The Missouri Ozark Forest Ecosystem Project: Past, Present, and Future

Brian L. Brookshire[1], Randy Jensen[2], and Daniel C. Dey[1]

Abstract.—In 1989, the Missouri Department of Conservation initiated a research project to examine the impacts of forest management practices on multiple ecosystem components. The Missouri Ozark Forest Ecosystem Project (MOFEP) is a landscape experiment comparing the impacts of even-aged management, uneven-aged management, and no harvesting on a wide array of ecosystem attributes. These three harvest treatments were replicated in three complete blocks on a total of nine sites in the southeast Missouri Ozarks. Each study site is approximately 1,000 acres (400 ha) in extent. More than 50 scientists are participating in this coordinated ecosystem research project.

Public attitudes toward natural resource management have changed considerably over the past 50 years, and in particular, the last decade. Since the late 19th century, we have exploited the forest for commodities, often with a short-term mentality. Now, the public enthusiastically supports a stronger conservation and stewardship ethic in forest management decisions (Missouri Department of Conservation 1996, Palmer 1996). In particular, the public has increasingly voiced concerns about tree harvest impacts on non-timber forest resources. Natural resource managers share these concerns and have embraced new concepts, such as adaptive and ecosystem management (Baskerville 1985, Baskerville and Moore 1988, Gordon 1993, Walters 1986). However, past forest management and research have concentrated heavily on the production of commodities, such as timber and game species. The Missouri Ozark Forest Ecosystem Project (MOFEP) was initiated in 1989 to investigate forest management impacts on multiple biotic and abiotic ecosystem attributes. In this paper, we present background information about the origin, design, status, and future direction of MOFEP.

[1]Silviculturist and Research Supervisor, respectively, Missouri Department of Conservation, Jefferson City, MO 65102.
[2]Research Forester, Missouri Department of Conservation, Ellington, MO 63638.

CONCEPT AND OBJECTIVES

During the mid-1980's, impacts of forest management on neotropical migrant songbirds became the subject of great debate following reports of their apparent population declines (Annand and Thompson 1997, Robbins *et al.* 1989, Robinson *et al.* 1995, Thompson *et al.* 1993). Population declines were attributed to forest fragmentation, brown-headed cowbird *(Molothrus ater)* parasitism of nests, predation of nests, and tropical deforestation (Rothstein *et al.* 1986, Thompson *et al.* 1993). In response to these concerns, scientists from the Missouri Department of Conservation (MDC) and the University of Missouri-Columbia proposed a project to determine the impacts of forest management on neotropical migrant songbirds (Clawson *et al.* 1997). The internal and external reviewers of this proposal suggested expanding the scope of the project to include the evaluation of forest management impacts on multiple ecosystem components, rather than just songbirds. Consequently, the objectives were broadened to evaluate forest management impacts on multiple ecosystem attributes for large sites (600+ ac (240 ha)). Additional objectives were derived to ultimately accomplish the goal of providing sound scientific information for the refinement of forest management practices in Missouri. Through numerous iterations, an experimental approach for determining forest management impacts on multiple ecosystem components was designed and was subse-

quently named the Missouri Ozark Forest Ecosystem Project (Kurzejeski *et al.* 1993). Sheriff and He (1997) explain the experimental design and evaluation procedures for MOFEP and associated studies. Each individual MOFEP study has associated objectives that are discussed in this volume.

SITE SELECTION

Selecting experimental sites for MOFEP was challenging. Suitable sites had to be: (1) at least 600 ac (240 ha) in size; (2) contiguous tracts with minimal edge; (3) largely free from manipulation for at least 40 years and preferably longer (less than 5 percent of area disturbed); (4) owned by MDC; (5) located in the southeast Missouri Ozarks; and (6) in close proximity to each other. Project leaders searched MDC records, talked with site managers, and made numerous aerial and field evaluations before finally selecting the nine sites that were used to develop the overall experimental design (fig. 1) (Sheriff and He 1997). A detailed description of the study area is provided by Brookshire and Hauser (1993) and Meinert *et al.* (1997).

Each MOFEP experimental site was divided into areas of common slope and aspect. These were further divided into stands that averaged approximately 12 ac (5 ha) in size (figs. 2 and 3). Stands were used to stratify the placement of 648 permanent vegetation plots (Sheriff and He 1997). Additionally, stand boundaries were used to implement the experimental treatments that will be discussed later in this paper.

TREATMENTS

Forest management treatments selected for MOFEP were even-aged management (EAM), uneven-aged management (UAM), and no-harvest management (NHM). The three treatments were each randomly assigned within three blocks, each containing three of the nine MOFEP sites (Sheriff and He 1997) (fig. 3). The treatments are briefly described below; additional detail is available in Brookshire and Hauser (1993).

Even-aged Management

Even-aged management was implemented according to MDC Forest Land Management Guidelines (1986), with a cutting rotation of 80 to 100 years per site resulting in a regulated harvest of 10 to 12 percent of the trees per entry on a 10-year re-entry period. This is Management Level II in the 1986 Guidelines and approximates the treatments applied to most MDC-administered forest land before these guidelines were developed. At this management level, 10 percent of each site is left as "old growth," and the desirable tree size class distribution on the remaining area is 10 percent seedlings, 20 percent small trees 2.5 to 5.5 in. (6 to 14 cm) d.b.h., 30 percent poles 5.6 to 11.5 in. (14 to 29 cm) d.b.h., and 40 percent sawtimber >11.5 in. (29 cm) d.b.h. Harvest prescriptions follow Roach and Gingrich (1968). In general, total area designated with a silvicultural prescription of regeneration by clearcutting was restricted to approximately 10 to 12 percent of the site, with those stands in greatest need of regeneration selected first (fig. 3). Remaining stands needing regeneration were deferred to the next entry. Immature stands with site index 55 (base age 50 years) and greater were treated with intermediate cutting according to Roach and Gingrich (1986) (fig. 3). Glades, food plots, ponds, and other amenities were managed according to the 1986 Guidelines.

Uneven-aged Management

Uneven-aged management was also implemented using MDC Forest Land Management Guidelines (1986) with stand treatments following Law and Lorimer (1989). Approximately 10 percent of each site was designated to be managed as "old growth," and the remaining 90 percent was available for UAM silvicultural treatment (fig. 3). Treatments on UAM sites will be timed to coincide with treatments for EAM sites over the next 80 to 100 years. Each UAM site was divided into management units of 20 to 80 ac (8 to 32 ha), and objectives were set for largest diameter tree (LDT), residual basal area (RBA), and q-value. The LDT objective was equal to the desired sawtimber size objective for an identical site under EAM. An overall RBA equivalent to B-level stocking was chosen, with adjustments made to anticipate for logging damage (Roach and Gingrich 1968). Q-value objectives ranged from 1.3 to 1.7 (Law and Lorimer 1989). The target tree size class distribution for UAM was identical to the composite size class distribution across the EAM sites. For example, for a mean poletimber diameter of

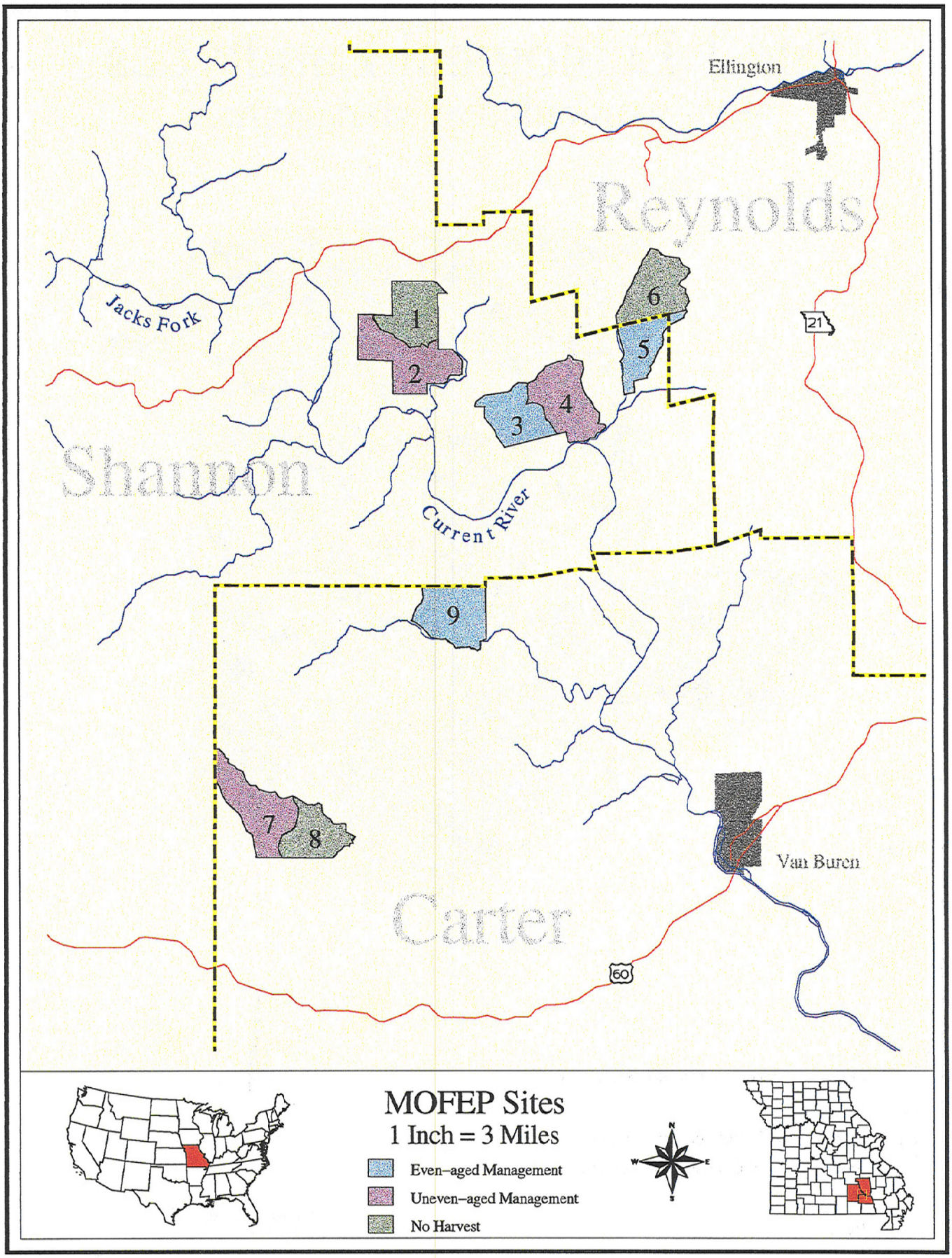
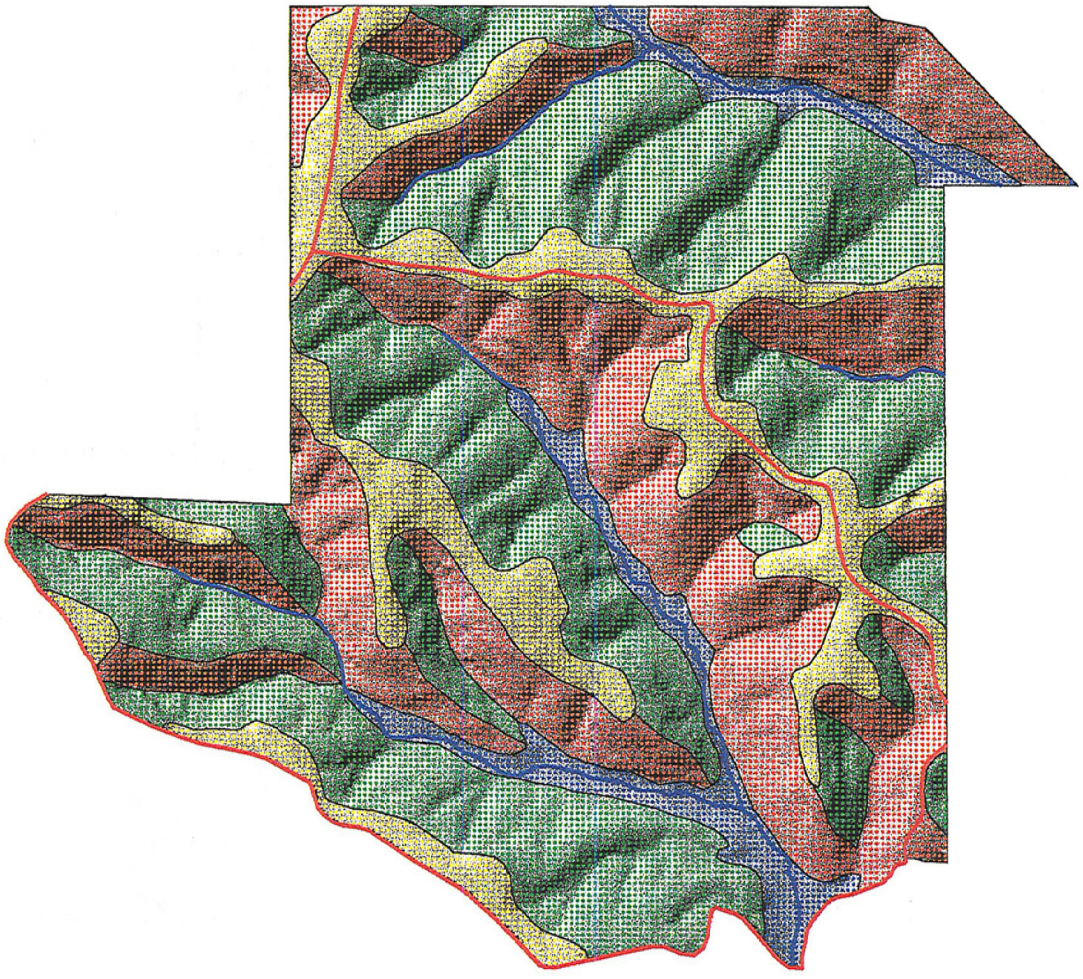


