Survival Rates and Adult Accompaniment of White-tailed Deer Fawns on Remington Farms

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Abstract: During the summer and fall of 1991 and 1992, 48 (21 M:27 F) white-tailed deer (*Odocoileus virginianus*) fawns were captured and radiocollared ($N = 43$) on Remington Farms near Chestertown, Maryland. Survival of radio-collared fawns, from 1 week old until the fall hunting season, was 91%. Collared fawn mortality ($N = 9$) was due to abandonment, tick infestation, infection, and roadkill. Visual locations ($N = 1,229$) were collected to determine adult accompaniment rates for radio-collared fawns. The likelihood of a fawn being with or without an adult was independent of sex of the fawn ($P > 0.10$). Hunting data from 1981–92 indicate that the number of male and female fawns killed ($N = 287$) was not significantly different overall ($P > 0.10$). However, buck fawns were more likely than doe fawns to be killed in the first half of the 1-week shotgun season ($P < 0.05$, $N = 265$).

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White-tailed deer are an important natural resource subject to regulatory management. To meet the demands of the public for defensible management practices and strategies, we need to expand our understanding of deer population dynamics. Identification of the causes and rates of fawn mortality is necessary to improve our understanding of herd dynamics.

White-tailed deer fawn mortality rates before the hunting season are site dependent and highly variable. High summer mortality has been documented in Oklahoma (64%, Logan 1972; 88%, Garner et al. 1976) and Texas (72%, Cook et al. 1971). In comparison, lower summer mortality rates have been reported in the East (8%, McGinnes and Downing 1969; 23%, Ozoga et al. 1982; 27%, Huegel et al. 1985; 30%, Nelson and Woolf 1987).

Managers who establish harvesting strategies for a specific sex ratio or for trophy concerns must consider the possibility that fawns of different sexes are not equally vulnerable to hunting. There is some evidence that male fawns are harvested at higher rates than female fawns (Roseberry and Klimstra 1974, Roseberry and Woolf 1988); however, Anderson (1953) and Dusek et al. (1989) found no, or only partial, evidence of greater buck fawn vulnerability.

Differential fawn vulnerability could result from behavioral differences between sexes (Roseberry and Klimstra 1974, Coe et al. 1980, Roseberry and Woolf 1988). Coe et al. (1980) reported that male fawns were more likely to travel alone. This could lead to buck fawns being more vulnerable to harvest than doe fawns because buck fawns would not be traveling with larger adults that are more attractive targets for hunters.

Our objectives were: (1) to estimate fawn survivorship for the Remington Farms deer population, (2) to test the hypothesis that buck fawns are more vulnerable to hunting mortality than are doe fawns, and (3) to test the hypothesis that male fawns are more vulnerable to mortality than are female fawns because they spend more time unaccompanied by adults.

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Methods

Field work was conducted on Remington Farms located on the northeast shore of Chesapeake Bay in Kent County, Maryland. Remington Farms is a 1,330-ha cash-grain farm and wildlife management demonstration area. The farm is 50% forested in predominantly non-alluvial swamps, with oaks (*Quercus alba, Q. falcata, Q. palustris, Q. phellos, Q. rubra*), sweetgum (*Liquidambar styraciflua*), black gum (*Nyssa sylvatica*), and red maple (*Acer rubrum*) as the primary tree species, and an understory composed of greenbrier (*Smilax* spp.), sweet pepperbush (*Clethra alnifolia*), and highbush blueberry (*Vaccinium corymbosum*). Crop fields, mostly corn, soybeans, and winter wheat, constitute 33% of the farm. The remaining 17% is wildlife cover areas such as multiflora rose (*Rosa multiflora*), other early successional species, and 80 ha of man-made waterfowl impoundments.

Fawn Capture and Survival

Fawns were captured during drive and foot searches beginning in May in 1991 and 1992. While we searched from vehicles, we observed behavior of solitary does to aid in locating fawns (Downing and McGinnes 1969, White et al. 1972). During mid-day we made foot searches in pairs along forest edges and hedge rows.

