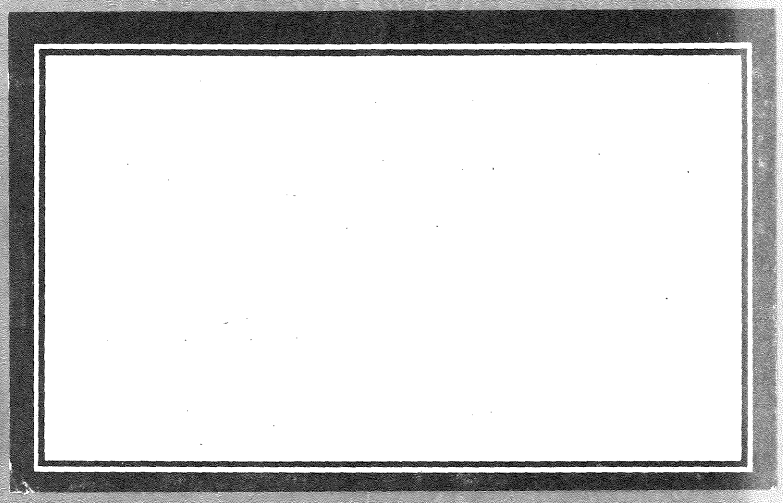

Management Plan
for
Western Prairie Scientific and Natural Area
North Unit
Wilkin County, Minnesota

E½ (Except E½ E½ NE¼) Section 17
Township 136 North, Range 45 West
Barnesville Quadrangle

Prepared by
Minnesota Chapter
The Nature Conservancy

and the

Scientific and Natural Areas Program
Section of Fish and Wildlife
Minnesota Department of Natural Resources

December 1982

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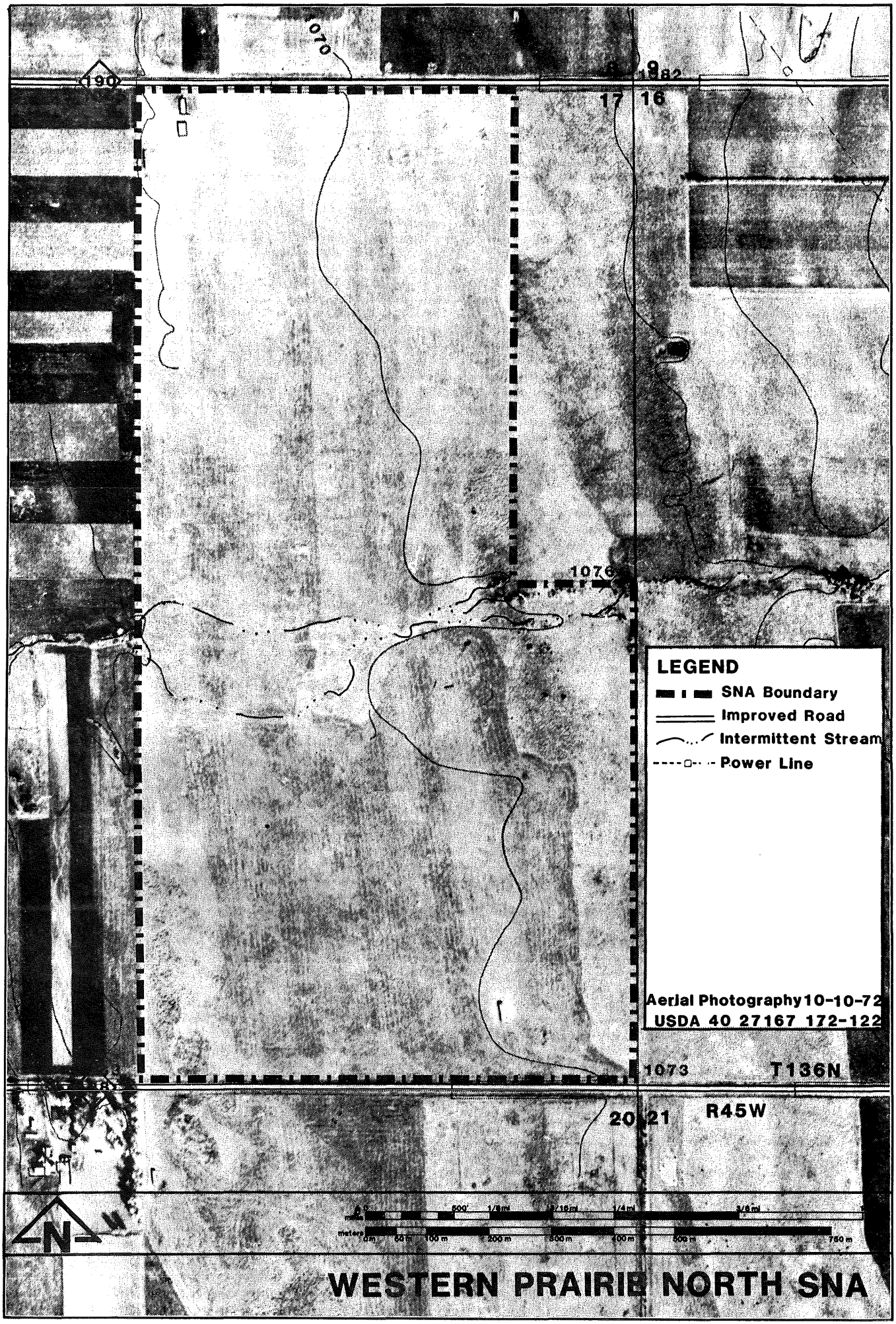


WESTERN PRAIRIE NORTH SNA

Introduction

Most Significant Resources

Western Prairie North is one of a small and rapidly diminishing number of native prairie tracts left in Minnesota. Before the intense agricultural development of the 19th and 20th centuries, the rich, diverse tallgrass ecosystem found on this preserve covered much of the western part of the state. These prairies supported large populations of many plants and animals that are now in danger of extinction. Because it is a valuable store of diversity in its own right, and because it is vital to the survival of a number of unusual species, the virgin tallgrass prairie plant community at Western Prairie North is the site's most significant resource. Of the many unique species that live here, the most rare and significant species discovered so far are described below. The gentian, Gentiana affinis, is classified as rare by the Minnesota Natural Heritage Program (1980). The small white ladyslipper (Cypripedium candidum), found on the wetter parts of the preserve, is relatively common in Minnesota but is rare in the United States as a whole. Several birds which have been seen at Western Prairie North are considered significant by the Minnesota Heritage Program (1981); these are the marbled godwit, Limosa fedoa (classified as rare), the upland sandpiper, Bartramia longicauda (a species of special concern), and the greater prairie chicken, Tympanuchus cupido (threatened). Finally, the prairie vole, Microtus ochrogaster, is a rare species found in Western Prairie North's mesic prairie community.

Unit Goal for Western Prairie (North) Scientific and Natural Area

The unit goal for Western Prairie North is to preserve and enhance the natural flora and fauna of this undisturbed tallgrass prairie, and to provide research and educational opportunities on the preserve where such use will not impair the quality of the preserve.

Scope and Organization of the Management Plan

Western Prairie North was acquired by The Nature Conservancy because knowledgeable individuals reported that the tract supports undisturbed tallgrass prairie with few alien plants, a vegetation type that is rare in Minnesota and throughout the United States and which is disappearing rapidly. Together with Western Prairie South and nearby federal and state lands, the tract enhances the possibility of maintaining a remnant population of prairie chickens in the area. Western Prairies North and South were dedicated as a state Scientific and Natural Area (SNA) in 1974 (Appendix A). The 1980 inventory, a cooperative project of the Minnesota Department of Natural Resources (DNR) and The Nature Conservancy, described and thoroughly documented the physical and biological resources of the sites.

The purpose of this management plan is to describe the specific actions which will be taken in managing Western Prairie North. General goals for management, called "management objectives," are listed on page 5; a summary of specific actions and the main body of the plan -- the actions themselves -- follow. The appendices (pp. 43 on) include detailed information on several considerations affecting the area's management: the SNA program, SNA and TNC management policies, relevant state and local land-use laws, and technical descriptions of several monitoring methods for plants and animals on the prairie.

Review of the Plan

The actions outlined in this plan must be considered provisional, not definitive, and should be reviewed periodically to see that they are still relevant in light of current conditions. Changes in the site's resources, users, and other management considerations are bound to occur. If warranted, the plan's management actions can and should be modified so that they more effectively and/or efficiently implement TNC guidelines and SNA policies. All proposed actions should be primarily directed at protecting and preserving elements which are a significant part of Minnesota's natural diversity. In any event the plan should be thoroughly reviewed and updated at intervals of no longer than every ten years.

Management Objectives and Considerations

The following management objectives were derived directly from TNC and SNA policy; the policy sources are listed after each objective. The actions that will implement each objective are listed in abbreviated form on the right, along with a number referring to the Management Actions section (see page 7).

Resource management objectives	Actions and action numbers
1. Re-establish fire (TNC policies 2, 3a; SNA policy 3)	Prescribed burn (2) Conservation easements (18)
2. Minimize damaging human impact (TNC policies 2,3b,4,9; SNA policies 3,7,8,15,16,17,19,22)	Wildfire containment (1) Old-field succession (3) Hayloader (8) Fence maintenance (9) Boundary signs (11) Parking (12) Conservation easements (18) Boundary lines (17)
3. Monitor general condition of preserve (TNC policies 2,3b,4; SNA policies 1,2,5,19,24)	Volunteer manager (20) Inspections (25) Water table (26) Annual report (27) Vegetation monitoring (28)
4. Minimize safety hazards to visitors (TNC policy 7; SNA policy 17)	Parking (12)
5. Complete collection of baseline data (TNC policy 6; SNA policies 1,2,15b)	Herpetological inventory (4) Rare plant search (6) Plant collections (7) Water table (26)
6. Inform local citizens of the nature and features of the preserve (TNC policies 5,6; SNA policies 4,12,18)	Wildfire containment (1) Boundary signs (11) Map (13) Brochure (14) Field walks (15) School use (16) Sign and registration box (19) Volunteer manager (20) Neighbor contacts (23)

Resource management objectives	Actions and action numbers
7. Maintain contact with resource professionals and educators (TNC policies 5,10; SNA policies 4, 9,13,14,15b)	School use (16) Professional contacts (21) C.O. contact (22) Monitor research (24)
8. Monitor populations of species of special concern (TNC policy 1; SNA policies 2,5)	Gentian study (5) Rare plant monitoring (29) Rare animal monitoring (30)
9. Provide suitable habitat for rare animal species (TNC policies 1,2; SNA policy 2)	Prescribed burn (2) Mow booming ground (10)

Summary of Management Actions -- Western Prairie North

Resources

1. Implement a wildfire containment plan that will protect the prairie from damage by fire-control equipment.
2. Periodically burn parts of Western Prairie North.
3. Allow natural succession to restore the old fields and former building sites.
4. Conduct a more thorough inventory of reptiles and amphibians on the preserve.
5. Survey size, locations, and condition of the *Gentiana affinis* population.
6. Attempt to locate *Rumex occidentalis*, *Gentiana macounii*, *Puccinellia nuttalliana*, *Carex scirpiformis*, and *Carex hallii* on the tract.
7. Complete collections for inventoried plant species.
8. Remove the old hayloader from the preserve.
9. Maintain the fence which marks the east edge of the northern half of the preserve.
10. Mow a small area for a prairie chicken booming ground in years when no part of the preserve is burned.

Use

11. Replace missing or damaged boundary signs as needed.
12. Continue to allow parking along the road that forms the preserve's south boundary.
13. Develop and distribute a map showing the tract's boundaries and general features of interest.
14. Develop a brochure on Western Prairie North and distribute it to users, potential users, adjacent landowners and other interested parties.
15. Conduct guided field walks on Western Prairie.
16. Encourage local middle and secondary schools, regional educational institutions, and researchers to use the site if appropriate.
17. Confirm and straighten boundary lines in agreement with neighboring landowners to the east and west; conduct legal surveys if necessary.
18. Acquire conservation easements around the preserve.
19. Erect a main recognition sign and registration box, and maintain them, keeping the box supplied with information and visitor registry materials.

Monitoring

20. Recruit a local volunteer land manager, preferably living within three to four miles of the tract.

21. Develop and maintain a close relationship with local and regional government officials, natural resource management professionals, and other appropriate individuals.
22. Contact the local DNR conservation officer (CO) and request his or her assistance in managing the site.
23. Develop closer communication with the local residents and promote good neighbor relations.
24. Maintain close contact with all scientists who are using the site for research and educational purposes.
25. Periodically inspect the site.
26. Develop and implement a water table monitoring program.
27. Submit an annual written report to TNC and the SNA program.
28. Develop and implement a vegetation monitoring program.
29. Map and monitor populations of Cypripedium candidum.
30. Monitor populations of the marbled godwit (Limosa fedoa) upland sandpiper (Bartramia longicauda), greater prairie chicken (Tympanuchus cupido), and prairie vole (Microtus ochrogaster).

Resource Management Actions

1. Implement a wildfire containment plan that will protect the preserve from damage by fire-control equipment.

At Western Prairie North, a wildfire starting on the preserve or spreading onto it from adjacent land could possibly move across the property boundary to the pasture land east of the tract. If a wildfire does start to spread across the prairie, and if it appears to threaten this adjacent land, or if it is advancing along the ditches at the tract's north and south ends, it should be contained within the preserve's boundaries. However, control techniques can be far more damaging to the prairie than a wildfire, so care should be taken to use the least destructive techniques possible. For example, a fire break could be burned along the north half of the east edge, or portable backpack-type pump cans could be used to extinguish a small fire. Heavy equipment, vehicles, and plowed breaks must not be used on the preserve. Once the danger of wildfire's spreading onto adjacent property is past, or if there is no such danger to begin with, the fire should be allowed to burn itself out. Local fire authorities should be contacted annually so they are aware of these restrictions on fire control techniques, and neighbors and the local volunteer manager should also be informed of the policy. All of the above people should also be provided with names and telephone numbers of the volunteer manager and the TNC stewardship director and fire boss to speed notification in care of wildfire.

2. Periodically burn parts of Western Prairie North.

Prairies in western Minnesota are thought to have burned regularly before white settlement (Curtis 1959, Daubenmire 1968). After white settlement, however, fire was suppressed. Prescribed burning reinstates a natural ecological process, maintains the tract's open character by suppressing the growth of brush and trees, and restores old fields and other disturbed areas. Fire removes built-up fuel, consequently enhancing nutrient cycling through more rapid breakdown of materials and earlier spring warmup of the soil, and it suppresses non-native plant species. In addition, it perpetuates fire-dependent prairie plants, and improves the habitat for certain animals.

Western Prairie North is divided into two burn units (Figure 1 , page 13). The south unit was burned in May of 1981; the next prescribed burn will be on the north unit, as described below.

Since Western Prairie North is in good condition at present (very few cool-season exotics or weeds are found here), the fire prescription is simple. Early- to mid-spring fires (usually in April) at three or four year intervals will serve to maintain floral diversity on the prairie. More frequent fires or later fires (May or even summer or fall) will become necessary only if alien species such as sweetclover become a problem, if woody-plant thickets are advancing onto the prairie, or if a particular spring season is too wet to allow burning.

Fall and summer fires as well as occasional mowing are possible alternatives to spring burns under certain conditions. For example, if sweetclover populations increase, three consecutive spring burns, or an alternative procedure including summer fire or mowing, may be necessary to control this species. Another possible modification of the early- to mid-spring fire program is use of followup burns in midsummer (June or July) on wetter portions of the preserve that failed to burn in spring. Such burns, preferably done only if birds are done nesting on the areas to be burned, help to simulate natural fires in dry weather -- fires which can seldom occur now with burning bans in effect during most extended dry periods.

Old haystacks are still present on Western Prairie North, in the northwest corner and hear the southeast corner of the tract. Burn crews at Western Prairie North should be careful to extinguish smoldering haybales by breaking them up to dissipate heat at the larger haystack sites; these larger stacks should be gradually removed by burning out their edges. The smaller stacks should be spread out and thoroughly burned to gradually reduce the weedy plant community they support.

