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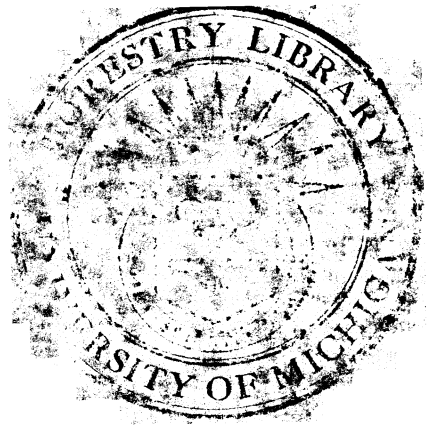
HABITATS OF THE RED FOX IN WASHTENAW COUNTY, MICHIGAN AS RELATED TO LAND UTILIZATION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HABITATS OF THE RED FOX IN WASHTENAW COUNTY, MICHIGAN AS RELATED TO LAND UTILIZATION

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TABLE OF CONTENTS

Introduction..... 1
Physiography and Climate of Washtenaw County..... 3
Geographical Location..... 3
Topography..... 3
Water and Drainage..... 4
Climate..... 5
Soils..... 6
Vegetation of Washtenaw County..... 8
Forests..... 8
Shrub areas..... 9
Fencerows..... 9
Fallow lands..... 10
Marshes and Swamps..... 11
Agriculture..... 13
Pasture..... 16
History and Numbers of the Red Fox..... 17
Brief Life History of the Red Fox..... 18
Habitat Relationships..... 23
Foxes in Relation to Forestry..... 23
Foxes in Relation to Agriculture..... 24
Foxes in Relation to Wildlife Refuges and Estates 25
The Bounty System..... 27
Statement of the Problem..... 29
Field Work..... 30
Preliminary Studies-Work of Others..... 30
Fox Hunting in Washtenaw County to Obtain Data-
Farmer-Fox hunter Relationships..... 32
Study of Dens..... 33
Presentation of Data..... 34
Analysis and Discussion-Considering Foxes and
their Habitats..... 54
Forests and Woodlands..... 54
Shrub areas..... 56
Abandoned Lands..... 57
Marshes and Swamps..... 58
Fallow Lands..... 60
Pasture..... 60
Crops and Crop Land..... 61
Ecotones and Fencerows..... 62
Soils..... 64

TABLE OF CONTENTS

Summary of Den Studies.....66
A. Vegetation and Cover.....66
B. Topography.....67
C. Exposure.....67
D. Location and Juxtaposition.....69
E. Soils.....69
F. Use from Year to Year.....71
Conclusions and Summary.....72
Literature Cited.....74

INTRODUCTION

The red fox, Vulpes fulva fulva (Desmarest), is one of the enigmas of the animal world. He has been cussed by farmer and bird hunter and defended by fox hunter, ecologist, and silviculturist. The value of his pelt from sale of hide and bounty runs into the thousands of dollars. Many fox hound breeders owe their living to his cunning ways. He is the subject of many folk tales and as 'Brer Fox' he is known to children before they can read. His habit of hunting at night shields him from the observation of the average citizen who rarely sees a fox. He is hunted by wealthy hunt clubs with their traditional red coats and fine hounds and by practically all other social groups in the country including the backbone of the country, the American farmer, who has the deepest interest of all because of his close association with the fox. In spite of his small size he is able to take a pack of larger hounds on a merry chase and will often have them running in circles while taking it easy in some swamp, hole, or from a lookout on a knoll. In spite of his fabulous cunning he can be lured into shooting distance by sucking on the back of the hand to simulate the squeaking of a mouse or by ringing a bell. In spite of his relentless pursuit by man with gun and trap he has managed to maintain his

numbers. Currently he is the object of much concern from the public health officials because of the spread of rabies.

As far as the author knows, no study has been made of fox habitats as related to land use and it is hoped that this study will contribute a little towards a better understanding of the fox from a broad general view and to scientific knowledge.

This study was conducted during the Fall, Winter, and Spring of 1946-47

PHYSIOGRAPHY AND CLIMATE OF WASHTENAW COUNTY

Geographical Location

Washtenaw County is in the Southeastern part of the Lower Peninsula of Michigan. It includes an area of 714 square miles or 456,960 acres.

Topography

The county lies in the glaciated plains part of the Central Lowlands province of the United States and in Michigan includes the moranic upland referred to as "the thumb" and a smooth former lake-bottom area usually referred to as the Erie lowland. The thumb upland is a broad glaciated upland, ranging in elevation from about 800 to 1300 feet above sea level. The Erie lowland comprises comparatively low plains, the beds of extinct glacial lakes, which occupy a considerable part of southeastern Michigan. The upland section of the county, which includes the northern, central, and western parts, is characterized as a whole by smooth or only moderately hilly relief. No sharp erosional features and no relief of magnitude occur, as local differences in altitude in few places exceed 100 feet, except in a short stretch along the Huron River near Ann Arbor, where the extreme difference between stream level and the higher land ranges from 200 to 250 feet. The secondary topographic forms consist of low ridges, or knobs, with smooth rounded slopes and complementary sags

and depression; level sandy and gravelly plains; level and rolling clay plain; and numerous potholes, lakes, and swamps. The surface features are of glacial origin and are constructional in character. The preglacial bedrock has been completely mantled by glacial deposits, and no considerable post glacial erosion has occurred, except directly along the Huron River. (Veatch, et. al., 1930).

Water and Drainage

Washtenaw County is generally drained by the Huron, Saline, and Raisin Rivers; all of which drain into Lake Erie. The Huron is the only sizeable stream of the three in the county. These streams and their tributaries originate in lakes and springs, their courses probably following old glacial beds.

Lakes are numerous and widely distributed, a total of 127 being known. The lakes differ greatly in size, shape, depth, character of vegetation, and shore-line features. Some are small circular bodies of only an acre or two in extent, whereas the larger ones are irregular in outline and cover areas of as much as 300 or 400 acres. Some have clean sandy bottoms and are bordered by high land, and others exhibit different stages of filling by vegetation. (Veatch, et. al., op. cit.).

Marshes and swamps are distributed throughout the county and range in size from a few acres to 1000 acres.

Many of these marshes and swamps were formerly shallow lakes that have now filled in with vegetation.

Climate

The climate of Washtenaw County is characterized by fairly cold winters and mild summers. The mean annual precipitation is 31.31 inches, including melted snow, and the average snowfall is about 37 inches. Wind movement and evaporation are low, humidity is moderately high, and the county receives 50 percent of the possible sunshine. The mean annual temperature is 47.4 degrees F. The average length of the frost-free season is 164 days, and is ample, at this latitude, to mature the staple crops grown. The precipitation is fairly evenly distributed throughout the year and is sufficient for high crop production. Although there is a rather wide and seasonal variation and marked differences exist in the moisture-holding capacity of the soils receiving the same amount of precipitation, crop failures seldom result from a deficiency or excess of water. Snowfall may be depended on every winter to furnish some protection to fall-sown grain. The prevailing winds are westerly. They rarely attain high velocity and, therefore, are rarely destructive to crops and cultivated soils, except on very dry muck soils and the loose incoherent sands in the more exposed situations.

Soils

The soils of Washtenaw County differ widely in texture, structure, chemical composition, productivity, and moisture-holding capacity--natural factors which bear a relation to plant growth and consequently to agricultural use. They also exhibit a lack of uniformity, such as extreme local variation in texture, and diverse soils are intimately associated in small bodies, a condition common to the state as a whole. The surface soils range from loose, incoherent, nearly pure sand to heavy silt loam and clay loam. Most of the soils are loams and sandy loams. The sands comprise less than 10 percent of the total area, and soils which have a clay or clay loam texture in the plow soil comprise less than 5 percent. Probably 50 percent contains from 2 to 4 percent by weight of this constituent; and that about 25 percent, including muck and peat, has a high organic-matter content. The humus layer in virgin well-drained soils does not exceed 3 inches in thickness, and consequently, in the cultivated soil very little coloring from organic matter occurs below a depth of 6 or 7 inches. The soils are deeply penetrable, however, as the parent soil material is unconsolidated glacial drift to a depth of several feet. About 90 percent of the soils are acid in reaction in the natural surface horizons and in the plow soil, but they contain sufficient calcium and magnesium carbonates, or other bases, at a depth ranging from 24 to 40 inches, to

give an alkaline reaction, and about 10 percent are nonacid, both in the surface and subsurface layers, under natural conditions. The organic soils, comprising about 13 percent of the area of the county, are in general neutral or only moderately acid, less than 5 percent being extremely acid peat. In the greater part of the county drainage is naturally fairly good, as the water table is not high and the slope is sufficient to provide free run-off. It is estimated that 25 percent of the soils were originally wet or swampy, therefore unsuitable for agricultural use until ditched or tiled. A small proportion of the mineral soils and greater part of the muck and peat remain undrained. (Veatch et al, op. cit.).

VEGETATION OF WASHTENAW COUNTY

Forests

Before the advent of the white man, his axe and sawmill, the forests of Washtenaw County consisted mostly of such intolerant species as sugar maple (Acer saccharum), basswood (Tilia americana), and beech (Fagus grandifolia) on the better soils and on the poorer soils such species as black oak (Quercus velutina), white oak (Quercus alba), several species of hickory (Carya), and elm (Ulmus). The upland forests, because of cutting, fire, and grazing now consist mainly of a mixture of white oak, black oak, hickories, and elm. Occasionally there is found a mixture of the more intolerant species such as sugar maple, basswood, and beech, this being the climax type. On sites that have been severely cut or grazed the next lower successional type is found. Such species as Aspen,(Populus), juniper (Juniperous), haw (Crataegus), and cherry (Prunus)are characteristic of this type. This type also represents, as do others, the successional stage that gradually evolves when bare land or cut over areas are protected and allowed to develop towards the climax type. Of course many other species are represented in each stand but a type may be recognized by the character of its dominant species. In many cases, the forests of the county are in a decadent condition due to improper care. Most of the

forests of the county are located in small woodlots, often on the poorer sites as protection against erosion.

Shrub Areas

The shrub areas of the county mostly represent a successional stage that has evolved from abandoned land. These shrub areas often harbor good populations of nesting birds and small mammals and are popular hunting places for the red fox. The primary species usually found are dogwoods (Cornus), rose (Rosa), blackberry (Rubus), witch-hazel (Hammamelis virginiana), and sumach (Rhus). An undercover of mixed perennials is usually present.

Fencerows

The fencerows of the county are represented by a variety of species and cover types. They range in size from little more than a grassy border on both sides of the fence to substantial growths that serve as very good shelterbelts. During the field work of this paper it was frequently noticed by the writer that many birds and small mammals utilized the food and cover of these fencerows. Red fox found these fencerows fertile hunting grounds and apparently often used them as cover when going from one area to another. Often the dominant species are forest-size trees such as elm (Ulmus), hickory (Carya),

and various oaks (Quercus), with an understory of such species as haw (Crataegus), sumach (Rhus), dogwood (Cornus), cherry (Prunus),,blackberry (Rubus), sassafras (Sassafras albidum), frost grape (Vitus), and bittersweet (Celastrus scandens).