Captured fawns were sexed, weighed, and ear tagged; the number of ticks were counted on the ears, around the eyes, and under the chin. We handled fawns with cotton gloves, and handling time was recorded for each fawn. We equipped

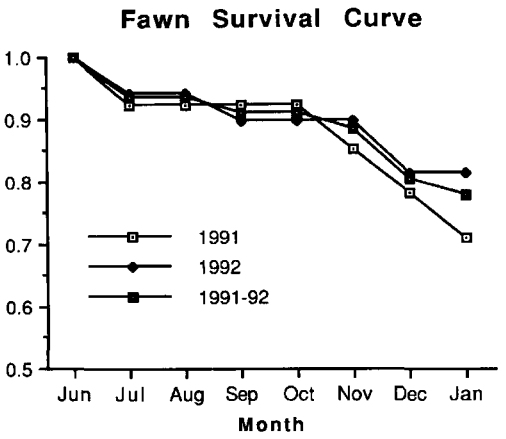

Figure 1. Survival rates for collared fawns on Remington Farms, Maryland, 1991–92.

fawns with mortality-sensing transmitters (model 5A Fawn Tabs, Advanced Telemetry Systems, Isanti, Minn.) mounted on expandible collars (Wickham 1993).

Telonics® model TR-2 receivers and a hand-held, 4-element yagi antenna were used to locate collared fawns. Signals were checked twice daily until 20 July and once a day thereafter until the second week in January. We used the Kaplan-Meier procedure (Pollock et al. 1989) to calculate survival from June through early January. We used a log-rank test to compare the estimates for each season to see if they could have come from the same underlying true survival curve (Pollock et al. 1989).

Differential Fawn Vulnerability

To test the hypothesis that buck fawns are more vulnerable to harvest than doe fawns, we examined the shotgun harvest record from 1981–92. Bow season spans mid-September to late January, and muzzle loader season is from mid-December until early January. However, about 80% of the harvest is during a 1-week shotgun season at the end of November.

Assuming an equal sex ratio of fawns entering hunting season (sex ratio of captured fawns was 1:1; see below), if buck fawns are more vulnerable than doe fawns, one would expect more buck than doe fawns to have been harvested over the 1981–92 period. A Chi-square test was used to make this comparison. To see if a temporal bias was evident, we used a Chi-square test to compare buck and doe fawn harvest totals for the first 3 days of the 7-day shotgun seasons to totals in the last 3 days.

To explore the hypothesis that buck fawns were more vulnerable to hunting than doe fawns because buck fawns spend more time unaccompanied by a larger adult which a hunter would consider a more desirable target, we asked hunters if the deer they harvested was with any adults when it was killed. We used questionnaires in 1991 and polled hunters at a check station in 1992.

To test the hypothesis that buck fawns spend more time unaccompanied by an adult, each radio-marked fawn was visually located 2–3 times a week beginning in late June. The order for locating fawns and the time for initiating tracking were determined randomly. Time of sighting, habitat, and the number of deer (adults and fawns) within 50 m of the observed fawn were recorded. We used a limit of 50 m because we reasoned that hunters would have difficulty comparing sizes of deer at greater distances. Chi-square tests were used to check for differences between the sexes in the likelihood of a fawn being with or without an adult.

Results and Discussion

Survival Estimates

A total of 48 fawns were captured in both field seasons (21 M, 27 F). The fawns weighed an average of 5.0 ± 1.3 kg (N = 44). Fawns receiving collars (N = 43) were handled for 12.8 minutes on average. There were no cases of transmitter failure or prolonged fawn disappearances.

Capture induced abandonment might have resulted in the deaths of 5 fawns; these fawns were censured from the survival analysis. Of the 38 remaining, 34 survived until the November hunting season. One lost its collar in early October and the other 3 died. The 3 deaths were attributable to a bladder/intestinal infection, tick infestation, and car accident.

Survivorship from capture at approximately 1 week of age through the end of the hunting season in January was 71% for fawns collared in 1991 and 81% for 1992. The log-rank test detected no significant difference between the years (P > 0.25), indicating they could have come from the same underlying survival curve. Survivorship data were pooled for a 78% survival estimate (Fig. 1). After October, the only mortality was due to hunting. Of the fawns radio-collared at the first week of age, 91% were alive (31/34) at the beginning of the hunting season, and of those entering the hunt, 85% survived (29/34) through its conclusion in January.

Ozoga and Clute (1988) reported that captured and tagged fawns suffered less mortality than unhandled fawns. They suggest that because many fawns die when <2 days old and therefore before they are captured for tagging, the healthier individuals are more likely to be taggeed causing mortality rates to be underestimated. Although the estimated 91% survivorship for fawns on Remington Farms from age 1 week up until the hunting season in November should be accurate for those surviving the initial week of life, the true rate is probably slightly lower.