Under no circumstances will both units be burned together during the spring of the same year; such an action would leave prairie animals without a refuge. The following TNC procedures should be implemented for all prescription burns: 1) a prescribed burning proposal must be prepared and approved by authorized TNC personnel; and 2) all conditions described in the

proposal, including the crew, fire boss, equipment, weather, firebreaks, DNR permits, courtesy notifications, and publicity, must be in effect for a burn to occur.

3. Allow natural succession to restore the old fields and former building sites.

With the reintroduction of fire and the natural dispersal of plant seeds from the adjacent prairie, the weedy, formerly plowed areas in the north half of the preserve, as well as the old building sites (see inventory, page 8), are expected to succeed to prairie. Thus, these areas will provide an opportunity for students and researchers to observe natural succession. If monitoring data (Action 38, page 34) show the prairie plants are not re-establishing themselves and expanding naturally on these areas, then consideration should be given to taking more active steps to restore them, such as gathering seeds from the adjacent prairie and planting them on the disturbed areas.

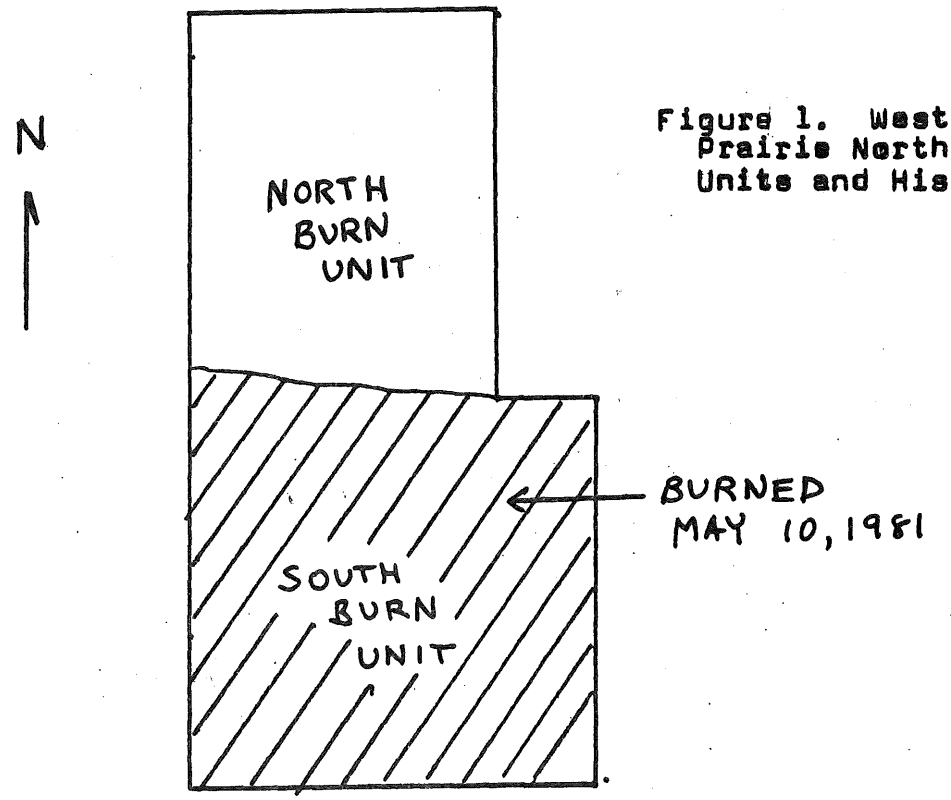


Figure 1. Western Prairie North Burn Units and History

4. Conduct a more thorough inventory of reptiles and amphibians on the preserve.

The 1980 inventory used a drift fence to capture reptiles and amphibians, but it was not set up until July. A spring starting date (late April through early June) is likely to improve results for this study. Amphibians and reptiles breed, congregate, and move about from hibernacula to summer habitat most actively in the early spring, and they are easier to locate and identify by their vocalizations at that time. In early fall, too, herps are active as they move back to hibernation sites. Drift fences would be useful at this time (mid- to late September) as well as in the spring.

Location of drift fences is important. Some of the old haystack sites on Western Prairie North have characteristics of mima mounds (inventory, page 18). These may be hibernation sites for amphibians and reptiles. To increase chances of capturing herps on the preserve, these mounds should be examined by someone who recognizes hibernation sites, and drift fences should be placed in rings around likely haystack mounds. Openings in the drift fence circles, and funnel traps below the openings, should be near low, wet areas toward which herps move in the spring. Abandoned ant hills are also used as hibernation sites by herps, and if they can be found on Western Prairie North, they would also make good drift fence locations.

A second technique for identifying amphibians on a site is identification through their vocalizations. Vocalizations should be recorded during early spring breeding periods; tapes of the sounds can then be used for

identification by Bell Museum personnel (University of Minnesota, Minneapolis), or other herpetologists.

5. Survey size, locations, and condition of the Gentiana affinis population and monitor population changes.

The gentian, Gentiana affinis, is considered rare in Minnesota, where it is on the eastern periphery of its range. It is known only from calcareous wet prairies in Ottertail, Polk, and Wilkin counties. Like many other species, its populations in Minnesota are declining with increased agricultural development. The 1980 inventory located one occurrence in the willow thicket at Western Prairie North, and other occurrences may exist on the tract. To provide for proper management of the preserve, further information should be obtained on the population characteristics of this species. First, a thorough visual search for the plant during its flowering period should allow mapping of other occurrences. This should be done by someone familiar with the species. At the time of this survey, an approximate count of flowering stalks can be made. If the total number of plants is small, followup monitoring should consist of marking the areas where it is found and doing total counts of flowering stalks in subsequent summers; permanent quadrats could be located around individuals or groups of plants to record changes in plant locations. If many individuals are found, representative areas could be marked off and a statistically adequate number of quadrats placed at random within these areas. Annual counts could then be made of the species' frequency (Appendix E), stem counts (density), and/or

reproductive success (number of flowering stalks and fruits). Such a study could be done in conjunction with overall plant community monitoring (Action 28, page 34), but emphasis should be placed on thorough evaluation of the habitat supporting Gentiana affinis. Choice of survey and monitoring methods from the above alternatives should be based on time and personnel requirements as well as reproducibility, sensitivity to population changes, and statistical validity of the technique. Possible contacts for recommendations on methods include Gerald Ownbey (Univ. of Minn.--St. Paul), Welby Smith (Minn. Natural Heritage Program), and Mark Heitlinger (The Nature Conservancy--Midwest Region, Mpls.).

6. Attempt to locate Rumex occidentalis, Gentiana macounii, Puccinellia nuttalliana, Carex scirpiformis, and Carex hallii on the tract.

These species are classified as threatened (G. macounii, C. scripiformis, C. hallii) or rare (R. occidentalis, P. nuttalliana) by the State of Minnesota's Natural Heritage Program (1980) and may be found on Western Prairie North. All are known to occur in similar habitats nearby. Careful visual searches for these species during their flowering periods should serve to determine their presence. If they are found on the prairie, population monitoring should begin in order to delineate their status on the preserve. Suggested techniques and levels of monitoring can be found in management actions 5, 28, and 29. Choice of monitoring techniques should be based on objectivity, limited observer bias, time requirements, statistical validity, and

sensitivity to population variations. Possible contacts for technique recommendations include Gerald Wheeler (University of Minnesota--St. Paul), Welby Smith (Minnesota Natural Heritage Program) and Mark Heitlinger (The Nature Conservancy, Midwest Regional Office--Minneapolis).

7. Complete collections for inventoried plant species.

Of the plant species collected by the 1980 inventory team, all but seven were deposited as voucher specimens. Vouchers for these seven (Apocynum sibiricum, Glycyrrhiza lepidota, Triglochin maritima, Andropogon scoparius, Glyceria striata, Muhlenbergia glomerata, Urtica dioica) should be collected and deposited at the University of Minnesota herbarium (St. Paul campus). The specimens will be useful for verification of species identification and for systematic placement of the plants in the event of taxonomic revision.

8. Remove the old hayloader from the preserve.

An old hayloader, a reminder of past hay harvests on Western Prairie North, still stands in the center of the Southern edge of the preserve. It should be removed, since its presence disrupts the visual expanse of undeveloped prairie. The hayloader appears to be several decades old and may have some historic value. This should be taken into account when disposing of the machine; a local farmer should be contacted about its value. If it appears to have historic value, the county or state historical society should be informed of its availability and asked for advice on its disposal.

9. Maintain the fence which marks the east edge of the northern half of the preserve.

Because cattle graze on the area just east of Western Prairie North, this fence must be maintained to prevent grazing on the preserve. The fence is currently in moderate condition; most of the posts are older wooden ones which support a 3-strand barbed wire fence. In addition, there is a single strand of electrified wire supported in part by newer metal T-posts, in part by metal arms attached to the older wooden posts. The fence should be inspected monthly for gaps and necessary repairs should be done promptly. Responsibility for repairs on the fence is shared between The Nature Conservancy and the owner of the adjacent land, so the owner of the pasture should be consulted when repairs are necessary.

10. Mow a small area for a prairie chicken booming ground in years when no part of the tract is burned.

Prairie chickens generally boom on open ground rather than in tall grass; they may use agricultural fields, burned grasslands, mowed areas, or barren ground. Since the prairie chicken is one of Western Prairie South's most significant resources, the tract should be managed to provide suitable booming grounds for these rare birds. The burn program for the preserve (Action 2, page 10) suggests that some part of the preserve should be burned every year for the first seven years; after that, there will be no burning two out of every four years. In those years when no part of the preserve is burned (whether through

deliberate planning or failure to reach planned goals) a small area should be mowed to provide open ground and encourage the prairie chickens to boom here. An area 30 to 50 meters square on high, dry ground would be suitable; exact size and shape of the mowed area are unimportant. Mowing should be done in the early spring as soon as snow is out, or if possible in the fall before the season when no burning is to be done. Location of the mowed area should be changed from year to year to avoid changing composition of the prairie.

Use Management Actions

11. Replace missing or damaged boundary signs as needed.

The boundaries of the preserve are marked with Scientific and Natural Area signs. These signs are necessary to prevent encroachment on the prairie by farm equipment or other vehicles, to discourage snowmobile use, and to inform visitors of the tract's purposes, ownership, and use restrictions. At present, two of the signs are missing from the posts at the northeast corner of the preserve. These should be replaced, and signs at all the boundaries should be repaired or replaced as necessary.

12. Continue to allow parking alongside the road that forms Western Prairie North's south boundary.

As long as visitation to the preserve remains light, parking along this road will be adequate. If records at the registration box (to be erected; see management action 19), indicate an increase in visitation to the point where roadside parking becomes dangerous or annoying to neighbors, the pullout in the southeast corner of the preserve (shown on M. L. Partch's map of the area, dated 1972 -- see Conservancy files) could be developed as a parking area. This area was used as access to the old haystack which still stands in the corner. If this area is developed for parking, placement of signs, posts, or fence may be necessary to discourage driving on the rest of the preserve. In any case, parking should not be allowed on the prairie when the ground is

saturated, since vehicle use under these circumstances would damage the prairie sod.

13. Develop and distribute a map showing the tract's boundaries and general features of interest.

This map should be distributed to users, potential users, adjacent landowners and interested parties until a Western Prairie brochure is developed. The map can be used to increase visitor appreciation of the area, and answer questions which visitors and landowers may have.

14. Develop a brochure on Western Prairie North and distribute it to users, potential users, adjacent landowners and other interested parties.

The brochure should include an accurate map of the area, a description of Western Prairie's history, natural features and significance, and a discussion of the impacts caused by people. It shall describe the Nature Conservancy-SNA Program, note conducted tours, promote a "pack out what you bring in" litter philosophy, identify people to contact for more information about the site, and encourage visitors to register, provide comments, and become involved in managing the area. Finally, the brochure should note Nature Conservancy and/or SNA rules and regulations governing use, including the requirement that all researchers obtain permission prior to conducting research on the area.

15. Conduct guided field walks on Western Prairie North.

The guided walks can be used to educate visitors about the area's resources, inform visitors about the Nature Conservancy-SNA Program,

obtain visitor feedback on management, and make visitors feel like land stewards -- involved in managing the site and responsible for its well-being. The number of conducted tours depends on time and money limitations, and the impact of the tours on the area. Late May through October are ideal times to lead walks on the tract. News releases should be sent to the local media to publicize the walks, and a reporter(s) should be periodically asked to participate in the walks.

16. Encourage local middle and secondary schools, regional education institutions, and researchers to use the site if appropriate.

Bemidji State University, Moorhead State University, North Dakota State University (Fargo), the University of Minnesota (Crookston), the University of North Dakota (Grand Forks), the Minnesota Environmental Education Board's region IV coordinator in Appleton, and all middle and secondary schools within the vicinity of Western Prairie North (up to thirty miles away) should be periodically contacted. These groups should know of the site's existence, its potential for teaching such topics as native flora and fauna, ecology and geology, and the names of whom to contact for more information (i.e., the local volunteer manager, SNA program, TNC preserve management coordinator, DNR regional naturalist). An effort should be made to meet annually with all teachers and researchers who express an interest in the site. Educational and research opportunities can be promoted at these meetings. However, the sensitivity of the resources and user responsibility in caring for

the land must also be stressed. Use should only be encouraged if appropriate, i.e., if such use cannot occur equally well on other less vulnerable areas. All teachers and researchers should be aware of site rules and regulations, such as the need to obtain a permit prior to collecting or conducting research in the area, before they step onto the tract. Before a class comes to the tract teacher workshops should be held so that the teachers are trained and well-informed about the area. When the class comes to the site managers or scientists should, if possible, also be present to assist the teachers.

17. Confirm and straighten boundary lines in agreement with neighboring landowners to the east and west; conduct legal surveys if necessary.

Notes from mid-1970's visits to the prairie indicate that the east boundary is uncertain and the fence line on the north half of the east side appears to be crooked. The western border, too, has been disputed by a neighboring landowner, who has complained that the boundary signs follow a crooked line. Preferably, all of these boundaries should be set in agreements between The Nature Conservancy and the adjacent landowners. However, if a dispute arises, legal surveys may be necessary. Considering the expense of such surveys, they should be used only as a last resort if other methods of resolving boundaries fail.

18. Acquire conservation easements around the preserve.

If houses were to be built near the preserve, fire management would become very difficult. Most winds would preclude burning, due to possible

health and property damage to adjacent landowners. Conservation easements barring development on a strip of land an eighth- or a sixteenth-mile wide surrounding the preserve would be most helpful in facilitating continued fire management on the tract. If such extensive easements could not be acquired, a lower level of protection would be provided by easements along the raods which form the preserve's north and sound boundaries. These would discourage construction adjacent to the prairie by limiting access from the road. For example, blocks of land an eighth-mile to the east and west of the prairie and a sixteenth-mile in towards the prairie from the north and south roads (Fig. 2) might be suitable as an intermediate level of protection.

At this time (1981) such easements are a low priority. First, the preserve is not on a major road, nor is it near any town, so development on its borders seems unlikely within the next few years. Second, the neighbors' feelings towards The Nature Conservancy (see action 23, page 31) are not currently conducive to acquisition of easements. For these reasons, acquisition of easements should be considered a long-term goal, but should not be pursued at this time.

