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Abstract

Ten permanent 15 m transects previously established in two oak/saw palmetto scrub stands burned in December 1986, while two transects remained unburned. We sampled vegetation in the > 0.5 m and < 0.5 m layers on these transects at 6, 12, 18, 24, and 36 months postburn and determined structural features of the vegetation (height, % bare ground, total cover). We analyzed vegetation data from each sampling by height layer using detrended correspondence analysis ordination. Vegetation data for the > 0.5 m layer for the entire time sequence were combined and analyzed using detrended correspondence analysis ordination. Soils were sampled at 6, 12, 18, and 24 months postburn and analyzed for pH, conductivity, organic matter, exchangeable cations (Ca, Mg, K, Na), NO_3-N, NH_4-N, Al, available metals (Cu, Fe, Mn, Zn), and PO_4-P.

Shrub species recovered at different rates postfire with saw palmetto reestablishing cover >0.5 m within one year, but the scrub oaks had not returned to preburn cover >0.5 m in 3 years after fire. These differences in growth rates resulted in dominance shifts after fire with saw palmetto increasing relative to the scrub oaks. Such shifts were not uniform across the scrub gradient. Mixed oak/saw palmetto-dominated transects changed the most and recovered more slowly than either oak or saw palmetto-dominated transects. Distances between preburn and successive postburn locations in ordination space appear to be a useful index of this recovery. In mature scrub, ordination of the > 0.5 m layer reflected the environmental gradient from wet to dry. Ordinations of the >0.5 m layer from 6 through 18 months after fire reflected the rate of recovery as well as environmental differences, while ordinations of the < 0.5 m layer reflected the main environmental gradient. Most of the forbs and grasses in scrub also resprouted after fire; several of these were more common in the wetter transects. Overall changes in species richness were minor, although changes occurred in species richness by height layers due to different growth rates. Mean total cover > 0.5 m increased linearly after fire but did not reach a maximum in 3 years. Mean total cover < 0.5 m was 50% at 6 months postfire and remained that at 36 months postfire. Mean height was about 76 cm at 3 years postfire.

Soils of well drained and poorly drained sites differed markedly. Soil responses to fire appeared minor. Soil pH increased at 6 and 12 months postfire; calcium increased at 6 months postburn. Nitrate-nitrogen increased at 12 months postburn. Low values of conductivity, PO_4-P, Mg, K, Na, and Fe at 12 months postburn may be related to heavy rainfall the preceeding month. Seasonal variability in some soil parameters appeared to occur.

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Introduction

Scrub vegetation dominated by shrub oaks (*Quercus chapmanii, Q. geminata, Q. myrtifolia*), ericaceous shrubs (e.g., *Lyonia fruticosa, L. lucida*) and saw palmetto (*Serenoa repens*) is an important upland vegetation type on Kennedy Space Center (KSC) (Provancha et al. 1986). It is a major habitat for the threatened Florida scrub jay (*Aphelocoma coerulescens coerulescens*) (Breininger 1981, 1989) and is used by the gopher tortoise (*Gopherus polyphemus*) and other species of concern (Breininger et al. 1988).

Oak/saw palmetto scrub vegetation is fire adapted and recovers from fire primarily by sprouting (Abrahamson 1984 a,b, Schmalzer and Hinkle 1987). Previously, we examined four stands of scrub vegetation of differing ages on similar sites in the Happy Creek area of KSC, established permanent transects, and resampled those transects in the absence of fire (Schmalzer and Hinkle 1987). The youngest stand sampled had burned two years before the first sampling.

In December 1986, a fire burned through two of the stands previously sampled. Resampling after this fire was conducted to determine early postfire responses not covered in the previous study. In addition, there are advantages to examining changes on permanent sample plots or transects rather than inferring temporal changes from sites of differing ages but similar in other environmental conditions (Mueller-Dombois and Ellenberg 1974, Austin 1977). Examples of permanent plot studies in Florida vegetation include Veno (1976), Abrahamson (1984a,b), Givens et al. (1984), Myers (1985), and Menges (1990).

The study site is an inland area of Merritt Island. Merritt Island has a warm, humid climate. Annual precipitation averages 131 cm, but year-to-year variability is high. Precipitation varies seasonally with a wet season occurring from May to October and the rest of the year being relatively dry (Mailander 1990). Thunderstorms are frequent in the summer months with lightning strikes being common (Eastern Space and Missile Center 1989). Moisture deficits typically occur between mid-March and mid-May and between mid-November and mid-December (Mailander 1990). Mean daily maximum temperatures are 22.3^{o}C for January and 33.3^{o}C for July; mean daily mininum temperatures are 9.6^{o}C for January and 21.9^{o}C for August (Titusville records, Mailander 1990).

The scrub stands in this study occur primarily on Pomello sand (Arenic Haplohumod), a moderately well drained soil, but the wetter end of the scrub gradient is on the poorly drained Immokalee (Arenic Haplaquod) or Myakka sand (Aeric Haplaquod) (Huckle et al. 1974). These soils are low in available nutrients with much of the nutrient standing crops in living and dead vegetation and litter rather than the mineral soil (Schmalzer and Hinkle 1987).

Methods

Vegetation Sampling and Analysis

Permanent vegetation transects were established and sampled in four scrub stands in January 1983; in January 1985, they were resampled (Schmalzer and Hinkle 1987). The December 1986 fire burned through scrub Stands 1 and 2; Stands 3 and 4 did not burn. In Stand 1 four of six transects (#2, 3, 4, 5) burned, and in Stand 2 all six transects (#7-12) burned. We sampled vegetation of the burned transects at 6, 12, 18, 24, and 36 months postfire using line-intercept techniques and sampling the 0-0.5 m and > 0.5 m height layers (Muelller-Dombois and Ellenberg 1974). Unburned transects (Stands 1, #1 and 6) were sampled 6, 24, and 36 months postfire. Sampling methods used were the same as before the fire.

Vegetation data from each sampling period were analyzed by height layer using detrended correspondence analysis ordination (Hill and Gauch 1980, Gauch 1982) in the PCORD package (McCune 1987). Vegetation data from all sampling periods were combined and detrended correspondence analysis ordination was used with this larger data set to examine the patterns of compositional change. Ordination techniques have been used previously to study vegetation dynamics (Austin 1977, Whittaker and Woodwell 1978, Swaine and Greig-Smith 1980, Menges 1990), and recovery after fire (Hobbs and Gimingham 1984, Westman and O'Leary 1985, Malanson and Trabaud 1987). The data from repeated sampling of the same scrub transects appeared particularly suited to this approach.

Soil Sampling and Analysis

All transects in Stand 1 were on soils mapped as Pomello sand (moderately well drained); in Stand 2, 4 transects (#9-12) were on Pomello sand and 2 transects (#7, 8) were on Myakka sand (poorly drained) (Huckle et al. 1974).

We sampled soils from the 0 to 15 cm and 15 to 30 cm depths near each burned transect immediately postfire and 6, 12, 18, and 24 months postfire. Unburned transects were sampled 6, 12, and 24 months postfire. Each sample was a composite of at least 5 soil cores. Soil samples were homogenized and subsampled; subsamples were oven-dried at 50° C for 24 hours. Oven-dried samples were analyzed for nitrate-nitrogen and ammonium-nitrogen. Other analyses were conducted on air-dried samples.

Analyses of all parameters except organic matter were made in the NASA/KSC Environmental Chemistry Laboratory. Soil pH was determined on a 1:1 soil to water slurry (McLean 1982) using an Orion pH meter. Conductivity was measured on a 1:5 soil to water solution using a conductivity meter (Rhoades 1982). Exchangeable cations, Ca, Mg, Na, and K, were extracted in neutral 1N ammonium acetate (Knudsen et al. 1982, Lanyon and Heald 1982) and analyzed by atomic absorption spectrophotometer (Perkin-Elmer Corporation 1982). Available metals, copper (Cu), iron (Fe), manganese (Mn), and zinc (Zn), were extracted in diethylenetriaminepentaacetic acid (DTPA) (Olson and Ellis 1982, Gambrell and Patrick 1982, Baker and Amacher 1982) and analyzed by atomic absorption spectrophotometer. Exchangeable aluminum was extracted in 1N potassium chloride (Barnhisel and Bertsch 1982) and analyzed by atomic absorption spectrophotometry (Perkin-Elmer Corporation 1982). Exchangeable nitrate-nitrogen (NO_3-N) and ammonium-nitrogen (NH_4-N) were extracted in 2N potassium chloride (Keeney and Nelson 1982) and then analyzed on a Technicon Autoanalyzer (Technicon Industrial Systems 1973, 1983a). Available phosphorus was determined by extraction in deionized water (Olsen and Sommers 1982) followed by analysis on a Technicon Autoanalyzer (Technicon Industrial Systems 1983c). Organic matter was determined by the combustion method (Nelson and Sommers 1982). Organic matter determinations were made by Post, Buckley, Schuh, and Jernigan, Inc., Orlando, Florida.

Results

Vegetation Composition

The response of all burned transects (Table 1, Table 2, Appendix I, Tables I-1 to I-4) indicated regrowth of the shrub species of scrub at differing rates postfire. In the > 0.5 m layer (Table 1), cover of saw palmetto returned to preburn values in one year after fire, wax myrtle (*Myrica cerifera*) required 2 years to reestablish preburn cover, *Ilex glabra*, *Befaria racemosa*, and *Lyonia lucida* required 3 years. The scrub oaks had not returned to preburn cover by 3 years after the fire. Myrtle oak (*Quercus myrtifolia*) had only about half its preburn cover by 3 years postfire.

In the < 0.5 m layer (Table 2), there were increases after fire in the cover of shrubs that before burning were in the > 0.5 m layer. These included *Lyonia lucida* and *L. fruticosa*, *Ilex glabra*, *Myrica cerifera* and the scrub oaks. By 3 years after fire, cover of many of these shrubs < 0.5 m was beginning to decline as they grew into the > 0.5 m layer. Some subshrubs (*Vaccinium myrsinites*, *Gaylussacia dumosa*) that often do not reach 0.5 m height also increased after the fire.

Response of herbaceous species varied. Perennial grasses such as *Aristida stricta* and *Andropogon* spp. resprouted and reestablished cover. There appeared to be modest increases in cover of *Carphephorus* spp., *Panicum* spp., and *Eupatorium rotundifolium*. *Pteridium aquilinum* and *Galactia elliottii* appeared only in the 6 months and 18 months postburn samples. This was a seasonal effect, since both species are deciduous. The fire occurred in

Table 1. Composition (Percent Cover) of Scrub Stands That Burned In December 1986 Pre- and Postburn (>0.5m).

Species	Preburn N=10	6 Months Postburn N=10	12 Months Postburn N=10	18 Months Postburn N=10	24 Months Postburn N=10	36 Months Postburn N=10
Andropogon spp.	0	0	0	0	0.1	0
Aristida stricta	1.2	0	0.2	1.0	2.1	6.9
Befaria racemosa	1.5	0	0.3	1.0	0.7	1.9
Eupatorium rotundifolium	0	0.03	0	0	0	0
Galactia elliottii	0	0.5	0	1.0	0	0
lex glabra	2.7	0	0.4	0.6	1.7	2.9
Lyonia fruticosa	2.3	0.2	0.3	0.5	0.9	1.5
Lyonia lucida	14.1	0.8	2.4	3.3	8.5	12.5
Myrica cerifera	1.2	0.2	0.1	1.4	1.5	2.6
Persea borbonia	0.4	0	0.07	0.2	0.1	0.3
Pteridium aquilinum	0	0.3	0	0.8	0	0
Quercus chapmanii	4.1	0	0.7	1.0	1.1	2.5
Quercus geminata	11.5	2.0	3.0	6.1	6.3	9.1
Quercus myrtifolia	26.5	0.9	1.1	6.1	7.7	13.9
Rhus copallina	0	0	0	0.1	0	0
Serenoa repens	39.9	24.2	37.9	40.2	38.2	36.3
Smilax auriculata	0	0.03	0	0	0.03	0

Table 1. (Continued)

Species	Preburn N=10	6 Months Postburn N=10	12 Months Postburn N=10	18 Months Postburn N=10	24 Months Postburn N=10	36 Months Postburn N=10
Vaccinium myrsinites	0	0	0	0	0	0.1
Total Cover	105.6	29.0	46.5	63.3	69.0	90.5
Height	109.3	39.2	57.6	65.6	67.1	76.5
Maximum Height	195.0	99.8	112.8	120.8	120.4	122.6
Species Richness	6.5	2.8	3.8	6.5	6.1	6.3
Species Richness (All Strata)	8.0	10.0	10.3	11.4	9.8	9.9

Table 2. Composition (Percent Cover) of Scrub Stands That Burned in December 1986 Pre- and Postburn (<0.5m).

Species	Preburn N=10	6 Months Postburn N=10	12 Months Postburn N=10	18 Months Postburn N=10	24 Months Postburn N=10	36 Months Postburn N=10
Andropogon spp.	0	0	0.1	0.1	0.2	0.2
Aristida stricta	3.1	2.3	4.1	3.3	3.4	7.5
Bare ground	0	19.6	13.5	5.0	4.0	0.6
Befaria racemosa	0.3	1.1	1.1	0.7	1.0	0.9
Carphephorus spp.	0	0.3	0.6	1.0	0.6	0.6
Drosera spp.	0	0	0.03	0	0.03	0.03
Eupatorium rotundifolium	0	0.07	0.03	0.2	0	0
Galactia elliottii	0	1.3	0	1.8	0	0
Gaylussacia dumosa	0	0.5	0.7	0.7	0.3	0.5
Hypericum reductum	0.1	0.03	0.03	0.1	0.1	0.1
Ilex glabra	0.1	1.2	1.7	1.6	1.0	0.6
Licania michauxii	0	0.03	0.03	0.03	0	0
Lyonia fruticosa	0.5	1.1	1.4	1.2	1.2	1.2
Lyonia lucida	1.4	9.2	11.3	10.5	6.1	6.0
Myrica cerifera	1.0	3.6	3.1	3.2	3.3	4.5
Panicum spp.	0	0.03	0.2	0.4	1.9	0.7
Pteridium aquilinum	0	5.4	0	4.3	0	0

Table 2. (Continued)

Species	Preburn N=10	6 Months Postburn N=10	12 Months Postburn N=10	18 Months Postburn N=10	24 Months Postburn N=10	36 Months Postburn N=10
Quercus chapmanii	1.2	3.4	2.7	3.5	3.8	3.1
Quercus geminata	1.1	7.5	5.6	5.5	3.2	4.2
Quercus myrtifolia	2.2	13.3	13.6	15.9	14.2	12.3
Rhus copallina	0	0.1	0	0.1	0	0
Serenoa repens	0.3	1.0	1.4	0.6	1.4	1.5
Seymeria pectinata	0	0	0	0.5	0	0
Smilax auriculata	0.1	0.07	0.06	0.1	0	0
Unknown herb	0	0	0	0.03	0	0
Vaccinium myrsinites	1.2	1.9	2.2	2.4	2.7	3.3
Vaccinium stamineum	0	0.07	0	0.1	0	0
Total Cover	12.4	53.6	49.9	57.8	44.4	47.2
Species Richness	5.7	9.9	10.0	10.6	8.5	9.2

December, thus only the 6 and 18 months postburn samples represented summer conditions.

The two stands that burned were not identical preburn. Stand 1 was older (11 vs. 7 years since fire) and on a drier site than Stand 2 (see Schmalzer and Hinkle 1987). Therefore, we also considered their postfire response separately. Stand 1 (Table 3, Table 4, see also Appendix I) showed the same general trends discussed above except that some shrubs such as *Ilex glabra* did not occur on the drier sites, and there were fewer herbaceous species. Conversely, Stand 2 (Table 5, Table 6, see also Appendix I) followed the same general trends but had additional shrub and herbaceous species.

The two unburned transects in Stand 1 (Table 7) showed only minor changes in composition and percent cover in the time since the December 1986 fire.

Ordination Analysis

Preburn ordination of the > 0.5 m layer (Appendix III, Figure 1) gave a pattern where Transects 7 and 8 defined the wet end of the gradient dominated by saw palmetto with *Ilex glabra* and *Persea borbonia*, while the oaks dominated the xeric end. The < 0.5 m layer gave a similar ordination pattern (Appendix III, Figure 2), reflecting the depth to water table gradient. Transect 7 was not represented in this ordination, since preburn it had no vegetation < 0.5 m.

At 6 months postburn, ordination of the > 0.5 m layer (Appendix III, Figure 3) had Transect 5 at one end and the other transects clustered near the other end of the first axis. Immediately after fire, regrowth of saw palmetto exceeded

Table 3. Composition (Percent Cover) of Transects in Scrub Stand 1 That Burned in December 1986 Pre- and Postburn (>0.5 m).

Species	Preburn N=4	6 Months Postburn N=4	12 Months Postburn N=4	18 Months Postburn N=4	24 Months Postburn N=4	36 Months Postburn N=4
Aristida stricta	2.2	0	0.5	1.7	2.0	11.6
Befaria racemosa	1.2	0	0.2	0.7	0.6	1.2
Galactia elliottii	0	0.8	0	1.7	0	0
Lyonia fruticosa	3.1	0	0.2	0.7	0.9	1.5
Lyonia lucida	15.7	0.5	1.2	2.8	6.4	9.8
Myrica cerifera	0.5	0.2	0	1.8	1.9	1.9
Pteridium aquilinum	0	0	0	0.1	0	0
Quercus chapmanii	8.3	0	1.7	2.4	2.9	6.0
Quercus geminata	14.9	3.9	4.5	9.0	8.9	13.6
Quercus myrtifolia	39.8	2.2	2.9	12.9	13.3	22.9
Serenoa repens	28.7	13.3	27.0	32.7	31.4	26.5
Smilax auriculata	0	0.08	0	0	0.08	0
Vaccinium myrsinites	0	0	0	0	0	0.3
Total Cover	114.3	21.0	38.1	66.3	68.2	95.2
Height	118.8	34.1	48.6	66.4	59.8	75.9
Max Height	207.5	108.0	120.0	122.0	117.5	125.8
Species Richness	7.3	3.5	5.0	7.5	7.0	7.3

Table 3. (Continued)

Species	Preburn N=4	6 Months Postburn N=4	12 Months Postburn N=4	18 Months Postburn N=4	24 Months Postburn N=4	36 Months Postburn N=4
Species Richness (All Strata)	9.0	11.8	11.5	11.8	9.5	10.3

Table 4. Composition (Percent Cover) of Transects In Scrub Stand 1 That Burned In December 1986 Pre- and Postburn (<0.5 m).

Species	Preburn N=4	6 Months Postburn N=4	12 Months Postburn N=4	18 Months Postburn N=4	24 Months Postburn N=4	36 Months Postburn N=4
Aristida stricta	2.0	2.5	3.3	2.8	4.7	4.7
Bare ground	0	21.6	12.9	5.8	5.3	0.8
Befaria racemosa	0.3	0.3	0.3	0.3	0.3	0
Carphephorus spp.	0	0.08	0.2	0.3	0.5	0.8
Drosera spp.	0	0	0.08	0	0.08	0.08
Galactia elliottii	0	2.0	0	2.8	0	0
Gaylussacia dumosa	0	1.0	1.3	1.3	0	0.9
Licania michauxii	0	0.08	0.08	0.08	0	0
Lyonia fruticosa	0.6	0.9	1.4	1.2	1.4	1.8
Lyonia lucida	1.3	9.3	10.3	12.3	6.9	6.7
Myrica cerifera	1.2	3.2	2.7	2.3	2.9	5.9
Panicum spp.	0	0	0	0.08	0.08	0
Pteridium aquilinum	0	1.1	0	1.8	0	0
Quercus chapmanii	1.8	7.9	6.2	7.2	7.3	5.7
Quercus geminata	1.1	5.8	4.6	2.7	1.5	2.1
Quercus myrtifolia	2.7	18.8	19.8	20.5	18.4	16.3
Serenoa repens	0.7	0.6	0.6	0.6	0.5	1.3

Table 4. (Continued)

Species	Preburn N=4	6 Months Postburn N=4	12 Months Postburn N=4	18 Months Postburn N=4	24 Months Postburn N=4	36 Months Postburn N=4
Smilax auriculata	0.2	0.2	0.2	0.2	0	0
Vaccinium myrsinites	2.0	2.9	2.5	3.2	3.3	5.0
Total Cover	13.8	56.3	53.2	59.2	47.7	51.1
Species Richness	7.5	11.3	11.3	11.0	8.3	9.3

Table 5. Composition (Percent Cover) of Transects In Scrub Strand 2 That Burned In December 1986 Pre- and Postburn (>0.5m).

Species	Preburn N=6	6 Months Postburn N=6	12 Months Postburn N=6	18 Months Postburn N=6	24 Months Postburn N=6	36 Months Postburn N=6
Andropogon spp.	0	0	0	0	0.1	0
Aristida stricta	0.6	0	0	0.6	2.2	3.7
Befaria racemosa	1.8	0	0.4	1.2	0.7	2.5
Eupatorium rotundifolium	0	0.05	0	0	0	0
Galactia elliottii	0	0.2	0	0.5	0	0
Ilex glabra	4.6	0	0.6	1.0	2.9	4.8
Lyonia fruticosa	1.8	0.3	0.3	0.4	1.0	1.5
Lyonia lucida	13.1	1.0	3.3	3.6	10.0	14.4
Myrica cerifera	1.7	0.2	0.2	1.1	1.3	3.1
Persea borbonia	0.7	0	0.1	0.3	0.2	0.5
Pteridium aquilinum	0	0.6	0	1.3	0	0
Quercus chapmanii	1.3	0	0	0	0	3.4
Quercus geminata	9.2	0.8	2.0	4.2	4.6	6.1
Quercus myrtifolia	17.7	0	0	1.6	3.9	7.9
Rhus copallina	0	0	0	0.2	0	0
Serenoa repens	47.3	31.4	45.1	45.2	42.8	42.8
Total cover	99.7	34.4	52.1	61.3	69.6	87.3

Table 5. (Continued)

Species	Preburn N=6	6 Months Postburn N=6	12 Months Postburn N=6	18 Months Postburn N=6	24 Months Postburn N=6	36 Months Postburn N=6
Height	103.0	42.7	63.9	65.1	72.2	77.0
Max Height	186.7	94.3	108.0	120.0	122.3	120.5
Species Richness	6.0	2.3	3.0	5.8	5.5	5.7
Species Richness (All Strata)	7.3	9.5	9.5	11.2	10.0	9.7

Table 6. Composition (Percent Cover) of Transects in Scrub Stand 2 That Burned in December 1986 Pre- and Postburn (<0.5m).

Species	Preburn N=6	6 Months Postburn N=6	12 Months Postburn N=6	18 Months Postburn N=6	24 Months Postburn N=6	36 Months Postburn N=6
Andropogon spp.	0	0	0.2	0.1	0.4	0.3
Aristida stricta	3.8	2.2	4.6	3.7	2.6	9.4
Bare ground	0	18.3	13.8	4.5	3.1	0.4
Befaria racemosa	0.2	1.6	1.7	1.1	1.5	1.4
Carphephorus spp.	0	0.5	0.8	1.6	0.6	0.4
Eupatorium rotundifolium	0	0.1	0.05	0.3	0	0
Galactia elliottii	0	0.8	0	1.1	0	0
Gaylussacia dumosa	0	0.2	0.4	0.3	0.4	0.2
Hypericum reductum	0.2	0.05	0.05	0.2	0.2	0.2
Ilex glabra	0.1	2.0	2.8	2.6	1.6	1.1
Lyonia fruticosa	0.4	1.3	1.5	1.2	1.1	0.9
Lyonia lucida	1.5	9.2	11.9	9.4	5.5	5.5
Myrica cerifera	0.9	3.9	3.3	3.9	3.6	3.6
Panicum spp.	0	0.05	0.4	0.7	3.2	1.2
Pteridium aquilinum	0	8.3	0	5.9	0	0
Quercus chapmanii	0.8	0.4	0.5	1.1	1.5	1.4
Quercus geminata	1.1	8.6	6.3	7.4	4.3	5.6

Table 6. (Continued)

Species	Preburn N=6	6 Months Postburn N=6	12 Months Postburn N=6	18 Months Postburn N=6	24 Months Postburn N=6	36 Months Postburn N=6
Quercus myrtifolia	1.9	9.7	9.4	12.8	11.4	9.7
Rhus copallina	0	0.2	0	0.1	0	0
Serenoa repens	0	1.3	1.9	0.6	2.0	1.7
Seymeria pectinata	0	0	0	0.8	0	0
Unknown herb	0	0	0	0.05	0	0
Vaccinium myrsinites	0.7	1.3	1.9	1.9	2.3	2.2
Vaccinium stamineum	0	0.1	0	0.2	0	0
Total Cover	11.5	51.8	47.7	56.8	42.2	44.6
Species Richness	4.5	9.0	9.2	10.3	8.7	9.2

Table 7. Composition of Unburned Scrub Transects After the December 1986 Fire.

Species	6 Months Postburn >0.5m N=2	6 Months Postburn <0.5m N=2	24 Months Postburn >0.5m N=2	24 Months Postburn <0.5m N=2	36 Months Postburn >0.5m N=2	36 Months Postburn <0.5m N=2
Aristida stricta	2.7 (3.7)	1.2 (1.6)	1.5 (2.1)	0.9 (1.2)	2.2 (3.0)	3.9 (5.4)
Bare ground	0 -	0.5 (0.7)	0 -	3.0 (2.8)	0 -	0 -
Carphephorus spp.	0 -	0 -	0 -	0 -	0 -	0.2 (0.2)
Galactia elliottii	1.3 (0.6)	0 -	0 -	0 -	0 -	0 -
Gaylussacia dumosa	0 -	0.5 (0.7)	0 -	0 -	0 -	0.8 (0.7)
Lyonia fruticosa	0 -	0.4 (0.1)	0.7 (0.9)	2.0 (1.8)	1.7 (2.3)	2.5 (3.1)
Lyonia lucida	6.5 (3.5)	5.3 (5.2)	9.8 (7.8)	5.0 (1.0)	9.9 (1.6)	6.4 (6.6)
Myrica cerifera	2.4 (3.3)	1.4 (1.9)	2.5 (3.5)	0.2 (0.2)	11.2 (6.9)	1.0 (1.4)
Quercus chapmanii	2.9 (3.0)	0.5 (0.7)	2.0 (2.8)	1.3 (1.4)	2.5 (3.5)	3.4 (3.3)
Quercus geminata	4.9 (1.6)	0.4 (0.6)	6.4 (5.2)	0.8 (0.7)	5.3 (0.0)	0.5 (0.7)
Quercus myrtifolia	60.5 (13.0)	3.8 (3.1)	48.8 (6.4)	8.7 (4.7)	51.2 (6.9)	7.9 (0.2)
Serenoa repens	28.1 (17.1)	0 -	30.3 (26.9)	0 -	34.4 (27.8)	0 -

Table 7. (Continued)

Species	6 Months Postburn >0.5m N=2	6 Months Postburn <0.5m N=2	24 Months Postburn >0.5m N=2	24 Months Postburn <0.5m N=2	36 Months Postburn >0.5m N=2	36 Months Postburn <0.5m N=2
Vaccinium myrsinites	2.4 (2.4)	5.8 (1.8)	0.7 (0.0)	3.7 (0.5)	1.4 (0.9)	4.5 (1.7)
Total Cover	111.5 (23.8)	19.1 (14.4)	102.6 (38.6)	23.1 (7.4)	119.5 (26.1)	30.9 (8.7)
Height (cm)	111.1 (54.2) N=7		105.9 (65.8) N=8		115.3 (79.0) N=8	
Maximum Height	162.5 (50.2) N=2		194.0 (79.2) N=2		209.5 (92.6) N=2	
Species Richness	8.0 (1.4) N=2	6.5 (2.1) N=2	7.0 (1.4) N=2	7.5 (2.1) N=2	7.5 (0.7)	8.0 (1.4)
Species Richness (All Strata)	9.5 (2.1)		8.5 (2.1)		10.0 (1.4)	

that of the oaks and dominated the > 0.5 m layer. Transect 5 lacked saw palmetto, and its regrowth was dominated by the oaks, as indicated in the species ordination. In contrast, the < 0.5 m layer ordination (Appendix III, Figure 4) reflected the environmental gradient previously shown in the > 0.5 m layer.

