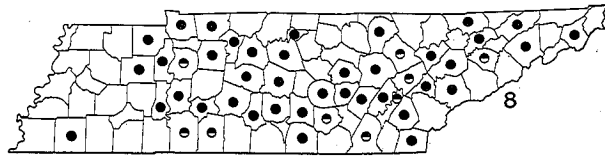


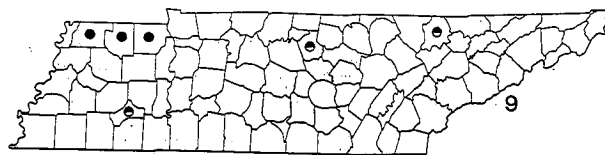
in "stem abundantly branched to the base with some 25-35 branches per plant; each branch terminated by an elongated, densely many-flowered spike."



MAP 8: *Verbena simplex* Lehm. Closed circles: specimens examined; half-closed circles: additional records cited by Moldenke.

7. *Verbena stricta* Vent., Hort. Cels. 53, 1800.

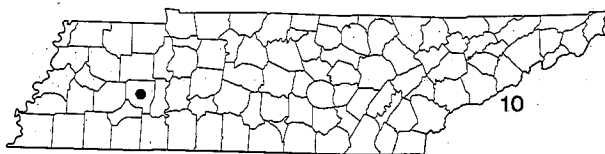
A species of prairies and barrens, this is known from southern Ontario to New Mexico and is adventive eastward. It has a very limited distribution in Tennessee, known from only six counties (Map 9). *Verbena x moechina* Moldenke, a hybrid between *V. simplex* and *V. stricta*, occurs where the ranges of these species overlap in central United States, e.g., Arkansas, Indiana, Illinois, Iowa, Missouri, Ohio, and Oklahoma (Moldenke, 1971). It was reported from Knox County by Moldenke (1964), based on an 1895 Ruth Collection. Otherwise, it has not been reported from the southeast. The hybrid resembles *V. simplex* and probably passes for it; its status in Tennessee has yet to be determined.



MAP 9: *Verbena stricta* Vent. Closed circles: specimens examined; half-closed circles: additional records cited by Moldenke.

8. *Verbena tenuisecta* Briq., Ann Cons. and Jard. Bot. Geneva 7-8: 294, 1904.

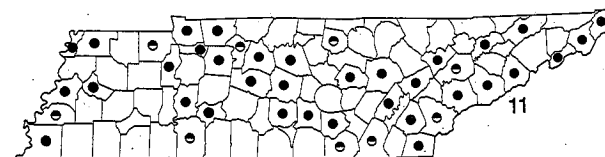
This South American introduction was not included by Gattinger, Small, or Fernald; Radford, Ahles, and Bell list it from Georgia, Florida, Alabama, and Mississippi, but not from Tennessee, while Gleason and Cronquist note its occurrence as far northward as St. Louis. Presently it is known only from Henderson County in western Tennessee (Sharp & Baker, 1964; Moldenke, 1971); but is expected in other Coastal Plain counties (Map 10).



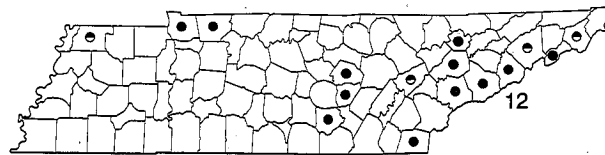
MAP 10: *Verbena tenuisecta* Briq. Closed circles: specimens examined; half-closed circles: additional records cited by Moldenke.

9. *Verbena urticifolia* L., Sp. Pl. 20, 1753.

A wide-ranging species known from all sections of the state, it is most often found in moist woodlands (Map 11). *Verbena urticifolia* var. *leiocarpa* Perry and Fernald differs from the stypical variety in smaller calyces (less than 2 mm.), smaller nutlets (less than 1.5 mm.) and leaves velutinous beneath rather than strigose. It is scattered over Tennessee with the typical variety (Map 12). *Verbena x engelmannii* Moldenke, a hybrid between *V. urticifolia* and *V. hastata* and intermediate between them in characteristics, was reported from Carroll County in western Tennessee by Moldenke (1958). This hybrid is known in at least 16 other states (Moldenke, 1971) and is included as part of the southeastern flora from North Carolina (Radford, Ahles, and Bell). Specimens have not been observed in this study and the further status of this hybrid in Tennessee has yet to be determined.