Fallow Lands

Ecological succession differs somewhat on land withdrawn from cultivation for short periods and abandoned lands. Grain fields, hay fields, corn fields and others each develop a plant community differing in vegetative cover from the other. Each may have certain plants that are found on all such areas but the plant community as a whole differs. Hay fields usually differ more than others due to the presence of such close growing plants as clover (Trifolium) and alfalfa (Medicago sativa). Such plants as ragweed (Ambrosia), wild carrot (Daucus carota), foxtail grass (Setaria), lambs quarter (Chenopodium album), and such woody plants as elm (Ulmus) and cherry (Prunus) are common immediately following abandonment on open land. These plants and their many associates form an environment that is very favorable to game birds and to such mammals as the cottontail (Sylvilagus floridanus mearnsii) and various small mammals such as mice. These animals in turn are favorite prey for the red fox. Such areas tend to

standardize somewhat as herbaceous vegetation of a perennial nature takes over from the earlier annuals but continues to furnish a favorable environment for small mammals and game birds for some time.

Marshes and Swamps

It is necessary to distinguish between several terms before a discussion is started on this subject. A marsh is a wet area that has been filled in from the bottom up while a bog has filled in by an accumulation of material known as a floating mat. A swamp may follow either one but usually differs somewhat in character depending on the original area and consists of various species of trees tolerant to wetland conditions. So-called relict areas of coniferous swamps are present in parts of the county, the dominant species being tamarack (Larix laricina) and black spruce (Picea mariana). The vast majority of the swamps consist of such hardwood species as red maple (Acer rubrum), elm (Ulmus), black ash (Fraxinus nigra), yellow birch (Betula lutea), and willow (Salix), their composition depending upon the character of the bog or marsh, the most common of which are stagnant and seepage. Other common plant species of lower successional order common in marshes and bogs are sedges (Cyperaceae), grasses (Gramineae), cattails (Typha), leatherleaf (Chamadeaphne calyculata), buttonbush (Cephalanthus)

occidentalis), dogwoods (Cornus), elderberry (Sambucus) and poison sumach (Rhus toxicodendron). Open bodies of water are usually surrounded, at least in part, by various species of wet-land vegetation.

Agriculture

According to Veatch et al, (op. cit.), the pioneer farmers followed a system of mixed agriculture from necessity and produced the things required for domestic use and home consumption to a much greater extent than was done later. In the earlier periods of settlement, cattle, furs, alkaline salts from wood ashes, and later, lumber were sources of cash. The influx of settlers was steady and the increase in the acreage of land placed under cultivation was rapid and steady to about 1880. However, in succeeding decades, very little or no increase occurred, and, according to the 1920 and 1930 United States census data, an actual decrease in the acreage of land under cultivation or in harvested crops has taken place since 1920. According to the 1930 census, the land in farms constitutes 82.9 percent of the total area of the county. Corn, wheat, hay, and potatoes were staple crops during the early period of farming. Oats have shown a greater proportional increase in acreage than wheat or corn since 1880. The acreage of wheat and red clover has shown a decline in late years, and alfalfa, small fruits, and tree fruits have increased in importance. The livestock industry has been marked by a decrease in the number of beef cattle and an increase in the number of milk cows. As in other parts of Michigan, agriculture here has been greatly

influenced by the marked industrial expansion and growth of cities in this and adjoining States. This urban growth has been the cause of abandonment of some farms, but, on the other hand it has brought about the production on individual farms of a greater number of direct-income products, the development of specialized farming, and an increase in dairying to meet the demands of the nearby industrial population.

Another influence has been caused by the buying up of large acreages for estate purposes, especially around Ann Arbor. These areas are usually removed, either partly or wholly from agriculture, [illegible] allowed to revert to natural vegetation by succession or by plantings of native hardwoods and some conifers. As will be explained later, it is these areas that produce large numbers of wildlife, including the fox.

Agriculture at present is of three types: (1) General farming, including the growing of grain and hay for the feeding of dairy cattle or other livestock; (2) a less distinct type which consists of general farming combined with the production of some special cash crops; and (3) the production of specialities, such as poultry, fruit, truck, and flowers on small farms. General farming is of the conservative type and is neither highly intensive nor, on the other hand, extensive. The farmer still relies

mainly on the inherent productiveness of the soil, although farming is passing through the purely exploitive stage to that in which measures are being taken to maintain productiveness or to increase yields through liming, the use of commercial fertilizer, more careful seed selection, and intensive tillage methods. The recent climb in meat prices has caused many farmers to switch to raising hogs and beef cattle instead of some other staple crops. Herds of sheep are fairly common throughout the county.

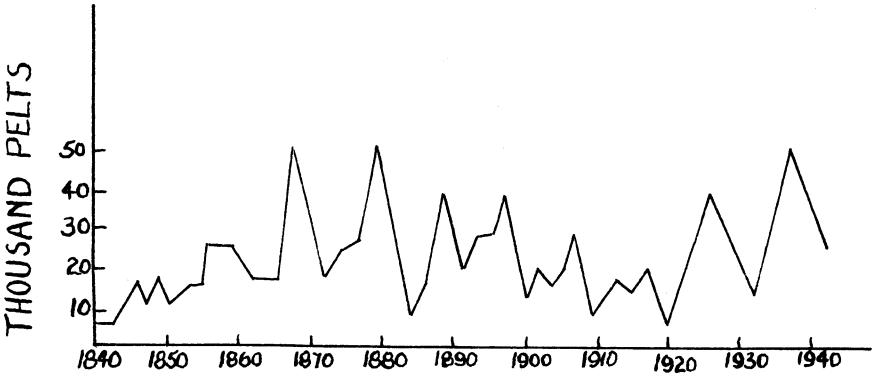
Pasture

On the ordinary farm there are usually some fields devoted to the production of hay and for pasture. In most hay meadows there is a considerable growth after the hay crop is removed, and except in the case of alfalfa, these meadows are not injured by a reasonable amount of grazing. Many acres not well suited for crop plants are used as pasture. Generally speaking, the land in pasture in Washtenaw County is not very productive as such, much of it being in poor condition with some erosion taking place. In addition to losing less soil by erosion than cultivated land, well managed grazing land loses less fertility because less is taken from the soil by pasture plants and part of that which is removed is restored directly through the excrement of grazing animals. Common plants found in pastures are reed canary grass (Phalaris arundinacea), bluegrass (Poa), timothy (Phleum pratense), alfalfa (Medicago sativa), alsike clover (Trifolium hybridium), red clover (Trifolium pratense), and white clover (Trifolium repens). Other associated plants which are often identified with poorer land are wild strawberry (Fasaria virginiana), various species of cinqfoil (Potentilla), thistle (Cirsium), and teasel (Dipsacus). Various species of small mammals, especially mice, often populate pasture land and thus furnish food for the red fox.

HISTORY AND NUMBERS OF THE RED FOX

There is no doubt that fox populations fluctuate. Testimony of long-experienced hunters and trappers indicates that there are lean years and fat years. Sometimes it may be a good fox year in one part of a state and not in another, although there is nothing but hearsay evidence to support this. The annual take fluctuations are not significant because they seem to be so dependent on pelt prices, and logically enough. Up in the vast Canadian region served by the Hudson's Bay Company, however, generations of trappers for centuries have caught foxes without too much regard for whether a pelt brought fifty cents for fifty dollars. So the records of the company, carefully kept over the years, would seem to be the best available evidence to show whether red foxes are or are not subject to population ups and downs when the trapping effort has remained equally constant. (Seagears, 1945).

As seen from the following graph, about every ten years the populations seem to hit a peak.



BRIEF LIFE HISTORY OF THE RED FOX*

The range of the red fox extends from Alaska to Newfoundland, south to central North Carolina and Georgia, west to central Texas, the Rocky Mountains and Sierra Nevadas.

Technical synonymy: Class, Mammalia; Order, Carnivora; Family, Canidae; Genus, Vulpes; Species, fulva; and subspecies, fulva.

Generally speaking, the red fox is a nocturnal animal but will often venture forth during the daytime. He is well known for his intelligence, slyness, and ability to outsmart his many types of prey and his erstwhile enemy, man and his fox hounds. He has a natural fear of man and for that reason is seldom seen. From his vantage points he usually spots a man long before the man sees him and slips away without being seen and if seen often offers only a short view before he disappears. During the day he usually rests in solitude in some sheltered sunny spot from which he may detect approaching danger. The home range is not more than five miles and when pursued by dogs, the fox usually circles at a radius of two to three miles.

*Note: The notes for this brief life history were secured partly from accounts by Seagears (1945), Seton (1929), and partly from the writer's own observations.

His principal method of intercommunication is doubtless by voice, although he uses such other devices as scent posts. The best speed of an average fox for one mile is about 26 miles an hour. This is faster than a coyote but slower than a jackrabbit.

Observations show that the fox is amply clad to resist the weather and finds it much safer in winter time to take his necessary sleep in some open place where he can see or hear the approach of any danger. During extremely cold weather and to escape hounds, he will often make use of a den or hollow log. During the natal period, the fox habitually makes use of a den. This den may be located in a natural cave, a tunnel dug into a slope of sandy soil, a hollow log or tree, and other convenient sheltered spots. Mice probably form the largest part of its diet. Rabbits, poultry and birds are also often taken. On occasions young sheep, pigs, goats and fawns have been known to be taken. Insects and berries are taken on occasion, especially by the cubs during their early life. Most animals of the dog family store up food when they have more than they need. The surplus food is usually buried or partly covered either by soil, litter, or snow and the fox returns to the cache invariably. Dens often have a separate compartment used for storage of surplus food. Secret hoards are liberally sprinkled with urine, the scent of which they seek when

locating the hoard.

The fox is more or less a solitary animal in winter. He may travel about with his mate at times when the snow is on the ground but he never assembles with others of his kind to form a pack as does his kin, the wolf. The mating instinct is awakened in late February or early March. Often the pursuit, the coquetting, copulation or even the fight between rivals may be read from signs in the snow. The fox is a strictly monogamous animal. Male and female are often seen together after the breeding season and the consensus of opinion is that they mate for life.

The female usually selects the den site and probably does most of the digging. Here a symbiotic relationship seems to exist between the fox and such burrowing animals as the woodchuck and badger as the fox will often select a den previously used by these animals and convert it to their own use. The ground is often still frozen when the need for a den presents itself and old dens greatly alleviate this situation. The den often has several entrances, a storeroom, and a nest. The period of gestation is 51 days, without more than 12 hours of variation. When the female feels her time approaching, she manifests something like hostility towards the male. The male again seems to be welcome about the time the young ones' eyes are open and at that time will often bring food to the cubs and help

teach them to hunt. The young are born in March or early April and number from four to nine. The cubs are clad in lead-colored fur and look as muck like kittens as foxes. They are blind till they are eight or nine days old. They do not venture out-of-doors until they are three or four weeks old and the den continues to be their only home for about three months. During this time they do not necessarily stay in the natal den, it often being too small to accomodate the growing cubs. Any threat of danger will cause the parents to move the cubs to another location.