At 12 months postburn, Transect 5 still defined one end of the ordination of the > 0.5 m layer (Appendix III, Figure 5). More species had grown into this layer, including some of those that characterize wetter sites. The < 0.5 m layer ordination (Appendix III, Figure 6) reflected the depth to water table gradient with Transects 7 and 8 defining the wet end.

By 18 months postfire (Appendix III, Figure 7), Transect 5 still defined the oak-dominated end of the first axis of the > 0.5 m layer ordination, Transects 7 and 8 emerged as saw palmetto-dominated transects on the other end, and a group of transects with mixed dominance was intermediate. Ordination of the < 0.5 m layer (Appendix III, Figure 8) reflected the differences between Transects 7 and 8 and the others. In species composition, the wet end of the gradient was partly determined by herbaceous species (e.g., *Panicum* spp., *Eupatorium rotundifolium*) and small shrubs (e.g., *Rhus copallina*), since other shrubs had grown into the > 0.5 m layer.

At 24 months postburn, the overall gradient was well defined in the > 0.5 m layer (Appendix III, Figure 9), but less so in the < 0.5 m layer (Appendix III, Figure 10). The ordination patterns at 36 months postburn were similar to those 24 months postburn (Appendix III, Figures 11, 12). Comparing the preburn ordination of the > 0.5 m layer (Appendix III, Figure 1) to 36 months postburn (Appendix III, Figure 11) indicated a general but incomplete recovery of the community pattern by this time. Oak cover was still less than preburn in the > 0.5

m layer; this was reflected in the intermediate location of many transects that preburn had greater oak dominance as indicated by their closer location to Transect 5 in the preburn ordination.

Further details of the recovery process are given by the detrended correspondence analysis ordination of the transects at all sampling times. The overall pattern (Appendix III, Figure 13) had the oak-dominated transects (e.g., #5) to the right side of the ordination and saw palmetto-dominated transects (#7,#8) to the left, as is also indicated by the species ordination (Appendix III, Figure 14).

Trajectories of individual transects over time are seen more easily by plotting fewer of the transects on one graph (Appendix III, Figures 15, 16, 17). Three patterns of responses occurred. Transect 5 with high oak dominance and little saw palmetto cover remained on the right side of the ordination (Appendix III, Figure 15). At 6 months after fire, it was located higher on the second axis, probably due to the cover of *Galactia* and *Smilax* in that sample. Over time, the position of the transect in the ordination space tracked back toward its original location but was not identical to preburn by 36 months postburn.

Saw palmetto-dominated transects (#7, Appendix III, Figure 16; #8, Figure 15) remained on the left side of the ordination. At 6 months postburn, both of these transects were located higher on the second axis than preburn, probably reflecting the cover of *Eupatorium* and *Pteridium* postfire. Transect 7 tracked back toward its preburn location relatively smoothly. Transect 8 showed a variation in that the 18 months postburn sample was closer to the 6 months than the 12 months sample. This was a seasonal response, since the herbs

Eupatorium and *Pteridium* were represented in the summer (6, 18 months) samples but not the winter ones.

Most of the transects (# 2, 3, 4, 9, 10, 11, 12) were originally of mixed oak/saw palmetto dominance or oak dominated but with saw palmetto abundant. These all moved from the oak end of the ordination to the saw palmetto end after fire and then gradually tracked back toward their original location (Appendix III, Figure 15, #10, 11, 12; Figure 16, #2, 4; Figure 17, #3, 9). Transect 2 showed a slight variation in this pattern in that the sample 12 months postburn had greater saw palmetto dominance than at 6 months after the fire; this seems to be due to slower initial growth on this transect.

We calculated two indices intended to reflect recovery based on the ordination results. The first was simply the difference between the first axis ordination score of the sample taken before the fire and the first axis score for each postfire sampling of that transect. The first axis was used since this is the most important in an ordination. These differences declined with increasing time since fire (Table 8). The group of transects of mixed dominance showed the greatest change 6 months postfire and the largest remaining differences 36 months postfire compared to the saw palmetto-dominated transects or the the single oak-dominated one (Table 8).

The second index was the euclidean distance between the preburn location of a transect and its location at each postburn sampling based on the first two ordination axes. This index takes into account information from the second ordination axis. See Malanson and Trabaud (1987) for a similar approach. These values declined with increasing time after the fire and

Table 8. Differences Between Preburn and Postburn Axis 1 Ordination Scores From Detrended Correspondence Analysis Ordination.

Transect	6 Months Postburn	12 Months Postburn	18 Months Postburn	24 Months Postburn	36 Months Postburn
2	62	86	39	38	21
3	113	94	59	55	20
4	106	85	72	67	14
5	36	38	9	11	0
7	20	22	13	21	7
8	10	7	13	1	(-2)[1]
9	84	74	46	12	(-12)[1]
10	96	95	70	45	14
11	140	133	97	90	41
12	49	30	22	8	2
$\bar{X}_{all}^{2}$	71.6	66.4	44.0	34.8	13.3
SD_{all}^{2}	43.0	40.0	30.1	29.3	12.2
$\bar{X}_{sp}^{3}$	15.0	14.5	13.0	11.0	4.5
SD_{sp}^{3}	7.1	10.6	0	14.1	3.5
$\bar{X}_{o/sp}^{4}$	92.9	85.3	57.9	45.0	17.7
$SD_{o/sp}^{4}$	31.0	30.6	24.7	29.2	12.0

[1] Calculations based on absolute values of negative differences.
[2] All transects (N=10).
[3] Saw palmetto transects (#7, 8) (N=2).
[4] Oak/saw palmetto transects (#2, 3, 4, 9, 10, 11, 12) (N=7).

alsosuggested that the mixed dominance transects changed to a greater degree than the saw palmetto or oak-dominated ones (Table 9).

Vegetation Structure

Mean total cover > 0.5 m increased almost linearly from 6 to 36 months postfire (Appendix III, Figure 18). Mean total cover < 0.5 m (Appendix III, Figure 19) reached a value of about 50% at 6 months postfire and fluctuated within that range through 36 months postfire. Percent bare ground (Appendix III, Figure 20) was high immediately after fire but declined rapidly, approaching zero at 36 months postfire. Mean height (Appendix III, Figure 21) increased rapidly through one year after fire and then at a slower rate. Mean maximum height (Appendix III, Figure 22) increased rapidly to 6 months after fire and then changed slowly. Species richness > 0.5 m (mean number of species per transect) (Appendix III, Figure 23) increased to 18 months postfire. Species richness < 0.5 m (Appendix III, Figure 24) and species richness of all strata (Appendix III, Figure 25) reached high values at 6 months postfire and changed little from then through 36 months postfire.

Soil Chemistry

Previous work (Schmalzer and Hinkle 1987) and initial analysis of the postburn soil data indicated that the more poorly drained scrub soils had higher levels of organic matter and nutrients related to organic matter. In order to reduce variation within the soil data set, well drained soils (8 burned transects) were considered separately from the poorly drained ones (2 burned transects). Some data from 2 unburned transects were also collected. The sample sizes of the poorly drained and unburned soils were not sufficient for definite conclusions. Soils of these transects were sampled previously in January 1983.

Table 9. Euclidean Distances Between Preburn and Postburn Locations (Axis 1, Axis 2) of Transects in Ordination Space from Detrended Correspondence Analysis Ordination.

Transect	6 Months Postburn	12 Months Postburn	18 Months Postburn	24 Months Postburn	36 Months Postburn
2	70.7	102.6	46.3	41.2	22.1
3	130.4	113.7	63.3	56.5	20.6
4	114.0	101.8	83.4	75.6	15.2
5	81.4	42.9	20.1	11.0	29.0
7	35.2	33.3	25.6	21.8	9.2
8	81.6	43.6	83.0	15.0	3.6
9	104.4	88.8	56.6	12.2	15.0
10	104.8	101.6	70.1	45.5	50.0
11	155.2	148.9	114.1	96.6	54.6
12	49.0	31.0	22.0	8.2	9.2
$\bar{X}_{all}$[1]	92.7	80.8	58.5	38.4	22.9
SD_{all}[1]	36.5	40.4	30.8	30.4	17.2
$\bar{X}_{sp}$[2]	58.4	38.5	54.3	18.4	6.4
SD_{sp}[2]	32.8	7.3	40.6	4.8	4.0
$\bar{X}_{o/sp}$[3]	104.1	98.3	65.1	48.0	26.7
$SD_{o/sp}$[3]	35.5	35.3	29.0	31.9	18.1

[1] All transects (N=10).
[2] Saw palmetto transects (#7, 8) (N=2).
[3] Oak/saw palmetto transects (#2, 3, 4, 9, 10, 11, 12) (N=7).

These data are given in Appendix II, Tables II-1 to II-3. Graphs are presented only for the well drained, burned soils.

Hydrogen ion concentration (Appendix III, Figure 26) decreased at 6 and 12 months after the fire and then returned to preburn values by 18 months postburn. Soil pH (Appendix III, Figure 27) increased with the hydrogen ion decrease and then returned to preburn values. Poorly drained soils (Table II-2) showed decreased hydrogen ion concentration (increased pH) at 12 and 24 but not 18 months postburn; unburned soils (Table II-3) showed a decrease in hydrogen ion concentration at 12 months after the fire.

Conductivity declined at 12 months postburn (Appendix III, Figure 28). This decline occurred in the burned, poorly drained scrub (Table II-2) but also in the unburned scrub (Table II-3).

Organic matter (Appendix III, Figure 29) did not show a clear pattern of change after the fire. At 12 months postburn, values were low in the surface layer, but 18 and 24 month postburn values were not. Poorly drained soils (Table II-2) and unburned soils (Table II-3) did not show this trend. As previously shown, organic matter levels were much higher in poorly drained than well drained soils.

Phosphorus (Appendix III, Figure 30) did not show a definite fire response. Values at 12 months postburn were lower than those preceeding and following. The same trend occurred in the poorly drained soils (Table II-2).

Calcium appeared slightly elevated at 6 months postfire (Appendix III, Figure 31) but by 12 months postburn returned more in range with preburn values. Magnesium (Appendix III, Figure 32) did not show a definite fire response. As with several other parameters, it decreased at 12 months postfire but increased later. Potassium (Appendix III, Figure 33) decreased at 12 months postburn, but values at 18 and 24 months postburn were higher than preburn. The poorly drained soils (Table II-2) also displayed this pattern. Sodium (Appendix III, Figure 34) showed a slight decrease at 12 months postburn followed by an increase at 18 and 24 months. Poorly drained soils (Table II-2) were similar; unburned soils (Table II-3) also had higher values 24 months postfire than before the fire.

Nitrate-nitrogen (Appendix III, Figure 35) was low immediately and 6 months postburn, increased at 12 months postburn, and remained high at 18 and 24 months postburn. The poorly drained soils (Table II-2) also displayed this pattern. Unburned soils (Table II-3) increased at 24 but not 12 months postfire. Ammonium-nitrogen (Appendix III, Figure 36) declined between immediately postburn and 12 months postburn, then increased sharply at 18 months, declining again at 24 months postburn. Poorly drained soils (Table II-2) followed the same pattern. Variability was evident even in the unburned soils (Table II-3).

Aluminum (Appendix III, Figure 37) increased at 18 months postburn in well drained soils and in poorly drained ones (Table II-2). Unburned soils also increased in aluminum at 24 months postfire (Table II-3). Copper (Appendix III, Figure 38) increased at 18 months postburn in well drained soils and in poorly drained ones (Table II-2), but unburned soils changed little (Table II-3). Iron (Appendix III, Figure 39), manganese (Appendix III, Figure 40), and zinc (Appendix III, Figure 41) varied some through time but did not show clear changes from fire.

Discussion

Vegetation Composition and Structure

Regrowth of oak/saw palmetto scrub immediately after fire was primarily by the resprouting of shrubs present before the fire, as indicated in our previous work (Schmalzer and Hinkle 1987) and in studies of similar vegetation (Abrahamson 1984a,b). Rates of regrowth differed between species. This is seen most clearly immediately after fire; saw palmetto reestablished preburn cover > 0.5 m in one year after fire, while scrub oaks did not reestablish preburn cover > 0.5 m in 3 years. Abrahamson (1984a,b) observed similar species differences in postfire regrowth.

Mean total cover > 0.5 m three years postfire was similar to cover recorded in our earlier study (Schmalzer and Hinkle 1987). At two years postfire, cover was greater than in the two year old stand previously sampled; that stand had greater oak dominance and exhibited slower reestablishment of cover in the > 0.5 m layer. Mean total cover < 0.5 m was also in the range reported previously (Schmalzer and Hinkle 1987). The decline in cover < 0.5 m that occurred in stands 4 years old (Schmalzer and Hinkle 1987) did not occur by 3 years postfire here.

Differential growth rates of the major shrub species resulted in shifts in dominance after fire. Ordination analyses indicated that these shifts were not uniform but were most pronounced in transects of mixed dominance. While earlier studies (Schmalzer and Hinkle 1987) indicated dominance changes, these changes were most pronounced in the first two years after fire, as reflected here.

Herbaceous species such as *Pteridium* and *Eupatorium* increased after fire, particulary in the saw palmetto-dominated transects, but this was of much less magnitude than the shrub response. Much of the herbaceous response was vegetative regrowth rather than seedling establishment. This was certainly the case with grasses (*Andropogon*, *Aristida*) and perennial forbs such as *Pteridium* and *Galactia*. Some species (e.g., *Eupatorium*) were encountered primarily in summer sampling; since sampling before the fire (Schmalzer and Hinkle 1987) was conducted in the winter, seedling establishment cannot be ruled out. At most, however, this is a minor component of the vegetation recovery in oak/saw palmetto scrub.

The subshrubs *Vaccinium myrsinites* and *Gaylussacia dumosa* increased immediately after fire. Abrahamson (1984a,b) observed this in Lake Wales Ridge vegetation but noted that these shrubs can persist for lengthy periods without fire.

A consequence of the dominance of sprouting species in oak/saw palmetto scrub vegetation and the rapid recovery of plant cover after fire is that there is little change in overall species richness. There are changes in species richness by strata due to differing rates of height growth. This confirms earlier results (Schmalzer and Hinkle 1987). Abrahamson (1984a) noted that only a small set of plant species were well-adapted to the set of envirionmental conditions that characterize scrub; these conditions include winter drought, acid, nutrient-poor, sandy soils, and repeated burning. In rosemary (*Ceratiola ericoides*) scrub, openings persist longer after fire due to the slower recovery by a seeder species, and there was a greater postfire response by herbaceous species (Johnson and Abrahamson 1990). Fire is thought to maintain species diversity in many shrublands (Gill and Groves 1981, Kruger 1983, Christensen 1985).

Bare ground did not persist long after fire in the oak/saw palmetto scrub. This is consistent with our previous study (Schmalzer and Hinkle 1987) and with observations that there is little bare ground in undisturbed oak/saw palmetto scrub not recently burned (Breininger et al. 1988, Breininger and Schmalzer 1990). Oak/saw palmetto scrub differs from much sand pine scrub (Mulvania 1931, Webber 1935) where openings are common and persist.

Rates of height growth were similar to those reported before (Schmalzer and Hinkle 1987). Mean height was 76 cm, well below one meter, at 3 years after fire.

Soil Chemistry

In general, values of most soil parameters were similar to previous results (Schmalzer and Hinkle 1987). For all major nutrients, concentrations were greater in the 0-15 cm layer than at 15-30 cm. Poorly drained scrub soils were higher in organic matter and most nutrients than the well drained soils.

There are several complications to interpreting the responses to fire of these soils. The preburn samples were taken 3 years before the fire, not immediately preburn. There was not a matched sampling of soils from unburned scrub; therefore, seasonal variation of soil parameters may influence the results. Madsen (1980) conducted quarterly sampling of KSC soils including those from scrub but concluded that the data were not sufficient to establish seasonal trends.

The decrease in hydrogen ion concentration (pH increase) at 6 and 12 months postfire is probably due to fire. Soil pH increases of differing magnitudes are commonly observed after fire and are related to the release of cations in ash (Raison 1979, Wells et al. 1979). The only cation to show an increase coinciding with pH is calcium which is the most abundant cation in scrub biomass and litter (Schmalzer and Hinkle 1987). Abrahamson (1984a) observed an increase in calcium after fire that lasted less than one year.

Conductivity, phosphorus, magnesium, potassium, sodium, and iron all decreased at 12 months postburn. By 18 and 24 months postburn all returned in line with preceeding values or, in the case of sodium and potassium, exceeded previous levels. Precipitation records (Appendix III, Figure 42) indicated that the rainfall of November 1987 (9.44 in, 24.0 cm), the month preceeding the 12 months postburn sampling, was the greatest monthly precipitation during the course of the study. It is possible that this resulted in leaching of mobile elements from the upper layers of the soil.

Nitrate-nitrogen and ammonium-nitrogen exhibited delayed responses to fire. Nitrate-nitrogen began increasing at 12 months extending to 18 and 24 months postburn. Similar delayed increases in nitrate-nitrogen occurred after fire in coastal strand vegetation on Canaveral National Seashore (Hinkle et al. 1989) and various other systems including chaparral (Christensen and Muller 1975, DeBano et al. 1977), South African fynbos (Stock and Lewis 1986), and pocosins (Wilbur and Christensen 1983). Delayed increases in nitrate-nitrogen have been related to initial declines in nitrifying bacteria (Dunn and DeBano 1977) followed by their subsequent recovery and mineralization of nitrogen made available by fire (DeBano et al. 1979, Raison 1979). Total Kjeldahl nitrogen data from these sites are not yet available.

Reasons for the increase of aluminum and copper at 18 and 24 months postburn are unclear. Increases in pH decrease the availability of aluminum and copper (Brady 1974, Marschner 1986), but the magnitude of the pH change here appears insufficient to have much effect. Additionally, pH returned to its preburn values at 18 months postburn, while aluminum and copper considerably exceeded preburn values then.

Conclusions

1. The general pattern of recovery of oak/saw palmetto scrub after fire is that of sprouting by the dominant shrub species with little overall change in species composition or species richness. Sampling of permanent transects repeatedly after fire reveals details of this process which were not as clear from previous work. Recovery patterns differ over the scrub gradient. Dominance of mixed oak/saw palmetto transects changes much more immediately after fire than either oak-dominated or saw palmetto-dominated transects, and recovery is not complete by 3 years after fire.

2. Many of the structural changes after fire are persistent. Percent bare ground is reduced quickly by resprouting shrubs, but cover in the > 0.5 m layer and shrub height recover more slowly. Yet unresolved are potential changes from repeated, frequent fires that might reduce root carbohydrate reserves (e.g., Hough 1968, Harrington 1985, 1989).

3. Scrub soils do not appear greatly changed by fire. There is a modest increase in pH that last for about one year after fire and an increase in calcium. There is a delayed increase in nitrate-nitrogen as seen in several other studies. Low values of several parameters at 12 months after the fire may be related to unusually high rainfall the preceeding month. Future work in effects of fire on scrub soils needs to examine the broader question of fire effects on nutrient cycling in scrub including losses of nutrients directly from fire (e.g., Raison et al. 1985a,b), possible importance of gaseous emissions of nitrogen oxides (Anderson et al. 1988, Levine et al. 1988, 1990), and the potential for leaching losses. Soil studies may require balanced sampling of unburned sites to account for seasonal variability which appears greater than anticipated.

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Appendix I

Species Composition of Scrub Stands Preburn Through 36 Months Postburn

Table I-1. Composition (Percent Cover) of Scrub Stands That Burned in December 1986 Preburn.

	1983						1985					
	> 0.5m			< 0.5m			> 0.5m			< 0.5m		
Species	All N=10	Stand 1 N=4	Stand 2 N=6	All N=10	Stand 1 N=4	Stand 2 N=6	All N=10	Stand 1 N=4	Stand 2 N=6	All N=10	Stand 1 N=4	Stand 2 N=6
Andropogon spp.	0 -	0 -	0 -	0.2 (0.7)	0 -	0.4 (0.9)	0 -	0 -	0 -	0 -	0 -	0 -
Aristida stricta	3.1 (5.0)	7.0 (6.3)	0.6 (1.1)	4.4 (4.4)	2.8 (3.5)	5.4 (4.9)	1.2 (1.7)	2.2 (2.3)	0.6 (1.1)	3.1 (3.1)	2.0 (2.4)	3.8 (3.5)
Befaria racemosa	0.8 (1.4)	1.3 (1.4)	0.6 (1.3)	0.2 (0.3)	0.4 (0.4)	0.1 (0.3)	1.5 (2.0)	1.2 (1.4)	1.8 (2.4)	0.3 (0.5)	0.3 (0.7)	0.2 (0.5)
Hypericum reductum	0 -	0 -	0 -	0.1 (0.3)	0 -	0.2 (0.4)	0 -	0 -	0 -	0.1 (0.3)	0 -	0.2 (0.4)
Ilex glabra	0.7 (2.1)	0 -	1.1 (2.7)	0.2 (0.6)	0 -	0.3 (0.8)	2.7 (5.8)	0 -	4.6 7.1	0.1 (0.2)	0 -	0.1 0.3
Lyonia fruticosa	1.0 (1.3)	2.0 (1.4)	0.3 (0.7)	0.7 (1.5)	0.3 (0.3)	1.0 (1.9)	2.3 (2.9)	3.1 (3.1)	1.8 (2.9)	0.5 (0.5)	0.6 (0.7)	0.4 (0.5)
Lyonia lucida	15.0 (8.0)	18.5 (7.8)	12.6 (7.9)	4.7 (3.7)	7.3 (4.8)	3.1 (1.8)	14.1 (9.3)	15.7 (7.8)	13.1 (10.7)	1.4 (1.1)	1.3 (0.3)	1.5 (1.5)
Myrica cerifera	0.5 (1.7)	0 -	0.9 (2.1)	2.5 (2.5)	2.5 (1.3)	2.5 (3.2)	1.2 (2.2)	0.5 (0.6)	1.7 (2.9)	1.0 (1.4)	1.2 (1.1)	0.9 (1.6)
Persea borbonia	0.1 (0.4)	0 -	0.2 (0.5)	0 -	0 -	0 -	0.4 (1.3)	0 -	0.7 (1.6)	0 -	0 -	0 -
Pteridium aquilinum	0.07 (0.2)	0 -	0.1 (0.3)	1.7 (2.6)	1.5 (2.5)	1.8 (2.8)	0 -	0 -	0 -	0 -	0 -	0 -
Quercus chapmanii	4.6 (5.8)	10.7 (4.4)	0.6 (1.0)	1.0 (2.0)	2.2 (2.8)	0.2 (0.4)	4.1 (4.0)	8.3 (2.0)	1.3 (1.7)	1.2 (1.6)	1.8 (0.6)	0.8 (1.9)
Quercus geminata	9.7 (16.7)	17.5 (24.4)	4.5 (7.9)	2.3 (2.5)	1.7 (1.1)	2.8 (3.1)	11.5 (16.5)	14.9 (21.2)	9.2 (14.2)	1.1 (1.6)	1.1 (1.1)	1.1 (2.0)
Quercus myrtifolia	16.2 (15.9)	33.6 (5.8)	4.6 (5.4)	6.6 (7.0)	7.4 (3.7)	6.1 (8.9)	26.5 (20.5)	39.8 (6.6)	17.7 (22.2)	2.2 (2.3)	2.7 (1.5)	1.9 (2.9)

Table I-1. (Continued)

Species	1983 > 0.5m All N=10	1983 > 0.5m Stand 1 N=4	1983 > 0.5m Stand 2 N=6	1983 < 0.5m All N=10	1983 < 0.5m Stand 1 N=4	1983 < 0.5m Stand 2 N=6	1985 > 0.5m All N=10	1985 > 0.5m Stand 1 N=4	1985 > 0.5m Stand 2 N=6	1985 < 0.5m All N=10	1985 < 0.5m Stand 1 N=4	1985 < 0.5m Stand 2 N=6
Serenoa repens	41.4 (18.5)	32.9 (13.5)	47.1 (20.3)	1.0 (1.6)	1.5 (2.2)	0.7 (1.2)	39.9 (21.7)	28.7 (15.9)	47.3 (22.9)	0.3 (0.5)	0.7 (0.8)	0 -
Smilax auriculata	0.3 (1.0)	0.8 (1.7)	0 -	0.07 (0.2)	0.2 (0.4)	0 -	0 -	0 -	0 -	0.1 (0.2)	0.2 (0.4)	0 -
Vaccinium myrsinites	0 -	0 -	0 -	1.4 (1.5)	2.5 (1.7)	0.7 (0.8)	0 -	0 -	0 -	1.2 (1.6)	2.0 (1.8)	0.7 (1.3)
Total Cover	93.5 (32.6)	124.2 (17.7)	73.1 (21.7)	27.2 (11.0)	30.2 (8.2)	25.3 (12.9)	105.6 (12.5)	114.3 (13.5)	99.7 (8.3)	12.4 (5.8)	13.8 (4.7)	11.5 (6.7)
Height	106.2 (37.9) N=40	117.4 (35.4) N=16	98.7 (38.3) N=24				109.3 (36.5) N=40	118.8 (31.4) N=16	103.0 (39.0) N=24			
Max Height	175.1 (45.3) N=10	209.8 (40.5) N=4	152.0 (33.2) N=6				195.0 (49.2) N=10	207.5 (65.0) N=4	186.7 (40.2) N=6			
Species Richness	5.6 (2.0) N=10	7.0 (2.0) N=4	4.7 (1.5) N=6	7.1 (2.4) N=10	8.5 (1.3) N=4	6.2 (2.6) N=6	6.5 (2.2) N=10	7.3 (2.4) N=4	6.0 (2.1) N=6	5.7 (2.5) N=10	7.5 (1.0) N=4	4.5 (2.6) N=6
Species Richness (All Strata)	8.6 (2.1) N=10	10.0 (2.2) N=4	7.7 (1.6) N=6				8.0 (2.1) N=10	9.0 (1.4) N=4	7.3 (2.3) N=6			

Table I-2. Composition (Percent Cover) of Scrub Stands That Burned in December 1986 at 6 Months and 12 Months Postburn.