Figure 1.—*Location of the nine MOFEP experimental sites. Colors indicate assigned treatment.*

Site 1 Ecological Landtypes
Non–manipulative Management



Upland Waterway – Dry Bottomland Forest
Ridge
Side Slope – South and West Aspects
Side Slope – North and East Aspects
Hydrology
Roads

1 mile

Map Scale 1:18480
1 inch = 2/7 mile

Figure 2A.—*Ecological landtypes, hydrology, and roads on MOFEP site 1.*

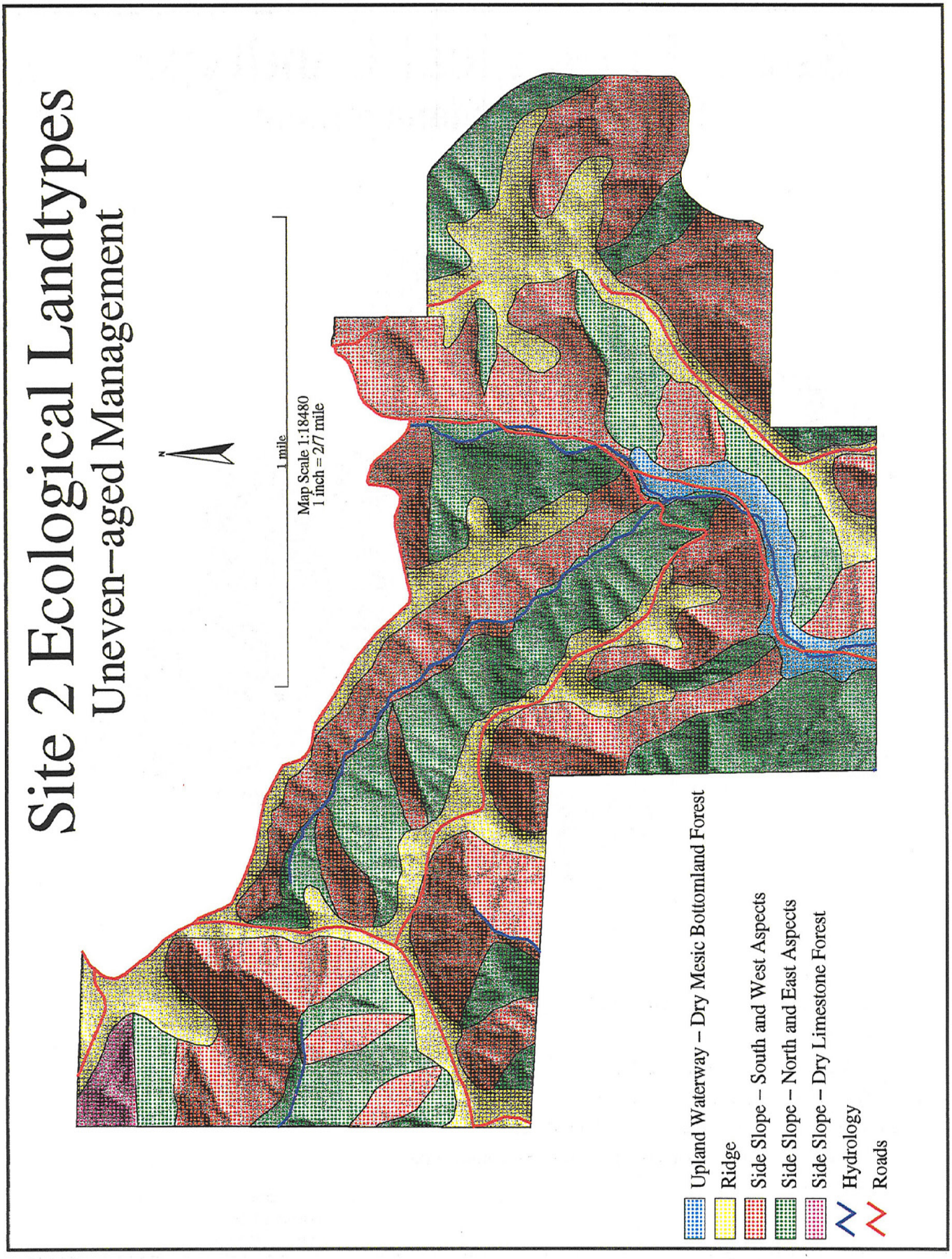
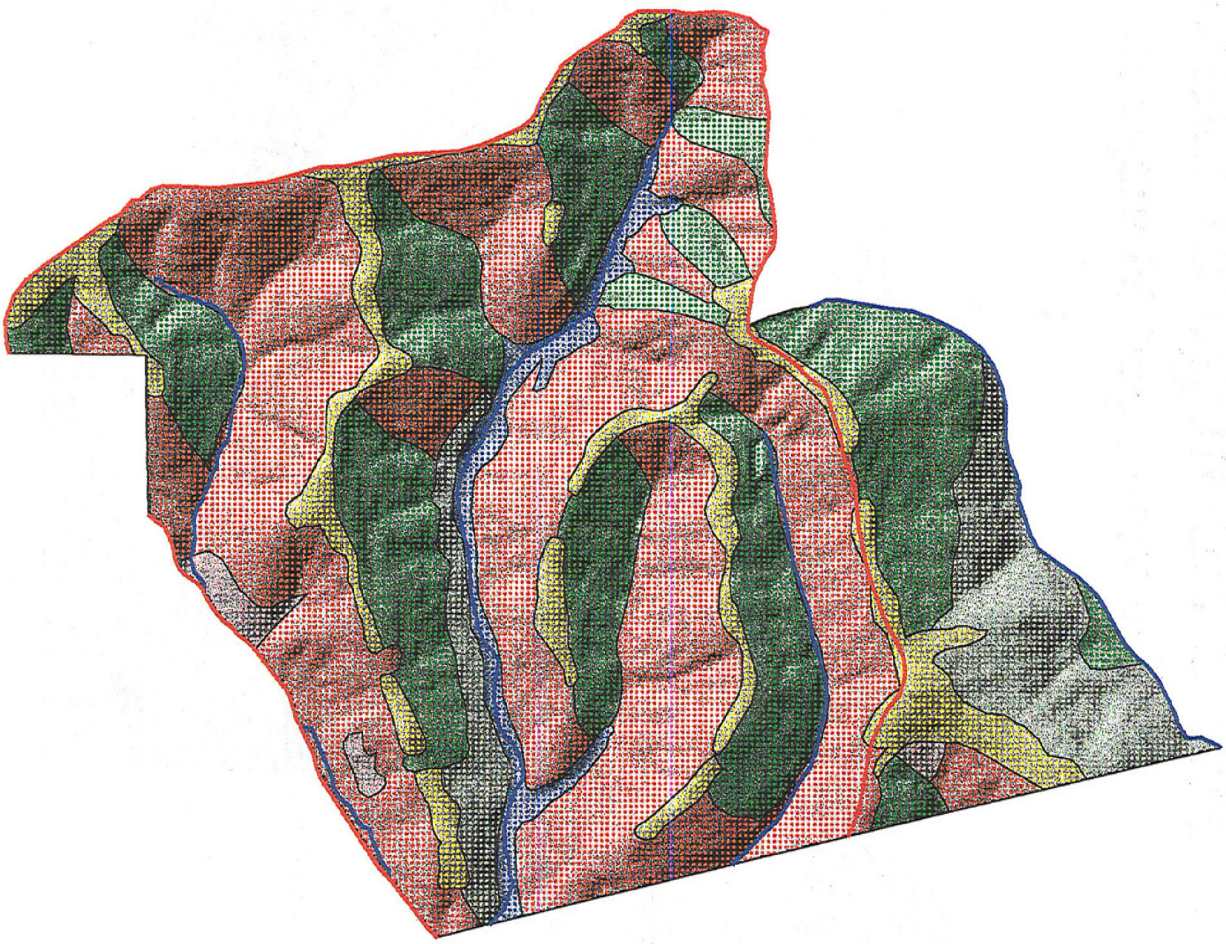


Figure 2B.—*Ecological landtypes, hydrology, and roads on MOFEP site 2.*

Site 3 Ecological Landtypes
Even–aged Management



Upland Waterway – Dry Bottomland Forest
Ridge
Side Slope – South and West Aspects
Side Slope – North and East Aspects
Side Slope – S and W Aspects – Glade Savanna
Side Slope – N and E Aspects – Dry Mesic Limestone Forest
Hydrology
Roads

