ROSS NATURAL HISTORY RESERVATION

The First Twenty Years
1959 to 1979
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INTRODUCTION

The F. B. and Rena G. Ross Natural History Reservation was established in November, 1958, through the cooperative efforts of Mr. and Mrs. F. B. Ross of Emporia and personnel of Kansas State Teachers College (now Emporia State University) on a 1040 acre tract of land located southwest of Americus, Kansas, in Lyon and Chase counties. Through a lease agreement the Rosses made the area available to the University for use by faculty and students of the Division of Biological Sciences with the understanding that the Reservation would provide an area for research and field study, aid in the teaching of biological sciences, and enable a segment of the tall grass prairie ecosystem to be preserved (Hartman, 1960).

As a result of intensive utilization and development of the area by faculty members and students during the subsequent three years, in January, 1961, Mr. and Mrs. Ross deeded to the University and the State of Kansas 200 acres of the 1040 tract; title to the remaining 840 acres was retained by the Ross family.

Hartman (1960), summarized the past history of the land area comprising the Reservation since settlement by European man, described the area physically and biologically, and speculated on the future of the Reservation in terms of research, teaching, and conservation. Breukelman, et. al. (1961), in an issue of the Kansas School Naturalist, reported on transferring ownership of 200 acres of the Reservation to the University, summarized pertinent information from Hartman’s publication, described improvements in the physical plant, and noted the addition of a weather recording station, a nature trail, and certain conservation practices on the area.

The primary purposes of this publication are threefold: 1. to report on physical and biological changes that have occurred on the 200-acre, state-owned portion of the Ross Natural History Reservation since its establishment; 2. to summarize educational and research activities, both past and present; and 3. to speculate on the future role of the Reservation as an educational and research facility and as a site for preservation of a portion of the tall grass prairie ecosystem.

The 200 acres comprising the state-owned portion of the Reservation lie in two sections of Lyon County as follows:

T18; R10 - the E. half of the SE quarter of section 7.
- the W. half and NE quarter of the SW quarter of Section 8.

Soon after the area was acquired from the Rosses a five-strand barb wire fence was constructed along the west and north boundaries of the tract separating it from the remainder of the Reservation on which there was a grazing lease held by Mr. Jack Lefler, a local farmer-rancher. Exclusion of cattle grazing and discontinuance of attendant management practices of periodic
burning and mowing of the vegetative cover was to have profound effects on the plant and animal life of the state-owned area in the following years.

Hartman (1960) described the major habitats of the Reservation and included general descriptions of prairie, aquatic, abandoned homestead and wooded sites. To fully appreciate changes that have occurred in the plant and animal communities after cattle were excluded from the area, and to understand why certain management practices have been employed in recent years in order to retain sufficient tall grass prairie habitat on the 200 acres, it is necessary to know more than was reported by Hartman about farming and grazing activities prior to establishment of the Reservation.

All portions of the area can readily be separated into one of two categories based on past land use practices: 1. Native grass tracts - those that were grazed but never plowed and that retained a vegetative cover composed primarily of native grasses and forbs; and 2. Abandoned cropland tracts - those that had been subjected to cultivation at some time in the past and whose vegetative cover as of 1960 was the result of the natural process of plant succession or of being seeded to legumes and non-native, cool season grasses after cultivation ceased.

Figure 1, a 1959 aerial photograph of the state-owned 200 acres, shows the 10-acre grid sections into which the area has been divided and the designation of each grid section by letter and number. Native grass tracts are: grids A37, A38, A40, A41, A42, A43, A58, B33, B34, B47, B48, that portion of A 39 south of the stream; approximately the north one-fourth of grids B49 and B50, and the west two-thirds of A44. Abandoned cropland tracts are: grids A55, A56, A57, B63, B64, that portion of A39 north of the stream, approximately the south three-fourths of grids B49 and B50, and east one-third of grid A44. The former farmstead site located in the southwest corner of A56 and the northwest corner of A57 is most appropriately included in this category.

Policies and procedures for operation of the Reservation, adopted in the early 1960's, outlined uses and acceptable activities for the various grid sections. Also, restrictions were placed on certain types of activities that were not compatible with the primary objectives for the area. For example, manipulation of the vegetative cover and introduction of non-native plants and animals were prohibited in most grid sections, but acceptable for those grids where such manipulations or introductions were necessary in order to carry out approved conservation practices or research activities. Prior to acquisition of the state-owned 200 acres, a large pond was constructed in B48 and various woody wildlife cover plantings were established in conjunction with it; an extensive shelterbelt [windbreak] had been planted in grids A55 and A56; an experimental garden plot had been set aside in A57; nursery stock of several tree species had been planted in A39; and a nature trail had been laid out to extend from A56, across portions of A55, A42, A43, A38, A39, A41, and back to A56.

In establishing policies and procedures that would enable the primary objectives of the Reservation to be accomplished, the Reservation committee in January, 1962, adopted the following policy concerning vegetative alterations:

"Artificial plantings or artificial disturbances of existing vegetation on the Reservation shall be restricted to the 50 acres in grids A55, 56, 57, 58, and B48."

An exception to the policy was soon granted. In the spring of 1962 a cooperative revegetation project was initiated in grids B50 and 63, between the Lyon County Soil Conservation Service and
the University, resulting in an increased area on which plantings or disturbances were allowed. Vegetation in the remaining 13 grids was to remain unaltered except for occasional mowing of the nature trail where it traversed grids A42, 43, 38, 40, and 41. This "hands off" policy of no manipulation in the 13 grids prevailed for the following five years and into the spring of 1967. In April, 1967, a decision was made to burn the dead vegetation from the east one-half of grid B33 to provide a demonstration area for observing, by students and visitors, the effects of burning vs. no burning of the vegetative cover. Due to circumstances beyond control of persons involved in the burning project, instead of the five acres in B33, approximately 15 acres in A39, A40, and B33 were burned on 1 May 1967. Response by native grasses and forbs to the burn was striking [Fig. 2] and the Reservation committee felt that the project was an educational success.

By the late 1960's it was apparent that the absence of cattle grazing, mowing and burning on major portions of the Reservation, and particularly on the native grass tracts, was resulting in a rapid invasion of woody plants into the grasslands. The combination of several years of normal or above normal precipitation throughout the 1960's and increasing quantities of dead vegetation on the ground was providing favorable conditions for the germination of woody plant seeds and vegetative propagation of woody species on the native grass areas at the expense of the grasses.

One of the primary objectives of the Ross Natural History Reservation was to preserve a segment of the tall grass prairie ecosystem. It was obvious by the late 1960's that the policy prohibiting manipulation of the vegetative cover on a large portion of the Reservation was at odds with this objective. Therefore, in the fall of 1968 a proposal to manipulate the vegetation in grids A40, B33, and B34 in order to discourage woody species and to encourage the native grasses was approved by the Reservation committee. Encouragement of native grasses by reducing competition from invading woody species was to be accomplished by periodic mowing of the vegetation and removal of the dead plant materials. Removal of the residue was deemed necessary in order to decrease the ground cover moisture level and thereby diminish one of the factors which seemed to encourage invasion of woody plants. The committee recognized that mowing and removal of the vegetation might not be adequate measures for maintaining the native grass cover so approval was given for the selective use of fire and herbicides, if necessary.

By the early 1970's an area in grid A42 through which the nature trail passed was losing its prairie characteristics because of the invasion of woody species. During the fall of 1971 large trees and shrubs in this prairie community were cut and removed, and the tract was burned in April, 1972. Hay and brush were mowed in July and the resulting residue was removed.

It had become obvious by this time that a long range plan for maintaining tall grass prairie areas on the Reservation was needed. Therefore, a proposal was submitted and approved in 1973 to set aside the following tracts on which grassland type vegetation would be encouraged:

1. Native grassland vegetation - grids A43 and A44, except for peripheral woodlands; approximately the west one-third of A42 and that portion of A41 south and east of the mowed nature trail; approximately the north one-half of A40 and a small area in the southwest corner of A39; grids B33 and B34.
2. Reseeded native grassland - grid B63 and the southern portion of B50.
3. Non-native grassland - B64, the southern portion of B49 and the northern portion of A39.

Again, manipulative methods to be employed were mowing, burning, herbicide application, and possible limited grazing. Where and how these methods have been and will be used will be reported in following sections of this paper.
Fig. 2. Response by native grasses to spring burning. Area was burned on 1 May 1967. Photo was taken in August, 1967.

It seems appropriate at this point, in view of the original and revised Reservation use policies, and after considering the past history of the area, to provide a current status report of the 200 acres comprising the state-owned portion of the Reservation. Information for this report has been obtained from local residents of the area, from records maintained by persons supervising the Reservation and other biology faculty members, from photographic records, and from personal observations by the author.

Some general statements have been made about the land use practices on the area prior to acquisition by the University; more specific information seems appropriate at this time. Even though the entire 200 acres of state-owned property were being subjected to grazing prior to construction of the boundary fence, utilization of the vegetation by cattle was dependent on its quantity and quality. Tracts of land that had been cultivated at some time in the past produced vegetation low in both quantity and quality, conditions directly attributed to the high degree of erosion and mineral depletion that had been occurring since the prairie sod was first broken in the 1860s;
native grass tracts that retained soil and soil nutrients were more productive and exhibited
greater species diversity than abandoned croplands (generally referred to as old field habitats by
ecologists and as go-back land by farmers and ranchers).

As noted before, abandoned fields had either been seeded to non-native legumes and grasses
or were allowed to undergo natural succession. The most reliable account of the recency of
cultivation on the 200 acres was provided by Ronald Moore, a local resident, whose uncle was
the last person to farm land on the state-owned portion of the Reservation. Mr. Moore informed
me that the old field comprising most of the area in grids A55 and A56 was last cultivated in the
summer of 1948, and in the fall of that year the field was hand-seeded to smooth brome grass
(Bromus inermis), and Korean lespedeza (Lespedeza stipulacea). Apparently, cropland which com-
prised most of grids B63 and B64 and the south three-fourths of grids B49 and B50 was seeded to
smooth brome and lespedeza at about the same time. No information is available on the last
tillage dates for portions of A39 and A44, but there is evidence that they were seeded to smooth
brome, whereas grid A57 does not appear to have been reseeded and natural plant succession was
allowed to take place.

Grid Descriptions

Because the two primary habitats (native grasslands and abandoned croplands) had been sub-
jected to livestock grazing and periodic burning and mowing until the 200 acres were enclosed by
construction of the west and north boundary fences in the spring of 1961, and because vegetation
in the two habitat types responded in the following years in different ways to the exclusion of
large herbivores, mowing and fire, a grid by grid description of the vegetation as it was in the ear-
ly 1960s and as it is at present seems in order. In the descriptions that follow various practices
that were employed to alter vegetation cover by discouraging woody species encroachment are
reported, whereas additions to the physical plant that may have affected the vegetation are
treated in greater detail in a later section of the paper.

Grids in Section 8, T18, R10 designated by the prefix A are described first followed by those
in Section 7, T18, R10 designated by the prefix B. Reference to figures 1 and 3 will supplement
the verbal description of each grid and enhance the reader’s appreciation of vegetation changes
that have occurred. Figure 1 is a 1959 aerial photo of the 200 acres and Figure 3 is a photo taken in
1977.

Grids A37 and A38

A major physical feature of these grids, and one that has a profound effect on vegetation in the
area, is the limestone outcrops that extend from southwest to northeast across the grids.
Topography is also influenced by the outcrops and the highest elevation is a ridge that extends
from SW to NE across the two grids with the surface sloping to the east and SE in A37 and to the
west and NW in A38. Predominant vegetation in the late 1950s was native tall grasses and forbs
with narrow bands of shrubs, primarily roughleaf dogwood (Cornus drummondi), smooth sumac
(Rhus glabra), and fragrant sumac (Rhus aromatica) growing below the rock outcrops. Scattered
clumps of American plum (Prunus ssp), and buckbush (Symphoricarpus orbiculatus) were found
throughout. American elm (Ulmus americana), green ash (Fraxinus pennsylvania) and hackberry
(Celtis occidentalis) were common along the creek bank in the NW corner of A38. Osage orange
(Maclura pomifera) hedge-rows bordered A38 on the west and the south half of the east side of
A37.
Fig. 4. Contrast in Reservation vegetation. Area left of fence was spring-burned and ungrazed; area on right was unburned and grazed.

By the spring of 1976, woody species had increased to the extent that there was virtually no open grassland in the two grids. The major invaders were dogwood, both smooth and fragrant sumac, plum and eastern red cedar (*Juniperus virginiana*). Most elms growing along the creek, and a few scattered throughout the grids had died, apparently from Dutch elm disease.

Grids A37 and A38 were excluded from the 1973 program to reduce woody vegetation and increase grasslands on the 200 acres. However, foot trails were cleared by mowing in the two grids each summer since 1975. Both grids have been moderately grazed by cattle during grazing seasons of 1975 and 1976; both were burned for the first time in at least 17 years on 19 April 1976.

As of this writing, woody species appear to have retained their vigor, except for some cedars of less than 10 feet in height that were eradicated by burning, and the area will probably continue to progress toward a woodland community.

**Grid A39**

Grid A39 is about evenly divided between abandoned cropland and native grassland; most of the grid north of the stream has been cultivated whereas south of the stream has not been cultivated. By the late 1950s the grid’s vegetation was mainly composed of smooth brome grass on the north side of the stream, a mixture of native grasses and forbs on the south side, and woody species of elm, cottonwood (*Populus deltoides*), boxelder (*Acer negundo*) and dogwood forming a narrow band along the stream. A few scattered, mature specimens of boxelder, osage orange, and mulberry (*Morus alba*) were growing in the northeast one-fourth along the abandoned road. The grid’s east boundary is the abandoned road and hedgerow shared with A38.
Drainage of the grid affects its vegetative cover. Land north of the stream drains to the south and southeast whereas that south of the stream drains to the north and northeast. Because of relatively level terrain and discharge from a spring in the southeast corner of the grid, soil in the area east and south of the stream in the northeast corner of the grid tends to have a high water content. Conditions for tree growth seem to be more favorable here than for any other area on the 200 acres. Also, the drainage below the spring supports a lush growth of sedges, rushes and watercress.