Ten mortalities of noncollared fawns <1 week old were recorded. A rough survival estimate was calculated for the first week of life using the 10 known mortalities of fawns <1 week old and fawns known to have survived the first week. This second category consisted of fawns that were (1) collared and survived their first week, or (2) chased but not captured due to their speed (fawns that could out-run us were probably ≥1 week old). In total, 96 fawns (10 that died, 86 that lived) were included in the analysis yielding a first-week survival estimate of 90% (Fig. 2).

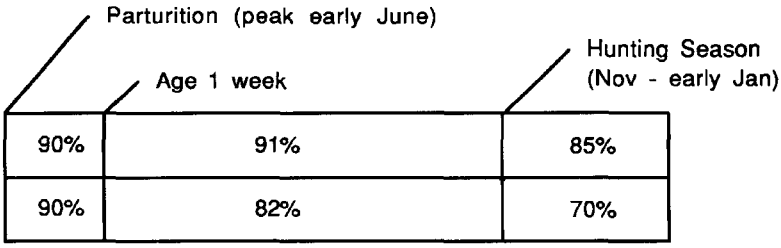

Figure 2. Survival estimates for fawns on Remington Farms, Maryland, 1991–92. Estimates for isolated periods given in upper boxes, cumulative estimates in lower boxes.

Differential Vulnerability

Coe et al. (1980) pointed out that if the number of animals entering the hunting season from each sex and age class is not known, no accurate measure of the harvest rate of each sex and age class is possible. However, Remington Farms was high quality range, captured fawn sex ratios were roughly even ($P > 0.25$, 21 M: 27 F), mortality was low (2 M: 1 F), and radio-marked fawns did not stray from the area. Therefore, we do not believe the sex ratio of fawns entering the hunt was skewed.

Harvest data from the 1981–92 shotgun seasons (Table 1) indicate that the number of male fawns killed was not significantly greater than the number of female fawns killed ($P > 0.10$, $N = 315$, 1 df). However, temporal analysis of the data shows that buck fawns were more likely than doe fawns to be killed in the first 3 days (78M : 54F) of the 1-week shotgun season than in the last 3 days (77M : 84F) ($P < 0.05$, $N = 293$, 1 df).

Using Illinois harvest record data for 1979–85 (Roseberry and Woolf 1988), a temporal bias was detected there as well. During Illinois' 6-day firearm season, not only were buck fawns more likely than doe fawns to be killed in the first half (days 1–3, 23,594M : 15,347F; days 4–6, 9,412M : 8,563F) ($P < 0.001$), they also were killed in significantly higher numbers overall (33,006M : 23,930F) ($P < 0.001$). However, prehunt herd composition of male:female fawns was unknown.

If buck fawns have a greater tendency to be active without an adult and thus are more vulnerable, then one would expect buck fawns to predominate in both the early and late portions of the 1-week hunting season. However, female fawns predominated in the latter portion of the season. Therefore, as the hunt progressed,

Table 1. Fawn harvest during 7-day shotgun seasons at Remington Farms, Maryland, 1981–92.

	Day							
Sex	1	2	3	4	5	6	7	Total
M	36	25	17	13	6	23	48	168
F	22	21	11	9	21	23	40	147

