Swamp Rabbit Distribution in Missouri

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Abstract: We determined the distribution of swamp rabbits (*Sylvilagus aquaticus*) and bottomland hardwood forests, potential swamp rabbit habitat, in Missouri during the 1991–92 winter. Presence of swamp rabbits was determined from information gathered from resource managers and by searching habitat for fecal pellets. Most potential swamp rabbit habitat in Missouri is located in the southeast, and we documented 45,218 ha of bottomland hardwood forest there by measuring tracts identified on aerial photos. The forest was highly fragmented in southeastern Missouri, especially on private land where 75% (N = 3,228) of the identified tracts contained <5 ha. We surveyed 274 tracts of potential habitat in southeastern Missouri and found 114 with a combined area of 23,529 ha that contained evidence of swamp rabbits. In southeastern Missouri, on tracts <100 ha, the minimum area that is believed necessary to have huntable populations, we found evidence of swamp rabbits on 16 of 30 public sites and 61 of 176 private sites. Our inability to find evidence of swamp rabbits in southwestern Missouri agrees with the observation of previous workers that the species was at best rare in the late 1960's.

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The potential demise of swamp rabbits along the northern edge of the species' range has been the focus of most contemporary studies of the species (Korte and Fredrickson 1977, Kjolhaug 1986). The current range of the species in the southeastern United States is unknown or poorly documented. In Missouri, swamp rabbits were once widely distributed throughout the southeastern lowlands and

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along southern Missouri rivers (Bennitt and Nagel 1937). Korte and Fredrickson (1977), however, estimated the amount of potential swamp rabbit habitat in Missouri declined from 850,000 ha in 1870 to <40,000 ha in 1973. Based on the small amount and fragmented distribution of swamp rabbit habitat, the species was classified as rare in Missouri in 1974 (Nordstrom et al. 1977).

Suitable swamp rabbit habitat is bottomland hardwood forest and contains dense understory vegetation, standing water, and above-water refugia such as logs, stumps, vine tangles, and land surface relief (Toll et al. 1960, Terrel 1972, Kjolhaug 1986). Korte (1975) suggested that hunted populations of swamp rabbits require ≥100 ha of suitable habitat if the species is to persist in an area.

Swamp rabbit distribution in Missouri was most recently determined in 1973 (Korte and Fredrickson 1977). The purpose of our study was to determine the distribution of swamp rabbits and associated bottomland hardwood forest habitat to provide current information for planning management and research objectives.

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Methods

We estimated the area of bottomland hardwood forest in southeastern Missouri from wetland habitat maps provided by the U. S. Department of Agriculture (USDA) Soil Conservation Service (SCS). Maps were created from aerial photos taken during 1984–89 by the USDA Agricultural Stabilization and Conservation Service (ASCS). The SCS used the following criteria to distinguish bottomland hardwood forests: (1) woody vegetation with ≥25% canopy cover, (2) hydric soils, and (3) flooded an average of 2 out of 5 years.

We conducted a statewide survey of Missouri Department of Conservation agents to provide inferences on statewide distribution of swamp rabbits. Federal and state natural resource personnel in historic swamp rabbit range provided information on current suitable habitat and sightings of swamp rabbits. Information was solicited from the general public through magazines and newspapers. Where presence of swamp rabbits was unknown or reports were deemed unreliable, we searched the site for swamp rabbits or their fecal pellets. We searched forested tracts from November 1991 to March 1992. Forests were divided into tracts based on presence of barriers that would diminish a swamp rabbit's ability to travel, e.g., rivers, major highways and large crop fields. Most tracts were isolated by crop fields. We substantiated the presence of swamp rabbits by walking through forest tracts and inspecting logs and stumps for fecal pellets (Terrel 1972, Korte 1975, Kjolhaug 1986). The observation of large, discoidal fecal pellets on elevated objects was interpreted to indicate presence of swamp rabbits (Korte and Fredrickson 1977). Because fecal pellets of eastern cottontail rabbits (*S. floridanus*) and white-tailed deer (*Odocoileus virginianus*) could be confused for those of swamp rabbits, observers studied known samples from each species at the beginning of fieldwork.