N

1 mile

Map Scale 1:18480
1 inch = 2/7 mile

Figure 2C.—*Ecological landtypes, hydrology, and roads on MOFEP site 3.*

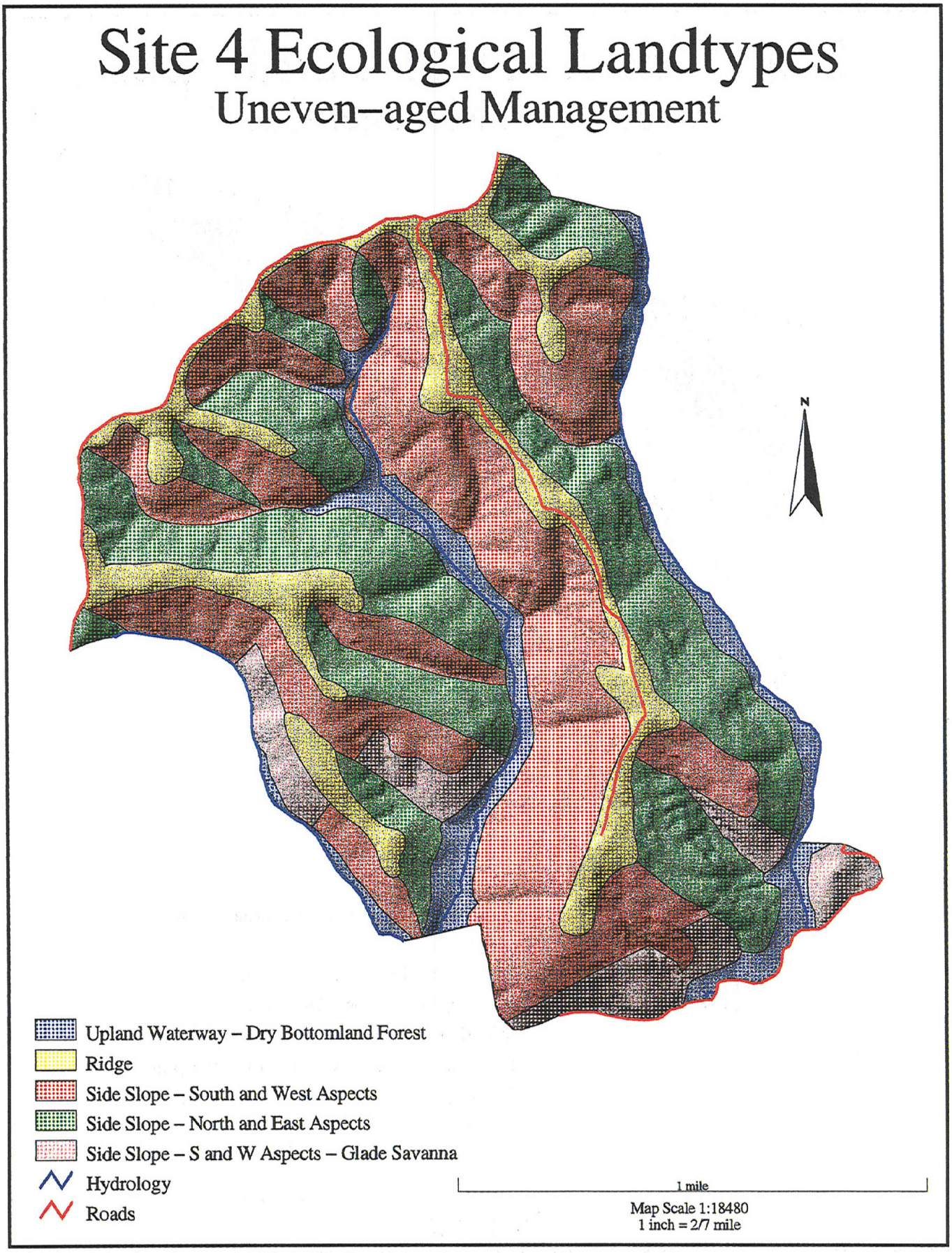


Figure 2D.—*Ecological landtypes, hydrology, and roads on MOFEP site 4.*

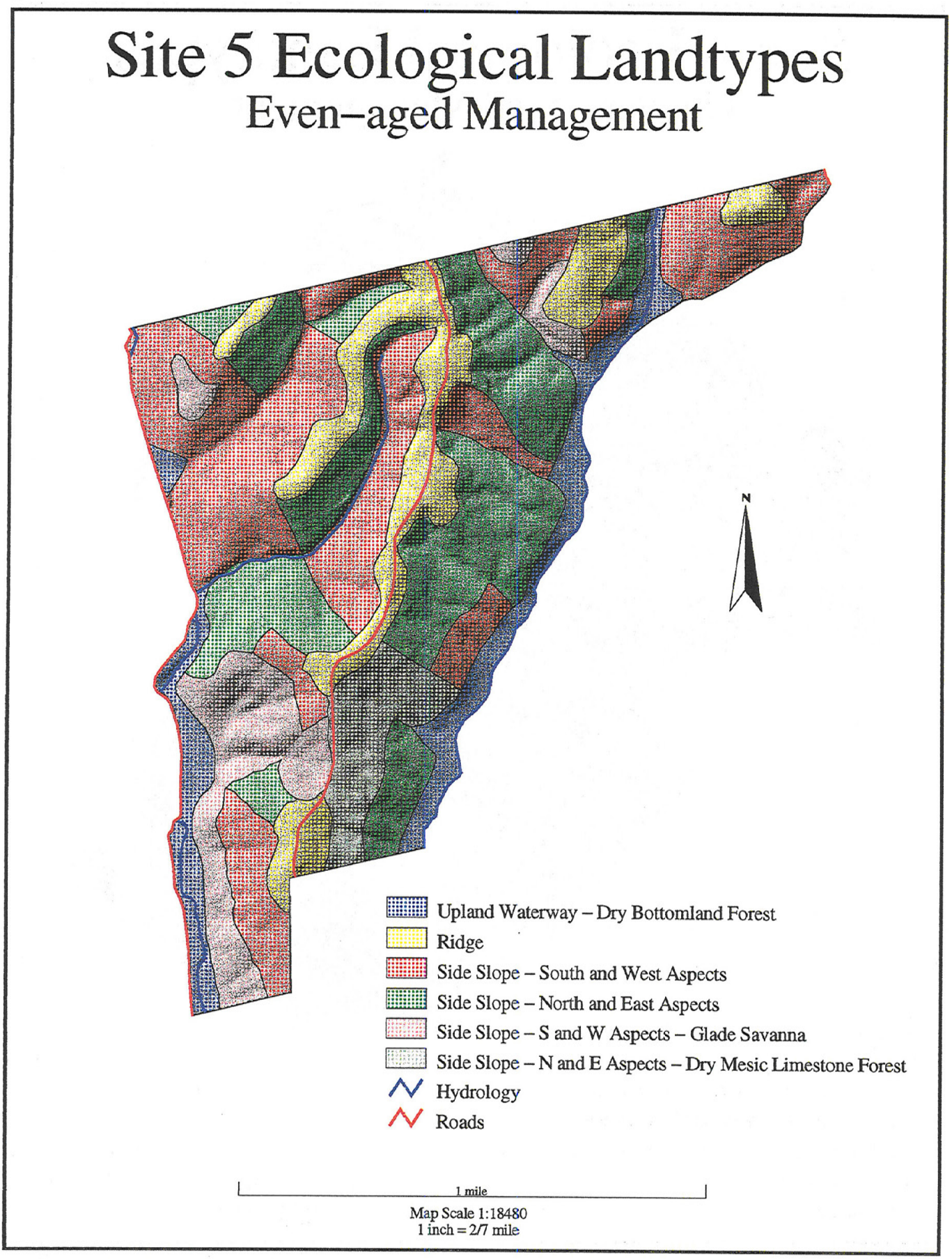


Figure 2E.—*Ecological landtypes, hydrology, and roads on MOFEP site 5.*

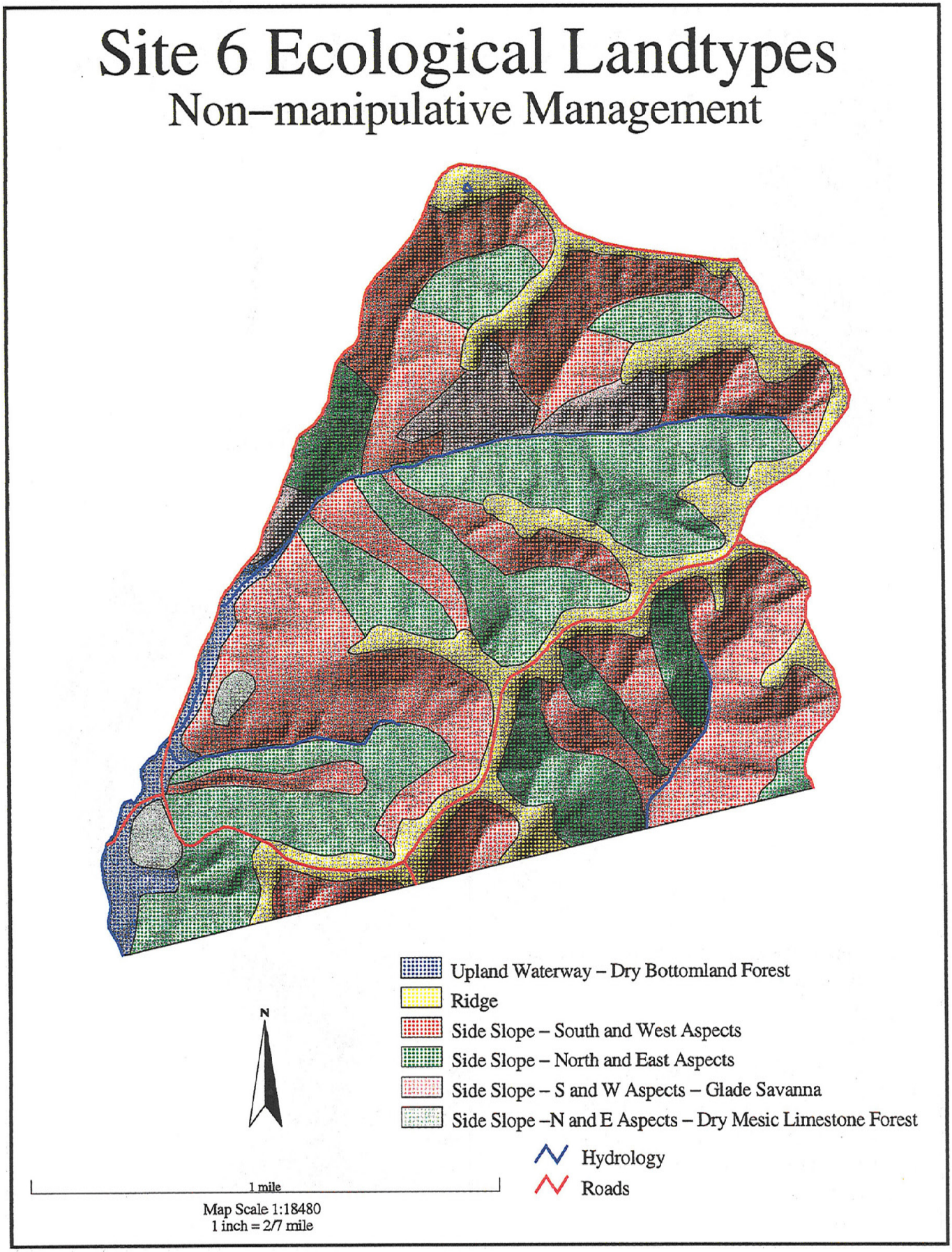


Figure 2F.—*Ecological landtypes, hydrology, and roads on MOFEP site 6.*

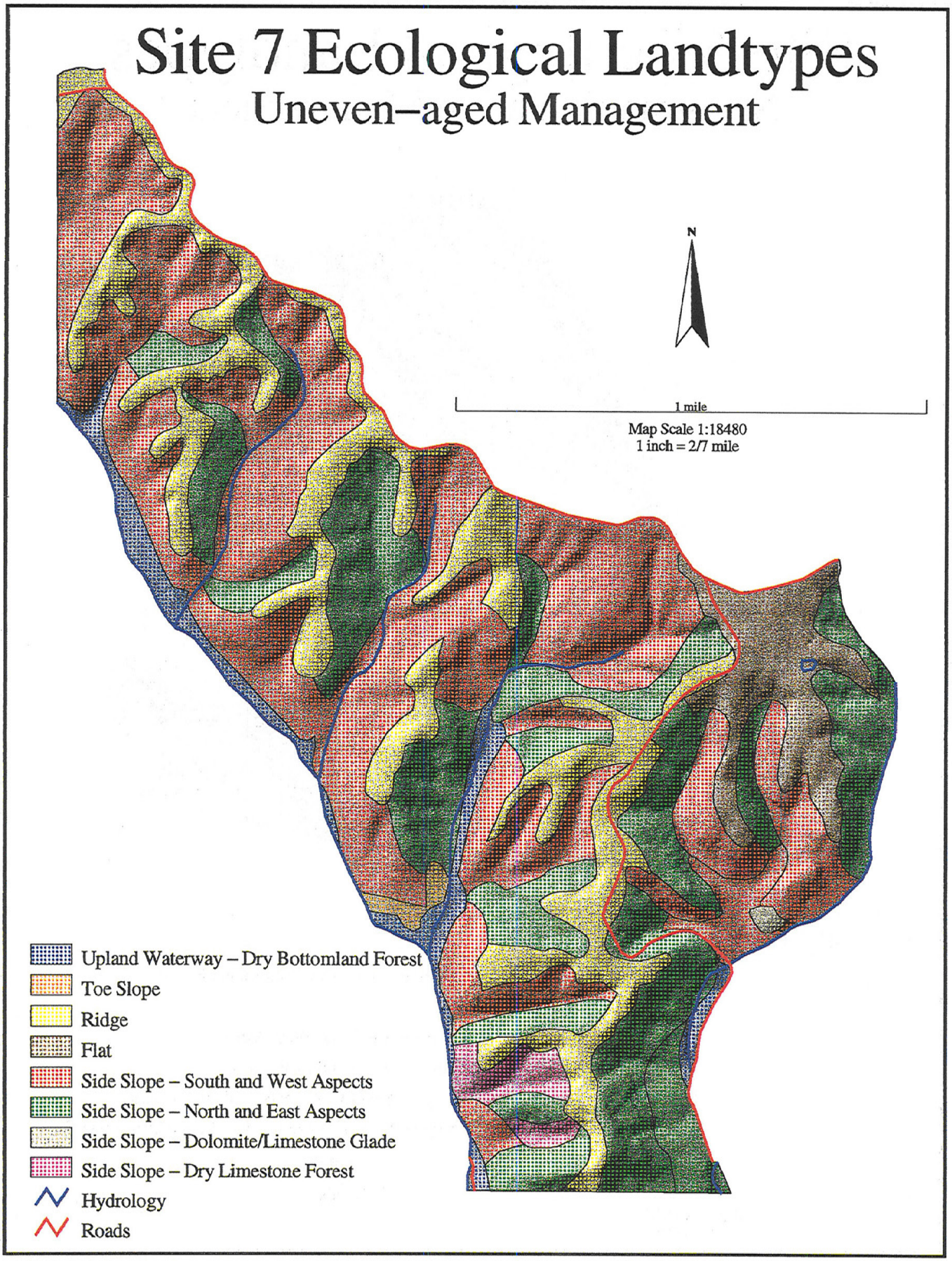
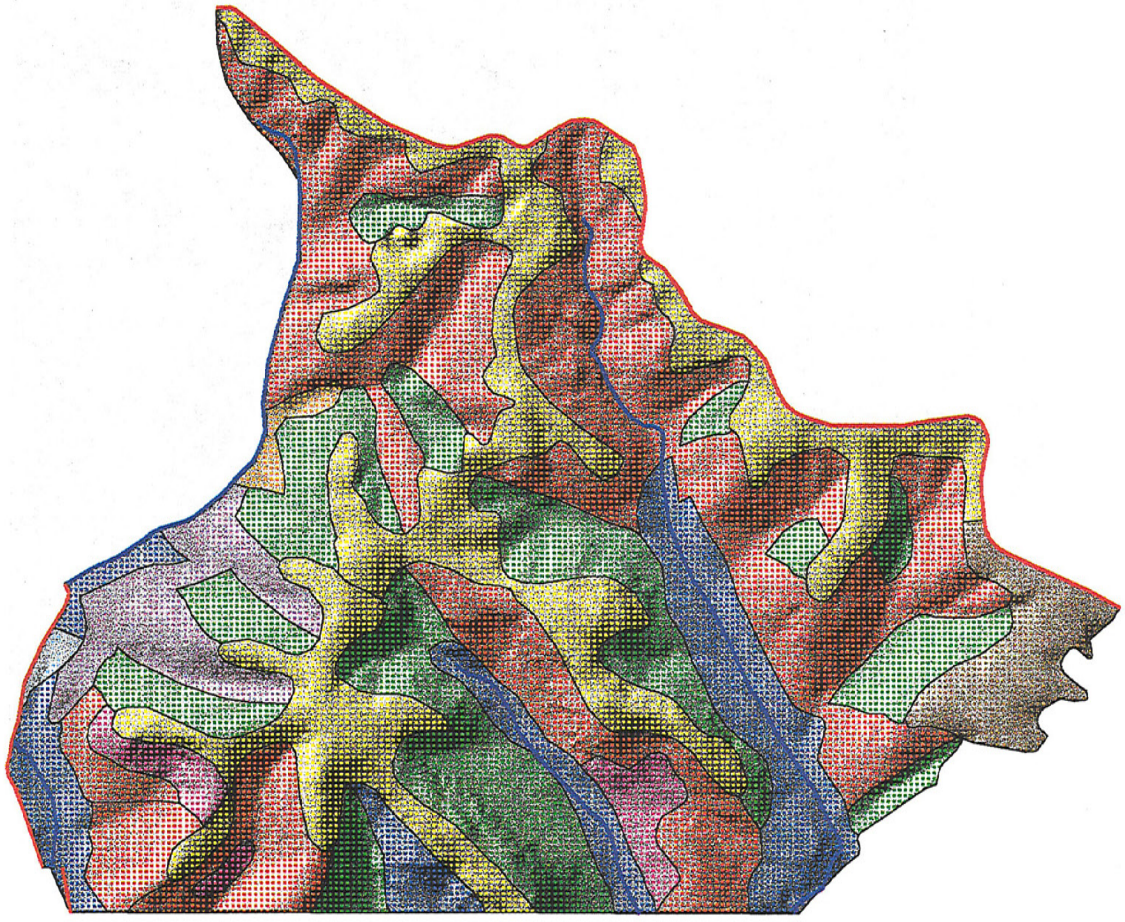


Figure 2G.—*Ecological landtypes, hydrology, and roads on MOFEP site 7.*

Site 8 Ecological Landtypes
