

DOCUMENTATION OF DISTINCT ECOLOGICAL AREAS AT
THE CONARD ENVIRONMENTAL RESEARCH AREA
(CERA)

RECOMMENDATIONS FOR THEIR MANAGEMENT AND USE

prepared by

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Draft 3 (all restored prairie and savanna, CRP grassland, and forest
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INTRODUCTION

CERA is a diverse landscape; its soils, the slope and aspect of the ravines and uplands and the past histories of different areas have led to many diverse plant and animal communities. To understand this heterogeneity, I have prepared a brief description of each ecological area (which might include more than one numbered location).

So that we could discuss the areas in committee without a long delay, my descriptions are still sketchy and use either common names or binomials, whichever easily came to mind. Later drafts will be more formal and more complete. Each new draft will include decisions for management and/or use decided at previous committee meetings.

Format for each section

Title

Location

General Description, including areas within the main area

Soils

History

 Presettlement

 Pre-CERA

 CERA

 Burning

 Clearing

 Herbicide

 Mowing

 Seeding

 Planting

Understory and/or ground cover

Rare or Unusual Species

Recommendations for management

 A. highest priority

 B., C. etc. lower priority because of biological reasons or financial/workforce limitations

Recommendations for Use

Material too detailed for the general descriptions (lists of species, detailed reports from research, etc.) will be in appendices.

Numbers in () refer to the CERA locations (page 4-5).

Definitions.

Savanna. Communities with an herbaceous groundcover and trees taller than 5m which form an incomplete canopy of 5-30% canopy cover; grasses predominate in the groundlayer. Fire is frequent and intense.

Closed savanna. 30-70% canopy coverage with less intense fire and a greater percentage of forbs in the groundlayer.

Woodland. 70-100% canopy coverage; forbs are more predominant and fire is less intense.

Forest. Multi-layered communities with well-developed woody understories and a forb dominated groundlayer; fire is infrequent.

CRP. Crop Reserve Program. Grasslands with the dominant tall grasses but with no seeding or planting of forbs.

Restored Area. An area that started with native graminoids, forbs, shrubs, and trees and was enriched by interseeding and planting.

Reconstructed Area. An area starting on recently plowed agriculture land.

Clearing. The cutting of unwanted shrubs, small trees and large trees. Similar to the concept of Timber Stand Improvement in silviculture.

CERA LOCATIONS

(detailed for restoration and management)

DIVERSE RECONSTRUCTED PRAIRIE (1987) (1-9)

1.	FB	Fall Burn	2.	P	Perley
3.	P2	Perley (2 yr)	4.	PNB	Perley (no burn)
5.	PB	Perley (burn)	6.	D	Deaner
7.	EPP	Experimental prairie plots	8.	NEL	NE lab
9.	L	Lab			

CRP GRASSLANDS

planted in 1987

(10)

11.	NWLE	NW Lab East	12.	NWLW	NW Lab West
13.	DM	Dam			

GRASSLANDS

planted 1969-75

(20)

24.	H	Hillcrest	25.	W	Wilson
26.	BB	Big Basin			

SAVANNA (restored)

(30, 40, 50)

30. N. Slope Savanna

31.	NSOO	Open oaks	32.	NSNEO	Northeast oaks
33.	NSNW	Maple-hackberry			

40. S. Slope Savanna

41.	SSS	Wigwam and West Ridge	43.	WG	Wigwam
42.	WR	West Ridge	45.	WEO	Wigwam entranced oaks
44.	WHO	Wigwam Hooper Oaks	47.	CR	Central Ridge
46.	WEO	E. oaks	49.	SSA	South slope alluvial bottomland
48.	EES	East edge savanna			

50. Morgan Savanna (closed)

51. WM **West Morgan Prairie**

FOREST (unmanaged)

(60)

60. Upland forest

61.	UFR	NW slope (recently-colonized)
62.	UFP	Upland woods (plateau)
69.	ERO	East of road oaks

ALLUVIAL PLAIN (unmanaged)

70. APF Alluvial plain forest (west-side gate to Wilson Prairie)

PRAIRIE (natural recolonization)
(80)

80. SLP South of Lake Prairie

TREE PLANTATIONS
(90)

90. APTP Alluvial plain tree plantation (pine-walnut-reed canary grass) and roadside ditch
91. CTP N. slope conifers

ROADSIDE
(100)

100. GRW Gravel roadside W of NE parking lot
101. GRE Gravel road E and roadside ditch

PERRY POND, NORTH SHORELINE, INTERMITTENT STREAM
(110)

110. NLS North Pond Shoreline
111. PP Perry Pond
115. ISW Intermittent Stream west of Pond
116. ISE Stream east of pond with alluvial riparian bottomland

MAP WITH LOCATIONS

AERIAL PHOTOGRAPH (1974)

NORTH SLOPE CLOSED SAVANNA (31), WOODLAND (32), and FOREST (33)

Location. North of Deaner Prairie and east of Fall Burn Prairie, east to the old road which runs north to the county road.

General Description. There are three distinct habitats. The area slopes to the north and drains from all sides into the north central bowl.

1. A north central low wet area with graminoids, *Bidens*, *Impatiens* (jewelweed), and *Salix exigua* (sandbar willow), surrounded by small elm, bur oak, white mulberry and one large cottonwood.
2. An area of higher ground with good drainage dominated by bur oak: on the east and south sides of (1).
 - a. the southern area of (2), that has a nearly complete overstory of bur oak and a graminoid understory; it is classified as woodland.
 - b. a multi-tiered area in the east part of (2) that has been burned, but contains some elm and white mulberry and is therefore a fire-influenced forest;
3. An east-facing slope, west of the central bowl; it is moister than (2) and is a diverse forest with large red and American elm, large hackberry and cutleaf maple, very large, tall, straight-trunked bur oaks, small box elder, and exotic mulberry. Most of the large trees are 60-80 yr. old, with the oaks closer to 150 yr.

Soils. Areas (1) and (3) are Lindley loam with seepage at the loess till line; it is formed from Kansan till under timber. The southern area (2) is Downs silt loam which developed from loess under a prairie-forest transition (savanna).

History. Pre-settlement. Several ecologists in the state and I feel that this north-slope region was most likely some sort of savanna-forest rather than prairie because of the soils, aspect, slope, and moisture.

Pre-CERA. According to the very elderly wife of the deceased former owner, the area was partially logged of bur oak. Nevertheless, the oldest trees (probably > 150 yr.) are bur oaks. The remainder of the trees probably date only from 1930-40 but grow fast and look large (cut-leafed maple, elm). A farmhouse stood at the east end and was bulldozed after CERA was purchased.

CERA. Vern Durkee started an "arboretum" here, but no species survived. I started restoring the area to a fire-influenced habitat in 1988. Brush and small trees were cleared under the southern and southeastern bur oaks. Grasses were planted only in the southern cleared area. The area has been mowed 1-2 times annually to control burdock and nettle in order to allow growth of the endemic and planted grasses.

Burning. All areas that would burn have been burned since 1988, but only the southern and eastern areas had a high enough density of oaks (and therefore oak leaves) to carry a fire. The bowl and western area have not burned.

Clearing. Shrubs and saplings in the early 80's in area (2a) and in the 90's in the eastern and northeastern part of (2).

Herbicide. Very seldom, on dense clumps of burdock.

Mowing. Only in the southern part of area (2a), yearly, since clearing until 1998 when the graminoid cover was dense and nettles were sparse.

Seeding. *Elymus hystrix* and *Elymus virginicus* were planted in area (2) in 1995. Both were originally present here and elsewhere at CERA.

Planting. None.

Understory. The areas that were cleared are developing a groundcover of already present grasses: *Agrostis hymelis* (tickle grass) *Muhlenbergia schreberi* (nimblewill) and *Elymus virginicus* (Virginia wild rye), and inter-seeded *Elymus hystrix* (bottlebrush grass) and *Elymus virginicus*.

The groundcover in uncleared areas (with denser canopy and sparse grass) consists in part of *Tovara virginiana* (knotweed), *Hydrophyllum virginianum* (Virginia waterleaf), *Eupatorium rugosum* (white snakeroot), *Pilea pumila* (clearweed), *Osmorhiza sp.*, *Chenopodium hybridum* (maple-leaved goosefoot), Virginia wild rye and nimblewill. There are very few spring ephemerals.

Rare or unusual species. None noted.

Recommendations for management.