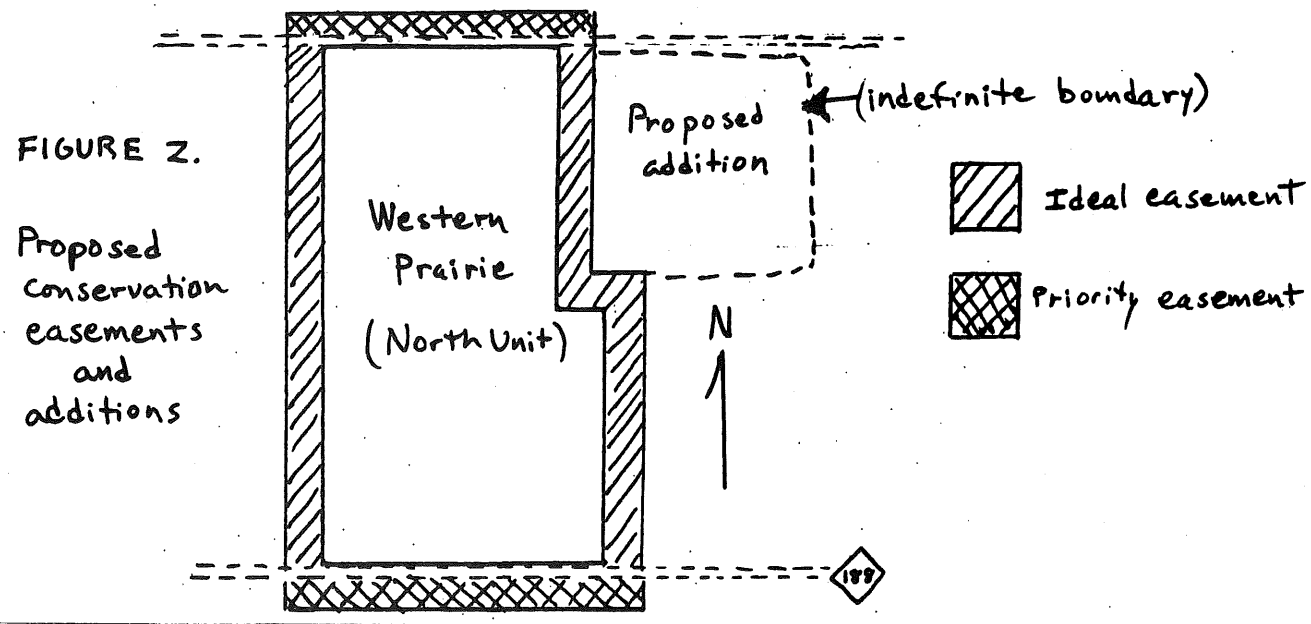


FIGURE 2.

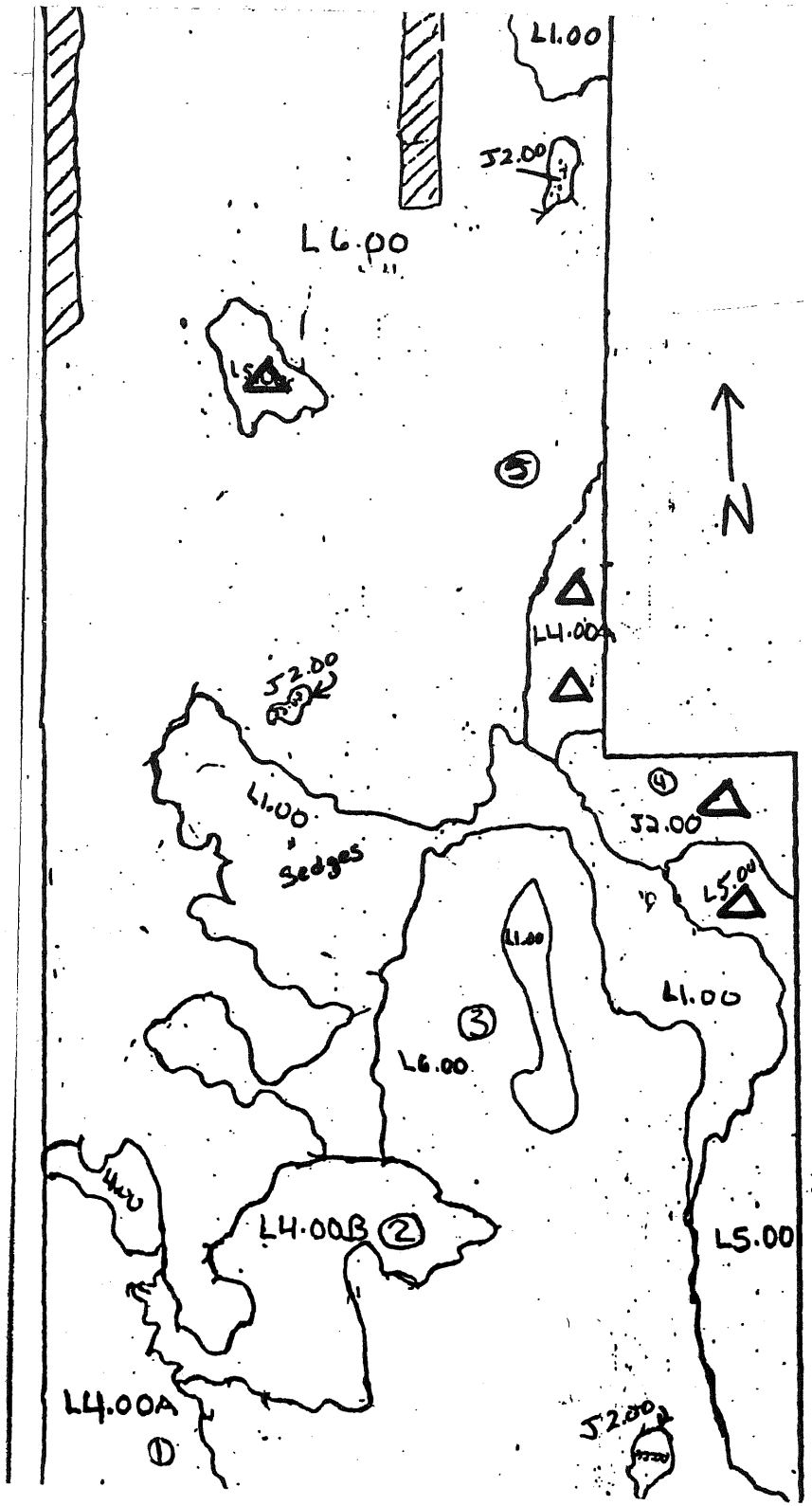
19. Erect a main recognition sign and a registration box, and maintain both, keeping the box supplied with information and visitor registry materials.

As of 1981, both of these items are low priority, but in the long run they will be necessary for proper management of the preserve. Current relations with local residents are not as friendly as could be, making erection of a registration box unadvisable at this time. Shortly after the powerline rerouting (see Action 23, page 31) a registration box on Western Prairie South was deliberately vandalized, so it seems best to wait a few more years before putting up a replacement there or, especially, putting up a new box at Western Prairie North, the actual site of the controversy. However, it would be valuable to have both box and sign once they seem appropriate, especially user registration will be helpful in determining the extent of preserve visitation, and thus the necessity of developing a parking area and other use management practices. The 1974 lease between TNC and DNR (renewable automatically, currently in effect until 1984) states that "DNR shall erect and maintain a permanent conspicuous sign on each tract demised under this lease [Western Prairies North and South] which shall read substantially as follows: "This area was acquired by The Nature Conservancy and has been designated by the Department of Natural Resources as a Scientific and Natural Area." The sign should be visible from the road once installed.

The registration box should be of standard TNC design. It should be erected in a conspicuous location approximately fifty feet from the road, near the potential parking area (southeast corner of the preserve). The registration box should be annually touched up with Olympic wood stain; other maintenance actions should be taken as required. During the spring, summer and fall the box should be checked bi-weekly to see that adequate copies of maps, brochures, registration sheets and other relevant information notices (including notices on upcoming special events, the nearest DNR or volunteer information source, the SNA rules and regulations (if appropriate) and/or TNC rules and regulations) are present.

Two sets of 5 x 7 standardized comment cards will also be kept in the box. One set of cards will be available for users to write comments on management and use of the tract (e.g., problems observed on the tract, proposals for management, evaluation of the managers). The other set of cards will be available for users to write observations on the site's natural features. These cards will ask: the observer's name and address; what species were seen; the number of individuals seen; where the species were observed (space can be left for a sketch); and other remarks (e.g., presence of nesting activity, territorial behavior, identifying marks of unknown species). The back of the cards will have instructions and note the purpose of the cards. A list of those species which are of particular interest to managers and scientists could also be included here. The observation cards, the management comment cards and the

registration sheets can provide valuable monitoring data to managers. It is therefore important to collect the cards and the registration sheets, and keep them for analysis.



Explanation

L6.00	Mesic Prairie
L5.00	Wet-Mesic Prairie
L4.00	Wet Prairie
L4.00B	Alkaline Wet Prairie
L1.00	Sedge Meadow
J2.00	Willow thicket
	Plowed Area
③	Releve Plot
△	Cypripedium candidum site

Figure 3. Plant communities and rare species occurrences on Western Prairie North

Monitoring Management Actions

20. Recruit a local volunteer manager, preferably living within three to four miles of the tract.

Volunteer managers must have the time, interest, and willingness to become intimately involved with the protection and management of the site. Their job is primarily to: 1) maintain the registration box supplies and collect registration sheets and comment cards; 2) monitor the tract for signs of misuse of management problems and communicate them to TNC (a "watchdog" function); 3) facilitate communications between TNC, local residents, and other parties; 4) aid professional resource managers when requested; 5) be informed of land use plans for the areas near the preserve (e.g. pipeline or powerline corridors, housing developments, and mining activities) and communicate potential problems to TNC; and 6) orient new managers to the site and the local community.

Due to the current atmosphere around Western Prairie North (see Action 22 concerning the powerline-routine controversy and resulting antagonism), there are no prospects at this time for the job of volunteer land manager. The summer intern who works on getting to know the neighbors (see management action 23) should also make an effort to find and/or recruit a good local manager. Integrity, sincere interest, and understanding of the Conservancy's goals on the part of the manager will be especially important at Western North.

21. Develop and maintain a close relationship with local and regional government officials, natural resource management professionals, and other appropriate individuals.

Local and regional governmental officials (e.g., the mayor, county assessor, county board members) and resource management professionals (e.g., the county extension agent, DNR area wildlife manager, Soil Conservation Service district conservationist, U.S. Fish & Wildlife Service managers) should be annually contacted and informed about the site. These individuals are all concerned with natural resources in their respective capacities. They should be aware of the site, its importance, and major management actions which are planned for or being implemented on the tract. This action can help eliminate public suspicions and misconceptions, build trust and rapport, and increase community support. It is also a way of monitoring what the public feels about the site and the managers.

Keeping in close contact with local and regional professional resource managers is also important. These individuals, if they are aware of the site and interested in its preservation, can provide valuable expertise and manpower, and lend equipment if needed for management. As local residents they can help generate community support for the tract. Cooperative management efforts can also sometimes be used to solve problems which affect (or could affect) several sites in the area, including the preserve.

22. Contact the local DNR conservation officer (C.O.) and request his assistance in managing the site.

This action should be taken at least once per year. Since the C.O. is the primary natural resource enforcement officer it is important to bring the site to his attention and familiarize him with its resources and problems. This action is also necessary to obtain advice on management, such as on enforcement activities.

23. Develop closer communication with local residents and promote good neighbor relations.

At present, some antagonism towards The Nature Conservancy is evident among residents of the Western Prairie area. This antagonism arose around 1976, when the Square Butte Electric Cooperative attempted condemnation of a high-voltage powerline easement through Western Prairie North (Appendix E). Because the area had been designated a state Scientific and Natural Area, the courts upheld The Nature Conservancy's refusal to allow condemnation of the prairie preserve. As a result, rerouting of the powerline across adjacent land was necessary, causing resentment on the part of adjacent condemned land's owners.

Better public relations are essential to the continued health and existence of Western Prairie. First, a summer intern should be assigned to get to know the local residents. Any other TNC personnel who travel through the area should make an effort to stop by and visit with the neighbors. Once closer communication is established, TNC is less distant from the local residents, and their complaints and feelings are known,

meetings should be scheduled for area residents. Press releases and individual contacts should be used to publicize the meetings; a reporter might be asked to attend. Such meetings should be held annually, perhaps in conjunction with a field trip or other activity. Though in this case the meetings will be especially useful in promoting friendly relations between TNC and its Western Prairie neighbors, they will also have other purposes. Meetings can help enlist support for project work (for example, preserve monitoring), serve as a forum to discuss management proposals, actions, and problems, and encourage landowners to adopt practices which could benefit the prairie. Since neighboring landowners and users can have a large impact on the preserve and vice versa, their presence is important. Records of all comments on management and other issues should be kept.

24. Maintain close contact with all scientists who are using the site for educational and research purposes.

Scientists, as trained observers, can provide valuable information and insights on managing the site. Data gathered from scientific studies are also important for monitoring the site. Thus all scientists using the site will be annually contacted and consulted about their studies, data, and conclusions. Researchers should also be consulted about natural changes and human impacts they discover while on the tract, and be encouraged to offer input into managing the tract. Finally, research information should be accumulated, stored in a site file, and shared with interested parties.

25. Periodically inspect the site.

The site shall be thoroughly inspected by the local manager and/or TNC-SNA personnel at least once per month for human impacts (e.g., vandalism, unauthorized trails, trampling of plants, littering, the disturbance of sensitive resources), signs of violations in rules and regulations (e.g., hunting, snowmobiling, horseback riding), and natural changes in the tract (e.g., insect infestations). If urgent action is required on the site TNC and the SNA program should be contacted immediately. Otherwise, records should be kept of observations for the annual status report.

The inspections are also an opportunity to gather feedback from users in the area concerning the site and management actions. Visitors observed violating rules and regulations should be tactfully asked to correct their behavior, e.g., remove rubbish dumped on the site. Serious problems requiring immediate attention should be referred to the DNA conservation officer or county sheriff. A report should be submitted to TNC and SNA if further action is advisable.

26. Develop and implement a water-table monitoring program.

The 1980 inventory did not measure water table depth, although literature indicates the general characteristics of the water table in this area (inventory, page 17). Changes in the water table would have an impact on the site's flora and fauna. Therefore, the depth of the groundwater should be measured annually using the method described by

Turnock and Lawrence (1953) or another simple and accurate method. Analysis of these data will show if any changes are occurring, the magnitude of the changes, and will possibly provide clues to the cause of the changes (e.g., climate or irrigation).

27. Submit an annual written report to TNC and the SNA Program.

The annual report, to be submitted by the local manager and TNC-SNA management personnel, shall note completed management actions, progress made in implementing other actions, number of users and violations (compared against preceding years), solicited and unsolicited comments regarding management, research proposals and studies underway, changes in the resources, problems identified by managers, local residents and researchers, and recommendations for changes in the management plan.

28. Develop and implement a vegetation monitoring program.

Changes in vegetation can asignificantly affect the quality of a preserve as a whole. Monitoring can help give advance warning of changes and, if the changes are undesirable, allow management action to be taken before the changes become irreversible. A minimal level of monitoring consists of ground photo points to be photographed yearly; such photo points were set up in 1980 on Western Prairie North, and are located at all 4 corners of each relevé plot facing the center of the plot. Color infrared photos should be taken once every five years (the first set was taken in 1976). Time and personnel limitations will determine the extent of further monitoring. Relevé plots set up during inventory serve as a basis for developing a more objective and sensitive monitoring

system. Criteria for selection of techniques shall include objectivity, limited observer bias, efficiency, sensitivity to changes, and statistical validity. For example, a statistically adequate number of quadrats could be placed at random points within the largest available areas of each plant community and frequency recorded for all species present (Appendix F-1). An alternative requiring less time would be to record frequency only for dominants and a few other indicator species; this method would indicate major changes in vegetation. A subdivided quadrat like the one used by Ed Brekke-Kramer in his study at Kasota Prairie (Kramer, 1974) would give useful information on relative abundance and aggregation of the prairie plants, and data from such a quadrat are more easily interpreted than data from an undivided quadrat (Appendix F-1).