Non–manipulative Management



High Flood Plain
Upland Waterway – Dry Bottomland Forest
Toe Slope
Ridge
Flat
Side Slope – South and West Aspects
Side Slope – North and East Aspects
Side Slope – Xeric Limestone Forest
Side Slope – Dry Limestone Forest
Hydrology
Roads

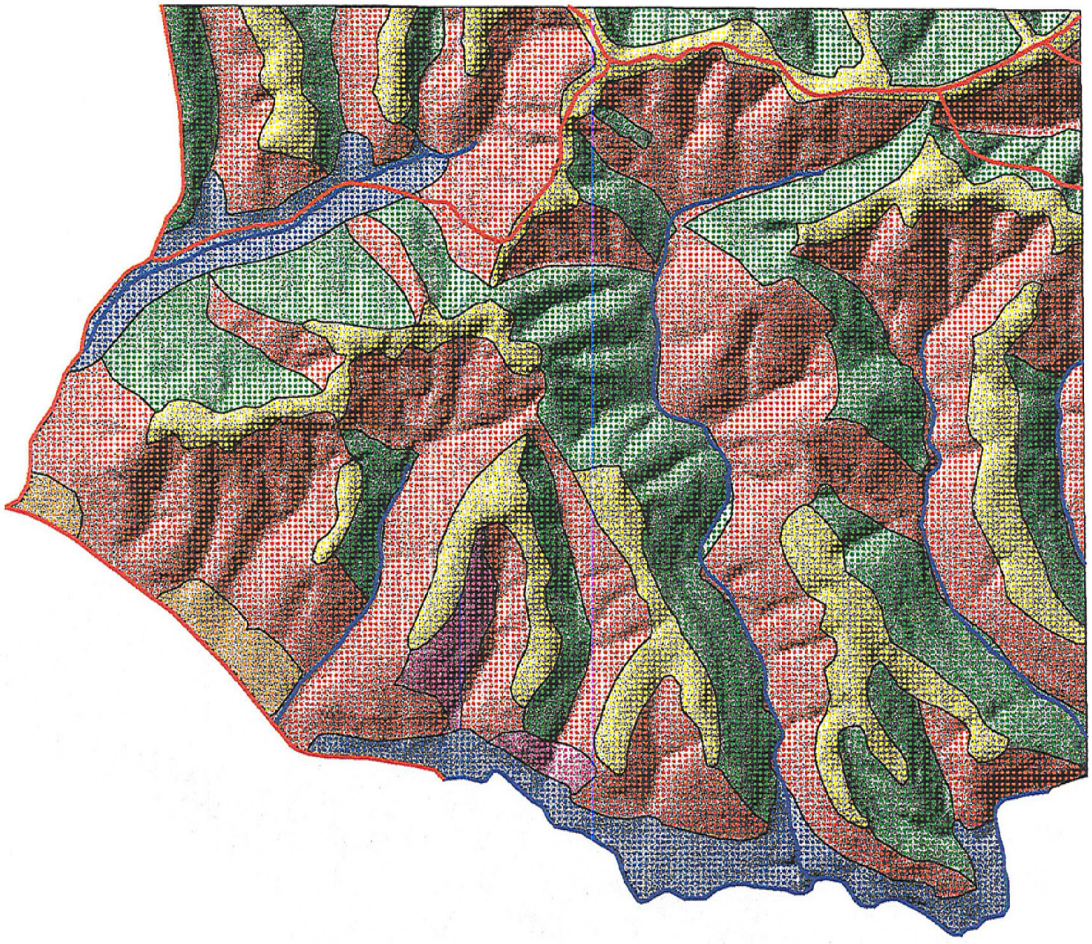
N

1 mile

Map Scale 1:18480
1 inch = 2/7 mile

Figure 2H.—*Ecological landtypes, hydrology, and roads on MOFEP site 8.*

Site 9 Ecological Landtypes
Even–aged Management



Upland Waterway – Dry Bottomland Forest
Toe Slope
Ridge
Side Slope – South and West Aspects
Side Slope – North and East Aspects
Side Slope – Dry Limestone Forest
Hydrology
Roads