A. Since area (2) has savanna soils and fits the slope and moisture regime thought to promote savanna or woodland, I recommend that the area be so maintained. Area (3) has forest soil but was probably closed savanna or woodland influenced by fire.

Approved.

Burning. Continue to burn in late fall or early spring for 5 more years. Then re-evaluate the frequency of burning. More open areas will develop when small and large trees die from disease or old age. Fire will kill only the seedlings and saplings of most species. Let natural processes determine what grasses, sedges, and groundcover develop. Let the fire decide what areas are burnable; areas (1) and (3) have never burned although we did not stop the fires. Perhaps they might burn on particularly dry years. This was expected. The oaks are sparse here and the leaves of other species dry slowly and burn poorly even when dry; further, there is almost no graminoid groundcover.

Approved.

Clearing. Clear elm and mulberry from under and near oaks in region (2).

Approved.

Herbicide. Continue to suppress burdock, but only in isolated spots.

Approved.

Mowing. Mow high and early to suppress stinging nettles and mow high and late to take off unripened seedheads of burdock.

Approved.

B. Clear all mulberry in area (3) and perhaps the elm near oaks if it is felt that the oaks should be preserved.

Approved.

Recommendations for use. Demonstration and study of restoration and succession processes.

NORTH SLOPE, EAST OF ROAD OAKS (69)

Location. This shallow depression-ravine lies between the gravel road east of areas (31-33) and the planted conifers (91).

General Description. This drainage slopes toward the north. Except for the \pm 150 yr. old bur oaks, the assemblage of elm, cut-leaved maple, black cherry and exotic mulberry is < 60 yr. with many trees < 20 yr., including young bur oak. The eastern side is denser with oaks and has a more native understory. The understory of most of the area is a mixture of exotic and native grasses, forbs and shrubs typical of most disturbed woods.

Soils. The highest area to the south, where oak is most concentrated, is Downs silt loam, formed from loess in a transition zone between timber and prairie. The lower area is Lindley loam formed from Kansan till with seepage at the loess till line and formed under timber.

History. Pre-settlement. We would have to microanalyze the soils on a smaller grid than that done by the soil survey. They claim that the soils were formed under trees and, given the moisture and the proximity to the Skunk R., this is highly likely. Since all of the trees now present are post settlement, anything from bur oak to mesic forest could have been here.

Pre-CERA. The northern end was an old orchard when the property was purchased. All the Jonathan apple trees have died. All of the area, given the young age of the trees except oaks, was probably grazed.

CERA. Untouched except clearing of trees (mulberry and elm) from around the large oaks on the southern border.

Burning. None.

Clearing. Only clearing of trees (mulberry and elm) from around the large oaks on the southern border.

Herbicide. None

Mowing. None.

Seeding. None.

Understory. The understory is a mixture of exotic and native grasses, forbs and shrubs typical of most disturbed woods. Exceptions are under the oaks north of the barn (exotic smooth brome) and near and under the oaks to the east of the barn where clearing was done (now stump sprouts, etc. (check on herbicide).

Rare or unusual species. None noted.

Recommendations for management. None, except to seed native tall grasses into the exotic brome under the southern ring of isolated oaks and to burn the narrow southern border.

Approved.

Recommendations for use. Use most of the area as an example of succession in a disturbed area after cessation of grazing. It could be experimentally manipulated in many ways.

NORTH SLOPE CONIFERS (91)

Location. Along the county gravel road north of Hillcrest Prairie (24) between the East of Road Oaks(69) and the Recently Colonized NW Slope Forest (61).

General Description. This grazed bluegrass meadow was planted in conifers (Red pine, Norway spruce, and European larch) by Ben Graham in 1969.

Soil. Downs silt loam, formed from loess in a transition zone between timber and prairie.

History. Presettlement. Probably changed between woodland, closed savanna, savanna and prairie. Pre-CERA. Apparently grazed bluegrass. CERA. Planted in conifers by Ben Graham in 1969 and subsequently mowed nearly yearly in the open spaces. An escaped fire in 197-? killed about 50% of the red pines. Most of the area still in conifers has been invaded by most species of trees: oaks, elm, cherry, etc. Some of these are now 25 yr. old and some of the oaks are vigorous and well-shaped.

Burning. None

Clearing. None

Herbicide. None

Mowing. Nearly annual in open area.

Seeding. None.

Planting. Red pine, white spruce, and European larch in 1969.

Understory. Mostly bluegrass and invasive weeds.

Rare or unucual species. *Habenaria nivea* (Showy orchid) on the eastern boundary ravine and to the east of there.

Recommendations for management.

Currently we do not have the work force to clear the invading oaks, elm, mulberry, etc. from the conifers; thus the conifers will be abandoned or studied as succession occurs. No management is needed.

Approved.

Recommendatons for use. This would be a good example of how established conifers are outcompeted on fertile soil in Iowa by more rapidly growing deciduous trees, and how conifers are prevented from reproducing on fertile soil by competition with grass.

**UPLAND WHITE OAK FOREST (60), MORGAN'S SAVANNA (50) and the
RECENTLY COLONIZED NW SECTION (61)**

Location. On the east and north-facing slopes leading down to the skunk river and on the plateau above them. A loop trail divides Morgan's savanna from the rest.

General Description. There are four major areas.

1. The upland white oak forest is typical of white oak forests in Iowa that have not been disturbed for more than a century. White oak dominates the forest canopy; slippery elm, American elm and basswood are also frequent and well-established.

On the western edge of the plateau, hackberry, bitternut, black walnut, honey locust and black cherry are present along with the dominant oak. On the eastern end of the plateau, and on the slopes toward the river, hop hornbeam is abundant as a subcanopy.

In the ravine and on the north-facing slopes, shagbark hickory, red oak and basswood are more plentiful.

The bench above the river is similar to the above but supports a slightly different understory on more mesic soil.

Elms, hickories and hackberry dominate the subcanopy throughout. The ground cover is nearly shrubless and supports one of the most diverse displays of abundant spring ephemerals in Iowa.

2. Morgan's closed savanna-woodland (50) represents the western edge of the white oak upland forest, but includes more bur oak. The groundcover has far fewer spring ephemerals than the rest of the upland forest and before burning resembled area (3) described below. In 1992 this experimental Area was partially cleared of trees other than oak and hickory to create a transition from prairie to forest that is more typical of presettlement conditions.

3. The western 60 yds. of the plateau, immediately east of the loop trail, has greater tree diversity (see above) and fewer species of spring ephemerals than does the rest of the upland white oak forest.

4. The recently-colonized northwest slope to the northwest of (62) has a row of old bur oak halfway down the slope and white oak on the north and south edges, and one old basswood; the rest consists of young trees (uncored, but probably 50-60 yr. old) that probably became established after grazing stopped in 1940-50; all are straight and without lower limbs. Bitternut hickory, basswood, red oak and cherry characterize the area. There is little development of spring ephemeral flora except one patch of rue anemone that is otherwise found only on the lower slopes near the river. The groundcover contains few shrubs or vines.

Soils. All areas are on Lindley loam that the Jasper County Soil Conservation Service states has developed under forest vegetation for at least 1000 yrs.

History. Presettlement. That most of these areas have been forested for 1000+ yr. is indicated by the soil analysis. The location of the forest, on eastward to northward slopes adjacent to the Skunk R., would also cause me to predict a history of forest.

Pre-CERA. The forest was probably cut in the mid 1860's. Note: virtually no forests of Iowa were left uncut during this time. Oak Ridge National Laboratory scientists, searching Iowa for presettlement white oaks in order to push back weather records, found only 30 trees in the state that predated settlement, and these were mostly on ridges or other areas inaccessible to timbering. Afterward, at least in the early 1900's, all of this area was lightly grazed (according to the former owners) until the 1940's.

Area 1. Coring (see appendix A. to this section; "Age Distribution of Upland Forest") shows that most of the oaks date from the 1860's, indicating that this forest was probably clearcut in the 1860's when the Rock Island Line RR owned part of the property and the railroad was built. The widespread canopy of many of the trees also indicates that some of them were grown in an open field (or clearcut).

Areas 2-3. The western 80+ yds. of the plateau, however, probably was savanna or fire-influenced woodland. These areas have a more diverse assemblage of younger, probably post 1940 trees, many of which need nearly full sun to grow. There are far fewer spring ephemerals; further, I cored the soil and found more of a savanna than a forest soil profile. Finally, these areas are more exposed to the southwestern drying winds of summer. Which of these factors explains the paucity of spring ephemerals?