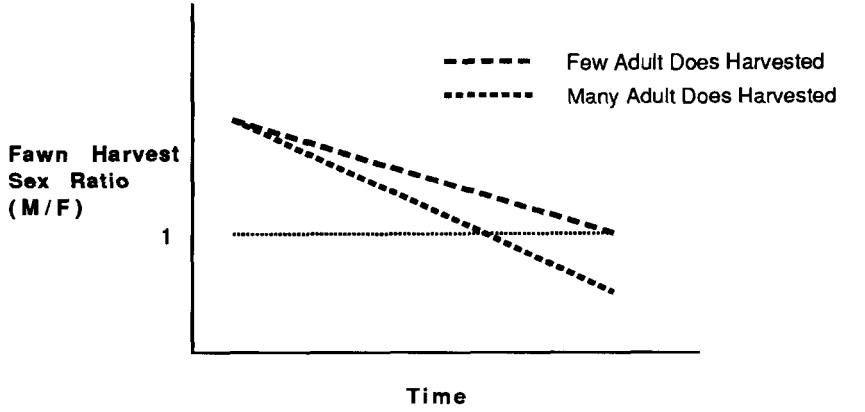

Figure 3. A schematic representation of changes in fawn harvest sex ratios. The solid line is indicative of the Illinois 1979–85 data (Roseberry and Woolf 1988) where the adult harvest sex ratio was 158M : 100F, and buck fawns were killed in larger numbers than doe fawns throughout the hunt. The dot-dash line is more indicative of the Remington Farms 1991–92 data where the adult harvest sex ratio was 49M : 100F, and initially buck fawns were killed in larger numbers than doe fawns. Note that a point on the line depicts the ratio at that point in time, not the cumulative harvested fawn sex ratio. A hunt typical of the upper line would end with a greater number of buck fawns killed than doe fawns, whereas a hunt typical of the lower line would end with a more balanced total.

some counterbalancing factor appears to have been operating on Remington Farms. Possibly during the second half of the hunt, the number of orphaned doe fawns increased due to dams being harvested, so that buck fawns were no longer more likely than doe fawns to be alone. If this is correct, then fawns, regardless of sex, would have had equal probabilities of being unaccompanied by an adult, and M:F fawn harvest ratios would even out or actually be biased towards does. In the latter half of the hunting season, doe fawns actually could be more numerous than buck fawns, because many more buck fawns were harvested in the first half of the hunt. If doe fawns become increasingly vulnerable as the hunt progresses due to orphaning, then areas that harvest relatively fewer adult does (thereby orphaning relatively fewer fawns) should have fawn harvest sex ratios more strongly biased towards bucks (Fig. 3). In areas where relatively more adult does are harvested, fawn harvest sex ratios should be more balanced. The Illinois and Remington data, respectively, fit these 2 scenarios.

Adult Accompaniment

Chi-square analysis for all months, June–November 1991 and 1992 indicated that the likelihood of a fawn being with or without an adult was independent of the sex of the fawn during these periods ($\alpha = 0.05$). Combined data for 1991–92 for these months also showed no significant differences (Table 2).

The majority of our observations occurred while the fawns were bedded, and therefore the results cannot be considered reliable indicators of how time was

Table 2. Chi-square analyses (1 df) for independence in the likelihood of fawns, by sex (M=male), being with or without an adult at Remington Farms, Maryland, 1991–92.

	1991					1992					91–92				
	w/adult		w/o adult			w/adult		w/o adult			w/adult		w/o adult		
Month	Total	M	Total	M	*P*	Total	M	Total	M	*P*	Total	M	Total	M	*P*
Jun–Jul	22	11	104	39	0.25	25	6	216	86	>0.10	47	17	320	125	0.50
Aug	10	2	59	23	0.25	33	10	65	21	0.90	43	12	124	44	0.50
Sep	32	16	45	18	0.25	43	9	53	19	>0.10	75	25	98	37	0.90
Oct	59	34	56	24	>0.10	95	36	88	31	0.90	154	70	144	55	0.20
Nov	60	26	29	14	0.50	90	30	45	20	0.25	150	56	74	34	0.25

spent when fawns were active. When active fawns were spotted, we could not be certain that activity was not merely due to our presence.

Because a fawn is more likely to be with its dam than another adult, a better method would be to collar does and their fawns. Simultaneous locations of the pair could be taken to determine if they were together. This method has advantages over collaring fawns only because: (1) actual sightings are not needed so more "snapshots" could be taken more quickly, (2) data could be collected when visibility is poor, including early morning and dusk, and (3) the animals would be subject to less disturbance and could be tracked more frequently without affecting behavior. Telemetry accuracy would, however, have to be sufficient to resolve small distances.

Hunter surveys in 1992 indicated that harvested fawns were more likely not to be accompanied by an adult (19/25) than to be accompanied (6/25, $P < 0.01$) (Table 3). A difference between the sexes was not detected ($P > 0.25$); however, the trend was for a higher proportion of male fawns to be unaccompanied (11/13, 85%) than female fawns (8/12, 75%). Fawns were more likely (19/25) to be unaccompanied by an adult when harvested than were adults (41/94, $P < 0.001$). There were no differences in accompaniment rates for adults ($P = 0.20$) or for male and female adults ($P = 0.50$).

Table 3. Adult accompaniment of harvested deer on Remington Farms, Maryland, 1992.