N

1 mile

Map Scale 1:18480
1 inch = 2/7 mile

Figure 2I.—*Ecological landtypes, hydrology, and roads on MOFEP site 9.*

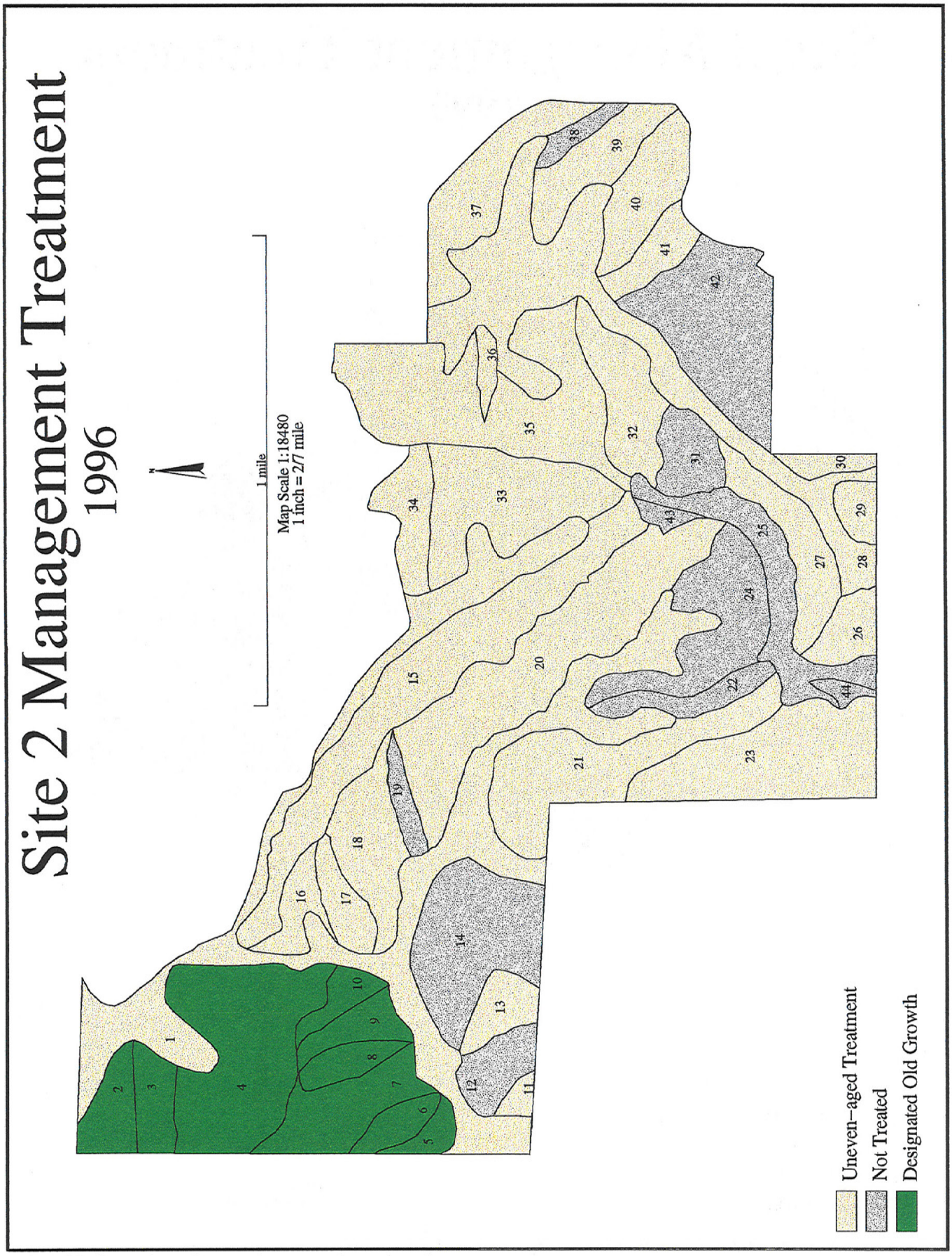
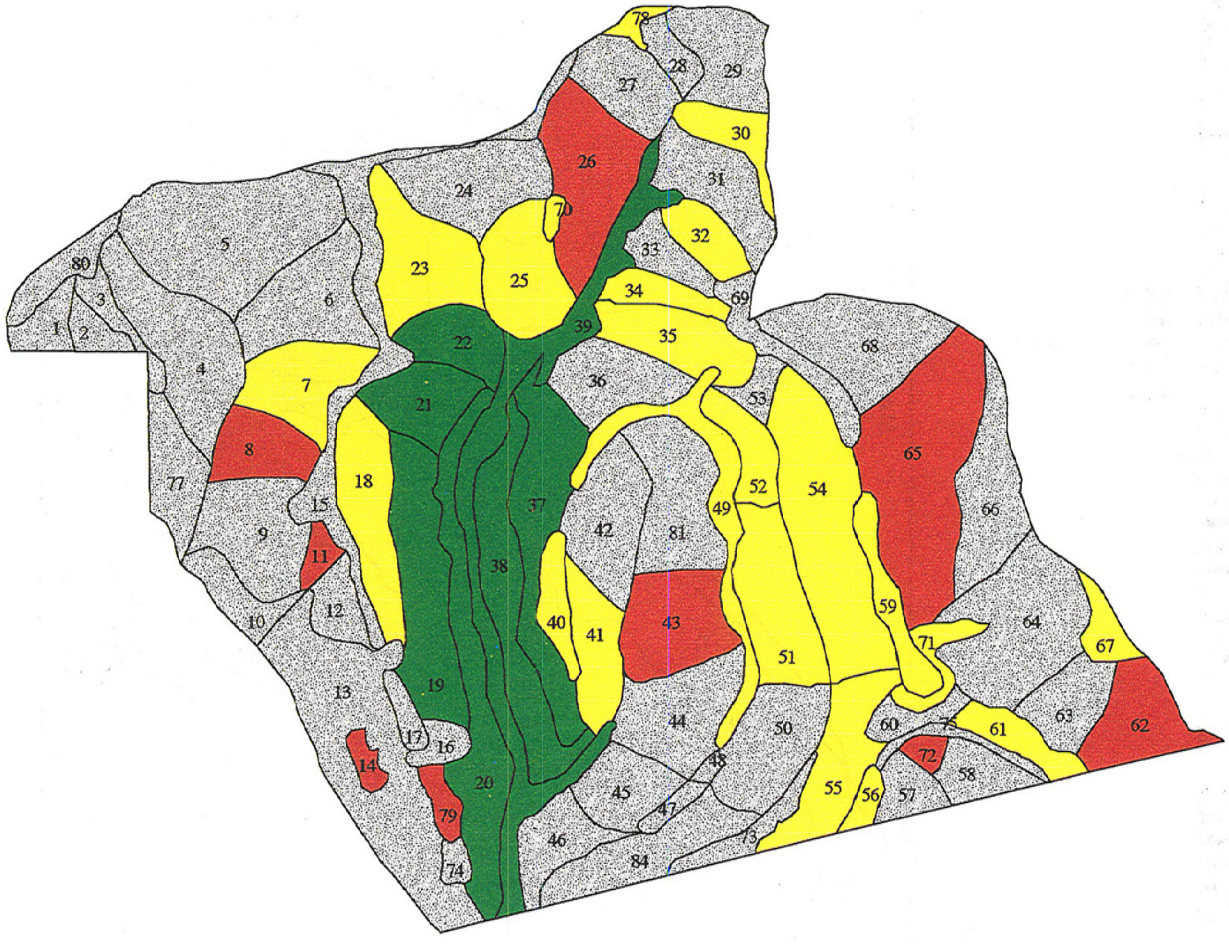


