# The Swamp Rabbit, *Sylvilagus aquaticus*, in Indiana, 1984-1985

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## Introduction

The first swamp rabbits from Indiana were collected in 1930 in canebrakes in Point Township, Posey County (3). Lyon (5) published additional records for Warrick and Posey Counties. Kirkpatrick (4) took a specimen from Spencer County. Terrel (8) summarized information on distribution, relative abundance, and ecology of swamp rabbits in Indiana.

Terrel intensively studied swamp rabbits on Cane Ridge (Gibson County), but this area has now been completely destroyed as habitat. Terrel found about 1 rabbit/2.4 hectares, that hunters killed about 40-45% of the population, and that the average home range was about 4.4 hectares.

Terrel (8) used an arbitrary figure of 1 swamp rabbit/4 hectares and estimated that about 1000 swamp rabbits occurred in Indiana on about 4050 hectares of remaining habitat from an original area of 40,500 ha. He suggested that swamp rabbits occurred in 25 bottomland forested tracts in six counties—Spencer, Warrick, Vanderburgh, Posey, Gibson, and Knox—although he had actual evidence of swamp rabbits from only 13 sites (see section on swamp rabbit populations now as compared to past).

The purpose of this study was to determine the present distribution and abundance of swamp rabbits in Indiana, to describe their habitat, to develop means of assessing their presence, and to derive recommendations for their management in Indiana.

## Methods

All previously known or suspected Indiana swamp rabbit sites as well as additional possible sites were visited and assessed for swamp rabbits (Table 1). It was early

Table 1. Sites checked for swamp rabbits, 1984-1985.

| | Acres | Acres with Rabbits | Rabbit Assessment |
|---|---|---|---|
| KNOX COUNTY | | | |
| •1 River DeShee | 200 | 0 | — |
| •2 Little Cypress Swamp | 800 | 0 | — |
| •3 Claypool Pond | 400 | 0 | — |
| 4 Swan Pond | 70 | 0 | — |
| GIBSON COUNTY | | | |
| •1 Long Pond | 500 | 180 | 18 |
| •2 Hannor Pond | 70 | 0 | — |
| •3 Patoka River Bottoms | 800 | 0 | — |
| •4 Patoka Island | 100 | 0 | — |
| •5 Broad Pond Swamp (Cane Ridge) | 0 | 0 | — |

TABLE 1.—Continued

| | | | | |
|---|---|---|---|---|
| *6 | Coffee Island & Woods | 600 | 0 | — |
| *7 | Foote Pond | 250 | 40 | 4 |
| *8 | Big Bend, Wabash R. | 60 | 0 | — |
| *9 | Goose Pond | 70 | 10 | 2 |
| *10 | Pearl Island | 60 | 1 | 1 |
| 11 | Woods SE Pearl Island | 70 | 40 | 4 |
| 12 | Woods E Pearl Island | 200 | 2 | 2 |
| *13 | Woods S Pearl Island | 440 | 440 | 44 |
| 14 | Woods-section 18, SE Schuh Bend, Wabash-Graysville Grid | 40 | 6 | 4 |
| 15 | Skelton | 6 | 1 | possible |
| 16 | Jimtown | 10 | 2 | 1 |
| 17 | Big Bayou | 110 | 10 | 1 |
| 18 | Swamp N of Big Bayou | 60 | 0 | — |
| 19 | ½ mi W Jimtown | 20 | 0 | — |
| 20 | 1 mi W Jimtown | 100 | 0 | — |
| 21 | Buckskin Bottoms | | 0 | |
| 22 | Woods along Wabash just across from Schuh Bend | 40 | 0 | — |
| 23 | Woods at south side of mouth of White River | | 0 | |
| VANDERBURGH COUNTY | | | | |
| *1 | Big Creek, South Fork | 80 | 0 | — |
| *2 | Dam #48 | 3 | 0 | — |
| POSEY COUNTY | | | | |
| *1 | Pitcher Lake | 600 | 0 | — |
| *2 | Halfmoon Pond | 120 | 0 | — |
| *3 | Goose & Slim Ponds | 700 | 0 | — |
| *4 | Goose Pd Cypress Slough | 500 | 0 | — |
| 5 | Old Ferry Landing | 100 | 0 | — |
| 6 | Pitcher Lake | 40 | 0 | — |
| 7 | Cypress Slough | 600 | 0 | — |
| 8 | Chain Cutoff | 40 | 0 | — |
| WARRICK COUNTY | | | | |
| *1 | Yankeetown Area | 800 | 0 | — |
| SPENCER COUNTY | | | | |
| *1 | Kramer's Bottoms | 200 | 0 | — |
| *2 | Patronville Area | 600 | 0 | — |
| *3 | Across from Lewisport, KY | 100 | 0 | — |
| 4 | Pigeon Creek Bottoms | 3000 | 0 | — |

