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PRELIMINARY REPORT ON THE MOVEMENT AND FATE OF RACCOONS RELEASED IN UNFAMILIAR TERRITORY

by

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ABSTRACT

Twelve raccoons (*Procyon lotor*) were trapped in the lower Coastal Plain of South Carolina and transported to the upper Piedmont of the state. The raccoons were held from one to three weeks during which time they were equipped with radio transmitters. Ten raccoons were released between 4 April and 28 May 1973 and their movements were monitored from 3 to 51 days (mean of 26.8). From 4 April to 17 July 1973 movements ranged from 0.1 to 14.5 linear kilometers (mean of 3.28). The health of the remaining two raccoons was not normal and therefore they were not released.

The raccoons remained relatively close to their sites of release for at least a few days following release (mean of 12.6). They often returned to areas where they had been found previously and their movements generally followed close to existing water courses with no apparent preference for direction of travel.

This study suggests that the relocating of raccoons into areas in which low populations exist can be successful. Also indicated was a need to hold the raccoons for a period of time before releasing them to determine their state of health.

Raccoons (*Procyon lotor*) in the Coastal Plain of South Carolina compete with deer and turkey for food and are a predator of turkeys (Nelson 1955). The raccoon causes much destruction to chufa (*Cyperus esculentus*) which is planted in many of the food patches in management areas throughout the Coastal Plain of the state. Raccoons account for a high percentage of the nest destruction of those sea turtles of the family Cheloniidae which nest on the coast of South Carolina. Because of these detrimental occurrences it has been advisable to remove raccoons from many areas of the lower Coastal Plain. The popularity of the raccoon as a game animal in the Piedmont of the state has resulted in the transferral and release of trapped raccoons into this area.

Little information is available concerning the movements of raccoons released in unfamiliar territory. Since 1950, in excess of 2,000 raccoons have been trapped from the lower Coastal Plain of the state, ear tagged, and released into the upper Piedmont of South Carolina. Tag return information is available on less than 30 of these released raccoons (data provided by South Carolina Wildlife and Marine Resources Department).

Studies have been conducted using trap-retrap and tag-return data to determine the movements of raccoons (Stuewer 1943, Butterfield 1944, Lueth 1962, and Cunningham 1962) on local populations. However, relatively few studies using these techniques have been made on raccoons released in unfamiliar territory. The Arkansas Fish and Game Commission tagged and released 256 raccoons between 1 December 1941 and 31 January 1942 into unfamiliar territory (Giles 1943). From 19 tag returns Giles concluded that the females wandered much less than the males. Johnson (1970) released 178 raccoons from 1962 to 1968 on unfamiliar lands that were actively hunted. Only three tag returns were reported. He concluded that, in all likelihood, if many of the raccoons had remained near release sites more of the raccoons would have been recovered.

With the recent use of radio telemetry to study animal behavior, much knowledge has been gained on the movement of raccoons, but information concerning the movements of raccoons released into unfamiliar territory is limited. Ellis (1964) radio-tracked a juvenile female raccoon released into unfamiliar territory in Piatt County, Illinois on 4 June 1962. The tracking period lasted only one night during which time the raccoon moved only 400 yards. Ellis also released an adult male obtained from Georgia into Piatt County, Illinois on 19 March 1962. The raccoon was tracked for only two hours during which time a movement of 0.5 mile occurred. Clements (1972) equipped seven raccoons with radio transmitters and released them into unfamiliar territory on the Little River Area of Southwest Virginia. The period in which they were monitored ranged from one hour to three days with a maximum linear movement of 8.3 miles.

The objectives of this study were to determine the movements and fate of raccoons trapped in the lower Coastal Plain and released in the upper Piedmont of South Carolina.

This study was sponsored by The Belle W. Baruch Research Institute in Forestry, Wildlife Science and Marine Biology of Clemson University. Appreciation is also due to personnel of the South Carolina Wildlife and Marine Resources Department for providing part of the trapping and all of the transportation of raccoons used in this study. The assistance of personnel of the United States Fish and Wildlife Service on Cape Romain National Wildlife Refuge for some of the trapping of raccoons was extremely helpful. Necropsies were performed by personnel of the Southeastern Cooperative Wildlife Disease Study (Wildlife Disease Study), in Athens, Georgia. Appreciation is due to Kenneth B. Stansell, Graduate Research Assistant, Clemson University, for assistance in the monitoring of the raccoons.