The young are carefully coached by the parents to the dangers they may encounter, the search for food, and how to stalk and hunt. As soon as they are large enough to come out-of-doors, they romp and play about the den but are ever ready to flee to the den at the slightest alarm. Usually the alarm is given by the ever-watchful parents. The young probably scatter voluntarily before winter sets in. A fox is old at ten years and rarely reaches fifteen.

Foxes are preyed on by wolves, lynxes, and fishers. In the prairie sections the foxes have decreased with the increase of the coyote, due probably to environmental conflicts. The larger birds of prey such as eagles will often take young foxes. In places where natural enemies have been eliminated, the job of keeping down excessive populations falls on man. Foxes are thought to be able to

withstand a 20 percent drain.

Every animal with fur so deep as that of the fox is more or less plagued with vermin. Foxes have been known to grasp moss or bark in their mouth and submerge the body so that only the nose and eyes are above water. The vermin take refuge in the moss or on the bark and the fox leaves the vermin and moss both floating in the water. Lice and ticks are often found on foxes but it is doubtful that it results in little more than physical discomfort. Mange is often reported as a disease of foxes.

Fox farms are operated in the Northern United States and Canada as fur producers and such enterprises often contribute substantially toward the welfare of a community. Strains of silver fox are the most popular. Fox skins, both farm raised and natural are important items in the fur trade and these skins bring good prices when taken in the prime.

HABITAT RELATIONSHIPS

Foxes in Relation to Forestry, particularly Silviculture and Nurseries

Wild animals of the forest play an important part in the ecology and biology of the forest community. Animals that have a direct relation between Forestry and the red fox are chiefly rabbits and mice, upon which the fox preys. Rabbits may cause injury to forest operations by biting off buds, small branches and stems and in gnawing the bark which often causes the death of a tree due to girdling. Seedlings and small trees are chiefly affected. Fast growing species may be attacked in preference to slow-growing specimens. Rabbits, at times, may be so numerous that either natural or artificial reproduction may be destroyed. Mice cause damage to seed beds by eating the seeds in nurseries. During the winter, when other food is scarce, mice will often gnaw the bark of seedlings and young trees, either above or below ground, often girdling them and causing death. The mice are most abundant on grass covered areas where there is some sun filtering through the trees. During years of high population, mice may do extensive damage both to nursery stock and to reproduction. Generally speaking, most nurserymen and silviculturists believe that the fox should be encouraged and some even believe that there should be a bounty on any one who proposes a bounty on foxes.

Foxes in relation to Agriculture - including Horticulture
Attitude of Farmers

As a result of an occasional raid on the farmers' poultry the fox has gained most of his bad reputation. Other prey of the fox that is a direct economic factor are such other farm animals as ducks, young pigs, young lambs, game birds, and muskrats, although none of these animals constitute the major portion of the foxes' diet. Another important consideration is the fact that the fox is not above wiping out a nest and thereby destroying potential sport for the farmer and his friends.

Another important item to consider is the spread of rabies by the fox. This has become a very serious matter in some parts of the country but as yet is not a serious matter in Washtenaw County. This may well, at some time, become a serious matter due to the difficulty of controlling such a cunning animal. On the credit side of the ledger there is also much to say in favor of ole Reynard. He serves as an important check on many mice that inhabit farmlands. These mice are notorious destroyers of shocked corn and other growing crops. For those farmers that have fruit trees, the fox assumes an even more important role. There is considerable money tied up in a single fruit tree and by feeding on mice and rabbits that are potential girdlers of these fruit trees, the fox renders a valuable

service. Also on the credit side is the sport that the fox offers during the chase and the price that his pelt brings for both the hide and as a bounty. Some farmer-trappers make a tidy sum during the winter trapping foxes when the farm work is slack. It is the opinion of the writer that most farmers favor either the extermination or the severe reduction of fox populations, mainly because of his depredations on poultry and in all fairness to the farmer, it is hard to see much worth in an animal after raids on the barnyard. Many of the better educated farmers realize, however, that there are two sides to the question and favor less drastic means of control than extermination.

Foxes in Relation to Wildlife Refuges and Estates

Generally speaking, both Federal and State Wildlife Refuges have as one of their objectives the protection of all wild animals native to the area. When a predator becomes so numerous that the welfare of more desirable species is threatened, steps are often necessary to bring the predator under control. During years of high population of a predator such as the red fox, such steps may be necessary but are usually undertaken with a great deal of caution.

The policy of estate owners is usually dictated by the prejudices and interests of the individual. If an estate

is maintained as a pheasant shooting area and foxes are apparently numerous, control measures are usually initiated. An estate owner near Ann Arbor, Michigan, maintains his lands primarily for their aesthetic values and no hunting is allowed. There is a good fox population in the area and each year a few are taken off to keep predation down so that it does not become a serious factor in the depletion of other desirable species.

THE BOUNTY SYSTEM

In Washtenaw County the bounty on a fox is $3.00. This bounty may be collected by either turning in to the County Auditor the carcass from which the ears are removed or the hide which is stamped with indelible dye. In spite of the fact that there has been a bounty on foxes for some time in the county, several reliable fox hunters say that they have been no appreciable decrease in the number of foxes. The proponents of the bounty system argue that it is an incentive to either trap or kill foxes and, as a result, more foxes are killed; which in turn reduces the breeding population which means less foxes. Foxes can withstand a drain of 20 percent of their population and still maintain a stable population over a period of time. The bounty is hardly high enough to prove a real incentive to make a farmer or trapper go to extra efforts to obtain more foxes. The fox hunters do not go out because they expect to collect a $3.00 bounty on each fox they get, their main interest being in the sport of the chase and listening to the music of hounds hot on the trail of a fox. The trapper in turn is governed more by the price of the fur and is going to concentrate his efforts mainly when prices are high. The farmer, on the other hand, is mainly interested in protecting his poultry and stock. As long as they are not bothered he is

not going to a lot of extra effort just to collect a bounty. It is the consensus of opinion of people who have worked with and studied the bounty system that it is just so much money down the drain.

One of the chief objections to the bounty system is the room for fraud. Numerous cases have been recorded where an animal was bountied several times. Other cases have been recorded where animals were sent in from other counties or even other states. Another objection is the failure of bounty officials to recognize a bounty species such as the difference between a sparrow and other insect eating song birds.

The following animals are now being bountied by at least on county in Michigan at the present time: fox, timber wolf, coyote, lynx, wildcat (bobcat), black bear, hawks, owls, weasel, woodchuck, rats, sparrows, muskrat, renegade dogs, and unclassified miscellaneous species. (D.F. Switzenberg, Mich. Dept. of Conservation).

Statement of the Problem

It may be well to here state the purposes and aims of this study. Because of the many controversies connected with foxes, which are very important matters to so many different groups, it was thought that a study of the habitats as related to land ut'lization would cast a little light on the ecology and life history of this enigma. The work done by previous workers, as far as the fox is concerned, were confined chiefly to the food habits and the results obtained by these workers has done much to clear up this important matter. However, unless we know something of the full story and its many implications we are always more or less groping in the dark. In a very general way foxes fit into the broad land management picture. This picture is a very complex one, involving economics, land use, culture, soil fertility, and many others. By fitting these many pieces together the land manager can make progress towards his goal of using each acre for the purposes to which it is best suited.

FIELD WORK

Preliminary Studies - Work of Others

The field work for this paper is divided into two main phases: (1) Study of fox habitats as related to land utilization by tracking foxes in the snow and hunting them by use of drivers and hounds; and (2) A spring study of natal dens. As originally set up, the study was to have been made on four study areas of approximately two sections each, each area having somewhat different cover types and environmental conditions than any other. It was soon found, however, that the movement of foxes on and off such a small area as two sections were so erratic that any results obtained would have little significance. It was then decided to extend the study to the entire county with emphasis on the habitat and land utilization in the spot location and immediate surrounding territory, taking into consideration that any fox tracked in the snow, shot or seen, had probably done considerable travelling prior to the observation. The study of natal dens consisted of locating as many dens as possible and an analysis of each. An attempt was made to find out how many successive years a particular den had been occupied by foxes. The writer has been unable to obtain from the literature more than an occasional two or three line sentence to any work or reference of a nature similar to that of this paper.

PLATE 1

Heading for the Cars

Discussing the Kill

Fox Hunting in Washtenaw County to Obtain Data - Farmer - Fox Hunter Relationships

Most of the data for this paper was obtained by fox hunting with a group of veteran hunters from Ann Arbor. This group hunted from late November until early March, on holidays, Saturdays and Sundays. The method of hunting was by use of dogs and drivers. Usually a section or similar land area was selected and hunters posted along the outer edges of the area towards which the drivers and hounds worked. When a fox was jumped by the hounds, the drivers themselves would halt until the fox had been killed or until the hounds lost the trail at which time the drive would be resumed. Usually an area with some woods or swamp was selected but occasionally a more or less open area would be driven. Experience has shown that it is generally a waste of time to drive a section with little or no cover, especially in winter. During these drives notes were taken on the character of the different habitats where foxes were either killed or seen but due to the time element, it was not possible to obtain accurate data on the habitat surrounding the actual area from which the fox was taken. To supplement the scanty data actually made on the spot, type maps prepared by students of the Forestry School and aerial photographs were examined in detail and several visits made to areas where there were known concentrations of foxes so that an examination of the area could be made at leisure.

Generally speaking, relations between farmers and fox hunters are cordial. Many farmers will go out of their way to invite fox hunters to hunt on their land, probably to save them the trouble of trapping a fox that they want eliminated. Although fox hunters are generally considerate of other people's property, a few farmers will bar them from their land for fear that they will break a fence down. Occasionally a landowner who allows no hunting on his property will bar fox hunters.

Study of Dens

Locating dens proved to be a very time consuming job. It was found that, if any dens were to be located, that the help of persons familiar with certain areas would be required. On several occasions, maps of dens prepared by former students were studied and these former location checked. Several dens were located by this procedure. Other dens were located with the help of fellow students and friends. All dens, except three, were personally visited and notes taken on cover, exposure, slope, topography, location, and juxtaposition of cover. Reliable information was secured by competent students for the dens not personally visited. Unless a den showed certain evidence of occupation by a fox, it was not recorded. Usual indications of use of a den by a fox are smell, tracks on the spoil outside the den, scats in the immediate vicinity of the den, and typical fox kills.

PRESENTATION OF DATA

Before an analysis of the field work could be made it was necessary to summarize all field records. This summary was divided into two major subdivisions; a summary of data on fox habitats obtained by kill records, tracking, and actual observations; and a summary of fox dens.