We focused our search on historic range, surveying 279 tracts of land, in southeastern Missouri, southwestern Missouri, and Missouri's islands in the Mississippi River south of St. Louis County (Bennitt and Nagel 1937, Korte and Fredrickson 1977). In southeastern Missouri we used aircraft flights in addition to aerial photos to identify potential swamp rabbit habitat. Because of limited resources, searches were focused on tracts ≥16 ha. We consider our documentation of swamp rabbit distribution as a minimum range estimate because swamp rabbits could inhabit some of the smaller areas not visited and our field investigations were not exhaustive.

We regressed presence of fecal pellets against tract size of private land using a maximum-likelihood logistic model. We did not analyze public land in this way because tract size distribution was skewed toward large tracts.

Results and Discussion

We documented 45,218 ha of bottomland hardwood forest in southeastern Missouri. Private land comprised 58% of the bottomland forest in the counties studied (Table 1). Compared to the same 11 counties examined by Korte and Fredrickson (1977), we observed a 56% decline in bottomland hardwood forests. However, we place little confidence in the accuracy of this comparison because methodology of the 2 studies differed substantially. Korte and Fredrickson's (1977) forest area estimates were based on U.S. Census of Agriculture data that were adjusted using tenuous assumptions. Therefore, we believe it is more appropriate to compare Korte and Fredrickson's (1977) estimate of bottomland hardwood forest

Table 1. Area (ha) of bottomland hardwood forest, potential swamp rabbit habitat, in southeastern Missouri in 1992.

	Available habitat			Occupied by swamp rabbits		
County	*N* (tracts)	Public	Private	*N*	Public	Private
Bollinger	153	285	1,193	3	285	340
Butler	929	3,106	3,868	25	2,441	634
Cape Girardeau	129	104	1,030	1	0	53
Dunklin	242	2,206	2,090	15	2,206	1,305
Jefferson	79	40	2,025	0	0	0
Mississippi	243	113	2,893	14	1,092	344
New Madrid	354	2,343	2,896	10	2,343	1,174
Oregon	5	1,074	0	5	1,074	0
Pemiscot	168	827	1,658	9	378	687
Perry	65	0	1,015	1	0	280
Ripley	142	2,679	1,527	19	1,126	1,159
Ste. Genevieve	51	0	1,378	0	0	0
Scott	157	6	1,428	4	0	243
Stoddard	541	4,106	2,075	7	4,054	203
Wayne	31	2,290	963	1	2,108	0
Total	3,289	19,180	26,038	114	17,107	6,422

in southeastern Missouri in 1870 (850,000 ha or 87% of the total lowland area) to our estimate for 1992 (45,218 ha or <5%).

We could not find evidence of swamp rabbits in the 5 tracts we surveyed in southwestern Missouri where swamp rabbits were last documented in 1967 in McDonald County (K. C. Sadler, unpubl. data). Our finding of the apparent extirpation of swamp rabbits in southwestern Missouri agrees with conclusions of Korte (1975). Similar to Korte and Fredrickson (1977), we documented only a few isolated populations of swamp rabbits in cane breaks along Ozark streams.

We found evidence of swamp rabbits on only 1 of Missouri's 13 Mississippi River islands south of St. Louis County that we searched. This finding could have implications for distribution of swamp rabbits on other states' Mississippi River islands. Korte and Fredrickson (1977) found evidence of swamp rabbits on 5 of 7 islands south of Cape Girardeau, which is 71 km south of where we began our search. Uninhabited islands are periodically scoured by the Mississippi River and, consequently, lack understory vegetation and appear to be unsuitable for swamp rabbits.