![Hay harvesting](image)

*Fig. 5. Hay is harvested as part of the Reservation grassland management plan.*

Little change in the vegetation occurred from the late 1950s to 1978 in that portion of A39 north of the stream. The predominant vegetation is still smooth brome grass, due in part to the sod-forming properties of brome grass which tends to discourage seed germination and growth of other plants, and in part to manipulation by Reservation personnel. Most of the grid north of the stream was inadvertently burned on 1 May 1967, an event that destroyed or severely retarded growth of some woody species that had become established. The area remained relatively undisturbed until July, 1974, at which time hay was cut, baled, and removed from the eastern two thirds; the practice was again employed in July, 1975, and again in early August each year thereafter.

The remaining southern one-third of A39 has been invaded by woody species to an extent that little native grass cover remains. A boxelder thicket has developed along the west side south of the stream; buckbrush, dogwood and smooth sumac are abundant in the remainder except for a small extension of the prairie community into the southwest corner of the grid. A report on manipulation of the prairie community appears under grid A42.

A fire that started along the south boundary of the Reservation on 20 July 1960 burned as far north as A39, but only a few square yards along the south boundary and west of the spring were subject to fire.

Vegetation, mostly watercress (*Nasturtium officinale*), has been removed from the spring in A39 at infrequent intervals in order to improve the aesthetic qualities of the site.
**Grid A40**

This grid is a native grassland site and as such has not been subjected to cultivation in the past. In the late 1950s the grid supported a healthy stand of native grasses and forbs. The only woody vegetation consisted of a few scattered trees and shrubs along the stream. By 1978, approximately the south half had become overgrown with woody vegetation and only isolated patches of open grassland remained; the north half was primarily grassland, the result of various methods designed to preserve its tall grass character.

As reported before, that portion of the grid north of the stream and north of the ravine that extends to the northwest into B33 was burned on 1 May 1967. No further manipulation occurred until the spring of 1975 when the same area was again burned on 16 April. Hay was cut, baled, and removed in July, 1975, or early August of each year since, except for a small area in the northeast corner. A severely eroded slope on the east side of the grid north of the stream has been partially stabilized by addition of brush cut from other areas.

At this time it appears that the northern portion of the grid can be maintained as a grassland with no manipulation other than periodic mowing and removal of the cut vegetation. That portion south and west of the stream will continue succession toward a woodland habitat.

**Grid A41**

Except for a few large trees (red cedar, honey locust and boxelder) associated with the site of a former dwelling along its southern boundary, grid A41 was an open native grassland tract in the late 1950s. The osage orange hedgerow which forms the common boundary between A41 and A55 to the south had recently been cut back and scars resulting from activities associated with the former dwelling were barely visible. There was virtually no remaining evidence of a road that formerly provided access to the county road, which forms the south boundary of the Reservation, and the still visible abandoned road along the east boundary of A39, 42, 55, and 58. The road was located on the north side of the hedgerow in A41 and A42 and connected the former Friends church in A42 with the parsonage in A41. No information is available on when these formerly occupied sites and the road were abandoned.

In 1959 a large pond was constructed in B48 and the pond dam was formed on a portion of the common boundary between A42 and B48. Following pond construction a variety of woody and herbaceous species was planted below the pond dam in A42. Woody species were cottonwood, red cedar, Russian olive, wild plum, Nanking cherry (*Prunus ssp.*) and western yellow pine (*Pinus ponderosa*). Sometime later, perhaps by 1962, weeping willow (*Salix babylonica*) cuttings were planted below the dam. Herbaceous species planted in or along the stream, listed in the order in which they were planted from west to east below the dam, were bulrush (*Scirpus acutus*), smartweed (*Polygonum lapathifolium*), burreed (*Spartanium sp.*), Sago pondweed (*Potamogeton pectinatus*), ducks meat (*Lemna sp.*), Wapato duck potato (*Sagittaria rigida*), and red head grass (*Potamogeton perfoliatus*).

Some woody species of these plantings survived and proliferated in subsequent years; some never became established or they survived for only a few years before dying out. No record exists of any of the herbaceous species having become established. A species of arum (*Peltandra virginica*) has become established a few meters below the base of the dam. There is no record of this species having been planted in the area. By the late 1970s dense stands of wild plum, Russian
olive, and dogwood exist on the east face and below the pond dam. A few cottonwood and weeping willows tower over the more shrubby species along the stream and apparently some red cedars survived on well drained sites. Nanking cherry can still be found in isolated clumps, but yellow pine did not survive. Smooth and fragrant sumac and hackberry are becoming well established on the east side of the dam.

Dominant vegetation in the remainder of the grid is composed of woody species; little open grassland remains except in the mowed nature trail and in a narrow strip along the east boundary, which is an extension from A42 of the managed prairie community. When the decision was made to preserve some grassland tracts on the Reservation that portion of A41 lying south of the nature trail was designated as one of the areas to be preserved in native grasses, an exception being that the large cedar trees associated with the former parsonage site where to remain.

To date, some manipulation of vegetation in the grid has occurred other than mowing the nature trail and maintaining the strip of prairie along the east side. During a student ‘work day’ in the spring of 1973 several honey locust and cedar trees up to three inches in diameter at the base were cut at ground level and removed from the southwest corner and the same area was rotary mowed in the spring of 1978. Also, several cedar seedlings growing under the branches of a large locust tree in the southwest corner of the grid were transplanted at sites on and off the Reservation. A 1970 count of the seedlings under one locust tree yielded 176 cedars, all approximately the same age. Competition among the seedlings and with the parent tree and its seedlings had markedly reduced the population by 1978.

A project of woody plant removal by cutting with a chain saw and rotary mower was begun in the fall of 1976 following some selective herbicide applications in the summer of 1976. Hopefully, within three or four years most of the grid will be restored to a native grassland. Exceptions will be areas on and below the pond dam, along the stream, the hedgerow and associated buckbrush cover along the south border, the bottom and sides of the ravine in the east third of the grid, and the large cedar trees in the old homesite.

**Grid A42**

By the late 1950s this grid was similar in many aspects to A41. It contained the remains of an abandoned dwelling (the old Friends church), an abandoned road and cut over hedgerow formed its south boundary, and most of the remainder was in native grasses. Large cedar trees were growing at the site of the former church, but unlike in A41, many mature green ash trees persisted in the church site. As in A41, a prominent limestone outcrop traverses the grid in a west to east direction. In addition, the east boundary of A42 supported a mature hedgerow east of the north-south abandoned road.

Except for a fire that burned across the west side of the grid in July, 1960, and establishment of the nature trail by 1960, little occurred in the area during the 1960s to disrupt the normal progress of plant succession toward a shrubby woodland. As noted before, the need for maintaining some tall grass prairie habitat on the Reservation was recognized so a project was implemented in the fall of 1971 to restore the prairie community characteristics of the west third of A42, that portion of A41 east of the ravine, the southwest corner of A39 and a small area in the southeast corner of A40. Large trees were cut and removed that fall and the tract was burned in April, 1972. Vegetation was mowed and hauled from the area during the summers of 1972 and 1973; by 1974
arrangements had been made with a local farmer to mow, bale and remove the vegetation from the prairie community. This has been done during July or early August from 1974 through 1978.

Between the prairie community on the west side and the abandoned road on the east most of the remainder of A42 is now a dense thicket of elm, ash, cedar, smooth and fragrant sumac, dogweed, wild plum and buckbrush, with lesser amounts of hackberry and boxelder. The only open areas are the nature trail, a foot trail along the south border, and a narrow strip of mostly tall grasses and forbs along the north border. Forbs and woody sprouts are occasionally removed from a clearing under the large cedar trees in order to have an open area in which student groups may gather for instruction or observation. A limestone table and benches were constructed at the site in the spring of 1977.

The prairie area will continue to be manipulated to discourage invasion by woody species, the nature and foot trails will be maintained, but the remaining portion of A42 will be allowed to undergo plant succession, except as the need may arise to alter the vegetation for research purposes.

**Grids A43 and A44**

Because of their similarity, grids A43 and 44 will be treated as one unit as were A37 and A39.

As of the late 1950s grids A43 and A44 were open grassland tracts. A few shrubs and small trees were growing below the limestone outcrops; scattered elm, walnut, and black locust (*Robinia pseudoacacia*) trees were established along the south boundary of A43; Osage orange hedgerows formed the west boundary of A43 and the south and east boundaries of A44; a strip of brome grass provided ground cover over approximately the east third of A44, but most of the two grids supported a stand of mixed native grasses and forbs.

Results of a decade of protection from grazing, mowing and burning, and the subsequent invasion and proliferation of woody species, was as conspicuous by the early 1970s in these grids as in other grids similarly protected. Dogwood, wild plum, cedar, the sumacs, and buckbrush were particularly successful in the open areas and black locust increased into the grassland from its original site along the south border. The only portion that remained relatively free of invasion by woody species was the brome grass area on the east side of A44.

The policy of restoring and maintaining grassland sites, adopted in 1973, included A43 and A44, therefore in the fall of 1973 hand cutting of the larger trees and mowing of brushy species was begun; trees along the borders were excluded from cutting as were most of the black locust in the southeast corner of A43. Brush cutting continued as time permitted throughout 1974 and the grids were burned on 11 April 1975. Herbicide, 2,4-5-T, was applied to woody sprouts in the late springs of 1975 and 1976 and moderate grazing by cattle occurred during grazing seasons of 1975 and 1976.

In order to maintain most of grids A43 and A44 as native grassland sites it will be necessary to periodically burn vegetation on the grids. It is highly improbable that cattle grazing alone will prevent a repetition of invasion by woody plants, and it is quite possible that overgrazing would reduce the grass cover and encourage shrub growth. Hay harvest from the grids would be nearly impossible, except in the east third of A44, because of exposed limestone ledges and other rocks scattered about.
A small pond was dug in the southwest corner of A44 during the fall of 1977 by the local Kansas National Guard unit.

**Grid A55**

Vegetation of A55 in the late 1950s was mostly smooth brome grass bordered on the north and south by Osage orange hedgerows, on the east by an abandoned road, and on the west by more brome grass in A56. As noted earlier, this abandoned field was last cultivated in 1948 and then seeded to brome grass and Korean lespedeza in the fall of that year. Except for a wildlife feed plot that was first planted in May, 1959, the subsequent abandonment of the feed plot and its conversion to a plant succession study area, and the establishing of a new feed patch immediately east of the original, little has been done to alter the vegetation in this grid since cattle grazing was terminated in 1961.

In keeping with accepted wildlife management practices, multiflora rose (*Rosa multiflora*) was planted in 1960 on the west, north and east sides of the original feed patch in the southwest corner of A55 and the southeast corner of A56 to provide cover and serve as a travel lane for wildlife; bicolor lespedeza (*Lespedeza bicolor*) seed was added to the north border plantings in the summer of 1961 and autumn olive (*Elaeagnus angustifolia*) and Amur maple (*Acer Ginnala*) seedlings were added a year later. All border plantings thrived and were well established by 1978.

By 1969 it was noted that repeated planting each summer of the original feed patch to grain sorghum had reached a point of diminishing returns, therefore, the area was converted to a plant succession study plot and another wildlife feed patch was created immediately east of the original. The second feed patch was maintained from 1970 through 1975 and then changed in 1976 to a native grass reseeding study plot.

The plant succession plot was divided into 10 units of approximately equal size and each unit was assigned a number from one through 10 with number one being the east unit and number 10 the west unit. Beginning with the spring of 1970, all units except number one were plowed and disked as a conventional cultivated field might be. This resulted in unit one undergoing the first year of plant succession during the growing season of 1970; in the spring of 1971 all units except numbers one and two were cultivated resulting in unit one being in the second year of succession during 1971 and unit two being in the first year of succession. This same plan will be followed with the remaining units through the summer of 1979 at which time unit one will be in the tenth year of succession. Future plans for the plant succession study area will be reviewed at that time.

The second feed patch in A55 was converted to a new use because of three factors. First, soil in the plot was low in fertility and increasing cost of sufficient fertilizer to help insure a crop was prohibitive; second, extensive early fall use by whitetail deer of grain that was produced resulted in little, if any, grain being available in winter as a supplementary food for birds and small mammals; and third, Mr. Leonard Jurgens, range management specialist for the Soil Conservation Service, had need for additional research space on which to carry out his native grass reseeding studies. Therefore, in the spring of 1976 the second feed patch plus a 50 foot wide strip along its north edge were converted to a grass research plot.

By 1978, some limited invasion of the grassy areas in A55 by woody species had occurred, but it has been minimal when compared to invasion in native grass tracts. Red cedar has been the principal woody invader and some isolated honey locust, green ash and fragrant sumac have ap-
peared. No plans for altering the grid’s vegetative cover exists at this time except for those associated with the plant succession and grass reseeding plots. Natural succession processes will probably result in native grasses and woody species slowly increasing in the grid but not as rapidly as in areas with more fertile soils.

**Grid A56**

Except for approximately two acres in the southwest corner, grid A56 had been subjected to land use practices prior to 1961 similar to those of A55. Most of the grid’s vegetation was smooth brome grass bordered on the north, west, and the east half of the south side by Osage orange hedgerows. Another hedgerow was growing along the north side of an area that formerly contained a barn, upright silo, and other structures associated with a farmstead in the southwest corner of the grid. The farm house was formerly located in the northwest corner of A57.

Since 1959, A56 has been the site of more human activity than any other grid on the Reservation. In May, 1959, a shelterbelt of approximately 1.5 acres was planted north of the farmstead and the first wildlife feed patch was established in the southeast corner and extended into A55. A portion of the southwest corner was soon to become a parking area because of its proximity to a small laboratory building that was constructed nearby in A57. Red cedar were planted north of the parking lot and Austrian pine (*Pinus nigra*) on the south of it in the spring of 1960. In 1961 a well was drilled, a pump was installed, and a pump house was built over the well and pump. In the summer of 1962 construction was begun on a large metal classroom-laboratory building, the parking lot was enlarged and gravelled, and the area was designated as the Reservation Headquarters. Soon several sheet metal “lizard pens” were constructed north of the classroom-lab building, and by the winter of 1967 another metal building and small storage shed had been moved from the University campus and erected in the headquarters area. Additional changes within the grid included installation of a septic tank and lateral field in 1966 and excavation of four small “fish behavior” ponds in the northwest portion of the grid during the summer of that year. In the fall of 1974 a 75 ft. x 90 ft. plot at the southeast corner of the shelterbelt was set aside for the study of three-awn grass (*Aristida oligantha*) control; one-half of the plot was burned in December, 1974, and herbicide was applied the following summer. A demonstration plot composed of eastern gama grass (*Tripsicum dactyloides*) ecotypes was established in the fall of 1977. Ornamental junipers were set out as foundation plantings around the classroom-lab building in the mid-1960s but the exact date is not known.