Fortunately there were four type maps of townships around Ann Arbor that had been prepared by former students. These type maps, aerial photographs and actual knowledge of certain areas were used in compiling a summary of field work. Each fox observation was classified as to the immediate habitat where it was first seen and additional information compiled to supplement the information on the immediate habitat. It is fully realized that because a fox was seen in a particular habitat that habitat is not necessarily the most favorable. With that thought in mind it was decided to compile supplementary information in the hope that a broad overall picture would be presented. Each fox observation was also plotted on a soil map of Washtenaw County and a summary made of the different types of habitats as related to soil types.

In summarizing data and field work obtained on natal dens an attempt was made to classify each den as to its immediate habitat, surrounding habitat, juxtaposition and soil types.

TABLE 1

Table 1 gives the ecological type of each observation of a red fox by the immediate habitat in which it was first seen or observation made and a list of surrounding habitats. These habitats were classified according to Graham's Ecological Classification of Cover types.

Summary of Table 1

Immediate habitat	Occurrences	Surrounding habitat	Occurrences
Shrubby woods	15	Crop land	44
Mid-tolerant woods	9	Pasture	41
Crop land	9	Mid-tolerant woods	23
Mid-tolerant swamp	7	Kettleholes	21
Shrubby swamp	5	Shrubby woods	14
Pasture	4	Stagnant bog swamp mixed types	9
Intolerant woods	4	Mid-tolerant swamp	8
Creek-bottom woods mid-tolerant	2	Intolerant woods	6
Mixed herbaceous	2	Bog	4
Apple orchard	1	Marsh	3
Shrubs (bog type)	1	Grass-perennials	3
Kettlehole	1	Creek-bottom woods	3
Intolerant woods swamp	1	Mixed herbaceous	2
Cattail marsh	1	Tolerant woods	1

TABLE 1

FOX HABITAT SUMMARY

Observation No.	Township	Sec.	Immediate Habitat	Surrounding Habitat
1	Northfield	19	Shrubby woods	Crop land, marsh, mid-tolerant woods
2	Northfield	19	Edge of Mid-tolerant woods	Crop land, marsh, mid-tolerant woods
3	Northfield	34	Apple orchard	Crop land, pasture, mid-tolerant woods
4	Webster	3	Shrubby woods	Stagnant bog swamp, pasture, crops, kettleholes
5	Webster	3	Shrubby woods	Stagnant bog swamp, pasture, crops, kettleholes
6	Webster	3	Shrubby woods	Stagnant bog swamp, pasture, crops, kettleholes
7	Webster	3	Shrubby woods	Stagnant bog swamp, pasture, crops, kettleholes
8	Webster	3	Shrubby woods	Stagnant bog swamp, pasture, crops, kettleholes
9	Webster	3	Shrubby woods	Stagnant bog swamp, pasture, crops, kettleholes
10	Webster	23	Shrubby swamp	Stagnant bog and swamp, crops on outer edge
11	Webster	23	Shrubby swamp	Stagnant bog and swamp, crops on outer edge
12	Webster	27	Crop land	Crop land and numerous kettleholes
13	Webster	27	Crop land	Crop land and numerous kettleholes
14	Webster	26	Shrubby swamp	Crop land, bogs, and pasture
15	Webster	26	Shrubs (bog type)	Crop land and intolerant trees in woodland
16	Webster	25	Crop land	Kettleholes, pasture and shrubby woodlands
17	Webster	34	Crop land	Kettleholes, pasture, and shrubby woodlands
18	Webster	34	Crop land	Kettleholes, pasture, and shrubby woodlands

TABLE 1 (cont.)

19	Webster	35	Crop land	Kettleholes, pasture, and shrubby woodlands
20	Dexter	11	Shrubby swamp	Pasture, mid-tolerant woods, crops, kettleholes
21	Dexter	11	Shrubby woods	Pasture, mid-tolerant woods, crops, kettleholes
22	Dexter	11	Shrubby woods	Pasture, mid-tolerant woods, crops, kettleholes
23	Dexter	11	Pasture	Mid-tolerant woods, crops, shrubs, kettleholes
24	Dexter	14	Mid-tolerant woods	Shrubs, crops, kettleholes
25	Limi	13	Kettlehole	Pasture, mid-tolerant woods, shrubby area, kettleholes
26	Limi	13	Pasture	Crop land, pasture, mid-tolerant woods, kettleholes
27	Limi	13	Mid-tolerant woods	Crop land, pasture, mid-tolerant woods, kettleholes
28	Scio	12	Shrubby woods	Pasture, crops, and shrubby woods
29	Scio	23	Shrubby woods	Pastures, crops, and shrubby woods
30	Scio	26	Shrubby woods	Crops, pasture, shrubby woods, grass and perennials
31	Ann Arbor	35	Creek bottom woods Mid-tolerant	Crops, pasture, mid-tolerant woods
32	Ann Arbor	25	Shrubby woods	Pasture, creek bottom woods, mid-tolerant woods
33	Ann Arbor	25	Mid-tolerant woods	Pasture, creek bottom woods, mid-tolerant woods
34	Ann Arbor	25	Pasture	Mid-tolerant woods, creek bottom woods, pasture

TABLE 1 (cont.)

35	Ann Arbor	25	Creek bottom woods Mid-tolerant	Pasture, mid-tolerant woods
36	Ann Arbor	25	Shrubby woods	Creek bottom woods, pasture, mid-tolerant woods
37	Ann Arbor	25	Cattail marsh	Mid-tolerant woods, pasture
38	Pittsfield	7	Intolerant woods	Crop land and pasture
39	Pittsfield	15	Mid-tolerant woods	Crop land and pasture
40	Lodi	1	Mixed herbaceous	Crop land, pasture, mid-tolerant woods
41	Lodi	2	Crop land	Crops, pasture, tolerant woods, mixed herbaceous
42	Lodi	3	Crop land	Pasture, crop land, intolerant woods
43	Lodi	3	Intolerant woods	Pasture, crop land, intolerant woods
44	Lodi	8	Crop land	Pasture, crop land, intolerant woods
45	Lodi	9	Pasture	Crops, pasture, shrubby woods, intolerant woods
46	Lodi	10	Intolerant woods	Crop land, pasture, intolerant woods
47	Lodi	29	Grass and other perennials	Bog, pasture, crop land, shrubby woods
48	Lodi	34	Crop land	Shrubby woods, crop land, grass and other perennials
49	Lodi	36	Intolerant woods	Grass-perennials, crop land, bogs and kettleholes
50	Freedom	3	Mid-tolerant woods	Crop land, mid-tolerant woods, pasture
51	Freedom	18	Mid-tolerant swamp	Mid-tolerant swamp, muck farm
52	Freedom	18	Mid-tolerant swamp	Mid-tolerant swamp, muck farm

TABLE 1 (cont.)

53	Freedom	18	Mid-tolerant swamp	Mid-tolerant swamp, muck farm
54	Freedom	18	Mid-tolerant swamp	Mid-tolerant swamp, muck farm
55	Freedom	18	Mid-tolerant swamp	Mid-tolerant swamp, muck farm
56	Freedom	18	Mid-tolerant swamp	Mid-tolerant swamp, muck farm
57	Freedom	18	Mid-tolerant swamp	Mid-tolerant swamp, muck farm
58	Freedom	20	Mid-tolerant woods	Crop land, pasture, kettlehole
59	Freedom	24	Intolerant woods swamp	Crop land, pasture, mid-tolerant woods
60	Freedom	36	Mid-tolerant woods	Crop land, pasture, mid-tolerant woods
61	Lodi	20	Mixed herbaceous	Open lake, pasture, grass-perennials, crop lands
62	Pittsfield	18	Shrubby swamp	Shrubby woods, pasture, crop land
63	Webster	12	Mid-tolerant woods	Crop land, bog swamp-mid-tolerant trees

TABLE 2

Table 2 is a breakdown of different types of land encountered by section in areas where foxes were located. Crop land and pasture are given separate classifications and other so-called natural land is listed according to its ecological classification. Although a section is a large area to consider when there has been possibly only one fox located in the section, it does give some indication of what cover types are found where foxes are also found.

Summary of Table 2

Type	Occurrences	Average %	Average of total area
Crop land	63	44	44.1
Pasture	17	17	14.1
A5(grass-perennials)	33	13	6.6
B5(grass-perennials in stagnant bog)	2	5	.16
A6(mixed herbaceous)	10	5.5	.8
B6(mixed herbaceous in stagnant bog)	4	12.5	.79
A7(shrubs)	47	10	8.7
B7(shrubs in stagnant bog)	2	5	.16
A8(Intolerant trees)	18	8	2.3
B8(Intolerant trees in stagnant bog)	10	8	1.27
A9(Mid-tolerant trees)	29	17	7.8
M9(Mid-tolerant trees in stagnant marsh)	9	66	9.5
A10(Tolerant trees)	1	10	.16
Kettleholes	11	8	2.35

TABLE 2

FOX HABITATS

Percentage by Section (640 acres)

Observation No.	Township	Sec.	Crop land	Pasture	Not farmed - Successional stage*					
					5	6	7	8	9	10
1	Northfield	19	60-	10	A5-5%		A7-10%		A9-15%	
2	Northfield	19	60	10	A5-5%		A7-10%		A9-15%	
3	Northfield	34	65	10	A5-5%		A7-10%		A9-10%	
4	Webster	3	30	10	A5-20%		A7-30%		Kettleholes 10%	
5	Webster	3	30	10	A5-20%		A7-30%		Kettleholes 10%	
6	Webster	3	30	10	A5-20%		A7-30%		Kettleholes 10%	
7	Webster	3	30	10	A5-20%		A7-30%		Kettleholes 10%	
8	Webster	3	30	10	A5-20%		A7-30%		Kettleholes 10%	
9	Webster	3	30	10	A5-20%		A7-30%		Kettleholes 10%	
10	Webster	23	25	15	B5-5%	B6-20%	A7-25%	B8-10%		
11	Webster	23	25	15	B5-5%	B6-20%	A7-25%	B8-10%		
12	Webster	27	85	5			A7-5%		Kettleholes 5%	

*Symbols taken from Graham, 1945, Ecological Classification of Cover Types.