STUDY AREA

Raccoons were trapped from the Francis Marion National Forest and from the Cape Romain National Wildlife Refuge in the lower Coastal Plain of South Carolina. Raccoons were released on the Clemson Wildlife Research Area in Pickens County approximately 9 kilometers (km) north of the main campus of Clemson University (Fig. 1). The release area includes approximately 7,000 acres that is managed by the Forestry Department of Clemson University and is classed as a wildlife and forestry research area where hunting is not permitted. The area consists of rolling hills reaching elevations up to 310 meters above sea level. Many small streams are found throughout the management area and ultimately drain into either Lake Issaqueena or Lake Hartwell. The forest vegetation within the study area includes pine, hardwood, and mixed stands. Sufficient food sources are available and den sites for raccoons are plentiful.

MATERIALS AND METHODS

Raccoons were transported to Clemson University and held for periods of one to three weeks in order to reduce the chances of spreading infectious diseases to the native wildlife population. They were fed daily on Purina Dog Chow and provided with fresh water at all times.

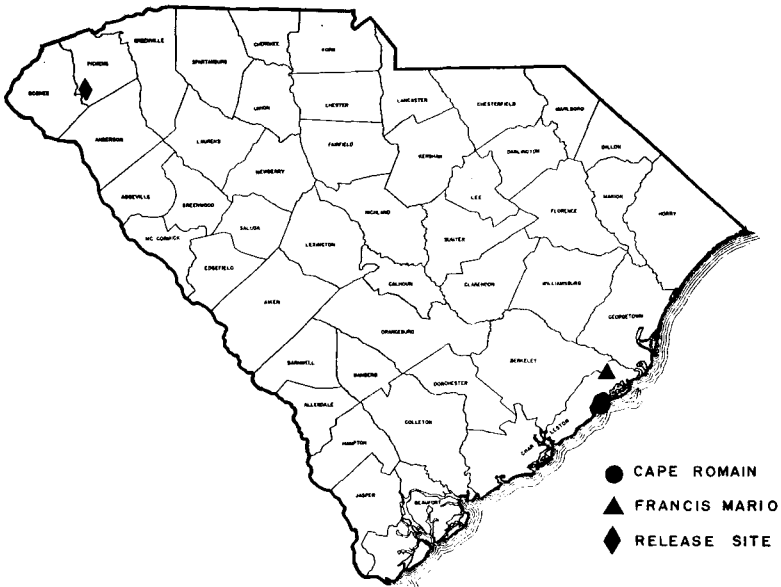


Figure 1. Map of South Carolina showing the trap areas and the release site of raccoons equipped with radio transmitters.

Prior to tagging, the raccoons were anesthetized by an intra-muscular injection of 0.25 cc of Ketaset (a ketamine hydrochloride equivalent to 100 mg per ml of ketamine) and then tagged in both ears with numbered metal tags. Radio

transmitters attached to plastic collars were securely fastened around the animals' necks. An adjustment period of not less than two days was allowed before the raccoons were released.

All raccoons were released at the same location. Attempts were made to obtain day-time positions of the raccoons each day. Locations were determined with the use of a portable radio receiver and directional antenna utilizing the following methods: (1) holding the antenna by hand and approaching the area on foot; (2) holding the antenna while seated on a platform on the top of a moving automobile; (3) mounting the antenna to the bow of an outboard motor boat; and (4) mounting the antenna to the wing strut of an airplane. Each raccoon's location was determined by obtaining multiple bearings from two or more positions when tracked from the ground, automobile, or boat. Multiple bearings were necessary because of thick vegetation and hills which were usually present between the raccoon and the receiver. When a raccoon was located from an airplane, a ground search was made to obtain a more precise position of the radio equipped raccoon.

Data recorded daily for each raccoon included its day-time location and its distance and direction of movement from the preceding location. Movements were recorded in linear distances.