Routine mowing of the ground cover adjacent to buildings and parking areas, pruning of trees in the headquarters area when necessary, mowing of the nature trail and foot paths, and continuation of the plant succession, gama grass and three-awn grass projects will constitute the extent of vegetation manipulation in A56 for the foreseeable future. Vegetation in the remainder of the grid will continue to undergo succession and will probably experience an increase in native grasses and cedar trees similar to that noted for A55.

**Grid A57**

This grid was probably the most representative “old field” habitat type on the Reservation prior to state ownership of the area. Except for a small portion in the northwest corner on which the old homesite was located, the grid appears to have been intensively cultivated and, unlike most other formerly cultivated areas on the 200-acre, does not appear to have been seeded to
brome grass when farming ceased. It, like A56, has been subjected to considerable human activity and modification since the late 1950's.

The initial Reservation headquarters was established in the northwest corner of A57 where the farm house was formerly located. In the spring of 1960, red cedar, Scotch pine *(Pinus sylvestris)*, and western yellow pine *(Pinus ponderosa)* seedlings were planted west, east and south, respectively of a site on which a small, frame laboratory was constructed. A fire of unknown origin in July, 1960, destroyed the lab building, its contents, and many of the tree seedlings, but by August, 1960, a second lab building of metal construction had been erected on the site of the first lab. Young cedar and pine trees that escaped the fire have been exposed to a variety of environmental hazards, including dry weather and deer damage: to date only two pine trees have survived in the headquarters area.

Soon after the Reservation was acquired a road was established from the entrance gate in the southeast corner of the grid and extended north-westerly from the country road toward headquarters. Gravel was placed on the road in the early 1960s and again during the summer of 1978. Small cedar trees were transplanted in the spring of 1967 from A41 into a row along the east side of the south portion of the road; by 1978 many of the trees were 10 to 12 feet tall.

As early as 1960 a small experimental garden plot was established south of the north boundary and east of the roadway. For a few years the plot was used to propagate several varieties of cactus *(Opuntia ssp.)* and gayfeathers *(Liatris ssp.)* but the plantings did not thrive and the plot has been invaded and overgrown by smooth brome grass.

Most of the grid west of the road and south of the homesite was set aside as a plant succession study plot. For a few years in the early 1960s successional data were recorded from the plot, but interest in the study waned and no permanent record of successional changes was maintained. In the spring of 1973 the area was reserved as a research plot for Leonard Jurgens of the Soil Conservation Service.

![Fig. 6. Native grass revegetation study plot in grid A55.](image-url)
Mr. Jurgens initiated in the spring of 1973 a study designed to determine the feasibility of using herbicides in various concentrations to hasten the reestablishment of native grasses on abandoned cropland by reducing competition from weeds. The study has increased in scope since 1973 and an additional tract in the northeast corner of A57 was set aside for use in the spring of 1975.

Arrangements were made with the Soil Conservation Service to plant and maintain a native grasses demonstration plot in the southeast corner of the grid. The site was cultivated then planted to grain sorghum in 1963. Residue from the sorghum crop was not harvested but remained as ground cover, and in the spring of 1965 the area was marked off into units of approximately equal size. Native grass seeds of several different genera, species and varieties were obtained and planted with each unit of the plot being seeded to a single variety. Some varieties flourished, where as others did not become established. The plot was burned in mid April, 1974, and again in mid April 1976; grasses were first mowed, baled and removed for hay in early August, 1976. By 1978 considerable dilution of the pure stands had occurred as a result of seed dispersal from grasses in neighboring units and surrounding native grasslands.

Some woody vegetation was well established around the margins of A57 at the time the Reservation was founded. Mature Osage orange hedgerows formed the east half of the north boundary and the east boundary; a hedgerow that had been cut over just prior to 1959 formed the west boundary and scattered Osage orange were growing along the county road on the south side. Several large cedar and ash tree were growing at the home site in the northwest corner, and an extensive plum thicket was thriving in the southwest corner.

Except for periodic removal of trees growing along the south fence and pruning of trees for aesthetic purposes at the old home site, little alteration of woody vegetation around the margins of the grid has occurred. Red bud (Cercis canadensis) seedlings and multiflora rose were planted near the entrance gate to enhance appearance of the site, and mowing of foot trails has destroyed some woody growth along the west and south sides.

A shelter house was constructed in the early 1970s among the large trees in the northwest corner of the grid. It represents the combined efforts of the University Physical Plant personnel and some faculty and students of the Division of Biological Sciences.

Grid A58

In the late 1950s vegetation of grid A58 was composed of native grasses and forbs bordered on the west and north by hedgerows, on the east by an abandoned road along which many trees native to the area were growing, and on the south by a fence and the county road. The most plausible reason for this grid remaining in native grasses and not being cultivated in the past appears in the form of a limestone outcrop extending from the middle of the south boundary northeasterly across the grid. A rather prominent ravine begins in the center and drains toward the south and east. The few trees not associated with border vegetation were growing along the ravine, and a spring of intermittent flow was near the head of the ravine.

A58 was protected from grazing, mowing and burning from 1961 through 1970 and by 1971 the predominant vegetation was no longer native grasses and forbs. Dogwood, the sumacs, wild plum, cedar, elm and honey locust had invaded open grassland areas and green ash and walnut had proliferated along the east boundary and the ravine.
In the spring of 1971 a project designed to return part of the grid to native grasses was initiated. The west half of the grid was divided from west to east into six tracts each 55 feet in width. The west tract [No. 1] adjacent to the boundary hedgerow was to remain unaltered, the next tract to the east [No. 2] was to be maintained in native grasses by being mowed once each year in mid-summer and the cut vegetation was to be removed, No. 3 was to remain unaltered, No. 4 was to be burned once each year between 15 April and 1 May, in order to discourage growth of woody species and encourage native grasses, No. 5 was to remain unaltered, and No. 6 was to be managed by periodically spraying woody species with an appropriate herbicide in order to reduce their competition with native grasses.

On 1 May 1971 boy scouts from the Sojadi district, as a part of their wildlife conservation activities, cleared by hand the existing woody vegetation from strips 2, 4, and 6. They also assisted in burning strip No. 4. Herbicide was applied to woody species in No. 6 in early June and No. 2 was mowed in mid-July.

Prescribed manipulation of vegetation in the three strips proceeded as planned during 1972, but by 1973 problems had arisen. Due to unusually heavy rains and wet vegetation in the spring of 1973, strip No. 4 was not burned, however strip No. 2 was mowed in mid-summer and some herbicide was applied in No. 6. In the spring of 1974 an attempt to burn No. 4 with a deficiency of equipment and manpower resulted in the entire grid and portions of A57 being burned. At that time the project was abandoned and a decision was made to rely on mowing and removal of cut vegetation as the single method for preserving some grassland in the grid. Because of a lack of adequate machinery to carry out the practice, arrangements were made with a local resident to cut, bale, and remove vegetation from the three strips and a portion of the northeast corner of the grid in July 1974. The strips were neither burned nor mowed in 1975, but the entire grid was burned by unknown persons in early May, 1976. Hay was again harvested from the strips in early August of 1976, 1977, and 1978.

Woody vegetation in the unaltered strips provides a striking contrast with that in strips 2, 4, and 6. In addition to demonstrating some of the practices that can be used to preserve grassland tracts in this area, the presence of alternating strips of grassland and woods enhance the area for wildlife by increasing habitat diversity and the "edge effect."

Vegetation in the east half of A58 remained relatively unaltered from 1961 through the summer of 1975 except for the ground litter being burned in the springs of 1974 and 1976. The burns had no visible adverse effects on established trees and larger shrubby species.

In the fall of 1975 arrangements were made with the local Kansas National Guard unit, the 169th Engineer Battalion, to construct a small pond in A58. The pond was constructed as a training exercise for the unit, without charge to the University, across the ravine that drains most of the grid, to impound water for wildlife and to provide an additional body of water on the Reservation for limnological studies. Except for brief periods in the spring of 1976 and the summer of 1977, the pond has been dry.

Ash and black walnut trees are abundant below the pond dam, along the east border, and particularly in the southeast corner of the grid. This area should, if left undisturbed, develop into one of the major woodland habitat sites on the Reservation.

Grids designated by the prefix B are located in Section 7; T18; R10, and the following grid descriptions are presented in numerical order.
Grids B33 and B34

Because of similar physical and biological characteristics and past history these grids are described as a single unit as were grids A37 and A38, and A43 and A44. Both are native grassland tracts, except for a strip approximately 50 feet wide on the west side of B34 that had been cultivated at one time, and escaped being cultivated because of shallow and outcropping limestone deposits. Grid B33 has two features not found in B34. A small shallow pond has been constructed along the north boundary sometime in the past; the date is unknown. Also, the spillway of the large pond in B48 extends across the southeast corner.

When the north boundary fence of the 200 acres was built it was offset so as to run along the south side of the pond and thereby exclude the pond from the state-owned part of the Reservation. This was done in order to make water available to cattle grazing on the non-state owned portion. The small pond in no longer needed for this purpose and the boundary fence was recently straightened and now runs along the north side of the pond. Also the pond’s depth was increased during the summer of 1978 by bulldozing out accumulated bottom sediments.

Vegetation in the two grids remained relatively undisturbed from 1961 to the fall of 1969. During this period wild plum, dogwood and smooth sumac had become well established at several sites and were spreading rapidly especially below rock outcrops in the southeast and northeast corners of B33 and in the southwest corner of B34. In the fall of 1969 a large rotary mower was used to cut over the most dense clumps of woody vegetation, and in the fall of 1970 all areas in the grids accessible to the mower were cut over in order to retard invasion of woody species. Some selective cutting of brushy patches continued in the fall and winter of 1972 and again in 1973. It was noted that mowing was effective in slowing the expansion of smooth sumac, but ineffective with dogwood, wild plum and fragrant sumac. Also, cedar seedlings were eradicated after being cut off one time.

Construction of a four-strand barb wire fence along the south boundary of the two grids and along the east boundary of B33 was begun in 1974 and completed in the summer of 1975. By the spring of 1975 it had become obvious that mowing alone was not an adequate brush control measure; too much area was inaccessible to the mower. Therefore, on 11 April 1975 the two grids, except a strip along the east side of B33, were burned for the first time in at least 16 years. A lush grass cover developed during the late spring and early summer, and hay was selectively cut, baled and removed in July. Tracts along rock outcrops and where woody vegetation was abundant were not cut. Both grids were again burned on 19 April 1976 and hay was cut, baled and removed in late July or early August of 1976 through 1978 from portions of the two grids that were accessible.

Light grazing of the grids by two horses occurred during the summers of 1975 and 1976 and two steers, averaging about 600 pounds each, grazed the grids in the summers of 1977 and 1978. The horses were used for transportation in conjunction with coyote and rabbit studies on the Reservation and surrounding areas.

B33 and B44 will be maintained in the future as grassland sites with mowing and hay removal as the primary manipulation methods. Because the grids are separated by a fence from the remainder of the 200 acres, studies involving grazing by cattle or other large herbivores could be initiated now that the north boundary fence has been relocated to run along the north side of the small pond and thus provide a source of drinking water.
**Grid B47**

Except for a narrow strip of former cropland along the west boundary, this grid was primarily native grassland in the late 1950s. Two ravines, one paralleling the north boundary and the other extending from southwest to northeast across the grid, drain considerable areas to the west of the 200 acres and discharge into the large pond in B48. Shallow and exposed rock deposits plus the drainage pattern have no doubt prevented the area from being cultivated in the past.

Vegetation in the grid remained virtually undisturbed from 1961 through the early spring of 1967. In April, 1967, the west five acres of the grid were burned as part of a study designed to determine survival rates of small animals in areas that had been burned. Most of the grid was burned on 19 April 1976 as a result of a fire escaping from persons burning the grasslands west of the state-owned Reservation.

![Image](image.png)

**Fig. 7.** A member of the Reservation herpetofauna, *Crotaphytus collaris*, the eastern collared lizard.

Marked changes have occurred in the grid's vegetation during the 17 years that have passed since it was last grazed. In 1961 woody vegetation consisted of not more than four or five trees growing along ravines in the grid; by 1978 approximately one third of the grid was covered by dogwood, wild plum, the sumacs, Osage orange, and buckbrush. The 1976 fire destroyed some above-ground parts of low-growing shrubs, but most sent out new growth before the end of the growing season. No plans exist at present for additional manipulation of vegetation in B47. The normal progression of plant succession should result in further reduction of native grasses and an increase in woody species.

**Grid B48**

B48 has been subjected to considerable alteration since the late 1950s. Soon after access to the Reservation area was granted by Mr. Ross, and before the 200 acres were deeded to the State, a large pond (Gladfelter Pond) was constructed in the northeast portion of the grid. The dam was
completed in 1959 and impounded approximately 2.5 surface acres of water. Numerous trees and shrubs were planted in 1959 around the periphery of the pond, and the pond dam and spillway were seeded to Bermuda grass \( \textit{Cynodon dactylon} \). On the west side of the pond a windbreak composed of cedar, pine, Russian olive, wild plum and multiflora rose has thrived; black willow \( \textit{Salix nigra} \) has become established along part of the west shoreline; cedar, wild plum and multiflora rose plantings south of the pond have grown; cottonwood has sprung up on the dam near the shoreline; but there is no evidence that Bermuda grass ever became established. At present the top of the pond dam is covered by smooth brome grass, and the spillway vegetation is mostly switch grass \( \textit{Panicum virgatum} \) and some Reed canary grass \( \textit{Phalaris arundinacea} \). Cattail \( \textit{Typha latifolia} \) and a variety of sedges and rushes are growing in the shallow upper arms of the pond and recently pondweed \( \textit{Pontamogeton ssp.} \) and \textit{Chara} have proliferated in the water.