Figure 3A.—*Stand boundaries and assigned treatments, MOFEP site 2.*

Site 3 Management Treatment
1996



N

Regeneration Cut
Intermediate Cut
Not Treated
Designated Old Growth

1 mile
Map Scale 1:18480
1 inch = 2/7 mile

Figure 3B.—*Stand boundaries and assigned treatments, MOFEP site 3.*

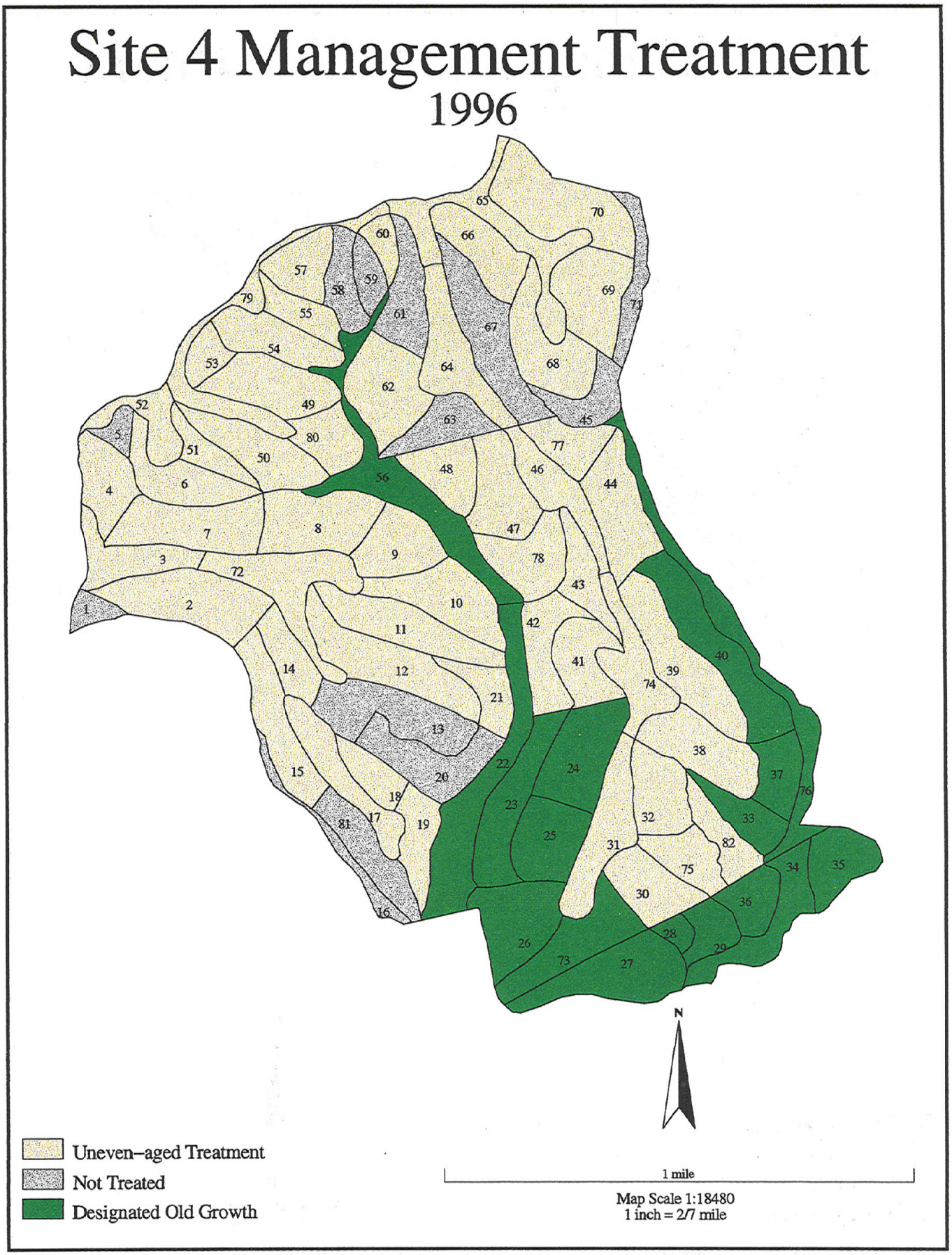


Figure 3C.—*Stand boundaries and assigned treatments, MOFEP site 4.*

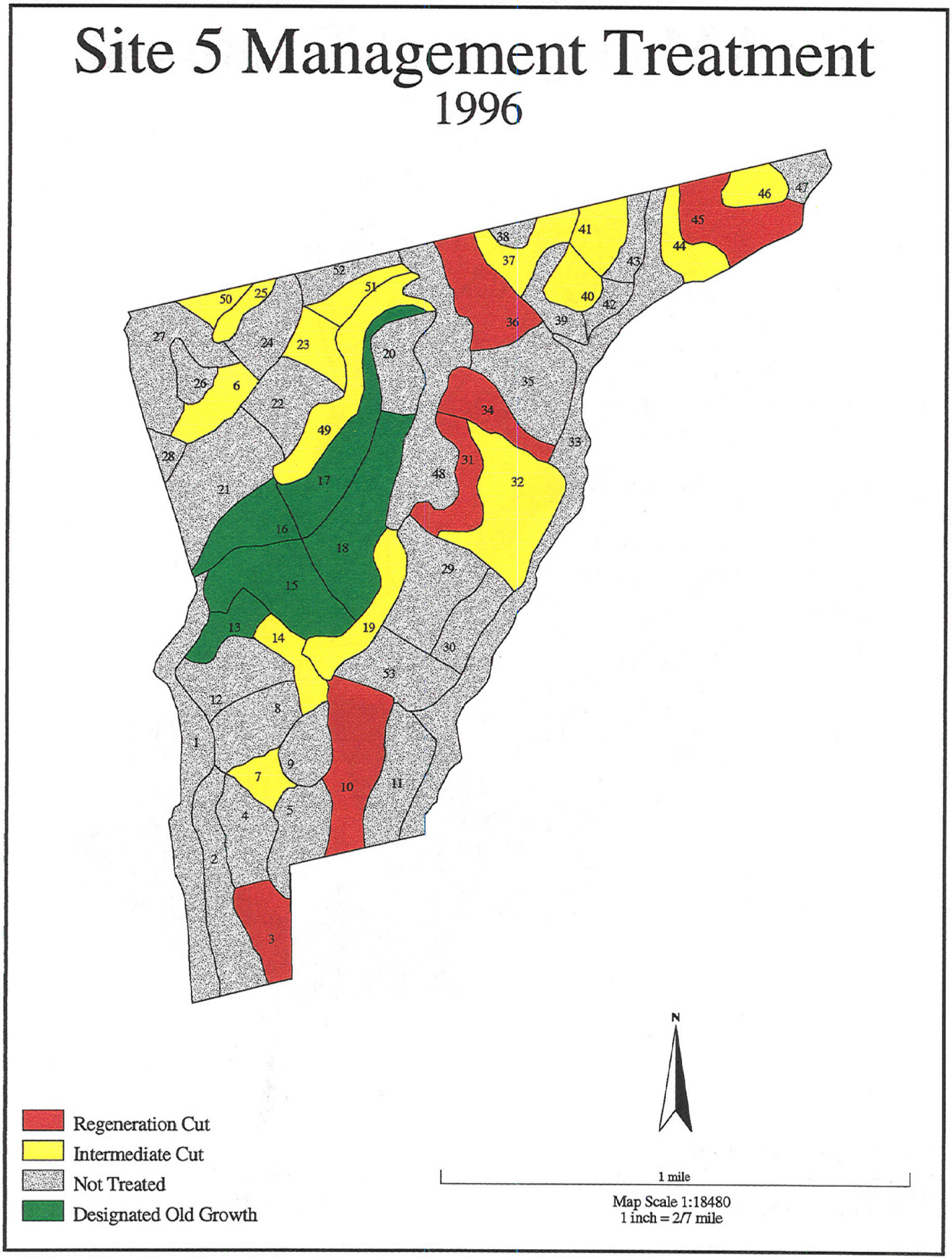


Figure 3D.—*Stand boundaries and assigned treatments, MOFEP site 5.*

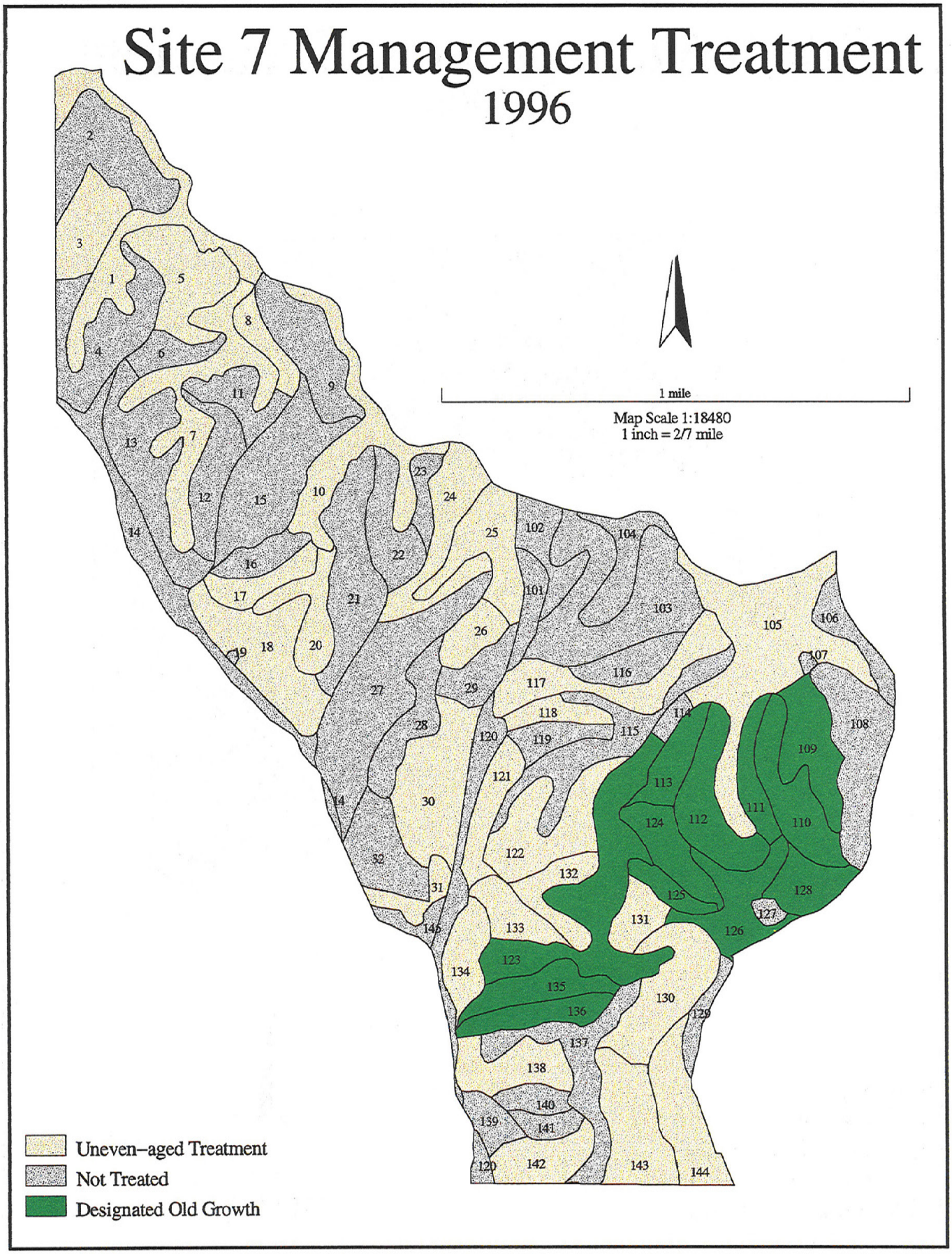
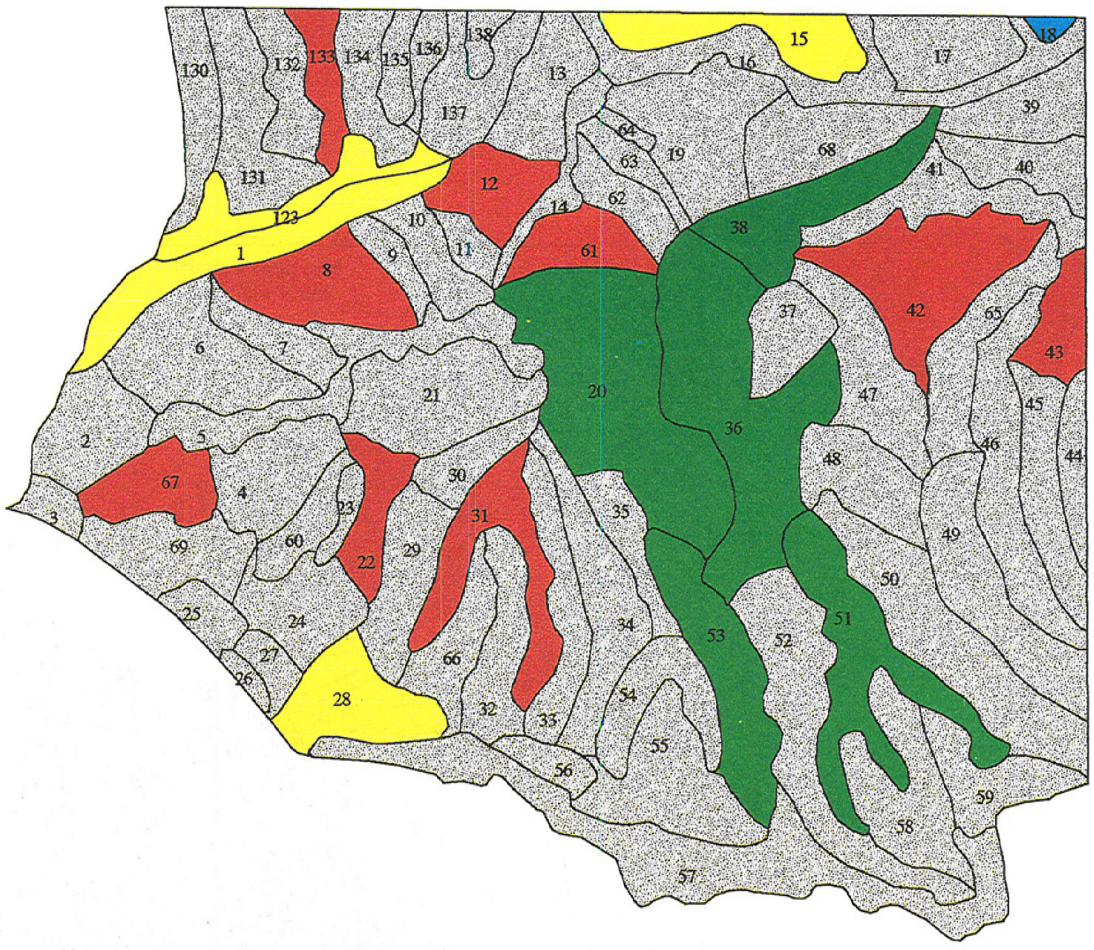


Figure 3E.—*Stand boundaries and assigned treatments, MOFEP site 7.*

Site 9 Management Treatment
1996



Regeneration Cut
Intermediate Cut
Timber Stand Improvement
Not Treated
Designated Old Growth

N

1 mile

Map Scale 1:18480
1 inch = 2/7 mile

Figure 3F.—*Stand boundaries and assigned treatments, MOFEP site 9.*

8.5 in. (22 cm) and sawtimber diameter of 15.5 in. (39 cm) (midpoints of ranges, assuming 20 in. (51 cm) maximum), with both size classes at B-level stocking, a typical EAM site of 1,000 ac (400 ha) would have 19,200 ft^2 (1,728 m^2) of poletimber basal area and 29,600 ft^2 (2,664 m^2) of sawtimber basal area. According to Law and Lorimer (1989), this is equivalent to a q-value of 1.5.

No Harvest Management

Sites under no-harvest management received no anthropogenic manipulation. Natural catastrophic events, including tornadoes, fires, insects, or disease, will be treated as if on any other State-owned forest land, except that salvage harvests will not occur. Wildfires will be suppressed and areas will receive control measures applied to surrounding areas in the event of a large-scale damaging insect outbreak. This treatment will somewhat resemble "old growth" management and will serve as an experimental control treatment in this project (Sheriff and He 1997).

Implementation

Treatments were implemented operationally by MDC foresters located on the Clearwater and Eminence Forest Districts. Each treatment site was divided into sale units with each sale comprised of a comparable amount of timber volume in both the even-aged and uneven-aged treatment sites (table 1). This ensured that each site received an equal influence from a particular logging operator. A total of seven timber sale contracts were prepared and advertised for sale to harvest contractors throughout Missouri and adjoining States.

Table 1.—*Acres harvested and tree volume taken from MOFEP management sites.*

MOFEP Site	Acres harvested [1]	Volume
		Thousand bd ft
2 (UAM)	860	1,146
3 (EAM)	272	754
4 (UAM)	697	952
5 (EAM)	244	927
7 (UAM)	502	1,344
9 (EAM)	192	773

[1]ha = ac/2.47

Meetings were held with prospective logging companies to explain how this project would differ from their usual operation. The experimental nature of MOFEP required companies to frequently move crews and machinery from one location to the other. Additionally, uneven-aged silviculture was explained because most companies were not familiar with that cutting practice. The meetings were an effort to inform prospective bidders of these requirements to help ensure an appropriate bid.

Commercial timber harvest began in early May 1996 and concluded by that November. Table 1 provides a summary of the acreage impacted and the volume harvested from each site. Removal of non-merchantable stems marked for removal during implementation of silvicultural prescriptions began in early November 1996, and continued through April 1997.

We are currently concentrating on documenting treatment impact on all permanent forest vegetation plots that were affected by harvest in 1996. Each plot is being mapped to indicate presence of primary and secondary skid trails, rut depths, log landings, and residual tree damage. This effort will be completed by June 1997.

Scientists resumed data collection on their respective studies in May 1997. No data collection occurred during the summer of 1996, as a result of harvest treatment implementation. We intend to collect data yearly for at least the next 5 years to properly document the response of specified ecosystem components to the treatments. Then we will evaluate the need for yearly collections and adjust sampling periods accordingly.

ONGOING RESEARCH PROJECTS

All MOFEP studies are administered by the Missouri Department of Conservation with research conducted by MDC, university, and Forest Service employees. Two studies, (1) Forest Vegetation and (2) Ecological Classification Refinement, provide baseline data used by all other investigators. These studies are discussed in the following sections.

Forest Vegetation

A system of 648 permanent cluster plots was distributed across the nine MOFEP sites to

document forest vegetation response to treatment (fig. 4). Plots were allocated among stands based on stand size with the constraint that each stand receive at least one plot. Location of plots within stands was random.

Data collected for each tree ≥ 4.5 in. (11 cm) d.b.h. included species, d.b.h., status (live or dead), crown class, size of cavities, and location of cavities. Height, canopy volume, form class, and merchantable volume were measured for up to 15 trees per plot (5 trees each in the white oak group, the red oak group, and shortleaf pine, where available). Species and d.b.h. were recorded for all trees at least 1.5 in. (4 cm) d.b.h. but less than 4.5 in. (11 cm) d.b.h. Trees less than 1.5 in. (4 cm) d.b.h. and at least 3.3 ft (1 m) tall were tallied by species and d.b.h. class.

Herbaceous vegetation was inventoried in 16 quadrats systematically distributed within each vegetation plot (fig. 4). Sampling protocols for herbaceous vegetation are described in Grabner *et al.* (1997).

Table 2 summarizes structural characteristics of trees on each of the nine MOFEP sites. A total of 49 woody species were observed (table 3).