The northernmost location of swamp rabbits in Missouri was along the Mississippi River at about 37.6° latitude in Perry County. On a latitudinal gradient, the location of this swamp rabbit population is similar to the site identified along the Mississippi River by Kjolhaug (1986). However, the Perry County population is >1° latitude south of historical sightings (Klimstra and Roseberry 1969).

Of the 274 tracts we surveyed in southeastern Missouri, 114 contained evidence of swamp rabbits. These tracts of forest contained 17,107 ha on public land and 6,422 ha on private land for a total of 23,529 ha (Table 1). Korte and Fredrickson (1977) speculated that occupied habitat in southeastern Missouri during 1973 amounted to <20,000 ha. We cannot, however, conclude that area of habitat occupied by swamp rabbits had increased in 1992 because methodology of the 2 studies differed. Swamp rabbit habitat in 1973 (Korte and Fredrickson 1977) was probably underestimated because forest tracts containing <100 ha were not considered potential habitat and were not measured. Moreover, our estimates for 1992 could be inflated relative to those for 1973 because Korte and Fredrickson (1977) were more conservative than we were in classifying entire forest tracts as potential swamp rabbit habitat.

Of the 114 tracts in southeastern Missouri where we found evidence of swamp rabbits, 56 were <52ha. The smallest tract was 4.0 ha. Of tracts <100 ha that we searched, swamp rabbit evidence was present on 16 of 30 public sites and 61 of 176 private sites. In Illinois, Kjolhaug (1986) found swamp rabbits in tracts as small as 25 ha, but most occupied tracts exceeded the minimum area (≥100 ha) recommended by Korte (1975).

The capability of private forest land to serve as suitable habitat for swamp rabbits could be limited by small size, isolation of tracts, etc. (Korte and Fredrickson 1977, Kjolhaug 1986). Regarding size, we found the average size of a bottomland forest tract in Missouri was 331 ha on public land ($N = 61$), but only 8 ha on private land ($N = 3,228$). Furthermore, 75% of private tracts contained <5 ha. In agreement

with the conclusion of previous investigators that most private land is unsuitable for swamp rabbits partly because of small size, we found swamp rabbits on 66% of the public tracts surveyed (N = 59), but on only 35% of the private sites (N = 217). However, small size apparently was not the sole factor limiting the value of private land as habitat for swamp rabbits. The frequency of swamp rabbit occurrence changed little as private tracts became larger; the proportion of private tracts that contained evidence of swamp rabbits was 34% for tracts ≤100 ha and 37% for sites >100 ha. Conversely, the corresponding values for public tracts increased from 53% to 79%. Tract size of private land was not significantly (X^2 = 0.710, P = 0.40) related to presence of swamp rabbits. Similar to previous investigators we attribute the absence of swamp rabbits on private tracts to inferior forest habitat or to lack of suitable habitat on adjacent land (e.g., absence of woody corridors, presence of row crops), or both.

Research and Management Implications

Lack of evidence of swamp rabbits on individual tracts could be interpreted to mean the species was absent temporarily or permanently or that the searching procedure was inadequate. Temporary habitation of isolated tracts by swamp rabbits could be a common phenomenon because of frequent flooding that occurs within the species' range. We speculate that recent flooding has reduced swamp rabbit production and, subsequently, range expansion in southeastern Missouri. Thus, suitable habitat should be revisited to verify the status of swamp rabbits during periods when individuals could be immigrating to currently unoccupied habitat.

Wise management of swamp rabbits in areas with fragmented habitat, such as southeastern Missouri, is likely dependent upon understanding the function of isolated tracts of forest in the species' population ecology. For example, are woody corridors important to long-term survival of swamp rabbits? How do movements between large and small isolated tracts affect long-term survival of the species? Are inbreeding or hunting, or both, a problem in areas dominated by isolated tracts of forest? Do cottontail rabbits adversely affect swamp rabbits inhabiting small tracts? Answers to these questions would provide managers an estimate of the scale at which bottomland hardwood forests need to be managed to ensure the continued existence of swamp rabbits in areas with fragmented forests.

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