	6 Months Postburn						12 Months Postburn					
	>0.5m			<0.5m			>0.5m			<0.5m		
Species	All N=10	Stand 1 N=4	Stand 2 N=6	All N=10	Stand 1 N=4	Stand 2 N=6	All N=10	Stand 1 N=4	Stand 2 N=6	All N=10	Stand 1 N=4	Stand 2 N=6
Andropogon spp.	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0.1 (0.3)	0 -	0.2 (0.4)
Aristida stricta	0 -	0 -	0 -	2.3 (2.4)	2.5 (1.9)	2.2 (2.9)	0.2 (0.6)	0.5 (1.0)	0 -	4.1 (4.1)	3.3 (2.1)	4.6 (5.1)
Bare ground	0 -	0 -	0 -	19.6 (12.3)	21.6 (13.0)	18.3 (12.8)	0 -	0 -	0 -	13.5 (5.3)	12.9 (5.0)	13.8 (5.9)
Befaria racemosa	0 -	0 -	0 -	1.1 (1.9)	0.3 (0.5)	1.6 (2.3)	0.3 (0.6)	0.2 (0.4)	0.4 (0.7)	1.1 (2.4)	0.3 (0.3)	1.7 (3.0)
Carphephorus spp.	0 -	0 -	0 -	0.3 (0.8)	0.08 (0.2)	0.5 (1.1)	0 -	0 -	0 -	0.6 (1.1)	0.2 (0.2)	0.8 (1.5)
Drosera spp.	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0.03 (0.09)	0.08 (0.2)	0 -
Eupatorium rotundifolium	0.03 (0.09)	0 -	0.05 (0.1)	0.07 (0.2)	0 -	0.1 (0.3)	0 -	0 -	0 -	0.03 (0.09)	0 -	0.05 (0.1)
Galactia elliottii	0.5 (1.0)	0.8 (1.5)	0.2 (0.5)	1.3 (1.2)	2.0 (1.4)	0.8 (1.0)	0 -	0 -	0 -	0 -	0 -	0 -
Gaylussacia dumosa	0 -	0 -	0 -	0.5 (0.6)	1.0 (0.6)	0.2 (0.4)	0 -	0 -	0 -	0.7 (0.9)	1.3 (1.1)	0.4 (0.5)
Hypericum reductum	0 -	0 -	0 -	0.03 (0.09)	0 -	0.05 (0.1)	0 -	0 -	0 -	0.03 (0.09)	0 -	0.05 (0.1)
Ilex glabra	0 -	0 -	0 -	1.2 (2.5)	0 -	2.0 (3.1)	0.4 (1.2)	0 -	0.6 (1.5)	1.7 (3.6)	0 -	2.8 (4.4)

Table I-2. (Continued)

Species	6 Months Postburn						12 Months Postburn					
	>0.5m			<0.5m			>0.5m			<0.5m		
	All N=10	Stand 1 N=4	Stand 2 N=6	All N=10	Stand 1 N=4	Stand 2 N=6	All N=10	Stand 1 N=4	Stand 2 N=6	All N=10	Stand 1 N=4	Stand 2 N=6
Licania michauxii	0 -	0 -	0 -	0.03 (0.09)	0.08 (0.2)	0 -	0 -	0 -	0 -	0.03 (0.09)	0.08 (0.2)	0 -
Lyonia fruticosa	0.2 (0.5)	0 -	0.3 (0.7)	1.1 (1.8)	0.9 (0.7)	1.3 (2.4)	0.3 (0.4)	0.2 (0.4)	0.3 (0.5)	1.4 (1.9)	1.4 (1.3)	1.5 (2.3)
Lyonia lucida	0.8 (1.3)	0.5 (0.4)	1.0 (1.6)	9.2 (5.9)	9.3 (2.4)	9.2 (7.6)	2.4 (3.3)	1.2 (0.8)	3.3 (4.2)	11.3 (7.7)	10.3 (2.8)	11.9 (10.0)
Myrica cerifera	0.2 (0.4)	0.2 (0.3)	0.2 (0.4)	3.6 (4.0)	3.2 (2.8)	3.9 (4.9)	0.1 (0.4)	0 -	0.2 (0.5)	3.1 (3.5)	2.7 (1.6)	3.3 (4.6)
Panicum spp.	0 -	0 -	0 -	0.03 (0.09)	0 -	0.05 (0.1)	0 -	0 -	0 -	0.2 (0.4)	0 -	0.4 (0.4)
Persea borbonia	0 -	0 -	0 -	0 -	0 -	0 -	0.07 (0.2)	0 -	0.1 (0.3)	0 -	0 -	0 -
Pteridium aquilinum	0.3 (1.0)	0 -	0.6 (1.4)	5.4 (10.4)	1.1 (1.2)	8.3 (12.9)	0 -	0 -	0 -	0 -	0 -	0 -
Quercus chapmanii	0 -	0 -	0 -	3.4 (4.3)	7.9 (3.1)	0.4 (0.6)	0.7 (1.5)	1.7 (2.2)	0 -	2.7 (3.7)	6.2 (3.6)	0.5 (0.6)
Quercus geminata	2.0 (5.0)	3.9 (7.8)	0.8 (1.8)	7.5 (8.6)	5.8 (3.5)	8.6 (11.0)	3.0 (5.2)	4.5 (6.3)	2.0 (4.7)	5.6 (6.8)	4.6 (5.6)	6.3 (8.0)
Quercus myrtifolia	0.9 (2.0)	2.2 (2.9)	0 -	13.3 (10.9)	18.8 (5.5)	9.7 (12.5)	1.1 (2.3)	2.9 (3.0)	0 -	13.6 (11.3)	19.8 (4.2)	9.4 (13.0)
Rhus copallina	0 -	0 -	0 -	0.1 (0.3)	0 -	0.2 (0.4)	0 -	0 -	0 -	0 -	0 -	0 -

Table I-2. (Continued)

Species	6 Months Postburn						12 Months Postburn					
	>0.5m			<0.5m			>0.5m			<0.5m		
	All N=10	Stand 1 N=4	Stand 2 N=6	All N=10	Stand 1 N=4	Stand 2 N=6	All N=10	Stand 1 N=4	Stand 2 N=6	All N=10	Stand 1 N=4	Stand 2 N=6
Serenoa repens	24.2 (17.6)	13.3 (8.0)	31.4 (19.0)	1.0 (1.5)	0.6 (0.7)	1.3 (1.8)	37.9 (20.2)	27.0 (12.5)	45.1 (22.0)	1.4 (1.6)	0.6 (0.8)	1.9 (1.8)
Smilax auriculata	0.03 (0.09)	0.08 (0.2)	0 -	0.07 (0.2)	0.2 (0.4)	0 -	0 -	0 -	0 -	0.06 (0.1)	0.2 (0.2)	0 -
Vaccinium myrsinites	0 -	0 -	0 -	1.9 (1.9)	2.9 (2.6)	1.3 (1.0)	0 -	0 -	0 -	2.2 (1.5)	2.5 (1.8)	1.9 (1.3)
Vaccinium stamineum	0 -	0 -	0 -	0.07 (0.2)	0 -	0.1 (0.3)	0 -	0 -	0 -	0 -	0 -	0 -
Total Cover	29.0 (17.6)	21.0 (10.5)	34.4 (20.2)	53.6 (10.3)	56.3 (11.4)	51.8 (10.1)	46.5 (18.9)	38.1 (7.0)	52.1 (22.8)	49.9 (13.7)	53.2 (7.1)	47.7 (17.1)
Height	39.2 (24.5) N=39	34.1 (21.0) N=16	42.7 (26.5) N=23				57.6 (34.7) N=39	48.6 (29.6) N=16	63.9 (37.2) N=23			
Max Height	99.8 (11.7) N=10	108.0 (8.1) N=4	94.3 (10.8) N=6				112.8 (16.6) N=10	120.0 (5.0) N=4	108.0 (20.3) N=6			
Species Richness	2.8 (1.6) N=10	3.5 (2.4) N=4	2.3 (0.8) N=6	9.9 (2.9) N=10	11.3 (2.1) N=4	9.0 (3.2) N=6	3.8 (1.6) N=10	5.0 (1.6) N=4	3.0 (1.1) N=6	10.0 (2.9) N=10	11.3 (1.7) N=4	9.2 (3.3) N=6
Species Richness (All Strata)	10.4 (2.9) N=10	11.8 (2.2) N=4	9.5 (3.1) N=6				10.3 (2.7) N=10	11.5 (1.7) N=4	9.5 (3.1) N=6			

Table I-3. Composition (Percent Cover) of Scrub Stands That Burned In December 1986 at 18 Months and 24 Months Postburn.

Species	18 Months Postburn						24 Months Postburn					
	> 0.5m			< 0.5m			> 0.5m			< 0.5m		
	All N=10	Stand 1 N=4	Stand 2 N=6	All N=10	Stand 1 N=4	Stand 2 N=6	All N=10	Stand 1 N=4	Stand 2 N=6	All N=10	Stand 1 N=4	Stand 2 N=6
Andropogon spp.	0 -	0 -	0 -	0.1 (0.1)	0 -	0.1 (0.2)	0.1 (0.2)	0 -	0.1 (0.3)	0.2 (0.4)	0 -	0.4 (0.5)
Aristida stricta	1.0 (1.2)	1.7 (1.6)	0.6 (0.8)	3.3 (3.3)	2.8 (2.6)	3.7 (3.9)	2.1 (3.4)	2.0 (2.2)	2.2 (4.2)	3.4 (3.7)	4.7 (5.4)	2.6 (2.2)
Bare ground	0 -	0 -	0 -	5.0 (3.8)	5.8 (2.3)	4.5 (4.8)	0 -	0 -	0 -	4.0 (3.8)	5.3 (5.0)	3.1 (3.1)
Befaria racemosa	1.0 (2.3)	0.7 (0.9)	1.2 (3.0)	0.7 (1.2)	0.3 (0.5)	1.1 (1.4)	0.7 (1.0)	0.6 (1.0)	0.7 (1.2)	1.0 (1.7)	0.3 (0.5)	1.5 (2.2)
Carphephorus spp.	0 -	0 -	0 -	1.0 (1.9)	0.3 (0.3)	1.6 (2.4)	0 -	0 -	0 -	0.6 (0.8)	0.5 (1.0)	0.6 (0.7)
Drosera spp.	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0 -	0.03 (0.09)	0.08 (0.15)	0 -
Eupatorium rotundifolium	0 -	0 -	0 -	0.2 (0.6)	0 -	0.3 (0.8)	0 -	0 -	0 -	0 -	0 -	0 -
Galactia elliottii	1.0 (1.2)	1.7 (1.3)	0.5 (0.9)	1.8 (2.1)	2.8 (2.4)	1.1 (1.7)	0 -	0 -	0 -	0 -	0 -	0 -
Gaylussacia dumosa.	0 -	0 -	0 -	0.7 (1.1)	1.3 (1.6)	0.3 (0.6)	0 -	0 -	0 -	0.3 (0.5)	0 -	0.4 (0.7)
Hypericum reductum	0 -	0 -	0 -	0.1 (0.4)	0 -	0.2 (0.5)	0 -	0 -	0 -	0.1 (0.4)	0 -	0.2 (0.5)
Ilex glabra	0.6 (1.3)	0 -	1.0 (1.7)	1.6 (3.6)	0 -	2.6 (4.4)	1.7 (4.0)	0 -	2.9 (4.9)	1.0 (2.0)	0 -	1.6 (2.5)
Licania michauxii	0 -	0 -	0 -	0.03 (0.09)	0.08 (0.15)	0 -	0 -	0 -	0 -	0 -	0 -	0 -

Table I-3. (Continued)

Species	18 Months Postburn						24 Months Postburn					
		> 0.5m			< 0.5m			> 0.5m			< 0.5m	
	All N=10	Stand 1 N=4	Stand 2 N=6	All N=10	Stand 1 N=4	Stand 2 N=6	All N=10	Stand 1 N=4	Stand 2 N=6	All N=10	Stand 1 N=4	Stand 2 N=6
Lyonia fruticosa	0.5 (1.0)	0.7 (1.4)	0.4 (0.8)	1.2 (1.7)	1.2 (0.9)	1.2 (2.1)	0.9 (1.3)	0.9 (1.3)	1.0 (1.5)	1.2 (2.1)	1.4 (1.1)	1.1 (2.7)
Lyonia lucida	3.3 (2.7)	2.8 (2.0)	3.6 (3.2)	10.5 (4.9)	12.3 (1.4)	9.4 (6.2)	8.5 (6.5)	6.4 (2.5)	10.0 (8.1)	6.1 (3.6)	6.9 (2.3)	5.5 (4.4)
Myrica cerifera	1.4 (2.0)	1.8 (2.4)	1.1 (2.0)	3.2 (3.7)	2.3 (1.2)	3.9 (4.7)	1.5 (2.0)	1.9 (2.2)	1.3 (2.0)	3.3 (3.8)	2.9 (2.6)	3.6 (4.6)
Panicum spp.	0 -	0 -	0 -	0.4 (0.9)	0.08 (0.15)	0.7 (1.1)	0 -	0 -	0 -	1.9 (3.6)	0.08 (0.15)	3.2 (4.3)
Persea borbonia	0.2 (0.6)	0 -	0.3 (0.8)	0 -	0 -	0 -	0.1 (0.4)	0 -	0.2 (0.5)	0 -	0 -	0 -
Pteridium aquilinum	0.8 (2.5)	0.1 (0.2)	1.3 (3.3)	4.3 (7.4)	1.8 (2.5)	5.9 (9.3)	0 -	0 -	0 -	0 -	0 -	0 -
Quercus chapmanii	1.0 (1.3)	2.4 (0.7)	0 -	3.5 (4.1)	7.2 (4.1)	1.1 (1.5)	1.1 (2.0)	2.9 (2.4)	0 -	3.8 (4.3)	7.3 (4.5)	1.5 (2.0)
Quercus geminata	6.1 (9.5)	9.0 (13.7)	4.2 (6.4)	5.5 (7.5)	2.7 (2.7)	7.4 (9.3)	6.3 (9.6)	8.9 (13.2)	4.6 (7.4)	3.2 (5.5)	1.5 (1.7)	4.3 (7.0)
Quercus myrtifolia	6.1 (9.2)	12.9 (12.0)	1.6 (2.0)	15.9 (14.2)	20.5 (6.5)	12.8 (17.6)	7.7 (8.5)	13.3 (10.4)	3.9 (4.7)	14.2 (13.5)	18.4 (7.8)	11.4 (16.4)
Rhus copallina	0.1 (0.4)	0 -	0.2 (0.5)	0.1 (0.2)	0 -	0.1 (0.3)	0 -	0 -	0 -	0 -	0 -	0 -

Table I-3. (Continued)

Species	18 Months Postburn					
		> 0.5m			< 0.5m	
	All N=10	Stand 1 N=4	Stand 2 N=6	All N=10	Stand 1 N=4	Stand 2 N=6
Serenoa repens	40.2 (19.0)	32.7 (18.0)	45.2 (19.5)	0.6 (0.9)	0.6 (0.7)	0.6 (1.1)
Seymeria pectinata	0 -	0 -	0 -	0.5 (1.0)	0 -	0.8 (1.3)
Smilax auriculata	0 -	0 -	0 -	0.1 (0.2)	0.2 (0.4)	0 -
Unknown herb	0 -	0 -	0 -	0.03 (0.09)	0 -	0.05 (0.1)
Vaccinium myrsinites	0 -	0 -	0 -	2.4 (2.1)	3.2 (2.5)	1.9 (1.8)
Vaccinium stamineum	0 -	0 -	0 -	0.1 (0.4)	0 -	0.2 (0.5)
Total Cover	63.3 (16.3)	66.3 (10.5)	61.3 (20.0)	57.8 (12.2)	59.2 (15.2)	56.8 (11.2)
Height	65.6 (34.4) (N=39)	66.4 (31.6) (N=16)	65.1 (36.9) (N=23)			
Max Height	120.8 (13.9) (N=10)	122.0 (5.0) (N=4)	120.0 (18.2) (N=6)			
Species Richness	6.5 (1.6) (N=10)	7.5 (1.3) (N=4)	5.8 (1.5) (N=6)	10.6 (2.3) (N=10)	11.0 (2.4) (N=4)	10.3 (2.4) (N=6)
Species Richness (All Strata)	11.4 (2.4) (N=10)	11.8 (2.6) (N=4)	11.2 (2.4) (N=6)			

Species	24 Months Postburn					
		> 0.5m			< 0.5m	
	All N=10	Stand 1 N=4	Stand 2 N=6	All N=10	Stand 1 N=4	Stand 2 N=6
Serenoa repens	38.2 (19.7)	31.4 (17.7)	42.8 (21.1)	1.4 (2.7)	0.5 (1.0)	2.0 (3.4)
Seymeria pectinata	0 -	0 -	0 -	0 -	0 -	0 -
Smilax auriculata	0.03 (0.09)	0.08 (0.15)	0 -	0 -	0 -	0 -
Unknown herb	0 -	0 -	0 -	0 -	0 -	0 -
Vaccinium myrsinites	0 -	0 -	0 -	2.7 (1.8)	3.3 (2.3)	2.3 (1.4)
Vaccinium stamineum	0 -	0 -	0 -	0 -	0 -	0 -
Total Cover	69.0 (19.6)	68.2 (13.1)	69.6 (24.2)	44.4 (13.7)	47.7 (17.9)	42.2 (11.6)
Height	67.1 (32.4) (N=39)	59.8 (29.6) (N=16)	72.2 (33.9) (N=23)			
Max Height	120.4 (14.5) (N=10)	117.5 (8.3) (N=4)	122.3 (18.1) (N=6)			
Species Richness	6.1 (1.8) (N=10)	7.0 (1.8) (N=4)	5.5 (1.6) (N=6)	8.5 (2.4) (N=10)	8.3 (2.4) (N=4)	8.7 (2.7) (N=6)
Species Richness (All Strata)	9.8 (2.4) (N=10)	9.5 (2.4) (N=4)	10.0 (2.7) (N=6)			

Table I-4. Composition (Percent Cover) of Scrub Stands That Burned In December 1986 at 36 Months Postburn.

Species	36 Months Postburn					
	> 0.5m			< 0.5m		
	All N=10	Stand 1 N=4	Stand 2 N=6	All N=10	Stand 1 N=4	Stand 2 N=6
Andropogon spp.	0 -	0 -	0 -	0.2 (0.4)	0 -	0.3 (0.5)
Aristida stricta	6.9 (10.7)	11.6 (16.2)	3.7 (4.5)	7.5 (6.7)	4.7 (2.3)	9.4 (8.1)
Bare ground	0 -	0 -	0 -	0.6 (0.8)	0.8 (1.1)	0.4 (0.7)
Befaria racemosa	1.9 (2.9)	1.2 (1.4)	2.5 (3.7)	0.9 (2.0)	0 -	1.4 (2.5)
Carphephorus spp.	0 -	0 -	0 -	0.6 (1.2)	0.8 (1.7)	0.4 (0.9)
Drosera spp.	0 -	0 -	0 -	0.03 (0.09)	0.08 (0.15)	0 -
Gaylussacia dumosa.	0 -	0 -	0 -	0.5 (0.7)	0.9 (1.0)	0.2 (0.2)
Hypericum reductum	0 -	0 -	0 -	0.1 (0.3)	0 -	0.2 (0.4)
Ilex glabra	2.9 (6.0)	0 -	4.8 (7.4)	0.6 (1.4)	0 -	1.1 (1.8)
Lyonia fruticosa	1.5 (2.4)	1.5 (1.9)	1.5 (2.8)	1.2 (1.6)	1.8 (1.7)	0.9 (1.6)
Lyonia lucida	12.5 (7.3)	9.8 (5.5)	14.4 (8.2)	6.0 (3.4)	6.7 (1.5)	5.5 (4.3)

Table I-4. (Continued)

Species	36 Months Postburn					
	> 0.5m			< 0.5m		
	All N=10	Stand 1 N=4	Stand 2 N=6	All N=10	Stand 1 N=4	Stand 2 N=6
Myrica cerifera	2.6 (3.5)	1.9 (2.8)	3.1 (4.1)	4.5 (4.6)	5.9 (1.1)	3.6 (5.9)
Panicum spp.	0 -	0 -	0 -	0.7 (1.0)	0 -	1.2 (1.0)
Persea borbonia	0.3 (0.9)	0 -	0.5 (1.1)	0 -	0 -	0 -
Quercus chapmanii	2.5 (3.6)	6.0 (0.2)	3.4 (0.4)	3.1 (3.2)	5.7 (2.2)	1.4 (2.7)
Quercus geminata	9.1 (14.3)	13.6 (20.4)	6.1 (9.5)	4.2 (6.5)	2.1 (2.9)	5.6 (8.0)
Quercus myrtifolia	13.9 (14.0)	22.9 (15.1)	7.9 (10.4)	12.3 (15.5)	16.3 (4.9)	9.7 (20.0)
Serenoa repens	36.3 (22.3)	26.5 (11.3)	42.8 (26.2)	1.5 (1.6)	1.3 (1.9)	1.7 (1.6)
Vaccinium myrsinites	0.1 (0.3)	0.3 (0.5)	0 -	3.3 (2.9)	5.0 (3.5)	2.2 (1.8)
Total Cover	90.5 (32.8)	95.2 (45.1)	87.3 (26.3)	47.2 (18.0)	51.1 (10.1)	44.6 (22.4)
Height (cm)	76.5 (33.3) N=39	75.9 (33.1) N=16	77.0 (34.2) N=23			
Max Height	122.6 (16.4) N=10	125.8 (14.7) N=4	120.5 (18.5) N=6			
Species Richness	6.3 (1.9) N=10	7.3 (1.7) N=4	5.7 (1.9) N=6	9.2 (2.5) N=10	9.3 (1.3) N=4	9.2 (3.2) N=6
Species Richness (All Strata)	9.9 (2.2) N=10	10.3 (1.7) (N=4)	9.7 (2.6) (N=6)			

Appendix II

Chemical Characteristics of Scrub Soils Before and After the December 1986 Fire

Table II-1. Chemical Characteristics of Well Drained Soils Where the Vegetation Burned In December 1986 Before and After the Fire.

Parameter	Horizon[1]	Preburn (Jan.1983)	Postburn	6 Months Postburn	12 Months Postburn	18 Months Postburn	24 Months Postburn
		$\bar{x}$ (sd) N=17	$\bar{x}$ (sd) N=8	$\bar{x}$ (sd) N=8	$\bar{x}$ (sd) N=8	$\bar{x}$ (sd) N=8	$\bar{x}$ (sd) N=8
Hydrogen Ion	a	13.2015E-5 (7.0990E-5)	14.4853E-5 (5.2640E-5)	8.2483E-5 (2.3940E-5)	6.9061E-5 (2.2114E-5)	12.3003E-5 (3.9666E-5)	13.7174E-5 (3.5048E-5)
	b	5.4776E-5 (3.2072E-5)	7.6673E-5 (4.0251E-5)	5.4298E-5 (1.8437E-5)	4.4649E-5 (2.7787E-5)	7.1328E-5 (2.1513E-5)	7.7847E-5 (2.7462E-5)
pH	a	3.88	3.84	4.08	4.16	3.91	3.86
	b	4.26	4.12	4.27	4.35	4.15	4.11
Conductivity (umhos/cm)	a	69 (18)	69 (15)	65 (15)	37 (5)	64 (8)	77 (21)
	b	31 (13)	41 (14)	39 (8)	24 (5)	38 (13)	41 (17)
Organic Matter (%)	a	5.6 (3.0)	4.3 (1.5)	5.2 (1.3)	3.4 (0.5)	6.2 (4.3)	4.4 (1.5)
	b	1.3 (1.2)	1.4 (0.6)	1.4 (0.6)	1.1 (0.2)	1.5 (1.0)	1.0 (0.1)

Table II-1. (Continued)

Parameter	Horizon[1]	Preburn (Jan.1983)	Postburn	6 Months Postburn	12 Months Postburn	18 Months Postburn	24 Months Postburn
		$\bar{x}$ (sd) N=17	$\bar{x}$ (sd) N=8	$\bar{x}$ (sd) N=8	$\bar{x}$ (sd) N=8	$\bar{x}$ (sd) N=8	$\bar{x}$ (sd) N=8
Phosphorus PO4-P (mg/kg)	a	4.72 (1.98)	3.94 (1.24)	4.00 (1.33)	1.63 (0.80)	3.95 (0.91)	2.42 (0.78)
	b	1.45 (1.26)	1.64 (0.79)	1.88 (0.45)	0.66 (0.58)	1.29 (1.08)	1.14 (0.87)
Calcium (mg/kg)	a	148.49 (131.87)	158.37 (60.51)	240.18 (113.63)	144.78 (24.54)	133.73 (98.88)	129.30 (46.26)
	b	34.48 (22.13)	57.81 (20.20)	81.80 (38.58)	30.67 (12.56)	33.33 (19.30)	27.45 (5.33)
Magnesium (mg/kg)	a	45.73 (26.68)	77.77 (52.98)	71.32 (36.60)	38.98 (16.28)	70.84 (34.50)	55.25 (21.16)
	b	10.84 (11.83)	14.51 (15.46)	15.61 (13.81)	6.05 (11.90)	12.48 (7.67)	12.74 (6.79)
Potassium (mg/kg)	a	37.86 (11.64)	39.41 (5.95)	43.65 (12.70)	19.73 (6.95)	62.58 (16.33)	69.36 (18.05)
	b	14.18 (10.53)	8.13 (3.88)	13.45 (3.65)	7.81 (4.31)	30.76 (13.32)	29.70 (10.53)

Table II-1. (Continued)

Parameter	Horizon[1]	Preburn (Jan.1983)	Postburn	6 Months Postburn	12 Months Postburn	18 Months Postburn	24 Months Postburn
		$\bar{x}$ (sd) N=17	$\bar{x}$ (sd) N=8	$\bar{x}$ (sd) N=8	$\bar{x}$ (sd) N=8	$\bar{x}$ (sd) N=8	$\bar{x}$ (sd) N=8
Sodium (mg/kg)	a	23.85 (5.58)	31.10 (6.88)	30.62 (7.89)	21.45 (3.76)	35.04 (8.28)	49.13 (11.89)
	b	15.01 (5.00)	22.03 (6.09)	23.28 (6.64)	18.79 (3.78)	23.30 (6.17)	38.79 (9.96)
Nitrate - nitrogen (mg/kg)	a	0.70 (0.23)	0.16 (0.09)	0.12 (0.06)	0.77 (0.11)	1.70 (0.44)	1.55 (0.18)
	b	0.65 (0.27)	0.14 (0.06)	0.27 (0.58)	0.90 (0.22)	1.54 (0.31)	1.42 (0.33)
Ammonium - nitrogen (mg/kg)	a	11.96 (3.93)	5.97 (2.22)	5.24 (2.23)	1.32 (0.29)	34.06 (10.45)	9.61 (1.43)
	b	3.62 (2.35)	2.54 (1.21)	1.94 (0.57)	0.94 (0.14)	15.83 (5.89)	5.74 (1.44)
Aluminum (mg/kg)	a	5.7 (4.0)	10.8 (4.9)	6.3 (1.6)	5.8 (1.7)	32.0 (13.7)	23.9 (5.5)
	b	4.9 (6.4)	3.8 (2.2)	2.9 (1.3)	2.0 (1.1)	8.0 (2.4)	8.4 (0.9)

Table II-1. (Continued)

Parameter	Horizon[1]	Preburn (Jan.1983)	Postburn	6 Months Postburn	12 Months Postburn	18 Months Postburn	24 Months Postburn
		$\bar{x}$ (sd) N=17	$\bar{x}$ (sd) N=8	$\bar{x}$ (sd) N=8	$\bar{x}$ (sd) N=8	$\bar{x}$ (sd) N=8	$\bar{x}$ (sd) N=8
Copper (mg/kg)	a	0.12 (0.03)	0.14 (0.05)	0.09 (0.03)	0.13 (0.04)	0.30 (0.08)	0.27 (0.10)
	b	0.09 (0.04)	0.15 (0.14)	0.06 (0.02)	0.09 (0.05)	0.22 (0.06)	0.17 (0.03)
Iron (mg/kg)	a	21.46 (11.23)	25.04 (13.89)	20.01 (8.19)	13.25 (4.78)	20.49 (7.47)	22.06 (7.66)
	b	10.68 (15.00)	7.20 (4.20)	6.48 (3.40)	3.82 (1.55)	4.12 (1.95)	5.41 (1.92)
Manganese (mg/kg)	a	1.54 (2.06)	0.54 (0.30)	1.10 (0.71)	0.89 (0.53)	0.90 (0.41)	1.29 (0.81)
	b	0.18 (0.18)	0.11 (0.05)	0.31 (0.26)	0.09 (0.03)	0.11 (0.08)	0.08 (0.0)
Zinc (mg/kg)	a	0.656 (0.388)	0.430 (0.118)	0.671 (0.331)	0.404 (0.066)	0.681 (0.182)	0.602 (0.204)
	b	0.191 (0.190)	0.147 (0.042)	0.199 (0.076)	0.261 (0.270)	0.293 (0.153)	0.203 (0.062)

[1] a = 0-15 cm, b = 15-30 cm depth

Table II-2. Chemical Characteristics of Poorly Drained Soils Where the Vegetation Burned in December 1986 Before and After the Fire.