Forest vegetation information will be used by all cooperating MOFEP scientists to help understand the response of various ecosystem components to forest management. Therefore, tremendous financial and personnel resources have been dedicated to the installation and subsequent data collection on the permanent vegetation plots. Initial data collection from permanent plots began in October 1990 and concluded 22 months later. A complete set of data was collected again on all MOFEP plots beginning in June 1994 and concluding 17 months later.

Ecological Classification Refinement

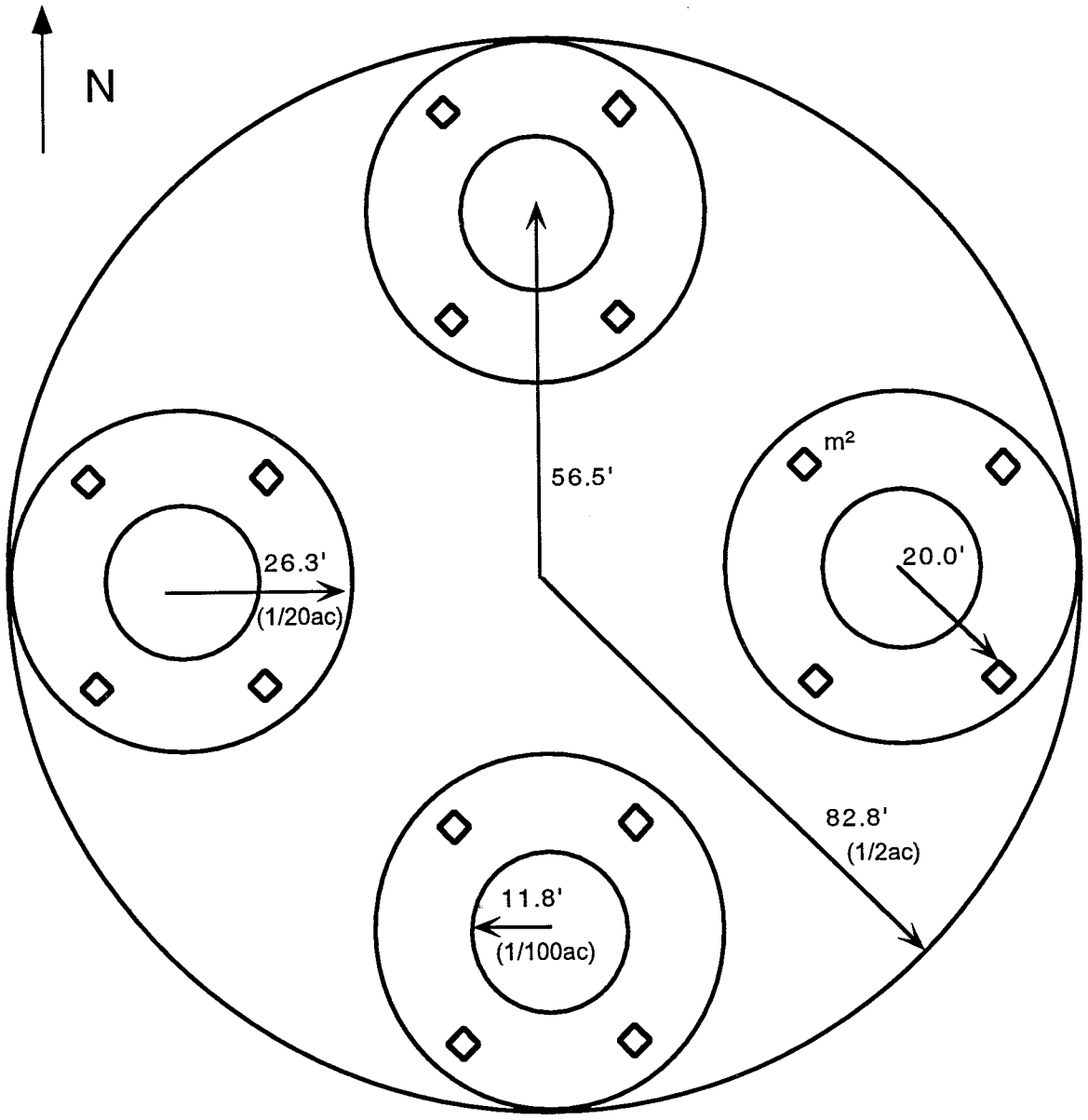
To develop a better understanding of forest vegetation and its relation to the physical environment, we classified the study region into Ecological Landtypes (ELT) following Miller (1981). Ecological landtypes were originally defined on MOFEP sites primarily by slope and aspect. ELT boundaries were drawn on 1:24,000 topographic maps and subsequently field checked. Detailed geology, soils, and vegetation information was not available when ELT designations were made in 1990.

Through field checking of ELT boundaries, we determined that additional geology, soils, and

Table 2.—*Pre-treatment characteristics of woody vegetation ≥ 1.5 in. d.b.h. for all MOFEP sites*[1].

	Trees ≥1.5 in. d.b.h.				Trees ≥ 4.5 in. d.b.h.					
Site	Plots	Trees	Basal area	Stocking	Trees	Basal area	Stocking	Volume[2]	Volume[3]	Down wood[4]
	Number	*n/ac*	*ft²/ac*	*Percent*	*n/ac*	*ft²/ac*	*Percent*	*ft³/ac*	*bd.ft/ac*	*ft³/ac*
1	76	515	95	90	184	82	70	1,180	5,340	194
2	73	557	96	91	176	80	69	1,160	5,300	155
3	72	500	99	90	169	85	71	1,270	6,060	302
4	74	499	96	88	167	82	69	1,220	5,770	107
5	70	498	96	88	160	32	68	1,210	5,770	153
6	71	429	100	87	160	89	72	1,370	6,730	429
7	71	389	91	81	140	81	67	1,280	6,700	225
8	70	279	92	81	133	83	68	1,280	6,730	250
9	71	546	88	83	126	73	60	1,130	5,740	355

[1]Metric equivalents: 1.5 in. = 4 cm; 4.5 in. = 11 cm; number/ha = 2.47 (number/ac); m^2/ha = (ft^2/ac)/4.356; m^3/ha = (ft^3/ac)/14.29.
[3]Trees ≥ 5.0 in. (13 cm) d.b.h.
[4]Trees ≥ 8.0 in. (20 cm) d.b.h.
[5]Material ≥ 2 in. (5 cm) in diameter and ≥ 2 ft (0.6 m) in length.



Size Limits for plots and sublots

1/2 acre includes trees ≥ 4.5" DBH
1/20 acre includes trees ≥ 1.5" and < 4.5" DBH
1/100 acre includes trees ≥ 1 m tall and < 1.5" DBH
1 m² for herbaceous vegetation

Down, dead wood transects

56.5' transects (4 per plot) used to measure down dead wood ≥ 2" diameter and ≥ 2' in length

Figure 4.—*MOFEP vegetation plot design.*

Table 3.—*MOFEP Importance Values*[1] *by site and species.*

Species	Scientific name	Importance value (percent)									
		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	All sites
Black oak	*Quercus velutina*	27.28	27.30	25.14	18.92	20.92	17.12	23.99	26.06	27.00	23.668
Scarlet oak	*Quercus coccinea*	24.70	19.83	20.12	21.28	14.51	16.61	31.45	22.39	21.37	21.330
White oak	*Quercus alba*	21.38	20.42	25.00	22.06	24.48	26.24	11.97	16.12	21.10	21.168
Shortleaf pine	*Pinus echinata*	10.30	5.61	8.35	9.66	9.10	13.52	12.11	7.40	4.38	9.019
Post oak	*Quercus stellata*	3.41	2.63	4.18	4.41	7.83	4.99	11.81	12.46	7.53	6.325
Black hickory	*Carya texana*	5.20	4.87	3.82	1.89	6.12	5.27	3.18	5.03	3.50	4.324
Pignut hickory	*Carya glabra*	2.62	6.36	3.16	6.43	5.36	4.62	0.60	2.63	3.28	3.972
Mockernut hickory	*Carya tomentosa*	2.54	4.47	4.03	6.73	4.71	3.82	2.35	0.64	6.33	3.968
Blackgum	*Nyssa sylvatica*	1.31	1.99	2.24	2.23	1.80	2.62	0.69	1.45	1.01	1.720
Chinkapin oak	*Quercus meuhlenbergii*	--	1.12	0.69	1.75	0.97	0.66	0.14	0.90	0.42	0.749
Flowering dogwood	*Cornus florida*	0.59	0.81	0.60	0.48	0.82	1.12	0.73	0.67	0.59	0.710
Blackjack oak	*Quercus marilandica*	0.25	0.63	0.30	0.26	0.27	0.03	0.64	2.54	1.40	0.655
Black walnut	*Juglans nigra*	0.07	1.12	0.16	0.63	0.79	0.39	--	--	0.63	0.424
Slippery elm	*Ulmus rubra*	0.01	0.36	0.34	0.71	0.46	0.36	0.02	0.03	0.34	0.297
White ash	*Fraxinus americana*	0.01	0.47	0.39	0.87	0.17	0.14	--	0.19	0.04	0.264
Winged elm	*Ulmus alata*	--	0.19	0.19	0.43	0.40	0.42	0.04	0.15	0.01	0.211
Red maple	*Acer rubrum*	0.25	0.09	0.29	0.06	0.15	0.57	0.04	0.11	0.18	0.197
Bitternut hickory	*Carya cordiformis*	--	0.19	--	0.37	0.14	0.24	0.03	0.01	0.32	0.144
Sassafras	*Sassafras albidum*	0.04	0.23	0.16	0.04	0.19	0.30	0.02	0.07	0.23	0.142
Eastern redcedar	*Juniperus virginiana*	--	0.31	0.05	0.09	0.02	0.39	0.06	0.31	0.03	0.139
Sugar maple	*Acer saccharum*	--	0.31	0.19	0.31	0.23	0.02	--	--	0.03	0 128
Red mulberry	*Morus rubra*	--	0.11	0.06	0.14	0.04	0.04	0.05	--	--	0.052
American sycamore	*Platanus occidentalis*	--	--	0.13	0.06	0.14	0.09	--	--	0.04	0.052
Black cherry	*Prunus serotina*	0.01	0.11	0.03	0.04	0.11	0.05	0.01	--	0.07	0.048
American elm	*Ulmus americana*	--	0.04	0.01	0.04	0.05	0.07	0.01	0.10	0.04	0.041
Redbud	*Cercis canadensis*	--	0.05	--	0.01	0.06	0.05	--	0.15	0.01	0.036
Shagbark hickory	*Carya ovata*	--	0.22	0.02	--	0.01	--	--	0.04	--	0.035
Persimmon	*Diospyros virginiana*	--	0.05	0.03	0.01	0.03	0.04	0.01	0.07	0.01	0.029
Shellbark hickory	*Carya laciniosa*	--	--	0.16	--	--	0.04	--	--	--	0.023
Shumard oak	*Quercus shumardii*	--	--	--	--	0.04	--	0.01	0.15	--	0.021
Gum bumelia	*Bumelia lanuginosa*	--	--	0.04	0.04	0.01	0.01	--	0.05	0.01	0.018
Serviceberry	*Amelanchier arborea*	0.02	0.01	0.02	--	0.04	0.01	--	--	0.05	0.015
Northern red oak	*Quercus rubra*	--	--	--	0.01	--	0.10	--	0.02	--	0.015
Green ash	*Fraxinus pennsylvanica*	--	--	--	--	--	--	--	0.11	--	0.011
Honeylocust	*Gleditsia triacanthos*	--	--	0.03	0.03	--	--	0.01	--	0.01	0.009
Hackberry	*Celtis occidentalis*	--	--	--	--	--	0.02	0.01	0.05	--	0.009
Hack/Sugarberry	*Celtis laevigata*	--	0.05	--	--	--	0.01	--	--	--	0.007
Carolina buckthorn	*Rhamnus caroliniana*	--	--	0.01	--	0.02	0.01	--	--	--	0.005
Smooth sumac	*Rhus glabra*	--	--	--	--	--	--	--	0.04	--	0.004
Overcup oak	*Quercus lyrata*	--	--	0.03	--	--	--	--	--	--	0.003
Pin oak	*Quercus. palustris*	--	0.01	--	--	--	--	--	0.02	--	0.003
Southern catalpa	*Catalpa bignonioides*	--	--	--	--	--	--	--	0.02	--	0.002
Mulberry spp.	*Morus* spp..	--	--	--	0.01	--	--	--	--	--	0.001
Water oak	*Quercus nigra*	--	0.01	--	--	--	--	--	--	--	0.001
Hawthorn	*Crataegus* spp.	--	--	0.01	--	--	--	--	--	--	0.001
Kentucky Coffeetree	*Gymnocladus dioicus*	--	--	0.01	--	--	--	--	--	--	0.001
Plum	*Prunus* spp.	--	--	--	--	--	--	0.01	--	--	0.001
American hornbeam	*Carpinus caroliniana*	--	--	--	--	--	0.01	--	--	--	0.001
Ironwood	*Ostrya* spp	--	--	--	--	--	--	--	0.01	--	0.001
	TOTAL	100	100	100	100	100	100	100	100	100	100

[1]Importance Value = (Relative basal area + Relative density)/2

vegetation information was needed to adequately designate ELT's on the MOFEP sites. In 1994 we initiated an intensive 1:12,000 geology and soil survey to provide this information (Meinert *et al.* 1997). Moreover, in 1995 we began supplementing existing herbaceous inventory information to further support ELT delineations. Revised ELT designations for the MOFEP sites will be available in early 1998.