MAP 11: *Verbena urticifolia* L. Closed circles: specimens examined; half-closed circles: additional records cited by Moldenke.



MAP 12: *Verbena urticifolia* L. var. *leiocarpa* Perry & Fernald. Closed circles: specimens examined; half-closed circles: additional records cited by Moldenke.

CULTIVATED TAXA

Moldenke lists several hundred taxa known from cultivation, mostly as ornamentals, over the world. The extent of cultivation in Tennessee is unknown; but most of the cultivated taxa do not escape, and as such are not considered part of the state flora here. However, three taxa are represented in herbaria:

Callicarpa dichotoma (Lour.) K. Koch. Beauty-Berry. A native of China, this shrub is known to be cultivated in Knox County. It has been reported as a possible escape in North Carolina and Virginia, but is not known outside of cultivation in Tennessee.

Vitex agnus-castus L. Chaste Tree. A native of Eurasia, this small tree or shrub is widely cultivated over the state but has not been reported as an escape. It is known from pastures in North and South Carolina, however.

Verbena x hybrida Voss. This hybrid, which is similar to *V. canadensis*, is a common cultivar and escape over the United States. It is reported as escaped in South

Carolina; moreover, Ellis, Wofford, and Chester (1971) have reported it from Lyon County, Kentucky. Although not presently known as an escape in Tennessee, the proximity of the nearby records indicate possibilities of its occurrence here and it should be sought by collectors.

EXCLUDED AND QUESTIONABLE TAXA

Verbena riparia Raf. Reported by Gattinger from "Banks of Staley Creek, at Marion; banks of Cedar Creek, S. W. Va., J. K. Small." While the first part of this statement might indicate a Tennessee record, the Marion collections are actually from Smyth County, Virginia (Perry, 1933).

Verbena ciliata Benth. Reported from Davidson County by Moldenke (1963, 1971), based on a Michaux specimen collected "in urbe Nashville." Perry describes the range of this species as southwestern United States and Mexico; Moldenke (1971) also notes its occurrence from South Dakota to Guatemala and eastward to Oklahoma. In the absence of recent reports, the status of this western taxon in the state is questionable.

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OBSERVATIONS ON THE PRESENCE OF FURBEARERS
 IN THE SEQUATCHIE RIVER, TENNESSEE

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ABSTRACT

East Tennessee is an area of highly diverse terrain harboring a great deal of wildlife. A number of rivers flow through the region, offering extensive habitat for many species of fish, waterfowl, and semi-aquatic mammals such as the muskrat (*Ondatra zibethica*), mink (*Mustela vison*), beaver (*Castor canadensis*) and river otter (*Lutra canadensis*). During the period since the beginning of the Great Depression in 1929, extensive changes have occurred in the state's watersheds which have caused the extirpation of many native species of wildlife (Wing, 1940). Due to the increasing development of industrial, agricultural and recreational uses of the rivers and watersheds, even though extensive protective measures have been instituted for wildlife populations, many of these previously extirpated species have been slow to return to their formerly occupied ranges.

The Sequatchie River in East Tennessee is one of the few rivers in the region which has virtually escaped the encroachment of industry, and has been less severely affected by agriculture than have most other neighboring streams of equal or larger size. Because of these environmental conditions, the potential for previously extirpated species of wildlife to recolonize the river is probably higher in the Sequatchie drainage system than in other rivers in this portion of the state. This report is an inventory and estimated status listing of the semi-aquatic mammals currently present in the Sequatchie River, excluding its tributaries. The report additionally includes recommendations concerning improvement of the drainage for wildlife production, and for a somewhat more extensive investigation of the semi-aquatic mammal populations currently present in the Sequatchie drainage.