TABLE 2 (cont.)
FOX HABITATS

Observation No.	Township	Sec.	Crop land	Pasture	Not farmed - Successional stage 5	6	7	8	9	10
13	Webster	27	85	5			A7-5%	Kettleholes 5%		
14	Webster	26	75	5		B6-5%	A7-5%	B8-5%	Kettleholes 5%	
15	Webster	26	75	5		B6-5%	A7-5%	B8-5%	Kettleholes 5%	
16	Webster	25	90	5				B8-5%		
17	Webster	34	90	5			A7-5%			
18	Webster	34	90	5			A7-5%			
19	Webster	35	90	5			A7-5%			
20	Dexter	11	20	30	A5-5%		A7-15%	B8-10%	A9-20%	
21	Dexter	11	20	30	A5-5%		A7-15%	B8-10%	A9-20%	
22	Dexter	11	20	30	A5-5%		A7-15%	B8-10%	A9-20%	
23	Dexter	11	20	30	A5-5%		A7-15%	B8-10%	A9-20%	
24	Dexter	14	30	30	A5-10%		A7-10%		A9-20%	
25	Limi	13	70	10			A7-5%		A9-15%	
26	Limi	13	70	10			A7-5%		A9-15%	
27	Limi	13	70	10			A7-5%		A9-15%	
28	Scio	12	35	50			A7-10%	A8-5%		

TABLE 2 (cont.)
FOX HABITATS

Observation No.	Township	Sec.	Crop land	Pasture	Not farmed - Successional stage					
					5	6	7	8	9	10
29	Scio	23	30	20	A5-30%		A7-15%		A9-5%	
30	Scio	26	50	30			A7-5% B7-5%	A8-5%	Kettleholes 5%	
31	Ann Arbor	35	50	10	A5-10%	A6-10%		A8-10%	A9-10%	
32	Ann Arbor	25	5	40	A5-10%	A6-5%	A7-5%	A8-5%	A9-30%	
33	Ann Arbor	25	5	40	A5-10%	A6-5%	A7-5%	A8-5%	A9-30%	
34	Ann Arbor	25	5	40	A5-10%	A6-5%	A7-5%	A8-5%	A9-30%	
35	Ann Arbor	25	5	40	A5-10%	A6-5%	A7-5%	A8-5%	A9-30%	
36	Ann Arbor	25	5	40	A5-10%	A6-5%	A7-5%	A8-5%	A9-30%	
37	Ann Arbor	25	5	40	A5-10%	A6-5%	A7-5%	A8-5%	A9-30%	
38	Pittsfield	7	75	10	A5-5%				A9-10%	
39	Pittsfield	15	60	10	A5-5%		A7-5%		A9-20%	
40	Lodi	1	65	15	A5-5%	A6-5%			A9-10%	
41	Lodi	2	65	15	A5-5%	A6-5%			A9-5%	A10-5%
42	Lodi	3	55	25			A7-5%	A8-5%	A9-10%	
43	Lodi	3	55	25			A7-5%	A8-5%	A9-10%	
44	Lodi	8	50	15	A5-10%		A7-10%	A8-15%		

TABLE 2 (cont.)
FOX HABITATS

Observation No.	Township	Sec.	Crop land	Pasture	Not farmed - Successional stage				
					5	6	7	8	9	10
45	Lodi	9	50	25			A7-5%	A8-20%		
46	Lodi	10	50	25				A8-25%		
47	Lodi	29	45	10	A5-10%		A7-20%		Bog(B-4) 15%	
48	Lodi	34	50	10	A5-10%		A7-15%	A8-5%	M9-10%	
49	Lodi	36	20	5	A5-50%		A7-10%	B8-5% A8-5%		
50	Freedom	3	75	10			A7-5%		A9-10%	
51	Freedom	18	20						M9-80%	
52	Freedom	18	20						M9-80%	
53	Freedom	18	20						M9-80%	
54	Freedom	18	20						M9-80%	
55	Freedom	18	20						M9-80%	
56	Freedom	18	20						M9-80%	
57	Freedom	18	20						M9-80%	
58	Freedom	20	60	10					M9-30%	
59	Freedom	24	60	5			M7-10%		A9-25%	
60	Freedom	36	50	5	A5-20%		B7-5% A7-15%	A8-5%		

TABLE 2 (cont.)
FOX HABITATS

Observation No.	Township	Sec.	Crop land	Pasture	Not farmed - Successional stage 5	6	7	8	9	10
61	Lodi	20	50	5	A5-20%		A7-20%	A8-5%		
62	Pittsfield	18	50	10	A5-5%	A6-5%	A7-10%	A8-10%	A9-10%	
63	Webster	12	50	10					A9-40%	

TABLE 3

This table summarizes the data gathered on the different soil types. Each observation made was plotted on a map. These observations were then transferred to a soil map of Washtenaw County and the type of soil occurring at the place of observation recorded in this table.

Summary of Table 3*

Soil type	Occurrences
Miami loam	21
Carlisle muck	15
Bellfontaine sandy loam	10
Miami silt loam	4
Fox sandy loam	3
Washtenaw loam (marsh land)	3
Rifle peat	2
Griffin loam	2
Houghton muck	1
Brookston clay loam	1
Conover loam	1

*Practically all observations were made in areas where Miami loam and Miami silt loam were the predominant soil types.

TABLE 3

FOX HABITATS IN RELATION TO SOILS

Observation No.	Soil Type
1	Miami loam
2	Miami loam
3	Fox sandy loam
4	Miami loam
5	Miami loam
6	Miami loam
7	Miami loam
8	Miami loam
9	Miami loam
10	Carlisle muck
11	Carlisle muck
12	Miami loam
13	Miami loam
14	Carlisle muck
15	Miami loam
16	Carlisle muck
17	Miami loam
18	Miami loam
19	Houghton muck
20	Rifle peat
21	Bellfontaine sandy loam
22	Bellfontaine sandy loam

TABLE 3 (cont.)

Observation No.	Soil Type
23	Bellfontaine sandy loam
24	Bellfontaine sandy loam
25	Bellfontaine sandy loam
26	Miami loam
27	Miami loam
28	Fox sandy loam
29	Miami loam
30	Fox sandy loam
31	Miami silt loam
32	Griffin loam
33	Bellfontaine sandy loam
34	Bellfontaine sandy loam
35	Bellfontaine sandy loam
36	Bellfontaine sandy loam
37	Bellfontaine sandy loam
38	Miami silt loam
39	Brookston clay loam
40	Miami silt loam
41	Miami loam
42-	Miami loam
43	Washtenaw loam (M)
44	Carlisle muck
45	Miami loam
46	Washtenaw loam (M)

TABLE 3 (cont.)

Observation No.	Soil Type
47	Carlisle muck
48	Washtenaw loam (M)
49	Griffin loam
50	Miami loam
51	Carlisle muck
52	Carlisle muck
53	Carlisle muck
54	Carlisle muck
55	Carlisle muck
56	Carlisle muck
57	Carlisle muck
58	Conover loam
59	Carlisle muck
60	Miami silt loam
61	Rifle peat
62	Carlisle muck
63	Miami loan

TABLE 4

Table 4 is a summary of the immediate and surrounding habitats found at fox den locations. The dens listed are all natal dens and were in use the Spring of 1947. Several other dens were located that might have been natal dens but, due to the lack of positive evidence establishing their identity, they are not listed.

Den No.	Immediate habitat	Surrounding habitat to 200 feet
1	Oak-hickory woods	Oak-hickory woods
2	Oak-hickory woods	Oak-hickory woods
3	Pasture	Pasture and shrub area (Sumach)
4	Open grassland	Fleming creek and oak-hickory woods
5	Oak-hickory woods	Woods (White pine) and pasture (creek bottom)
6	Oak-hickory woods	Cattail marsh and oak-hickory woods
7	Mixed herbaceous area	Gravel pit, pasture, tolerant woods
8	Oak-hickory woods	Bog swamp, oak-hickory woods
9	Under old log cabin	Plowed field and oak-hickory woods
10	Sparse oak stand - mixed herbaceous	Mixed herbaceous and creek bottom woods
11	Oak-hickory woods	Pasture and bog swamp (mid-tolerant trees)
12	Sumach clump	Cornfield and cattail marsh
13	Oak-hickory woods	Marsh, gravel pit and crop land
14	Oak-hickory woods	Oak-hickory woods
15	Edge of woods-cornfield	Sumach clumps, cornfield and mid-tolerant woods
16	Shrub woods	Shrubby woods and some pasture

TABLE 5

Slope, topography, exposure and juxtaposition seem to play an important part in the location of dens as well as do soils. This table summarizes information gathered at each den. Soils are treated in another table. It is realized that the lack of a large number of dens in a summary such as this detracts somewhat from any final conclusions that might be drawn, but it is believed that enough information on dens in varied localities were gathered to give the conclusions some significance.

Natal Fox Den Habitats

Den No.	Slope	Topography	Exposure	Location & Juxtaposition
1	8%	Very hilly moraine	South	Woods-pasture-creek bottom
2	50%	Very hilly moraine	North	Woods-pasture-creek bottom
3	6%	Very hilly moraine	NW	Pasture-shrubs-creek bottom
4	7%	Very hilly moraine	SW	Pasture-creek bottom
5	20%	Very hilly moraine	SE	Woods-creek bottom-pasture
6	25%	Very hilly moraine	SE	Woods-creek bottom-pasture
7	None	Gently rolling moraine	None	Gravel pit-pasture-woods
8	7%	Rolling moraine-bog swamp	West	Woods-bog swamp
9	None	Rolling moraine-bog swamp	None	Crop land-bog swamp
10	8%	Rollihg moraine-creek bottom	SW	Pasture-crop land-bog swamp

TABLE 5 (cont.)

Den No.	Slope	Topography	Exposure	Location & Juxtaposition
11	25%	Rolling moraine-bog swamp	North	Woods-crop land-bog swamp
12	7%	Rolling moraine-marsh	SE	Shrubby, crop land-marsh
13	6%	Rolling moraine	Top of knoll	Knoll-marsh-gravel pit
14	8%	Gently rolling moraine	SW	Woods-creek bottom-crops
15	None	Gently rolling moraine	South	Woods-crops
16	10%	Very hilly moraine	South	Shrubs-marsh

TABLE 6

Table 6 is a summary of the different soil types found at natal den locations. The soil map of Washtenaw County prepared by Veatch, et al, was used.

SOIL TYPES AT NATAL FOX DEN LOCATIONS

Den No.	Soil Type
1	Bellfontaine sandy loam
2	Bellfontaine sandy loam
3	Bellfontaine sandy loam
4	Bellfontaine sandy loam
5	Bellfontaine sandy loam
6	Bellfontaine sandy loam
7	Miami loam
8	Miami loam
9	Miami loam
10	Miami loam
11	Miami loam
12	Hillsdale sandy loam
13	Miami loam
14	Fox sandy loam
15	Miami loam
16	Fox sandy loam

Summary

Soil Type	Occurrences
Miami loam	7
Bellfontaine sandy loam	6
Fox sandy loam	2
Hillsdale sandy loam	1

ANALYSIS AND DISCUSSION

Considering Foxes and their Habitats

Forests and Woodlands

Seton, 1929, states in his Lives of Game Animals, "that the unbroken forest seems as little suited to the red fox as is absolute civilization. It is essentially a species of the half-open country, and always increases in the half-settled districts. It was very scarce in the days of primitive woods. I remember very well once, in June, 1885, near Coboconk, Ontario, seeing a fox trot out of the woods ahead of me for 50 yards along the path, then disappear without knowing I was near. I mentioned this at a camp I came to in the evening. Two lumbermen were its total population; one had been 16 years in the Muskoka woods, the other a little less, but both said they had never yet seen a wild live fox in the country. Many other writers could be cited to show that in primitive days the red fox was rare or even unknown in regions where now it is abundant; a fact that has given rise to the myth that the red fox is not a native of America, but a European introduction. There seem to be two grand tests of a species so widely dispersed. First, can it stand the winter in the North; second, can it stand the insects in the South? The fox has solved the first riddle. Its ideal habitat and surroundings, its center of abundance, is the

great varied farming region of southern New England, New York, Pennsylvania, New Jersey, Maryland, southern Ontario, and Michigan. Here are man-made supplies for winter stores, fences enough to bother the dogs and riders, broken country for cover, and dangers enough to serve as tonic and a source of exhilarating exercise and amusement. In this region the fox is abundant, today probably more than at any time of its history."