* Areas thought by Terrel (1969) to contain swamp rabbits

determined that searching for fecal pellets on logs was the only reasonable way to determine whether swamp rabbits were present. Attempts were made to determine the nature of suitable habitat, how much suitable habitat remained, how much occupied habitat occurred at each site, and an estimate was made of the number of rabbits at each site. Terrel's value of 1 rabbit/4 ha (about 1 rabbit/10 acres) was used to estimate the numbers of rabbits per site and the number of swamp rabbits still occurring in Indiana (Table 2).

## Results

### *Present Distribution of Swamp Rabbits in Indiana*

We surveyed 43 sites for swamp rabbits, including all 25 sites included by Terrel (Table 1).

We found no sign of swamp rabbits in five of the six counties formerly inhabited, Knox, Vanderburgh, Posey, Warrick, and Spencer. Swamp rabbits are apparently extirpated from some of the best earlier localities, including Cane Ridge (Gibson County), River DeShee (Knox County), and Yankeetown (Warrick County).

TABLE 2. Numbers of swamp rabbit pellets per pile (all sources).

| Number of pellets | No. piles |
|---|---|
| 1 | 31 |
| 2 | 20 |
| 3 | 21 |
| 4 | 16 |
| 5 | 9 |
| 6 | 8 |
| 7 | 4 |
| 8 | 11 |
| 9 | 7 |
| 10 | 7 |
| 11 | 8 |
| 12 | 2 |
| 13 | 4 |
| 14 | 3 |
| 15 | 1 |
| 16 | 3 |
| 17 | 3 |
| 18 | 4 |
| 19 | 4 |
| 20 | — |
| 21 | 4 |
| 22 | 1 |
| 23 | 1 |
| 24 | 2 |
| 25 | 3 |
| 26 | 1 |
| 29 | 1 |
| 30 | 1 |
| 31 | 1 |
| 33 | 1 |
| 34 | 2 |
| 35 | 1 |
| 37 | 1 |
| 38 | 1 |
| 41 | 1 |
| 46 | 1 |
| 50 | 1 |
| 56 | 1 |
| 61 | 1 |
| 71 | 1 |
| 78 | 1 |
| — | — |
| n | 194 |
| $\bar{x}$ = | 11.26 |
| $EX_i$ | 2184 |
| $EX_i^2$ | 53440 |
| SD | 12.23 |
| SE | 0.88 |

We found evidence of swamp rabbits presently existing in Indiana at 10 sites (Table 1), one of them Long Pond in northern Gibson County, the other 9 on or fairly close to the big river bend in southern Gibson County containing Pearl Island, which we refer to as the "Pearl Island area." Apparently Long Pond and the Pearl Island area are the two remaining centers for swamp rabbits in Indiana, and serve as the only sources of repopulation for other areas. All of the small populations are near these, although Foote Pond and the area SE of Schuh Bend seem to have small resident populations. However, three of the sites were estimated at the time of observation to harbor only one rabbit. Other sites with recent rabbit sign but apparently

with few rabbits are Goose Pond (half mile south of Pearl Island area), woods in south portion of Section 18 and Big Bayou, 1½-2 miles SE of the Pearl Island area, and the Jimtown and Foote Pond sites just east of Big Bayou, and about 4 miles east of the Pearl Island area. These latter two sites are essentially connected to the Pearl Island area through Big Bayou.