Area 4. The recently colonized north slope (61) is still different. Except for the above-mentioned large oaks, the trees probably became established after grazing stopped in 1940-50.

CERA. Two areas were manipulated.

1. Nineteen 25 x 25 m experimental burned and unburned plots were established in April 1997 on the plateau in a checkerboard configuration (the most northwesterly plot is burned). No burns were possible during either the fall of 1997 or the spring of 1998. In the future, we will burn only during the fall.

2. Morgan's Savanna was cleared of all trees except oaks in 1992 by Morgan Robertson, a student, in order to restore a more natural prairie-forest transition. Burning was not possible until the spring of 1997. At that time, 3 species of prairie-savanna grasses (found in the prairie and elsewhere in the woods) were raked into the soil to speed up the succession. The shade and the small quantity of seed should prevent domination by these grasses and the development of a diverse groundcover.

Burning. Last week of March, 1997. The experimental checkerboard and Morgan's savanna.

Clearing. Only Morgan's savanna.

Herbicide. None.

Mowing. None.

Seeding. On Morgan's savanna, spring 1997. Low density of *Andropogon gerardi*, *Schizachyrium scoparium*, and *Elymus hystrix*.

Understory.

Subcanopy. See Appendix C; Species List.

Groundcover. Few individuals of shrubs or vines are numerous other than gooseberry (*Ribes missourienses*), some grey dogwood (*Cornus foemina*), Virginia creeper

(*Parthenociscus quinquefolia*), hog peanut (*Amphicarpa bracteata*) and poison ivy. The abundant spring ephemerals and the summer and fall species are typical of mature white oak forests in Iowa (see Appendix C).

Rare or unusual species. *Delphinium tricornis* (upland larkspur), *Hepatica acutiloba* (hepatica), *Habenaria nivea* (showy orchid), *Trillium nivale* (snow trillium), *Trillium recurvatum* (prairie trillium), *Cystopteris protusa* (creeping fragile fern), *Athyrium filix-femina* (northern lady fern).

Recommendations for management.

A. Continue the burned and unburned checkerboard plots and the burning on Morgan's Savanna. Burn in the fall so that spring ephemerals, are not damaged. Skip a year if the fall burn is not possible.

Approved.

B. Ideally, I would like to see a more gradual, fire-influenced transition between the upland forest and Wilson prairie, rather than an abrupt, former agricultural boundary. This would be easier if Bio 135 instructors had not set up a linear transect along the southern (and rather ugly) edge of the upland forest without even notifying the director! Currently, the boundary is softening as the elms die, and oak and walnut establish in the grasslands. But there is still a "moat" of exotic smooth brome between the prairie and woods. Without this I would expect certain woodland and certain prairie species to enter the partial sunlight in the transition zone. Burning on the woods side of the firebreak in the early spring would weaken the Brome; this area could then be seeded to prairie species in the early spring.

Not approved, but should be discussed further.

C. Future of the forest. All literature indicates that oak forests will not recolonize without burning to create less than 80% canopy and to reduce the understory. My own computer simulations starting with the current CERA forest predict decline of oak with no recolonization (to be included). Managers of a few Iowa areas burn their oak woodland (ex. Indian Creek), but most state areas do not. In other states (Wis., Missouri) some oak woodlands are burned. The program is extensive in Missouri and has existed since 1983 (pers. com.). I think we should burn some area of the CERA forest and clear (minor) that area of species not considered by the Iowa experts (Dr. D. Farrar (ISU) and others) to be upland species.

I suggest that the area west of the experimental plots be burned in the fall as a unit and cleared of elm so that light increases to that under an 80% canopy. This area is large enough (about 40 x 70m) to allow oblique rays through the canopy (small plots would be ineffective). No seeding or planting should be done.

No conclusion. Continue to discuss.

ALLUVIAL RIPARIAN FOREST (70)

Location. On the Skunk River floodplain east of the upland forest and west of the river.

General Description. The Alluvial-Riparian forest lies in the alluvial plain of the former unchannelized Skunk River and therefore dates from the mid 1920s (the old bed of the river can be discerned somewhat on the topo map and from the ground). See article on channelization of the Skunk R. by John Madson. 1972 (Sept.). A plague on all your rivers. Audubon. pp.30-41. Large silver maple, box elder, walnut, cottonwood and green ash are present; some probably were present before the channelization. Butternut was common until the 1970s, after which disease killed most of the butternut in Iowa. The understory is distinctly different from that of the upland forest. Small ephemeral ponds, originally part of the unchannelized Skunk R., form in the spring and serve as breeding sites for invertebrates, tree frogs, cricket frogs, and perhaps for other amphibians.

Soils. Uncertain from map. 220A? Needs to be checked.

History. Presettlement. This area was the overflow basin of the Skunk River, and the original bed of the river before channelization.

Pre-CERA. After the river was channelized in 192? this area was left approximately 10 ft. above the normal river level. Nevertheless the plain slopes away from the current riverbank toward the west; therefore the area is not well drained.

CERA. No management.

Burning, clearing, herbicide, mowing, seeding, planting. None.

Understory. Elderberry (*Sambucus canadensis*), gooseberry (*Ribes missouriensis*), hog peanut (*Amphicarpa bracteata*), wood nettle (*Laportea canadensis*), stinging nettle (*Urtica dioica*), blue phlox (*Phlox divaricata*), *Osmorhiza claytoniana*, *O. longistylis*), Virginia waterleaf (*Hydrophyla virginianum*), violets (*V. sororia*, *V. pratincola*), swamp buttercup (*Ranunculus septentrionalis*), etc.

Recommendations for management. None.

Recommendations for Use. Study of riparian forest on alluvial soil.

**WETLANDS ALLUVIAL PLAIN (tree plantation) (90)
ROADSIDE DITCH (101)**

Location. East of the Skunk River.

General description. When CERA was purchased, riparian forest existed along the channelized Skunk River banks, and east of the channelized Skunk R. where the old Skunk River bed swings more easterly. Here there are several large ephemeral ponds, large cut-leaved maple, and very large green ash and black walnut (8 ft. circumference). Most of the forest of elm, cottonwood and box elder and its understory, however, is far younger (< 80 yr. old) than the riparian forest on the west side of the Skunk R. There is a stand of mature black locust, not native here, but brought into most of the midwest and planted for fence posts because of its resistance to rot. Many farms had a stand.

The rest of the area had been cultivated. In 1970 the northern section was planted with black walnut alternating with white pine (to self-prune the walnut), and the southern section was planted in reed canary grass, big bluestem and Indian grass. This was then invaded by cutleaf maple (a dog-hair stand).

The roadside ditch is an ordinary ditch but contains some infrequent to rare plants (*Spirea alba*, *Iris shreveri*, water plantain (*Alisma plantago-aquatica*), Arrowhead (*Sagittaria*) sp. It is always filled with about one foot of water in the spring, and often contains water through the summer. It is an excellent breeding site for Blanchard's cricket frog and perhaps other aquatic amphibians and insects.

Soils. Near the river (on both sides)**no reference to map numbers - 220A.** Further east is a band of Kennebec silt loam, an alluvial soil formed under prairie vegetation with over 20" of topsoil remaining. The northeastern 1/3 is Zook silty clay, an alluvial soil with over 12" of topsoil remaining. No association with a vegetation type is mentioned in my literature.

History. Presettlement. The topography would seem to indicate that the Skunk River flood plain stretches more than 1/4 mile to the east, and that all of this area was flooded quite frequently. Even with a deep channel, the Skunk has covered this entire flood plain at least once in the last 30 years (pers. obs.). Undoubtedly it was wet to wet-mesic prairie (given the soil description), and perhaps too wet for trees.

Pre-CERA. The river was channeled in the 1920s and most of the area to the east was probably cultivated thereafter, except in the forested area. I assume that the road and ditch were constructed at this time.

CERA. Cultivation was stopped and the area was planted in trees and grass in 1970. No management has been done since.

Burning, clearing, herbicide, mowing. None.

Seeding. Reed canary grass (18.7 seeds/sq./ ft.), big bluestem (18.7 seeds/sq. ft.) and Indiangrass (4.8 seeds/sq. ft.). Unfortunately, only the exotic reed canary grass is common.

Planting. Black walnut (1250), white pine (2000) and Douglas Fir (100).

Understory and Ground cover. Nothing unusual was seen in one visit. In the wooded areas there is much black raspberry, *Osmorhiza*, clearweed, black snakeroot, and stinging nettle; wood nettle, common on the same soil next to the river on the other side, is not abundant.

Recommendations for management.