RESULTS AND DISCUSSION

Ten raccoons were released with radio equipped collars between 4 April and 28 May 1973 near Lake Issaqueena in the Clemson University Wildlife Research Area. Pertinent data relative to these raccoons are shown in Table 1. In addition, the table includes data on two other raccoons which were held in anticipation of release. After release, attempts were made to monitor the raccoon's daily positions through 17 July 1973. The locations at which the raccoons were found are shown in Figures 2-6. The period in which individual animals were monitored ranged from 3 to 51 days (mean of 26.8 days). The number of days on which individual raccoons were located within these monitored periods ranged from 3 to 49 days (mean of 23.1 days). On certain days, as noted on Figures 2-6, an animal may not have been located. On such days extensive searching was usually conducted.

Figures 2-6 give the day-time locations of the animals monitored. Tracking is not discussed in detail but movements and notes taken during the monitoring period are discussed briefly.

Raccoon number 1. For two days following release the raccoon was found denning in a rock outcropping in a small stream (Fig. 2). Heavy rains apparently drove the raccoon out of this area. Subsequent locations through the 10th day after release are illustrated in Figure 2. On the 10th night after release the raccoon crossed Lake Hartwell, moved upstream approximately 2 km and for the next 12 days was located within a radius of 0.5 km. On six occasions during this period the raccoon was observed resting completely exposed on branches of hardwoods not yet in spring foliage. Twenty-two days after release the raccoon was found dead 4.6 linear kilometers (lin km) southwest of the site of release. Necropsy performed by personnel of the Wildlife Disease Study attributed death to trauma from a dog bite. However, pathological conditions of enteritis and mild pneumonia were present at death and may have contributed to a weakened condition.

Raccoon number 2. The day following release raccoon number 2 was located approximately 0.2 km southeast of the site of release (Fig. 3). At 2330 hours on the second day after release it was located on the east side of Lake Issaqueena, 2.5 km south of the site of release. At 0500 hours on the third day after release the raccoon was killed inside of a chicken pen 2.5 km northwest of its second day

location. The raccoon appeared to have crossed Lake Issaqueena and traversed a linear minimum of 2.5 km, void of any water course, in 5.5 hours. At death the raccoon was 2.5 lin km from the site of release.

Raccoon number 3. At the time of release raccoon number 3 was known to be pregnant. For the first five days following release this raccoon was located 0.2 km east of the site of release occupying the same den (Fig. 4). On the sixth day after release one young was found dead in the den. On the 10th day after release the female and one living young were observed in the den. The following day the young was found dead in the den. The female remained within 1.5 km of the site of release through the 50th day after release. Subsequent observations of the den site and additional den sites occupied by the raccoon revealed no additional young. On the 51st day after release (1 July) the raccoon could not be located. Subsequent daily searches through 17 July failed to locate the raccoon. However, on the night before contact was lost, dogs were heard running in the area and may have killed the raccoon and damaged the transmitter. The raccoon's last monitored location was 0.75 lin km from the site of release.

The causes of death of the young were not determined and neither young was removed from the den. The stress that the mother experienced during the ordeal of being trapped, transported, drugged, and collared may have attributed to the death of the young. In addition the author's presence in the area may have caused abandonment of the young.

Raccoon number 4. Raccoon number 4 was located within 1 km of the site of release for seven consecutive days following release (Fig. 5). For the next two days it was located approximately 1.5 km south of the site of release. On the 10th day after release the raccoon was located north of the site of release and continued to move for the next three days. Contact was lost after the 12th day after release. It was not located again until the 36th day after release when a strong signal was picked up from an airplane 14.5 lin km north of the site of release. Subsequent ground and aerial searching failed to locate the raccoon.

Raccoon number 5. For six days following release the raccoon was located within 0.7 km of the site of release (Fig. 6). Weakening of the radio signal occurred rapidly over this period. Since the radio collar was the same as used on raccoon number 1, failure to pick up the raccoon on the seventh and subsequent days was attributed to weak batteries within the radio collar pack.

Raccoon number 6. For seven days following release this raccoon was located within 0.3 km of the site of release (Fig. 3). On the eight and ninth days after release it was found approximately 1.5 km south of the site of release on the east side of Lake Issaqueena. The raccoon was not located on the next day but from the 11th through 20th days after release it was located within 0.5 km of the site of release. The raccoon was not located again until the 25th day after release when it was located 1.8 lin km northeast of the site of release. Subsequent searches through 17 July failed to locate the raccoon.