As shown by Table 1, forests and woodlands are a definite favorite of the Red fox. They seem to be especially prone to stay in a wooded or shrubby area during the day, usually preferring a knoll or the side of a sunny hill. In hunting foxes the hunters nearly always select an area with some woodlands and it is in such an area that most of the kills are made. The hunters usually station themselves at the edge of a wood and shoot the fox as he comes out. Of the 63 observations made during this study, 43 were made in woodlands of various types. Marshy swamps of mid-tolerant trees seem to be a favorite habitat, especially during winter when they are frozen over. Many types of game and other animals seek the shelter of such places during windy days and drifting snow and the fox takes advantage of this concentration of prey. One area in particular seemed to be a very favorable habitat for the fox. This area is known as the

onion marsh and is located in Section 18 of Freedom Township. Seven foxes were taken from this area as a result of four drives on as many days and two more were jumped the last time the marsh was hunted before it thawed out. This area consisted of a large tract of intolerant and mid-tolerant trees, several cattail marshes and a huge muck farm where onions and potatoes are raised.

From the evidence at hand it seems that forests and woodlands are one of the most favorable areas for fox, especially if they are dispersed over an area large enough to offer refuge and some hunting area during the winter under severe conditions.

Shrub Areas

Actually more foxes were found in shrub areas than in any other ecological type. Species usually dominant in such areas were Panicled dogwood (Cornus paniculata), red-osier dogwood (Cornus stolonifera), rose (Rosa), blackberry (Rubus), witchhazel (Hamamelis virginiana), highbush cranberry (Viburnum Opulus), willows (Salix), elderberry (Sambucus), buttonbush (Cephalanthus occidentalis), and others. Many favorite prey of the red fox frequent shrub areas, especially mice, rabbits, and other small mammals. During the winter, when those areas that are located on low ground freeze over, the fox finds this habitat a favorite one. Not only does it offer good hunting grounds with concentrations of prey, but it also offers some

shelter from wind and snow on bitter days or nights. Concentrations of such game birds as the ring-necked pheasant were often flushed from such areas while fox hunting.

Abandoned Lands

As virgin forests are cut and land cleared for agriculture, the red fox begins to increase. This increase grows proportionately up to a certain point. When clean farming is practiced and a diversity of cover types are absent, as well as good populations of small mammals and birds, the foxes become scarce. As worn out land is abandoned, however, cover types become more diversified, populations of small mammals and birds increase and the fox again becomes more numerous. Thus, abandoned lands are an important factor when considering habitats as related to land utilization. Often lands that have been abandoned for several years furnish some of the best cover and, indirectly, food of any of the ecological types found in Washtenaw County. Thus we see that an environment that furnishes a good supply of prey, as do abandoned lands, and at the same time offers a diversity of cover types for hunting purposes and refuge from enemies is made to order for the red fox.

Hamilton and Cook (1944) state that on the descending phase of human occupancy, the red fox appears to increase as land is abandoned and falls out of cultivation. This may

be due in part to the lessened numbers of its enemies - farmers, trappers, and dogs - and in part to the increase of brush and overgrown land which produce abundant fox food.

Marshes and Swamps

A discussion of these ecological types overlaps, somewhat, previous discussions on woodlands and shrubby areas but it is believed that marshes and swamps constitute such an important part of the environment of the red fox that a separate discussion is in order. As already mentioned, in the discussion under woodlands, the onion marsh with its adjacent marsh woodlands and swales constituted one of the most favorable environments found during the course of this investigation. Numerous small mammals and game birds seek such places during the winter resulting also in a concentration of foxes. A typical lowland swamp in Section 18 of Freedom Township (the onion marsh swamp) is shown in Plate 2. This area is fairly open from recent cuttings but still offers considerable cover and refuge.

A creek bottom swamp on Section 25 of Ann Arbor Township was another favorite area for foxes. Rabbits, squirrels, muskrats, mice, and pheasants were abundant in this area. Several foxes were known to hunt up and down this creek bottom. The adjacent area of diversified cover types has been known to carry a large fox population for some time.

Plate 2

View of the Onion Marsh Swamp

Another View of the Onion Marsh Swamp

Fallow Lands

Fallow lands often support large populations of mice and other small mammals which are the favorite prey of the red fox. Several observations were made during the winter, when there was snow on the ground, where foxes had dug into an old corn shock or a blown over pile of weeds or old crops in search of mice. When such lands are close to other habitats of the fox, he will often make fallow lands a favorite hunting area. However, it is believed that such lands offer only hunting areas where prey may be found and as such have little to offer in the way of a maximum favorable habitat.

Pasture

During the winter months when pastures are not intensively grazed, many small mammals will take advantage of the cover present and establish nests and other types of homes. In some pastures it was noted that mice nests were very abundant and as a result, fox tracks were also present in considerable numbers. Pastures are an ever-present part of almost any type of habitat found in Washtenaw County and as such contribute to the overall requirements of habitat distribution that are so important in maintaining high fox populations. During the investigation, four observations of foxes were

actually made in pasture land and in 41 cases pasture constituted part of the surrounding habitat.

Crops and Crop Land

Crop land constitutes such an important part of any environment in Washtenaw County that a discussion of fox habitats would not be complete without reference to such lands. Since this discussion is mainly concerned with winter conditions, crop land assumes more importance than it would otherwise during the summer when it is cleaned and tilled. Many farmers leave standing corn in their fields during the winter, either shocked or standing, which is eagerly sought by many kinds of small mammals, song birds, and game birds. The destruction of shocked corn by mice during the winter is well known. Such areas nearly always harbor large populations of mice. Rabbits will often use shock corn fields both as refuge within the shocked corn and as source of food. Many song birds and game birds depend on such areas for a large part of their winter food. Other crop lands such as soybean fields also attract large populations of small mammals and birds. Such lands offer very favorable hunting to the red fox. Observations were made on many occasions where foxes had dug into a stack of shocked corn in search of mice or rabbits and were often successful in such a search. No doubt some

song and game birds as well as squirrels were taken on occasion from such areas. Nine actual observations of red foxes were made on crop land and in forty-one areas observations were made where crop land was part of the surrounding habitat. Crop land constituted an average of 44.1% of the total land area by sections where fox observations were made.

Ecotones and Fencerows

An ecotone is commonly known as a transition area between a more or less open area and a woodlot or forest. It is common knowledge that such areas support higher small animal populations of certain species than do either the open area or the woodlot. The ecotones in this area usually consist of a variety of shrub species along the outer edge of a woodlot. Foxes were often tracked in the snow along such areas. They appeared to be used by foxes both as a hunting area and as a travel zone to other areas.

Fencerows in this area are variable mainly in length, width, and composition. Generally speaking, the larger it is the better for wildlife. Some fencerows consist of little more than a grassy area on one or both sides of a fence while others are ten to twenty feet wide with a considerable variety in composition. Such a fencerow is shown in Plate 3. This area supported a large rabbit population, considerable mice, a few squirrels and four pheasants and is located in

Plate 3

An Ideal Fencerow

Section 1 of Lodi Township. Fox tracks were observed along this fencerow from time to time throughout the winter and they evidently found the area very good for hunting as well as a travel lane from one area to another. There was a good supply of food available in this area which attracted the large population of animals and in turn attracted the red fox because of the good hunting. It is believed that fencerows are a very important part of a good wildlife management program on any farm.

Soils

In making any analysis of soil conditions as related to fox habitats, consideration must be given as to which soil types are predominant in the locality studied. It was found that Miami loam and Miami silt loam constituted the majority of soil types in Washtenaw County where fox observations were made. The largest number of observations made were on Miami loam, there being twenty-one occurrences. Next in line was Carlisle muck with 15 occurrences. Carlisle muck actually constituted a very small proportion of all the soil types and is therefore the most significant figure obtained. Bellfontaine sandy loam occurred in ten observations. Various other lowland soil types were present on six observations. Most of the observations made on Miami loam were in upland forest types while those made on such lowland soils as Carlisle muck were in swamp shrubs and forest.

Plate 4

Den No. 1, Oak-hickory woods Habitat

Den No. 3, Pasture Habitat

Summary of Den Studies

The study of fox den habitats as related to land utilisation could very well be made the subject of a separate study. The study made here, in conjunction with the habitat study, proved to be very interesting. It is a well known fact that the red fox habitually selects a den location that has been previously dug by such animals as woodchucks and badgers. It is therefore necessary to be careful in identifying a den as a fox den, looking for such things as bones, carrion, fur, feathers, tracks, scats, smell, and the size of the entrance or entrances. Most fox dens have several entrances from five to twenty feet apart but one den observed in a pasture had only one entrance. It is not too difficult to tell when the pups first come out of the den if signs about the immediate vicinity of the den are observed carefully. Soon after the pups come out, the vicinity of the den has a well worn appearance due to the playful habits of the young foxes.

A. Vegetation and cover: Generally speaking, dens were located in some sort of cover, only two observations being made where there was a definite lack of cover. As shown by Table 4, Oak-hickory woods proved to be the favorite habitat for the location of a den. Eight observations out of sixteen were made in Oak-hickory woods. Plate 4 shows two typical fox den locations. The top picture is of Den No. 1

in Section 25 of Ann Arbor Township. Both the immediate cover and the surrounding cover and vegetation were of the Oak-hickory type. The lower picture shows Den No. 3 in Section 25 of Ann Arbor Township. This den is located in a pasture area surrounded by a well-grazed clump of sumach bushes. A large tract of Oak-hickory woods is in the left middle background.

B. Topography: Most dens are located in gently rolling to very hilly moraines in Washtenaw as shown by Table 5. The slope on which the dens are actually located varies from zero to fifty percent with an average of about twelve percent. Two dens were located on the tops of knolls without any apparent slope. Plate 5 shows two dens that are located on slopes of eight percent and fifty percent. The upper photograph is of the den located on an eight percent slope and shows the remains of several kills at the entrance to the den. Pheasant feathers and the remains of a muskrat may be identified. The lower photograph, of a den on a fifty percent slope, had three entrances, one of which is shown, another is at the base of the large tree in the background. Skulls of a rabbit, muskrat, squirrel and mice were picked up at this den indicating that it had been previously used.