For a period of several years following completion of the pond and planting of woody vegetation around its periphery, no additional disturbance or manipulation on land or in the water occurred in B48. The pond was set aside for limnological studies and was allowed to undergo natural succession while several students studied the process. In 1967 the policy concerning activities at Gladfelter pond was changed, and in the fall of that year bluegill \( \textit{Lepomis macrochirus} \), largemouth bass \( \textit{Micropterus salmoides} \), and channel catfish \( \textit{Ictalurus punctatus} \) fingerlings were obtained from the Kansas Fish and Game Commission and placed in the pond. Also during the same year, mallard ducks \( \textit{Anas platyrhynchos} \) were placed on the pond as part of a duck nesting study. The fishes grew and were harvested for a variety of purposes over the following years; ducks left over after the study were killed by predators and poached until none remained; and students continued with limnological studies. The pond was again stocked with bluegill and channel catfish fingerlings in the fall of 1975 and largemouth bass fingerlings were added in August, 1976. A captive Canda goose flock was established on the pond in April, 1978.

Alteration of terrestrial vegetation in the grid has been minimal. Cottonwood trees have been cut and removed at intervals from the pond dam, an unintentional fire burned into the grid from the west in the spring of 1976, and some vegetation on the north side of the pond was burned when grid B33 to the north was fired in 1976. A footpath entering the grid from southwest of the pond has been mowed at irregular intervals. A strip along the west border was mowed in September, 1976, in order to disrupt a dense grass-brush ground cover and to increase habitat diversity.

Trees and shrubs continue to increase in size and ground cover along ravines draining into the pond and in the southeast corner of the grid. Within a few years B48 will consist of a body of water surrounded on the east, south and west by woodland plus a small tract of open grassland along the west border if it is maintained by periodic mowing.

\textbf{Grid B49}

B49 is approximately three-fourths abandoned cropland and one-fourth native grassland. It has undergone little change since 1961; the south three-fourths was seeded to smooth brome grass nearly 30 years ago and this remains as the dominant vegetative cover; the north one-fourth was native grassland and, except for some invasion by woody species, remains much the same in 1978.

Rather prominent features of the grid are the two terraces constructed along the slope that drains away from the high point in the southeast corner. Information is lacking as to the age of
the terraces, but because there has been little erosion from their slopes it is assumed they were constructed just prior to the area being seeded to grass around 1948.

Because of its proximity to the Reservation headquarters, B49 has been subjected to considerable human activity. The original Reservation weather station was set up in the southeast corner, and it remains there in 1978. A road was established in the late 1950s between the headquarters area and Gladfelter pond, and it paralleled on the west side the hedgerow that forms the east boundary of the grid. Use of the road was later restricted because of excessive water erosion along its course, and it was closed to vehicle traffic in the mid 1970s. An observation tower, to which a radio-telemetry receiving antenna was attached, was erected in the southeast corner of the grid in 1973.

Vegetation has remained virtually unaltered since 1961. The south three-fourths was burned in February, 1974, following a year of excessive precipitation and vegetation growth in 1973. Hay was cut and baled on the burned area in July, 1974, and on the north slope only in 1975. Because of low yield, hay will probably not be harvested from the grid again in the near future.

Invasion of the former cropland portion of the grid by woody species has been minimal due in part to poor soil in the area and in part to the difficulty woody species encounter in becoming established in the brome grass sod. Maintaining the area as a cool season grass habitat type can be readily accomplished by occasional mowing and without resorting to fire or herbicides.

The north one-fourth of the grid will undergo succession and invasion of woody species will occur accompanied by diminishing native grass cover.
Grid B50

This grid is similar to B49 in many respects. It too is about three-fourths former cropland and one-fourth native grassland, but it lacks the terraces that are present in B49. The primary ground cover of the southern portion was smooth brome grass and the northern one-fourth was native grassland in the early 1960s. Except for the south one-fourth that was incorporated into a revegetation study, little change has occurred in the grid's vegetation beyond some increase in a woody species on the north one-fourth. Changes brought about as a result of the revegetation study will be referred to in the description of B63.

Grid B63

B63 shows the effects of extensive cultivation over a considerable period of time. Drainage on the grid is from a high point in the northwest corner toward the east and south. Two short, severely eroded terraces extend across the northwest corner and topsoil between and immediately below the terraces is virtually non-existent. Woody vegetation is restricted to a small area in the southwest corner plus one mature green ash tree growing along the east border.

In the spring of 1962 this grid and the south one-fourth of B50 were selected as the site for a cooperative revegetation study to be conducted by personnel from the U.S. Soil Conservation Service and the Biology Department. The tract was divided from west to east into seven study plots with each plot to receive the following treatment:

1. Native grasses seeded into a grain sorghum cover crop
2. Native grasses seeded into forage sorghum cover crop
3. Native grasses seeded into sudangrass cover crop
4. Native grasses seeded into the existing vegetation
5. Native grasses seeded into lightly disced soil
6. Native grasses seeded by the range interseeding method
7. Control plot

Fig. 9. A graduate student photographing lizard behavior.
Plots 1, 2, and 3 were cultivated and seeded to their respective cover crops in 1962 and a seed mixture composed of native grasses and a legume was planted in all plots, except the control, in the spring of 1963.

The mixture contained seeds of the following species: big bluestem (*Andropogon gerardii*), little bluestem (*A. scoparius*), switch grass (*Panicum virgatum*), Indian grass (*Sorghastrum nutans*), side oats grama (*Bouteloua curtipendula*), blue grama (*B. gracilis*), buffalo grass (*Buchloe dactyloides*), western wheatgrass (*Agropyron smithii*), and Illinois bundleflower (*Desmanthus illinoensis*).

Success of the various treatments and species was studied by faculty members and students for several years. Results were recorded and reported by Ahshapanek (personal communication).

Following termination of the study, the tract was burned in April, 1974, in order to recycle nutrients tied up in ground litter and to control seedlings of woody species. Hay was cut, baled, and removed from the area in the summers of 1974 through 1978.

Grid B63 will be maintained as a reseeded native grass habitat type. Mowing and removal of cut vegetation will be employed to maintain the grass cover and to discourage invasion by woody species.

**Grid B64**

B64 is another abandoned cropland grid. Considerable evidence of past abuse remains under the grass cover. The two terraces from B49 extend into the north side of the grid and drain runoff water toward the east into an abandoned road that parallels on the west a hedgerow that forms the boundary between B64 and A57. South of the terraces are remains of several shallow gullies that are now stabilized by grasses and forbs. The northern portion of the grid supports a grass cover composed primarily of tall dropseed (*Sporobolus asper*), whereas smooth brome grass predominates in the southern half except for a small area in the southwest corner that retains cover of native grasses and woody vegetation. Vegetation of the small area indicates that the corner has not been cultivated, due, no doubt, to the presence of a ravine that drains portions of B63 and B64.

Little disturbance occurred in the grid between 1961 and 1973. When the decision was made in 1973 to manipulate vegetation in certain grids in order to preserve some grassland areas, B64 and most of B49 were designated as sites on which to preserve the primary, non-native, cool season grass habitat type. Hay was baled and removed from open areas of the grid in July, 1974, and from the southern half in 1975. The small area in the southwest corner was excluded from the haying operation.

Hay was not harvested during the 1976-78 period because accumulating effects of below normal precipitation for three successive growing seasons had resulted in little grass growth.

Vegetation in B64 and the southern three-fourths of B49 will be manipulated in the future in order to retain the cool season grass cover. Some revision of the practice may become necessary if tall dropseed continues to increase.
PHYSICAL FACILITIES AND IMPROVEMENTS

Certain physical improvements that have been made on the Reservation have already been mentioned. However, a more detailed description of improvements and physical facilities in chronological order by type seems warranted.

Fences

Although a temporary, single strand electric fence was erected around the headquarters areas in 1959 in order to exclude grazing animals, it was not until the 200 acres were deeded to the University in 1961 that a fence was constructed to partition state-owned from the non-state-owned portion of the Reservation. A five-strand barb wire fence built along the west boundaries of grids B63, B50, B47, B34 and along the north boundaries of B34, B33, A40, A39, A38 and A37 separated the two portions and made possible exclusion of grazing animals from the 200 acres. A metal gate was installed in the northwest corner of B34 to allow access to the surrounding area, and in later years wooden stiles were placed over the boundary fence in grids B50, B34, A39 and A37 for the same purpose. By 1976 all stiles had been dismantled and removed because of advanced decomposition and absence of a need for them.

Fences along the east and south boundaries of the 200 acres were in existence in 1961. They have been subjected to extensive repair and replacement of wire and posts over the years.

In the summer of 1974 a four-strand barb wire fence was built along the east and south borders of grid B33 and the south border of B34. The fence was constructed so that studies of the effects of grazing on native grassland could be conducted in the future.

Buildings

As noted earlier, the first building constructed by University personnel on the Reservation was a small, frame laboratory located in the northwest corner of A57. Following destruction of the lab by fire in July, 1960, a replacement structure made of corrugated metal was constructed at the same site in August 1960. The metal building, in excellent condition in 1978, is now used for storage of Reservation equipment.

Two corrugated metal outhouses (toilets) were built in the headquarters area as sanitary facilities. They were no longer needed and have been dismantled.

Construction was begun in the summer of 1962 on a large classroom-laboratory building (Fig. 10) located in the southwest quadrant of grid A56. The "Butler-type" metal building, 96 ft. long by 38 ft. wide, was erected over a poured concrete slab. Ceiling and sidewalls were insulated with fiberglass. The internal space was divided by eight foot high partitions into the following:

1. a 32' x 38' classroom
2. a 30' x 18' classroom
3. four 10' x 10' research labs
4. two 4' x 10' restrooms
5. a 14' x 18' garage
6. a 10' x 8' utility area
7. a 32' x 4' north-south hallway
8. a 52' x 4' east-west hallway

Utilities consist of electricity, water from a drilled well, plumbing connected to a septic tank and lateral field, and heating provided by two forced air, overhead, propane heaters.
Fig. 10. The Reservation classroom-laboratory building constructed in 1963.

Early in 1968 a 36 ft. by 24 ft. metal building, formerly in use as an animal house on the University campus, was moved to the Reservation and reassembled on a concrete slab. It is currently being used as a workshop and for storage.

A small, corrugated metal building adjacent to the animal house was also relocated on the Reservation and is used for tool storage.

Shelterhouse

A shelterhouse, begun in 1972 and completed in 1973, was constructed on a poured concrete slab at the site of the former farm house in A57. The structure measures approximately 30 ft. x 18 ft. and serves as a gathering point for tour groups and social events held on the Reservation. It was built by the cooperative efforts of University Physical Plant personnel and biology faculty members and students.

Well

In order to provide a potable and reliable supply of water a well was drilled in the southwest quadrant of A56 in June, 1961. Water-bearing shale was encountered at a depth of 63 feet and provided water at the rate of 20 gallons per minute. The well was cased with 64 feet of six inch diameter iron casing, a double impeller pump and pressure tank were installed, and a pump house was constructed over the well and pump. Water was piped into the classroom-lab and maintenance building.

Ponds

Except for the small, shallow pond in grid B33 and outflow from springs in A42 and B48, the supply of surface water on the Reservation was intermittent and confined to ravines and the small creek. The need for larger and more dependable water sources was soon recognized, therefore, in 1958 arrangements were made for construction of a large pond in grid B48. By late
June, 1959, a pond impounding approximately 2.5 surface acres of water had been completed and was full as a result of plentiful rain and runoff. The impoundment (Figs. 11 and 12) became known as Gladfelter Pond in recognition of the role Mr. C. F. Gladfelter had played in obtaining access for the Biology Department to the Reservation. Gladfelter Pond serves a valuable role by providing much needed aquatic habitat and a site for aquatic studies.

In the mid-1960s four small ponds were excavated in the northwest corner of A56. They were established to provide aquatic communities in which observations of fish and amphibian behavior could be made. Because of difficulty in maintaining proper water levels and subsequent invasion by cattails, the ponds have been abandoned for behavior studies.

In the fall of 1975 arrangements were made with the 169th Engineer Company, Kansas National Guard, to construct a pond in grid A58. The project was undertaken as a training exercise for the unit and resulted in an increase in aquatic habitat on the Reservation. Although the pond is small (<1 surface acre), it will provide an additional source of water for wildlife and serve as an outdoor laboratory for aquatic biology.

A small pond was constructed by the National Guard unit in grid A44 during the fall of 1977. It is similar in size to the A58 pond but differs in being an excavated depression without a dam. Its functions will be similar to those of the A58 pond.

**Signs**

Signs varying in size and function have been placed at appropriate locations on the Reservation. They have been used to designate the Reservation boundary (Fig. 13), entrance (Fig. 14), study areas (Fig. 15), nature trail (Fig. 16), and major communities.
Fig. 12. Gladfelter Pond, looking south from spillway.

Fig. 13. Reservation Boundary Sign.
COOPERATIVE
REVEGETATION STUDY AREA

UNITED STATES SOIL CONSERVATION
SERVICE AND BIOLOGY DEPARTMENT
KANSAS STATE TEACHERS COLLEGE

This is an experimental study to determine the most
proper method of revegetating abandoned cropland,
USING NATIVE GRASSES UNDER CULTIVATION. FOR
WHICH IT IS NO LONGER SUITABLE, AND PROPERLY CAN
BE SEEDED AND CULTIVATED PROFITABLY.

FOR SEEDING A MIXTURE OF NATIVE GRASSES INTO SIX
OF THE SEVEN 100FT. X 100FT. STUDY PLOTS USING
DIFFERENT SEEDING TECHNIQUES IN EACH PLOT. WE HOPE
TO DETERMINE THE MOST FEASIBLE METHOD OF RESTORING
THE RETURN TO PRODUCIVE GRASSLAND.

