in Group 1 ($\bar{x}$ = 18.3 ± 0.6 cm) than Group 2 ($\bar{x}$ = 14.7 ± 0.4 cm) or Group 3 ($\bar{x}$ =11.22 ± 0.5 cm): length of main beams was also greater (P <0.05) in Group 2 than Group 3 (Fig 2B). Circumference of the main beams decreased ($F_{2,620}$= 11.34; P < 0.001) as birth date became later and was greater (P < 0.05) in Group 1 ($\bar{x}$ = 5.54 ± 0.11 cm) than Group 2 ($\bar{x}$ = 5.28 ± 0.12 cm) or Group 3 ($\bar{x}$ = 4.58 ± 0.11 cm): circumference was also greater (P < 0.05) in Group 2 than Group 3 ($\bar{x}$ = 4.58 ± 0.11cm) (Fig 2C). Number of antler points decreased ($F_{2.668}$ = 20.83; P < 0.001) as the birth date became later and was greater (P < 0.05) in Group 1 ($\bar{x}$ = 3.10 ± 0.11) than Group 2 ($\bar{x}$ = 2.62 ± 0.06) or Group 3 ($\bar{x}$ = 2.30 ± 0.06): antler points was also greater (P < 0.05) in Group 2 than Group 3 (Fig. 2D). We found a decrease (x^2 = 38.35, *df* = 2; P < 0.001) in the proportion of fork-antlered deer as birth date increased (Fig. 3). Group 1 had a greater proportion (49.1)% of fork-antlered deer than Group 2 (31.4%; x^2 = 15.09; *df* = 1; P < 0.001) and 3 (17.5%; x^2 = 37.48, *df* = 1; P < 0.001), and Group 2 had a greater (x^2 = 11.05, *df* = 2; P = 0.001) proportion of fork-antlered yearlings than Group 3. We also observed a difference (t_{675} = 6.10; P < 0.001) between mean date of birth of spike- and fork-antlered deer (23 Jul and 26 Jun, respectively).

Date of birth did not differ ($F_{3,16}$ = 0.48; P = 0.700) among physiographic regions. We did not detect any birth group*physiographic region interactions (P > 0.363), so we were able to test for differences in physical characteristics of yearling males between physiographic regions without confounding effects of birth date. We did not detect differences in body mass ($F_{3,16}$ = 0.79; P = 0.519) or the circumference of the main beams ($F_{3,16}$ = 2.79; P = 0.074) among deer from the 4 physiographic regions. However, we did detect differences in length of the main beam ($F_{3,16}$ = 8.15; P = 0.002) and the number of antler points ($F_{3,16}$ = 4.04; P = 0.026) among physiographic regions. Lengths of the main beam and number of antler points were less (P < 0.05) on deer harvested in the Lower Coastal Plain than the other physiographic regions. The Lower Coastal Plain had a lower proportion of fork-antlered deer (18.4%) that were harvested than the Appalachian Plateau (46.6%; x^2 = 34.98, *df* = 1; P < 0.001), Piedmont Plateau (40.9%; x^2 = 18.49, df = 1; P < 0.001), and Upper Coastal Plain (38.2%; x^2 = 22.49, df = 1; P < 0.001). We did not detect differences (P > 0.05) in proportion of fork-antlered deer among the Appalachian Plateau, Piedmont Plateau, or Upper Coastal Plain.

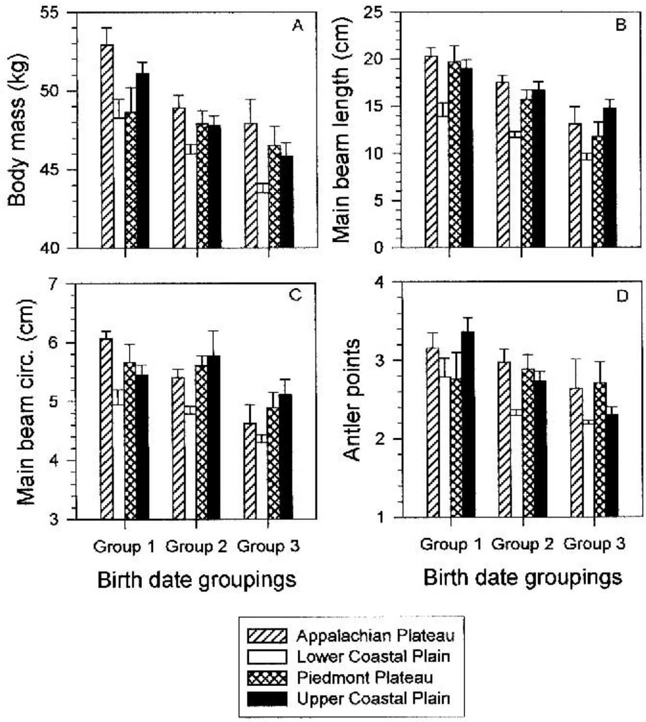

Figure 2. Means and SE bars of (A) body mass, (B) length of the main beam, (C) basal circumference of the main beam, and (D) number of antler points of yearling male white-tailed with early birth (Apr–May; Group 1), mid-season (Jun–Aug; Group 2), and late (Sep–Nov; Group 3) birth dates on 23 wildlife management areas from 4 physiographic regions in Alabama during 1998–99 and 1999–2000.