Parameter	Horizon[1]	Preburn (Jan. 1983) $\bar{x}$ (sd) N=4	Postburn $\bar{x}$ (sd) N=2	6 Months Postburn $\bar{x}$ (sd) N=2	12 Months Postburn $\bar{x}$ (sd) N=2	18 Months Postburn $\bar{x}$ (sd) N=2	24 Months Postburn $\bar{x}$ (sd) N=2
Hydrogen Ion	a	16.0761E-5 (7.3796E-5)	13.8624E-5 (1.8005E-5)	12.6994E-5 (4.4541E-5)	8.6948E-5 (2.5123E-5)	14.7540E-5 (9.3701E-5)	8.6948E-5 (2.5123E-5)
	b	8.9878E-5 (3.5907E-5)	11.3870E-5 (1.2950E-5)	7.5831E-5 (1.5932E-5)	8.6791E-5 (1.5462E-5)	12.3549E-5 (1.6047E-5)	13.0056E-5 (2.5250E-5)
pH	a	3.79	3.86	3.90	4.06	3.83	4.06
	b	4.05	3.94	4.12	4.06	3.91	3.89
Conductivity (umhos/cm)	a	131 (32)	118 (9)	102 (33)	71 (9)	111 (7)	97 (16)
	b	55 (16)	91 (33)	58 (6)	57 (23)	83 (4)	94 (28)
Organic Matter (%)	a	15.3 (4.4)	20.5 (5.4)	12.5 (2.3)	19.0 (3.1)	21.6 (20.9)	14.1 (2.1)
	b	5.4 (5.6)	7.4 (3.0)	4.1 (0.9)	2.3 (0.1)	3.4 (1.5)	2.8 (0.1)

Table II-2. (Continued)

Parameter	Horizon[1]	Preburn (Jan. 1983)	Postburn	6 Months Postburn	12 Months Postburn	18 Months Postburn	24 Months Postburn
		$\bar{x}$ (sd) N=4	$\bar{x}$ (sd) N=2	$\bar{x}$ (sd) N=2	$\bar{x}$ (sd) N=2	$\bar{x}$ (sd) N=2	$\bar{x}$ (sd) N=8
Phosphorus (mg/kg)	a	19.00 (4.85)	20.75 (1.63)	11.34 (1.19)	1.87 (1.89)	16.24 (3.28)	6.43 (2.48)
	b	4.13 (1.09)	7.02 (3.56)	3.53 (0.75)	2.09 (1.40)	2.85 (0.26)	3.99 (0.30)
Calcium (mg/kg)	a	222.10 (71.42)	805.86 (311.75)	367.33 (117.49)	419.49 (54.57)	375.00 (110.31)	434.10 (139.58)
	b	62.10 (15.53)	309.91 (65.62)	130.22 (30.00)	67.67 (20.27)	60.45 (15.91)	65.40 (26.30)
Magnesium (mg/kg)	a	118.06 (41.84)	359.56 (28.73)	208.80 (0.84)	199.19 (21.97)	202.35 (52.40)	251.67 (76.66)
	b	39.22 (12.52)	157.65 (13.38)	73.89 (12.91)	35.83 (8.12)	47.87 (13.81)	49.92 (12.13)
Potassium (mg/kg)	a	106.10 (51.66)	109.10 (1.27)	63.20 (7.92)	49.60 (20.65)	117.99 (13.28)	123.87 (22.61)
	b	24.70 (4.28)	40.20 (8.20)	34.80 (0.28)	17.60 (0.28)	44.48 (14.57)	43.86 (1.53)

Table II-2. (Continued)

Parameter	Horizon[1]	Preburn (Jan. 1983) $\bar{x}$ (sd) N=4	Postburn $\bar{x}$ (sd) N=2	6 Months Postburn $\bar{x}$ (sd) N=2	12 Months Postburn $\bar{x}$ (sd) N=2	18 Months Postburn $\bar{x}$ (sd) N=2	24 Months Postburn $\bar{x}$ (sd) N=2
Sodium (mg/kg)	a	65.03 (15.84)	85.28 (14.81)	46.85 (3.32)	45.10 (8.91)	81.30 (4.79)	110.95 (10.22)
	b	30.82 (9.90)	61.70 (3.25)	45.00 (5.80)	48.50 (3.54)	56.69 (8.92)	71.70 (3.92)
Nitrate - nitrogen (mg/kg)	a	0.77 (0.25)	0.27 (0.06)	0.25 (0.01)	1.05 (0.08)	1.89 (0.12)	1.45 (0.18)
	b	0.48 (0.08)	0.19 (0.02)	0.15 (0.06)	0.87 (0.10)	1.77 (0.08)	1.19 (0.11)
Ammonium - nitrogen (mg/kg)	a	48.35 (23.67)	12.03 (1.66)	8.09 (0.10)	2.60 (0.45)	53.43 (2.22)	16.59 (0.26)
	b	6.13 (1.23)	5.93 (1.15)	6.91 (0.09)	1.50 (0.43)	23.78 (13.31)	5.98 (0.17)
Aluminum (mg/kg)	a	15.8 (6.9)	8.4 (1.4)	12.9 (5.2)	5.9 (2.7)	86.3 (9.3)	52.4 (5.5)
	b	6.1 (2.4)	9.6 (2.0)	5.5 (0.1)	4.9 (0.7)	20.5 (2.1)	12.1 (1.4)

Table II-2. (Continued)

Parameter	Horizon[1]	Preburn (Jan. 1983)	Postburn	6 Months Postburn	12 Months Postburn	18 Months Postburn	24 Months Postburn
		$\bar{x}$ (sd) N=4	$\bar{x}$ (sd) N=2	$\bar{x}$ (sd) N=2	$\bar{x}$ (sd) N=2	$\bar{x}$ (sd) N=2	$\bar{x}$ (sd) N=2
Copper (mg/kg)	a	0.13 (0.04)	0.15 (0.01)	0.12 (0.03)	0.15 (0.04)	0.44 (0.28)	0.40 (0.11)
	b	0.10 (0.07)	0.12 (0.03)	0.11 (0.01)	0.09 (0.01)	0.36 (0.06)	0.20 (0.06)
Iron (mg/kg)	a	54.57 (36.42)	93.94 (7.67)	77.56 (5.43)	47.90 (5.54)	115.76 (36.77)	88.76 (6.05)
	b	14.40 (9.43)	45.78 (13.66)	18.94 (0.17)	15.67 (2.05)	25.14 (3.87)	23.52 (4.64)
Manganese (mg/kg)	a	1.03 (0.86)	0.53 (0.13)	0.47 (0.10)	1.49 (0.13)	1.92 (1.58)	1.32 (0.85)
	b	0.13 (0.14)	0.20 (0.06)	0.49 (0.44)	0.07 (0.04)	0.08 (0.0)	0.16 (0.11)
Zinc (mg/kg)	a	0.947 (0.692)	0.818 (0.218)	2.695 (3.042)	0.680 (0.201)	1.452 (0.481)	1.292 (0.130)
	b	0.165 (0.025)	0.287 (0.066)	0.208 (0.020)	0.211 (0.033)	0.986 (0.959)	0.272 (0.057)

[1] a = 0-15 cm, b = 15-30 cm depth

Table II-3. Chemical Characteristics of Well Drained Soils Where the Vegetation Remained Unburned Before and After the December 1986 Fire.

Parameter	Horizon[1]	Prefire (Jan. 1983)	6 Months Postfire	12 Months Postfire	24 Months Postfire
		$\bar{x}$ (sd) N=3	$\bar{x}$ (sd) N=2	$\bar{x}$ (sd) N=2	$\bar{x}$ (sd) N=2
Hydrogen Ion	a	9.9460E-5 (8.8048E-5)	9.4862E-5 (9.5204E-5)	6.5239E-5 (3.9720E-5)	10.1070E-5 (8.1203E-5)
	b	2.6654E-5 (1.0625E-5)	3.6449E-5 (2.2672E-5)	1.1787E-5 (3.7719E-6)	3.1538E-5 (1.5726E-5)
pH	a	4.00	4.02	4.19	4.00
	b	4.57	4.44	4.93	4.50
Conductivity (umhos/cm)	a	43 (19)	56 (25)	37 (15)	55 (17)
	b	16 (5)	32 (0)	27 (10)	26 (11)
Organic Matter (%)	a	1.4 (0.8)	2.6 (2.1)	2.4 (0.9)	3.7 (3.3)
	b	0.2 (0.1)	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)

Table II-3. (Continued)

Parameter	Horizon[1]	Prefire (Jan. 1983)	6 Months Postfire	12 Months Postfire	24 Months Postfire
		$\bar{x}$ (sd) N=3	$\bar{x}$ (sd) N=2	$\bar{x}$ (sd) N=2	$\bar{x}$ (sd) N=2
Phosphorus (mg/kg)	a	0.64 (0.07)	2.69 (1.97)	0.54 (0.74)	0.98 (0.79)
	b	0.09 (0.12)	0.93 (0.44)	0.02 (0.0)	0.10 (0.08)
Calcium (mg/kg)	a	70.53 (65.77)	124.40 (49.75)	93.22 (43.09)	49.80 (17.82)
	b	12.27 (3.00)	32.85 (14.64)	15.25 (3.20)	17.40 (3.39)
Magnesium (mg/kg)	a	13.65 (5.13)	16.99 (22.17)	12.93 (14.22)	16.71 (5.47)
	b	1.48 (1.43)	0.02 (0.0)	0.02 (0.0)	1.95 (0.89)
Potassium (mg/kg)	a	17.73 (2.72)	24.95 (19.02)	18.60 (11.60)	41.64 (3.73)
	b	5.47 (2.20)	8.30 (8.91)	5.55 (4.60)	17.58 (1.02)

Table II-3. (Continued)

Parameter	Horizon[1]	Prefire (Jan. 1983)	6 Months Postfire	12 Months Postfire	24 Months Postfire
		$\bar{x}$ (sd) N=3	$\bar{x}$ (sd) N=2	$\bar{x}$ (sd) N=2	$\bar{x}$ (sd) N=2
Sodium (mg/kg)	a	15.87 (1.55)	26.13 (6.40)	20.15 (6.29)	36.61 (4.02)
	b	10.70 (1.90)	16.10 (0.57)	17.88 (1.66)	25.64 (2.60)
Nitrate - nitrogen (mg/kg)	a	0.67 (0.12)	0.13 (0.04)	0.53 (0.50)	1.47 (0.04)
	b	0.78 (0.38)	0.15 (0.09)	0.54 (0.45)	1.32 (0.21)
Ammonium - nitrogen (mg/kg)	a	5.69 (1.17)	2.63 (1.54)	1.22 (0.35)	9.80 (3.08)
	b	1.76 (0.55)	1.20 (0.0)	0.89 (0.11)	4.56 (3.08)
Aluminum (mg/kg)	a	7.9 (7.9)	9.3 (9.8)	15.3 (16.3)	25.4 (10.3)
	b	2.7 (1.9)	4.5 (3.0)	15.7 (4.0)	12.1 (4.8)

Table II-3. (Continued)

Parameter	Horizon[1]	Prefire (Jan. 1983)	6 Months Postfire	12 Months Postfire	24 Months Postfire
		$\bar{x}$ (sd) N=3	$\bar{x}$ (sd) N=2	$\bar{x}$ (sd) N=2	$\bar{x}$ (sd) N=2
Copper (mg/kg)	a	0.11 (0.04)	0.10 (0.04)	0.08 (0.03)	0.16 (0.11)
	b	0.09 (0.08)	0.05 (0.01)	0.07 (0.03)	0.12 (0.06)
Iron (mg/kg)	a	16.08 (17.29)	14.36 (9.11)	20.83 (20.69)	12.96 (10.63)
	b	4.85 (5.09)	5.21 (2.70)	6.82 (7.00)	6.76 (5.94)
Manganese (mg/kg)	a	1.75 (2.59)	1.15 (0.91)	1.20 (1.33)	0.80 (0.57)
	b	0.08 (0.04)	0.11 (0.01)	0.06 (0.01)	0.08 (0.0)
Zinc (mg/kg)	a	0.441 (0.061)	0.404 (0.100)	0.349 (0.115)	0.532 (0.096)
	b	0.080 (0.030)	0.181 (0.018)	0.118 (0.034)	0.224 (0.068)

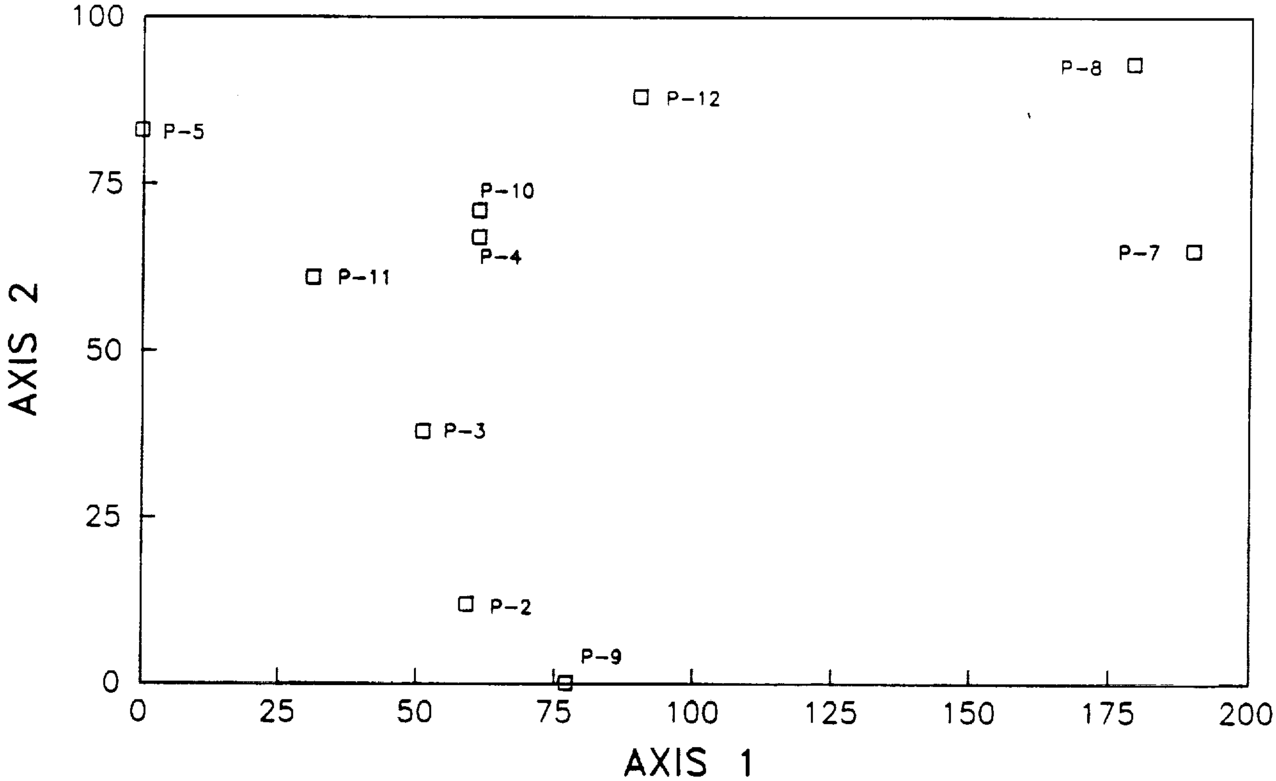
[1] a = 0-15 cm, b = 15-30 cm depth

Appendix III

Ordination, Community Structure, and Soil Chemistry Figures

Figure 1. Detrended correspondence analysis ordination of the > 0.5 m layer of scrub transects sampled in January 1985 that burned in December 1986. Sample ordination shows individual transects. Species shown are ARISTR (*Aristida stricta*), BEFRAC (*Befaria racemosa*), ILEGLA (*Ilex glabra*), LYOFRU (*Lyonia fruticosa*), LYOLUC (*Lyonia lucida*), MYRCER (*Myrica cerifera*), PERBOR (*Persea borbonia*), QUECHA (*Quercus chapmanii*), QUEGEM (*Quercus geminata*), QUEMYR (*Quercus myrtifolia*), and SERREP (*Serenoa repens*).

DCA ORDINATION PREBURN GREATER THAN 0.5 m



SPECIES

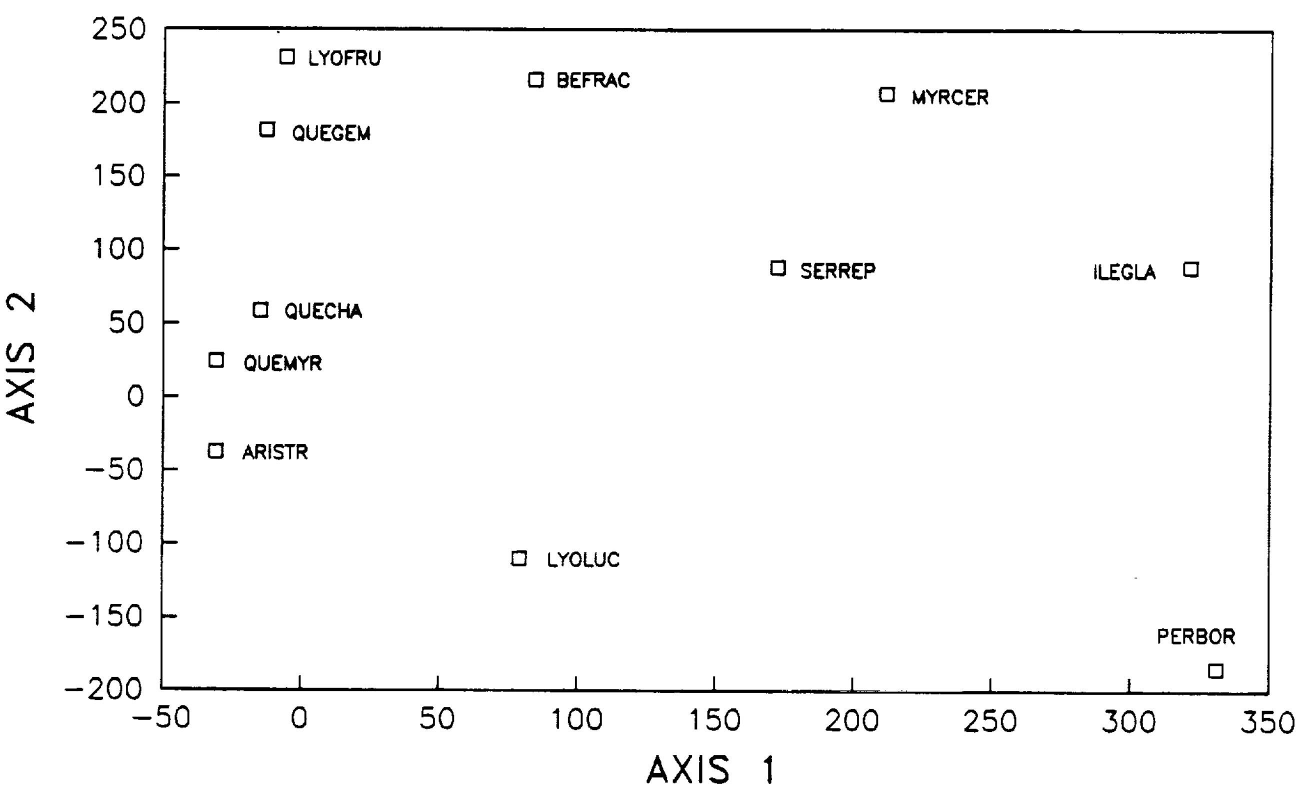
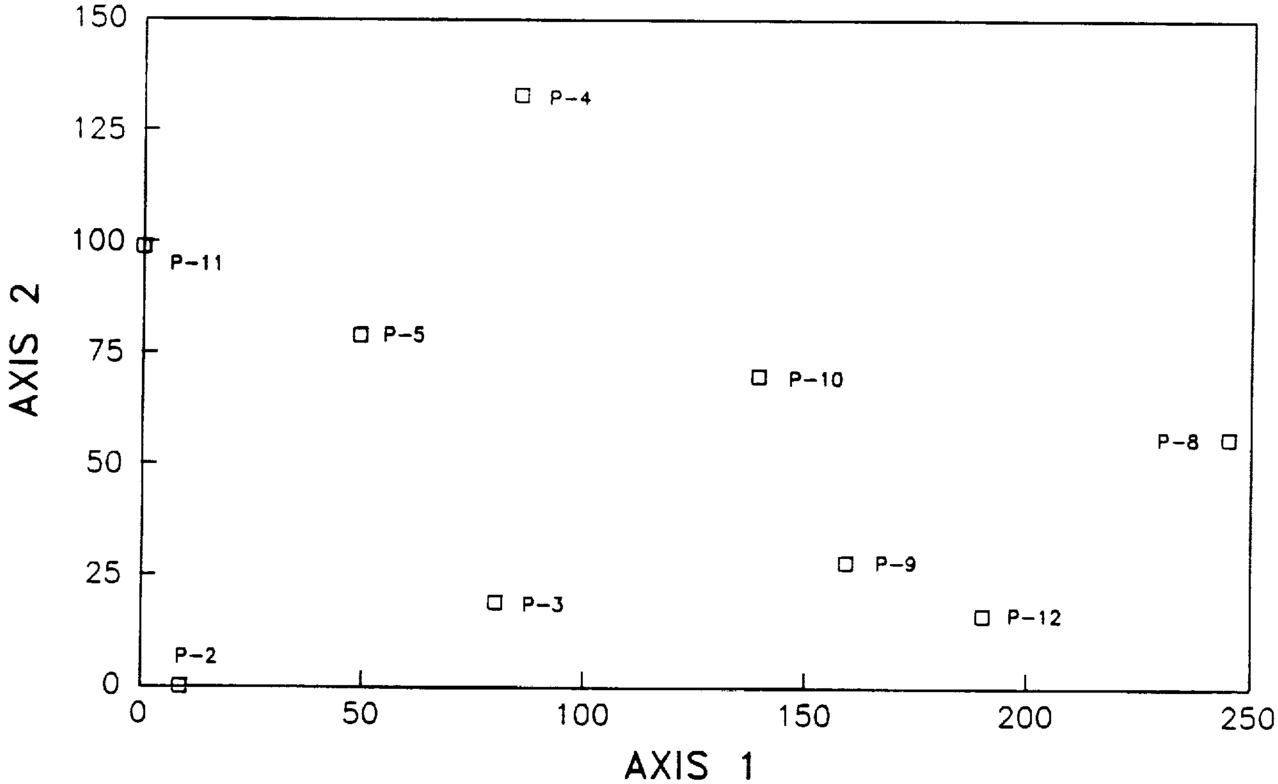


Figure 2. Detrended correspondence analysis ordination of the < 0.5 m layer of scrub transects sampled in January 1985 that burned in December 1986. Sample ordination shows individual transects. Species are as in Figure 1 with the addition of HYPRED (*Hypericum reductium*), SMIAUR (*Smilax auriculata*), and VACMYR (*Vaccinium myrsinites*).