A second type of analysis which is efficient and informative is step-point cover analysis (Evans and Love, 1957; Owensby, 1973). In this technique, the botanist walks a randomly-located transect, recording at intervals the species contacted by a systematically-placed sampling point held in a frame (Appendix F-2). These data reflect cover; if a properly-sized frame is used, species' frequencies within that frame can be recorded simultaneously (Appendix F-2). Thus the step-point method can be modified to a step-point/frequency method to give information on both frequency and dominance of the species investigated. (For further information on the step-point and frequency method, contact Mark Heitlinger, The Nature Conservancy, Midwest Regional Office, Minneapolis).

A review of these and other monitoring techniques is found in Walker (1970).

To evaluate one parameter of the success of fire management, a permanent transect should be marked across one of the most dence willow thickets. Point-quarter analysis of the willow population (Appendix F-3) should be repeated at intervals of 2 or 3 years to determine the brush control effectiveness of prescribed burning.

Possible contacts for further recommendations on monitoring techniques include Gerald Ownbey (Univ. of MN--St. Paul), Welby Smith (MNHP) and Mark Heitlinger (above).

29. Map and monitor populations of Cypripedium candidum on the preserve.

Although this species is not rare in Minnesota, it is rare on a national level, and 40% of its United States populations are in Minnesota (Welby Smith, personal communication, 1981). For these reasons, its numbers on prairie preserves in Minnesota should be monitored. A preliminary level of monitoring could consist of a visual survey during its flowering period and mapping of the plants' locations (some are marked on the map in Figure 3). If time limitations permit, a more intensive monitoring program should begin, consisting of placement of permanent quadrats around individual plants or groups of plants, periodic counts of flowering stalks and seedpods, and/or records of changes in numbers of stems and amount of clover. Since C. candidum is a rhizomatous species, individual plants may be hard to distinguish,

making monitoring more difficult and time-consuming. Because of this, the species need only be monitored on a few of the many preserves on which it occurs. For example, C. candidum could be monitored at Western Prairie North or at another preserve of similar vegetation type and management techniques.

30. Monitor populations of the marbled godwit (Limosa fedoa), upland sandpiper (Bartramia longicauda), and greater prairie chicken (Tympanuchus cupido), and prairie vole (Microtus ochrogaster).

The Minnesota Natural Heritage Program recognizes these species as meriting special consideration by planners, biologists, and land developers throughout the state. During the 1980 inventory, marbled godwits (listed as rare by the Heritage Program) were seen only before mid-June, making breeding on the site unlikely. Upland sandpipers, a species of special concern (Minnesota Natural Heritage Program, 1980), were seen only in mid-summer; their breeding status on the preserve is uncertain. During spring of 1981, greater prairie chickens (classified as threatened) were seen repeatedly on the tract, ending the species' three-year absence from the site. A group of three chickens was seen several times in the tract's southeast corner, and another pair was seen just north of the above trio. The prairie chickens were probably not nesting on the preserve, but rather were using it for cover; their presence reaffirms the importance of Western Prairie as habitat for this valuable remnant population of prairie chickens.

Since all of these birds occur on a number of preserves, and since limited time and personnel are available, monitoring could be conducted on either Western Prairie North or on other tracts representative of its vegetation type and management techniques. Site records for the species should include number of individuals, sex if known, activity and date when observed, evidence for nesting (e.g., singing males, nests, adults carrying nesting material, etc.), and exact location of sighting.

One efficient technique for monitoring bird populations is the Point Count method (see inventory, p. 39), using circular stations at which a trained observer stands for 10 minutes. Because the method was used in the inventory, a monitoring program using the same technique would allow direct comparison of the results to the 1980 inventory. To supplement point-count data, information on prairie chickens could be gathered from booming-ground counts in early spring. Finally, if time permits, use of a trained bird dog to flush nesting females during the early part of the nesting season could help investigators locate nests of several species, count eggs, and thus estimate reproductive success.

Ornithologists (e.g., Dan Svedarsky at University of Minnesota--Crookston), nongame wildlife specialists (e.g., Carrol Henderson, DNR) and entomologists (e.g., Bob Dana, University of Minnesota--Minneapolis) can help devise other monitoring techniques; criteria to be used in selection of monitoring techniques are described on page 34 (Action 28).

The prairie vole, Microtus ochrogaster, is restricted to the dry sandy prairies of the central and northern prairie states. Like the

birds mentioned above, its populations in Minnesota have declined significantly as agricultural production converts prairies to plowed fields. Only one prairie vole was captured on Western Prairie North; it was found in the mesic prairie community. Although the status of the prairie vole in Minnesota is uncertain and monitoring would be desirable, the species is very difficult to identify in the field. A monitoring program would require killing captured voles to identify them (using skull and tooth characteristics), and the prairie vole appears to be rare enough to make such a destructive monitoring program unwise.

Boundary Adjustments

Although most of the land surrounding Western Prairie North is cultivated, a few areas of native grassland remain. The only area which may be suitable for acquisition is the E½ E½ Section 17 (the notch out of the preserve's northeast corner) and the land just east of this notch) parts of the NW¼ Section 16); the area *is* shown in Figure 2 (page 24). The owner, Rudolph Bekkerus, has used this area for grazing cattle, but the 1980 inventory team reported a good native plant community and a variety of prairie bird species on the area. Its acquisition would also facilitate prescribed burning on the north burn unit, since a firebreak between the proposed addition and the current preserve would not then be necessary. This tract should be inspected by a prairie expert and considered for acquisition if its quality is high.

Tentative priority listing for Management Actions, Western Prairie North

Actions in order of priority	Action numbers
1. Fire management: prescribed burns, wildfire containment	1,2
2. Physical management: hayloader removal, mow prairie chicken booming ground, fence maintenance	8,9,10
3. Search for rare plants; neighbor contacts; straighten boundary lines	6,17,23
4. Monitoring: photo points, rare plant and animal species monitoring (low level), vegetation community monitoring (low level), monthly inspection, local volunteer manager, annual reports	5,20,25,27, 28,29,30
5. Completion of baseline data: herpetological inventory, plant collections	4,7
6. Professional contacts, conservation easements, boundary signs	11,16,18,21, 22,24
7. Monitoring of vegetation community, rare plants, and rare animals (higher-level); water-table monitoring	5,26,28,29, 30
8. Registration box, maps, brochures, field walks, parking	12,13,14,15, 19

Literature Cited

Curtis, J. T. 1959. The Vegetation of Wisconsin. Univ. Wis. Press, Madison.

Daubenmire, R. 1968. Ecology of fire in grasslands. Advanc. Ecol. Res. 5:209-266.

Evans, R. A., and R. M. Love. 1957. The step-point method of sampling -- a practical tool in range research. J. Range Mgmt. 10: 208-212.

Huber, R. 1979. Minnesota Butterflies. Unpub. report.

Kramer, E. J. 1975. Floristics and selected ecological aspects of a southern Minnesota native prairie. M.S. Thesis, Mankato State College, Mankato, MN.

Minnesota Natural Heritage Program. 1981. Animal element lists. Unpub. report.

Minnesota Natural Heritage Program. 1980. Rare plants in Minnesota. Unpub. report.

Owensby, C. E. 1973. A modified step-point system for botanical composition and basal cover estimates. J. Range Mgmt. 26(4):302-3.

Pollard, E. 1977. A method for assessing changes in abundance of butterflies. Biol. Conserv. 12:115-134.

Smith, Welby. 1981. Minnesota Natural Heritage Program. Personal communication.

Walker, B. H. 1970. An evaluation of eight methods of botanical analysis of grasslands in Rhodesia. J. Appl. Ecol. 7:403-416.

Addenda:

Heitlinger, M. 1979. Vegetation analysis for 1979 SNA-MDNR Inventory. Unpub. report.

Heitlinger, M. 1980. Pilot study - Vegetation Monitoring. Memo, The Nature Conservancy (unpublished).

Mueller-Dombois, D., and H. Ellenberg. 1974. Aims and Methods of Vegetation Ecology. Wiley, New York.

Appendix A.

The Minnesota Scientific & Natural Area (SNA) Program

Since the SNA Program is involved in the stewardship of Western Prairie North, a description of the SNA Program management policies, rules and regulations, and pertinent legislation is included here. Western Prairie North will be managed in accordance with these statutes, policies, rules and regulations.

The SNA Program is located in the Minnesota Department of Natural Resource's (DNR) Division of Parks. The Scientific & Natural Areas Act (M.S.A. 84.033) of 1969 created the program. It authorized the Commissioner of the DNR to acquire, designate and maintain SNAs, and to adopt pertinent rules and regulations governing the use of the areas.

The DNR issued rules and regulations governing the SNAs in 1973 (Minnesota Reg. NR 300-303). The rules and regulations, still in effect, cover permitted and restricted uses of SNAs, provide for environmental protection, prohibit certain uses and acts, and establish legal penalties for violations. The rules and regulations also state that the Commissioner of the DNR can restrict: 1) travel within the unit; 2) the hours of visitation; and 3) the number of visitors within the area at any given time.

In 1975 the Scientific and Natural Areas Act was amended by the Outdoor Recreation Act (ORA; M.S.A. 86A.05). This statute further defined and more adequately funded the program. It included SNAs within the Minnesota Outdoor Recreation System, defined the purpose of SNAs,

delineated resource and site qualifications, provided for administration of the units, and classified SNAs into one of three "use designations": Research, Education and Public Use. The law states that only scientific, educational or public uses which do not impair or threaten the preservation objectives are to be allowed. Physical development is limited to facilities absolutely necessary for protection, research and education projects, and when appropriate for interpretive services. Finally, the statute requires plans be drawn up for each SNA. No development funds can be spent by the DNR until these plans have been approved.

To be designated as an SNA a site must: 1) contain elements of "exceptional scientific and educational value," and 2) "be large enough to preserve their inherent natural values and permit effective research or educational functions." The SNA staff notifies the DNR Commissioner's Advisory Committee (CAC) on SNAs and the Minnesota Natural Heritage Program of all new nominations. The SNA staff then is responsible for conducting a field survey of the site to determine the site's qualities, vulnerability, extent of man-made disturbances and management practices which may be needed. The results of this field survey are forwarded to the Heritage Program which then evaluates the significance of the site's elements. Using the field survey data and the Heritage Program evaluation the CAC assesses the site and sends a recommendation to the SNA Program. Based on the CAC recommendation, the priorities for protection as established by the Heritage Program, and on other considerations, such as the opportunity to acquire the area, the SNA Program sets a priority

for designating the area as an SNA. Recommended proposals are next sent to the Director of the Division of Parks for approval. Finally, the proposal is passed on to the Commissioner of the DNR. If the Commissioner approves the site then the land rights are acquired either by fee simple purchase, lease, donation or conservation easement. Once the Commissioner determines sufficient land rights have been acquired to administer the area as an SNA it is formally designated. The formal designation includes the classification of the site as either a Research, Educational or Public Use unit.

Since Western Prairie North has been designated an SNA, the Outdoor Recreation Act requires that a master plan for the area be completed and approved. The SNA Program is responsible for completing the SNA plan. After this SNA draft plan is completed the CAC and DNR review and approve it. An announcement is then made to the public and other state agencies regarding the existence of the plan. Interested persons and agencies are invited to review and comment on the plan within thirty days of the announcement. Comments received by the DNR are reviewed and appropriate changes are made in the plan. Finally, the revised plan is submitted to the State Planning Agency for review. After the DNR reviews this agency's recommendations, and makes the necessary changes, the plan is officially approved.

In July, 1979 the DNR issued a policy statement on SNAs. These policies affect the management of Western Prairie North. The full text of the policy statement can be found in Appendix B-1.

Appendix B

Management considerations: DNR-SNA and TNC management policies

Western Prairie North was leased to the DNR for dedication as a Scientific and Natural Area in 1974. Since the automatically-renewable, five-year lease states that management of the tract is a joint responsibility of the DNR and TNC, it is appropriate to describe the management policies of both groups here.

1. DNR-SNA Policies

The Scientific and Natural Area (SNA) Program of the Minnesota Department of Natural Resources (DNR) was created by legislative statute in 1969. Its goal is to:

> Preserve and perpetuate the ecological diversity of Minnesota's natural heritage, including landforms, fossil remains, plant and animal communities, rare and endangered species, or other biotic features and geological formations for the scientific study and public edification as components of a healthy environment.
>
> (DNR Policy on Scientific & Natural Areas, July, 1979)
> (The SNA Program is described in detail beginning on page 43 of Appendix A.)

1. DNR-SNA Management Policies

To ensure the preservation of the SNA's elements of natural diversity it is the DNR's policy to:

1. IDENTIFY AND CATALOG THE NATURAL FEATURES OF THE AREA.

2. ENSURE THAT RESOURCE MANAGEMENT IS DIRECTED TOWARD PRESERVATION AND MAINTENANCE OF ALL SIGNIFICANT ELEMENTS OF THE AREA.

3. MANAGE THE AREA IN SO FAR AS POSSIBLE TO PERPETUATE OR ESTABLISH NATURAL PROCESSES AND LIMIT THE EFFECTS OF HUMAN ACTIVITIES.

4. PROMOTE WISE STEWARDSHIP WITH USERS, LOCAL RESIDENTS AND SPECIAL INTEREST GROUPS.

To fulfill these general policies the DNR will:

5. MONITOR AND EVALUATE SNA MANAGEMENT PERIODICALLY TO DETERMINE IF MANAGEMENT OBJECTIVES ARE BEING ACHIEVED.

6. USE MANAGEMENT METHOD(S) CONSIDERED MOST NATURAL AND APPROPRIATE TO THE TOTAL ENVIRONMENT OF THE AREA AND:
   A) NOT USE COST ALONE TO DICTATE SELECTION OF THE APPROPRIATE MANAGEMENT METHODS;
   B) DESIGN MANAGEMENT PLANS TO ADDRESS THE ECOLOGICAL INTEGRITY OF THE AREA TO PREVENT MISMANAGEMENT;
   C) REMOVE EXISTING DEVELOPMENTS OR UNNATURAL OBJECTS UNLESS THEY ARE UNOBTRUSIVE AND NOT DETRIMENTAL TO THE PURPOSES FOR WHICH THE AREA WAS DESIGNATED OR OF HISTORIC VALUE.

7. PROHIBIT THE FOLLOWING:
   A) CUTTING OF GRASS, BRUSH, OR OTHER VEGETATION, THINNING TREES, REMOVAL OF DEAD WOOD AND WINDFALLS, OPENING OF SCENIC VISTAS OR PLANTING EXCEPT AS PROVIDED FOR IN THE MANAGEMENT PLAN;
   B) INTRUSIONS OF DEVELOPMENT ON, THROUGH OR OVER SNAs UNLESS ESSENTIAL TO THE MANAGEMENT OF THE UNIT;
   C) MINERAL EXTRACTION, PEAT HARVESTING AND WATER INUNDATION OR APPROPRIATION;

D) COLLECTION OF PLANT, ANIMAL, HISTORIC OR GEOLOGICAL SPECIMENS (EXCEPT BY PERMIT) OR ANY CONSUMPTIVE USE OF NATURAL RESOURCES;
E) INTRODUCTION OF PLANT, ANIMAL OR OTHER OBJECTS, INCLUDING LIVE SEEDS OR DISEASE ORGANISMS, UNLESS EXPRESSLY PROVIDED FOR IN THE MANAGEMENT PLAN.

8. PROVIDE THE FOLLOWING:
A) SPECIAL MANAGEMENT TO TRANSIENT SPECIES ONLY WHEN THERE IS A WELL DEFINED NEED;
B) SPECIAL MANAGEMENT FOR BALD EAGLE NESTS AND COLONIAL WATER BIRD NESTING SITES WHERE APPROPRIATE;
C) REVIEW OF DNR PERMITS AND ACTIONS TO MINIMIZE ADVERSE EFFECTS ON A DESIGNATED SNA.