PHYSIOGRAPHY

The Sequatchie River arises in the Grassy Cove region of the Cumberland Plateau in Cumberland County. Flowing generally south southwest (Fig. 1) for approximately 179 kilometers through agricultural land which is predominantly under cultivation or pasture, the Sequatchie drains portions of Cumberland, Bledsoe, Vanburen, Sequatchie, Grundy and Marion Counties. The only significant portions of land adjacent to the river which are not being used for some agriculture purposes are in the Grassy Cove headwaters region. At its mouth, the Sequatchie forms a confluence with the Tennessee River west of Nickajack Dam near the town of Jasper. The stream drops from approximately 376 meters above mean sea level at its head, to 181 meters above mean sea level where it joins the Tennessee. Nearly all tributaries of the Sequatchie arise from the Cumberland Plateau at elevations of 610 meters or higher, with the maximum elevation of one of these feeder streams being 929 meters (TVA, 1972).

The geologic formation of the Sequatchie Valley resulted from the tremendous pressures created by the eruption of the mountains to the southeast, which caused the wholesale shifting of the Cumberland Plateau in a northeasterly direction. This violent shift and the subsequent fault exposed extensive deposits of soluble dolomites and limestone, thus accelerating the rate of erosion beyond that of the surrounding areas. As a result of this erosion, the floor of the Sequatchie Valley today lies some 305 meters below the adjacent Plateau surface (TVA, 1972).

There are approximately 320 kilometers of streams which comprise the Sequatchie drainage system, with the basin containing some 1567 square kilometers. The average annual discharge of the river near the town of Whitwell is 20.44 cubic meters per second with rainfall over the Valley averaging 142 centimeters annually. March is normally the wettest month of the year, with October being the driest month (TVA, 1972).

About 40 percent of the soil in the Valley is suitable for cultivation and is being worked, with the predominant crop being corn (TVA, 1972). Because most fields have not been tilled closer than 10 to 100 meters from the river, a reasonable margin for wildlife harborage exists in most areas. An additional agricultural use of the Valley is in livestock production on non-tillable land along the river, with several cattle and swine pastures located adjacent to the stream. The forested portions of the drainage basin are predominantly in an Oak-Hickory climatic state. The riparian zone, however, is comprised primarily of Sycamore (*Platanus occidentalis*), box elder (*Acer negundo*), willow (*Salix nigra*) and river birch (*Betula nigra*). There are numerous hornbeams (*Ostrya virginica*) in the understory layer along the river.

HISTORICAL PRESENCE OF FURBEARING MAMMALS

A number of authors have investigated the status of wild mammals in East Tennessee during the past forty years. Perhaps the most detailed inventory was published by Kellogg (1939) and listed the probable distribution of mammals either present at that time or previously documented in the state. The paper listed both beaver and otter as having previously occurred in East Tennessee, but no record existed for either species after 1896 in that area.

Wing (1940) surveyed the same species in northeast Tennessee from the Kentucky border to approximately the Holston River, including the upper portions of the Sequatchie Valley. He indicated that both mink and muskrats, although nowhere abundant, had resident reproducing populations in the region. Both beaver and otter, however, had been extirpated from that portion of the state. He further indicated that the poverty of the human population at that time, in conjunction with the tremendous amount of free time due to lack of employment, had a larger deleterious effect upon the region's wildlife fauna. The intensified farming practices and the extensive killing of wild animals for food or other purposes had caused heavy losses in both transient and resident species of wildlife. Further and probably equally significant losses in wildlife populations were being caused, at that time, by wild-roaming and feral packs of dogs which were not adequately cared for by their