PLOT
1. NATIVE GRASSES SEEDED INTO GRAIN SORGHUM COVER CROP
2. NATIVE GRASSES SEEDED INTO FORAGE SORGHUM COVER CROP
3. NATIVE GRASSES SEEDED INTO SODGRASS COVER CROP
4. NATIVE GRASSES SEEDED INTO EXISTING VEGETATION
5. NATIVE GRASSES SEEDED INTO LIGHTLY BISCUCK SOIL
6. NATIVE GRASSES SEEDED BY RANGE INTER-SEEDING METHOD
7. CONTROL PLOT - NO SEEDING ON CULTIVATION

NATIVE GRASSES
BIG BLUESTEM, LITTLE BLUESTEM, INDIAN GRASS,
SOUTHCENTRAL, STEELE'S GRAMA, BLUE GRAMA, BUFFALOGRASS,
MOROCCO WHEATGRASS ALSO SEEDED ILLINOIS BURRO GRASS

Fig. 15. Cooperative Revegetation Study Area.
Fig. 16. Sign at beginning of the Nature Trail in Grid A56.

Pens

Pens of various sizes and functions have been built in the headquarters area. In the mid-1960s, 14 "lizard" pens varying in size from 24 ft. by 24 ft. to 4 ft. by 8 ft. were constructed north of the classroom-lab building in A56. Their initial function was to confine lizards being used by Dr. Robert Clarke and his students in studies of lizard behavior. They have also been used in studies of a variety of birds and mammals.

A large, mobile, wood-frame cage covered with hardware cloth was originally built to house Harris sparrows being studied by Dale Greiner. Of late, the cage has been used as a holding pen for prairie chickens trapped by personnel of the Kansas Fish and Game Commission and for ducks used in physiology studies on campus.

Towers

An aluminum frame observation tower approximately 40 feet in height was erected in the southeast corner of grid A56 in the early 1960s. It was disassembled in 1973 and with additional frame materials was used to construct two towers, one in grid B49 and the other in A40, for supporting radio-telemetry receiving antennas [Fig. 17].

Nature Trail

By the spring of 1961 a nature trail had been established on the Reservation. The trail, approximately one mile in length, was laid out in such a way that it passed through or near the eight
Fig. 17. Observation tower with radiotelemetry antenna in grid B49.

major types of biotic communities. The communities were: hedgerow-field edge, tall grass, spring-marsh, shrub, woodland, stream-wash, prairie creek and pond.

The nature trail route has been modified somewhat over the years and is now restricted to the state-owned, 200 acres. It begins in grid A56 and extends northeast through the old field community, through the hedgerow into the prairie community and by the wooded, old church site in A42, across the abandoned road and into A43, northward through the shrub community in A43 and A38, across the prairie creek, back south along the abandoned road to the spring in A39, toward the northwest in A39, then passes to the south side of Gladfelter Pond, and returns along the west side of A56 to the point of beginning.

Signs (Figs. 18, 19 and 20) along the route designate the various communities.
Fig. 18. Prairie Community sign located on grid A42.

Fig. 19. Plant Succession Plot sign in grid A56.

Fig. 20. Signs designating characterization of substance in Plant Succession Plot, grid A56.
A common member of the Reservation mammal fauna, *Canis latrans*, the coyote.
A saw-whet owl that spent from mid-December, 1975 through mid-March, 1976, on Ross Reservation. Saw-whet owls usually winter north of Kansas.
EDUCATIONAL PROGRAMS

A major function of the Ross Natural History Reservation is to provide space and facilities for implementation of educational programs in the sciences. Because of its physical and biological characteristics the Reservation is best adapted for education in the biological sciences, however, it is by no means restricted to these disciplines. Opportunities for education in astronomy, geology, meteorology, hydrology and soil chemistry are numerous. The area has had a rich and varied history since settlement by European man and should be an interesting study subject for historians.

Past and present educational activities are of three basic types: 1. those involving regularly enrolled students at Emporia State University; 2. those designed especially for summer session programs; and 3. those set up and maintained for visiting groups.

Educational activities for regularly enrolled college students include classes that are conducted at the Reservation, scheduled field trips to the area, and independent study projects carried out at the Reservation. Some biology classes such as Mammalogy and Community Ecology are scheduled and meet at the Reservation; others that are scheduled there occasionally are Wildlife Management, Entomology and Animal Behavior. Most other field-oriented biology courses take field trips to or have field exercises on the area. Both undergraduate and graduate students carry out independent studies in aquatic and terrestrial communities.

From the mid-1960s to the early 1970s, a period when the National Science Foundation funded many summer science institutes for inservice teachers and high school and college students, the Reservation was the instruction site for several of these programs that were ecologically oriented. Access to a variety of natural communities on or near the Reservation made the area extremely valuable for instruction in the environmental sciences.

One of the earliest educational endeavors at the Reservation was the establishment of a nature trail along which tours could be conducted through a variety of natural communities. Invitations to participate in guided tours were sent to elementary and secondary schools in Lyon and contiguous counties during the spring of most years in the 1960s. Records show that response to invitations varied from year to year with spring weather conditions being the major factor determining the number of groups visiting the Reservation. After a rather slow start in the early 1960s, the tour program gained momentum to the extent that 500 to 600 students and teachers were taking spring tours by 1970.

In 1970 the program was modified somewhat. Because of increasing numbers of groups requesting spring tours and inadequate personnel at the Reservation to provide meaningful educational tour experiences for the increasing numbers, a decision was made to cease issuing tour invitations in hope that enough teachers were aware of the service to maintain the programs at a sustained but not increasing level. Also, an attempt was made to encourage some groups to take tours in the fall of the year and thereby disperse them over a greater period of time.

The change accomplished the desired results. In fact, through October, 1976, over 700 students and teachers had taken spring, summer or fall tours in 1976 and it was the consensus of persons conducting tours that a professional job had been done, yet not at the expense of other Reservation activities.

Tours are not limited to groups from Lyon and contiguous counties, although, because of their proximity, most groups are from the area. High school classes and science clubs from as far
away as Shawnee Mission, Lawrence, Topeka, Hutchinson, Haysville, and even Minneola in southwest Kansas have toured the Reservation, and a group from Mulvane has visited the area every summer for over five years.

A few groups have camped out overnight at the Reservation before or following tours. This type of activity is encouraged, but group sponsors are informed of the lack of tents and other special camping facilities and limitations placed on unsupervised movement within the area.

Groups other than those from elementary and secondary schools and colleges visit the Reservation. They include boy and girl scouts, garden clubs, church groups, those interested in bird watching and nature photography, Soil Conservation Service personnel, and physically and mentally handicapped individuals. The 1976 spring meeting of the Kansas-Oklahoma chapter of The Society of Range Management scheduled a tour of Leonard Jurgen’s research area on the Reservation, and the Kansas Association of Biology Teachers has met there in the past.

![Fig. 21. Boy Scouts of the Sojadi District camp out at the Reservation.](image)

Some activities indirectly related to education have occurred at the Reservation. A college fraternity has used the classroom-lab building for a weekend retreat; numerous ‘work days’ have been sponsored by the Biology Club and the Beta Beta Beta chapter during which much physical effort was expended on improvement projects; social events involving the biology faculty and students have been held there; and visiting groups from other colleges have used the facilities for overnight lodging. Two weddings involving University students have occurred on the area.

A valuable asset to the Reservation education program was added in 1976. Mr. H. A. (Steve) Stephens, retired field botanist from the University of Kansas, was granted permission to reside at the Reservation. In addition to providing visiting groups and university students with an enormous reservoir of natural history information, Mr. Stephens has made available to selected
biology students certain funds for furthering their research activities on the Reservation. Also, his presence provides an element of round-the-clock security heretofore lacking.

Although the educational potential of the Reservation is not currently being realized it is hoped that increased involvement in the future by biology and other University faculty members will result in more complete development and utilization of the faculty for education and research.

**Fig. 22. Recording weather conditions as part of an ecological study.**

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**RESERVATION RESEARCH**

Research at Ross Natural History Reservation has varied in intensity and coverage with time and with the interests of biology faculty members and students. Most components of the Reservation flora and fauna have been studied to some degree, but the research potential of no single element has been exhausted, by any means. The most serious fault with the Reservation research program has been the failure to adequately record both qualitative and quantitative changes in the vegetation that have occurred since the early 1960s; much of the study of animal populations is less meaningful, and therefore more difficult to interpret, because of the absence of adequate botanical data. However, in spite of these deficiencies, a great deal of important research has been undertaken on the Reservation and in the immediate vicinity.

Research activities have been of four basic types:

1. *long-range studies*, supervised by a faculty member and assisted by students, of a particular community or element of the flora or fauna.
2. *graduate student research*, usually of one or two years duration, that culminates in a research problem paper or a masters thesis.
3. *graduate and undergraduate research projects*, usually of one semester or academic year duration, for which the student receives one to three hours credit toward the masters or bachelors degree.
4. *class field studies*, undertaken by members of a given class while learning investigative methods or the characteristics of a community, habitat type, or life history.
There are several long-range studies in progress as follows:

1. Limnology of Gladfeather Pond - immediately following water impoundment in the pond a study of its physical, chemical and biological characteristics was initiated (Griffith, 1961). A series of studies, supervised by Drs. Carl Prophet and John Ransom followed, and two new studies were initiated in 1976.

2. Small Mammal Survey - two small mammal survey transect lines were established in 1961 along which specimens were trapped three times, and more recently two times, per year in order to determine species present, and their relative abundance, in a variety of habitats (Greiner, 1965). Line A, consisting of 11 stations at 50m intervals, begins in grid A42 and extends into A43. Line B, consisting of 32 stations at 50m intervals, begins at the southwest corner of grid B63 and extends north one mile to the county road north of the Reservation (Appendix A). Line A is essentially a woodland line, whereas, Line B is mostly grassland.

3. Field Observations - in the late 1960s a procedure was established for making and recording field observations on the Reservation (Appendix B). At weekly intervals the reservation naturalist traverses the Reservation along a fixed route and records pertinent field data. Quality of the data has varied with the competency and conscientiousness of naturalists.

4. Meteorological Conditions - since establishment of a weather station in 1960, certain meteorological data have been recorded on a more or less continuous basis. Weather conditions for which recording instruments are not available are temperature, barometric pressure, relative humidity, precipitation, and wind velocity. Malfunctioning instruments at various times have prevented compilation of a continuous record of these meteorological conditions.

5. Plant Succession Study - the plant succession plot established in 1970 in grids A55 and 56 has been studied intermittently by students enrolled in Community Ecology and in biology projects. At the end of a ten-year period, at which time successional stages of from one to 10 years of age will be present, data from the plot will be particularly valuable.

6. Revegetation Studies - the grass revegetation project initiated in grid B63, and more recently Leonard Jurgens' studies of native grass revegetation affected with the aid of herbicides, have provided research experiences for both graduate and undergraduate students.

The following list is composed of literature citations of faculty and student research conducted entirely, or for the most part, on Ross Natural History Reservation or in the immediate vicinity of the Reservation. Also included are citations of student research currently in progress.

**Botanical Research**


In progress (1976-78)
Jurgens, Leonard. Effects of herbicides on reestablishing native grasses on abandoned cropland.

Invertebrate Research


Limnological Research


Mycological Research

Vertebrate Research


Brandt, Joni. 1977. Population size and distribution of woodrats on the Chase County portion of the Ross Natural History Reservation. Undergraduate project, Emporia State University.


In progress (1976-78)

Rose, Robert. Population size and movements of ornate box turtles on the Ross Natural History Reservation, Undergraduate project, Emporia State University.


Other Research


**BIRDS OF ROSS NATURAL HISTORY RESERVATION**

A systematic procedure for recording bird life of the Reservation has not been employed on a regular basis. A file, containing data cards on which bird sightings have been recorded, has been maintained since the late 1960s and some research has been done on a few bird species, but in spite of extensive use made of the Reservation for bird watching by individuals and groups, no complete bird list for the area exists.

At present, the data card file shows that birds representing 15 orders and 37 families have been sighted or heard vocalizing on the Reservation. It is believed that most of the more conspicuous and easily recognized migrants and permanent, summer and winter residents have been recorded, whereas, groups such as shore birds and warblers, have not been adequately recorded. Also, nesting records are incomplete.

It seems safe to conclude that as the Reservation vegetation has changed through the years from predominantly grassland to more shrub-woodland, bird populations have changed also. For example, the upland sandpiper (\textit{Brachyptila longicauda}) frequently nested in sparsely vegetated, grazed grasslands typical of the area in the early 1960s. With the increase in grass height and woody vegetation resulting from the exclusion of grazing and burning, the Reservation apparently became less suitable as a nesting site for this species. On the other hand, mourning doves (\textit{Zenaida macroura}) commonly nest on the ground in grassy areas as well as in trees and shrubs. Perhaps ground nesting by this species has increased in response to the lack of nest disturbance by large grazing mammals. It has been proposed that mourning doves may have evolved as ground nesters, and are secondarily tree nesters, as their simple twig platform tree nest might indicate, an adaption to disturbance and destruction of ground nests by grazing mammals and predators (R. F. Clarke, personal communication).

Other evidence is available to support the assumption that Reservation bird populations have changed as the vegetation has changed. Rufous-sided towhees (\textit{Pipilo erythrophthalmus}) are now
sighted year-round in heavily wooded areas; woodcocks *Philohela minor* have been caught in live traps and sighted from March through December in damp woodlands and below Gladfelter pond: a saw-whet owl *Otus asio* spent from mid-December, 1975, through mid-March, 1976, in or near a cedar grove in A39; and cedar waxwings *Bombycilla adrorum*, are common in winters, feeding on an increasing supply of juniper berries and multiflora rose hips. Longeared owls *Asio otus* utilize the shelterbelt and dense juniper stands as winter roosting sites.

The potential and need for a wide variety of bird research on the Reservation is readily apparent. Hopefully, with increasing interest in non-game wildlife species more students and faculty members will undertake projects utilizing Reservation bird populations as research subjects.

Fig. 24. One of the many bluebird houses constructed to provide artificial nest sites for "cavity nesters".