DCA ORDINATION
PREBURN
LESS THAN 0.5 m



SPECIES

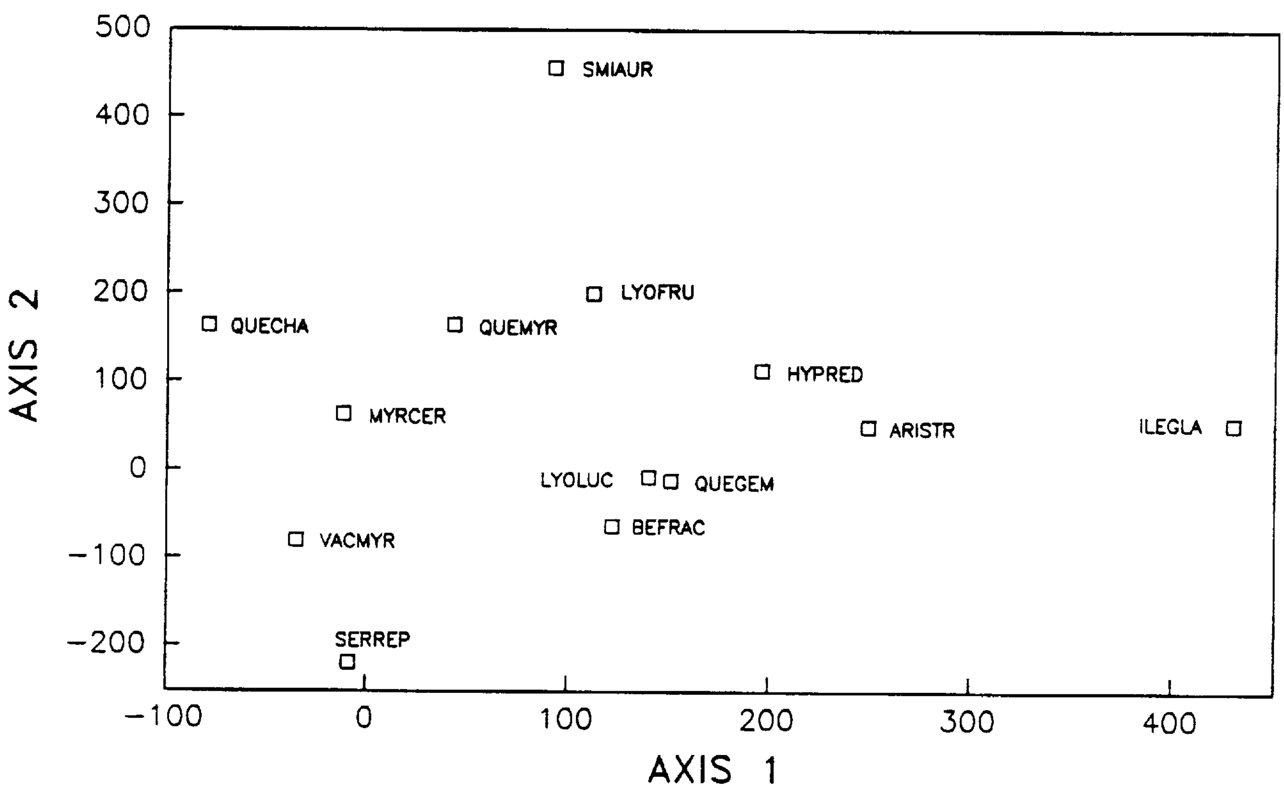
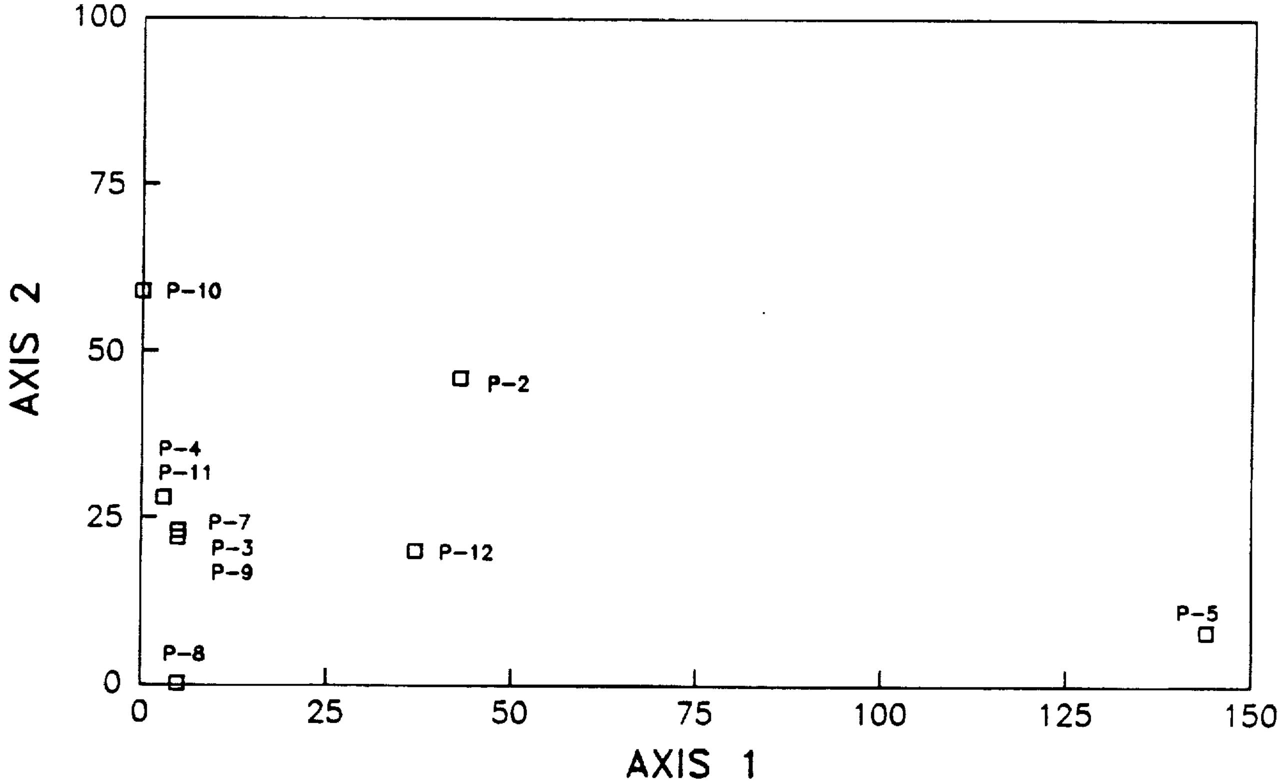


Figure 3. Detrended correspondence analysis ordination of the > 0.5 m layer of scrub transects that burned in December 1986 six months postburn. Species are as previously defined with the addition of EUPROT (*Eupatorium rotundifolium*), GALELL (*Galactia elliottii*), and PTEAQU (*Pteridium aquilinum*).

DCA ORDINATION
6 MONTHS POSTBURN
GREATER THAN 0.5 m



SPECIES

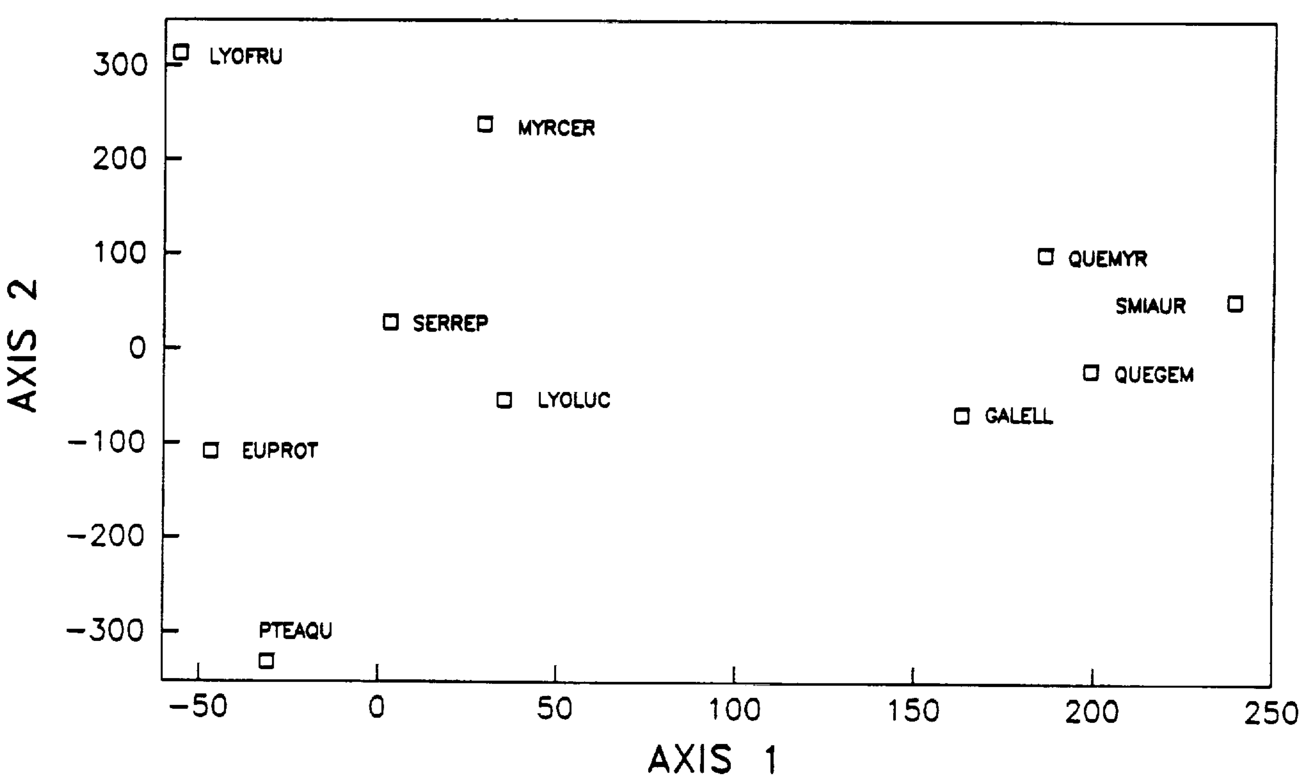
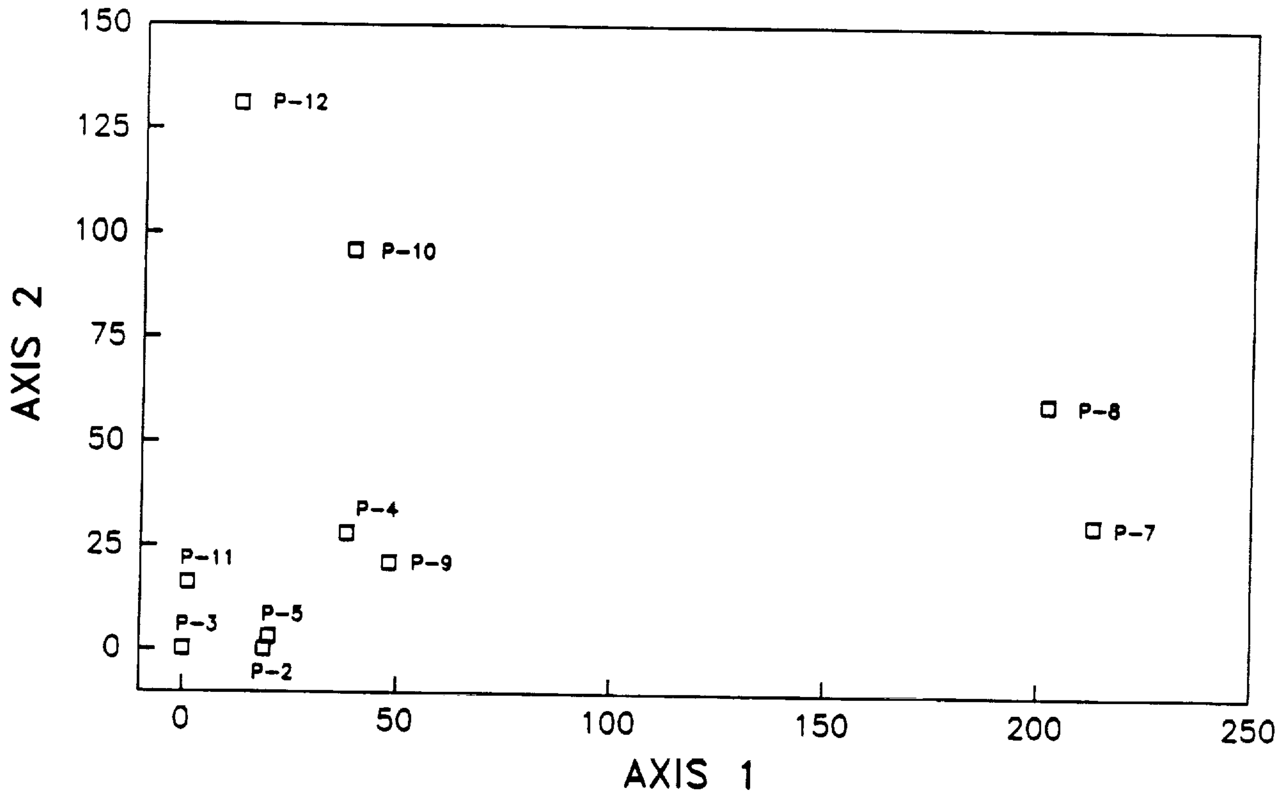


Figure 4. Detrended correspondence analysis ordination of the < 0.5 m layer of scrub transects that burned in December 1986 six months postburn. Species are as previously defined with the addition of BAREGR (Bare ground), CARSPP (*Carphephorus* spp.), GAYDUM (*Gaylussacia dumosa*), LICMIC (*Licania michauxii*), PANSPP (*Panicum* spp.), RHUCOP (*Rhus copallina*), and VACSTA (*Vaccinium stamineum*).

DCA ORDINATION
6 MONTHS POSTBURN
LESS THAN 0.5 m



SPECIES

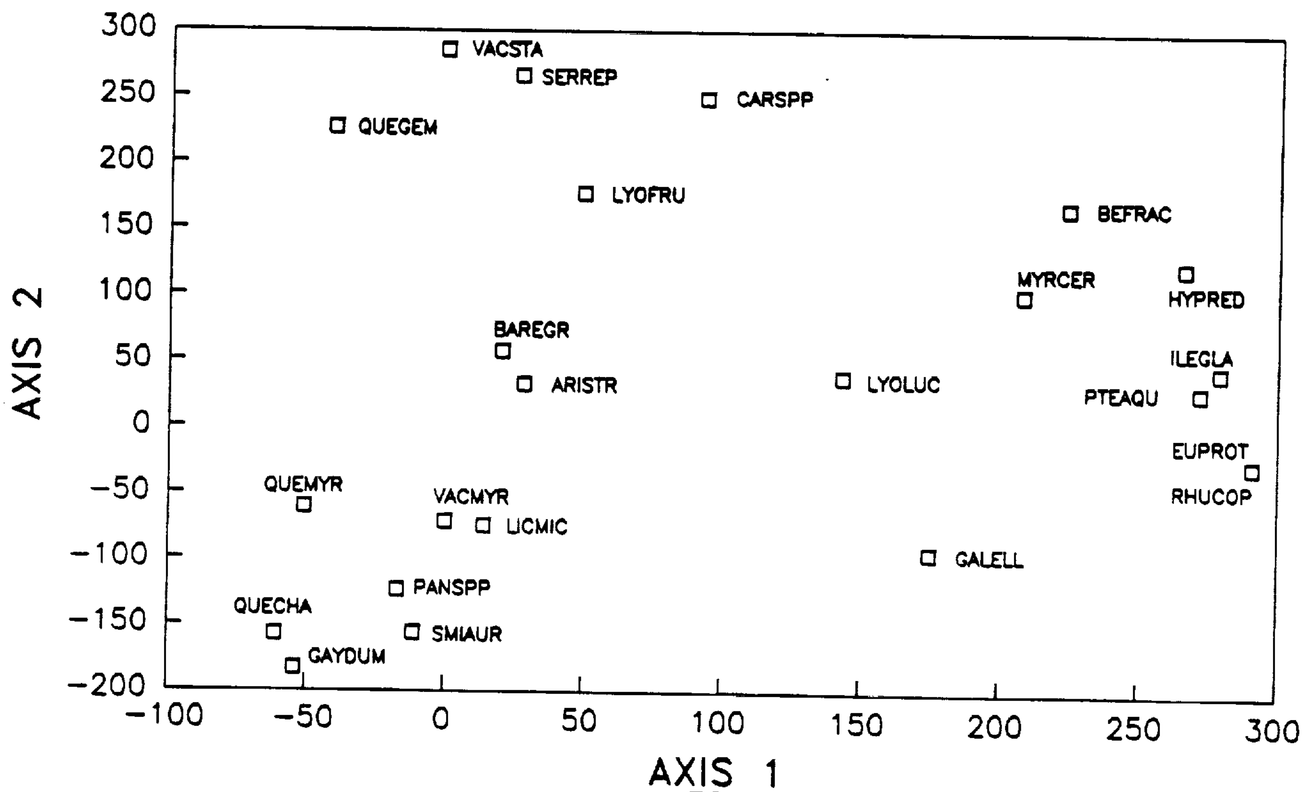
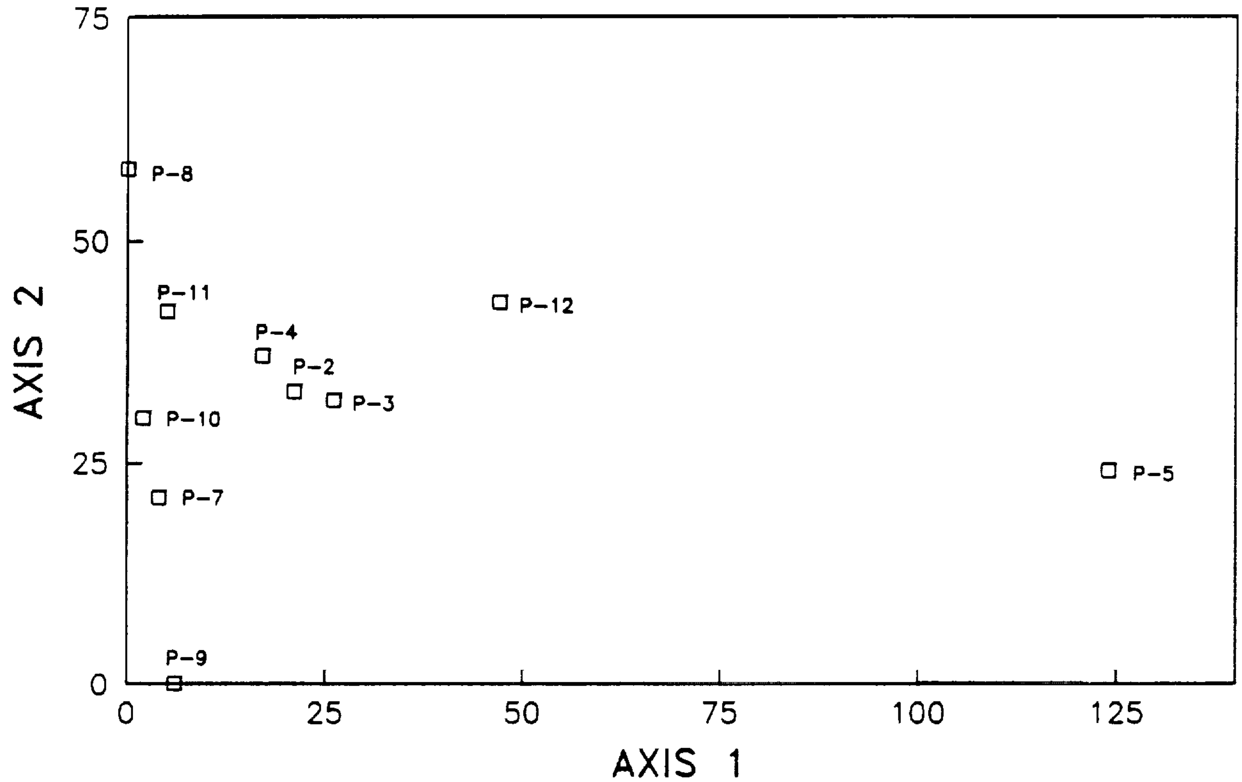


Figure 5. Detrended correspondence analysis ordination of the > 0.5 m layer of scrub transects that burned in December 1986 12 months postburn. Species are as previously defined.

DCA ORDINATION
12 MONTHS POSTBURN
GREATER THAN 0.5 m



SPECIES

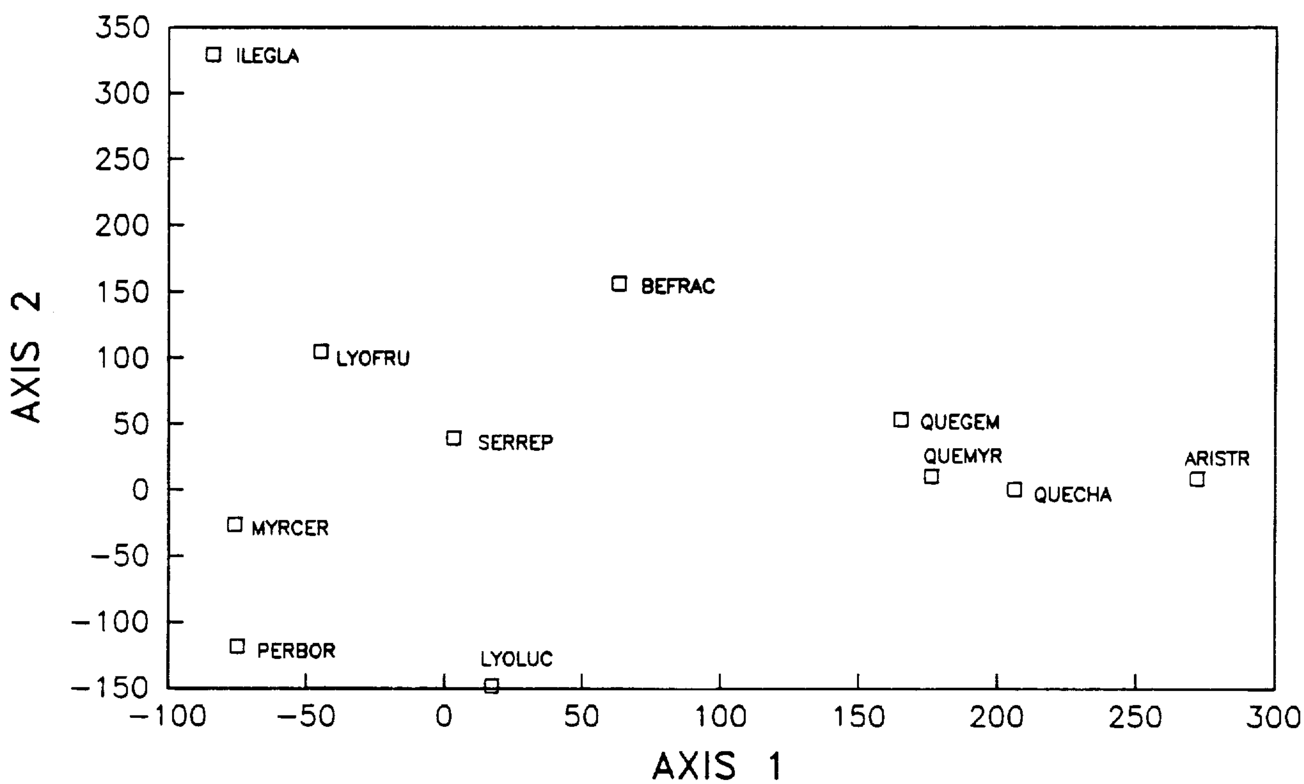
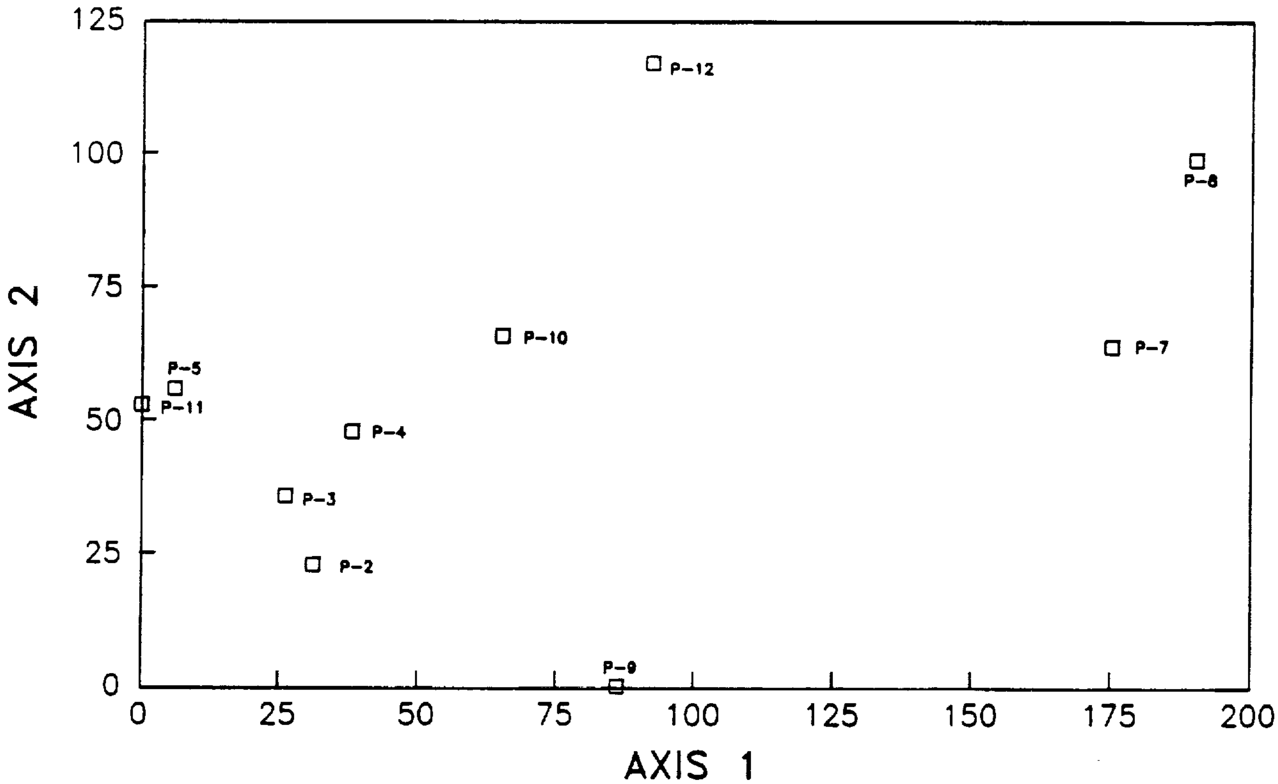


Figure 6. Detrended correspondence analysis ordination of the < 0.5 m layer of scrub transects that burned in December 1986 12 months postburn. Species are as previously defined with the addition of ANDSPP (*Andropogon* spp.) and DROSPP (*Drosera* spp.).

