Fawn Survival on Davis Island, Mississippi, After an Early Summer Flood

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Abstract: We studied fawn survival during 1995 on Davis Island, Mississippi, an island in the Mississippi River. Newborn fawns were captured using line searches or vaginal implant transmitters. We captured 20 fawns with 8 surviving to 6 months. Cause of fawn mortality included coyotes (3) and natural mortality (2). Additionally, six fawns lost their transmitters and one transmitter failed. Overall survival rate of fawns to 180 days was 0.72. Male and female survival to 180 days was 0.66 and 0.78 respectively. Our results suggest fawn survival is not adversely affected by early summer flooding.

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Floodplain systems are driven by the flood pulse, which is responsible for the floodplains existence, productivity, and interactions of its organisms (Junk et al. 1989). Channelization of the Mississippi River began in the late 1800s followed by extensive levee construction starting in the 1920s (Reinecke et al. 1988, Fremling et al. 1989). This extensive levee system has protected farmland throughout the Mississippi Alluvial Valley (Reinecke et al. 1988). However, levees have caused areas inside the main Mississippi River levees, commonly known as the Batture, to be subjected to intensified flood pulses (Junk et al. 1989). The Batture area is relatively uninhabited and encompasses most of the remaining bottomland hardwoods in the Mississippi Alluvial Valley of Mississippi.

Many researchers have studied early survival of white-tailed deer fawns (*Odocoileus virginianus*) (Cook et al. 1971, Carroll and Brown 1977, Bartush and Garner 1979, Porath 1980, Kie and White 1985, Boulay 1992, Wickham et al. 1993). However, little data exists regarding fawn survival in bottomland hardwood

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systems. Estimates of survival rates have ranged from 9%–90% in various habitat types (Wickham et al. 1993, Bartush 1978). High mortality rates resulted primarily from predation, with most attributed to bobcats (*Lynx rufus*) and coyotes (*Canis latrans*) (Cook et al. 1971, Carroll and Brown 1977, Bartush and Garner 1979, Porath 1980, Kie and White 1985, Boulay 1992).

Recently, concern has arisen over the welfare of fawns when does are subjected to floods late in pregnancy. Sheppe and Osborne (1971) determined that floods profoundly affected faunal communities, from small mammals to large ungulates. The objective of our study was to examine early fawn survival in bottomland hardwoods on Davis Island, Mississippi, after an early summer flood pulse. Additionally, we compared our estimates of fawn survival to those from other studies.

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Study Area

Davis Island is a privately-owned 7,200-ha island in Warren County, 21 km southwest of Vicksburg, Mississippi, in the Delta physiographic region (Morgan 1995). Six hunting clubs were the primary use of the island with some agriculture and timber management also conducted. This area contained 1 soil association, Commerce-Robinsonville-Crevasse, ranging from poor drained to excessively drained soils with slopes of 0%–2% (Morgan 1995). Annual maximum and minimum temperatures averaged 25 C and 13 C, respectively (Natl. Oceanic and Atmos. Admin. 1994). The area experiences high humidity and an average annual precipitation of 142 cm (Natl. Oceanic and Atmos. Admin. 1995).

Vegetation communities were dominated by pecan (*Carya illinoensis*), sugarberry (*Celtis laevigata*), sweetgum (*Liquidambar styraciflua*), American sycamore (*Platanus occidentalis*), swamp cottonwood (*Populus heterophylla*), oaks (*Quercus* spp.), willows (*Salix* spp.), and baldcypress (*Taxodium distichum*) (Herriman 1983). Common understory associates were boxelder (*Acer negundo*), crossvine (*Anisostichus capreolata*), peppervine (*Ampelopsis arborea*), Alabama supplejack (*Berchemia scandens*), flowering dogwood (*Cornus florida*), common poison ivy (*Toxicodendron radicans*), dewberry (*Rubus trivialis*), greenbriar (*Smilax* spp.), and grape (*Vitis* spp.) (Herriman 1983).