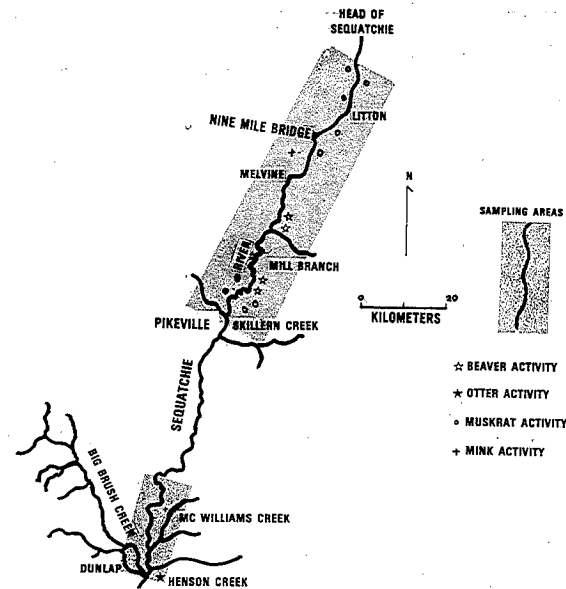


FIG. 1: Semi-aquatic mammal activity in Sequatchie River Basin, 1976.

owners. Wing attributed this, at least in part, to the extremely low income levels in the area which did not allow for the feeding of family dogs.

Howell and Conaway (1962) conducted a field sampling investigation of mammals throughout the Cumberland Mountains of East Tennessee which included points along the Sequatchie Valley near the headwaters and in the Pikeville area about 180 kilometers from the mouth. Though mink were listed as present but uncommon at that time, there was no evidence to indicate the presence of beaver or otter. Muskrats were not mentioned in the report.

In 1954, Schultz reported on the status of beaver and otter throughout the state of Tennessee, based upon observations of both professional biologists and local residents. Schultz's (1954) data indicate that in 1948, four beavers were transplanted from Alabama to an area on the Cumberland Plateau just east of the Sequatchie. Stream drainage from the point of introduction, called Patton's Refuge, flows primarily toward the Tennessee River to the east. Some runoff, however, drains into the Sequatchie Valley to the west, thus providing a potential avenue for migration by the beavers into the Sequatchie River. Between the years 1946 and 1954, observations of beaver were reported from several parts of the Sequatchie drainage basin in both Bledsoe and Sequatchie counties. Schultz (1954) attributes these to the probable migration of the introduced Alabama beavers, and indicates that reports of sightings prior to 1948 introduction are probably due to erroneous listing of dates.

Schultz (1954) also reported two observations of otters by local residents in or near the Sequatchie Valley. One such observation was northwest of the valley in the Obed river in Morgan County in 1951, and the other occurred in 1910 in the Sequatchie River in Sequatchie County.

A later report by the same author (Schultz, 1959) evaluated the status and distribution of both mink and muskrats in Tennessee. Data provided from landowner surveys and other knowledgeable segments of the general public who were contacted by biologists indicated that approximately 16% of the farms in the Sequatchie Valley had resident populations of mink. Some 42% of the farms in the same area were supporting muskrat populations.

The most recent publication which lists distribution of semi-aquatic furbearers in East Tennessee is by Byford (1974) and indicates scattered reports of beavers from areas in Middle Tennessee, but lists no specific dates or locations.

PROCEDURES

In order to determine the presence or absence of fur bearing semi-aquatic mammals and to evaluate their current status in the Sequatchie River, several sections of the river in Cumberland, Bledsoe and Sequatchie counties (Fig. 1) were sampled by aircraft, automobile, canoe, and on foot during the months of May, June and July 1976. In early May a preliminary automobile survey was made by driving as near as possible along the river from its headwaters to slightly south of Dunlap. In late June the headwaters of the river in the Grassy Cove area were investigated on foot, and in early July the entire river was observed from the air at altitudes from 245 to 460 meters above the valley floor. The most extensive and efficient method of investigation involved the use of a canoe, in late June and early July, to float several sections of the Sequatchie between Litton and Dunlap. All detailed observations were made using the latter technique.

RESULTS

Mink Activity

Sampling of the Sequatchie River by canoe in the vicinity of Dunlap, some 71.6 to 93.3 kilometers above the confluence, resulted in the confirmation of both mink and otter in that portion of the river. Approximately 3.2 kilometers above the Dunlap bridge entry point, an overhanging rock shelf was located under which was a second shelf above water level. This lower shelf was covered with a layer of mud. Tracks on this muddy shelf indicated that it had been used previously by a mink as a feeding area. On a separate occasion, a mink was observed at the base of a hollow tree adjacent to the creek above Nine Mile bridge.