9. INVOLVE USERS, LOCAL RESIDENTS, AND SPECIAL INTEREST GROUPS IN THE MANAGEMENT OF THE SNA AND ENFORCEMENT OF RULES.

10. ESTABLISH A WORKING RELATIONSHIP WITH ADJACENT LANDOWNERS SO AS TO MINIMIZE OR ELIMINATE THOSE LAND USE PRACTICES HAVING AN ADVERSE IMPACT ON THE SNA.

To ensure the preservation of SNA resources and provide for use of the area it is the DNR's policy to:

11. LIMIT HUMAN USE ON SNAs TO THE AMOUNT THE RESOURCE CAN TOLERATE WITHOUT DAMAGE TO SPECIAL FEATURES.

12. PROVIDE FOR THE INTERPRETATION OF THE SPECIAL FEATURES AND THEIR MANAGEMENT.

13. SEEK INPUT FROM USERS, LOCAL RESIDENTS AND SPECIAL INTEREST GROUPS IN DECISIONS REGARDING MUST SUITABLE USE(S).

14. REQUIRE USERS ENGAGED IN SCIENTIFIC STUDY TO MAKE INFORMATION OBTAINED ON THE SNA AVAILABLE TO THE DNR AND ENCOURAGE USERS TO MAKE THEIR STUDIES AVAILABLE TO THE SCIENTIFIC COMMUNITY THROUGH REPORTS OR PUBLISHED ARTICLES.

To fulfill these general policies the DNR will:

15. ENCOURAGE:
A) ACTIVITIES WHICH CAN OCCUR EQUALLY WELL ON LESS VULNERABLE OUTDOOR AREAS TO BE CONDUCTED ELSEWHERE;

B) SCIENTIFIC STUDIES, PHOTOGRAPHY, AND KEEPING OF PHENOLOGICAL RECORDS AND FAUNAL AND FLORAL LISTS FOR LONG TERM RESEARCH AND EDUCATIONAL BENEFITS;
C) APPROPRIATE USERS AND PUBLIC SUPPORT RATHER THAN UNRESTRICTED PUBLIC USE.

16. PROHIBIT THE FOLLOWING ACTIVITIES UNLESS NECESSARY FOR MANAGEMENT PURPOSES OR SPECIFICALLY AUTHORIZED BY THE MANAGEMENT PLAN: COLLECTING PLANTS AND ANIMALS, HUNTING, FISHING, CAMPING, PICNICKING, HORSEBACK RIDING, MOTORIZED VEHICLE USE WITH THE EXCEPTION OF PARKING FACILITIES AND SIMILAR ACTIVITIES.

17. ASSURE STRUCTURES, TRAILS AND SIGNS ARE AS SPECIFIED IN THE MANAGEMENT PLAN AND IN KEEPING WITH THE NATURAL SURROUNDINGS AND PRESENT ONLY SO FAR AS REQUIRED FOR RESOURCE PROTECTION AND PROVISION OF BASIC USER NEEDS.

18. ADAPT INTERPRETIVE TECHNIQUES AND MATERIALS TO THE USER.

19. LIMIT OR EXCLUDE USE FROM AN AREA FOR AN APPROPRIATE PERIOD OF TIME WHEN IMPORTANT NATURAL FEATURES ARE THREATENED AS A RESULT OF SUCH USE.

20. CLEARLY POST THE PROCESS FOR OBTAINING A VISITOR USE PERMIT WHEN REQUIRED, AT THE ENTRANCE TO THE SNA.

21. NOTIFY ADJACENT LANDOWNERS AND INTERESTED PARTIES PRIOR TO IMPLEMENTING MAJOR MANAGEMENT ACTIONS.

22. ERECT BOUNDARY SIGNS AS SPECIFIED IN THE MANAGEMENT PLAN TO DISCOURAGE ENCROACHMENT AND TRESPASS ONTO THE SNA AND ONTO ADJACENT PROPERTY BY SNA USERS.

23. REQUIRE A "PACK OUT WHAT YOU BRING IN" LITTER PHILOSOPHY AND ENFORCE LITTER REGULATIONS.

24. FENCE ONLY WHEN NECESSARY TO CORRECT PERSISTENT ENCROACHMENT OR TRESPASS PROBLEMS TO THE SNA OR ADJACENT PROPERTY.

25. REGULATE USE BY EMPLOYING, SINGLY OR IN COMBINATION, METHODS THAT INCLUDE BUT ARE NOT LIMITED TO THE FOLLOWING:
A) NO ACCESS RESTRICTIONS;
B) ACCESS BY PERMIT ONLY;
C) ACCESS ON DESIGNATED TRAILS ONLY;
D) TEMPORAL OR SPATIAL ZONING.

26. REQUIRE:
A) REVIEW OF ALL RESEARCH PROPOSALS FOR THE SNA WITH EMPHASIS ON THE PROPOSED RESEARCH METHODOLOGY;

B) IF NECESSARY, BONDING OF RESEARCHERS TO GUARANTEE CLEAN-UP FOLLOWING COMPLETION OF THE PROJECT(S).

2. The Nature Conservancy's Management Guidelines

TNA's management guidelines govern what management actions will be implemented on Western Prairie North. The two primary TNC stewardship objectives are as follows:

> The primary objective is to maintain areas so that they sustain species, communities, and natural features that make significant contributions to the preservation of natural diversity. The secondary objective is to determine and promote land uses compatible with the preservation of natural diversity on the preserve, in order to foster local support for individual preserves and recognition by the general public of the values of natural diversity preservation.
>
> (Stewardship Guide for Preserve Committees, 1978)

The primary objective, the ecological objective, is closely tied to determining which of the preserve's resources are most significant for preservation. The Minnesota Natural Heritage Program will play a major role in identifying which elements of the preserve are most significant. This assessment in turn determines how the preserve will be managed. For example, if an endangered species is the most significant element on the tract and that species requires a successional plant community, then management should be directed at perpetuating this successional stage in order to preserve the endangered species. If, on the other hand, the most significant element on the tract is a climax community then a different management program is necessary.

Management may be directed at species, communities, natural features, etc. In January, 1978 the Minnesota Chapter of TNC developed a Manual for Stewardship of Nature Conservancy Lands in Minnesota. The following guidelines are taken from this document.

If the occurrence of one or more species are determined to be significant on a preserve TNC will:

1. MAINTAIN POPULATION LEVELS SO THAT THE SPECIES CHANCES OF LONG TERM SURVIVAL ON THE TRACT REMAIN STABLE OR ARE IMPROVED.

Management to increase the population of any species should be integrated with perpetuating other native species and maintaining the tract as a diverse and naturally functioning system. There may be important ecological factors regulating the population size of significant species and it may not be desirable in all cases to attempt to increase populations.

2. MANAGEMENT OF SPECIES POPULATIONS WILL BE ACCOMPLISHED PRINCIPALLY THROUGH MANAGEMENT OF THE SPECIES' NATURAL HABITAT AND THROUGH PROTECTION OF THE SPECIES FROM VANDALISM, POACHING AND SIMILAR THREATS.

Thus managers generally will not use artificial means, such as direct control of natural predation, manipulation of food supply through food plots, or improvement of nesting habitat through plantings or artificial shelters to manage populations. Exceptions to this guideline should only be made in certain circumstances when special actions are necessary for the survival of a species or to redress an imbalance due to a factor such as predator extinction.

Management of plant communities should also be guided by an assessment of the preserve's communities. When management is directed toward plant communities TNC will:

3. MAINTAIN OR RESTORE SELECTED PLANT COMMUNITIES AS NEAR AS POSSIBLE TO THE CONDITIONS THEY WOULD BE IN TODAY HAD NATURAL ECOLOGICAL PROCESSES NOT BEEN DISRUPTED. THIS GUIDELINE WILL BE ACHIEVED, TO THE EXTENT FEASIBLE, BY:
   A) PERPETUATING AND AS NECESSARY REESTABLISHING NATURAL ECOLOGICAL PROCESSES; AND
   B) MINIMIZING IMPACTS OF CHEMICAL, MECHANICAL AND SIMILAR ARTIFICIAL PROCESSES ASSOCIATED WITH HUMAN INFLUENCES.

Some preserves will be protected because they contain significant geological, hydrological or other natural features. The same Heritage Program methodology used to evaluate species and plant communities should be used to assess the importance of these features. TNC will:

4. MAINTAIN NATURAL FEATURES IN PRISTINE CONDITION AND PROTECT THEM FROM UNNATURAL CORROSION AND DETERIORATION. THIS WILL BE ACCOMPLISHED PRIMARILY THROUGH REGULATING THE LEVELS AND TYPES OF HUMAN USE AND IMPACTS THAT ACCELERATE CORROSION AND DETERIORATION.

In special instances steps may be taken to prevent or diminish even natural processes of deterioration in order to perpetuate significant natural features and other natural elements.

TNC's secondary objective, the social stewardship objective, is to foster local support for preserves and recognition by the general public of the value of natural diversity preservation. The future preservation of natural areas depends upon a constituency of users and supporters.

TNC should foster the development of such a constituency by encouraging the appropriate use of preserves by educators, students, researchers, and other members of the general public. The management plan should identify appropriate types and levels of use, and specify programs to facilitate such use.

To achieve the above stewardship objective TNC will:

5. INVOLVE LOCAL RESIDENTS, USERS, AND OTHER INTERESTED MEMBERS OF THE PUBLIC IN DISCUSSIONS ABOUT STEWARDSHIP PLANNING AND IMPLEMENTATION.

6. PROVIDE INFORMATION ABOUT THE PURPOSE AND NATURAL QUALITIES OF THE PRESERVE TO THE LOCAL COMMUNITIES AND PRESERVE USERS.

7. KEEP THE PRESERVE AS FREE FROM HAZARDS TO USERS AS POSSIBLE.

8. CONDUCT STEWARDSHIP ACTIVITIES IN A WAY THAT MINIMIZES UNNECESSARY ANNOYANCES AND HAZARDS TO RESIDENTS NEAR THE PRESERVE.

9. UTILIZE PRESERVE DESIGN, SUCH AS THE PLACEMENT OF TRAILS, PARKING AREAS AND SIGNS, TO BOTH OPTIMIZE ACCESSIBILITY OF THE PRESERVE AND MINIMIZE UNDESIRABLE HUMAN IMPACTS TO THE EXTENT THAT SUCH DESIGN MEASURES DO NOT CONFLICT WITH OTHER PRESERVE OBJECTIVES.

10. PROMOTE APPROPRIATE RESEARCH AND EDUCATIONAL USE OF THE PRESERVE.

The two major stewardship objectives -- ecological and social -- may at times conflict with each other. People crush vegetation, erode and compact soil, alter the behavior of wildlife and transport onto preserves the seeds of unwanted plants that stick to shoes and clothing. It is the Nature Conservancy's position that:

11. ECOLOGICAL CONSIDERATIONS SHOULD BE WEIGHED MORE HEAVILY THAN HUMAN CONSIDERATIONS WHEN THERE IS A THREAT THAT SIGNIFICANT NATURAL ELEMENTS ON A PRESERVE WILL BE ALTERED OR SIGNIFICANTLY DAMAGED.

Appendix C

SNA Deed/Lease Considerations

The 1974 lease signed between The Nature Conservancy and the DNR contains several paragraphs relating to management of Western Prairie North.

1. Management planning is a joint and cooperative responsibility of the DNR and The Nature Conservancy.

2. The DNR will notify TNC thirty days prior to any proposed change in the rules and regulations. The Conservancy will then notify the DNR within thirty days if the change is acceptable or not.

3. The DNR shall provide authorized personnel to enforce the applicable SNA rules and regulations and other applicable state laws on the preserve.

4. The DNR shall erect and maintain a permanent, conspicuous sign on the preserve stating that it was acquired by TNC and has been designated an SNA.

5. TNC may, with the consent of the DNR, lease all or any portion of the unit for purposes consistent with the management plan.

6. Both TNC and the DNR can terminate the lease when there is a breach of the contract.

Appendix D

Relevant State and Local Land-use Laws

Finally, several Minnesota statutes may affect the management of Western Prairie North. They include:

1. Collecting and taking of wild animals:

   Under state law (M.S. 98.48) special permits are required from the DNR, Division of Fish and Wildlife, for the collection or taking of protected wild animals.

2. Endangered species:

   The Endangered Species Act (M.S.A. 97.488, as amended in 1981) states that no endangered wild animal or plant or parts thereof may be taken except under special circumstances. The DNR, Division of Fish and Wildlife, may undertake programs or promulgate rules and regulations which also affect the management of endangered or threatened species.

3. Conservation of certain flowers:

   Under state law (M.S. 17.23) no member of the Orchid or Trillium families, or any species of Lotus (Nelumbo lutea), Gentian (Gentiana), Arbutus (Epigaea repens) or Lily (Lilium) can be taken or gathered in any manner from public land without the permission of the Commissioner of Agriculture and then only for scientific and herbarium purposes.

4. Control of noxious weeds:

It is the duty of all land owners, according to state law (M.S. 18.181), to eradicate or otherwise destroy all noxious weeds. Section 18.315 also states that towns and cities may take steps to control noxious weeds on state lands within the territorial limits of the towns or cities provided that the managing agency fails to take action within fourteen days of receiving notice to cut or control the weeds. The following plants are considered noxious weeds statewide: field bindweed; hemp; poison ivy; leafy spurge; perennial sowthistle; bull thistle; canada thistle; musk thistle; and plumeless thistle. In addition, in Wilkin County hoary alyssum, cocklebur, giant foxtail, kochia, lambsquarter, redroot pigweed, and wild sunflower are classified as noxious weeds.

STEWARDSHIP

The Nature Conservancy

Vol. III, No. 2 May, 1976

WESTERN PRAIRIE VS TRANSMISSION LINE

The Minnesota Chapter of The Nature Conservancy recently won a decisive victory for the preservation of Western Prairie, a 600 acre preserve in northwestern Minnesota. On January 6th, District Judge C.A. Rolloff dismissed a lawsuit brought by Square Butte Electric Cooperative against the Conservancy to condemn Western Prairie for a high power transmission line.

Since September of 1974, the Conservancy has been resisting attempts by Square Butte to cross the prairie, which has also been dedicated as a State Scientific and Natural Area. The power line would have damaged the prairie during construction and maintenance, resulted in a visual eyesore in the middle of a wilderness preserve, and created a continual hazard to low flying prairie chickens. This was also the first effort to condemn a Conservancy preserve in Minnesota. The Chapter was concerned that a firm precedent be established not to tamper with Conservancy preserves. This was also the first time Minnesota's Scientific and Natural Areas Law was challenged.

Attorneys Lee Johnson and John Flicker appeared in court on behalf of the Conservancy, and submitted memorandum briefs. In an effort to get the Conservancy to back down, Square Butte proceeded with construction of the lines on both sides of Western Prairie before initiating a condemnation suit.

After the Conservancy received a favorable decision on the District Court level, Square Butte proceeded to appeal the case to the State Supreme Court. Prior to a hearing on the appeal, however, a settlement was reached out of court. The Conservancy was demanding that the power line be rerouted a minimum of 1/2 mile from the prairie. The settlement provides that at no point will the line be less than 1/4 mile from the prairie, and at most points it will be a full 1/2 mile away. A stipulation is being prepared for execution, at which time the appeal will be dropped.

The determining factor which prevented condemnation in this case was the fact that Western Prairie had been dedicated as a State Scientific and Natural Area. In addition to upholding the effectiveness of dedication, the case is a clear statement of the fact that the Conservancy is willing and able to do whatever is necessary to protect the integrity of its preserves.

Lee Johnson, a St. Paul attorney and member of the Minnesota Chapter Board of Trustees, takes his job as a volunteer seriously. Lee handles all tax exemption matters for the Chapter. He has applied for exemption on some 40 preserves. On three occasions he had to go to court to obtain exemption. In the case of Western Prairie, he worked diligently to see that the Prairie would be protected from condemnation.

CONTENTS

Appendix F-1.
Frequency sampling. From Heitlinger 1979.

