NOTES ON THE ECOLOGY OF MAMMALS OF A STRIP-MINED AREA IN SOUTHERN ILLINOIS

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Where lands are progressively laid bare by strip-mining, observations of changes of habitat and responses of animals become possible on a scale not often available to ecologists and provide a ready means of obtaining data useful in understanding faunal distribution. Nevertheless the ecology of striplands has not been studied extensively. Often they are not within easy distance of interested students.

The revegetation of such areas in southern Illinois has been described by Bell (1956:85-91) and Brewer and Triner (1956:73-84), and that of other Illinois strip-mined areas by McDougall (1925:378) and Croxton (1928:158). The invertebrates of several selected communities were studied by Smith (1928:493). Yeager (1942: 619) recognized that invasion of striplands by mammals was related to the age of the areas since mining. Brewer (1958:544) found no significant correlation between the age of stripped area and species of birds breeding there. He believed that "local variation in vegetation may have been most important in determining density." In a study of the distribution of *Peromyscus leucopus* ssp. and *P. maniculatus bairdi*, Verts (1957:56) found that *P. leucopus* ssp. preferred older strip-mined areas and *P. m. bairdi* preferred more recently mined areas. In Ohio, Riley (1954:324) compared wildlife populations on strip-mined land with those on various types of agricultural land. Lewis and Peters (1955: 117-124) reported on the physicochemical characteristics of stripland ponds in southern Illinois.

As part of an investigation to determine the wildlife potential of coal strip-mined lands in southern Illinois, an ecological study of the mammalian fauna was conducted. The study was started August 4, 1954, and terminated May 30, 1956. Distribution and populations of mammals as related to the age of strip-mined areas, vegetative composition, and topography were aspects most intensively investigated.

Description of the Area

The 1,792-acre research area is located in Perry County, about 5 miles south of Pinckneyville and 2 miles west of Pyatts, Illinois. Southern Illinois University holds title to the western 920 acres, and the remaining 872 acres is owned by Truax-Traer Coal Company.

Strip-mining operations began on this land in 1932 and continued until 1950, with the exception of 1934. The study area, therefore, contains 18 areas which vary in age from 6 to 24 years. The acreage, direction of stripping, and shape of these tracts are not uniform. There are also several unmined areas which vary in size from 4 to 51 acres and total approximately 154 acres.

Topographic, soil, and vegetative characteristics of this area have been previously described (Verts, 1957: 53). In general, there were few

differences in vegetative composition between the oldest and the most recently mined areas. The only major difference in vegetative characteristics was an increase in diameter and height of trees corresponding to an increase in time elapsed since mining.

Materials and Methods

Techniques used in small-mammal censusing were as follows: 30 to 50 stations were established in lines at about 10-yard intervals and 2 museum-special or ordinary mouse traps, baited with a mixture of peanut butter, oatmeal, and DDT, were set within a 3-foot radius of each station marker. Traplines of this type were operated for two consecutive nights in a strip-mined area of each age in late summer and early autumn of 1954 and late winter and early spring of 1955.

Distribution and relative abundance of larger mammals were determined by observing sign (tracks, scats, cuttings, and dens) and individuals. As this area was open to public hunting and trapping, an index by use of questionnaires was made of numbers of game and fur mammals removed.

A representative collection of stripland mammals was desposited in the Cooperative Wildlife Research collection of Southern Illinois University.

Nomenclature of mammals used in this paper is that of Miller and Kellogg (1955).

Accounts of Species

Didelphis marsupialis Kerr. Opossum. Tracks and scats indicated relatively uniform distribution. In autumn of 1954, sign was found on almost every spoil pile, but by autumn of 1955 was much reduced. Three specimens collected; none by hunters and trappers.

Blarina brevicauda (Say). Short-tailed shrew. One taken in black locust plantation, strip-mined in 1939.

Cryptotis parva (Say). Least shrew. Skull found in area strip-mined in 1944.

Scalopus aquaticus (Linnaeus). Eastern mole. As indicated by extent of runways, found to be restricted usually to moist sites between spoil piles and in unmined areas. In periods of heavy precipitation, runways were more extensive and occasionally crossed crests of spoil piles. Two collected.

Pipistrellus subflavus (F. Cuvier). Eastern pipistrelle. Six shot near unmined woodlands on west edge of study area. Pipistrelles probably use area only to feed and drink; sites favored for roosting (Hamilton, 1943:86) relatively few.

Lasiurus borealis (Müller). Red bat. Five taken in same locality as pipistrelles. Probably feeds and drinks on area but roosts elsewhere.

