Home Range and Mortality of White-Tailed Deer Fawns in Coastal South Carolina

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Abstract: During the summers of 1981 and 1982, 48 white-tailed deer *(Odocoileus virginianus)* fawns were captured and radio-collared on the Cat and South island portions of the Tom Yawkey Wildlife Center, Georgetown, South Carolina. Significantly ($x^2 = 4.10$, $P < 0.05$) more male fawns were captured than females. Telemetry and visual locations ($N = 731$, range = 18 to 224) were taken on 11 fawns. All fawns utilized open inter-tidal marsh/marsh edge habitat. Home range and activity of individual fawns were highly variable. Mortality of radio collared fawns was 84.4% (38 of 45). Marking activities were directly responsible for the death of 3 fawns. Of the 45 fawns included in the mortality analysis, 89.5% died within 1 month of age. High fawn mortality may regulate or stabilize the size of the South Island deer population.

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Information on home range and mortality of white-tailed deer fawns in the coastal southeastern United States is minimal. These factors were studied on the Tom Yawkey Wildlife Center because the area has minimal disturbance by man, no predator control program, no competition from livestock and no alternate large prey species. Using the same data base, Epstein et al. (1983) reported the extent of pre-

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dation on fawns by bobcats *(Felis rufus)*, red foxes *(Vulpes vulpes)*, gray foxes *(Urocyon cinereoargenteus)* and alligators *(Alligator mississippiensis)*, and developed criteria for assessing predator damage. Objectives were to determine: (1) fawn home ranges in relation to age in coastal maritime habitats; and (2) mortality of fawns.

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Methods

The 8,100-ha Tom Yawkey Wildlife Center comprises 3 islands in the northeastern Coastal Sea Island Region of South Carolina. The study was conducted on South and Cat islands; North Island was not included. South and Cat islands are separated from the mainland by the Atlantic Intracoastal Waterway and from each other by a brackish marsh about 1.6-km wide. This marsh does not prohibit movement of deer between islands. An earthen causeway connecting the 2 islands allows inter-island automobile traffic. Details of the study area are given in Epstein (1983). Predators include bobcats, red foxes, gray foxes, and alligators (Epstein et al. 1983).

Use and management of this property were stipulated in the late Thomas A. Yawkey's will to include wildlife management, education, and research. Specifically, South Island was to be managed primarily for waterfowl feeding and protection, and Cat Island as a refuge for migratory waterfowl, and game and nongame wildlife.

The Coastal Sea Island Region has warm, humid summers and short, mild winters. Mean annual temperature is 18° C. Mean annual precipitation is 132 cm (Stuckey 1982). Average rainfall is 64 cm during the fawning season (April-August); however, droughts are not uncommon. Like many sea island locations, extremely high densities of nuisance insects *(Dipterans)* inhabit the study area.

Newborn fawns were located from April-August 1981 and 1982 by searching likely habitat, observing solitary does, and spotlighting at night. Age of fawns was estimated by color, condition, and growth of hooves and dewclaws, condition of umbilicus, degree of agility, and behavior (Haugen and Speake 1958). Fawns were captured and fitted with expandable, motion-sensitive radiotransmitter collars (Telemetry Systems, W1). From 1-3 telemetry locations per individual were taken daily. Home ranges were calculated for 11 fawns surviving $\geq$20 days postcapture

using the minimum-range method (Dalke and Sime 1938). This method is frequently used and thus allows comparisons with previous studies. The cause of death was determined whenever possible (Epstein et al. 1983).

Results

Forty-eight fawns were captured, 40 on South Island and 8 on Cat Island. More males ($N = 31$; $x^2 = 4.10$, $P < 0.05$) were captured than females. The higher capture success on South Island was due perhaps to more open habitat and concentration of deer in a relatively limited area. Of the 40 fawns taken on South Island, 30 were captured in the northern portion and 10 on the diked portion.