C. Exposure: From evidence gathered during this investigation it appears that a southern exposure is the

Plate 5

Fox Den located on an eight percent slope

Fox Den located on a fifty percent slope

most common. As shown by Table 5 nine dens faced in a southern direction while only three faced in a northern direction. Apparently a sunny side is preferred to obtain the maximum warmth from the early spring sun. Several dens were placed at the summit of a knoll giving them a maximum exposure to the sun. A sunny exposure is probably not of first importance, however, as dens were located in so many different types of exposures. Apparently those that are located in wooded areas show the greatest variation in types of exposure.

D. Location and Juxtaposition: The location and juxtaposition of dens seem to fit into a variety of land use types just as do fox habitats. Only on isolated occasions were dens located in a type that extended for some distance. One of the favorite combinations was a den on a slope in an upland woods overlooking a marsh or swamp. Apparently such an area offered the maximum in protection, usually was not too much molested by man and the immediate surrounding area offered good hunting. Another combination noted several times was a den located on a slope of an upland woods overlooking a creek bottom. Here again good cover and hunting grounds were present.

E. Soils: Sandy soils are a preferred location for fox dens. These soils are more easily dug out during the spring of the year, especially when the ground is still

Plate 6.

Sandy spoil at Entrance to Fox Den

Fox tracks, Old bones and Scat on Sandy spoil

frozen. As shown by Table 6, nine of the sixteen dens were located on sandy soils and even those that were located in a loam soil were dug from areas where there was some sand. As mentioned Before, fox dens are often located in holes that were originally dug by woodchucks or badgers, so it may be that the original digger selects the types of soil that are best suited for digging. Plate 6 shows two close-ups of a fox den, the sandy nature of the soil being well illustrated. This den was located in a pasture in Section 25 of Ann Arbor Township. The lower photograph shows the tracks of a fox, two pieces of bone and a scat of a fox.

F. Use from year to year: One observer, Mr. Doug Cattanach, manager of an estate in Ann Arbor Township, reported that three dens which he has been watching for six years have been used by foxes each year. It may be safely concluded from this evidence, and other, that if dens are not smoked out, dug out, or filled in, they will be used from year to year, probably by the same family or their offspring.

CONCLUSIONS AND SUMMARY

This study was made during the Fall, Winter, and Spring of 1946-1947 in Washtenaw County, Michigan. The purpose of the study was to determine what, if any, relationships there were between the habitats of the red fox (Vulpes fulva) and their relation to land utilization.

Data for this study was obtained by following tracks in the snow, by fox hunting with a group of local hunters and taking notes on habitats and land utilization where foxes were jumped, by several actual observations and by a study of natal dens.

Farming practices and the activity of trapping, hunting and the destruction of natal dens has considerable effect on what habitats foxes will select. It is believed that when such activity becomes intense that what foxes are left will seek new territories, this being especially true when there is only one fox left in a certain area. Clean farming itself is a detriment to fox populations and small scattered populations are most often found in such areas.

The preferred winter habitat seems to be wooded areas, either upland or swampy. During the winter swampy areas freeze over and their protection and supply of food offer refuge for large numbers of small mammals and birds which are

favorite prey of the red fox. However, a number of well distributed ecological types located within the cruising radius seems to be the best habitat, just as we find such a distribution is most favorable to the bobwhite quail. Different land types each offer some advantages, mainly in the different concentrations of prey that is preferred by the red fox. Some type of woodland or brushy area seems to be one of the prime requirements in the distribution of ecological types. Another ecological type that seems to be necessary for maximum populations is at least some area of abandoned land which supports large populations of small mammals, mice, and birds.

Land types that support small populations of the Red fox are large tracts of virgin timber and areas where intensive farming practices are used.

Fox dens are usually located in forested or wooded areas, with sandy soil, some slope and rolling topography. Here again we find that a distribution of species requirements with a variation in cover types is the most favorable area for location of the natal dens.

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WASHTENAW COUNTY MICHIGAN

1945

SCALE OF MILES 0 1 2 3 4 5

KEY

- HARD SURFACE U.S. AND STATE ROADS
- GRAVEL STATE ROADS
- HARD SURFACE COUNTY ROADS
- GRAVEL COUNTY ROADS
- UNIMPROVED COUNTY ROADS
- COUNTY AND STATE PARKS
- SCHOOL
- TOWN HALL
- GOLF COURSE
- AIRPORT
- CHURCH
- CEMETERY

POINTS OF INTEREST INDICATED BY NUMBERS

LEGEND
X Observations
O Dens

RANGE 3 E. RANGE 4E. RANGE 5E. RANGE 6E. RANGE 7E.

TOWN 1 S. TOWN 2 S. TOWN 3 S. TOWN 4 S.

LIVINGSTON COUNTY

LYNDON DEXTER WEBSTER NORTHFIELD SALEM

SYLVAN LIMA SCIO ANN ARBOR SUPERIOR

SHARON FREEDOM LODI PITTSFIELD YPSILANTI

JACKSON COUNTY

MANCHESTER BRIDGEWATER SALINE YORK AUGUSTA

LENAWEE COUNTY MONROE COUNTY

OAKLAND CO.

WAYNE CO.

Revised 12-44. M.R.

MAP OF WASHTENAW COUNTY

AND DIRECTORY OF PLACES OF INTEREST

Geddes Road East of Ann Arbor

Prepared and Published by

THE BOARD OF COUNTY ROAD COMMISSIONERS

for

FREE DISTRIBUTION ONLY

MAP OF WASHTENAW COUNTY

LITHO. WM. J. KELLER CO., BUFFALO

· INDEX TO ROADS ·

A
Abel . . . . . Saline
Ahrens . . . . . Shar
Alber . . . . . Lodi
Allan . . . . . Man-Brw
Altenbrent . . . . . Free
Alvord . . . . . Syl
Angle . . . . . Salem
Ann Arbor-
Saline . . . . . Lodi-Pitt
Ann Arbor -
Whitmore Lake Nfld-AA
Arkona . . . . . Brw-Saline
York-Aug
Arlington . . . . . AA

B
Baker . . . . . Scio
Barker . . . . . Web
Bartell . . . . . Lyn
Bauer . . . . . Syl
Beach . . . . . Lima
Beeman . . . . . Lyn
Begols . . . . . York
Bemis . . . . . Pitt-Free-Brw-
York-Aug-Ypsi
Bell . . . . . Dex
Below . . . . . Shar
Berry . . . . . Sup
Bethel Church
Shar-Free-Lodi
Bird . . . . . AA
Bishop . . . . . York
Boetger . . . . . Man
Boettner . . . . . Brw-Free
Bolla . . . . . Aug-York
Boyce . . . . . Lyn
Bowdish . . . . . Lyn
Bowens . . . . . Man
Bramen . . . . . Man
Brand . . . . . Dex
Brassow . . . . . Lodi
Braun . . . . . Brw-Saline
Bridge . . . . . Ypsi
Brookville . . . . . Salem
Bunton . . . . . Ypsi-Aug
Burmeister . . . . . Brw
Burtis . . . . . Syl
Burtless . . . . . Man
Bush . . . . . Man-Syl
Buss . . . . . Man
Butler . . . . . Aug

C
Campbell . . . . . Pitts
Carpenter . . . . York-Pitt
Case . . . . . Saline
Cash . . . . . Shar
Cassidy . . . . . Lyn
Cavanaugh Lake . . . . Syl
Chamberlin . . . . . Web
Chelsea-Manchester
Shar-Man-Syl
Cherry Hill . . . . . Sup
Chubb . . . . . Salem
Clark . . Ypsi-Sup-Pitt-AA
Clinton . . . . . Brw
Colby . . . . . Dex
Congress . . . . . Ypsi
Conlin . . . . . Dex
Conway . . . . . Syl
Craig . . . . . Scio
Crane . . . . . Pitt-York
Cross . . . . . Ypsi
Currie . . . . . Salem
Curtis . . . . . Sup-Salem

D
Daly . . . . . Web
Dan Hoey . . . . . Scio
Dancer . . . . . Dex-Lima
Day . . . . . York
Deckert . . . . . Syl
Delhi, East . . . . . Scio
Delhi, North . . . Web-Scio
Delhi, West . . . . . Scio
Dell . . . . . Lodi-Saline
Dennison . . . . . York
Devenna . . . . . York
Devonshire* . . . . . AA
Dexter-Ann Arbor
Scio-AA
Dexter-Chelsea Scio-Lima
Dexter-Pinckney
Dex-Web
Dexter Townhall . . . . Dex
Dhu Varren . . . . . AA
Diuble . . . . . Lodi
Dixboro
Sup-AA-Nfld-Salem
Donovan . . . . . Web
Donner . . . . . Dex
Dunn . . . . . Saline

E
Earhart . . . . . Nfld-AA
East Delhi . . . . . Scio
East Shore . . . . . Nfld
Easton . . . . . Lima
Easudes . . . . . Shar
Ecorse . . . . . Ypsi
Eight Mile . . . Nfld-Salem
Eiseman . . . . . Free-Brw
Ellis . . . . . Ypsi
Ellsworth . . Free-Lodi-Pitt
Ypsi
Ely . . . . . Man
Embury . . . . . Lyn
English . . . . . Man
Ernest . . . . . Brw-Free
Esch . . . . . Free

F
Fahrner . . . . . Syl
Farnswo rth . . . . . Lyn
Farrell . . . . . Web
Feldkamp . . . . . Saline
Fisk . . . . . Brw
Five Mile . . . Salem-Nfld
Fleming . . . . . Dex
Fletcher . . . . . Lima-Free
Ford . . . . . AA-Sup
Ford Blvd. . . . . Ypsi
Forest . . . . . Ypsi
Fosdick . . . . . Pitt-York
Frains Lake . . . . . Sup
Freer . . . . . Lima
Fuller . . . . . Aug

G
Gale . . . . . Sup
Garvey . . . . . Syl
Geddes . . . . . AA-Sup
Geddes Avenue . . . . . AA
Geiske . . . . . Man
Gensley . . . . . Lodi
Glazier . . . . . Syl
Glazier Way . . . . . AA
Gleaner Hall . . . . . AA
Golfside . . . . . Pitt-Ypsi
Gotfredson . . . . Salem-Sup
Goodband . . . . . Lyn
Gooding . . . . . Aug
Goodrich . . . . . Saline
Goss . . . . . AA
Grabell . . . . . Syl
Grass . . . . . Saline-Lodi
Grass Lake . . . . . Shar
Green . . . . . AA
Greenview Drive . . . . AA
Gregory . . . . . Web
Gross . . . . . Lima
Grove . . . . . Ypsi
Grossman . . . . . Man
Guenther . . . . . Lima