We found traces of old pellets at three additional areas, all in Gibson County: Skelton, mouth of the Patoka River, and along the shore of the Wabash River east of Patoka Island.

*Estimated Number of Swamp Rabbits Presently Occurring in Indiana*

We feel that the 1969 estimate of Terrel of 1000 rabbits is high, as he included much area which, although bottomland woods, was not good habitat (i.e., it lacked cane and/or elderberry on raised areas with adequate cover, protected from most flooding; see below). Only about 700 acres are presently inhabited by swamp rabbits; the population totals an estimated 80 rabbits (Table 1).

*Tree Species and Swamp Rabbits*

It didn't appear to matter which tree species were present or dominant in bottomland forest. Factors other than the particular tree species appeared to determine whether swamp rabbits were present or absent.

Major tree species in bottomland woods where swamp rabbits occur were Sugar Berry, (*Celtis laevigata*), Hackberry (*Celtis occidentalis*), Silver Maple (*Acer saccharinum*), Hickories and Pecan (*Carya laciniosa*, *C. cordiformis*, *C. pecan*), Elms (*Ulmus* sp.), Ashes (*Fraxinus* sp.), Sweet Gum (*Liquidambar styraciflua*), Cottonwood (*Populus deltoides*), Sycamore (*Platanus occidentalis*), several species of oak (*Quercus* sp.), and Box Elder (*Acer negundo*).

*Swamp Rabbit Populations Now as Compared to Past*

We believe many of the 43 sites under consideration probably never harbored rabbits, and in addition that much of the acreage in inhabited areas probably did not recently harbor swamp rabbits. There is simply relatively little area with good habitat.

Areas where rabbits were definitely present in 1969 are listed below, along with their present status. Also, the Jimtown site is included where rabbit sign was seen in 1982 (IDNR).

| | | 1969 | 1984-85 |
|---|---|---|---|
| GIBSON COUNTY | | | |
| 1. | Hannor Pond | Sign scarce | None found |
| 2. | Patoka River Bottom, from Hannor to Mouth | Sign not abundant | None found (except few old pellets on 1-2 logs) |
| 3. | Patoka Island | Sign abundant on island | None found |
| 4. | Broad Pond Swamp (Cane Ridge) | Abundant | Habitat destroyed |
| 5. | Coffee Island | Scattered sign in NE corner of woods (Island reported, not checked) | None found in woods or on island |

| | | | |
|---|---|---|---|
| 6. | Foote Pond | Some sign | Some sign |
| 7. | Woods south of Pearl Island | Sign abundant | Sign abundant |
| 8.* | Jimtown Site | Sign found | Sparse sign |
| 9. | Long Pond | Sign not plentiful | Sign present |
| KNOX COUNTY | | | |
| 10. | River DeShee | Abundant sign | None |
| 11. | Little Cypress Swamp | Sparse sign | None |
| 12. | Claypool Pond | Sparse sign | None |
| WARRICK COUNTY | | | |
| 13. | Yankeetown Area | Sign scattered throughout | None |
| POSEY COUNTY | | | |
| 14. | Point Township | First rabbits taken | none |

Thus rabbits are still present at only four of the 14 sites where rabbits previously occurred (8), but really at two main centers in Indiana, the Long Pond and Pearl Island areas.

*Characteristics of Logs with Pellets*

Fecal deposition on logs is common from about November or December through May, but is not reliable in summer or early fall. We visited portions of the Pearl Island area on 11 September, 1985, where we had always been able to find numerous pellets on logs in winter and spring. We flushed one large swamp rabbit, yet were unable to find any fresh pellets on logs in any of the areas.