Otter Activity

Some distance upstream from the mink feeding shelf, at the mouth of Henson Creek, an old otter scat was located on a fallen sycamore log which crossed the tributary stream. Examination of the scat indicated that the otter had been feeding upon crayfish (Field, 1970). Several pieces of crayfish exoskeleton were present in the scat. Although there was some mold present on the scat, normally establishing relative age, when broken open the characteristic odor of otter was still present. This would indicate that the scat had been deposited since the last high water period in early spring. Had the scat been inundated, the water would either have washed the material away or at least have eliminated the odor.

A flight over the river valley in early July provided sufficient visual evidence to indicate that the most productive region for wildlife could be expected to be between the Dunlap area and the headwaters of the Sequatchie. South of Dunlap, agriculture and human habitation become a more significant factor affecting the river. Consequently, the remainder of the investigation involved the portion of the Sequatchie between Litton and Pikeville.

Subsequent to the aerial observation of the Sequatchie Valley, the river between Litton and Pikeville was extensively investigated by canoe. This operation, which was carried out over three days, resulted in the confirmation of resident populations of both muskrats and beaver in the river.

Muskrat Activity

The entire section of river between the Litton Bridge and Pikeville showed evidence of moderate to heavy

muskrat activity. In many areas, trails running up the creek bank from the water into adjacent cornfields occurred at 50 to 60 meter intervals on either side of the creek. Since corn is the predominant crop in the valley, and has been identified as an important food source for muskrats in many areas of the U.S. (Errington, 1941; Willner et al., 1975; Freeman, 1945), a heavy muskrat population can be supported.

In addition to the extensive foraging in cornfields, evidence indicated that muskrats apparently caused considerable damage to the roots of numerous sycamore and willow trees along parts of the Sequatchie which were exposed as a result of stream action. Large patches of epidermal tissue were gnawed off these exposed roots at, or just above, the waterline. On one occasion, I observed a muskrat near a tree which had been chewed in this fashion. Errington (1937), Freeman (1945) and Willner et al. (1975) have each reported evidence of muskrats eating willow roots, and Bednarik (1956) has observed muskrats gnawing the bark of cottonwoods. The extensive use of sycamore roots as a food source by muskrats has not previously been reported.

Beaver Activity

The section of the Sequatchie River from approximately 1.6 kilometers above to approximately 3.2 kilometers below the Mill Branch tributary (See Fig. 1) provided evidence of beaver activity. The area just north of the Mill Branch shows moderate beaver sign in the form of cuttings, most of which are old. South of the Mill Branch, more recent and more extensive beaver cuttings were identified, along with a dam which was under construction at the time of observation. Due to the sparseness of cuttings, probably no more than one pair or family of beavers are resident in the vicinity, and all evidence indicates that these are bank beavers which have not yet attempted to construct a lodge in the stream.

One additional observation of beaver activity was made less than 1.6 kilometers above the Nine Mile Bridge, about five kilometers upstream from the previously described area. This additional evidence was in the form of a willow stem, approximately five centimeters in diameter, which had been freshly cut and partially peeled by a beaver. The stick was located floating in the stream but there was no indication how far downstream it had floated from the site of the original growth.

Other Wildlife

In addition to the semi-aquatic mammals listed above, several other species of wildlife were encountered along the Sequatchie River.

Nearly all sandbars in the river in the Dunlap vicinity showed evidence of feeding activity by raccoons (*Procyon lotor*). A number of clams had been excavated and opened on the bars, and raccoon tracks were present in the mud.

There is apparently a moderate population of both fox and gray squirrels (*Sciurus niger* and *S. carolinensis*) in the woods adjoining the river, based upon observations made from the canoe during this investiga-

tion. Six gray squirrels and two fox squirrels were identified between Litton and Pikeville in the trees adjacent to the river.