Raccoon number 7. During the first four days following release the raccoon was found denning in a squirrel nest in a large oak tree 0.2 km from the site of release (Fig. 6). During this period the transmitter was operating at irregular intervals. No signal was received after the fourth day following release. This failure to receive signals was attributed to transmitter failure.

Raccoon number 8. For 14 days following release raccoon number 8 was located within a 0.5 km radius of its site of release after which a gradual movement away from the release area occurred (Fig. 2). Periodic locations through the 51st day following release were obtained (days that the raccoon was not located are listed in the Fig. 2 title). On the days that the raccoon was not located extensive ground searching proved unsuccessful.

As can be noticed in Fig. 2, on numerous occasions the raccoon moved into areas in which prior daily resting locations were not noted. After these

Table 1. Data on movement and fate of 12 raccoons collected in the lower Coastal Plain of South Carolina, of which ten were released in the upper Piedmont of the state in 1973.

Animal number	Sex	Age ¹	Trap Site	Period Monitored (Days)	Days Located Within Period	Cause of Termination	Linear Distance From Release At Termination (km)	
1	F	J	Cape Romain	22	22	Killed	4.60	
2	M	A	Francis Marion	3	3	Killed	2.50	
3	F	A	Cape Romain	50	49	Lost	.75	
4	M	A	Cape Romain	36	13	Lost	14.50	
5	M	J	Cape Romain	6	6	Transmitter failure	.65	
6	F	A	Cape Romain	25	21	Lost	1.80	
7	F	A	Cape Romain	4	4	Transmitter failure	.20	
8	M	A	Francis Marion	51	44	Presently monitoring	6.00	
9	M	J	Francis Marion	51	49	Presently monitoring	1.70	
10	M	A	Francis Marion	20	20	Receiver malfunction	.10	
11	F	J	Francis Marion	Died 25 May				
12	M	A	Cape Romain	Euthanized 10 May				
Mean	--	--	--	26.8	23.1	--	3.28	

¹Animals aged as either juvenile or adult. J=juvenile A=adult

movements occurred the raccoon usually returned to an area that had been visited previously. A movement of over 5 lin km occurred on the night of the 39th day after release. This was the greatest movement found to take place within a 24 hour period for any raccoon monitored during the study. On 17 July, raccoon number 8 was located 6.0 lin km from its site of release.

Raccoon number 9. Daily locations of this raccoon were obtained for 49 of the 51 days that the raccoon was monitored (Fig. 6). On the 12th and 50th days after release no attempt was made to locate the raccoon. The day-time resting positions of the raccoon were found to be within 1.8 km of the site of release throughout the monitored period. At least 21 different day-time resting locations were found to be utilized by this raccoon — all being relatively close to water courses. The location data also showed that the raccoon often frequented areas that it had visited previously. On 17 July (the 51st day after release), the raccoon was found 1.7 lin km south of the site of release.

Raccoon number 10. This raccoon was monitored for 20 days and was not located in excess of 0.3 km from the site of release (Fig. 4). On the 21st day after release the radio receiver became nonfunctional and had to be replaced. This replacement receiver lacked the capacity to receive on the frequency of the transmitter attached to this raccoon. The last location obtained for this raccoon was 0.1 lin km from the site of release.

Raccoon 11 and 12. Raccoons number 11 and 12 were not released. Raccoon number 11 was discovered dead in a holding pen on 25 May, and taken immediately to the Wildlife Disease Study for necropsy. The necropsy indicated that at the time of death the animal was heavily infected with intestinal parasites (hookworms). Dermatitis and interstitial pneumonia were also detected.

The physical condition of raccoon number 12 steadily deteriorated while in captivity. A weight loss of 1.14 kilograms occurred between 28 April and 10 May. On 10 May, the live raccoon was taken to the Wildlife Disease Study for necropsy. The necropsy indicated that gastric ulcers were present in the stomach mucosa with fibrinopurulent inflammatory reaction extending into the muscle walls. The animal's critical condition was caused by hemorrhagic gastritis and enteritis. *Salmonella* sp. was also isolated from the intestinal contents.

From a study of movements of the ten raccoons equipped with transmitters there appears to be a tendency for the raccoons to remain relatively close to their site of release for a few days following release. In all but one case (raccoon number 2) the raccoons were located within 1 km of the site of release for periods ranging from 3 to 50 days with a mean of 12.6 days. Further study of the daily locations suggested that the raccoons often returned to familiar areas.