DCA ORDINATION
12 MONTHS POSTBURN
LESS THAN 0.5 m



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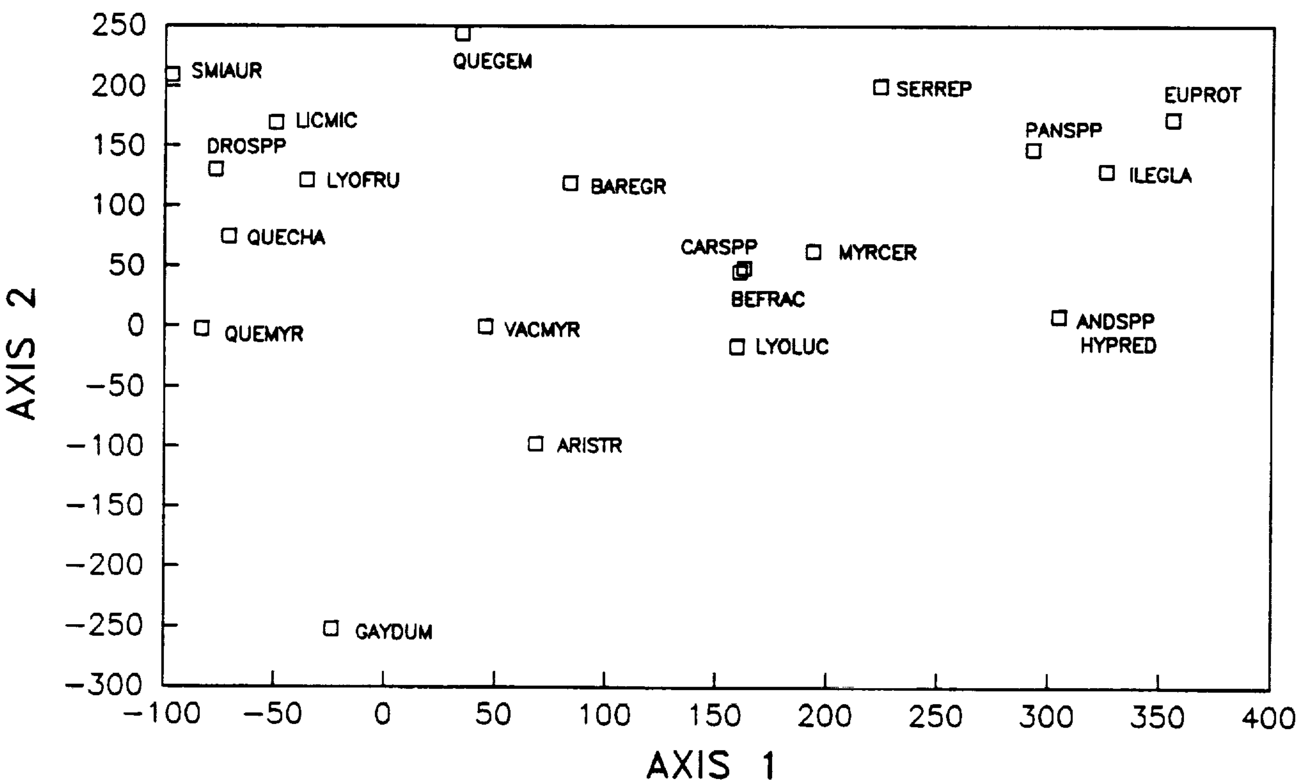
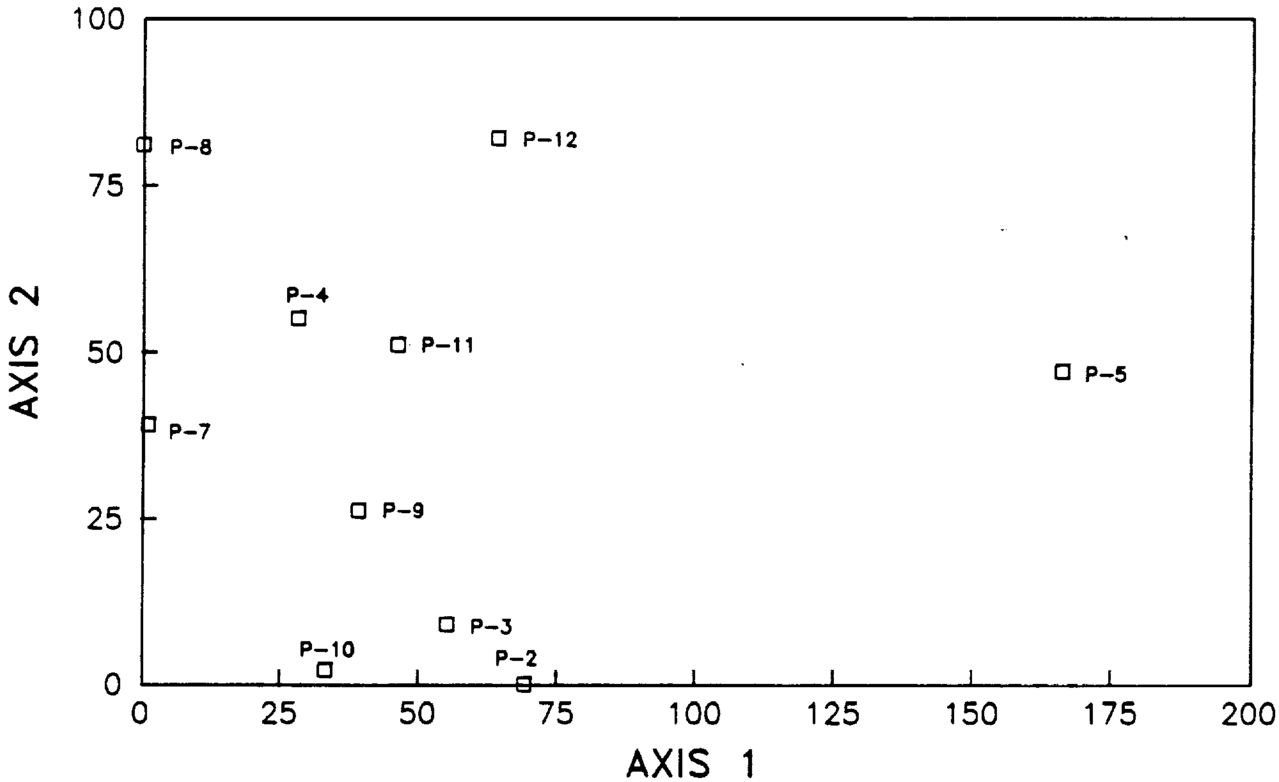


Figure 7. Detrended correspondence analysis ordination of the > 0.5 m layer of scrub transects that burned in December 1986 18 months postburn. Species are as previously defined.

DCA ORDINATION
18 MONTHS POSTBURN
GREATER THAN 0.5 m



SPECIES

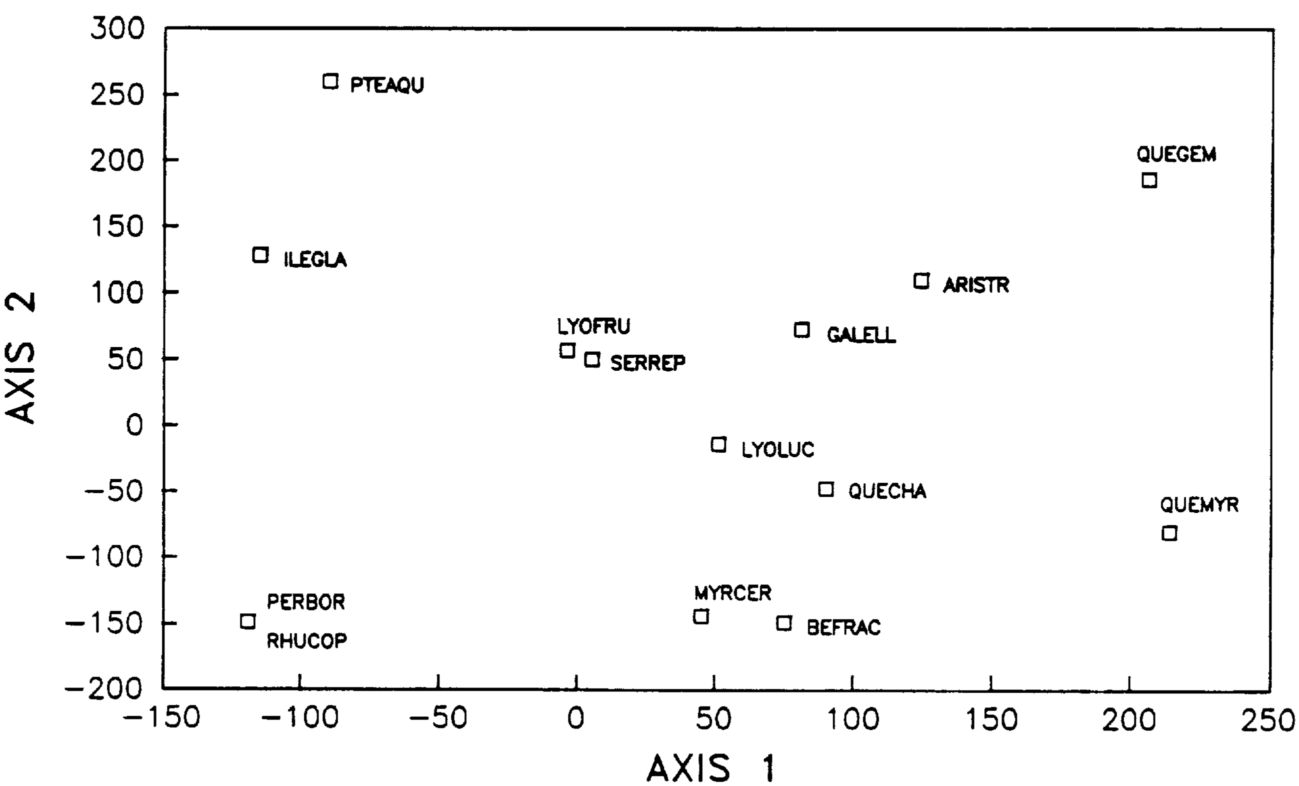
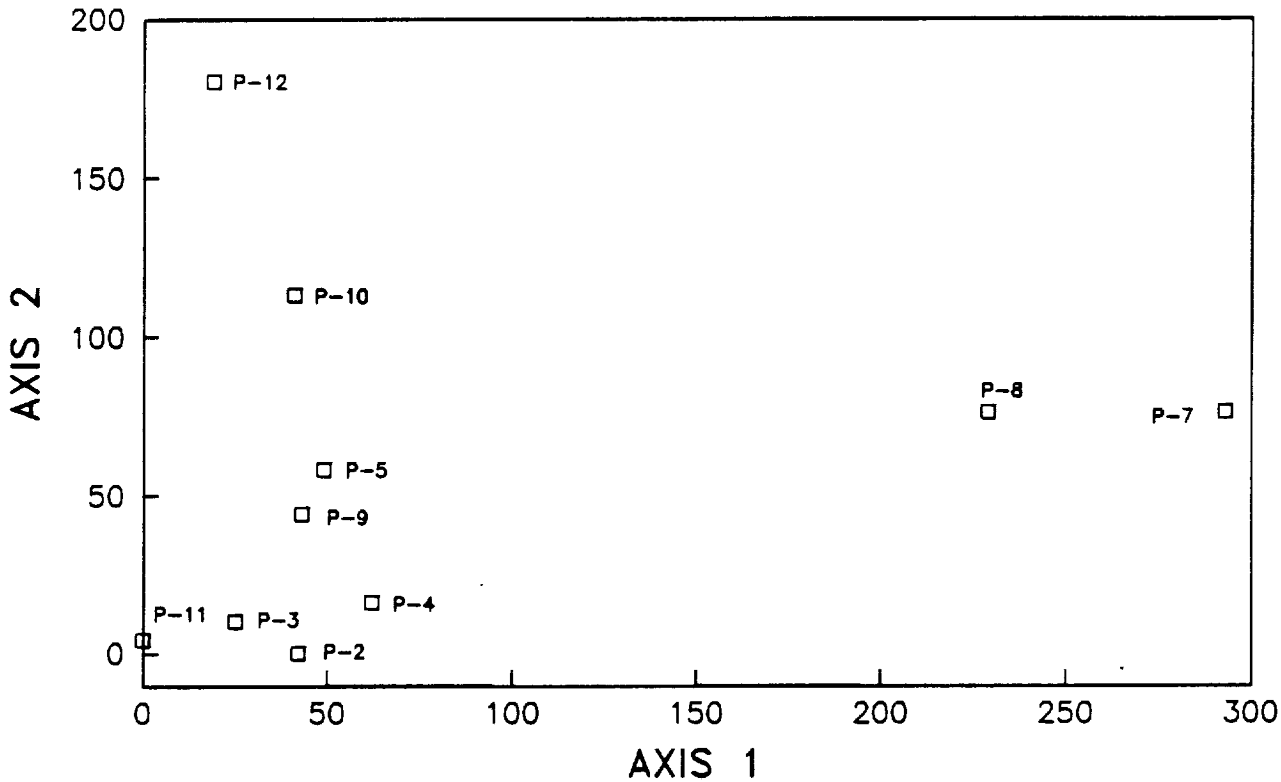


Figure 8. Detrended correspondence analysis ordination of the < 0.5 m layer of scrub transects that burned in December 1986 18 months postburn. Species are as previously defined with the addition of SEYPEC (*Seymeria pectinata*) and UNKHER (Unknown herb).

DCA ORDINATION
18 MONTHS POSTBURN
LESS THAN 0.5 m



SPECIES

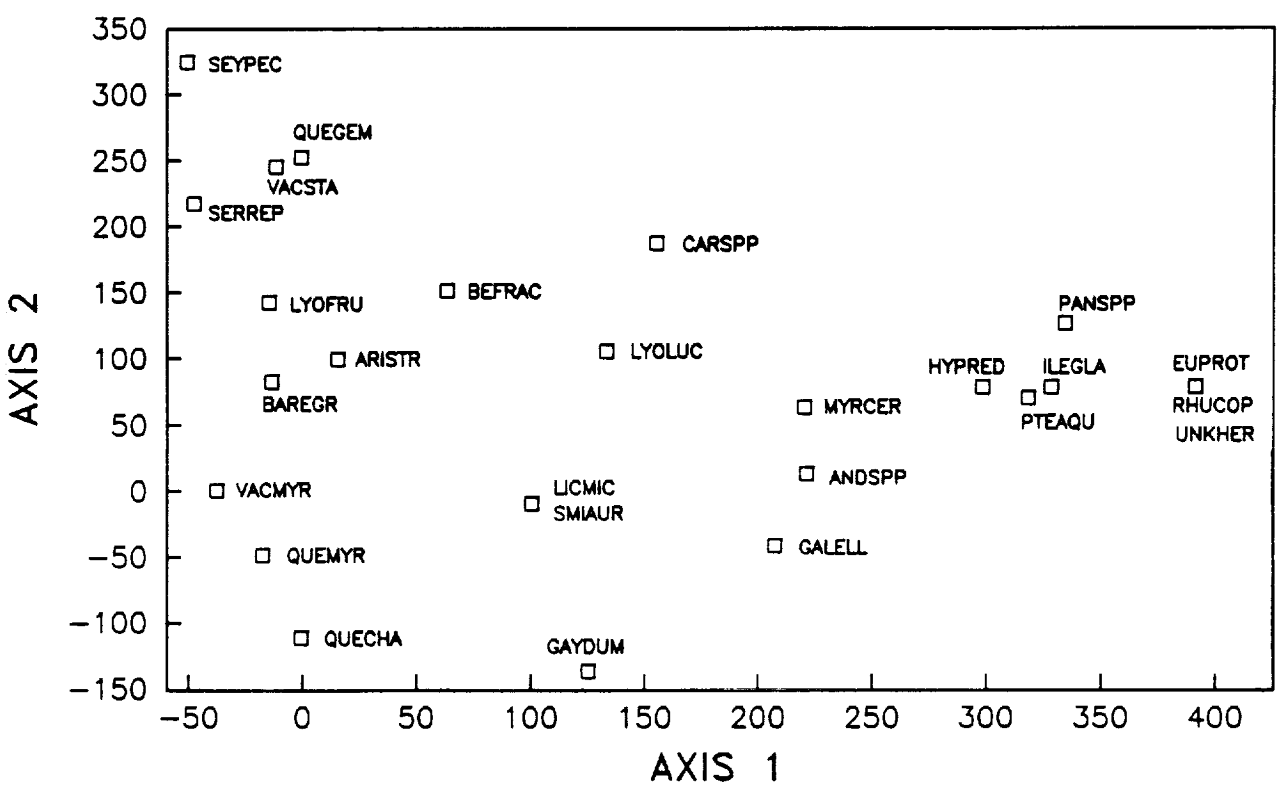
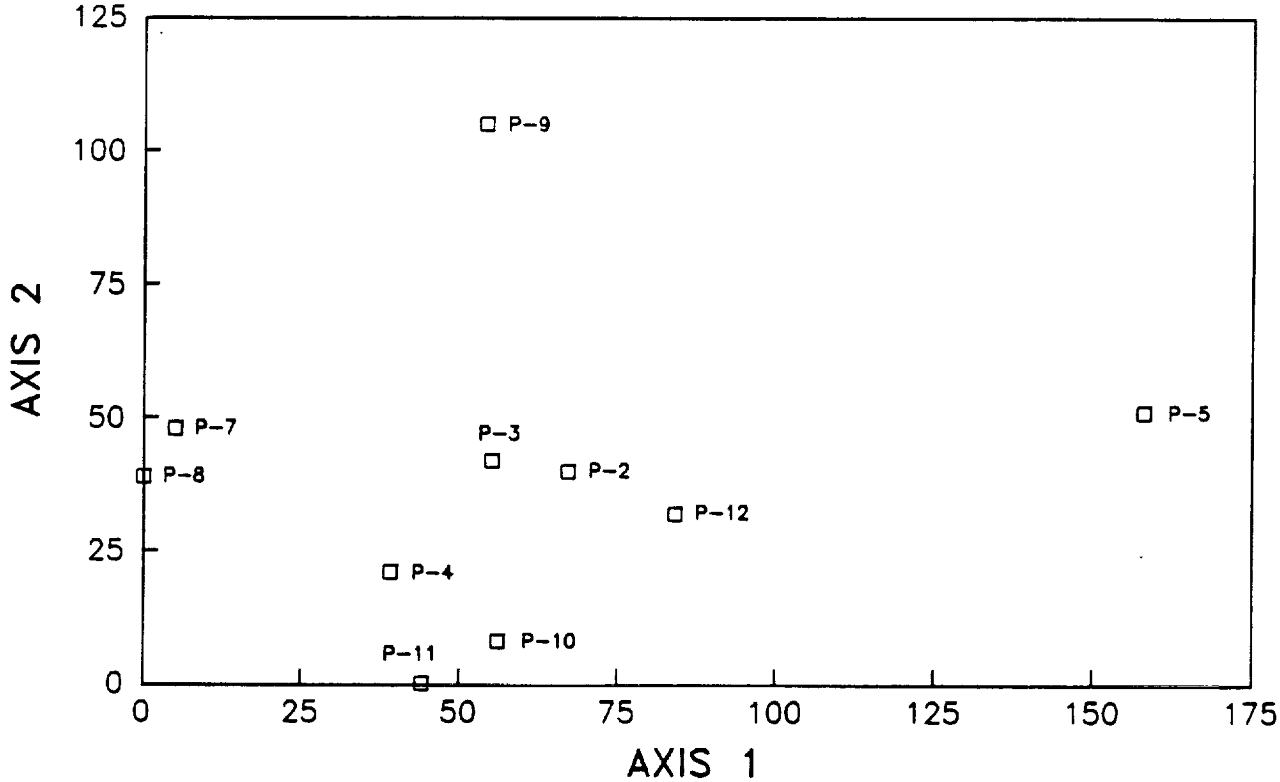


Figure 9. Detrended correspondence analysis ordination of the > 0.5 m layer of scrub transects that burned in December 1986 24 months postburn. Species are as previously defined.

DCA ORDINATION
24 MONTHS POSTBURN
GREATER THAN 0.5 m



SPECIES

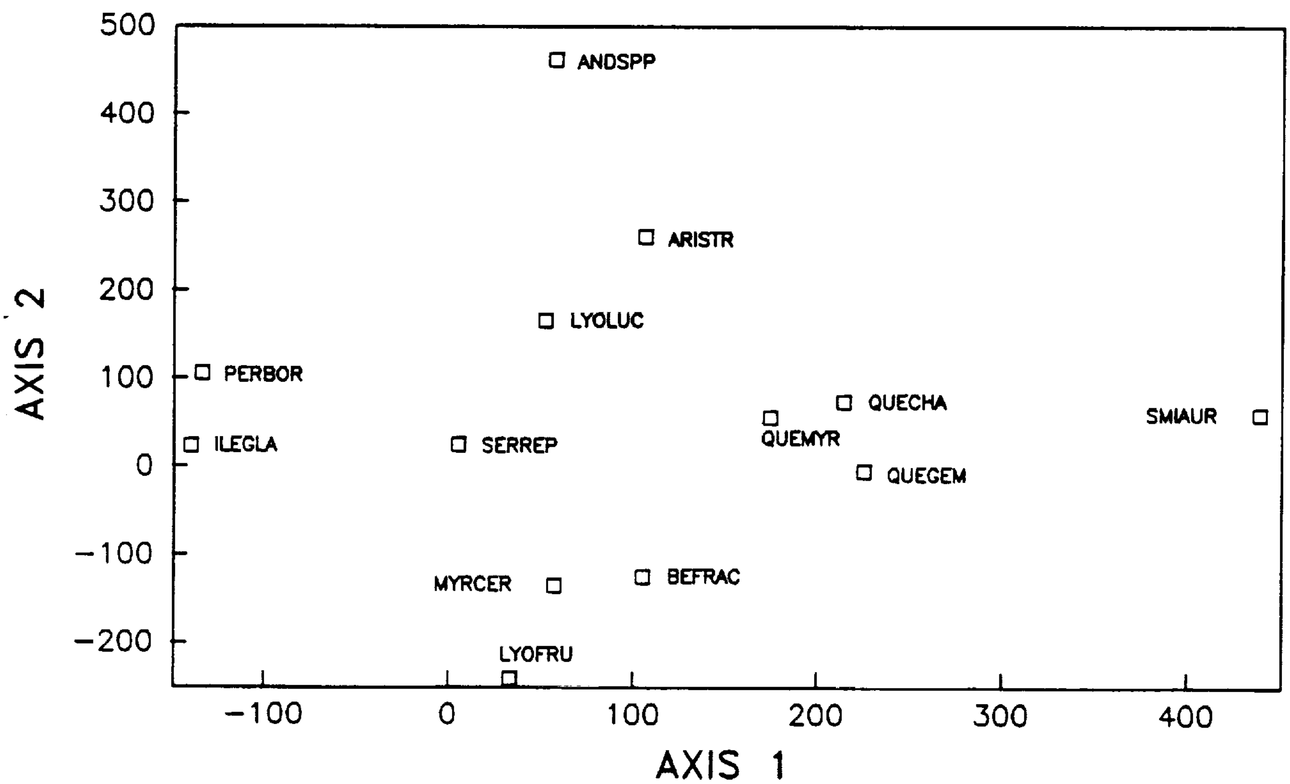
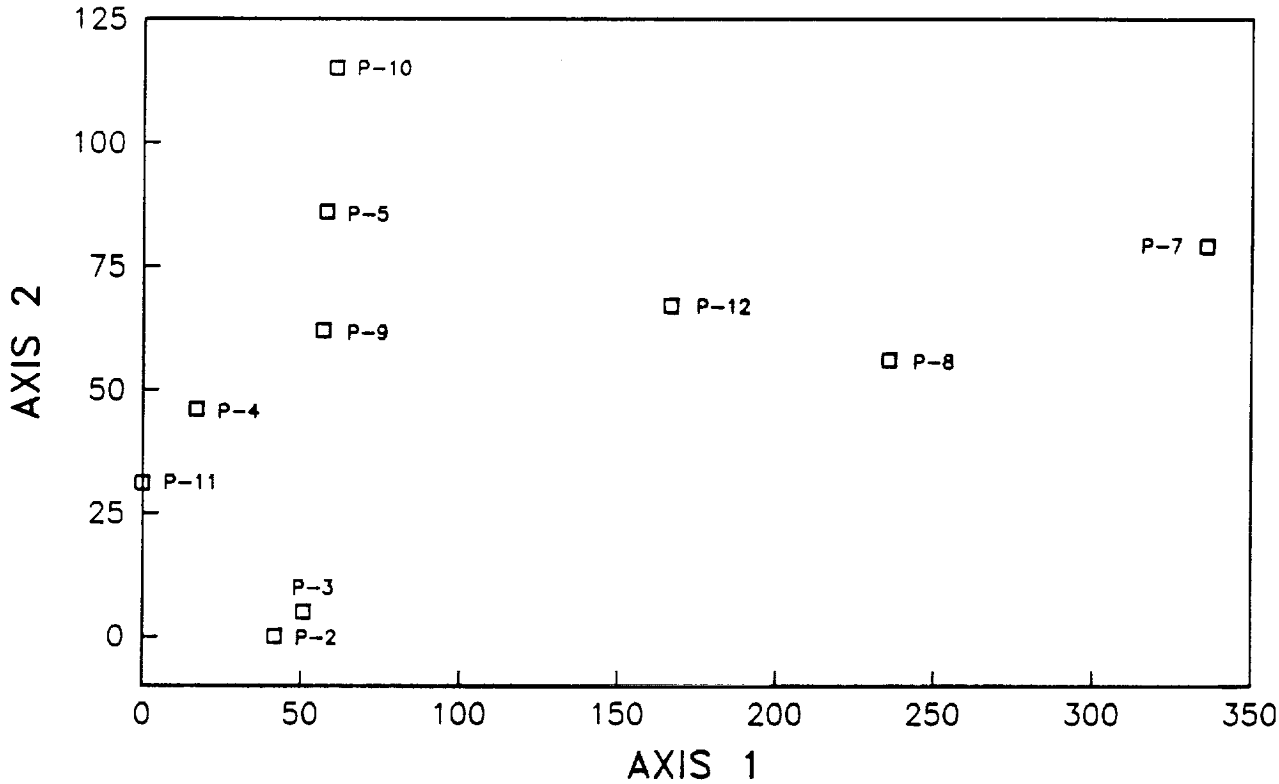


Figure 10. Detrended correspondence analysis ordination of the < 0.5 m layer of scrub transects that burned in December 1986 24 months postburn. Species are as previously defined.