Sylvilagus floridanus (J. A. Allen). Cottontail rabbit. Populations determined by counting groups of droppings (pellets) in 4- by 100- foot quadrats. Ten quadrats established in strip-mined areas of each age, with approximately equal numbers on spoil-crests, slopes, and in valleys. As indicated by mean number of piles of pellets per quadrat, cottontails occurred throughout area, but most abundantly in more recently mined areas, especially in tracts mined in 1947, 1948, and 1949.

Cottontail populations apparently not correlated with height, density, or composition of vegetation, except in dense pine plantations where sign was rarely observed.

Hunter-success reports indicated that 138 (0.74 per hunter-hour) and 141 (0.53 per hunter-hour) cottontails were harvested in the 1954-1955 and 1955-1956 hunting seasons, respectively. Pellet counts indicated a population decline of similar magnitude.

Marmota monax (Linnaeus). Woodchuck. Active dens observed in strip-mined areas of all ages. No apparent correlation between numbers of den sites and age of strip-mined areas. Concentrations of burrows in unshaded rocky areas supporting dense stands of sweet clover.

Tamias striatus (Linnaeus). Eastern chipmunk. Nine taken in autumn of

1954 near west edge of study area. Although all activity was noted within 50 yards of unmined woodlands, two animals had burrows in spoil piles. Repeated hunting and trapping in 1955 produced no chipmunks.

Sciurus carolinensis Gmelin. Gray squirrel. Individuals noted on several occasions on unmined portions of study area; it may be assumed that they ranged short distances into spoil piles. Lack of mature forest and mast-producing trees probably exclude this species.

Sciurus niger Linnaeus. Fox squirrel. None observed on striplands, but leaf nests containing fur of fox squirrels were found in areas strip-mined in 1932, 1933, 1943, and 1945, and in several unmined tracts. Low density of woodlands and lack of mast-producing trees probably limit this species.

Glaucomys volans (Linnaeus). Southern flying squirrel. Evidence was fur left in rat trap nailed to large tree near west edge of area. Limiting factors probably same as those listed for tree squirrels.

Castor canadensis Kuhl. Beaver. Cuttings indicate periodic use of some stripland ponds. Evidence of heavy beaver activity previous to this investigation was noted in one pond. A freshly cut cottonwood was found in small pond nearby in May, 1955, but repeated observations revealed no additional sign. An insufficient food supply probably limits this species.

Peromyscus leucopus (Rafinesque). White-footed mouse. Taken in strip-mined areas of all ages, this was predominate species of *Peromyscus* in older tracts, and was only *Peromyscus* taken in areas strip-mined in 1932, 1933, 1935, and 1939. Three hundred sixteen taken in 6,221 trap-nights from August, 1954, to May, 1955.

Peromyscus maniculatus (Wagner). Deer mouse. Taken in areas of all ages except those mined in 1932, 1933, 1935, and 1939. Predominate species of *Peromyscus* and attained highest population levels in more recently strip-mined areas (Verts, 1957:56). Four hundred twenty-seven taken in 6,221 trap-nights from August, 1954, to May, 1955.

Pedomys ochrogaster (Wagner). Prairie vole. Taken in all areas except those mined in 1937, 1938, 1939, 1941, 1942, and 1945. Usually associated with large areas of cheat and bluegrass, but, in winter, runways found beneath fallen sweet clover stems. Only 32 taken in 6,221 trap-nights; eight in 400 trap-nights in the area strip-mined in 1944.

Ondatra zibethicus (Linnaeus). Muskrat. Populations indexed by recording numbers of cuttings, den entrances, and scats in ponds easily accessible by boat. Activity noted in almost every pond of sufficient depth to retain water throughout year but was relatively more intense in smaller ponds.

Definite correlation noted between quantity of muskrat sign and character of shoreline soils. Little muskrat activity noted in ponds with high proportion of rock and shale to clay in their banks. Banks which facilitated tunneling apparently essential as water depth usually too great and aquatic vegetation too limited to allow construction of houses.

Trappers reported taking 7 and 102 muskrats in the 1954-1955 and 1955-1956 seasons, respectively. Improved reporting system in 1955-1956 season was undoubtedly responsible for most of difference between two years.

Mus musculus Linnaeus. House mouse. Seventeen taken in spring of 1955 in areas mined in 1940, 1943, 1947, 1949, and 1950. Habitat near water apparently preferred as most specimens taken within 25 yards of pond.

Canis latrans Say. Coyote. Similiarity between coyote and dog sign made study difficult, but tracks found in areas mined in 1932, 1933, 1947, and 1950 were believed those of coyotes. In December, 1954, adult female trapped in tract mined in 1950. Farmers and hunters reported two "wolves" nearby.

Vulpes fulva (Desmarest). Red fox. Tracks rarely observed, but when found, usually in the same locations as those of gray foxes. None seen, but skull found in area mined in 1932.