Raccoon movements also appeared to follow relatively close to existing water courses. Daily locations suggested that raccoons successfully crossed bodies of water over 200 meters in width without detrimental effects to the radio transmitters. The composite map of the movements of all 10 raccoons suggests that no preference in direction or homing instinct was manifested during the study period (Fig. 7).

This study suggested that relocating raccoons into areas of low population levels can be successful. Raccoons released did not immediately begin a movement over long distances but instead remained relatively close to their release locations. Movements appeared to be somewhat gradual. Movements over extended periods of time and for long distances have yet to be determined using radio telemetry. Occasional movements in excess of 200 lin km have been reported but such movements are believed to be rare (Priewert 1961 and Lynch 1967).

If raccoons are healthy when released the chance of survival would naturally be higher than that of unhealthy raccoons. Holding raccoons for periods ranging from one to three weeks was practiced in hopes that any diseases carried by

the captive raccoons would become apparent within this period. The chance of spreading diseases into native populations is relatively high when raccoons are trapped from highly populated areas and released without observations. The death of raccoon number 11 and the condition of raccoon number 12 when taken to the Wildlife Disease Study supports the hypothesis that the raccoons should be held for observation prior to release.

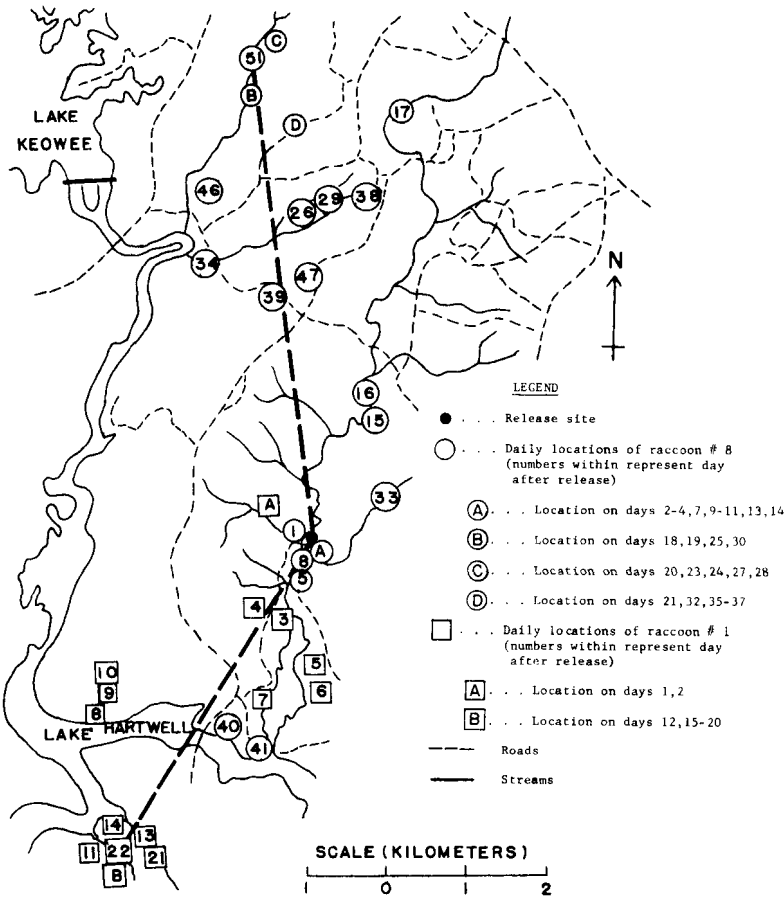


Figure 2. The daily locations of raccoons numbered 1 and 8 (no data obtained for raccoon numbered 8 on days 6, 12, 22, 31, 42-45, 48-50).