The Mississippi River crested on 12–13 June 1995 at 14.3 m (47.0 ft.) on the Vicksburg Gauge. At this level of inundation, the entire island was covered except a few isolated high areas. No deer were seen on the island when an aerial check was made in early June. The river fell to 12.3 m (40.3 ft.) on the Vicksburg Gauge on 28 June. Deer usually begin returning to the island when levels fall below 12.2 m (40 ft.)

(Jacobson, unpubl. data). Ancillary observations supported this as we began to see deer swimming back to the island on 29 June. Deer were not restocked into this area of Mississippi; thus, they evolved under a system of natural flooding. Flood pulses are common in late winter or early spring, but a late summer flood occurs at least every 5–10 years.

Methods

We captured fawns using line searches or vaginal implant transmitters (Bowman and Jacobson 1998). Line searches consisted of 2–3 people walking in a line to systematically search the area. Additionally, we captured does pre-partum and implanted each with a transmitter in their vaginal canal (Bowman and Jacobson 1998). Vaginal implant transmitters were used to signal birth and immediately after birth searchers systematically searched the area around recovered transmitters (Bowman and Jacobson 1998). The search was expanded outward from the starting point until the fawn was located (Bowman and Jacobson 1998).

Each captured fawn received a solar ear tag transmitter (Advanced Telemetry Systems, Isanti, Minn.) and numbered cattle ear tag. We measured hindleg length, mandible length, crown-rump length, heart girth, and weight. Age was determined using physical and behavioral characteristics (Haugen and Speake 1958, Bartush 1978).

We located fawns daily using telemetry for the first 30 days following capture to determine survival and, when possible, causes of mortality. Most fawn survival studies have reported the highest mortality prior to 30 days post-partum (Cook et al. 1971, Logan 1972, Garner 1976, Bartush 1978, O'Pezio 1978, Epstein et al. 1984). Fawns were located at least once weekly until 90 days of age, then bimonthly to 180 days of age. We determined causes of predation as described by Garner (1976). Mortalities not attributed to predation were sent to the MSU College of Veterinary Medicine for necropsy.

We calculated survival rates using program Kaplan (Pollock et al. 1989). Bartush (1978) and Garrott et al. (1985) reported transmitters did not increase mortality rates of fawns in their study. Consequently, we assumed that transmitters did not increase fawn mortality. Time of mortality within the 24-hour day was not investigated and we assumed no bias due to predators being primarily crepuscular and nocturnal. Monthly, and male and female survival rates were compared using program CONTRAST to examine temporal patterns of mortality and differences between sexes (Hines and Sauer 1989). Additionally, cause-specific mortality rates were estimated (i.e., coyote, natural mortality, etc.) to describe the most common causes of early fawn mortality (Heisey and Fuller 1985).

Results

We captured 20 fawns (9 females and 11 males) from 4 July–1 August 1995. Median birth date was 18 July. Five mortalities were recorded: 3 coyote depredations

(1 female and 2 males), 1 epizootic hemorrhagic disease (male), and 1 undetermined natural mortality (female). Additionally, 6 fawns lost their transmitters and 1 transmitter failed. The 180-day survival rate for all fawns was 0.72 (SE = 0.135). Male and female survival rates were 0.66 (SE = 0.192) and 0.78 (SE = 0.183), respectively, and did not differ statistically ($\chi^2 = 0.2151$, df = 1, $P = 0.643$). No differences were detected for survival rates at 30−day intervals to 180 days of age (Table 1) ($\chi^2 = 0.0650$, df = 5, $P = 1.00$). Cause-specific mortality rates were 0.24 (SE = 0.118), 0.08 (SE = 0.076), and 0.08 (SE = 0.076) for coyote predation, epizootic hemorrhagic disease, and unknown natural mortality, respectively.