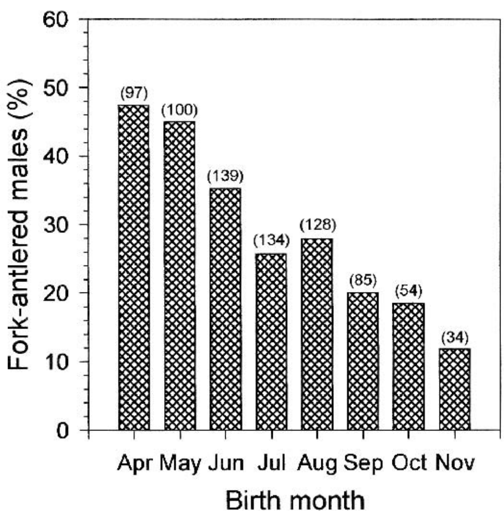

Figure 3. Percentage of yearling male white-tailed deer in each birth month with forked antlers (≥3 total antler points) on 23 wildlife management areas in Alabama during 1998–99 and 1999–2000.

Discussion

Factors that influence physical development in yearling male deer have been controversial and widely debated. Birth date is often referenced as a factor that may affect physical development in yearling males, yet there are few studies that quantify effects of birth date. Zwank and Zeno (1986) noted that birth date influenced weight gain in Louisiana fawns, and Knox et al. (1991) observed a significant relationship between estimated relative age and physical development of yearlings in South Carolina. Ostensibly, there are 2 primary reasons birth date may affect physical development of yearling males. First, earlier born fawns are born at a time when food items are more palatable and have greater nutritional value. In Louisiana, Thill and Morris (1983) found that nutritive values of deer diets decreased by an average of 43% for crude protein, 56% for phosphorous, and 9% for digestibility from mid-March to late May. Early born fawns have advantages of being nursed by well-fed does during a period of optimal habitat quality, and being weaned at a time when nutritional quality of the habitat is greater. Secondly, earlier born fawns have several additional months to develop. Such an animal could better afford to divert nutritional intake toward antler development at a later date (French et al. 1956).

Research conducted with captive herds in Texas suggests body size and antler development are primarily a function of genetic predisposition and these traits may be improved through selective harvest of animals with undesirable antler qualities, in particular spike-antlered yearlings (Brothers and Ray 1975, Harmel 1982). In a captive Louisiana deer herd, Shultz and Johnson (1992) found similar but inconclusive antler development patterns among yearlings. Differences in total antler points and antler mass between spike and fork-antlered yearlings were undetectable by age 4.5. Other studies (Jacobson and White 1985, Lukefahr and Jacobson 1998) have concluded that physical characteristics of yearling males can not be used to accurately predict future potential for body mass and antler development.

While the role of genetics in physical development of deer can not be discounted, other factors may be equally important. In sub-optimal habitats, poor soil and/or nutritional conditions may negate potential advantages of an early birth. Effects of birth date also may be negated in areas where habitat quality or soil fertility is high, but excessive deer densities have degraded range quality. Conversely, under optimal nutritional conditions, effects of birth date may be insignificant with respect to physical development of yearling males (Causey 1990). In Alabama, there is no conclusive data to suggest selective harvest strategies based on physical characteristics of yearling male deer are effective approaches for improving genetic characteristics of a population with regards to antler development.

Relatively late breeding and fawning periods reported for most Alabama deer populations may be the result of a genetic predisposition for this reproductive trait. There is considerable research to suggest deer herds skewed heavily toward females and having buck age structures consisting primarily of yearling males are typically characterized by asynchronous breeding and fawning periods (Gruver et al. 1984, Ozoga and Verme 1985, Guynn et al. 1986, Miller et al. 1987). Management strategies designed to improve adult sex ratios, reduce (if necessary) or stabilize total deer numbers, and improve antlered buck age structure may help address the problem of protracted breeding and fawning periods. Reproductive surveys conducted in Alabama indicate properly balanced herds display earlier mean conception/parturition dates as well as shorter ranges of conception and parturition (Gray, unpubl. data).

Differences in antler development noted for deer in the Lower Coastal Plain (LCP) region may be attributed to several factors. Typically, deep sands and lower natural fertility (with the exception of prairie soils found in the black-belt) characterize soils of this region. Consequently, browse items are, on average, of lower nutritive value than those found in other, more fertile soil regions. This LCP region encompasses approximately the entire southern half of Alabama. Historically, excessive deer densities have been reported for this region far longer than in any other region of the state. Large tracts of privately held lands and relatively limited hunting have resulted in exponential population growth in recent decades across much of the LCP region. A further reduction in overall habitat quality has occurred over much of this area as excessive deer populations have over-browsed an already limited number of nutritious forage species.

Data gathered in this study as well as data gathered throughout Alabama indicate high variability in breeding and fawning periods. Consequently, physical development of yearling male deer is highly variable as well. Our data suggest birth date has a significant effect on physical development of yearling male deer. In addition, our data suggest that physiographic region, or more specifically, soil quality, also influences antler development of yearling male deer. In Alabama, the concept of genetic enhancement through selection for or against a particular phenotypic "profile" among yearling males must be questioned. Use of selective harvest techniques in Alabama may be most appropriate on areas where long-term harvest histories are available, habitat quality is excellent, and breeding/fawning periods are relatively uniform. Even under such conditions, selective harvest, or "culling" may be most effective when applied to older age classes of males ($\geq$3.5 years old).

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