To bring the area back to a native state, the Reed canary grass (*Phalaris arundinacea*) should be eliminated with Roundup.

The cutleaf or silver maple is native here and belongs at this level of moisture. If we want a wet-mesic prairie, however, the maple should be cut and treated with 30-50% Roundup or with RTU Tordon.

Ben Graham planted the walnuts as a demonstration woodlot and for income (well into the future when the trees are harvestable).

SOUTH SLOPE SAVANNAS, CLOSED SAVANNAS AND WOODLAND (40-49)

Introduction. Classification of savannas is in a state of flux (DeLong, 1996). The most recent classification, and the most logical biologically, is that of Henderson (1994). These ecosystems in Iowa probably were not extensive areas of savanna, closed savanna, or woodland similar to those that were found in southern Wisconsin, Missouri and Illinois. Rather, the oak-prairie transition in Iowa was probably a mosaic of prairie and fire-influenced forest with steep gradients from one type to another: prairie here, a few oaks there, and closed savannas and woodland on east to north-facing slopes.

Description and classification of savannas (from DeLong, 1996). Oak ecosystems in the Midwest range from closed-canopy forests to scattered trees in prairies. A broad part of this continuum, generally called savanna, has a two-tiered structure, an incomplete canopy, and a predominantly herbaceous understory of graminoids and forbs (Bray 1955, 1960; Curtis 1959; White and Madany 1978; Nuzzo 1986; Packard 1993). The composition of the understory is closely related to both prairie and dry oak forest communities (Curtis 1959), but includes a higher proportion of forbs than a prairie, and a lower proportion of forbs, vines and shrubs than an oak forest (Bray 1960).

Bur oak (*Quercus macrocarpa*) was the dominant tree of the oak savanna in the prairie-forest transition zone in Iowa, Minnesota, Wisconsin, and Illinois (Burns and Honkala 1990), and bur oak savannas probably occurred intermittently throughout the entire ecological range of bur oak, from dry uplands and droughty sandy plains to black prairie loams, fertile sandstone or limestone soils, and moist bottomlands (Curtis 1959; Moran 1980; Burns and Honkala 1990). *Quercus alba* also formed savannas on dry slopes, *Q. velutina* and *Q. ellipsoides* (NE Iowa only) on dry slopes and sandy alluvial flats, and *Q. bicolor* (primarily SE Iowa) on alluvial plains (Curtis 1959; Eilers and Roosa 1994).

Unfortunately the term *savanna* has been applied to a fairly wide range of habitats with varying degrees of canopy closure, and there is no single accepted classification. Curtis (1959) defined savanna as having between one tree per acre and a canopy coverage of 50%, whereas Madany (1981) used the definition of the Illinois Natural History Areas Inventory of 10-80% canopy coverage (White and Madany 1978). Other classifications have been proposed, some of which classify communities with between 30 and 70% canopy coverage as closed canopy savanna or woodland (Botts, et al. 1994; Faber-Langendoen 1994, 1995). In each classification, the term forest was used for communities with the highest canopy coverage.

Henderson (1994) classified oak-dominated communities in the prairie-forest continuum by utilizing fire and floristics of the understory as well as physiognomy and the coverage of the canopy. By his classification, intermediate between forests and prairies are the communities with a two-tiered structure of trees taller than 5m which form an incomplete canopy; the understory is predominantly herbaceous. Summer- and fall-blooming groundlayer plants are prevalent and productive; fires are frequent. Within this continuum, savannas have a canopy coverage of 5-30%; grasses predominate in the groundlayer; fires can be frequent and intense. Closed savannas and woodlands are characterized by a higher percentage of canopy coverage: 30-70% for closed savannas and 70-100% for woodlands. In addition, in both closed savannas and woodlands, forbs are increasingly co-dominant with grasses, and there is frequent, less intense, fire. Finally, forests are multi-layered, with well-developed woody understories. Spring ephemerals and fire-sensitive herbs are increasingly prominent, and summer- and fall-blooming groundlayer plants are less prominent or absent. Fires are infrequent.

Location. From Perley Prairies south to the intermittent stream (Perry stream) leading to Perry Pond, and from the western boundary of CERA to the road between the machine shed and the bridge across the stream.

General Description of the South Slope Savannas. This ridge and ravine system, with the ravines oriented north-south, is on soils typical of a timber-prairie mosaic. The most heavily wooded areas are the east-facing slopes of the ravines, and the lower gentle slopes near the southern alluvial-colluvial region. The crests and west-facing slopes are more open savanna.

These areas consisted only of grassland and large oaks in the 1950s and the early 1960s (see the 1974 aerial photo). By the 1980s, encroachment of many species of trees and multiflora rose had turned the savanna between the large oaks into a thicket of native and exotic woody plants. Nevertheless, some native graminoids and forbs survived and served as a base for a diverse restored community.

In 1998 the area was a partially restored forest-prairie mosaic with savanna, closed savanna, woodland and forest all represented. The native grasses are becoming prominent, whether planted (see appendix), or endemic and encouraged through fire (nimblewill (*Muhlenbergia schreberii*), Virginia wild rye (*Elymus virginicus*), downy wild rye (*E. villosus*), bottlebrush grass (*E. hystrix*), *Panicum implicatum*, *Panicum oligoanthos*, prairie three-awn (*Aristida oligantha*), bead grass (*Paspalum setaceum*), upland bentgrass (*Agrostis perennans*), ticklegrass (*A. hymelis*), whitegrass (*Leersia virginica*), and numerous sedges and rushes. Before seeding, the diversity of high quality prairie and savanna forbs was poor except for a large population of prairie violet (*Viola palmata*), scattered violet wood sorrel (*Oxalis violacea*), and a scattering of common forbs: great blue lobelia (*Lobelia siphilitica*), pale spike lobelia (*L. spicata*), bell flower (*Campanula americana*), partridge pea (*Chamaecrista fasciculata*), late boneset (*Eupatorium altissimum*), round-headed bush-clover (*Lespedeza capita*), bergamont (*Monarda fistulosa*), and prairie ragwort (*Senecio platensis*).

Soils. Down's silt loam, a silty clay loam formed from loess under mixed prairie and forest vegetation. The ridges are mesic to dry-mesic. The flat bottomland along the stream is Colo-Judson alluvium and colluvium which is mesic to wet-mesic.

History. Presettlement. Most of this area was probably prairie with a few bur oaks on the east-facing slopes of the ravines and in the bottomland. As in all transitional areas, however, an ebb and flow of trees probably occurred between periods (years, decades or centuries) of hot, more frequent fires, and cooler, infrequent fires.

Pre-CERA. We only know that most of the area was grazed until the late 1940s by horses, cattle and sheep. This accounts for the predominance of grasses rather than forbs or trees at the time of purchase. Apparently the area was also seeded to exotic smooth brome (*B. inermis*) sometime in the early 1900s; this the grass commonly planted on Iowa roadsides and in many grazed pastures.

CERA. I remember walking this open area with no difficulty from 1967 to the late 1970s (see aerial photo, 1974). By the late 1980s the concept of tallgrass savanna arose in the literature, and in 1988 we began to clear the then invaded area of extensive crab-apple, hawthorn, plum, elm, and exotic multiflora rose and mulberry. Burning began at this time but was inept; we did not know what would burn when, or how. By 1990 much of Wigwam Ridge and West Ridge (41-43) had been cleared; seeding of native grasses and forbs began in 1993 and has continued through 1998. Currently, a very diverse mixture of endemic, seeded and planted grasses, forbs and shrubs is present, although the exotic annual yellow and green foxtails and the perennial brome and blue grasses are still visible. By 1998 most of the large oaks on the eastern

boundary (46, 48), were isolated from small elm and the grassy areas (bluegrass and smooth brome) were seeded to native grasses.

Burning. All that would burn, since 1988; on most years the burns were nearly complete.

Clearing. Wigwam in 1988-92, West ridge in the early 1990s, southern parts of wigwam and west ridge in 93-95, central ridge and the eastern boundary 94-97, and more southern parts of Wigwam and West Ridge in 1998.

Herbicide. Tordon (RTU) or roundup (33%) were used on some stumps, crossbow was used on multiflora rose, burdock, and sweet clover, and roundup (1-2%) was used on Reed canary grass .

Mowing. To chop off immature seedheads of burdock and sweet clovers, and to reduce plum, blackberry, and other sprouts before and after seeding.

Seeding and Planting. See Appendix B.