Steve Stephens maintained a bird feeding and watering station in the headquarters area during the winters of 1976-77 and 1977-78. In addition to recording kinds and numbers of birds visiting the station, Steve has noted the kinds and amounts of feed consumed by the birds, and has compiled weather data during the periods the station was in operation. A detailed account of these data is in the Reservation file. The following is a summary of his observations:

A. Birds that regularly feed and water at the station
   1. Harris Sparrow
   2. Tree Sparrow
   3. Slate Colored Junco
   4. Red-bellied Woodpecker
   5. Blue Jay
   6. Cardinal
   7. Rufous-sided Towhee
B. Birds that occasionally feed and water at the station
1. Red-winged Blackbird
2. Starling
3. House Sparrow
4. Rusty Blackbird
5. Meadow Lark
6. Flicker
7. Cowbird
8. Bobwhite
9. Goldfinch
10. Siskin
11. Downy Woodpecker
12. Grackle
13. Field Sparrow
14. Song Sparrow
15. Clay-colored Sparrow
16. White-crowned Sparrow
17. Crow

C. Birds that visit the station for water only
1. Cedar Waxwing
2. Robin
3. Kestrel

D. Other Notes
1. A dominance "peck order" develops at the station with the following species, listed in order of dominance, involved: Red-bellied Woodpecker, Blue Jay, Harris Sparrow, Junco, Tree Sparrow. Other birds do not establish a position in the order. There is more aggressive interaction within a species than between species.
2. Most intense feeding activity occurs just prior to "stormy" weather.
3. Regular feeding periods are at dawn and approximately 4:30 p.m.
4. Predators that frequent the feeding areas are house cats, Kestrel, and Sharp-shinned Hawk. Mammals that feed at the station are fox squirrel, cotton rat and white-tailed deer.
5. Feeding activity is markedly diminished at the station by mid-March.
6. The number of birds feeding at the station was around 100, about 50% Juncos, 40% Harris Sparrows and 10% all others. In January, 1978, approximately 200 birds were feeding at any given period.
7. In 1978, Harris Sparrows did not begin using the station until January and Tree Sparrows were not abundant until late January.
8. By the first week of February the birds start using water at the station for bathing.
9. In winter of 1976-77 feed dispensed at the station was 350 pounds of milo and chopped corn in winter of 1977-78. 500 pounds of milo and chopped corn plus 20 pounds of sunflower seeds and 10 pounds of mixed commercial bird feed were used.

MAMMALS OF ROSS NATURAL HISTORY RESERVATION

Records of mammals living on or passing through the Reservation have been kept since the early 1960s. Data sources were trapping and sight records supplemented by track and scat identification. A total of seven orders, 16 families, 31 genera and 36 species have been recorded, with some species being represented by as few as one sighting or track in 18 years and others by multiple trappings or sightings in a single day. Some mammal species, as yet unrecorded, may have occurred on the Reservation without being detected, but the number would be small and probably restricted to the order Chiroptera (bats).

In the following list of mammals recorded for the Reservation scientific and vernacular names are after Jones, et. al. (1973). Relative abundance of each species is indicated by one of the following defined terms (after Clarke, et. al., 1958):

- abundant - Individuals can be expected to be found in large numbers in appropriate habitat.
- common - Individuals can be expected to be found regularly and in small numbers in appropriate habitat.
- occasional - Individuals can be expected to be found irregularly; on most visits to appropriate habitat specimens will not be found.
- scarce - Only a few individuals have been recorded.

Order Marsupialia
Family Didelphidae
Order Insectivora
Family Soricidae
Blarina brevicauda. Short-tailed Shrew. Common. At times, one of the most common small mammals caught on survey trap lines in woody habitat.


Family Tadidae
Scalopus aquaticus. Eastern Mole. Common. Tunnels most commonly observed along foot trails and in mowed grassland.

Order Chiroptera
Family Vespertilionidae
Eptesicus fuscus. Big Brown Bat. Occasional. Have been captured in mist nets and observed around outside lights. May be more common than records indicate.

Lasius borealis. Red Bat. Common. Have been in mist nets and observed on the ground after summer storms.

Lasius cinereus. Hoary Bat. Scarce. Only one specimen collected in daytime from small juniper tree.

Order Lagomorpha
Family Leporidae
Sylvilagus floridanus. Eastern Cottontail. Abundant. Sighted daily and live-trapped in large numbers in conjunction with research project.

Lepus californicus. Black-tailed Jack Rabbit. Scarce. Sightings have recently increased perhaps because of below normal precipitation during a recent period.

Order Rodentia
Family Sciuridae
Marmota monax. Woodchuck. Scarce. Known only from one sighting by H. A. Stephens on 3 November 1976 along roadside east of entrance gate. The Reservation may be on the western edge of woodchuck range in Lyon County.

Spermophilus tridecemlineatus. Thirteen-lined Ground Squirrel. Occasional. Are sighted along roadsides and have been captured in live and snap traps. Seem to be less abundant now than formerly when grazing reduced height of grasses.

Sciurus niger. Fox Squirrel. Common. Seems to be increasing as trees become larger and more numerous and as year-round food supply increases.

Family Geomyidae

Family Heteromyidae
Perognathus hispidus. Hispid Pocket Mouse. Occasional. Only four specimens recorded since 1960. Population appears to have declined as grasses and woody vegetation increased in height and ground cover.

Family Cricetidae
Reithrodontomys montanus. Plains Harvest Mouse. Occasional. Appears to have declined as weedy species of forbs declined and woody species increased.

Reithrodontomys megalotis. Western Harvest Mouse. Common. Population size varies from year to year. Some R. montanus may have been misidentified as R. megalotis by inexperienced persons.

Peromyscus maniculatus. Deer Mouse. Abundant. Suitable grassland habitat has been reduced by invasion of woody plants.

Peromyscus leucopus. White-footed Mouse. Abundant. Population has increased with increase in woodland habitat.

*Neotoma floridana.* Eastern Woodrat. Abundant. Seems to have increased as hedgerows have grown larger and provide more favorable habitat.

*Microtus ochrogaster.* Prairie Vole. Common to abundant. Population varies with weather conditions. The most common small mammal represented in owl pellets collected on Reservation.

*Microtus pinetorum.* Woodland Vole. Scarce. Only two specimens recorded from non-state-owned portion of Reservation. May increase as woodland increases.

*Ondatra zibethicus.* Muskrat. Occasional. A few appeared in Gladfelter Pond soon after pond was constructed. No evidence of muskrats at present in spite of increase of rooted aquatic plants in pond.

*Synaptomys cooperi.* Southern Bog Lemming. Occasional to common. Only one specimen has been trapped yet remains are common in longeared owl pellets picked up in winter.

**Family Muridae**

*Rattus norvegicus.* Norway Rat. Occasional. Seldom trapped and little evidence of scat or burrows, however, in the summer of 1976 four specimens were captured in rabbit live traps within a two-week period.

*Mus musculus.* House Mouse. Common. Are occasionally caught in grasslands in summer and are common in buildings throughout the year.

**Family Zapodidae**

*Zapus hudsonius.* Meadow Jumping Mouse. Scarce. Only four specimens have been caught, all by hand during daytime and all in close proximity to rock wall in grid A39.

**Order Carnivora**

**Family Canidae**

*Canis latrans.* Coyote. Common. Tracks, scat, vocalizations and sightings are common. Abundance varies by years and seasons; population appeared to be at low level in 1978 following peak years of 1972 and 1973.

*Vulpes vulpes.* Red Fox. Occasional. Only evidence of species is from tracks in snow on two occasions: probably more abundant than evidence would indicate although population level has been low in Lyon County since the early 1970s.

**Family Procyonidae**

*Procyon lotor.* Raccoon. Common. Tracks and scat are readily evident from year to year and season to season around ponds and along the stream.

**Family Mustelidae**

*Mustela vision.* Mink. Scarce. Only records are one set of tracks of questionable identity and one specimen caught in rabbit live trap.

*Taxidea taxus.* Badger. Occasional. Evidence is available from sightings, specimens caught in traps set for coyotes, and from young dug from a den in the vicinity. Species seems to be increasing in east-central Kansas.

*Spilogale putorius.* Eastern Spotted Skunk. Scarce. Three specimens have been caught since 1960 in live traps set for woodrats.

*Mephitis mephitis.* Striped Skunk. Common. Numerous specimens have been sighted and caught in live traps set for cottontail rabbits.

**Family Felidae**

*Lynx rufus.* Bobcat. Scarce. Known only from one set of tracks in the snow, although bowhunters and hunters using predator calls frequently report bobcat in the vicinity. In late October, 1976, a partially eaten rabbit equipped with a radio transmitter was recovered from under a pile of leaves in grid A41. Covering of the rabbit with leaves was believed to be the work of a bobcat.

**Order Artiodactyla**

**Family Cervidae**

*Odocoileus virginiana.* White-tailed Deer. Common. Sightings, tracks, scat, buck rubs and scrapes and evidence of feeding are common. Some deer seem to be year-round residents of the Reservation and immediate vicinity, whereas others apparently move onto the area in winter to take advantage of dense woody cover and available food.
Other Vertebrates

Systematic records of other vertebrates (fishes, amphibians and reptiles), have not been kept. This is unfortunate and points to a major weakness in the Reservation research program. However, Robert F. Clarke has provided me with the following list of amphibians and reptiles that are known or presumed to occur on the tract. Scientific and common names are after Collins, et. al., (1978).

Amphibians
Salamanders
   Ambystoma texanum - Smallmouth Salamander
   Ambystoma tigrinum - Tiger Salamander
Toads and Frogs
   Bufo americanus - American Toad
   Bufo woodhousei - Woodhouse's Toad
   Acris crepitans - Northern Cricket Frog
   Pseudacris triseriata - Striped Chorus Frog
   Hyla chrysocelis - Cope's Gray Tree Frog
   Rana catesbeiana - Bullfrog
   Rana blairi - Plains Leopard Frog
   Gastrophyne olivacea - Great Plains Narrowmouth Toad

Reptiles
Turtles
   Chelydra serpentina - Snapping Turtle
   Terrapene ornata - Ornate Box Turtle
   Chrysemys picta - Painted Turtle
   Chrysemys scripta - Red-eared Turtle
Lizards
   *Holbrookia maculata - Eastern Earless Lizard
   Crotaphytus collaris - Eastern Collared Lizard
   Phrynosoma cornutum - Texas Horned Lizard
   *Eumeces fasiatus - Five-lined Skink
   Eumeces obsoletus - Great Plains Skink
   Eumeces septentrionalis - Prairie Skink
   Cnemidophorus sexlineatus - Six-lined Racerunner
   *Ophisaurus attenuatus - Slender Glass Lizard
Snakes
   *Carphophis amoenus - Worm Snake
   Diadophis punctatus - Ringneck Snake
   Coluber constrictor - Yellowbelly Racer
   Elaphe guttata - Great Plains Rat Snake
   Elaphe obsoleta - Black Rat Snake
   Pituophis melanoleucus - Bullsnake
   Lampropeltis calligaster - Prairie Kingsnake
   Lampropeltis getulus - Speckled Kingsnake
   Lampropeltis triangulum - Red Milk Snake
Tantilla gracilis - Flathead Snake
Thamnophis proximus - Western Ribbon Snake
*Thamnophis radix - Plains Garter Snake
Thamnophis sirtalis - Red-sided Garter Snake
Tropidoclonion lineatum - Lined Snake
Storeria dekayi - Texas Brown Snake
Regina grahami - Grayfish Snake
Nerodia erythrogaster - Blotched Water Snake
*Nerodia rhombifera - Diamondback Water Snake
Nerodia sipedon - Northern Water Snake
*Agristrodon contortrix - Copperhead
Sistrurus catenatus - Massasauga

* Species whose presence is questionable because of the absence of suitable habitat on the Reservation.

FLOWERING PLANTS OF ROSS NATURAL HISTORY RESERVATION

Many changes in the Reservation flora have occurred since Wilson reported on flowering plants on the Reservation in the early 1960s (Wilson, 1963). Generalized references to these changes have been made in the section of this paper in which each grid was described, and it has been acknowledged that precise qualitative and quantitative data on vegetation changes are lacking. However, the Reservation herbarium does contain a reasonably complete collection of flowering plants that are now, or were, growing in the area. Many specimens have been added to the herbarium since the early 1960s by Reservation naturalists and interested faculty members and students.

Steve Stephens has recently spent many hours checking information on herbarium specimens and revising nomenclature, where needed. The following list of Reservation flowering plants prepared by Mr. Stephens from herbarium specimens contains 72 plant families, 231 genera and 376 species and is believed to represent approximately 90 percent of the different kinds of flowering plants now grown on the Reservation (Stephens, personal communication). Nomenclature follows McGregor, et. al., 1976; families are arranged alphabetically as they are in the herbarium.

Specimens in the Herbarium of the
Ross Natural History Reservation
1 July 1978

ACANTHACEAE
Ruellia humilis Nutt.
*R. strepens L.

ALISMATACEA
Alisima subcordatum Raf.
Echinodorus rostratus (Nutt.) Engelm.

ACERACEAE
Acer negundo L.
A. saccharinum L.
A. tataricum L.

AMARANTHACEAE
Amaranthus albus L.
A. graecizans L.
A. retroflexus L.
A. rudis Sauer
ANACARDIACEAE
Rhus aromatic Ait.
R. glabra L.
Toxicodendron radicans [L.] O. Ktze.

APOCYNACEAE
Apocynum cannabinum L.
A. sibiricum Jacq.

ARACEAE
Peltandra virginica (Raf.) Blake

ASCLEPIADACEAE
Asclepias incarnata L.
A. sullivantii Engelm.
A. syriaca L.
A. tuberosa L.
A. verticillata L.
A. viridiflora Engelm.
A. viridis Walt.
Cynanchum laeve [Michx.] Pers.

BIGNONIACEAE
Campsis radicans [L.] Seem.
Catalpa speciosa Warder

BORAGINACEAE
Lithospermum arvense L.
L. incisum Lehm.
Myosotis verna Nutt.
Onosmodium molle Michx. var.
occidentale (Mack.) I.M. Johnst.

CACTACEAE
Opuntia macrorhiza Engelm.

CAMPANULACEAE
Lobelia siphilitica L.
Triodanis leptocarpa [Nutt.] Nieuw.