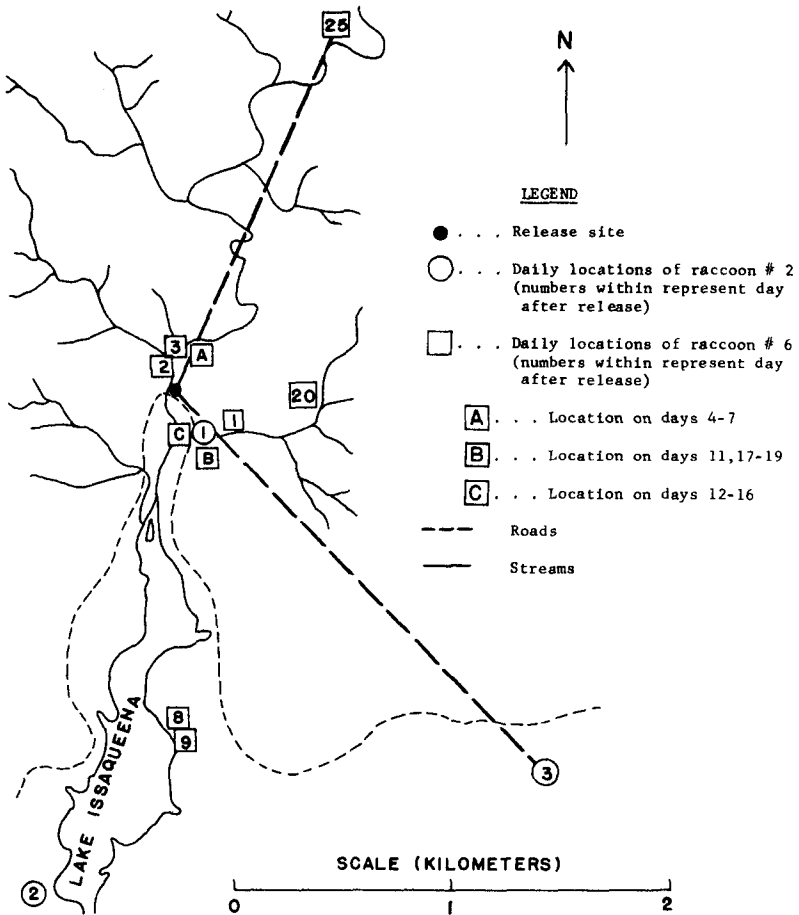


Figure 3. The daily locations of raccoons numbered 2 and 6 (no data obtained on raccoon numbered 6 on days 10, 21-24).

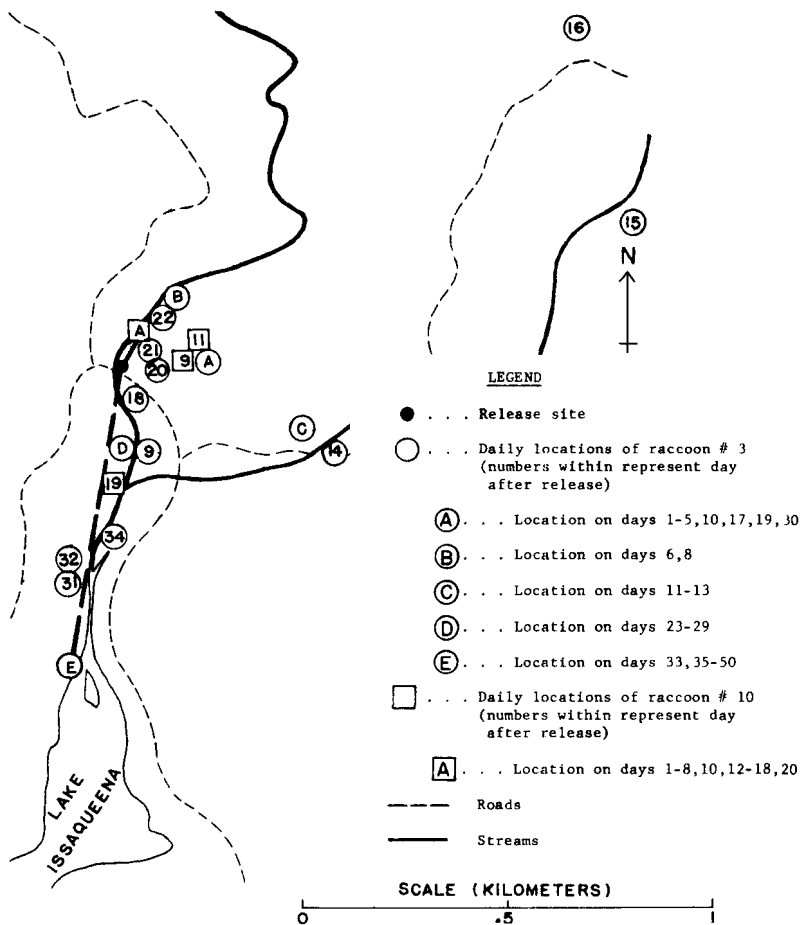


Figure 4. The daily locations of raccoons numbered 3 and 10 (no data obtained on raccoon numbered 3 on day 7).