Understory and groundcover. Too complex to describe briefly - see *Description of the South Slope Savannas*. The tall grasses, and the short *Paspalum*, and *Panicum*, all of which thrive in full sun, give way to ticklegrass, upland bent grass, nimblewill, bottlebrush grass, Virginia wild rye and sedges as cover increases. Purple oxalis, hairy wood mint, yellow and purple giant hyssop, geranium, sweet cicily and anise-root, Virginia waterleaf, white snakeroot, and spring ephemerals increase as cover increases. In the alluvial bottomland, sedges, Virginia mountain mint and other mesic to wet-mesic species are more common.

Rare or unusual species.

Plant. *Paspalum* is found only at the south end of the wigwam ridge, prairie violet is found only on the lower slopes of wigwam and west ridge. *Panicum leibergii*, and *P. scribnerianum* are found on the dry-mesic hill crests of west and wigwam. *Oxalis violacea* is found near Hooper oaks and at the drip line of the oaks south of Wigwam crest. *Gentiana alba* is abundant on west ridge.

Animal. A large number of nests of the mound-building ant *Formica* (I was told) are present on the lower southern slopes and flats. They should be counted and marked with numbered metal stakes.

Recommendations for management. Burn yearly in the spring until the tall native prairie grasses replace cool-season smooth brome and bluegrass and will carry a fall fire. After that the savanna, closed savanna and woodland can be burned in the late fall (after oak leaves have fallen) or early spring (late spring would probably damage the prairie violets, *Oxalis violacea* and woodland ephemerals). Introduce more legumes, butterfly weed, phlox, pale purple coneflower and spurge. These have been planted, but have not yet appeared (1998). Seeded again in 1998.

Clear exotics and elms; proceed south through the oaks south of west ridge and wigwam, and west from the shed-bridge road.

Note! The area to the south of the firebreak-trail (continuation of the south slope alluvial bottomland) is an impenetrable tangle of nettle and tall (10 ft) dense multiflora rose.

1. This could act as a control to the area to the north, or

2. We could burn to the intermittent stream and have an accessible, more natural bottomland. The first burn would top-kill the rose; the second burn would decrease the size of the remaining dense, thorny brush, and subsequent burns would clear the area, leaving only small yearly sprouts of multiflora rose which could then be spot-sprayed easily. If cleared, this area would probably be seen to house more of the interesting *Formica* ant nests and the willows and cottonwood would be accessible, as would the north-facing slope across the stream. This slope was an easily walked-thru bur oak closed savanna with a dense understory of hazelnut in the late 1970s. It could be a valuable study area easily reached from the trails through the savanna complex.

Not discussed.

Recommendations for Use. Maintain as an area restored toward the presettlement condition for visual effect, habitat for animals, classroom projects, research, etc.

**PRE-1987 GRASSLANDS
BIG BASIN (26), HILLCREST (24), WILSON (25),
WEST MORGAN (51)**

Location. All of these areas are east of the lab prairies (Lab, NW Lab and NE Lab).

General Description. Two types of habitats must be considered: the formerly cultivated or grazed areas now in grass, and the ravines.

1. The cultivated areas [Hillcrest, which includes Morgan Prairie, (10.7 acres), Wilson (18.2 a), Big Basin (13.3 a)] were seeded in the late 1960s - early 1970s with cultivars from Wilson Seed Co. in NB. No forbs were included. They were burned only 2-3 times. Some areas in Big Basin and along the edges of Wilson Prairie are smooth brome and there is considerable exotic reed canary grass and smooth brome in the swale in big basin along with native endemic sloughgrass. Forbs are mostly native and exotic weedy invasives.

2. The ravines had some trees at the time of purchase; they were populated with elm, mulberry, black cherry, and some willow and cottonwood. About half of the elms have now died. A few isolated stands of black oak, with some bur and red oak, also occur on islands of higher ground.

Soils.

Tama Silt loam was formed from loess under prairie and it is the base of Hillcrest and upper Big Basin.

Downs silt loam was formed from loess under a timber-prairie transition (savanna, closed savanna, woodland) and it is the base for lower parts of big basin, and upper Wilson.

Fayette silt loam was formed from loess under timber, and it forms the lower part of Wilson.

History. Presettlement. Based on soils alone, the higher parts of these areas were prairie, and the lower parts of all but Wilson probably had scattered trees, or alternated between savanna and prairie. The lower part of Wilson adjacent to the Skunk R. was forested to some degree. I suspect that the ravines adjacent to the prairie were prairie swales.

Pre-CERA. When we purchased the area, all of these sections were cultivated except for big basin (grazed pasture); we have no idea when cultivation started. This might be determined by searching for and analyzing early aerial photos. The degree of erosion (only 7-12 inches of topsoil on the upper level areas and 3-7 inches on the slopes) indicates to me that cultivation had taken place for at least the first 40 years of this century. Erosion could also have been caused by over-grazing. Cultivation, at least recently, also implies treatment with herbicides and addition of lime and fertilizer.

CERA. These areas were seeded into tall grasses on April 25, 1969. Big basin was then inadvertently plowed and over-planted with soybeans. It was reseeded in July, 1975. Subsequently, these grasslands were burned, but very infrequently (1-3 times in 20 years). The badly eroded lower slopes of Wilson were first colonized by little bluestem, but after the first decade following planting this species was replaced by the taller grasses and it has mostly disappeared (1998).

Burning. Only 1-3 times in 20 years.

Clearing. Unnecessary.

Herbicide. Unknown.

Mowing. These areas were mowed at about 6" for a few years after seeding.

Seeding. Seeds were obtained from Wilson Seed Farm, Folk, NB.

	density (live seed/ft ²)
<i>Andropogon gerardi</i>	7.6
<i>A. scoparius</i>	5.9
<i>Sorghastrum nutans</i>	4.0
<i>Panicum virgatum</i>	8.9
<i>Stipa viridula</i>	8.2

Species. Grasses are still limited to the first 4 species. At least for big basin, the cultivars were Kaw big bluestem, Oto Indiangrass, Blackwell switchgrass, and Blaze little bluestem. *Stipa* was never seen and should not have been planted - it is native only as far east as the loess hills of w. Iowa. Forbs are mostly limited to weedy invasives: ex. *Artemisia ludoviciana*, *Solidago altissima*, *Solidago gigantea*, *Helianthus grosseserratus*, *Aster ericoides*, *A. pilosus*, and *Asclepias syriaca*..

At the northern edge of big basin on the high ground is some *Echinacea pallida*, presumed to be native because this area was pasture and was plowed only once.

In the seep north of Hillcrest are several species uncommon at CERA: grass-leaved goldenrod (*Solidago graminifolia*), sandbar willow (*Salix exigua*), *Juncus* sp. and *Carex* sp.

Morgan prairie has a large area of blackberry and an area seeded with locally-obtained *Amorpha canescens* and *Eryngium yuccifolium*.

The ravines consist of black and bur oak, black cherry, cottonwood, willow (sandbar in upper NE BB ravine, and large black (*S. nigra*) or peach (*S. amygdaloides*) in the lower ravine), box elder and elm. A beautiful stand of black oak (uncommon at CERA) is found on slightly higher ground at the NE end of the Big Basin Ravine. A stand of large willow with an understory of jewelweed is at the southern end of Wilson-Dam prairie ravine. It attracts large numbers of hummingbirds in mid September.

Rare or Unusual Species. None

Recommendations for management. Consider 3 areas: the grasslands, the boundaries of these grasslands with other habitats, and the ravines.

1. Formerly cultivated areas or pasture seeded to tall grasses. These areas are not prairies; rather, they are a mixture of western cultivars invaded by weedy native and exotic forbs and bluegrass. There has been little invasion by native grasses (for an example, see the list for the South Slope Savannas) or sedges. There is some colonization by multiflora rose, and by oaks, hickory, walnut, box elder, hawthorn, plum and crab around the edges.

Currently, we do not have the manpower to introduce native prairie species into these areas. Therefore, no management, except burning, should be done until a use is determined. Burning was rejected before this report in 5/97 without much discussion in the committee.

Burning would at least partially suppress invasion of some exotics and non prairie species and maintain the areas with vigorous tall grasses. Given the heterogeneity of these areas with respect to past history, slope, aspect, moisture and soil type, I would think that occasional burns would be desirable if a work force is available, and if time permits. Further, at least in the big basin section, the entire big basin, NE lab and W dam area, with the included ravine, could be burned as a unit. See below - ravines.

Discuss more fully.

I recommend burning west Morgan to suppress blackberry and to maintain a natural ecotone with Morgan's savanna - see the section on the forest.