Logs where fecal pellets were found were almost always well rotted, and somewhat isolated (not in a log pile or brush pile and usually in at least a slight clearing). Logs were without vegetation (other than moss, which was common) growing on them at time of use, and they were usually flat on the ground. One 12-inch log was rotted only at one end. Two piles of 8 and 46 pellets occurred there, but none on the rest of the log. Piles of pellets were found on only two logs which were unrotted.

We did not measure log lengths, but there was much variation, with logs with pellets running from 2 to about 15 feet in length, some of these with pellets at several places.

Certain logs were used several times as indicated by pellets of different ages. Also, additional pellets often appeared on logs from which we had removed pellets and tagged the log. Besides being on logs, some pellets of a cluster were often on the ground next to the log.

*Log (or stump) diameter.* We generally estimated the diameter of the log or stump and also the height of a stump.

The diameter of logs with pellets ranged from 4-26 inches except for one 36-inch log with 10 pellets. There was no relation between diameter of log and number of pellets. The average log diameter with pellets was 8.7 inches.

*Number of Pellets per Pile.* The numbers of pellets per pile overall (Table 2) ranged from 1 to 78 ($\bar{x}$ = 11.26, SD = 12.23, SE = 0.88). The nine piles on stumps ranged from 4 to 78 pellets ($\bar{x}$ = 27 pellets; SD = 28.53, SE = 9.5).

*Size of Fecal Pellets*

Sixty-two pellets of swamp rabbits found on logs at Long Pond and 26 from

TABLE 3. Diameter of swamp rabbit and cottontail rabbit pellets.

| | Swamp Rabbits | | Cottontails |
|---|---|---|---|
| | Long Pond | Pearl Island | Little Bluestem Prairie Vigo County |
| | n = 62 | n = 26 | n = 90 |
| mm | no. pellets | no. pellets | no. pellets |
| 4 | | | |
| 5 | | | |
| 6 | | | 4 |
| 7 | 1 | | 36 |
| 8 | | | 45 |
| 9 | | | 4 |
| 10 | 2 | 1 | 1 |
| 11 | 11 | — | |
| 12 | 17 | 10 | |
| 13 | 25 | 11 | |
| 14 | 5 | 4 | |
| 15 | 1 | | |
| | —— | —— | —— |
| range | 7-15 | 10-14 | 6-10 |
| $\bar{x}$ = | 12.29 | 12.65 | 7.58 |
| SD = | 1.23 | 0.89 | 0.73 |
| SE = | 0.16 | 0.17 | 0.08 |

Pearl Island were measured (greatest diameter, Table 3). They ranged in size from 7 to 15 mm and averaged 12.29 (Long Pond) and 12.65 (Pearl Island). Ninety cottontail pellets from near Terre Haute, taken 20 July 1985, in contrast ranged from 6 to 10 mm in diameter ($\bar{x}$ = 7.58, SD = 0.73 and SE = 0.08), thus are considerably smaller than swamp rabbit pellets.

## Discussion

Swamp rabbits in Indiana occur in bottomland woods along larger rivers, ponds or sloughs. Portions of the Pearl Island area occupied by swamp rabbits are protected by a levee; however, other inhabited areas are not. Swamp rabbits deposit their fecal pellets on logs during winter and spring months, mainly in and along raised areas (ridges, or marginal refugia), which they must have in order to survive. Pellets may range from 1 to many (see section on numbers of pellets) and some often fall to the ground. The logs are almost always fairly well rotted, and the pellets are often in grooves or depressions in the log. Recently fallen (unrotted) logs are seldom used. Short sections of logs (3-8 ft long), especially ones lying flat on the ground and somewhat isolated, are most often used. We never found pellets in piles of logs. Where swamp rabbits are active, pellets can be found during winter and spring on many or most suitable logs in the occupied area.