Deer harvested	w/adult	w/o adult	Total
Fawns:			
Male	2	11	13
Female	4	8	12
Total	6	19	25
Adults:			
Male	15	14	29
Female	38	27	65
Total	53	41	94

Management Implications

Fawn survival was high on Remington Farms. Therefore, if an increase in the deer population were a goal, it would be impractical to try to increase fawn survival prior to the hunting season. Because fawns, regardless of sex, were most often killed while alone, a biologist managing to increase the number of bucks in a herd could possibly reduce the harvest of all fawns, and thereby the button buck harvest, by requesting hunters not to shoot solitary antlerless deer.

Such a strategy could best be employed in areas where hunter success rates are high, and it would likely increase the harvest of adults rather than reduce the overall harvest. Cover density could limit the usefulness of this practice. At the Radford Army Ammunition Plant in Dublin, Virginia, hunters reported 21% of the deer killed were alone (Coe et al. 1980). In contrast, 87% at the Savannah River Project, Aiken, South Carolina, and 68% of the deer harvested at the Piedmont National Wildlife Refuge, Round Oak, Georgia, were reported to be alone (Coe et al. 1980). Coe et al. (1980) believed that this was due to differences in cover density, rather than a difference in deer behavior. If hunters perceive most deer as being solitary, then asking them not to shoot solitary antlerless deer could reduce hunter success rates to unacceptable levels.

Literature Cited

Anderson, J. 1953. Analysis of a Danish roe-deer population. Danish Rev. Game Biol. 2:127–133.

Coe, R. J., R. L. Downing, and B. S. McGinnes. 1980. Sex and age bias in hunter killed white-tailed deer. J. Wildl. Manage. 44:245–249.

Cook, R. S., M. White, D. O. Trainer, and W. C. Glazner. 1971. Mortality of young white-tailed deer fawns in south Texas. J. Wildl. Manage. 35:47–56.

Downing, R. L. and B. S. McGinnes. 1969. Capturing and marking white-tailed deer fawns. J. Wildl. Manage. 33:711–714.

Dusek, G. L., R. J. Mackie, J. D. Herriges, and B. B. Compton. 1989. Population ecology of white-tailed deer along the lower Yellowstone River. Wildl. Monogr. 104. 68pp.

Garner, G. W., J. A. Morrison, and J. C. Lewis. 1976. Mortality of white-tailed deer fawns in the Wichita Mountains, Oklahoma. Proc. Southeast. Assoc. Fish and Wildl. Agencies 30:493–506.

Huegel, C. N., R. B. Dahlgren, and H. L. Gladfelter. 1985. Mortality of white-tailed deer fawns in south-central Iowa. J. Wildl. Manage. 49:377–380.

Logan, T. 1972. Study of white-tailed deer mortality on Cookson Hills deer refuge, eastern Oklahoma. Proc. Southeast. Assoc. Game and Fish Comm. 26:27–38.

McGinnes, B. S. and R. L. Downing. 1969. Fawn mortality in a confined Virginia deer herd. Proc. Southeast. Assoc. Game and Fish Comm. 23:188–191.

Nelson, T. A. and A. Woolf. 1987. Mortality of white-tailed deer fawns in southern Illinois. J. Wildl. Manage. 51:326–329.

Ozoga, J. J., and R. K. Clute. 1988. Mortality rates of marked and unmarked fawns. J. Wildl. Manage. 52:549–551.

———, L. J. Verme, and C. S. Bienz. 1982. Partuition behavior and territoriality in white-tailed deer: impact on neonatal mortality. J. Wildl. Manage. 46:1–11.

———,
Pollock, K. H., S. R. Winterstein, C. M. Bunick, and P. D. Curtis. 1989. Survival analysis in telemetry studies: the staggered entry design. J. Wildl. Manage. 46:1–11.
Roseberry, J. L. and W. D. Klimstra. 1974. Differential vulnerability during a controlled deer harvest. J. Wildl. Manage. 38:499–507.
——— and A. Woolf. 1988. Evidence for and consequences of deer harvest data biases. Proc. Southeast. Assoc. Fish and Wild. Agencies 42:306–314.
White, M., F. F. Knowlton, and W. C. Glazner. 1972. Effects of dam-newborn fawn behavior on capture and mortality. J. Wildl. Manage. 36:897–906.
Wickham, B. M. 1993. Survival rates and adult accompaniment of white-tailed deer fawns on Remington Farms, MD. M.S. Thesis, N.C. State Univ., Raleigh. 45pp.