Home Range.—Individual home ranges varied from 9.7 ha to 70.2 ha. Home range size and number of telemetry locations were not significantly correlated. Predominant habitat use varied considerably among fawns. For example, 5 fawns remained exclusively in marsh/dike habitats; 2 fawns mainly used upland or maritime forests. All fawns used marsh/dike habitat to some extent. Of 731 telemetry and visual locations for 11 fawns analyzed, 335 (45.7%) were in marsh/dike habitat. Twin fawns (#5-82 and #12-82) bedded separately until 2.5 weeks of age. They bedded together more often after 3 weeks of age. Mean home range generally increased with age of fawns with the largest mean increase between 4 and 6 weeks of age (Table 1).

Mortality.—Capture activities resulted in the death of 3 fawns; 1 each from abandonment (starvation), predation, and accident. These fawns were not included in mortality statistics. Of 45 fawns included in analyses of mortality, 7 survived during the study period. Thirty-five of 45 fawns (77.8%) were captured in May or June. Thirty of 38 fawn mortalities (78.9%) also occurred during this period (Fig. 1). During June, the average age of fawns at death was 19.5 days with a mean of 12 days between capture and mortality. There was no difference in mean age at time of capture for fawns that survived ($\bar{x} = 13.2$ days, SD = 11.0) versus those that died ($\bar{x} = 8.2$, SD = 7.2) ($t = 1.38$, $P > 0.05$). Similarly, there was no difference in the average age at death for fawns dying due to predation versus starvation. Of the 38

Table 1. Mean home range areas at 2-week intervals of white-tailed deer fawns on the Tom Yawkey Center, Georgetown, S.C., 1981–82.

Age of fawns (weeks)	*N* fawns[a]	Total *N* locations	Mean home range (ha) ± SD
0–1+	8	110	12.1 ± 12.3
2–3+	8	160	13.8 ± 5.0
4–5+	7	146	24.1 ± 10.2
6–7+	4	111	33.4 ± 24.9
8–9+	3	99	22.7 ± 4.6
10–12	2	42	28.8 ± 1.7

[a]A different combination of fawns makes up each age group depending on age at capture and mortality patterns. Sexes are combined.

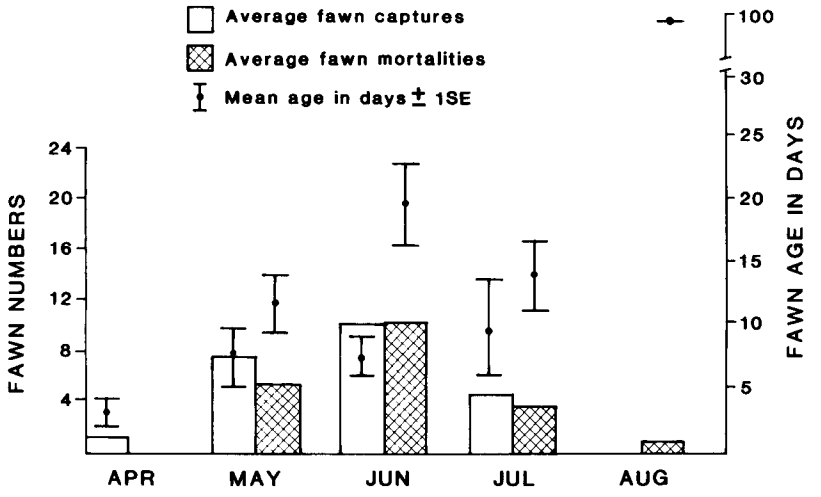

Figure 1. Chronology of average monthly fawn captures and mortalities during 1981 and 1982 on the Tom Yawkey Wildlife Center, Georgetown, S.C.

radio-collared fawns that died of natural causes, 13 died within 1 week of age, 9 within 2 weeks of age, 9 within 3 weeks of age, and 3 within 4 weeks of age. Thus, of 38 fawn mortalities, 34 (89.5%) occurred before 1 month of age. Three other fawns died within 60 days of age, and 1 was 95 days old when preyed upon by an alligator. For those fawns that died, there was no relationship between the age at capture and the subsequent length of survival ($R = -0.03$).

Predation was the greatest cause of fawn mortality (Table 2). Bobcats were the main predator, with foxes and alligators less significant factors (Epstein et al. 1983). Diseases included peritonitis, dermatophilosis, and staphylococcal infection. One fawn death was attributed directly to anemia and hypovolemia. All starvation and disease-related fawn deaths occurred on South Island. For fawns that died of starvation, it was not possible to distinguish between those that had been abandoned and those that starved for other reasons.