The upper one third of the Sequatchie River as far south as Pikeville provides nesting habitat which is utilized by wood ducks (*Aix sponsa*). Within the section of the river between the bridge east of Melvine, and the Smyrna Church, there were three separate encounters of wood duck hens with broods of four to seven ducklings each. In the same expanse of river, a single aggregation of 12 to 15 adult wood ducks was observed in eclipse plumage while they were loafing and feeding on the river.

Effects of Livestock

A number of farms bordering the Sequatchie raise cattle which are pastured adjacent to the stream. At least one land owner along the upper river raises pigs on his land. These livestock-producing farms, particularly in the eight-and-one-half-kilometer stretch between Litton and the Nine Mile Bridge, cause substantial modifications in the characteristics of the stream. Both cattle and swine have free access to the river on several farms. Consequently, extensive erosion of the stream banks is occurring and an excessive amount of animal waste material is being deposited in the river in these areas.

While apparently not all landowners along the Sequatchie provide their livestock unlimited access to the river, the practice appears to be widespread enough to be damaging to the quality of the river. The grazing and trampling of vegetation by cattle and the rooting by swine have eliminated considerable cover for wildlife species, while the excretory pollutants of the livestock may have some effect upon the incidence of disease in wildlife populations which are exposed to them.

ESTIMATED POPULATION STATUS OF SEMI-AQUATIC MAMMALS AND RECOMMENDED MANAGEMENT PRACTICES

Muskrats

All evidence recorded during this investigation indicates that there is a heavy population of muskrats in the upper section of the Sequatchie River. The damaged riparian vegetation previously described suggests that there is possibly an overpopulation of muskrats which would warrant harvesting, ostensibly by fur trappers.

Mink

Although only two sightings of mink or mink sign were made in this investigation, there is a high probability of a moderate resident population in at least the upper portion of the river. The environmental conditions are suitable for supporting the species, and previously cited reports (Wing, 1940; Schultz, 1959) indicate that the species has continued to exist in the Sequatchie Valley even under adverse conditions.

Beaver

There is apparently a small and localized population of beaver in the Sequatchie in the general vicinity of the confluence with the Mill Branch tributary. The extent and age of beaver cuttings in this area indicate that the population may be expanding in the main river, and probably extends into at least the Mill Branch Creek. Livestock do not appear to be causing any deleterious effects at this location on the river, and there seems to be little, if any, current interaction between beaver and human populations.

Otter

The single otter scat found at the juncture of Henson Creek with the Sequatchie is sufficient evidence to confirm the presence of this species. It is not possible, however, to determine the population status with only this limited information.

Recommended Further Study

The documentation of a resident otter population in East Tennessee would be of significant import in view of the apparent absence of the species during most of the twentieth century. For this reason, an additional investigation concerning both otters and beaver in the Valley is highly recommended. This investigation should be carried out during the December through March period when a covering of snow would allow a more complete track and sign analysis. A research effort of this nature could well be centered in the river, but be expanded to include those tributary streams which might be suspected of housing either otter or beavers.

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JUNIOR ACADEMY OF SCIENCE RECOGNITION PROGRAM FOR 1978

The 36th Annual Tennessee Junior Academy of Science Recognition Program has been announced for 1978. This Program provides state-wide opportunities for students, grades 9-12, to complete an experimental or investigative science project and prepare a written paper describing the project, its findings, and subsequent conclusions. The paper must be endorsed by a local science or mathematics teacher before being submitted to the Director of the Tennessee Junior Academy of Science. The director will submit the papers to a panel of judges, who will recommend 12 to 25 papers to be read at the state meeting of the Tennessee Junior Academy of Science at Peabody College in Nashville, April 14, 1978. The number of invitations to be issued will depend upon available funds. Science students, along with their sponsoring teachers, will be invited to attend the state meeting. In selecting individuals for participation and entry, and in all administration of the project, the Tennessee Junior Academy of Science does not discriminate on the grounds of race, color, creed, or national origin of any applicant.

All papers must be received by March 1, 1978, and must be accompanied by an official cover sheet. To obtain cover sheets and detailed information concerning entry, please inquire: Tennessee Junior Academy of Science, P.O. Box 22900A, East Tennessee State University, Johnson City, Tennessee 37601.