DCA ORDINATION
24 MONTHS POSTBURN
LESS THAN 0.5 m



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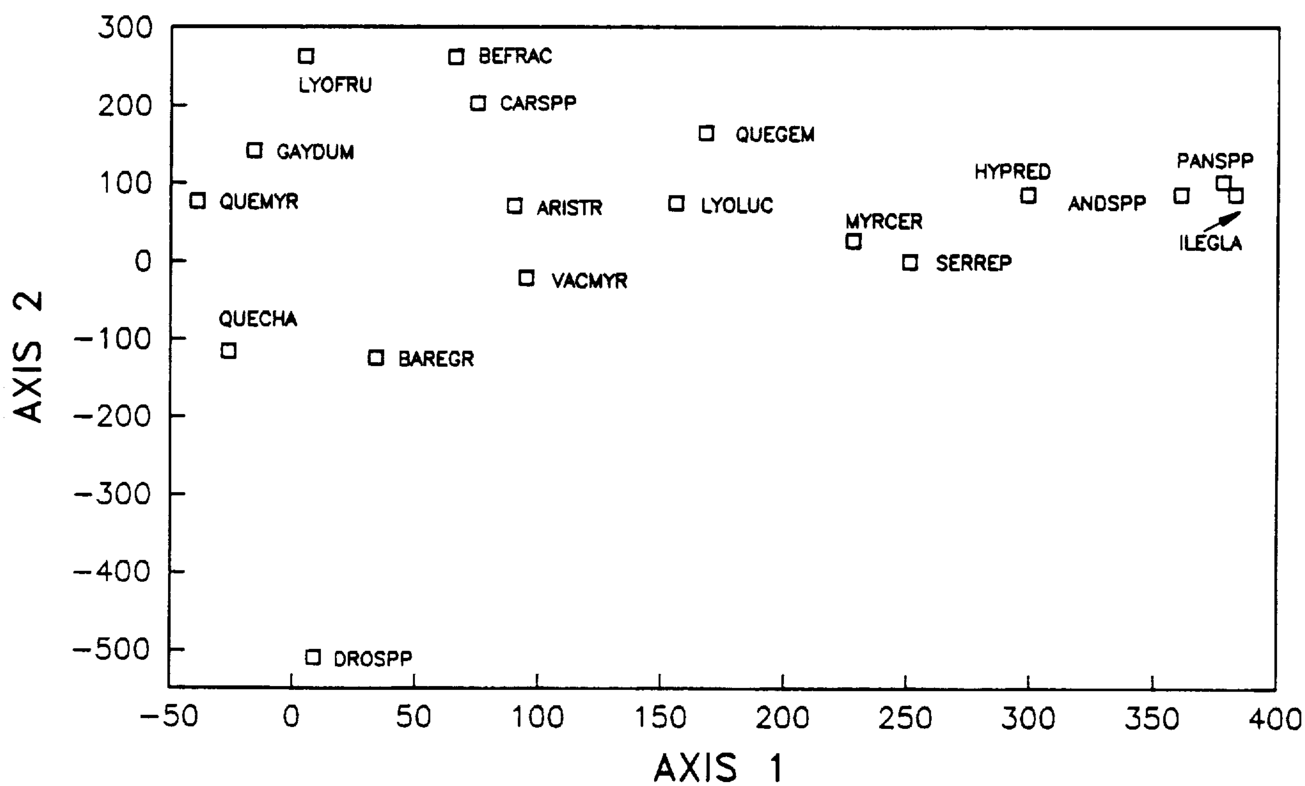
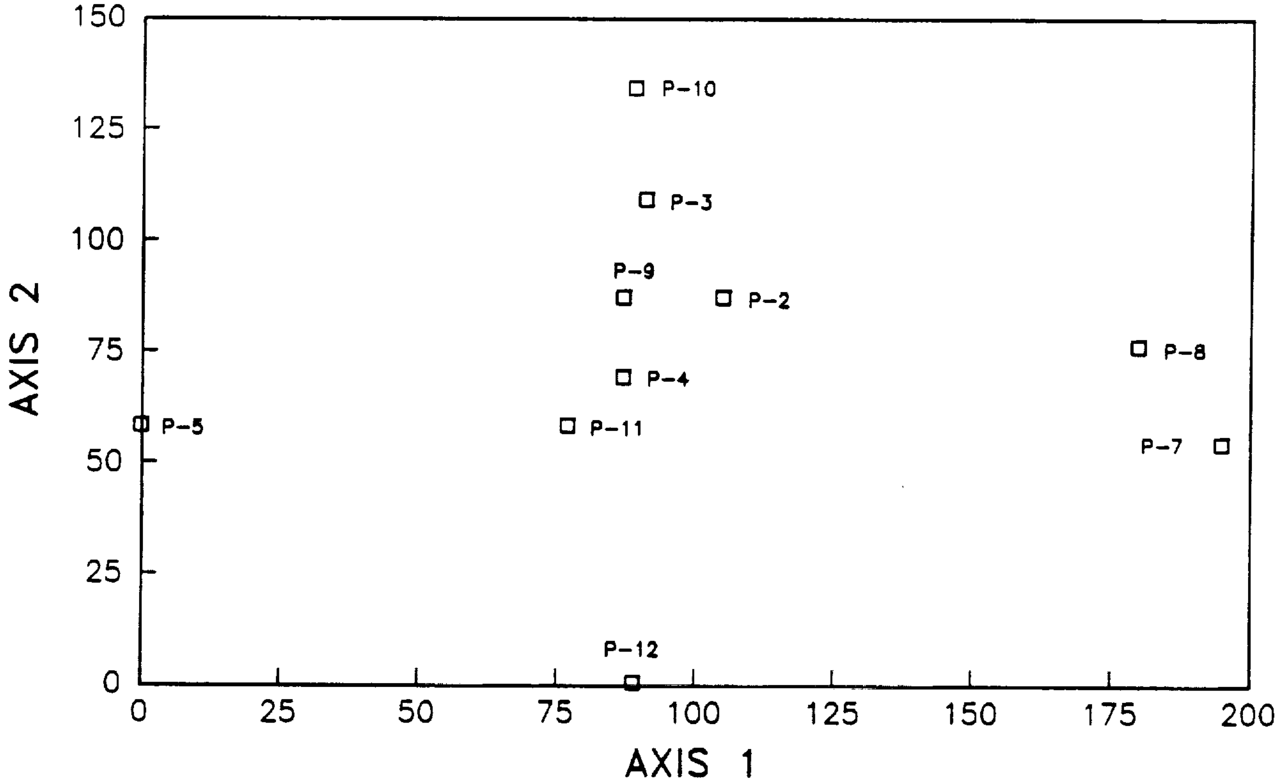


Figure 11. Detrended correspondence analysis ordination of the > 0.5 m layer of scrub transects that burned in December 1986 36 months postburn. Species are as previously defined.

DCA ORDINATION
36 MONTHS POSTBURN
GREATER THAN 0.5 m



SPECIES

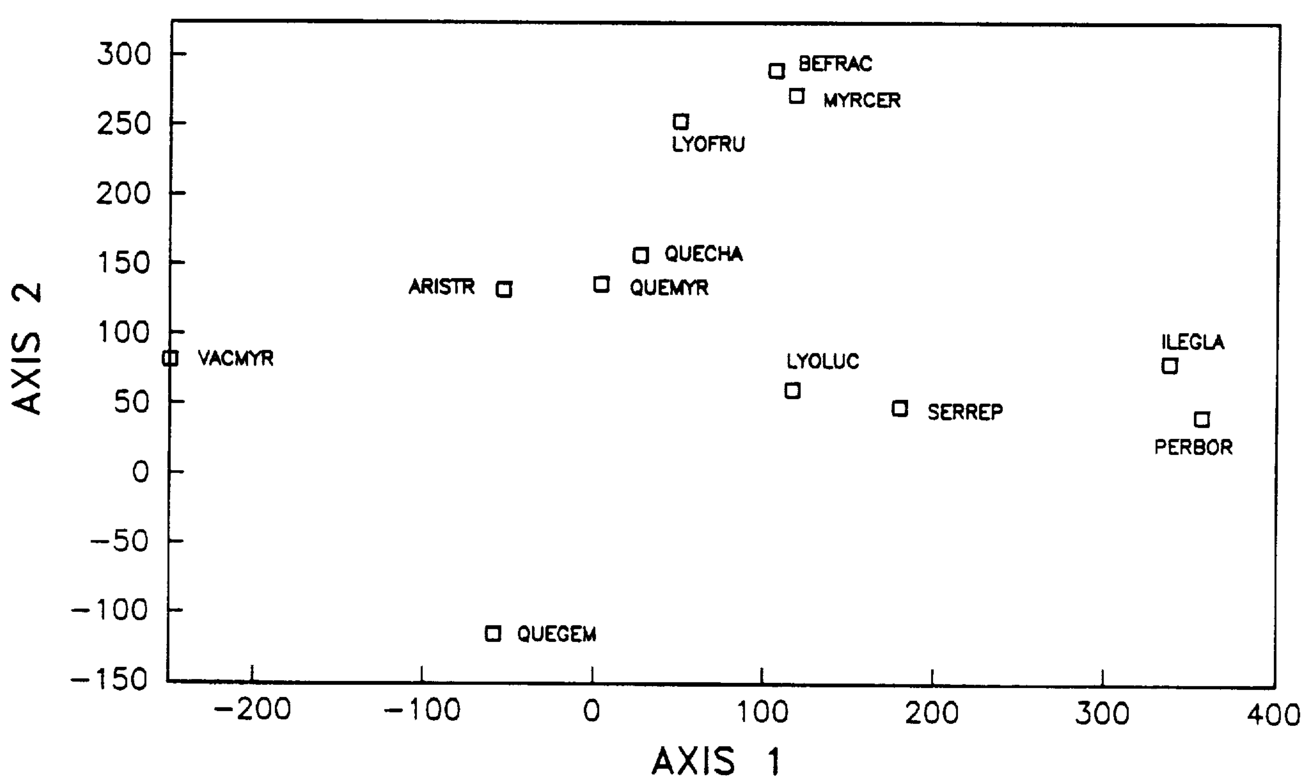
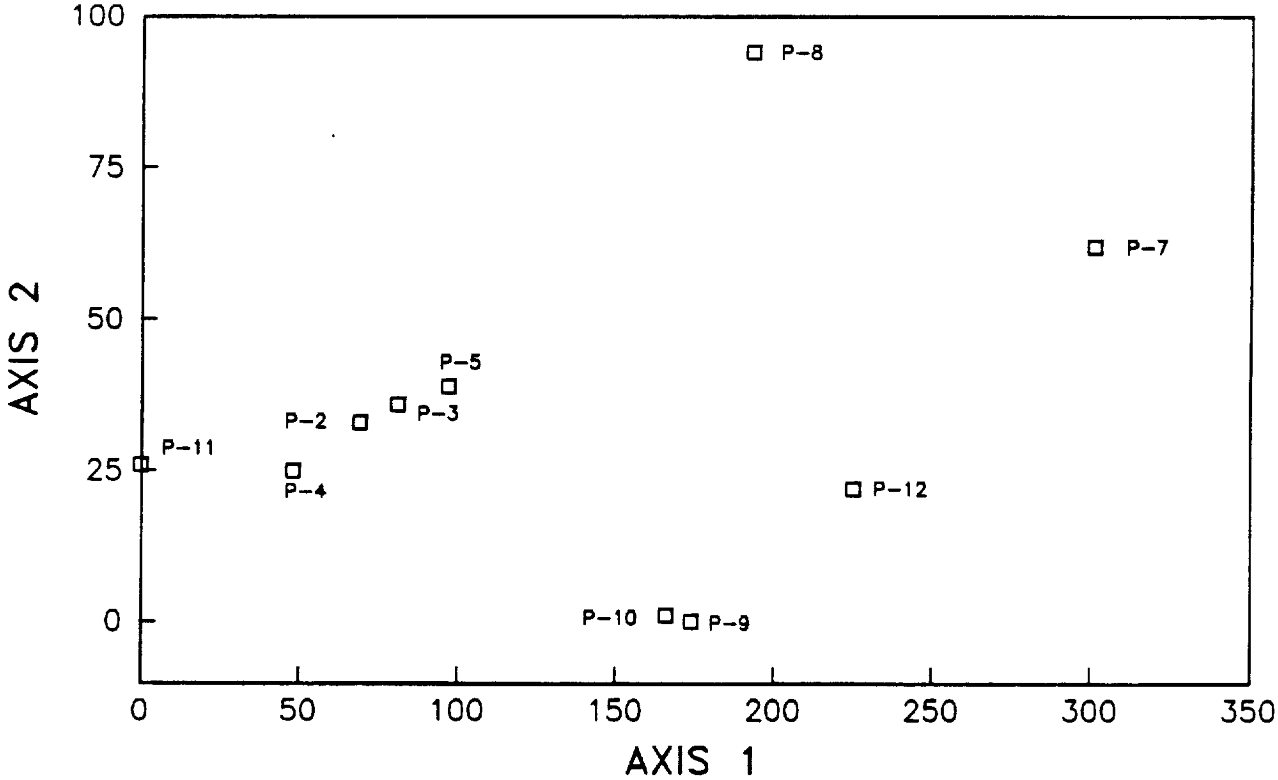


Figure 12. Detrended correspondence analysis ordination of the < 0.5 m layer of scrub transects that burned in December 1986 36 months postburn. Species are as previously defined.

DCA ORDINATION
36 MONTHS POSTBURN
LESS THAN 0.5 m



SPECIES

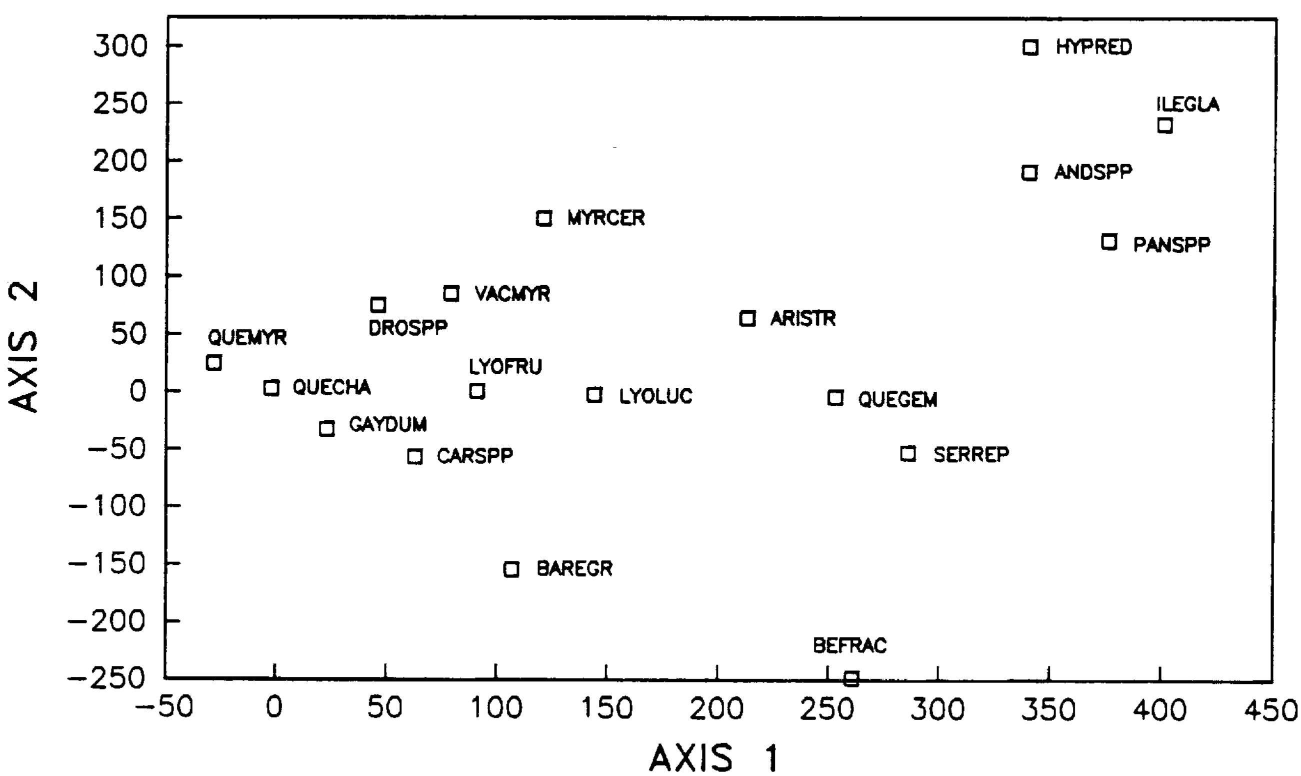


Figure 13. Detrended correspondence analysis sample ordination of the > 0.5 m layer of all burned transects of scrub vegetation from preburn through 36 months postburn.

DCA ORDINATION SCRUB VEGETATION
PREBURN – 36 MONTHS POSTBURN
ALL TRANSECTS

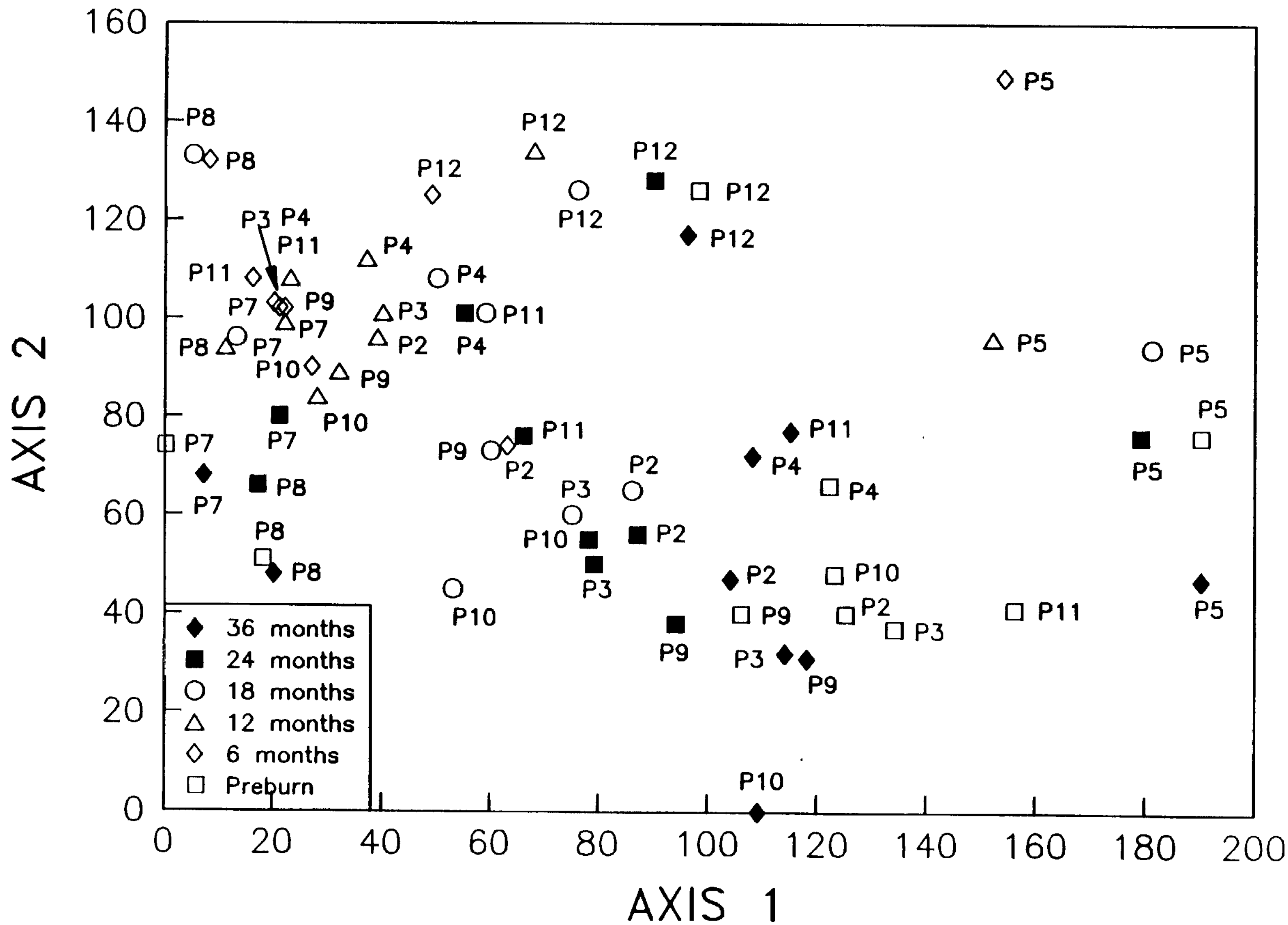


Figure 14. Detrended correspondence analysis species ordination of the > 0.5 m layer of all burned transects of scrub vegetation from preburn through 36 months postburn. Species are as previously defined.

DCA ORDINATION SCRUB VEGETATION
PREBURN — 36 MONTHS POSTBURN
SPECIES

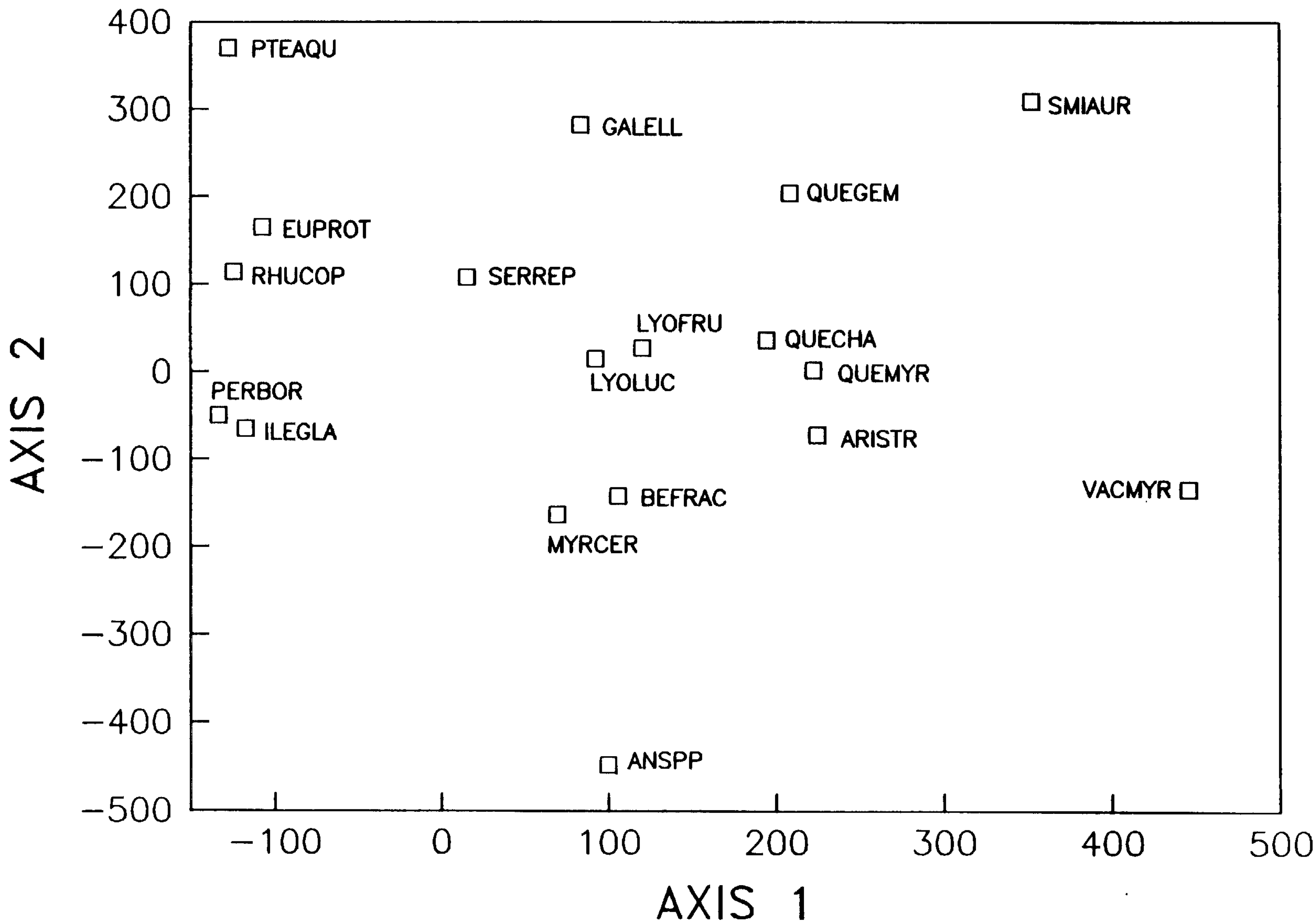


Figure 15. Detrended correspondence analysis sample ordination of the > 0.5 m layer showing changes of selected transects from preburn through 36 months postburn. Shown are transects 5, 8, 10, 11, and 12.