Approved

2. Boundaries between these grasslands and other habitats:

a) with West Morgan

Approved

b) with the forest north of Wilson

Not approved

c) with the bottomland along the intermittent stream to the south

Not discussed

d) with the seep along the north side of Hillcrest

Not discussed

e) with the ravines

Not fully discussed

These ecotones might be managed differently than the grasslands.

3. Ravines. We can leave them as they are, or manage toward prairie swales with scattered oak and cottonwood.

I recommend creation of prairie swales with scattered oak and cottonwood as a goal, since thickets and recycling elm communities are very common at CERA and throughout central Iowa. Prairie swales are not common and could be a very interesting habitat to reconstruct and study.

To do this, the ravines should be isolated from the grasslands and burned (if the grasslands are not burned). With little effort, regrowth of elm and the rosaceous small trees would be prevented. Plugs of sloughgrass (*Spartina*) could then be used to slowly colonize the wetter areas, and the tall grasses could easily be inter-seeded around and in the ravines.

We do not have the resources now to actively manage (cut and clear) these areas.

Not fully discussed

Recommendations for use.

Grasslands. Use as areas for experiments on burning, invasion, productivity, diversity, development of soils, experimental planting, dispersal, animal density and composition, etc. They have little value as representations of prairie, but have considerable value as habitat for animal species and communities and to rebuild the soil.

Borders. Use as experiments in restoration, as examples of natural ecotones, and for study and experimentation.

Ravines. Use as experiments in restoration, as examples of prairie sloughs, and for study and restoration.

**1987 DIVERSE RECONSTRUCTED PRAIRIES
FALL BURN (1), PERLEY (2-5), DEANER (6),
EXPERIMENTAL PRAIRIE PLOTS (7), NE LAB (8), LAB (10)
and
1987 CRP GRASSLANDS
NWLAB (11,12), DAM(13)**

Location. The Dam Grasslands lie between Big Basin and Morgan to the north, and the dam and lake to the south. All other 1987 grasslands and reconstructions are east of Big Basin.

General description. These grasslands were planted in 1987 on land that had been cultivated before and after CERA was purchased, and after the purchase until 1987. As far as I know, fertilizers and herbicides were utilized before and after purchase of CERA. Thus, there was little residual seed bank except for common agricultural weeds. All areas were seeded with grasses in 1987. Enrichment with forbs began in 1990 on Deaner, and continued on subsequent years on all areas except the Dam and NW Lab Grasslands. These enriched areas support a very diverse forb flora. Except for the dam prairie, which has been burned only 3 times, most areas have been burned yearly, or on another approved schedule.

Soils. Fall burn, Perley, Deaner, upper Dam, and the upper diverse areas of NE and NWLab are on Tama silt loam with 7-12 inches of topsoil formed from loess under prairie vegetation. The Lab prairie and the lower parts of NWLab, and most of Dam are on Downs silt loam formed from loess under mixed prairie-forest vegetation.

History. Presettlement. Based on soils alone, most of these areas were prairie; the lower parts of NW Lab Prairie and the Dam Grasslands probably had scattered trees, or trees alternating with prairie through time.

Pre-CERA. When we purchased the area, all of these sections were cultivated, but we have no idea when cultivation started. Perhaps this could be determined by searching for and analyzing early aerial photos. The degree of erosion (only 7-12 inches of topsoil on the upper level areas and 3-7 inches on the slopes) indicates to me that cultivation had taken place for at least the first half of the century. But perhaps this erosion was caused by over-grazing. Further, the mixed prairie-forest vegetation would cause a soil with less topsoil when the forest component was high. Cultivation, at least recently, also implies treatment with herbicides and addition of lime and fertilizer.

CERA. These areas were cultivated until 1987 when they were entered into the CRP. By agreement, 3300 lb. of actual lime, 30 lb. of P and 40 lb. of K were applied (this was the stipulation; I'll try to find out if it was done). In 1987 all areas were planted to prairie cultivars from the Stock seed farm in Murdock, NB:

	pounds
<i>Andropogon gerardi</i>	72
<i>A. scoparius</i>	36
<i>Sorghastrum nutans</i>	36
<i>Panicum virgatum</i>	22

Ratios were stipulated by the CRP agreement.

Starting in 1990, all of Fall Burn, Deaner, Lab and NE Lab, the higher parts of NW Lab and most of Perley were heavily and repeatedly seeded with forbs, and were planted with a few select forbs (see appendix B). This has continued through 1997. Seeds were spread by hand and worked into the soil with a drag harrow pulled by a tractor or 4-wheeler which also compressed the soil for a firm seed-soil contact. Deaner was also seeded with noncultivar northern dropseed (*Sporobolus heterolepis*) and the Lab Prairie with side-oats grama (*Bouteloua curtipendula*).

In 1997 a series of 20 experimental burned and unburned plots was set up adjacent to the road on NWLab (E). These have now been used extensively in Ecology (upper level) and in Evolution and Ecology (freshman).

Burning.

Deaner and most of Perley have been burned annually since 1990, in the spring. Deaner was not burned in the spring, 1998 to start a new regime of intermittent burning. No burning appears to lead to suppression of early-season forbs, and to increased prominence of late-season forbs (perhaps they are less visible because of decreased flowering of the grasses).

Fall Burn has been burned annually in the fall.

Perley 2-yr. has been burned every two years.

Perley No Burn has not been burned.

NW and NE Lab were burned annually from 1989 until 1996 when a series of burn-no burn plots were set up on NWLab. Only these plots were burned in 1997-98.

Dam Grassland was burned 3 times.

Clearing. Bob cleared both ravines west of the lab of all trees but the oaks during two winters.

Herbicide. I think both grass and dicot herbicides were applied prior to 1987. Since that time there has been only spot spraying with crossbow for exotic forbs and shrubs, and stem treatment with tordon.

Mowing. Only for 2 years after the initial planting of grass, and after initial planting of forbs.

Seeding and planting. See appendix B for the time of seeding and the weight of seed used for each species on each area.

Groundcover. See appendix B, C.

Rare or unusual species. Some of the planted species are currently rare or very infrequent in central Iowa although they were not so when prairies were far more common. Among them are: *Aster azureus (oolentangiensis)*, *Astragalus canadensis*, *Baptisia leucophaea*, *Dalea candida*, *Parthenium integrifolium*, *Solidago speciosa*, *Zizia aptera*.

Recommendations for management.

1. Reconstructed diverse prairies. Burn when scheduled (Fall Burn, Deaner, No Burn, 2-yr. Burn) or every 1-4 years in either the spring or fall. This should be varied between areas (do not burn all every year, or all in the spring, etc.). Continue to seed and plant to increase diversity. Continue to control exotics.

Approved

2. Experimental plots. Burn annually in the early spring.

Approved

3. NE Lab prairie across road from Experimental plots. I read How, Henry F. 1994a. Succession and fire season in experimental prairie plantings. Ecology 76(6): 1917-1925. and found a lot of statistics and an interesting concept, but one tried on a very early succession of planted species with almost no well-represented species of high quality prairie present (many

weedy and exotic species were present). Indeed, even the cover was probably very unrepresentative of a natural prairie. Unfortunately he studied only cover, not flowering or production of viable seed. The thrust of the article was that mid-July fires were probably those that effected prairies before anthropogenic burns, and that these probably had a different effect than fall, winter or spring burns. In contrast to great plains prairies, however, midwestern prairies probably evolved with anthropogenic rather than lightning-caused burns.

Despite these shortcomings, a similar experiment could be very interesting for students and we might try a series of summer burn plots, alternating with spring or unburned plots, across the road from the current experiment. A good test of Huston's hypotheses on diversity. If started next summer, the experiment would be there to use whenever the faculty desires. This area is fairly rich in forbs.

See Roger C. Anderson. 1997. Summer fires. The tallgrass restoration handbook. This gives an overview and a critical analysis of Howe's work - Anderson is a highly respected person.

An alternative experiment would be alternating mowed and unmowed plots, or plots mowed at different times of the season to simulate grazing. Cut grass could be removed or left to decompose.

Not discussed

4. CRP grasslands. Burn infrequently to invigorate grasses, and to suppress invaders. I especially think that the ravines west of the lab should be burned. If the NWLab Grasslands are not to be burned, then the ravines should be isolated and burned to suppress the brome and allow the seeded tall grasses to increase. Especially here, where the ravines are clear, burning will maintain the "prairie" gestalt and increase the chances of nest success for grassland birds. It will also maintain the view of prairie and then savanna to the west of the lab prairie. A bit of culture is also a part of biology, although one often not presented to students, even in field biology. Just as the ACM Wilderness Field Station gains by being a *wilderness* field station rather than one using all modern conveniences and tools, so can CERA benefit from this approach in some areas, at least until a carefully considered more important use is determined.