The rabbits do not occur in just any bottomland woods. Bottomland woods which are lacking in cover, which are covered primarily with poison ivy, or which are frequently flooded, are not generally inhabited (unless they border good habitat). Rabbits generally exist in areas with good ground cover, and particularly with cane, *Arundinaria gigantea*, and elderberry, *Sambucus canadensis*. The Yankeetown site, although it supported rabbits earlier, now appears at best, only marginal for swamp rabbits. It is primarily of poison ivy. In one area at Long Pond there was much grass present.

Areas occupied by swamp rabbits are obvious in winter and spring because of the clusters of fecal pellets on logs. Our present hypothesis of why pellets are on logs

is that the rabbits spend much time sitting on logs for use as observation posts, thus happen to defecate there. If this is correct, log sitting might be uncommon in summer because high vegetation obscures the view from the log, or because the vegetation provides much denser cover, thus perhaps not stimulating the need to use observation posts.

*Reasons for Decline of Swamp Rabbits*

We believe the following reasons account for the decline of swamp rabbits in Indiana.

*1. Loss of Available Habitat.* This is obviously a major factor and is the reason for the elimination of the largest population, that on Cane Ridge, Gibson County. The Cane Ridge area now contains man-made lakes in association with a power plant. In other areas, much of the forest has been cut and the land is now under cultivation. This has occurred and is still occuring over much of the former swamp rabbit habitat. Areas cleared for farming usually include the higher ridges, i.e., the areas most suitable for swamp rabbits. Moderate cutting, however, probably does not radically harm, and may enhance swamp rabbit habitat. The rabbits can swim, but they apparently cannot tolerate frequent or prolonged flooding of their habitat.

Loss of prime habitat apparently hurts more than just the area actually involved. Prime habitats serve as supply areas for surrounding areas small in size or of marginal habitat, such as the eight small populations near the main Pearl Island woods. The loss of Cane Ridge we think has led to extirpation at Patoka Island, Coffee Island and woods, Skelton, and other areas near Cane Ridge. We think these areas might have been continually resupplied if Cane Ridge still persisted.

*2. Hunting Pressure.* Terrel (8) determined that about 40-45% of the population of rabbits at Cane Ridge was removed each year by hunting. Hunting still occurs at the Pearl Island area, but is probably less severe at Long Pond because of limited access. We think hunting is a main reason that swamp rabbits are gone from some areas, especially Yankeetown, Kramers Bottoms, River DeShee, and Little Cypress Slough. Once populations become low and isolated, it is easy for one to die out altogether. Hunting pressure is particularly severe when there is no major source of resupply.

*3. Flooding.* Areas that are regularly flooded apparently do not hold permanent populations of swamp rabbits, although the rabbits utilize such areas at times. Klimstra (pers. comm.) found that "high water can be disastrous to adult animals." Some of his radio-marked individuals (in Illinois) died during flooding because of a combination of starving and, in turn, drowning. This accentuates the importance of the raised ridges as an integral part of swamp rabbit habitat.

*4. Predator pressure.* Some landowners think the coyote has increased in recent years and has had a detrimental effect on swamp rabbits. Coyotes undoubtedly take rabbits at times, thus may contribute to their decline; however, we do not feel that coyote or other predation is a major factor leading to the decline.

**Recommendations**

1) Hunting of swamp rabbits in Indiana should be immediately stopped. This should include the Pearl Island and Long Pond areas in Gibson County, and effort should be made to purchase or otherwise set aside these areas.

2) Reintroduce rabbits into areas of good habitat which once did but no longer harbor swamp rabbits. The best areas are (listed in order of decreasing suitability because of size and/or habitat type): River DeShee (Knox County), Goose Pond Cypress Slough (Posey County), Chain Cutoff (Posey County), and Yankeetown (Warrick County).

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