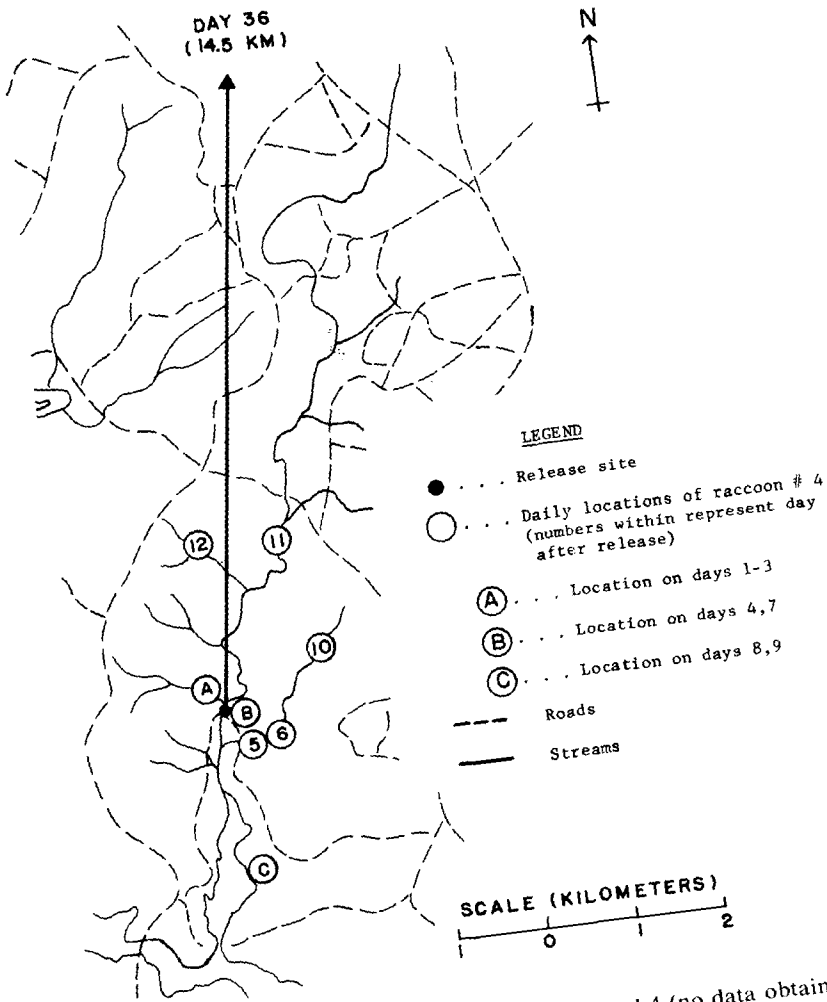


Figure 5. The daily locations of raccoon numbered 4 (no data obtained on days 13-35).