Discussed briefly and rejected. I think this should be discussed further.

Appendix A.

Probable History and future succession of the Upland Forest

prepared by

Karl T. DeLong

CERA Director, 1987-1996

CERA Assistant Director, Restoration manager, 1997-

From a Laboratory in Bio 368 based on research done in 1986-87
In Microsoft Word and Cricket Graph

Procedure. I established 21 permanent 200m² quadrats on the upland plateau in 1986. All trees, saplings and seedlings were censused, and height and DBH were recorded; over 800 trees were cored (cores are mounted in a permanent collection with each individual identifiable by quadrat and distance and compass bearing from the center of the quadrat). The results given are for these plots on a single soil type, slope and aspect. Plots were also established in the south ravine and on the north slope, but are not included here.

Probable pre-CERA history. The oldest tree (white oak) that we found was a seedling in 1800, most were seedlings in the 1840s, and small saplings during the Rock Island Line ownership. The youngest white oaks were seedlings in the 1880s. The large horizontal branches of many of the oaks indicate that they were open-grown, so the area was probably clear-cut, or nearly so. Few of the white oaks are double-trunked, so most individuals probably arose from acorns or seedlings present at the time of cutting rather than from stump sprouts. Because of the dominance of white oak, I guess that white oak also dominated prior to the cutting, but at that time it was probably an open woodland subject to intermittent cool (E to N slope) fires which would have kept basswood, elm, cherry, etc. from establishing. I find it interesting that black maple is not present as it is at Christiansen woods, and at Ledges and Palisades-Kepler St. Pks.

The *Age Distribution Upland* histogram indicates that all of the old trees are white oak (remember that this is only the center of the upland plateau). Red oak occurs in the ravines and north slope and bur oak and black oak are found only near the edges. Note that American elm and slippery elm mostly colonized during 1940-60 and that basswood, ironwood and black cherry colonized during the 1950s *after* grazing stopped and *before* white-tailed deer became abundant in Iowa. Only bitternut hickory shows a pattern of increased colonization.

Basswood, bitternut, hackberry, black cherry and elm fill in most gaps caused by dying canopy oaks and elms. Note that only six white oak exist between 0 and 100 yrs.

Size, growth rates, and tolerances for trees found at CERA

Species	Maximum Height (m)	Maximum Age (yr)	Shade Tolerance *	Drought Tolerance **	Max Growth Rate ***
Bitternut Hickory	35	300	3	.3	86
Shagbark Hickory	35	350	3	.2	86
Hackberry	30	200	3	?	132
Black Walnut	50	250	4	.3	215
Hop Hornbeam (ironwood)	18	150	1	.28	128
Black Cherry	40	250	4	.16	198
White Oak	42	400	3	.33	91
Bur Oak	40	400	3	.35	87
Basswood	38	175	2	.2	189
American Elm	35	250	3	.33	205
Slippery Elm	35	200	3	.33	205

Note:

Maximum height: this is the genetic potential realized in the best habitat in the country; similar to 7' 10" for humans

Maximum age: this is the realized genetic potential in the best habitat in the country; similar to 100 yrs. for humans. Note also that a long-lived tree, once it occupies a space in the canopy, will hold that space unless another tree grows faster and overtops it.

* After Baker. 1 is most tolerant, 5 is least tolerant

The data on light tolerance are mostly from observation and were first published in the 40's. We now know that for each tree the photosynthetic ability, efficiency of respiration, shoot growth rate and top growth rate vary with respect to availability of light, moisture and different nutrients, and that the demand for each of these resources varies with the time of year, the age of the tree, and the level of the other resources (somewhat complex). Although this can be put together with a computer, you can not do it in your head. Thus, judge the relative competitive ability of the trees by what you see (trees integrate the above) and what you can glean from the data on the forest distributed to you. Pay special attention to the relative abundance of species in each size category.

** proportion of the growing season during which drought can be tolerated

*** a relative figure from which increment of the diameter and increment of height can be calculated. Keep in mind that if two trees have the same tolerance for shade and one grows faster, it will outcompete the other for light.

A guide to interpret some of the above data (taken in 1986).

These figures are gleaned from the nearly 800 trees at CERA on which we have complete data. Keep in mind that all trees < 100 yrs old were grown near or under white oaks and therefore in at least partial shade for part of the day. Secondly, there are no old representatives of many of the species.

white oaks: 100 - 184 yrs old, a rather normal distribution with by far the most trees in the 130 - 150 yr classes. The tallest is 30 m. The only trees less than 100 yrs old are small seedlings less than 10-20 cm tall; very few of these live more than 2-6 yrs.

bur oak: few exist in the central part of the main woods; those that do are \pm .5 m DBH and 120 yrs old.

American elm: 10-30 cm DBH trees are 25 - 60 yrs of age; the oldest is 70 yrs, 20 m high and 34 cm DBH

slippery elm: 13 -30 cm DBH trees are 25 - 60 yrs of age; the oldest is 86 yrs, 25 m high and 50 cm DBH

bitternut hickory: 10 - 30 cm DBH trees are 25 - 50 yrs of age; the oldest is 70 yrs, 18 m high and 50 cm DBH

shagbark hickory: a 5 cm DBH tree can be 40 yrs of age; 23 cm DBH trees are close to 100 yrs. The tallest is 20 m on the study area.

basswood: 2.5 cm DBH trees are about 15 yrs old; 15 cm DBH trees are about 40 yrs old.

black walnut: an 21 cm DBH tree is about 35 yrs old; a 50 cm DBH tree is 50 yrs old and 30 m high. Walnut appears to be able to grow very rapidly the first year due to the large storage of energy in the nut, and thus can rise above the herbaceous ground vegetation which is 10 - 30 cm high during the summer and is most sparse under the most dense overstory. Similarly, oak, using energy from acorns can survive the first year, but if light is not above a critical level, leaf area will decline yearly until the seedling dies.

hackberry: much variability; 3 -20 cm DBH trees are 30 to 50 yrs old with a large scatter (size dependent on light more than age).

hop hornbeam: 5 cm DBH trees are close to 30 yrs old and 11-16 cm trees are close to 50 yrs old.

cherry: no data

Statistical Averages for Forest Data from the Main Upland Study Area at CERA, 1986
21 200 m² quadrats

	# Ind	Freq	RF	Dens	RDen	Dom	RDom	IV
American Elm	21	.62	.18	50	.15	52	.06	.38
basswood	13	.38	.11	31	.09	19	.02	.22
bitternut hickory	4	.19	.05	10	.03	6	.01	.09
black cherry	2	.10	.03	5	.01	4	.00	.04
black walnut	6	.19	.05	14	.05	65	.07	.18
box elder	1	.05	.01	2	.01	5	.00	.02
bur oak	1	.05	.01	2	.01	12	.03	.05
hackberry	9	.29	.08	21	.06	14	.02	.16
ironwood	6	.19	.05	14	.04	22	.02	.12
shagbark hickory	3	.10	.03	7	.02	15	.02	.06
slippery elm	18	.38	.11	43	.13	50	.08	.31
white oak	50	.95	.27	119	.39	660	.67	1.33

Statistics for: trees with DBH >= 13 cm DBH

This analysis of the forest was done on the VAX using RS1 and procedures written by Susan Bowen in RPL (research programming language) during the summer of 1986.

	# Ind	Freq	RF	Dens	RD	Dom	RDom	IV
American Elm	53	.76	.17	126	.22	10.9	.21	.60
basswood	38	.48	.11	90	.16	8.0	.10	.37
bitternut hickory	22	.67	.25	52	.09	3.5	.07	.31
black cherry	5	.24	.05	12	.02	1.8	.03	.10
black walnut	1	.05	.01	2	.00	.5	.01	.02
box elder	2	.10	.02	5	.00	.8	.02	.04
hackberry	18	.62	.14	43	.08	.3	.14	.35
ironwood	53	.57	.13	126	.22	12.4	.18	.53
slippery elm	42	.76	.17	100	.27	11.0	.22	.56

Statistics for: trees with 2.5 cm DBH >= DBH <13 cm DBH and height > 1 meter

	# Ind	Freq	RF	Dens	RD
American Elm	8	.24	.18	19	.15
basswood	3	.14	.11	7	.06
bitternut hickory	14	.52	.39	33	.40
hackberry	6	.14	.11	14	.12
ironwood	5	.19	.14	12	.11
slippery elm	1	.05	.04	2	.05

Statistics for: trees with DBH < 2.5 cm DBH and height > 1 meter.