Discussion

Predation is the primary cause of white-tailed deer fawn mortality, but no cause-specific mortality rates have been calculated. Bartush and Garner (1979) reported that bobcats and coyotes caused 91.7% of fawn mortalities in Oklahoma. Porath (1980) and Boulay (1992) reported that most early fawn mortality was caused only by bobcats. Only coyote predation was documented in our study and at much lower rates than in previous research.

Low coyote predation in this study is likely a function of periodic flooding the island receives. Local residents indicated that coyotes and bobcats were rare, based on ancillary observations, after the 1978 flood which completely inundated the island. Additionally, we found little evidence of either species during normal daily activities (1 bobcat sighting, 2 different sets of coyote tracks). Thus, our low mortality rate within sparse vegetation is likely due to depressed predator numbers.

Our high survival rates demonstrate that does did not appear to be stressed by leaving the island and returning near parturition, as they were able to achieve parturition and sufficient lactation to ensure fawn survival. However, stressed does may not have produced any fawns. Our data demonstrate that a high water period 1 month prior to parturition does not lower post-partum fawn survival, although we acknowledge that we did not measure in utero fawn survival. Our results are similar to those of Sheppe and Osborne (1971), who demonstrated that several African ungulates adapted to flood pulses and some even required flood pulses as part of their annual cycle.

Caution should be taken interpreting our results because of the low sample size and short study duration. Unreplicated studies, either temporally or spatially, allow

Table 1. Monthly and cumulative survival rates and associated standard errors for white-tailed deer fawns to 180 days for Davis Island, Mississippi, 1995.

Period	Monthly survival rate (SE)	Cumulative survival rate (SE)	*N* at risk	Predation mortality	Natural mortality	Censored
0–30 days	0.800 (0.092)	0.800 (0.092)	20	2	2	1
31–60 days	1.000 (0.000)	0.800 (0.092)	15	0	0	3
61–90 days	0.900 (0.101)	0.720 (0.127)	12	1	0	3
91–120 days	1.000 (0.000)	0.720 (0.135)	8	0	0	0
121–150 days	1.000 (0.000)	0.720 (0.135)	8	0	0	0
151–180 days	1.000 (0.000)	0.720 (0.135)	8	0	0	0

the opportunity for high Type II error. Additionally, our low sample size most likely caused very low power to detect differences. Future research in other river systems and over several years is needed before the effect of flooding on fawn survival can be precisely quantified.

Management Implications

Our results suggest that the deer on Davis Island are adapted to early summer flood pulses, at least from the perspective of fawn survival. Managers should not expect a decrease in recruitment because of a flood pulse of the severity and duration observed during our study. Additionally, fawns may actually benefit from these flood pulses by being exposed to less predation.

Literature Cited

Bartush, W. S. 1978. Mortality of white-tailed deer fawns in the Wichita Mountains, Comanche County, Oklahoma—Part II. M.S. Thesis, Okla. State Univ., Stillwater. 165pp.

Bartush, W. S. and G. W. Garner. 1979. Mortality of white-tailed fawns in the Wichita Mountains, Oklahoma. Proc. 2nd Annu. Meet. Southeast. Deer Study Group. Mississippi State, Miss. P. 15.

Bowman, J. L. and H. A. Jacobson. 1998. An improved vaginal implant transmitter for locating white-tailed deer birth sites and fawns. Wildl. Soc. Bull. 26:295–298.

Boulay, M. C. 1992. Mortality and recruitment of white-tailed deer fawns in the wet prairie/tree island habitat of the Everglades. M.S. Thesis, Univ. Fla., Gainesville. 77pp.

Carroll, B. K. and D. L. Brown. 1977. Factors affecting neonatal fawn survival in south-central Texas. J. Wildl. Manage. 41:63–69.

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

Epstein, M. B., G. A. Feldhamer, R. L. Joyner, R. J. Hamilton, and W. G. Moore. 1984. Movements and mortality of white-tailed deer fawns on two coastal islands in South Carolina. Proc. 7th Annu. Meet. Southeast. Deer Study Group. Little Rock, Ark. Pp. 9–10.