To collect frequency data one simply notes the presence or absence of a species in a sampling unit (quadrat). Frequency is usually expressed as a percentage. If a species is observed in half of the quadrats in a sample, for instance 40 out of 80 quadrats, the frequency of the species is 50%.

The number of stems and biomass are disregarded in frequency sampling. All judgements are reduced to a yes or a no decision, which is objective and determined quickly.

The methods to be used are slightly modified from those of Hyder (1963, 1966, 1975a, 1975b). Frequency data will be used for monitoring grassland vegetation over time.

1. Determine which SNAs and which homogeneous areas (identified for relevé studies) will also be sampled with frequency analysis. Only grasslands will be sampled with frequency techniques. Check with supervisor about the choice. Lay out and mark the corners of the frequency plot using the same method as for relevé plots.

2. Frequency sampling will be conducted once, between August 15 and 30.

3. The frequency plot will be 100 feet by 75 feet (30.5m x 23m). It is placed near the center of the homogeneous area, near but not contiguous to the relevé plot (see figure 5, page 60).

4. Locate transects along the base line. Use graph paper to plot locations. The 100 foot baseline is divided into five 20 foot segments. Within each segment, two transect locations are chosen through random selection. Use a table of random numbers to select five pairs of two digit numbers between 01 and 20. Each pair must be different numbers but otherwise duplicate numbers are permitted.

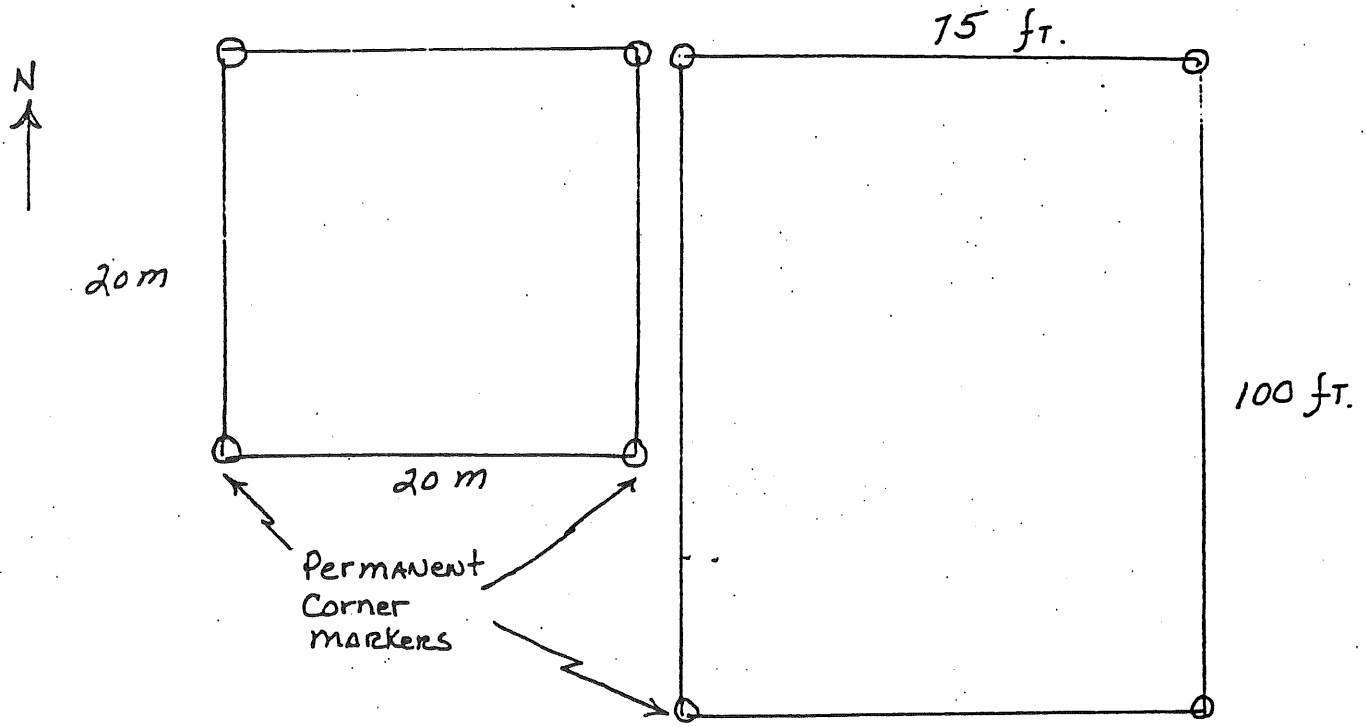


Fig. 5. Releve and frequency plots.

Each pair of numbers is used to locate two transects in each 20 foot segment. See figure 6.

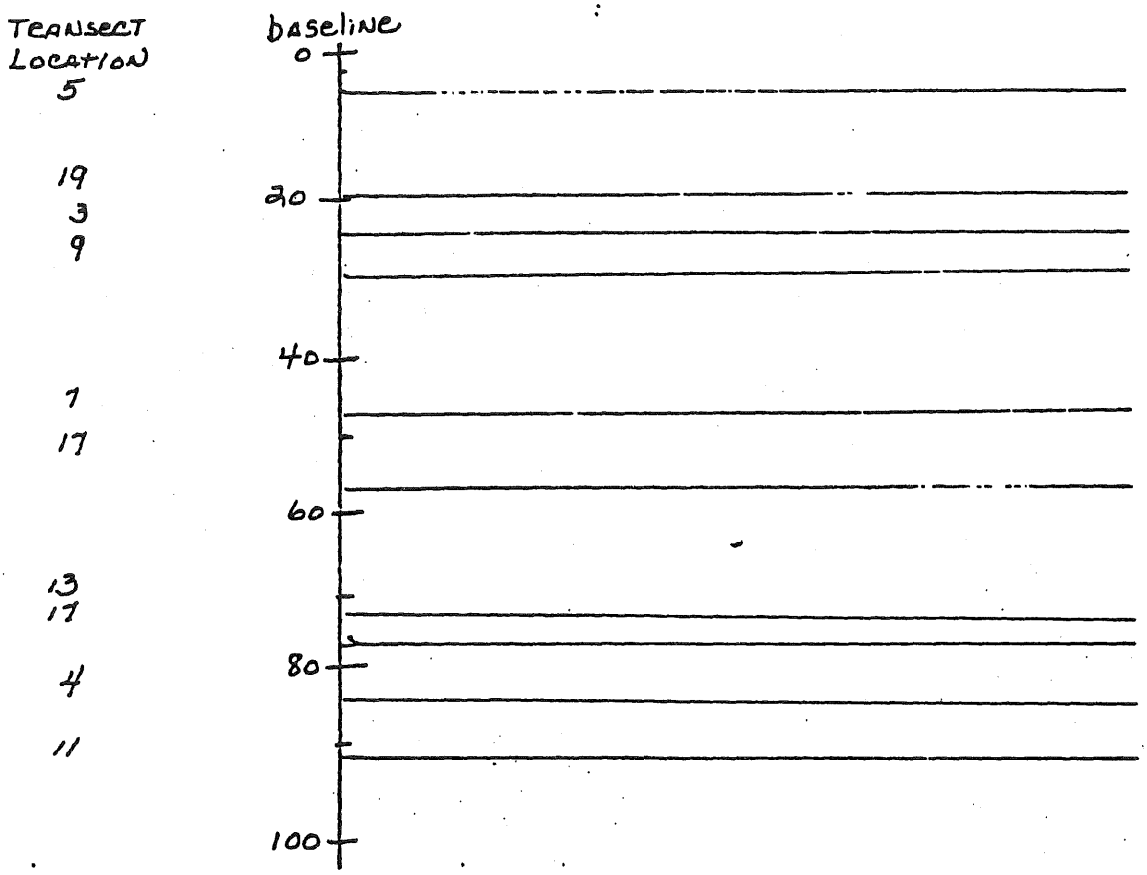


Fig. 6. Transect locations along the baseline. Pairs of randomly selected numbers between 01 and 20 are converted to numbers of feet to locate two transects in each 20 foot segment of the baseline.

5. Locate quadrat placements along each transect. Use graph paper to plot locations. Using a table of random numbers, select 20 numbers between 00 and 89. Each number in a set must be different. Multiply each of the 20 numbers by 10. These numbers are transposed to inches along a 75 foot (900 inch) transect, and indicate where the side of the quadrat closest to the baseline is located. Repeat random selection for quadrat placements ten times, so that each of the ten transects has a total of 20 quadrat locations, making a total of 200 quadrat locations per plot. Repeat the entire process for each plot.

6. After locating on graph paper the transect and quadrat placements for each plot, locate transects in the field and mark each transect

with a pair of 5' lengths of electrical conduit driven three feet into the ground. Quadrat placements need not be marked in the field.

7. Frequency sampling procedure.

   a) Prepare (or obtain copies of) data sheets. See figure 7. Obtain a quadrat frame (10 inches square).

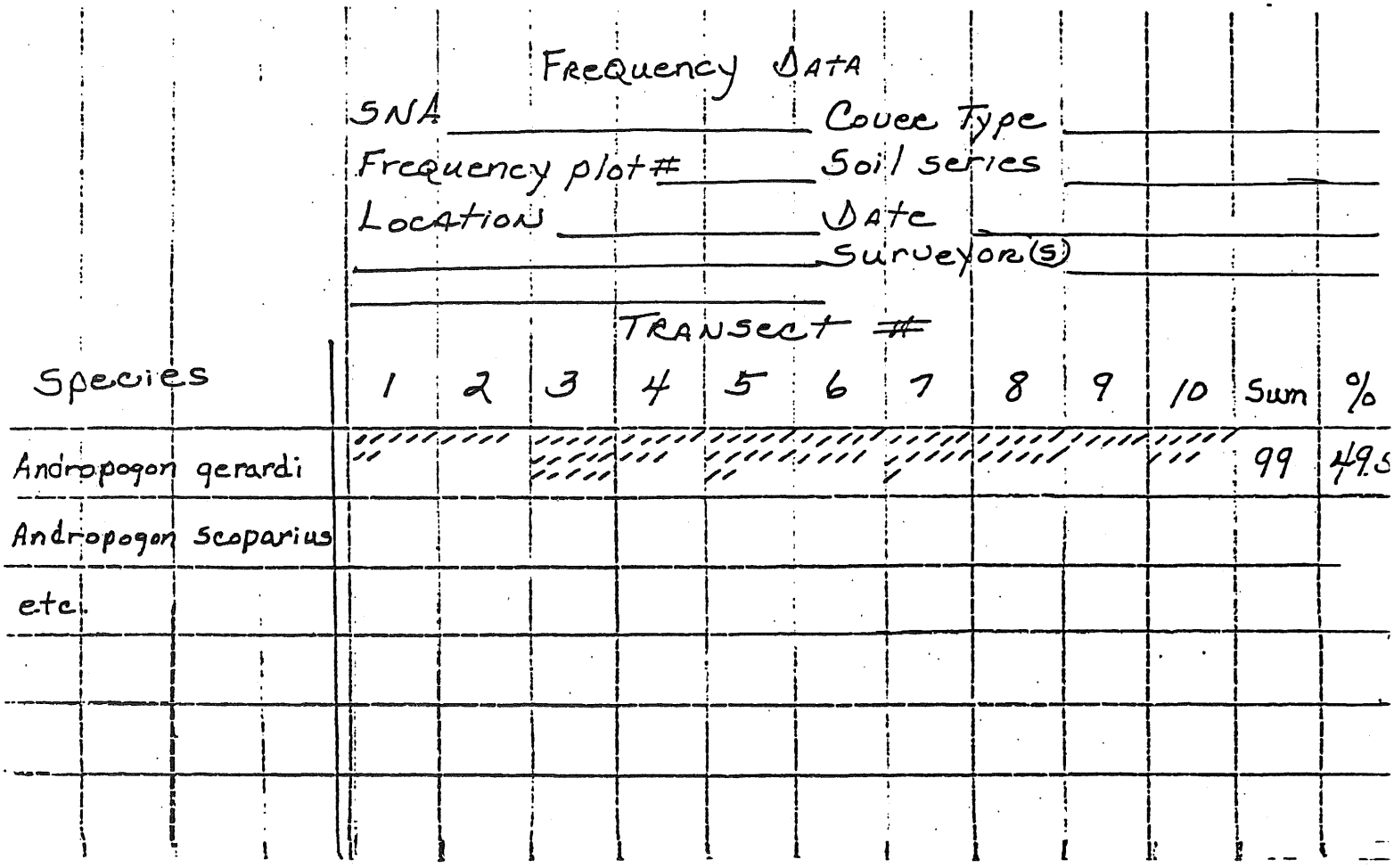


Fig. 7. Design of frequency data sheet showing data tallies for Andropogon gerardi which occurred in 7 quadrats in transect 1, 4 in transect 2, 15 in transect 3, etc.

   b) Use the releve data to make a list of all the species you may expect to encounter in the frequency plot adjacent to where the releve was made. List the grasses alphabetically, and then all other species alphabetically.

   c) Tightly stretch a measuring tape along a transect line. Refer to graph paper for positions of quadrats along the transect.

   d) Conduct sampling. Two people are needed for sampling. One inspects the quadrat placements and calls the names

of the species present. The other carries the data sheet, pencil and a ruler, and tallies data by a diagonal slash, one slash for each quadrat placement in which a species occurs. Overhangs do not count; the plant must be rooted in the quadrat. Tallies are kept separate by transect. A dot counter is used for tallying data. Double check all tallies.

Bare soil from pocket gopher or other ground disturbance is recorded as if it were a species.

Put a ? before any species name for which identification is in doubt. Describe unknowns under categories such as "unidentified grasses," " unidentified forbs," etc.

8. Record frequency data for an SNA using exactly the same format and method species arrangement as in the relevé synthesis table, but instead of using an x to simply record presence of the species write in the frequency percent.

9. Submit all data sheets with a map showing location of the frequency plot attached to the data sheet for that plot. Also submit "notes" mentioning any special problems, time spent in conducting sampling in the field, and any additional observations not recorded in the data that may be significant. Do not abbreviate species names and use only scientific names. Data sheets and tables need not be typed, but writing must be clear and spelling carefully proofed.

10. References for Frequency Method

Hyder, D.N., C. E. Conrad, P.T. Tueller, L. D. Calvin, C. E. Poultou, and F. A. Shera. 1963. Frequency sampling in sagebrush-bunchgrass vegetation. Ecology 44:740-746.

Hyder, D.M., R. E. Bement, E. E. Remmenga, and C. Terwilliger, Jr. 1966. Vegetation - soils and vegetation - grazing relations from frequency data. J. Range Mangt. 19:11-17.

Hyder, D.R., W.R. Houston, and J.B. Burwell, 1975. Tally equipment for frequency sampling of herbaceous vegetation. U.S.D.A., Agric. Res. Service, Western Region. 21p.

Hyder, D.R., R.E. Bement, E.E. Remmerga, and D.F. Hervey. 1975. Ecological responses of native plants and guidelines for management of shortgrass range. U.S.D.A., Agric. Res. Service, Technical Bul. 1503. 87p.

11. Materials for Frequency Method.

Maps and aerial photos as for releve method
Measuring tapes, 100 feet or longer
½" steel conduit (corners and transect positions)
Compass
Post pounder and stepladder
Quadrat frame - - 20 inches x 10 inches square, one side open, with handle
Grid paper, data sheets
Dot counter

Appendix F-1b. Frequency analysis, subdivided quadrat. From Kramer 1975

Frequency Analysis

Frequency analysis was based on fifty 0.5M (1 X 0.25M) sample sites. All sample sites were determined by a restricted randomization method. The grid map (Figure 5) was used as the base for the ordered restriction. The restriction required that each 50M block would be sampled at one site. The randomization was accomplished by selecting sample site coordinates in each block from a random numbers table (Cox, 1972).