Table 2. Number and causes of radio-collared white-tailed deer fawn mortalities on the Tom Yawkey Center, Georgetown, S.C., 1981–1982.

	South Island		Cat Island		
Cause of death	1981	1982	1981	1982	Totals
Predation	11	8	3	3	25
Starvation/disease	4	8	0	0	12
Accident	1	0	0	0	1
Total fawn mortality	16	16	3	3	38
Total fawn survival to 1 Nov	1	5	0	1	7

Discussion

Diel home ranges for fawns were generally smaller than those in southwestern Alabama (Byford 1970). Differences in home range calculation methods, habitat, terrain, food availability, predation, insect density, and management programs affect the home range size of fawns. In this study, home range and activity of individual fawns were quite variable. Some of the variability possibly was the result of supplemental feeding and insect harassment. Some fawns increased their home ranges by accompanying dams to feeders. Linear diel movement of 2 such fawns, whose actual ranges were just outside the feeding area, was about 1,609 m. Fawns were observed at feeders as early as 10 days of age. However, they were not observed actually eating from the feeders until about 30 days old. As found by Garner and Morrison (1977) and Ozoga et al. (1982), home range sizes of fawns in this study generally increased with age. The greatest increase occurred between 4 and 6 weeks of age and coincided with actual use of supplemental food. However, the actual use of feeders by fawns may not be an important factor in predation since most fawns died prior to 4 weeks of age. Most fawns did not have to increase their home range to use a feeder because home ranges of many fawns less than 4 weeks of age already encompassed one.

The supplemental feeding program concentrates deer in the north section of South Island and may create an "ecological trap" (Gates and Gysel 1978) by concentrating fawns, and thereby increasing mortality rates (Ozoga et al. 1982). Predators may have increased their chance of success by "keying" on feeders, especially in overbrowsed habitat with reduced cover for fawns. Three fawns not affected by feeders generally remained in the area of capture; 2 of these fawns were killed by predators.

Insect harassment can stress ungulates in certain coastal areas (Keiper and Berger 1982). Epstein (1983) observed that insect annoyance influenced fawn movements, habitat selection, and other avoidance behavior that may have predisposed fawns to predation and mortality. Intense and/or prolonged disruption factors that decrease lactating, feeding or grooming, or increase energy expenditure, affect the health of fawns and dams (Harwood and James 1979). Fawn necropsies showed numerous petechical hemorrhages in the subcutis of the forehead, back, and legs, presumably the result of insect bites (E. Couvillion, pers. commun.). At capture, these fawns had hair around the forehead and ears matted with dried blood, again probably the result of feeding insects. The death of 1 fawn from anemia and hypovolemia was directly attributed to hematophagus insects. Also, a tagged yearling from 1981 had Elaeophorosis, which is transmitted by biting flies. Insect annoyance appeared to be high on both islands. Fawns and adults may have used marsh habitat primarily to avoid periods of high insect abundance (Epstein 1983), although thermoregulatory benefits also are likely (Keiper and Berger 1982). One-third of Louisiana's white-tailed deer population lives in coastal marshes (primarily fresh marshes), and prefers sites similar to impoundment dikes for travel, bedding and fawning (Gos-

selink 1984). The white-tailed deer herd on the Tom Yawkey Wildlife Center has been supplementally fed for over 30 years. Good antler development, large body size, and low abomasal parasite counts (Moore 1976, R. L. Joyner unpubl. data) indicate deer on both islands are not nutritionally stressed. For the South Island herd, the main stabilizing factor was high fawn mortality. High fawn mortality is common in dense deer herds (Cook et al. 1971, White 1973, Garner et al. 1976, Carrol and Brown 1977). In the north end of South Island the herd has remained at a high density without die-offs for 30 years. Predation was an important factor on Cat Island, but comparisons with South Island are limited because of small samples and differences in habitat and management. Although there is some inter-island movement of deer, dispersal rates are unknown.

In conclusion, no single factor was responsible for the high fawn mortality. On South Island, high predation rates of fawns, in addition to other important mortality factors, were an effective natural control on a dense, healthy, unhunted deer population, and probably contributed significantly to herd stability for the past 30 years.

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