CAPRIFOLIACEAE
Sambucus canadensis L.
Symphoricarpos orbiculatus Moench

CARYOPHYLLACEAE
Arenaria serpyllifolia L.
Cerastium brachypodium [Engelm.] Robins.
Saponaria officinalis L.
Silene antirrhina L.

CELASTRACEAE
Celastrus scandens L.

CHENOPODIACEAE
Chenopodium album L.
C. hybridum L.
C. missourienne Aellen
C. standleyanum Aellen
Monolepis nuttalliana (Schult.) Greene

COMMELINACEAE
Tradescantia bracteata Small
T. ochiensis Raf.

COMPOSITAE
Achillea millefolium L. var. lanulosa
[Nutt.] Piper
Ambrosia artemisiifolia L.
A. psilostachya DC.
A. trifida L.
Antennaria neglecta Greene
Anthemis cotula [L.] DC.
Artemisia ludoviciana Nutt. ssp.
ludoviciana
A. l. mexicana [Willd.] Keck
Aster drummondii Lindl.
A. ericoideus L.
A. oblongifolius Nutt.
A. simplex Willd. var. interior
[Weig.] Cronq.
B. frondosa L.
B. polylepis Blake
Cacalia tuberosa Nutt.
C. undulatum [Nutt.] Spreng.
Coryza canadensis [L.] Cronq.
C. ramosissima Cronq.
Dyssodia papposa (Vent.) Hitchc.
Echinacea angustifolia DC.
Erigeron annuus (L.) Pers.
E. philadelphicus L.
E. strigosus Muhl.
Eupatorium altissimum L.
E. rogosum Houtt.
Gutierrezia dracunculoides (DC.) Blake
Helianthus autumnale L.
Helianthus annuus L.
H. maximiliani Schrad.
H. rigidus (Cass.) Desf.
H. tuberosus L.
Heliopsis helianthoides (L.) Sweet var. scabra (Dun.) Fern.
Hieracium longipilum Torr.
Iva annua L.
Krigia oppositifolia Raf.
Kuhnia eupatorioides L. var. corymbulosa T.&G.
Lactuca ludoviciana (Nutt.) DC.
L. saligna L.
L. serriola L.
Liatris aspera Michx.
L. punctata Hook.
Prenanthes aspera Michx.
Pyrrhopappus carolinianus (Walt.) DC.
Ratibida columnifera (Nutt.) Woot. & Standl.
Rudbeckia hirta L.
Senecio platensis Nutt.
Silphium integrifolium Michx.
S. laciniatum L.
S. speciosum Nutt.
Solidago canadensis L. var. harteri Fern.
S. c. scabra T.&G.
S. graminifolia (L.) Salisb. var. gymnospermoides (Greene) T.B. Croat
S. missouriensis Nutt.
S. petiolaris Ait.
S. rigida L.
Taraxacum officinale Weber
T. laevigatum (Willd.) DC.
Tragopogon dubius Scop.
Vernonia baldwini Torr.
Xanthium strumarium L.

CONVOLVULACEAE
Convulvus arvensis L.
C. sepium L.
Evolvulus nuttallianus R.&S.
Ipomoea hederacea (L.) Jacq.
I. lacunosa L.

CORNACEAE
Cornus amomum Mill. ssp. obliqua (Raf.) J.S. Wils.
C. drummondii Meg.

CRUCIFERAE
Camelina microcarpa Andrz.
Capsella bursa-pastoris (L.) Medic.
Descurainia pinnata (Nutt.) Britt.
Draba cuneifolia Nutt.
D. reptans (Lam.) Fern.
Erysimum repandum L.
Lepidium densiflorum Schrad.
Nasturtium officinale R. Br.
Thlaspi arvense L.

CUPRESSACEAE
Juniperus virginiana L.

CYPERACEAE
Carex annectans Bickn. var. xanthocarpa (Bickn.) Weg.
C. heliophila Mack.
C. hystericina Muhl.
C. lanuginosa Michx.
C. molesta Mack.
C. muhlenbergii Schk.
Cyperus filiculmis Vahl.
Scirpus atrovirens Wild.
var. atrovirens
S. a. pallidus Muhl.
S. pendulus Muhl.
S. validus Vahl.
EBANACEAE
   Diospyros virginiana L.

ELAEAGNACEAE
   Elaeagnus angustifolia L.

EQUISETACEAE
   Equisetum laevigatum A. Br.

EUPHORBIACEAE
   Acalypha ostryaefolia Ridell
     A. virginica L.
     Croton capitatus Michx.
   C. monanthogynus Michx.
   Euphorbia cyathophora Murr.
     E. dentata Michx.
     E. maculata L.
     E. marginata Pursh
     E. nutans Lag.
     E. prostrata Ait.
     E. serpens HBK.
     E. spathulata Lam.
     E. stictospora Engelm.

FAGACEAE
   Quercus muhlenbergii Englem.
     Q. macrocarpa Michx.

FUMARIACEAE
   Corydalis micrantha (Engelm.) Gray

GERANACEAE
   Geranium carolinianum L.

GRAMINEAE
   Aegilops cylindrica Host
     Agropyron smithii Rhyd.
     Agrostis hyemalis [Walt.] BSP.
     Andropogon gerardi Vitm.
     A. scoparius Michx.
     Aristida oligantha Michx.
     Bouteloua curtipendula [Michx.] Torr.
     B. hirsuta Lag.
     Bromus inermis Leyss.
     B. japonicus Thunb.
     B. tectorum L.
     Buchloe dactyloides [Nutt.] Englem.
     Chloris verticillata Nutt.
     Digitaria sanguinalis [L.] Scop.
     Echinochloa muricata [Beauv.] Fern.
       var. microstachya Wieg.
     Elymus canadensis L.
     E. virginicus L.
     Eragrostis ciliaris [M.] E. Mosher
     E. pectinacea [Michx.] Nees.
     Eriochloa contracta Hitchc.
     Festuca arundinacea Schreb.
     F. octoflora Walt.
     Hordeum jubatum L.
     H. pusillum Nutt.
     Koeleria pyramidata [Lam.] Beauv.
     Leersia oryzoides [L.] Sw.
     Leptoloma cognatum [Schultes] Chase
     Muhlenbergia bushii Pohl
     M. cuspidata [Torr.] Pydb.
     M. frondosa [Poir.] Fern.
     M. schreberi Gmel.
     Panicum capillare L.
     P. dichotomiflorum Michx.
     P. obiligosanthes Shultes var.
     P. virgatum L.
     Phalaris arundinacea L.
     Poa compressa L.
     P. pratensis L.
     Schiedonnardus paniculatus [Nutt.]
       Trel.
     Setaria faberii Herm.
     Sorghastrum avenaceum [Michx.]
       Nash
     S. sudanense [Piper] Stapf.
     Spartina pectinata Link.
     Sphenopholis obtusata [Michx.]
Scribn.
\textit{Sporobolus vaginiflorus} (Torr.)
Wood.
\textit{S. asper} (Michx.) Kunth. var. \textit{asper}.
\textit{S. asper} (Michx.) Kunth. var. \textit{hookeri}
(Trin.) Vasey
\textit{Tridens flavus} (L.) Hitchc.
\textit{Tripsacum dactyloides} L.
\textit{Triticum aestivum} L.

\textbf{HYDROPHYLLACEAE}
\textit{Ellisia nuculea} L.

\textbf{HYPERICACEAE}
\textit{Hypericum perforatum} L.
\textit{H. sphaerocarpum} Michx.

\textbf{IRIDACEAE}
\textit{Sisyrinchium campestre} Bickn. var.
\textit{kansanum} Bickn.
\textit{S.c.} Bickn., var. \textit{campestre}

\textbf{JUGLANDACEAE}
\textit{Juglans nigra} L.

\textbf{JUNCACEAE}
\textit{Juncus dudleyi} Wieg
\textit{J. interior} Wieg.
\textit{J. torreyi} Cov.

\textbf{LABIATAE}
\textit{Agastache nepetoides} (L.) Ktze.
\textit{Hedeoma hispida} Pursh
\textit{Isanthus brachiatius} (L.) B.S.P.
\textit{Lamium amplexicaule} L.
\textit{Lycopus americanus} Muhl.
\textit{Marrubium vulgare} L.
\textit{Monarda fistulosa} L.
\textit{Nepeta cataria} L.
\textit{Pycnanthemum tenuifolium} Schrad.
\textit{Salvia pitcheri} Torr.
\textit{S. reflexa} Hornem.
\textit{Scutellaria parvula} Michx.
\textit{Teucrium canadense} L. var.
\textit{occidentale} [Gray] McCl. & Epl.
\textit{T.c.}, var. \textit{virginicum} (L.) Eat.

\textbf{LEGUMINOSAE}
\textit{Amorpha canescens} Pursh
\textit{A. fruticosa} L.
\textit{Astragalus crassicarpus} Nutt.
\textit{A. lotiflorus} Hook.
\textit{A. plattensis} Nutt.
\textit{Baptisia australis} (L.) R. Br. var.
\textit{minor} (Lehm.) Fern.
\textit{B. leucophaea} Nutt.
\textit{Cassia fasciculata} Michx.
\textit{C. marilandica} L.
\textit{Cercis canadensis} L.
\textit{Desmanthus illinoensis} (Michx.)
MacM.
\textit{Desmodium canadense} (L.) DC.
\textit{D. illinoense} Gray
\textit{Gleditsia triacanthos} L.
\textit{Glycyrrhiza lepidota} (Nutt.) Pursh
\textit{Gymnocladus dioica} (L.) K. Koch
\textit{Lespedeza capitata} Michx.
\textit{L. stipulacea} Maxim.
\textit{Medicago lupulina} L.
\textit{Melilotus alba} Desr.
\textit{M. officinalis} (L.) Lam.
\textit{Petalostemon candidum} (Willd.)
Michx.
\textit{P. multiflorum} Nutt.
\textit{P. purpureum} (Vent.) Rydb.
\textit{Psoralea argophylla} Pursh
\textit{P. esculenta} Pursh
\textit{P. tenuiflora} Pursh var. \textit{floribunda}
(Nutt.) Rydb.
\textit{Robinia pseudoacacia} L.
\textit{Schrankia nuttallii} (DC) Standl.
\textit{Strophostyles leiosperma} (T. & G.)
Piper
\textit{Trifolium pratense} L.
\textit{T. repens} L.
\textit{Vicia americana} Muhl.

\textbf{LILIACEAE}
\textit{Allium canadense} L. var. \textit{canadense}
\textit{A.c. L. var. lavendulare} [Bates] M.
\textit{Ownby} & Aase
\textit{Asparagus officinalis} L.
Camassia angusta (Englem. & Gray)
Blank.
Erythronium mesochoreum Knerr
Nothoscordum bivalve (L.) Britt.

LINACEAE
Linum sulcatum Riddell

LYTHRACEAE
Ammania coccinea Rottb.
Lythrum doucetanum Nieuw.
Rotala ramosior (L.) Koehne

MALVACEAE
Abutilon theophrasti Medic.
Callirhoe alceaeflora (Michx.) Gray
Hibiscus trionum L.
Malvastrum hispidum (Pursh) Hoeh.
Sida spinosa L.

MENISPERMACEAE
Menispernum cacadense L.

MORACEAE
Maclura pomifera (Raf.) Schneid.
Morus alba L.

NYCTAGINACEAE
Dicliptera brachiata (Pursh) Spreng.
Mirabilis alibida (Walt.) Heimerl.
M. nytageina (Michx.) MacM.

ONAGRACEAE
Gaura parviflora Doug.
Ludwigia palustris (L.) Ell.
Oenothera biennis L. ssp. centralis
Munz.
O. macrocarpa Nutt. ssp. macro-
carpa
O. speciosa Nutt.

OLEACEAE
Fraxinus pennsylvanica Marsh. var.
subintergerrima (Vahl) Fern.

ORCHIDACEAE
Spiranthes cernua (L.) Rich.

OXALIDACEAE
Oxalis dillenii Jacq.
O. violacea L.

PHYTOLACCACEAE
Phytolacca americana L.

PLANTAGINACEAE
Plantago patagonica Jacq.
P. rugellii Dcne.
P. virginica L.

POLYGONACEAE
Polygonum arenastrum Jord.
P. convolvulus L.
P. lapathifolium L.
P. pensylvanicum L.
P. punctatum Ell.
P. ramosissimum Michx.
Rumex altissimusus Wood
R. crispus L.

POTAMOGETONACEAE
Potamogeton nodosus Poir.

PRIMULACEAE
Androsace occidentalis Pursh

RANUNCULACEAE
Anemone caroliniana Walt.
Delphinium virescens Nutt.
Ranunculus abortivus L.

RHAMNACEAE
Ceanothus herbaceus Raf. var.
pubescens (T.&G.) Shinners
Rhamnus lanceolatus Pursh var.
glabratus Gl.

ROSACEAE
Geum canadense Jacq.
Potentilla recta L.
Prunus americana Marsh.
P. tomentosa Thunb.
P. virginiana L.
Pyrus communis L.
Rosa arkansana Porter
R. multiflora Thunb.
Rubus occidentalis L.
Rubus ostryifolius Rydb.
Spiraea prunifolia Sieb. & Zucc.

RUBIACEAE
Galium aparine L.
G. circaezans Michx.

RUTACEAE
Zanthoxylum americana Mill.

SALICACEAE
Populus deltoides Marsh.
Salix amygdaloides Anderss.
S. babylonica L.
S. caroliniana Michx.
S. exigua Nutt. ssp. interior (Rowlee)
   Cronq.
S. nigra Marsh.

SAXIFRAGACEAE
Ribes missourianum Nutt.

SCROPHULARIACEAE
Leucospora multifida (Michx.) Nutt.
Penstemon cobaea Nutt.
Verbasum thapsus L.
Veronica arvensis L.
V. peregrina L., var. xalapensis
   (HBK.) St. John & Warren

SOLANCEAE
Lycium halimifolium Mill.
Physalis angulata L. var. pendula
   (Rydb.) Waterfall
P. missouriensis Mack. & Bush
P. pumila Nutt.
P. virginiana Mill. var. sonorae
   (Torr.) Waterfall
Solanum americanum Mill.
S. carolinense L.
S. rostratum Dun.

SPARGANIACEAE
Sparganium eurycarpum Englem.