Fremling, C. R., J. L. Rasmussen, R. E. Sparks, S. P. Cobb, C. F. Bryan, and T. O. Claflin. 1989. Mississippi River fisheries: a case history. Pages 309–351 *in* D. P. Dodge, ed., Proc. Internatl. Large River Symp. Can. Spec. Publ. Fish. Aquat. Sci. 106.

Garner, G. W. 1976. Mortality of white-tailed deer fawns in the Wichita Mountains, Comanche County, Oklahoma. Ph.D. Thesis, Okla. State Univ., Stillwater. 113pp.

Garrott, R. A., R. M. Bartmann, G. C. White. 1985. Comparison of radio-transmitter package relative to deer fawn mortality. J. Wildl. Manage. 49:758–759.

Haugen, A. O. and D. W. Speake. 1958. Determining age of young fawn white-tailed deer. J. Wildl. Manage. 23:319–321.

Heisey, D. M. and T. K. Fuller. 1985. Evaluation of survival and cause-specific mortality rates using telemetry data. J. Wildl. Manage. 49:668–674.

Herriman, K. R. 1983. Hunting season movements of male white-tailed deer on Davis Island. M.S. Thesis, Miss. State Univ., Miss. State. 67pp.

Hines, J. E. and J. R. Sauer. 1989. Program CONTRAST: a general program for the analysis of several survival or recovery rate estimates. U.S. Dep. Int. Fish and Wildl. Serv. Fish and Wildl. Tech. Rep. 24. Washington, D.C. 7pp.

Junk, W. J., P. B. Bayley, and R. E. Sparks. 1989. The flood pulse concept in river-floodplain systems. Pages 110–127 *in* D. P. Dodge, ed. Proc. Internatl. Large River Symp. Can. Spec. Publ. Fish. Aquat. Sci. 106.

Kie, J. G. and M. White. 1985. Population dynamics of white-tailed deer (*Odocoileus virginianus*) on the Welder Wildlife Refuge, Texas. Southwest. Nat. 30:105–118.

Logan, T. 1972. Study of white-tailed deer fawn mortality on Cookson Hills deer refuge eastern Oklahoma. Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm. 26:27–39.

Morgan, Z. R. 1995. Male white-tailed deer daytime home range size and shape in relation to age and physiographic region in Mississippi. M.S. Thesis, Miss. State Univ., Miss. State. 51pp.

National Oceanic and Atmospheric Administration (NOAA). 1994. Precipitation and temperature normals. Natl. Weather Serv. Forecast Off. Jackson, Miss. 5pp.

———. 1995. Precipitation and temperature normals. Natl. Weather Serv. Forecast Off. Jackson, Miss. 5pp.

O'Pezio, J. P. 1978. Mortality among white-tailed deer fawns on the Seneca Army Depot. N.Y. Fish and Game J. 25:1–15.

Pollock, K. H., S. R. Winterstein, C. M. Burck, and P. D. Curtis. 1989. Survival analysis in telemetry studies: the staggered entry design. J. Wildl. Manage. 53:7–15.

Porath, W. R. 1980. Fawn mortality estimates in farmland deer range. Pages 55–63 *in* R. L. Hines and S. Nehls, eds., White-tailed deer population management in the northcentral states. Proc. 1979 Symp. North Cent. Sect. Wildl. Soc. 116pp.

Reinecke, K. J., R. C. Barkley, and C. K. Baxter. 1988. Potential effects of changing water conditions on mallards wintering in the Mississippi Alluvial Valley. Pages 325–337 *in* M. W. Weller, ed. Waterfowl in winter. Univ. Minn. Press, Minneapolis.

Sheppe, W. and T. Osborne. 1971. Patterns of use of a flood plain by Zambian mammals. Ecol. Mono. 41:179–205.

Wickham, B. H., R. A. Lancia, and M. C. Conner. 1993. Survival rates and adult accompaniment of white-tailed deer fawns on Remington Farms. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 47:222–230.