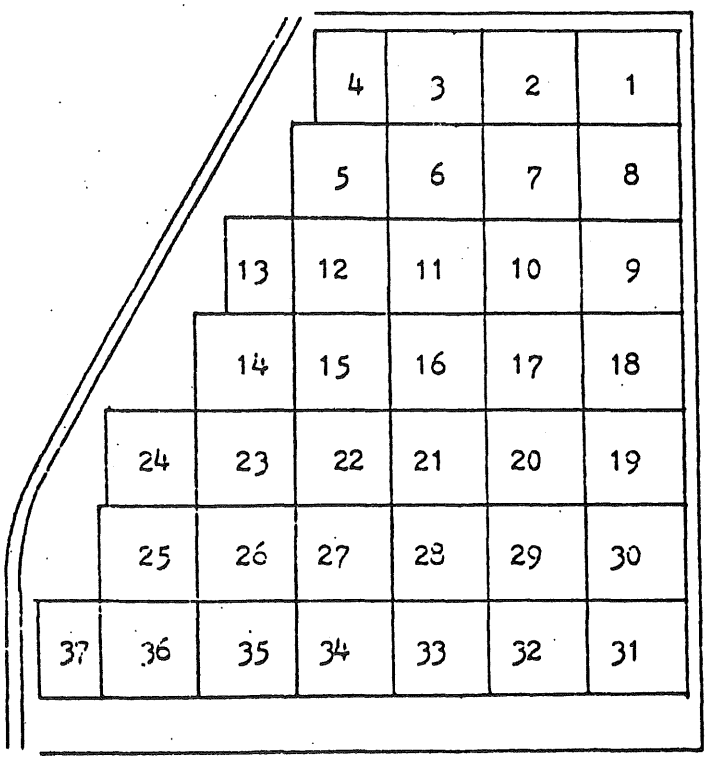


Figure 5. Grid map. Numbered blocks are 50M sq except 4, 13, 24, & 37.

Three grid blocks, each having 25% or more of its area in a buffer zone (Nos. 4,13, & 37), were not considered in the sample site selection. The remaining 34 blocks were treated equally. Sixteen additional sample sites were selected at random, one per randomly selected 50M block.

Each sample site was located by triangulation from block corners and 25M midpoints along the east-west boundary lines. Each site was marked with a flag.

A 0.25 X 1M sampler was constructed of 1in angle aluminum. Three-sixteenth in diameter holes were drilled at decimeter intervals along the 1M sides to accomodate 12-strand stainless steel crosswires affixed to three-sixteenth in bolts. Two taut crosswires were positioned between the sides and were marked with solder drops at decimeter intervals to delimit each square decimeter within the 0.5M sampler.

The 0.5M sampler was placed with the marker flag abutting its northeast corner. The sampler was positioned randomly in a north-south or east-west direction and alligned by magnetic compass. Vegetation growing along the edges of the sampler was carefully parted to position the sampler. Vegetation growing immediately outside the sampler edges was cliped at ground level to permit better viewing of the edge and to allow precise repositioning of the sampler at a later date. Additional corner flags were used to aid in establishing the sampler position. Loose debris from previous seasons was removed to aid viewing at ground level. Crosswires were positioned by threading them through the vegetation (Figure 6).

Basal frequency was recorded for each decimeter. All sites were sampled from 4 July through 29 August 1974 with most sites revisited several times in 1974 and some sites checked in 1975.

Field analysis of composition was limited to methods meeting the following requirements: the time required for each sample must not preclude making numerous replications; each site must be precisely relocatable to verify identifications; data should include a large number of the species present; data should be comparable to other studies; and the data should reflect composition of the entire site.

The assessment of population values or community structure by frequency analysis was the most commonly applied quantitative measure for the analysis of herbaceous communities in North American descriptive studies (Müller-Dombois, 1974).

Walker (1970) considered frequency to be the only method to provide acceptable estimates of all species without expenditure of excessive amounts of time. Because of the difficulty in counting individuals or estimating basal area, Curtis (1955) believed that "quadrat frequency is perhaps the best method of gaining information on the quantitative relations of the prairie plants." Greig-Smith (1957) also considered quadrat frequency the easiest of quantitative measures to determine.

Becker and Crockett (1973) compared various sampling techniques in grassland vegetation and found the quadrat an advantage over other methods when time was considered. They also found that frequency values determined by quadrat and line transect methods best reflected dispersion of the major species or species groups.

The selection of a modified quadrat system seemed appropriate but questions remained concerning size (area) of samples and number of sample replications. The vast majority of reported studies selected the most traditional size, 1sq M. Cain and Castro (1959) suggest a 1 to 2 sq M frame size for sampling a herb layer. Some recent studies have used smaller sizes (Smeins & Olsen, 1970; Becker & Crockett, 1973).

To provide ease of sampling and to permit using a greater number of samples, a sample unit size of 1 X ½M was selected. The resulting data indicated this size was suitable for this site. Only one species was recorded with 100% frequency. A 100% value indicates a plot size larger than the maximum size of the gaps between individuals of that species (Daubenmire, 1968). If several species had reached 100%, the sample could be too large and values for these species would not indicate relative distances between individuals.

Evans (1952) demonstrated that changes in frequency were not directly proportional to changes in the size of the sampling unit. He also stated that

> the size of quadrat was found to affect the resulting values of frequency and abundance, as well as the frequency distributions of the number of individuals per quadrat. It was also shown to have a marked effect upon various measures of dispersion.

The data presented here is thus most directly comparable to those studies using a sampler of the same dimensions.

Frequency may be defined as the estimate of the chance of an individual occurring in any sample (Greig-Smith, 1957) or as Daubenmire (1968) defined it

> frequency . . . provides information about the uniformity of distribution with out necessarily indicating how many or how much. It is defined as the percentage of occurrence of a species in a series of samples of uniform size contained in a single stand, the numbers and sizes of plants in each sample being ignored.

It has been noted repeatedly that frequency is dependent on density and distribution (Dice, 1948; Greig-Smith, 1957; Goodall, 1952). Goodall stated that

> certainly the frequency found reflects certain absolute characteristics of the vegetation, as well as the size and distribution of the quadrats used; but it combines so many

> (density, distribution, and in many cases size of individuals) and unites them in so complex a fashion, that it is not possible to argue back from the frequency to the features of the vegetation on which it depends.

Dice has shown that

> the calculation of the population density of a species from the frequency of its occurrence in samples of any kind may give erroneous figures when the distribution of the form is non-random . . . therefore, frequency should not be used as an indication of population density.

Simple frequency data therefore does not deal comprehensively with the importance of a species in a community. As an example, Poa pratensis has a 0.5% frequency of 100% at this site. Does it also have a high value of cover? Apparently not. Drew (1947) reported that in domestic prairies, this species had a high frequency value (79%) but low cover value (6.5%). Smeins and Olsen (1970) reported on three community types in Minnesota tall-grass prairie. In a Stipa community, Poa had a 14% cover value for a 100% frequency value. In an Andropogon gerardi community, it had 12% cover for 85% frequency. In a Spartina community it had 5% cover for 40% frequency. All three of these communities were catagorized by high frequency and cover values for the named species.

Simple frequency may tell us that a species has wide distribution, such as Poa, Carex, Andropogon gerardi, and Helianthus rigidus in this study. However, it relates little about other characteristics of dominance such as great abundance, comparatively large size (height and volume), long life span, and good vigor (Weaver, 1954). Indications of relative abundance and aggregation are possible if the frequency sample contains several sub-samples. Table 2 lists sub-sample frequency at two levels. The first considers total decimeter frequency (TDF). If this value is high compared to the corresponding 0.5% frequency (THF), then that species clearly is more abundant than the species with a low

TDF and a similar TMF. Curtis (1959) stated that species behavior analysis based on this type of frequency was identical to that based on density values.

The second level considers decimeter frequency in only those 0.5M samples occupied by the species (DF/OM). This value will exceed the TDF for all species except those with TMF of 100%. The TDF value, if relatively high, may indicate aggregation, but it is the ratio between TMF and TDF that is of importance. This is more apparent when converted to DF/OM. If both DF/OM and TDF values are high, no aggregation is apparent and a sod forming grass is indicated. If the TMF value is high with low TDF and DF/OM values, a frequent but widely dispersed species is indicated. As the DF/OM value rises and approaches or exceeds twice the TDF value, a bunch grass or otherwise aggregated grass or forb is indicated. Extreme aggregation occurs where the DF/OM value exceeds the TMF.

The validity of the number of samples taken was tested by application of the species-area curve as employed by Cain, Nelson & McLean (1937) and Cain (1938).

The cumulative number of species sampled is plotted against the number of samples taken. The minimum number of samples needed is found where the resulting curve begins to level out or where a 10% increase in the total sample area results in a 10% increase in the total number of species. The curve levels at approximately 21 samples and the 10% relationship is satisfied at approximately 15 samples (Figure 11). Twenty samples as minimum was selected for data comparison.

Frequency values for these samples are listed in Table 2. Species of less than 10% frequency in the 50 sample total are not included.

Appendix F-2. Step-point plus frequency method.

Pilot Study to Test Step-point and Step-point plus Frequency Sampling for Prairie Vegetation Monitoring

Heitlinger 1980

Vegetation relevé plots (20m x 20m and 10m x 10m) have been permanently located on several Minnesota prairies. While useful in classifying vegetation, this system is inadequate for long-term vegetation monitoring. It requires estimates of cover which are subjective and hence can vary by observer, cover is recorded in broad cover classes which hampers identification of small changes and statistical treatment, and the relevé plot is not necessarily representative of the community in which it occurs. Alternative methods should be tested.

The step-point method is a "rapid, accurate, and objective method of determining the botanical composition and total cover of herbaceous vegetation." (Evans and Love 1957). Cook et al 1962 state "The technique is most suitable for measuring major characteristics of the vegetation of an area... . Often the technique is useful to determine features of the plant composition and density rapidly as a preliminary step toward more refined and detailed appraisal." A method for decreasing subjectivity in point placement was developed by Owensby (1973). Step-point is a common sampling method in tallgrass range management studies. Evans and Love (1957) used 100 points per acre (30 minutes per acre for one person); Owensby recommends about 60 points per acre (6-7 minutes per acre for a three-person crew). The standard approach is to use a regular distribution of sampling points.

Step-point sampling avoids the problems of estimating cover and tedious stem-counts. The main drawback is that it does not sample the less frequent plants and forbs as well as the dominant grasses.

A test is needed to determine if some modifications will significantly increase the number of species recorded, and to apply the step-point technique in classifying vegetation to identify representative areas which may be sampled more intensively.

A. Modifications to be tested are:

1. Varying the points per acre. By a greater density of points more species may be sampled. One application would be to sample at low density generally and higher density selectively in areas where rarer species occur.
2. Sampling in two seasons. By sampling once in the cool and once in the warm season we may pick up many additional species.
3. Combining step-point and frequency sampling. In frequency sampling the species present in a quadrat are recorded, regardless of size or number, as present. This type of binomial (yes or no) technique is quick but requires a relatively high number of observations. Hyder (no date) found that 150 or more quadrats were needed to detect as significant

(at $p < .05$) a 20 percent change in density. No other method is as efficient for obtaining valid information about a large number of subdominant and relatively rare species. By combining step-point for common species and a $0.5m^2$ quadrat for less frequent plants we may pick up many additional species. One application would be to sample with step-point generally to measure dominant grasses, and use $0.5m^2$ quadrat frequency measurements in selected areas to record less common species.

B. Vegetation classification.

1. After conducting the studies listed above and determining the optimal method, it will be tested to quantitatively map vegetation. Data will be tabulated per unit area (e.g., per acre or hectare) and units with closely similar values lumped into a cover type. The questions to be resolved are 1) how much time per acre does it require to use the optimal method, and 2) is the data useful in generating a vegetation map which can then be used to select representative sites for long-term monitoring?

Method

Sites and study areas. The site or sites (preserves) selected should have fairly complete species inventories, so that the number of species recorded in the trials can be compared to the total number of species. The preserve should be small enough so that 10 percent of the preserve area can be included in the study of method modifications without having an inordinately large area for study. The preserve should be diverse enough so that a test is provided in dry-to-wet prairie communities. Schaefer Prairie would be a good test site (120 acres not including formerly cultivated land, 275 vascular plants including 188 wet-to-dry native prairie species).

For the study of method modifications, 1-acre study plots totaling 10% of the site acreage will be randomly selected. Selections qualify for study if they are less than 50 percent in wetland, woodland, and other non-native prairie communities. The corners of study plots will be marked with stakes, and located with a tape measure and compass.

Data collection points. To increase the speed of sampling, transect and data collection points will be located in the field by paces and steps. The researcher will have to determine the average length of his/her pace (two steps) and how many paces equal one side of a square one-acre area (approximately 209 feet). The variability of measuring with paces should increase the randomness factor each time data is sampled in an area, as well as greatly reduce the time required.

Transects will be located by restricted randomization of one transect per one-tenth of the baseline length. The researcher will randomly select one among numbers from 1 to the number of paces per 20.9 feet rounded to the nearest whole number. For example, if a step equals 2.25 feet, there are 9.3 steps per

Table 1. Variations in sampling method.

	Sampling density (per acre)	Method (sampling area)	Season	Species		
				total #	# grasses	# recorded 60-90% frequen
1.	50	point	spring			
2.			summer			
3.			both			
4.		.25m^2	spring			
5.			summer			
6.			both			
7.	100	point	spring			
8.			summer			
9.			both			
10.		.25m^2	spring			
11.			summer			
12.			both			
13.	200	point	spring			
14.			summer			
15.			both			
16.		.25m^2	spring			
17.			summer			
18.			both			
19.	400	point	spring			
20.			summer			
21.			both			
22.		.25m^2	spring			
23.			summer			
24.			both			

20.9 feet. Round this to 9 and randomly select a number from 1-9 to locate the base of the transect. Repeat ten times, once every 20.9 feet. The 20.9-foot interval also should be measured by pacing.

The data collection points along transects will be located at randomly selected one-step intervals. For example, if a step equals 2.25 feet, there are 93 steps per transect length (209 feet), and 40 of the 93 will be randomly selected for each transect for placement of the point and quadrat frame. The date need only be collected at the highest density of points to be studied (400) since results at lower densities can be determined through sub-sampling the data set. The easiest way to make this selection is to number cards from 1-93 (or whatever the number of paces per 209 feet), shuffle and select without replacement 40 cards, each card read as the number of steps along the transect where data is collected. The same method may be used for sub-sampling the data set for results at different densities of data collection points.

Materials and personnel. A cover type map or aerial photo will be needed for locating study areas and classification mapping. An overlay grid will be used for random selection of study areas within a site. A tape measure and lengths of steel conduit are needed for measuring and marking study plots. Wire flags can be used for marking transect bases. A quadrat frame will be constructed incorporating a single point for step-point data and a three-sided quadrat frame. Determining the optimal size of a quadrat is rather complicated. Hyder et al (1963) recommended 9-inch square quadrats for frequency sampling in sagebrush-bunchgrass vegetation. Curtis and McIntosh (1950) suggest a quadrat should be one to two times as large as the mean area per individual of the most common species. The greatest precision in detecting changes occurs when percent frequency falls between 60-90 percent (Hyder, no date), so the ideal size would record species of greatest interest within this range. Since dominant species will be sampled with the step-point method, a fairly large quadrat of 50cm by 50cm ($0.25m^2$) will be used for this study. A data sheet is attached.

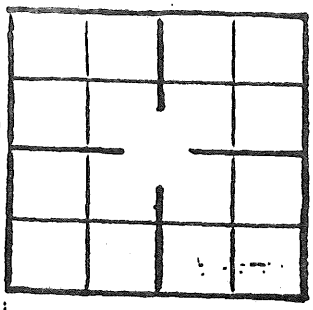
Field procedures. After locating transect bases with flags, a compass is used to sight a straight line. As a sampling point is reached the back of the quadrat frame is placed against the boot and leaned forward until contact is made with the ground. For point data, plants are recorded if the point strikes the base of the plant. If no plant base is hit then the plant nearest the point and within a forward 180^{o} arc is recorded. For frequency all species identifiable will be recorded as present if rooted within the quadrat. The procedure will be repeated twice: mid-June and late August. Unknowns will be recorded as unknown seedling, grass, sedge spp. forb, or shrub.