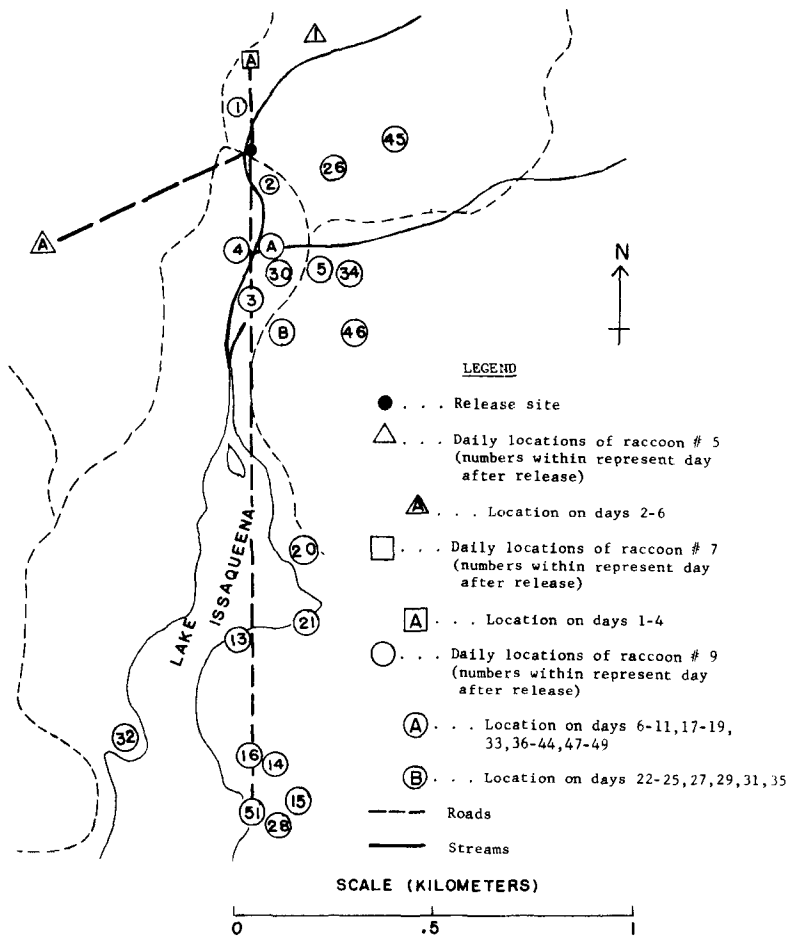


Figure 6. The daily locations of raccoons numbered 5, 7, and 9 (no data obtained for raccoon numbered 9 on days 12, 50).

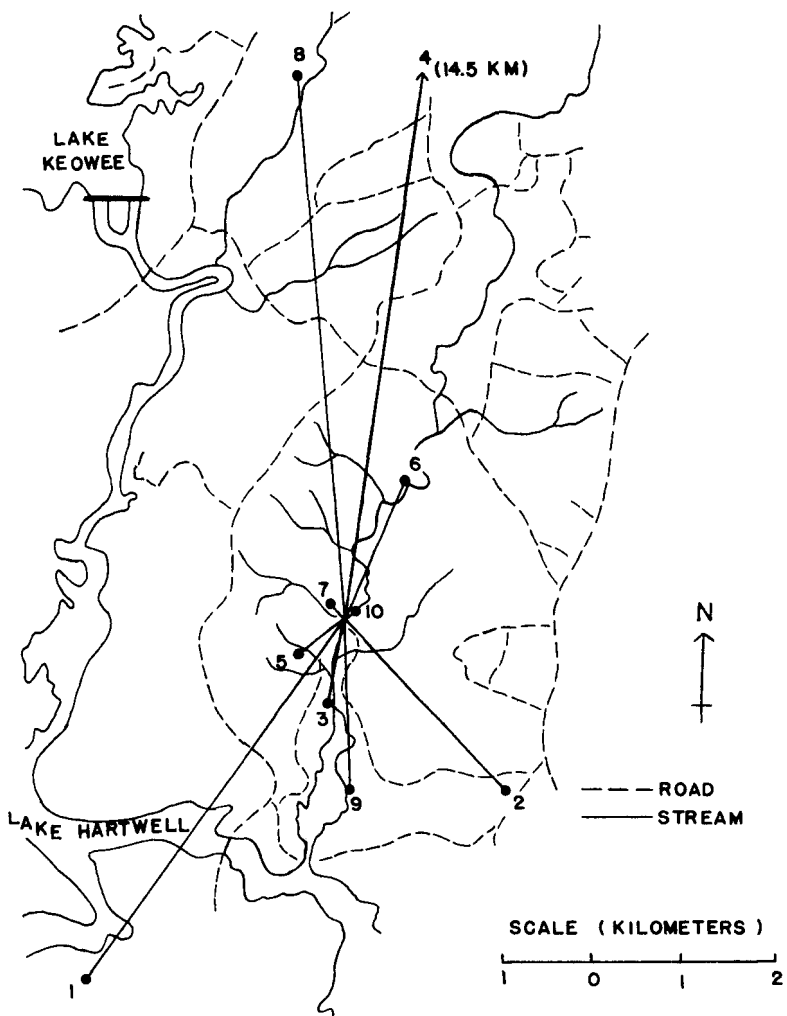


Figure 7. Movements from the release site to terminal locations of the ten raccoons equipped with radio transmitters (numbers represent raccoon number).

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