H
Haab . . . . . Free
Hack . . . Brw-Saline-York
Hadley . . . . . Lyn
Haist . . . . . Lima
Hankard . . . . . Dex
Harris . . . . . Sup-Ypsi
Hartman . . . . . Saline
Hashley . . . . . Shar
Hauck . . . . . Man
Hayes . . . . . Syl-Shar
Hazel . . . . . Shar
Heather Way* . . . . . AA
Heim . . . . . Syl-Shar
Hellner . . . . . Nfld
Henzie . . . . . Man
Herman . . . . . Man
Henster . . . . . Shar
Hewitt . . . . . Ypsi
Hickman . . . . . Sup
Hitchingham . . . Ypsi-Aug
Hoelzer . . . . . Brw
Hogan . . . . . Man-Brw
Hogback . . . . . AA
Holmes . . . . . Ypsi
Hoppe . . . . . Syl
Houck . . . . . Man
Hudson . . . . . Man
Huron River Drive
Ypsi-Web-Scio-AA

I
Island Lake . . . . Dex-Lyn
Ivey . . . . . Syl

J
Jackson Syl-Lima-Scio-AA
Jacob . . . . . Shar
Jacox . . . . . Lyn
Jennings . . . . . Nfld-Web
Jerusalem . . . . . Lima-Syl
Jewell . . . . . York
Johnson . . . . . Saline
Jordon . . . . . Saline
Joslin Lake . . . . . Lyn
Joy . . . Sup-AA-Scio-Web-
Nfld-Salem
Judd . . . . . York-Aug

K
Kaiser . . . . . Brw
Kalmbach . . . . . Syl
Kapp . . . . . Man
Kearney . . . . . Nfld
Kendall . . . . . Shar
Kies . . . . . Brw
Kilmer . . . . . Syl
Kirk . . . . . Man
Klager . . . . . Saline-Brw
Klingler . . . . . Lima
Knight . . . . . Scio
Koebbe . . . . . Free
Kothe . . . . . Free-Shar
Kruse . . . . . Syl
Kuhl . . . . . Man

L
Lamb . . . . . Man-Shar
Lamming . . . . . Man-Shar
Leeke . . . . . Lyn
Leforge . . . . . Sup-Ypsi
Lemm . . . . . Man
Lima-Center
Brw-Lima-Dex-Free
Liberty . . . AA-Scio-Lima
Liebeck . . . . . Syl
Lindeman . . . . . Lodi
Lindley . . . . . Lyn
Lindsley . . . . . Saline
Lingane . . . . . Lyn-Syl
Liss . . . . . Aug
Loeffler . . . . . Free-Lima
Logan . . . . . Man-Brw
Lohr . . . . . Pitt
Loveland . . . . . Syl
Lowry . . . . . Syl
Luckhardt . . . . . Free

M
Macey . . . . . Aug
Macon . . . . . Saline
Madden . . . . . Dex
Mahrle . . . . . Man
Main . . . . . AA
Maple
Nfld-Web-Scio-AA-Pitt-
Lodi-Saline-York
Marion . . . . . Saline
Marshall . . . . . Scio
Mast . . . . . Web
Marton . . . . . Pitt
Martz . . . . . Ypsi
McArthur Blvd. *Sup-Ypsi
McCallum . . . . . Brw
McCrone . . . . . Aug
McGregor . . . . . Dex-Web
McGuiness . . . . . Dex
McKean . . . . . Ypsi-Aug
McKinley . . . . . Syl
McLure . . . . . Syl
Merkle . . . . . Web
Merrill . . . . . Web
Merritt . . . . . Ypsi-Pitt
Mertz . . . . . Free
Meyers . . . . . Shar
Mester . . . . . Lyn
Michigan
Pitt-Man-Brw-Saline-
Ypsi
Midway* . . . . . Sup-Ypsi
Milan-Oakville York-Aug
Milford . . Salem-AA-Nfld
Milky . . . . . York
Miller . . . . . Scio-AA
Mohart . . . . . Saline
Moon . . . . . York
Mooreville . . . York-Saline
Morgan . . . . . Pitt-Ypsi
Mott . . . . . Sup-Ypsi
Mull . . . . . Man
Mulvaney . . . . . Man
Munger . . . . . Pitt-Ypsi
Muschbach . . . . . Syl
Meyers . . . . . Sharon

N
Napier . . . . . Salem-Sup
Napoleon-Manchester
Man
Neal . . . . . Brw
Newport . . . . . AA
Nixon . . . . . AA
Noah . . . . . Dex
Noble . . . . . Lodi
Noggles . . . . . Man
Nollar . . . . . Nfld
North Delhi . . . Scio-Web
Northfield Church
Nfld-Web
North Lake . . . . . Lyn-Dex
North Territorial
Nfld-Web-Dex-Lyn-
Salem

O
Oak . . . . . Aug
Oakville-Waltz . . . . . Aug
Osius . . . . . Lyn

P
Packard . . . . AA-Ypsi-Pitt
Park . . . . . Scio
Parker
Lodi-Free-Brw-Saline-
Lima-Scio
Parr . . . . . Shar
Paul . . . . . Man
Payeur . . . . . Pitt
Peckins
Free-Shar-Lima-Syl
Peters . . . . . Scio
Petersburg . . . . . York
Pfaus . . . . . Free
Pierce . . . . . Syl
Pitman . . . . . Aug
Pittsfield Blvd.* . . . . . Pitt
Platt . . . . . Aug-Pitt
Pleasant Lake
Free-Shar-Lodi
Plymouth-Ann Arbor
AA-Sup
Pontiac . . . . . Salem
Pritchard . . . . . Syl
Pratt . . . . . Scio
Prospect . . . . . Sup-Ypsi

Q
Quigley . . . . . Dex

R
Rank . . . . . Syl-Shar
Rawsonville . . . Aug-Ypsi
Reiman . . . . . Syl
Reno . . . . . Free
Rentz . . . . . Free
Ridge . . . . Ypsi-York-Sup
Riker . . . . . Dex
River . . . . . Ypsi
Roe . . . . . Lyn
Roehm . . . . . Saline
Roepke . . . . . Lyn
Rosbolt . . . . . Aug
Rushton . . . . . Nfld

S
Sager . . . . . Lima
Salem . . . . . Salem
Saline-Manchester
Saline-Brw-Man
Saline-Milan . Saline-York
Saline-Water Works
Lodi-Free
Samer . . . . . York
Sandborn . . . . . Man
Sanford . . . . . York
Schellenberger . . . . . Brw
Schill . . . . . Saline
Schleeweis . . . . . Man
Schmitz . . . . . Free
Schneider . . . . . Free-Brw
Schwab . . . . . Brw-Man
Scio . . . . . Scio
Scio Church
Pitt-Lodi-Free-AA-
Scio-Lima
Scully . . . . . Web-Man
Seven Mile . . . Salem-Nfld
Sharon Hollow . Shar-Man
Shield . . . . . Scio
Shipley . . . . . Shar
Sheridan . . . . . Man-Brw
Shore-East . . . . . Nfld
Sibley . . . . . Syl
Silver Hill . . . . . Dex
Six Mile . . . . . Salem-Nfld
Smythe . . . . . Shar
Sooten . . . . . Man
South Hamburg . . . . Web
South Main . . . . . Pitt
South State . . . . . AA-Pitt
Spencer . . . . . Ypsi
Spencer . . . . . Nfld
Spies . . . . . Free
Stadium . . . . . AA
Staebler . . . . . Scio
Stein . . . . . Scio-AA
Steinbach . . . . . Lima-Free
Stinchfield Woods . . . Dex
Stockbridge-Chelsea
Syl-Lyn
Stofer . . . . . Dex-Lyn
Stommel . . . . . Sup
Stone School . . . . . Pitt
Stony Creek
Ypsi-York-Aug
Strawberry Lake . . . . Web
Strieter . . . . . Scio-Lodi
Struthers . . . . . Shar
Sunset* . . . . . AA
Superior . . . . . Sup-Ypsi
Sutton . . . . . Nfld
Sweet* . . . . . Ypsi
Sylvan . . . . . Syl-Shar

T
Talladay . . . . . Aug
Territorial, North
Salem-Nfld-Lyn-
Dex-Web-Lodi
Tessmer . . . . . Lodi
Textile
Ypsi-Pitt-Lodi-Free
Thomas . . . . . Pitt
Toma . . . . . Dex
Torrey . . . . . Aug
Tower . . . . . Salem
Tracy . . . . . Man
Traft . . . . . Shar
Traver . . . . . AA
Trinkle . . . . . Lima
Trolz . . . . . Shar
Tubbs . . . . . Scio
Tuttle Hill . . . . . Aug-Ypsi
Tyler . . . . . Ypsi

V
Valentine . . . . . Web
Van Tile . . . . . Man
Vaughn . . . . . Web
Viesel . . . . . Syl
Vorheis . . . . . Salem-Sup
Vreeland . . . . . Sup

W
Wagner . . . . . Scio-Lodi
Waldo . . . . . Shar
Wallace . . . . . Brw
Walsh . . . . . Web
Waltrous . . . . . Lima-Syl
Walter . . . . . Brw
Warner . . . . . York-Pitt
Warker . . . . . Shar
Warren . . . . . AA-Sup
Warthley . . . . . Syl
Washburne . . . . . Shar
Washtenaw . AA-Pitt-Ypsi
Waterloo . . . . . Dex-Lyn
Waters . . . Free-Lodi-Pitt
Watkins . . . . . Man
Weber . . . . . Free-Lodi
Webster Church . . . . Web
Weed . . . . . Salem
Wellwood . . . . . Man
Werkner . . . . . Lyn
West Delhi . . . . . Scio
Whitmore Lake . . Nfld-AA
Whittaker . . . . . Ypsi-Aug
Wiard . . . . . Ypsi
Wilbur . . . . . Brw
Willis . . . Saline-York-Aug
Willow
Brw-Saline-York-Aug
Wingate . . . . . Syl
Winters . . . . . Syl
Wolff . . . . . Man
Wright . . . . . York-Aug
Wylie . . . . . Dex-Lima

Y
Yoakam . . . . . Dex-Lima

Z
Zeeb . . . . . Web-Scio-Lodi
*Name not shown on map.

INDEX TO ROAD NAMES

Ann Arbor Township . . AA
Augusta Township . . Aug
Bridgewater Township
Brw
Dexter Township . . . . Dex
Freedom Township . . Free
Lima Township . . . . Lima
Lodi Township . . . . . Lodi
Lyndon Township . . . Lyn
Manchester Township
Man
Northfield Township Nfld
Pittsfield Township Pitt
Salem Township . . Salem
Saline Township . . . Saline
Scio Township . . . . . Scio
Sharon Township . . . Shar
Superior Township . . Sup
Sylvan Township . . . . Syl
Webster Township . . Web
York Township . . . . York
Ypsilanti Township . . Ypsi