TYPHACEAE
Typha latifolia L.

ULMACEAE
Celtis occidentalis L.
Ulmus americana L.
U. pumila L.
U. rubra Muhl.

UMBELLIFERAE
Lomatium foeniculaceum [Nutt.]
   C. & R
Polytaenia nuttallii DC.
Sanicula canadensis L.
S. gregaria Bickn.
Spermolepis enormis (Nutt.) Math
   & Const.

URTICACEAE
Parietaria pensylvanica Muhl.

VERBENACEAE
Phyla lanceolata (Michx.) Greene
Verbena bracteata Lag. & Rodr.
V. moechina Moldenke
V. simplex Lehm.
V. stricta Vent.
V. urticifolia L.

VIOLACEAE
Viola missouriensis Greene
V. pedatifida G. Don
V. rafinesquii Greene

VITACEAE
Vitis cinerea Engelm.
V. riparia Michx.
FUTURE ROLE OF ROSS NATURAL HISTORY RESERVATION

The future role of the Ross Natural History Reservation as an educational and research facility, and as a tract on which a segment of the tall grass prairie ecosystem is to be preserved, is an interesting topic for speculation. During the early planning stages, policies and procedures for operation of the Reservation were adopted with the goal in mind of eventually developing the Reservation into a grasslands biology station, the thinking being that such a facility would enable the objectives of education, research and preservation to be accomplished and at the same time provide a unique and much-needed focal point for studies in grasslands ecology. Establishment of such a station was predicated on certain conditions among which were:

1. Obtaining by gift or purchase, first, the 200 acre tract of land, and at some later time the remaining 840 acres that comprised the Reservation.
2. Receiving adequate funds from the State of Kansas and other sources to provide the necessary physical facilities for operation and staffing of a biology station.
3. Developing a sound educational and research program for which there was sufficient demand to warrant expansion of modest facilities into those necessary for operation of a year-round biology station.
4. Availability of a reservoir of faculty members and administrators whose interests in and support of the educational and research values of a natural area would persist through time.
5. The continuing demand by college students, and other segments of the populace, for educational opportunities in and exposure to the natural environment.

The Reservation has not at this time attained the status of a biology station. It is an area with enormous potential whose development has been slowed somewhat by failure in varying degrees to meet one or more of the above conditions. Although Mr. and Mrs. Ross deeded to the State the 200-acre tract referred to herein as the state-owned portion of the Reservation, or more commonly as the Reservation, no overt attempt has been made to acquire segments or all of the remaining 840 acres.

In the mid-sixties the Reservation Committee established priorities for acquiring additional tracts and listed the Chase County portion (grids C33 through C64), grids B25, B26, B39 and B40 and grids A5, A6, A11, A12, A21, A22, A27, an A28 as three preferred areas. Selection of the three tracts was based on their physical and biological diversity and apparent high value as study areas and their low economic value for grazing. Although the committee’s request to obtain the tracts was forwarded through the proper administrative channels, no positive action resulted. It seems as appropriate to pursue acquisition of these tracts now or in the future as it did a decade ago.

Considerable progress has been made toward providing adequate physical facilities for operation of a field station, as noted in the section on physical facilities and improvements. However, there are no provisions at present for accommodating visiting researchers for an extended period or of even providing sufficient laboratory space for students carrying on research on the Reservation. This problem could be readily solved by the addition of one or two mobile classroom - lab units to be used for research labs, temporary housing, and storage.

In order to enhance the area for wildlife and to increase aquatic habitat, it is recommended that at least one additional pond be constructed. A large impoundment should be built on the border between grids A39 and A40.

Funds for additional physical facilities, if not forthcoming from the State of Kansas, should be sought from private philanthropic individuals or organizations.

Staffing of the Reservation at a level sufficient to maintain the physical plant and to carry out educational and research programs has been a mixed success. At present, and for the past several
years, the Reservation staff has been composed of a part-time director, a half-time graduate assistant naturalist, and varying numbers of student employees during summer months. College courses scheduled at the Reservation are taught by members of the biology faculty.

Duties of the director are many and varied among which are:

1. To supervise operation of the Reservation by following accepted policies and procedures established by the Natural Areas Committee of the School of Liberal Arts and Sciences.
2. To expend funds, as available, for purchase of supplies and equipment needed to operate the Reservation.
3. To supervise work of the Reservation naturalist and other student assistants.
4. To initiate and supervise long-range research projects on the area.
5. To encourage and make arrangements for use of the Reservation by tour groups and for other educational activities.

The director is allocated one-fourth of his work load for carrying out Reservation duties. However, the allocation works better in theory than in practice, because too often what appear as more pressing duties take priority over Reservation obligations.

Primary duties of the Reservation naturalist are:

1. To maintain the buildings and grounds as directed by the Reservation director.
2. To conduct guided tours of the area for visiting groups.
3. To record data from some long-range research projects.

The naturalist, employed on a half-time graduate assistantship, devotes approximately 20 hours per week to carrying out his duties. The time is adequate for completion of necessary work
during late fall, winter, and early spring, but inadequate for the remainder of the year during which time maintenance and tour work are at a peak. Undergraduate assistants employed during summer months alleviate the problem somewhat but are not a solution during the periods mid-April to mid-May and mid-September to mid-October when the greatest demand for tours prevails.

Having a graduate assistantship assigned to the Reservation has several advantages. It enables the director to employ a person knowledgeable in field biology for conducting educational tours and assisting in recording field data. Also, the naturalist job enables the graduate student holding the position to gain invaluable work experience prior to entering the job market, in addition to the stipend received each month.

One marked disadvantage is the yearly turnover in personnel holding the assistantship. It seems that soon after each naturalist becomes proficient in carrying out his duties it is time to look for next year's replacement. However, this disadvantage is outweighed by advantages of having the assistantship.

Fig. 26. A secondary school student is introduced to ecological research.

At present the educational and research programs developed for the Reservation are not sufficiently broad in scope and intensity to warrant expansion of Reservation facilities into those necessary for operation of a year-round biology station. Although programs in these areas do exist as a result of efforts by some biology faculty members and Reservation staff, the major impediment to full development of Reservation potential has been the lack of availability of faculty members and administrators who are willing to schedule and teach classes and become involved in their own or students' research on the Reservation. Currently, only three biology members regularly teach a class at the Reservation and only five regularly supervise graduate or undergraduate research projects on the area. This occurs in spite of one of the major emphases and areas of interest of biology faculty and students being in environmental biology.
It must be acknowledged, however, that making frequent trips to the Reservation to teach a class or supervise research presents certain problems. A round trip from campus to the Reservation is 34 miles if one travels by hard-surfaced roads as much as possible. Minimum time for a round trip is approximately 45 minutes, therefore, time and distance become problems for both faculty members and students. Also, transporting laboratory equipment and teaching aids not readily available at the Reservation compound these difficulties. Yet, these obstacles can be overcome if there is a sufficiently strong belief in the value of educational and research experiences in a natural area.

In spite of a recent decline in employment opportunities for college students educated via the traditional curricula of conversation and wildlife biology, there is no reason to believe that the demand for college graduates who are well versed in basic ecological principals will cease to exist. In fact, the demand should increase as man learns to more fully appreciate the need to live in harmony with his environment. This should result in an ever increasing interest in and demand for formal education in the environmental sciences, and thereby enhance the value of the use of the Reservation.

If one accepts the thesis that the Reservation is a highly valuable adjunct to teaching and research in environmental science, but that under prevailing conditions it is neither appropriate nor feasible to develop it into a biology station in the near future, then certain changes should be made in operational procedures and attitudes involving the facility.

The following are recommended:

1. Appoint a full-time Reservation director whose duties, in addition to those listed above, would include teaching at least one class each semester at the Reservation, establishing several long range research projects in those areas that have been most neglected over the years (vegetation changes and phenology, terrestrial invertebrate populations, some aspects of vertebrate ecology, microclimate conditions), being available on the area to supervise student research, expanding the educational program to involve more activities for non-college students and the public, and supervising development and use of other college natural areas such as Reading Woods, McKinney Marsh, and the Nature Conservancy tract.

2. Increase use of the Reservation, through administrative channels, by assigning more classes to be taught there and by encouraging more faculty members to become involved in their own and student research on the Reservation. A full-time Reservation director would be invaluable in assisting instructors with some of the current problems associated with teaching and research at the facility.

3. Continue to employ a graduate student naturalist to carry out duties listed above and supplement the naturalists’ efforts in maintaining the physical plant by hiring other students on a seasonal basis, but also seek funds for hiring students to assist with long range research projects and to initiate their own field studies.

4. Consider harvesting the hay crop from portions of the Reservation and grazing other portions as means to raise money for improving facilities or for student scholarships. These practices could be used to assist in managing Reservation grasslands and also be incorporated as variables into vegetation research.

Profitable hay harvest could be accomplished by either selling the hay crop to the highest bidder or by having the hay custom cut and then selling the product. Profitable controlled grazing could result from leasing certain tracts for the grazing season to a local cattleman or by having the University purchase a few head of cattle in the spring, allow them to graze portions of the Reservation during the grazing season, then sell them in the fall, hopefully for a profit. Perhaps one or more benefactors of the University or faculty members who donate to scholarship funds would be interested in contributing animals or money for such a venture.
No doubt there are many additional worthwhile recommendations that could be made concerning ways to enhance the Reservation's role in education research and preservation of native grassland. However, it is my belief that action taken on these four recommendation would produce some immediate benefits and insure continuity of this viable and valuable facility of Emporia State University and the State of Kansas.

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APPENDIX A

PROCEDURE FOR CARRYING OUT SMALL MAMMAL SURVEYS
AT ROSS NATURAL HISTORY RESERVATION

Introduction

Two permanent small mammal trap lines were established at the Ross Natural History Reservation in the fall of 1961 and designated as lined A and B. Line A, consisting of 11 stations, is approximately 280 yards long and is located in grid sections A-38 and A39. Line B, consisting of 32 stations, is one mile in length and extends north from the south boundary of the Reservation along a line separating grids B-63 and 64, B-50 and 49, B-47 and 48, B-34 and 33, B-31 and 32, B-18 and 17, B-15 and 16, and B-2 and 1.

Small mammal population surveys are conducted along each line three times a year. Months in which surveys are conducted are as follows:

Line A - April, August, and December
Line B - March, July, and November

Procedure

The following procedure is strictly adhered to in conducting survey along both lines:

1. Select a three-day period, during the appropriate month, which will allow sufficient time and favorable weather for the survey.
2. Obtain the following:
   a. Museum special snap traps (at least 96-105 for Line B and 33-40 for Line A) and a container for traps.
   b. Bait consisting of peanut butter and rolled oats.
   c. Data sheets.
   d. Specimen bags.
   e. Plastic bags.
   f. Plastic marking tape.
3. Set three baited traps at each trap line station in late afternoon of first day of the survey. The three traps are to be arranged in a triangular pattern around each station marker and no trap is to be located farther than five feet from the station marker. All traps are to be placed in contact with the ground and in runways or other sites of apparent small mammal activity. Under no circumstances are traps to be placed on top of the vegetative ground cover.
4. Mark location of each trap by tying or vegetation above the trap a two-inch piece of marking tape. All pieces of marking tape are to be removed and destroyed on final day of each survey.
5. Check traps early in the morning following trap-setting previous evening. Prior to checking trap line, fill out top of data sheet(s) for that particular date of survey. Make special effort to designate sheet as Line A or Line B sheet.
6. Remove all specimens from traps and as each specimen is removed, firmly attach a specimen tag to one of its rear legs. Record on the tag the following: date and time, station number, common name and/or specific name, and sex. Record these data on data sheet.
7. Place all tagged specimens in a plastic bag, reset and rebait each trap that has been sprung or that contained a specimen. Record on the back of the data sheet the number of sprung traps - those set off that did not contain specimens - for each station.
8. Repeat above process for three consecutive days. For example, if traps are first set on Friday evening, they should be checked Saturday, Sunday, and Monday mornings and picked up on Monday morning.
9. After all traps have been checked and specimens tagged and recorded on data sheets, two alternatives are available:
   a. Return to the lab and record all remaining data indicated on data sheet for each specimen. Uncertain identifications must be validated by some authoritative source. Methods of taking body measurements are shown in Hall's Handbook of Mammals of Kansas, pp. 267-69. If uncertain about

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how to detect embryos and/or placental scars, see department mammalogist.
b. If time does not permit immediate processing of "catch," specimens from each trapline run must be placed in a large, sealed plastic bag and frozen immediately. Be certain to include in the bag a card containing date, time of day traps were run, trapline (either A or B), and name of collector. Specimens can be frozen for a week or so, but should be processed as soon as possible.

11. Return all completed data sheets to Reservation director immediately following processing of catch for the three-day trapping period.

APPENDIX B

PROCEDURE FOR MAKING AND RECORDING FIELD OBSERVATIONS
ON THE ROSS NATURAL HISTORY RESERVATION

In order to compile a meaningful and accurate file of field notes for the 200-acre, state-owned portion of the Ross Natural History Reservation, a systematic routine for recording data has been established. At weekly intervals the reservation naturalist is to employ the following procedure:

1. Obtain an adequate supply of Reservation species data cards and "field notes" forms.
2. Beginning at grid post in southwest corner of grid A-56, proceed as follows:
   d. South across west side of B-33, B-48, B-49, and B-64 to southwest corner of B-64.
   e. East across west side of B-64 and A-57 to southeast corner of A-57.
   g. West across north side of A-57 to northwest corner of A-57 (starting point).
3. Record on "field notes" form all observations of significance. Some significant observations are as follows:
   a. Visual and/or auditory evidence of all vertebrates, their tracks, droppings, diggings, dens, nests, remains, etc.
   b. Changes in vegetation, such as first leafing out and first flowering of all plants, evidence of disease or excessive damage by animals, evidence of increase or decrease, appearance of new forms.
   c. Evidence of invertebrates that can be noted by standing in or walking along trail.
   d. Changes in physical environment, such as soil changes during low rainfall; pond, stream, and spring levels and flow; effects of rain, wind, snowfall, etc.
4. File with Reservation director original copies of all field notes and specimen-data cards no later than two days following observations.