Analysis of methods. Species area curves for total species, dominant grass species, and number of species recorded with frequency of 60-90% will be drawn for 24 variations in sampling method (Table 1). This will graphically depict the relation between completeness and utility of the sampling variation,

and increased number and size of the sample. For a general picture of the dominant species it is anticipated that step-point at 50-100 points per acre will be adequate. Additional points probably won't add a proportional amount of information about dominant grasses. For sub-dominants we would look for a sharper climb in the species area curve with increased number of frequency quadrats. If we see a flattening of the curve at a certain number of quadrats, that would provide a rationale for sampling at that density. The number of species recorded with frequencies between 60-90% is of interest because in this range the detection of change is best.

Mapping and classification. The selected method should be used in late August or early September on the entire preserve. Data should be recorded so that it can be analyzed per acre. One-acre blocks can then be characterized quantitatively, e.g., by the species occurring above a given frequency. Such a map would be useful as a quantitative baseline for the entire preserve and as a systematic way to identify plots for long-term study which are representative of communities on the preserve. By mapping several preserves in this way, we would increase our confidence in generalizing treatment responses from one preserve to another. The purpose of the pilot trial would be to determine the time per acre to use this system on a large scale, and the time and other constraints in generating maps from the data.

Field time. It is estimated to take 1 hour for set-up and 4 hours to collect data per 1-acre study plot. If Schaefer Prairie is used, we would have 6-12 study plots, requiring 3-6 long field days in spring and in summer. If step-point is used at 100 points per acre for mapping, it would take 50-60 field hours to collect mapping data. Required time might be reduced considerably if more than one person was involved in data collection. Analysis and writing might take an additional 4 days. The total commitment for one person would be 10 to 16 days.



Sect ____ Preserve _____, _____ Co., M

Plot # ☐ By _____ Date ____

Location = X

Transect (N-S or E-W) # ☐ , . = step-point ✓ = frequency

--- Data Collection Points 1-40 per transect

Code	Species
	Graminoids
	? grass
	? sedge
Andro	Andropogon ger.
A.	scop.
Bouteloua	curt.
Bromus	inerm.
Bromus	kal.
Koeleria	crist.
Panicum	spp.
P.	virg.
Poa	comp.
Sorghastrum	nut.
Sporobolus	het.
Spartina	pect.
Stipa	spart.
	Forbs + Shrubs
	? Forb

Appendix F-3.

Point-centered quarter sampling. From Mueller-Dombois and Ellenberg 1974.

Vegetation Analysis in the Field

7.63 **The Point-Centered Quarter Method.** In the point-centered quarter method four distances instead of one are measured at each sampling point. Four quarters are established at the sampling point through a cross formed by two lines. One line is the compass direction and the second a line running perpendicular to the compass direction through the sampling point. The line-cross can also be randomly established by spinning a cross over each sampling point. The distance to the midpoint of the nearest tree from the sampling point is measured in each quarter (FIG. 7.4).

The four distances of a number of sampling points are averaged and when squared are found to be equal to the mean area occupied by each tree. COTTAM and CURTIS (1956) tested the reliability of this method on several random populations by checking the result with the plot method. They ranked the four quarter (Q) distances of each sampling point by computing the mean of the shortest (Q1), the second shortest (Q2), the third (Q3) and the longest (Q4) distances. The following estimates of the correct mean area per tree (MA) were found to apply to each of the different sets of mean distance.

Q1 shortest	$=0.5\ \sqrt{MA}$
Q2	$=0.8\ \sqrt{MA}$
Q3	$=1.12\sqrt{MA}$
Q4 longest	$=1.57\sqrt{MA}$
Q mean of 4	$=1.0\ \sqrt{MA}$

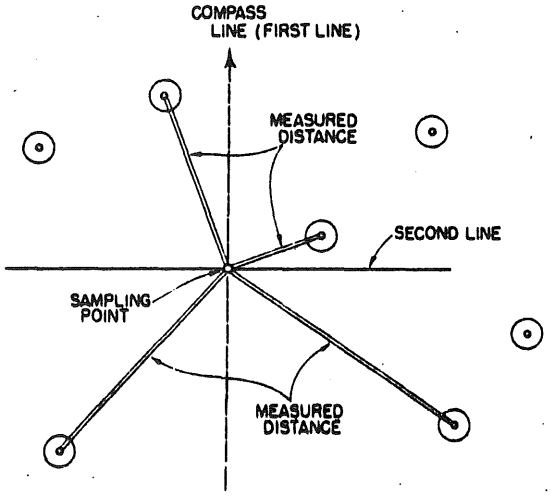


FIGURE 7.4. Point-centered quarter method.

Therefore, no correction factor is needed when the four quarter distances are averaged; and $MA = D^2$, where D = the mean distance of four point-to-nearest-tree distances taken in each of four quarters. Mathematical proof of the workability of this method has been given by MORISITA (1954).

Of course, the accuracy increases with the number of sampling points, and a minimum of 20 points is recommended (COTTAM and CURTIS 1956).

The method has two limitations (NEWSOME and DIX 1968) for field applications. An individual must be located within each quarter, and an individual must not be measured twice. Therefore, stands with wide spacing of individuals present a problem in using this method. The second limitation applies also to the random pairs method.

The parameters obtained in the distance methods are:

1. Species.
2. Density (from mean distance).
3. Diameter (and therefore basal area and dominance).
4. Frequency (as the occurrence of a species at a sampling point).

The same parameters are also obtained from plots. However, the distance methods have an advantage in that they do not require laying out of plot boundaries. This saves considerable time. It also eliminates to a certain extent the personal error from judging whether boundary individuals are inside or outside the quadrat.

7.64 Example of a Point-Centered Quarter Analysis. The following example relates to the same tropical rain forest stand that served for the relevé example (SECTION 5.3) and for the quantitative plot example (SECTION 7.3). The point-centered quarter example is shown only for five sampling points to save space (TABLE 7.4). It is recommended to sample at least 20 points per stand. The adequacy of sampling points can, of course, also be determined by plotting the running mean as described in SECTION 6.42.

In the example analysis in TABLE 7.4, trees with basal diameters less than 3 cm were omitted. These included all woody plants under 2 m height. The small trees could, however, be sampled as a second size category from the same sampling points with each four distances. The objective was to determine (from individuals taller than 2 m):

1. the density for each tree species,
2. the dominance of each tree species, and
3. the frequency of each tree species.

A second objective was to convert these absolute values into relative values as an example for deriving the importance value, which will be discussed in SECTION 7.67.

TABLE 7.4 shows the raw data for five sampling points that were arranged in a transect, one point every 5 m. TABLE 7.5 shows the derivation of the mean basal area by species. This value is needed to determine the dominance of the species, which is a combination of number and basal area.

7.65 Limitations of the Distance Methods. The point-centered quarter method has become well accepted as shown by many vegetation studies (CAPLENOR 1968, HABEK 1968, RISSER and ZEDLER 1968, NEWSOME and DIX 1968, among others). Apart from its less complicated field application and greater information value per sampling point, the method seems more reliable than the random pairs method. This is based on the observation that the distances of trees to sampling points are more truly random than the distances among trees located through sampling points (COTTAM, CURTIS and HALE 1953, PIELOU 1959).

However, the point-centered quarter method is similarly applicable only to random distributions. Plot studies are more reliable where plant individuals are not randomly distributed (SCHMELZ 1969). Yet plots or quadrats are not fully reliable either. The reason is that a plot may also include either aggregations or underdispersed groupings of individuals in contagiously distributed species combinations. Clumping of individuals or contagious distribution applies to nearly all plant life forms, except trees and annuals. But even among the latter life forms nonrandom distributions are the norm for the individuals of single species in mixed-species stands. Therefore, the method should not be applied to single species in mixed stands. Instead, it should be applied only to broad size classes as shown in the preceding example, where the method was applied to tree individuals of all species taller than 2 m. The density of each species is subsequently established by partitioning the total density estimate.

GREIG-SMITH (1964) has cautioned against applying the point-centered quarter method to herbaceous life forms, such as bunch grass vegetation, because the resulting density values are inaccurate where the distribution of individuals occurs in aggregations. This has been supported by RISSER and ZEDLER (1968) who found in Wisconsin grassland that the point-centered quarter method consistently underestimated the number of individuals in contagiously distributed species. This can be explained by the greater probability of a sampling point to fall between the clumps of individuals than within the clumps in contagious distributions in which the clump diameter is small. By falling

TABLE 7.4. Quantitative Analysis by Point-Centered Quarter Method. Five Sampling Points, One at Every 5 m Along 110°, Starting at End of Convex, Gently Sloping Ridge Below Pauoa Flats Trail Going Upslope Toward the Trail. Raw Data, March 4, 1972.

SAMPLING POINT	QUARTER NUMBER	DISTANCE (M)	SPECIES	DIAMETER AT BASE (CM)
1	1	0.7	*Psidium guajava*	5.5
	2	1.6	*Acacia koa*	42.5
	3	3.5	*Metrosideros collina*	17.0
	4	2.0	*Metrosideros tremuloides*	25.0
2	1	1.1	*Psidium guajava*	4.0
	2	0.8	*Psidium guajava*	5.0
	3	1.9	*Psidium guajava*	5.0
	4	1.8	*Psidium guajava*	4.0
3	1	1.3	*Acacia koa*	75.0
	2	0.7	*Psidium guajava*	3.0
	3	1.5	*Metrosideros collina*	9.0
	4	2.0	*Metrosideros collina*	23.0
4	1	3.1	*Acacia koa*	14.0
	2	1.7	*Psidium guajava*	6.0
	3	1.1	*Psidium guajava*	5.0
	4	1.9	*Acacia koa*	12.0
5	1	2.5	*Acacia koa*	23.0
	2	2.2	*Acacia koa*	18.0
	3	1.4	*Psidium guajava*	5.0
	4	2.8	*Metrosideros collina*	25.0
		Total 35.6		

Results:

Mean distance (D) = 35.6/20 = 1.78 m

Absolute density = Area/D^2

Where D = mean distance

Number of trees per 100 m^2 = $100/(1.78)^2$ = 100/3.17 = 31.5

Absolute dominance = mean *ba* per tree × number of trees in species

Where *ba* = basal area

Number of trees in species

SPECIES	NUMBER IN QUARTERS	NUMBER OF TREES IN 100 M^2
Acacia koa	6/20=0.3	0.3 ×31.5= 9.4
Metrosideros collina	4/20=0.2	0.2 ×31.5= 6.3
Metrosideros tremuloides	1/20=0.05	0.05×31.5= 1.6
Psidium guajava	9/20=0.45	0.45×31.5=14.2
		Total 31.5

Vegetation Analysis in the Field

TABLE 7.5. Mean Basal Area by Species for the 20 Trees Shown in TABLE 7.4.

ACACIA KOA		*METROSIDEROS COLLINA*		*METROSIDEROS TREMULOIDES*		*PSIDIUM GUAJAVA*	
DIAMETER (CM)	*BA* (CM^2)	DIAMETER (CM)	*BA* (CM^2)	DIAMETER (CM)	*BA* (CM^2)	DIAMETER (CM)	*BA* (CM^2)
42.5	1418	17.0	227	25.0	491	5.5	24
75.0	4418	9.0	64	..	..	4.0	13
14.0	154	23.0	415	..	..	5.0	20
12.0	113	25.0	491	..	..	5.0	20
23.0	415	..	..	..	..	4.0	13
18.0	254	..	..	..	..	3.0	7
..	..	..	..	..	..	6.0	28
..	..	..	..	..	..	5.0	20
..	..	..	..	..	..	5.0	20
Total *ba*	6772		1197		491		165
Mean *ba*	1129		299		491		18

Therefore, dominance of — Dominance rank

Acacia koa	$1129 \times 9.4 = 10613\ cm^2$	1
Metrosideros collina	$299 \times 6.3 = 1884\ cm^2$	2
Metrosideros tremuloides	$491 \times 1.6 = 786\ cm^2$	3
Psidium guajava	$18 \times 14.2 = 256\ cm^2$	4
	$13539\ cm^2/100m^2$	

$$\text{Absolute frequency} = \frac{\text{number of points with species}}{\text{total points}} \times 100$$

Acacia koa	$= \frac{4}{5} \times 100 =$	80 percent
Metrosideros collina	$= \frac{3}{5} \times 100 =$	60 percent
Metrosideros tremuloides	$= \frac{1}{5} \times 100 =$	20 percent
Psidium guajava	$= \frac{5}{5} \times 100 =$	100 percent
		260 percent

between clumps, the point to plant distances will be longer than average. The longer distances result in an overestimate of the mean area per individual and thus in an underestimate of density.

The opposite, namely overestimation of the number of individuals, is true for regularly distributed individuals. This is shown in FIGURE 7.5. In a regular, quadrangular distribution, such as often found in a planted tree stand, the correct mean area is obtained by squaring the shortest distance between any two trees. This result would be obtained only by sampling point 1 in FIGURE 7.5. Such locating may occur once in a very large number of random point placements or not at all. The most

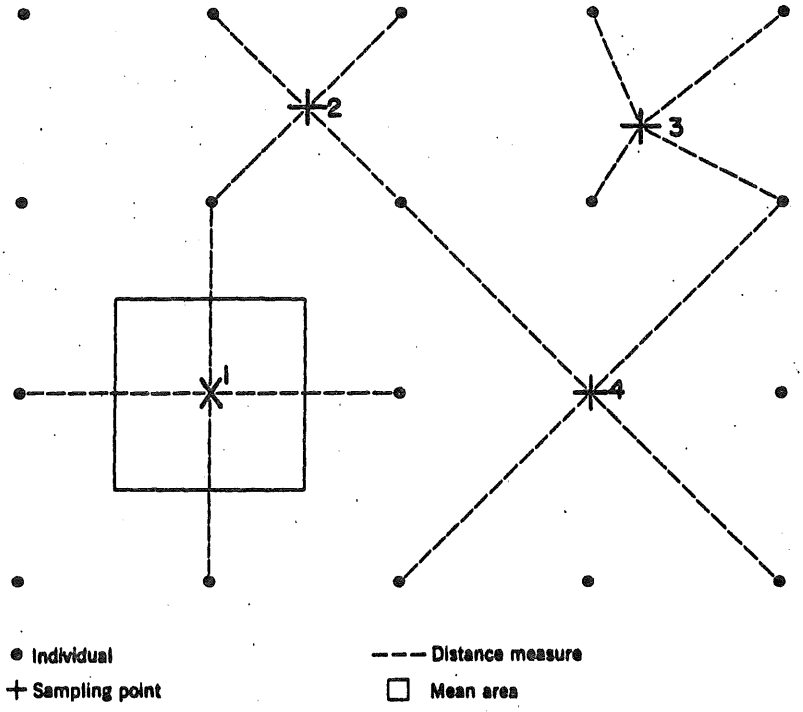


FIGURE 7.5. Application of point-centered quarter method to a regular distribution of individuals. Here only sampling point 1 gives the correct estimate of mean area. Further explanation in text.

common placement would be between trees, such as indicated by points 2 and 3. At these positions the mean distance of four quarters and therefore the mean area will always be underestimated. This will result in a considerable overestimate of tree density. Only position 4 would result in an overestimate of mean distance and thus an underestimate of density, as is found for contagiously distributed individuals. However, for a sampling point to give this result, not only must the point fall directly on a tree, but also the quarter dividing lines must pass through the center of the nearest trees, which would render them invalid for inclusion in the sample. This also shows that the boundary problem, found to be a disadvantage in any plot method, is not entirely eliminated in the plotless methods. However, it is highly improbable that position 4 will occur randomly. Instead, tree density can always be expected to be overestimated by this method when applied to regularly distributed individuals. This is true also for rectangular and rhombic regular distributions.