The original ELT's represented the best available classification at the time of study initiation, and in this volume some MOFEP scientists report their results based on these ELT's.

Table 4. *Studies associated with the Missouri Ozark Forest Ecosystem Project.*

Principal investigator(s)	Study title
1. J. Bruhn, J. Wetteroff, Jr., J. Mihail	Determination of the Ecological and Geographic Distributions of *Armillaria* Species in Missouri Ozark Forest Ecosystems
2. J. Bruhn, J. Mihail, D. Stokke, S. Burks	Mechanical Damage to Residual Stem Root Systems Associated with Forest Operations in Ozark Forest Ecosystems
3. R. Cecich	White Oak Acorn Production Along a Slope Transect
4. J. Chen, M. Xu, K. Brosofske	Microclimatic Characteristics in Southeastern Missouri's Ozarks
5. R. Clawson, J. Faaborg, E. Seon	The Effects of Selected Timber Management Practices on Forest Interior Birds in Missouri Oak-Hickory Forests
6. D. Dey, D. Larsen, R. Jensen	Stump Sprout Response to MOFEP Harvest Treatments
7. J. Dwyer	Economic Comparisons of Harvest Practices on MOFEP Study Sites
8. J. Dwyer	Tree Grading on the MOFEP Study Sites
9. J. Dwyer, R. Jensen	Documenting Harvest Damage to MOFEP Study Sites
10. D. Fantz, D. Hamilton	Abundance and Production of Berry Producing Plants on MOFEP study Sites: The Soft Mast Study (Pre-Harvest Conditions)
11. D. Fantz, R. Renken	Small Mammal Communities on MOFEP Sites and Their Response to Treatment
12. J. Grabner, D. Larsen, J. Kabrick	Composition, Structure and Dynamics of MOFEP Ground Flora
13. W. Gram, V. Sork, R. Marquis	Synthesis and Integration of Pretreatment Results from the Missouri Ozark Forest Ecosystem Project
14. R. Guyette, D. Dey	Historic Shortleaf Pine (*Pinus echinata* Mill.) Abundance and Fire Frequency in a Mixed Oak-Pine Forest (MOFEP, compartment 8).
15. L. Herbeck, D. Larsen	Ecological Interactions of Vegetation and Plethodontial Salamanders in Missouri Ozark Forests
16. R. Jensen, E Wiggers	Tree Cavity Abundance, Size and Use on MOFEP Study Sites
17. J. Kabrick, D. Larsen, S. Shifley	Analysis of MOFEP Woody Vegetation and Environmental Data
18. D. Ladd	Profiling MOFEP Lichen Vegetation
19. D. Larsen	Simulated Long-Term Effects of the MOFEP Cutting Treatments
20. R. Marquis, J. Le Corff	The Oak Herbivore Fauna of the Missouri Ozark Forest Ecosystem Project
21. S. Pallardy	Vegetation Analysis, Environmental Relationships, and Potential Successional Trends in the Missouri Ozark Forest Ecosystem Project
22. R. Renken	The Herpetofaunal Communities on Missouri Ozark Forest Ecosystem Project (MOFEP) Study Sites
23. S. Sheriff, Z. He	The Experimental Design of the Missouri Ozarks Forest Ecosystem Project
24. S. Shifley, B. Brookshire, D. Larsen, L. Herbeck, R. Jensen	Snags and Down Wood on Upland Oak Sites in the Missouri Ozark Forest Ecosystem Project
25. V. Sork, A. Koop, M. de la Fuente, P. Foster, J. Raveill	Patterns of Genetic Variation in Woody Plant Species in the Missouri Ozark Forest Ecosystem Project
26. H. Spratt, Jr.	Aspects of Carbon and Sulfur Transformations in MOFEP Surface Soils
27. L. Vangilder	Acorn Production on the MOFEP Study Sites: Pretreatment Data
28. J. Weaver, S. Heyman	The Distribution and Abundance of Leaf Litter Arthropods

Stratification by ELT was done to reduce variation. Under the current ELT designations, three predominant ELT's exist: ridges (ELT #11), south- and west-facing side slopes (ELT #17), and north- and east-facing side slopes (ELT #18) (Miller 1981). Additional ELT's and their designated numbers are defined by Miller (1981).

Additional Projects

To date, 28 research projects have been initiated on the MOFEP sites, and 22 of these are currently active (table 4). Research plots are spread across 9,200 ac (3,680 ha) included in the MOFEP study. Research plots for current projects are identified in figure 5 (map pocket, back cover). Throughout this volume, authors will refer back to figure 5. Authors will provide specific details about their respective sampling sites.

THE FUTURE OF MOFEP

The future emphasis of MOFEP will be to support collaborative, integrated research. To date, we have concentrated on collecting information on various components of an Ozark ecosystem. In the future, we will support efforts to investigate how the ecosystem components fit together and how they are ultimately affected by forest management practices. Management recommendations will be developed that address the mandate of MDC and the concerns of Missourians regarding the use and condition of their forests.

Since the inception of MOFEP in 1989, the project has grown exponentially. We have concentrated on supporting research to better understand forest ecosystem components that have received little or no support in the past. This volume is designed to present information compiled from the pre-treatment phase of MOFEP. It provides an excellent opportunity for MOFEP scientists to thoroughly document their methodology and pre-treatment findings and to archive that information for decades to come. MOFEP is designed to be a century-long project, and the initial documentation of pre-treatment findings will help ensure its future success.

LITERATURE CITED

Annand, Elizabeth M.; Thompson, Frank R. III. 1997. Forest bird response to regeneration practices in Central Hardwood forests. Journal of Wildlife Management. 61(1): 159-171.

Baskerville, G. 1985. Adaptive management, wood availability, and habitat availability. Forestry Chronicle. 61: 171-175.

Baskerville, G.; Moore, T. 1988. Forest information systems that really work. Forestry Chronicle. 64: 136-140.

Brookshire, B.L.; Hauser, C.H. 1993. The Missouri Ozark Forest Ecosystem Project: the effects of forest management on the forest ecosystem. In: Gillespie, A.R.; Parker, G.R.; Pope, P.E.; Rink, G.R., eds. Proceedings of the 9th central hardwood forest conference; 1993 March 8-10; Purdue University, West Lafayette, IN. Gen. Tech. Rep. NC-161. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 289-307.

Clawson, R.L.; Faaborg, J.; Seon, E. 1997. Effects of selected timber management practices on forest birds in Missouri oak-hickory forests: pre-treatment results. In: Brookshire, Brian L.; Shifley, Stephen R., eds. Proceedings of the Missouri Ozark Forest Ecosystem Project symposium: an experimental approach to landscape research; 1997 June 3-5; St. Louis, MO. Gen. Tech. Rep. NC-193. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 274-288.

Gordon, J.C. 1993. Ecosystem management: an idiosyncratic overview. In: Aplet, G.H.; Johnson, N.; Olson, J.T; Sample, V.A., eds. Defining sustainable forestry. Washington, DC: Island Press: 240-244.

Grabner, J.K.; Larsen, D.R.; Kabrick, J.M. 1997. An analysis of MOFEP ground flora: pre-treatment conditions. In: Brookshire, Brian L.; Shifley, Stephen R., eds. Proceedings of the Missouri Ozark Forest Ecosystem Project symposium: an experimental approach to landscape research; 1997 June 3-5; St. Louis, MO. Gen. Tech. Rep. NC-193. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 169-197.

Kurzejeski, E.W.; Clawson, R.L.; Renken, R.B.; Sheriff, S.L.; Vangilder, L.D.; Hauser, C.; Faaborg, J. 1993. Experimental evaluation of forest management: The Missouri Ozark Forest Ecosystem Project. Transactions of the 58th North American Wildlife and Natural Resources Conference: 599-609.

Law, J.R.; Lorimer, C.G. 1989. Managing uneven-aged stands. In: Clark, F.B.; Hutchinson, J.G., eds. Central Hardwood Notes. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 6.08:1-6.

Meinert, D.; Nigh, T.; Kabrick, J. 1997. Landforms, geology, and soils of the MOFEP study area. In: Brookshire, Brian L.; Shifley, Stephen R., eds. Proceedings of the Missouri Ozark Forest Ecosystem Project symposium: an experimental approach to landscape research; 1997 June 3-5; St. Louis, MO. Gen. Tech. Rep. NC-193. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 56-68.

Miller, M.R. 1981. Ecological land classification subsystem - a basic inventory system for planning management of the Mark Twain National Forest. Rolla, MO: U.S. Department of Agriculture, Forest Service, Mark Twain National Forest. 56 p.

Missouri Department of Conservation. 1986. Forest land management guidelines. Jefferson City, MO: Missouri Department of Conservation. 86 p.

Missouri Department of Conservation. 1996. Missouri's annual "Conservation Monitor" 1994-1996, three years of Gallup polls of Missourians' conservation interests and opinions. Public Profile 2-96. Jefferson City, MO: Missouri Department of Conservation. 28 p.

Palmer, Bruce. 1996. A regional forest resource attitude assessment - urban vs. rural Missourians. Columbia, MO: University of Missouri. 150 p.

Roach, B.A.; Gingrich, S.F. 1968. Even-aged silviculture for upland central hardwoods. Agric. Handb. 355. Washington, DC: U.S. Department of Agriculture, Forest Service. 39 p.

Robbins, C.S.; Sauer, J.R.; Greenberg, R.S.; Droege, S. 1989. Population declines in North American birds that migrate to the neotropics. Proceedings of the National Academy of Science. 86: 7658-7662.

Robinson, S.K.; Thompson, F.R. III; Donovan, T.M.; Whitehead, D.R.; Faaborg, J. 1995. Regional forest fragmentation and the nesting success of migratory birds. Science. 267: 1987-1990.

Rothstein, S.I.; Yokel, D.A., Fleischer, R.C. 1986. Social dominance, mating and spacing systems, female fecundity, and vocal dialects in captive and free-ranging brown-headed cowbirds. Current Ornithology. 3: 127-185.

Sheriff, S.L.; He, Zhuoqiong. 1997. The experimental design of the Missouri Ozark Forest Ecosystem Project. In: Brookshire, Brian L.; Shifley, Stephen R., eds. Proceedings of the Missouri Ozark Forest Ecosystem Project symposium: an experimental approach to landscape research; 1997 June 3-5; St. Louis, MO. Gen. Tech. Rep. NC-193. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 26-40.

Thompson, Frank R. III; Lewis, S.J.; Green, J.; Ewert, D. 1993. Status of neotropical migrant land birds in the Midwest: identifying species of management concern. In: Finch, D.M.; Stangel, P.W., eds. Status and management of Neotropical migratory birds. New York, NY: Oxford University Press: 145-158.

Walters, Carl. 1986. Adaptive management of renewable resources. New York, NY: Macmillan Publishing Co. 374 p.