	# Ind	Freq	RF	Dens	RD
basswood	1	.05	.03	5	.01
bitternut hickory	14	.38	.21	67	.18
black walnut	4	.19	.10	19	.04
hackberry	15	.48	.26	71	.19
red oak	3	.14	.08	14	.07
shagbark hickory	2	.05	.03	10	.02
elm	27	.38	.21	127	.19

Statistics for: seedlings (ht < 1 meter).

(21 100 m² quadrats)

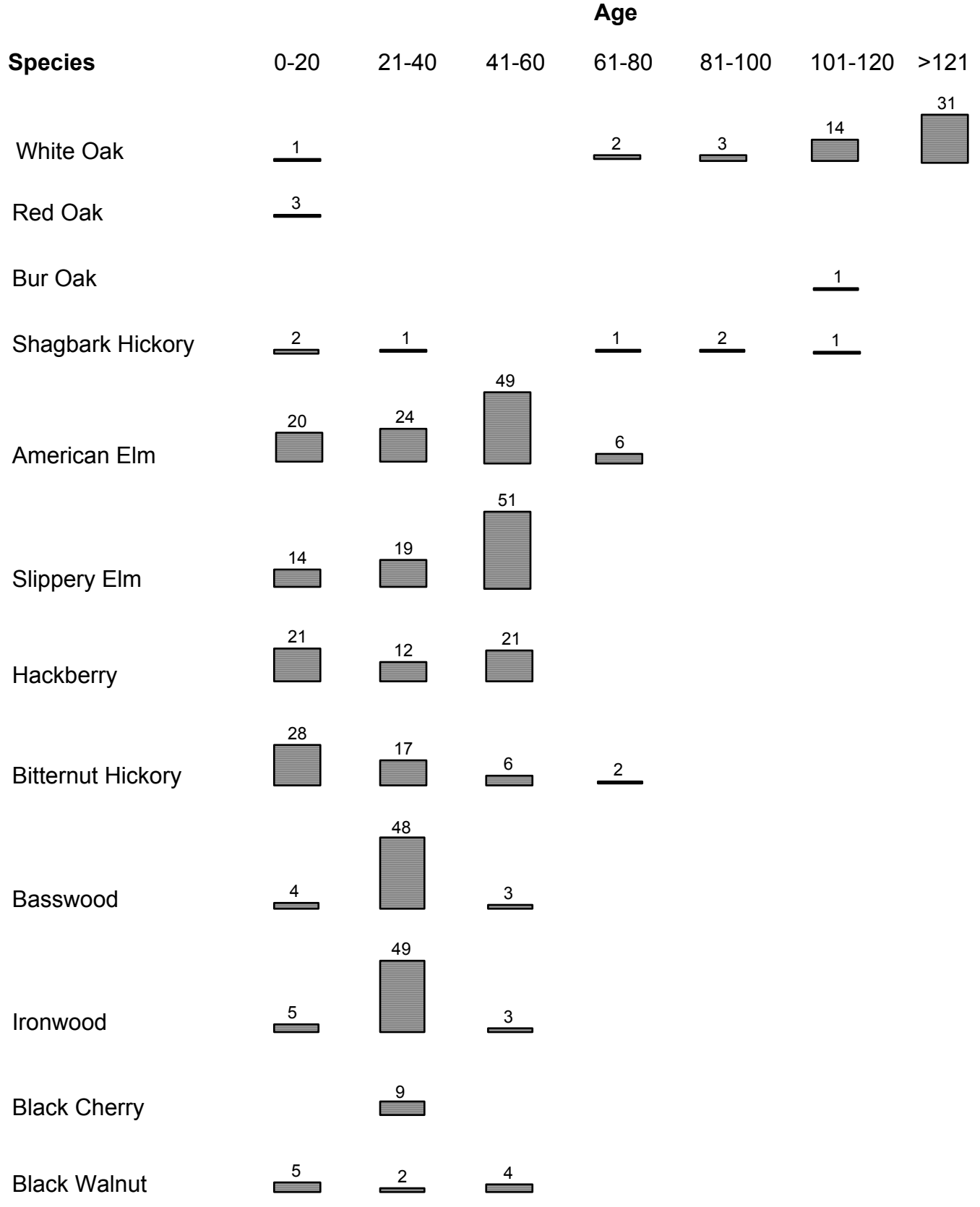
frequency: the proportion of quadrats in which the species is found.

density: # individuals per hectare (10,000 sq. meters)

dominance: based on basal area at breast height which is proportional to coverage (the area of the canopy)

importance value: RF + RD + RDom

AGE DISTRIBUTION UPLAND



← increase in deer ← grazing, browsing cattle, sheep, horses → ?

Year 1990 1970 1950 1930 1910 1890 1870

APPENDIX B

SCHEDULE OF SEEDING and PLANTING

on

RECONSTRUCTED AND RESTORED AREAS

prepared by

Karl T. DeLong

CERA Director, 1987-1996

CERA Assistant Director, Restoration manager, 1997-

An EXCEL table

Completed through Summer, 1998

2nd Edition, with new place locations, and with one species list for each area; after each species the dates of repeated seedings or plantings and the amount/number of individuals is given.

Introduction

The previous table of seeding and planting was awkward. When I checked locations for the success of seeding, I would have to go through one list of species for each year that I seeded; this resulted in four lists for some areas. Secondly, there was no way to separate the results of each seeding (established plants) when the same species was repeatedly introduced. Thirdly, if students and faculty wanted to know the seeding of an area, to separate endemic from introduced species, or to have a quick reference for the introduced plants in a restoration, the chronological organization was inconvenient. Thus, four changes have been made.

1. There is only one species list for each area, with the dates and amounts of seed for multiple seedings given after each species.

2. The new location numbers and abbreviations used in the *Documentation of Distinct Ecological Areas* has been used.

3. The multiple listings for some areas have been condensed.

a) For example, in the Perley complex (No Burn, 2 Year Burn, Burn) we initially seeded grasses into all of Perley in 1987, and then interseeded forbs over the entire area in 1992 (34 species of forbs). Because of the expense of seeds, this entire area was not completely interseeded again (I now wish that it had been). Rather, I enriched the area along the road from the entrance to the 2 Year Burn in a strip about 30 meters wide, and then added some seed to particular areas which had not taken (some areas lacked grass) or which were distinct (*Liatris pycnostachya*) in the seep at the north end of the ravine. For the Perley Prairies, the three areas are still listed separately with notes under *Remarks* indicating that all species of Perley (02) apply to all areas as a minimum, and that some seedings were in restricted areas.

b) The organization of the South Slope Savanna has been altered. This area originally consisted of just West Ridge and Wigwam and was termed the South Slope Savanna. An initial seeding was done here in 1993 in both areas. Later seedings were made to more carefully match habitat and the two areas were treated differently. In this case it makes sense to drop the old South Slope Savanna specific heading for this table and to incorporate the seeds sown in 1993 into the two regions of West Ridge and Wigwam.

4. Names of other small areas have been dropped from this table. Seeds or plants introduced to these areas are listed under the larger areas, with the specific location of the seeds indicated under *Remarks*.

Finally, I find that categorizing the abundance of each species on each area is close to impossible. Not only does this take many repeated censuses throughout the year, but the apparent abundance changes according to rainfall, etc. If an abundance is listed, however, you at least know the approximate abundance. If an abundance is not listed, it does not mean that the species is not present - it might have been overlooked, or the area (ex. EPP) might not have been thoroughly checked. Please let me know if you or your students record species not listed as C, I, R, or present.

APPENDIX C

A CHECKLIST OF SPECIES FOUND AT CERA
including
SPECIES NOT YET FOUND, BUT KNOWN TO BE COMMON OR FREQUENT IN SC IOWA

Microsoft Word - sortable by column
Edited 9/98

Introduction.

Key. IA nSC. Before I wrote my paper on Iowa savanna, some plants native to Iowa, but not to south-central Iowa, were seeded or planted. I was unaware of Van Bruggen's thesis, *The Flora of South-Central Iowa*, and Eilers and Roosa had not yet written *The Vascular Plants of Iowa, an Annotated Checklist*. (1994).