Urocyon cinereoargenteus (Schreber). Gray fox. Tracks found in strip-mined areas of all ages. In general, numbers of tracks observed greater in 1955 than in 1954. Increase attributed, in part, to additional roads on area, thus increasing opportunity to observe sign. Several gray foxes flushed, but none taken.

Procyon lotor (Linnaeus). Raccoon. As indicated by sign, raccoons more or less uniformly distributed, but greatest activity noted at edges of ponds and along roadsides. Apparently most raccoons were ground dwellers.

Trappers and hunters reported taking none in 1954-1955 season and 17 in 1955-1956 season. According to reports, night hunting with dogs not productive on

striplands as raccoons habitually entered ground dens. Two collected.

Mustela frenata Lichtenstein. Long-tailed weasel. Sign noted in areas strip-mined in 1932, 1933, and 1936 where temporary ponds were surrounded by heavy growths of sandbar willow. Tracks in snow in January, 1956, were especially numerous in area mined in 1932.

Mustela vison Schreber. Mink. Sign found near seven of larger ponds. In general, more sign was observed in autumn of 1954 than in 1955. Trappers reported taking two and five in 1954-1955 and 1955-1956 seasons, respectively.

Mephitis mephitis (Schreber). Striped skunk. Sign rarely observed in autumn 1954; believed that striplands did not provide suitable habitat. In summer of 1955 sign more abundant, and skunks commonly observed in early morning or late evening. Some seen in 1932, 1933, 1936, 1945, and 1946 strip-mined areas, and tracks were seen in all areas.

Odocoileus virginianus (Zimmermann). White-tailed deer. Except for one animal flushed in September, 1954, in area mined in 1932, no evidence of deer was noted. Residents near area reported observing deer on striplands.

Discussion

The mammalian fauna of the striplands may be divided into four ecological groups: 1) Species becoming established in older strip-mined area; 2) Species distributed throughout striplands; 3) Species which apparently invade striplands soon after mining and are absent or reduced in numbers in older strip-mined areas; and 4) Species whose distribution is dependent on special conditions prevailing in localized areas on striplands.

In the first group may be placed the short-tailed shrew, eastern pipistrelle, red bat, chipmunk, gray squirrel, fox squirrel, flying squirrel, white-footed mouse, long-tailed weasel, and white-tailed deer. These species may, in general, be classified as woodland forms, or at least associated with woodlands. Plantation-type tree plantings (except pine plantings) in some of the older strip-mined areas probably are materially aiding invasion by woodland species.

Mammals more or less uniformly distributed throughout the striplands are the opossum, cottontail rabbit, woodchuck, coyote, red fox, gray fox, raccoon, and striped skunk. Most of these can be found in a wide variety of habitats, and cannot be classified as species associated with preference for specific vegetative types. It is possible that the general uniformity of vegetative cover is responsible for wide distribution of these forms on the striplands.

The only mammal which apparently invades striplands soon after mining and then is eliminated by changes associated with increased age of strip-mined areas is the deer mouse. Undoubtedly, other species will exhibit this same tendency, but length of time since mining is not sufficient for many such changes to be evident.

Mammals limited in distribution by special factors are the eastern mole, beaver, prairie vole, muskrat, house mouse, and mink. Except for the prairie vole, quantity and presence of water are apparently limiting. This species was usually found in areas which supported heavy growths of grasses. The beaver, muskrat, and mink are predominately aquatic forms and were associated with permanent water. Within this special habitat, soil composition further limited the muskrat. The house mouse and eastern mole tended to be associated with moist soils.

These ecological groups, except the latter one, appear to be seral stages in a succession toward a forest type fauna. Although there were no measurable differences in species composition of the vegetation which could be interpreted as succession toward a forest climax, slight changes in light intensity, relative humidity, temperature, wind velocity, and surface litter due to greater height and canopy size of trees in older strip-mined areas may have been sufficient to initiate changes in faunal distribution. Herbaceous composition will probably show greater responses in the future to the physical changes caused by greater height and canopy size of trees.

Summary

Mammals of a southern Illinois strip-mined area were studied with emphasis on factors which limit distribution of various species on such lands. The area contained 18 tracts mined in various years from 1932 to 1950, excluding 1934.

The only observable major difference in vegetation was increased height and diameter of trees on older strip-mined areas. Species composition or number of stems of herbaceous vegetation were not significantly different between areas of different age.

Evidence of 26 species of mammals was found on the area.

Stripland mammals were divided into four ecological groups: those becoming established on older strip-mined land, those established on more recently mined land but absent or scarce in older areas, species distributed throughout the area, and species limited by some special factor to a localized habitat.

Changes in the physical conditions due to increased height and canopy-size of trees may be sufficient to initiate changes in mammal distribution.

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