DCA ORDINATION SCRUB VEGETATION PREBURN — 36 MONTHS POSTBURN

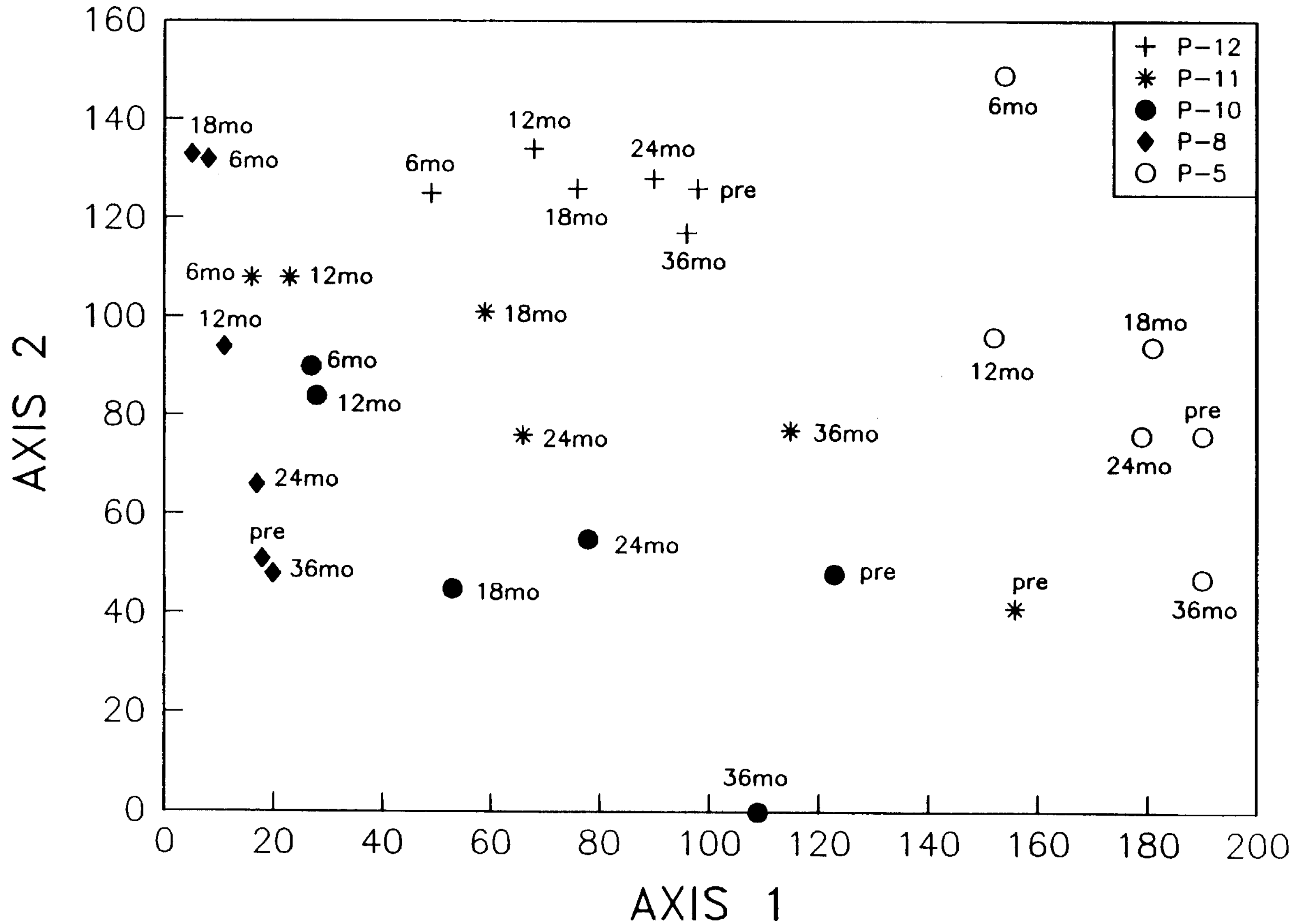


Figure 16. Detrended correspondence analysis sample ordination of the > 0.5 m layer showing changes of selected transects from preburn through 36 months postburn. Shown are transects 2, 4, and 7.

DCA ORDINATION SCRUB VEGETATION PREBURN – 36 MONTHS POSTBURN

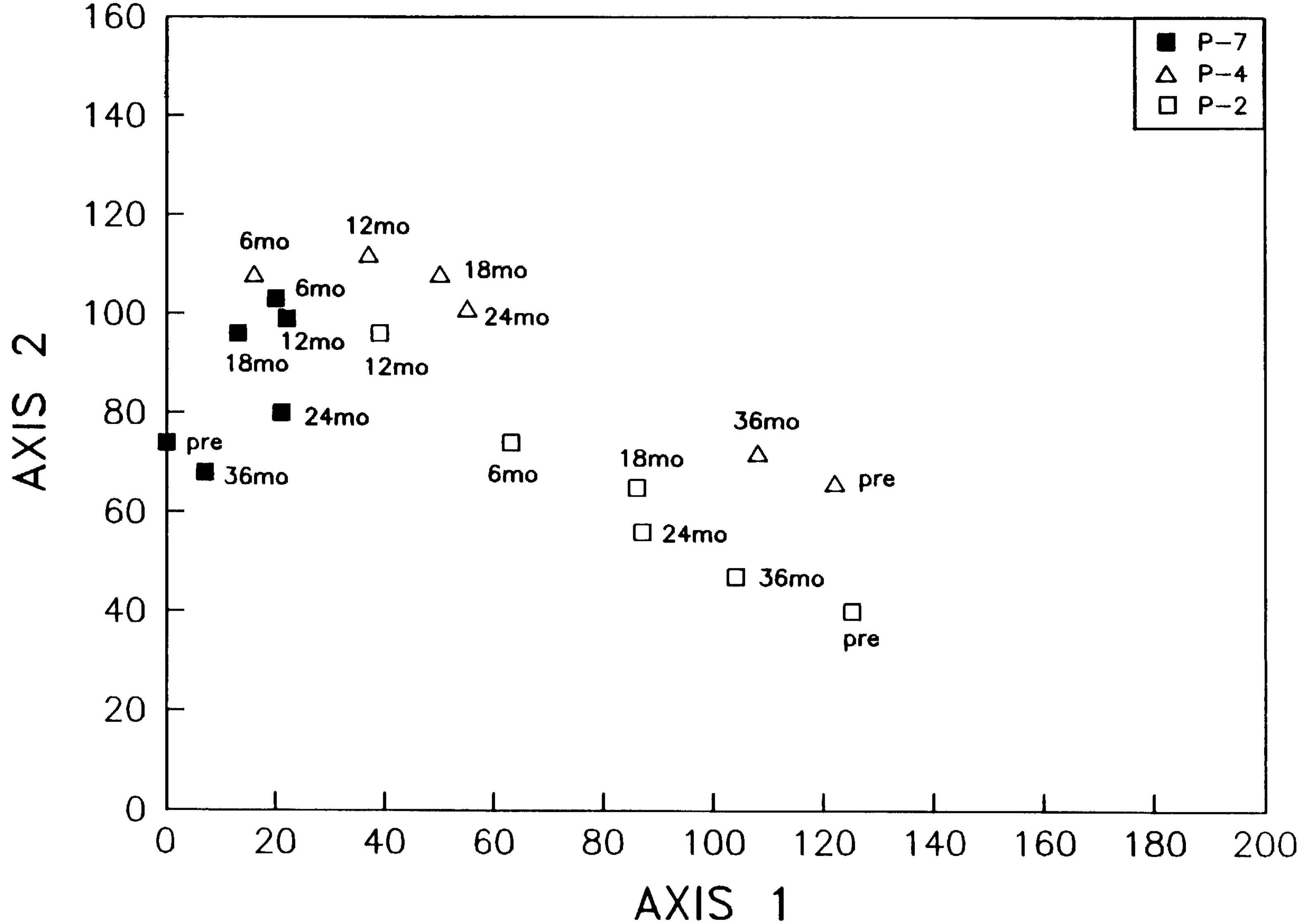


Figure 17. Detrended correspondence analysis sample ordination of the > 0.5 m layer showing changes of selected transects from preburn through 36 months postburn. Shown are transects 3 and 9.

DCA ORDINATION SCRUB VEGETATION PREBURN — 36 MONTHS POSTBURN

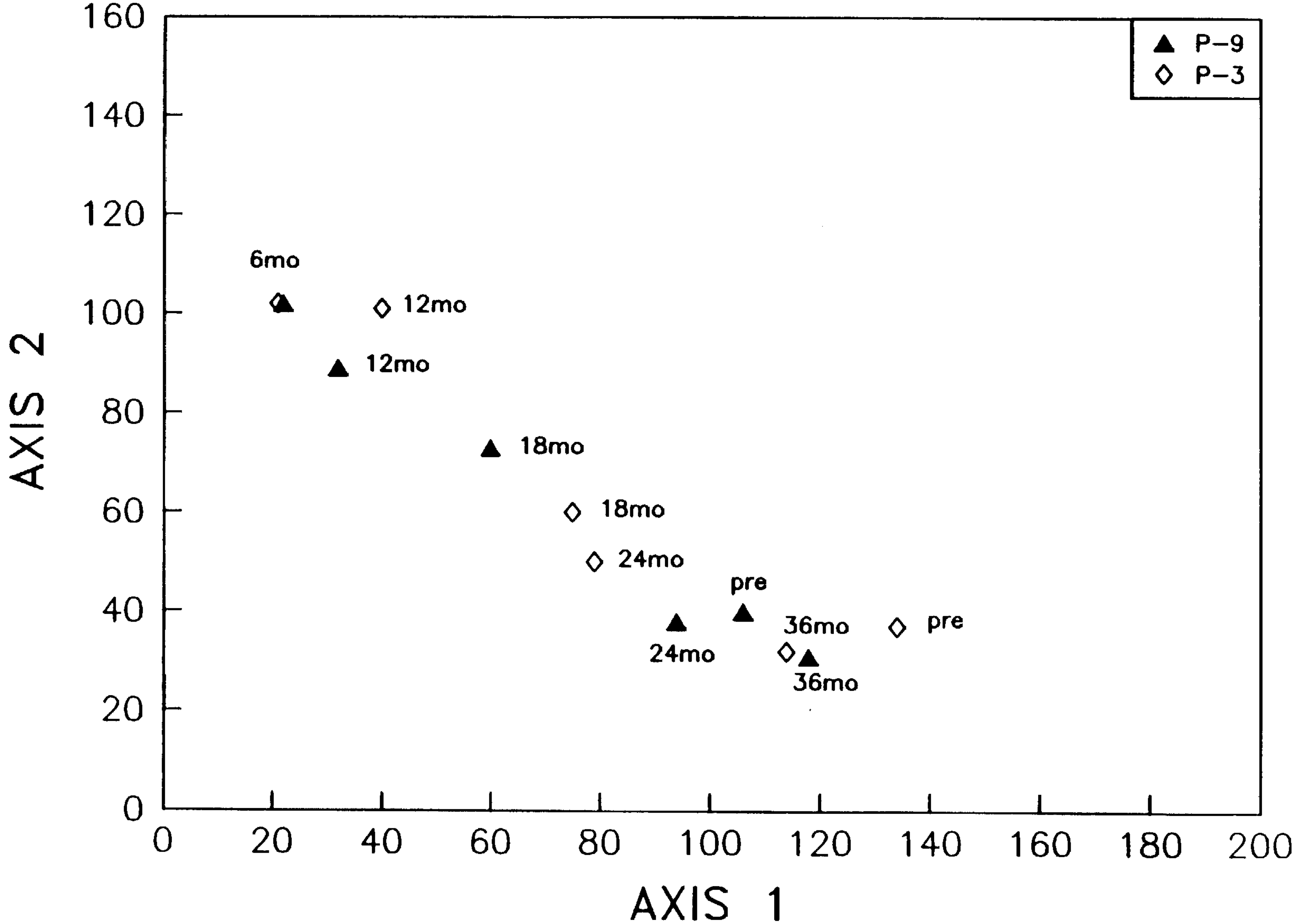


Figure 18. Mean total cover preburn and through 36 months postburn of the > 0.5 m layer of scrub transects that burned in December 1986. Shown are means and 95% confidence intervals. Data are the sum of the cover of individual species per transect.

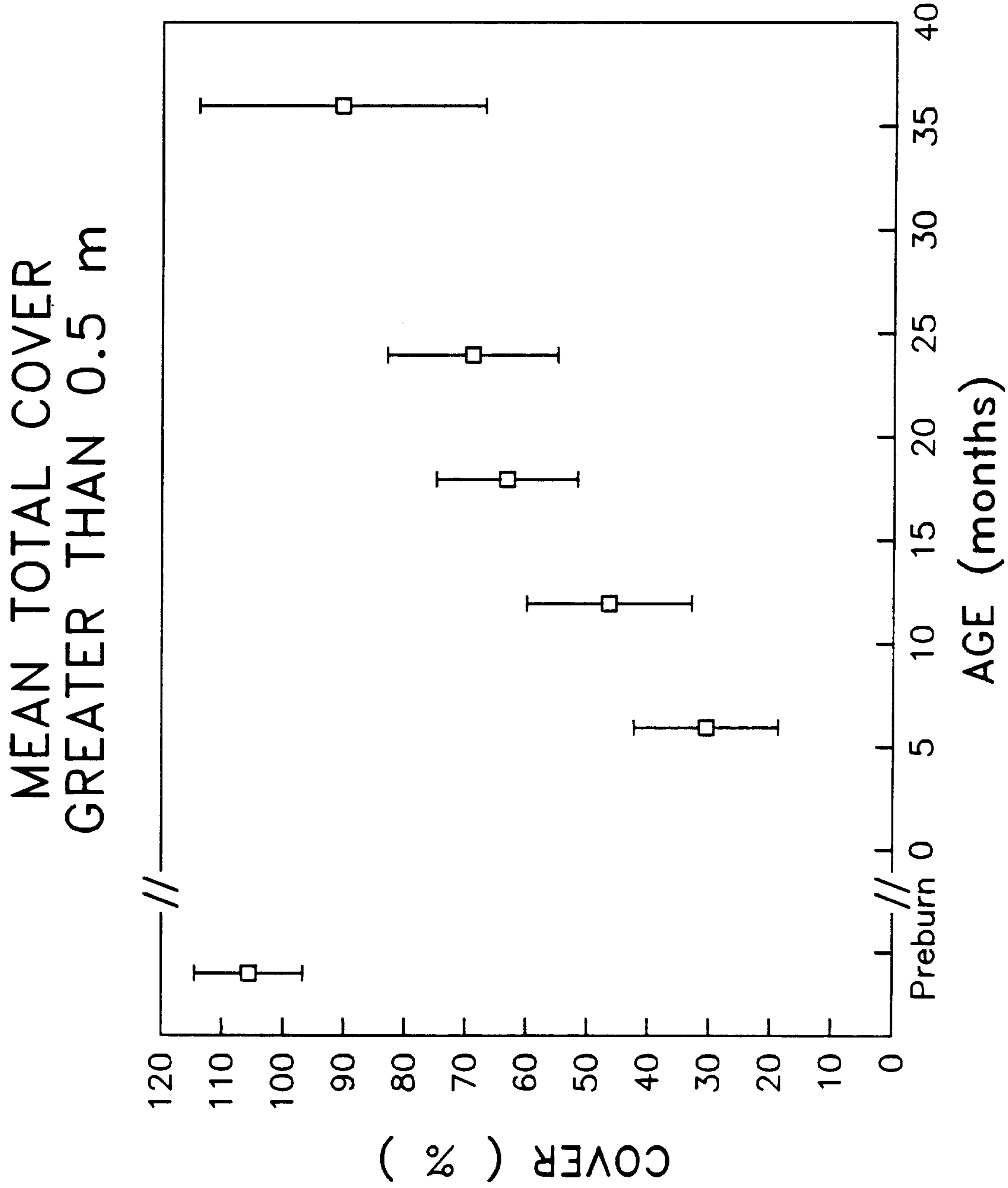

MEAN TOTAL COVER
GREATER THAN 0.5 m
COVER (%)
0
10
20
30
40
50
60
70
80
90
100
110
120
AGE (months)
Preburn
0
5
10
15
20
25
30
35
40

Figure 19. Mean total cover preburn and through 36 months postburn of the < 0.5 m layer of scrub transects that burned in December 1986. Shown are means and 95% confidence intervals. Data are the sum of the cover of individual species per transect.

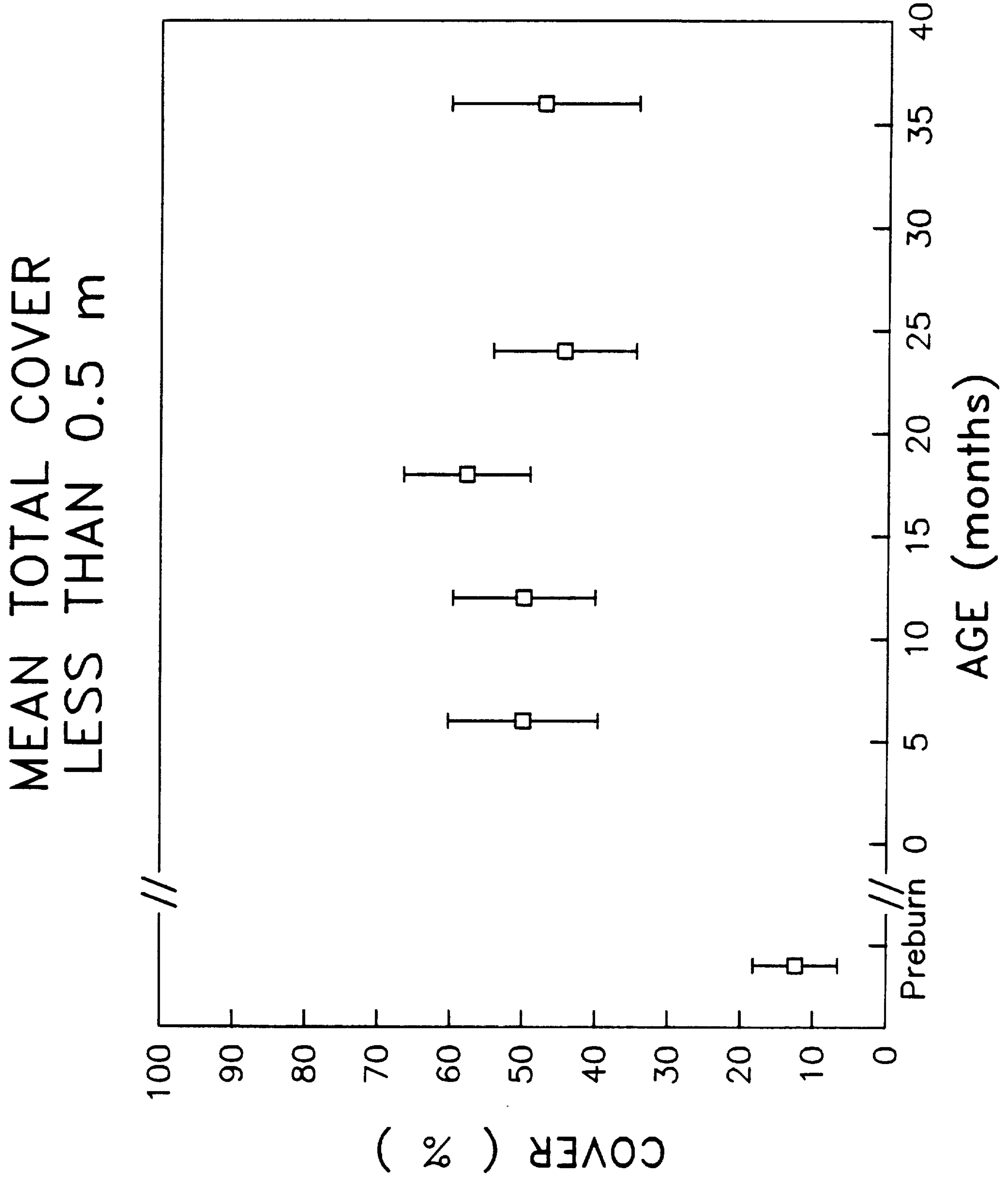

MEAN TOTAL COVER
LESS THAN 0.5 m
COVER (%)
100
90
80
70
60
50
40
30
20
10
0
Preburn
0
5
10
15
20
25
30
35
40
AGE (months)

Figure 20. Percent bare ground preburn and through 36 months postburn of scrub transects that burned in December 1986. Shown are means and 95% confidence intervals.

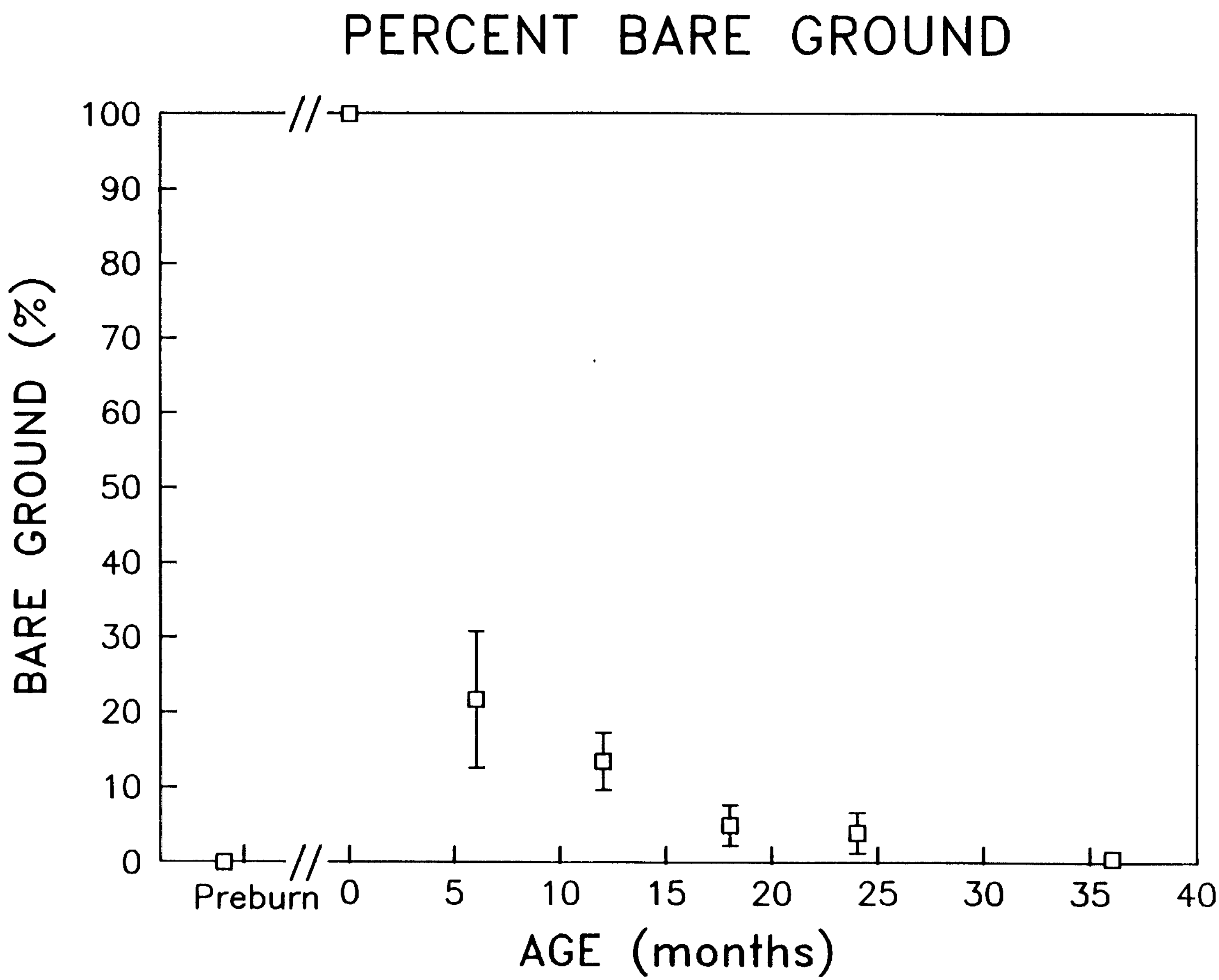

PERCENT BARE GROUND
BARE GROUND (%)
100
90
80
70
60
50
40
30
20
10
0
Preburn
0
5
10
15
20
25
30
35
40
AGE (months)

Figure 21. Mean height preburn and through 36 months postburn of scrub transects that burned in December 1986. Shown are means and 95% confidence intervals. Data are heights measured at four intervals (0, 5, 10, 15 m) along each transect.

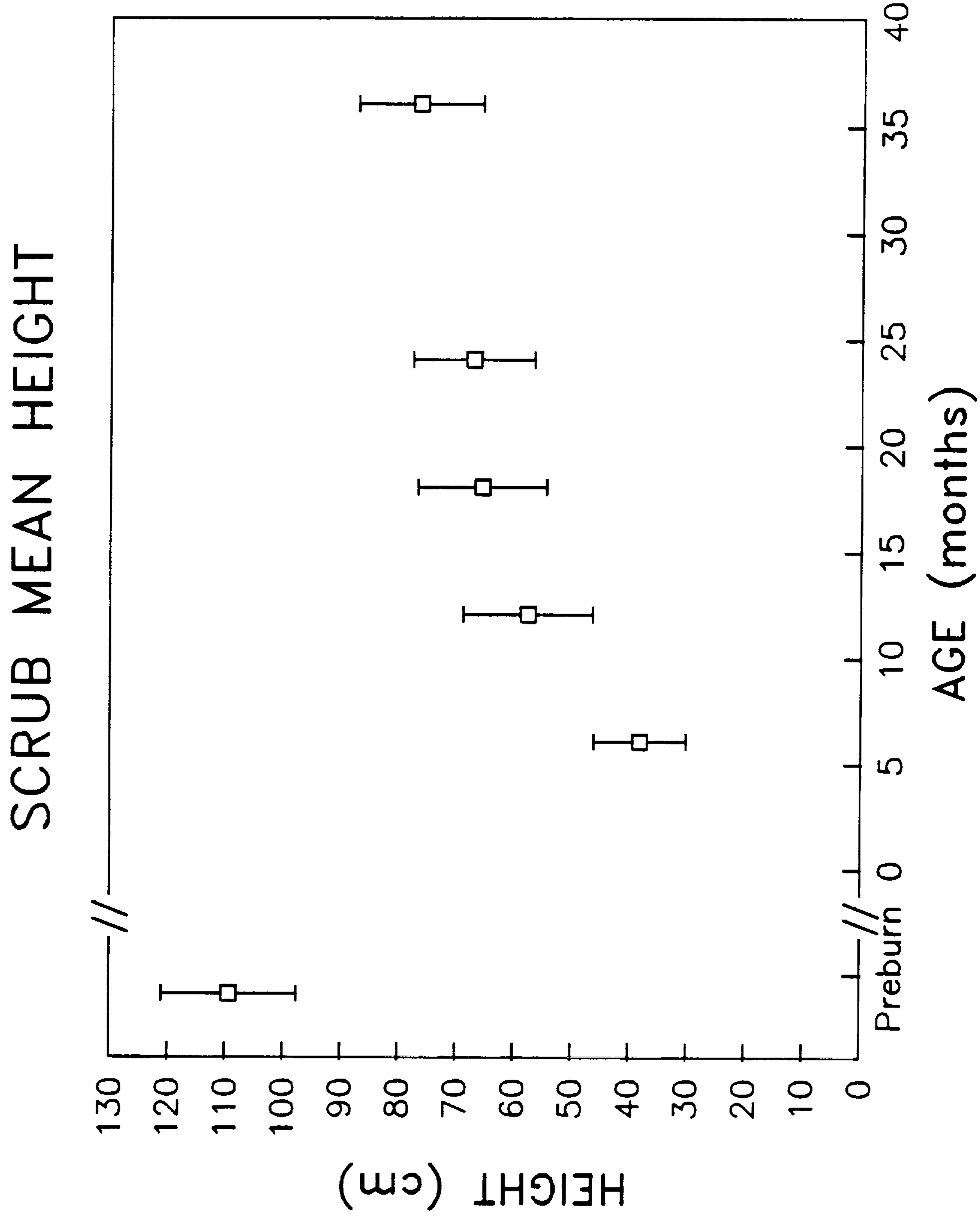

SCRUB MEAN HEIGHT
HEIGHT (cm)
AGE (months)
Preburn
0
5
10
15
20
25
30
35
40
130
120
110
100
90
80
70
60
50
40
30
20
10
0

Figure 22. Mean maximum height preburn and through 36 months postburn of scrub transects that burned in December 1986. Shown are means and 95% confidence intervals. Data are the maximum height of any shrub along each transect.

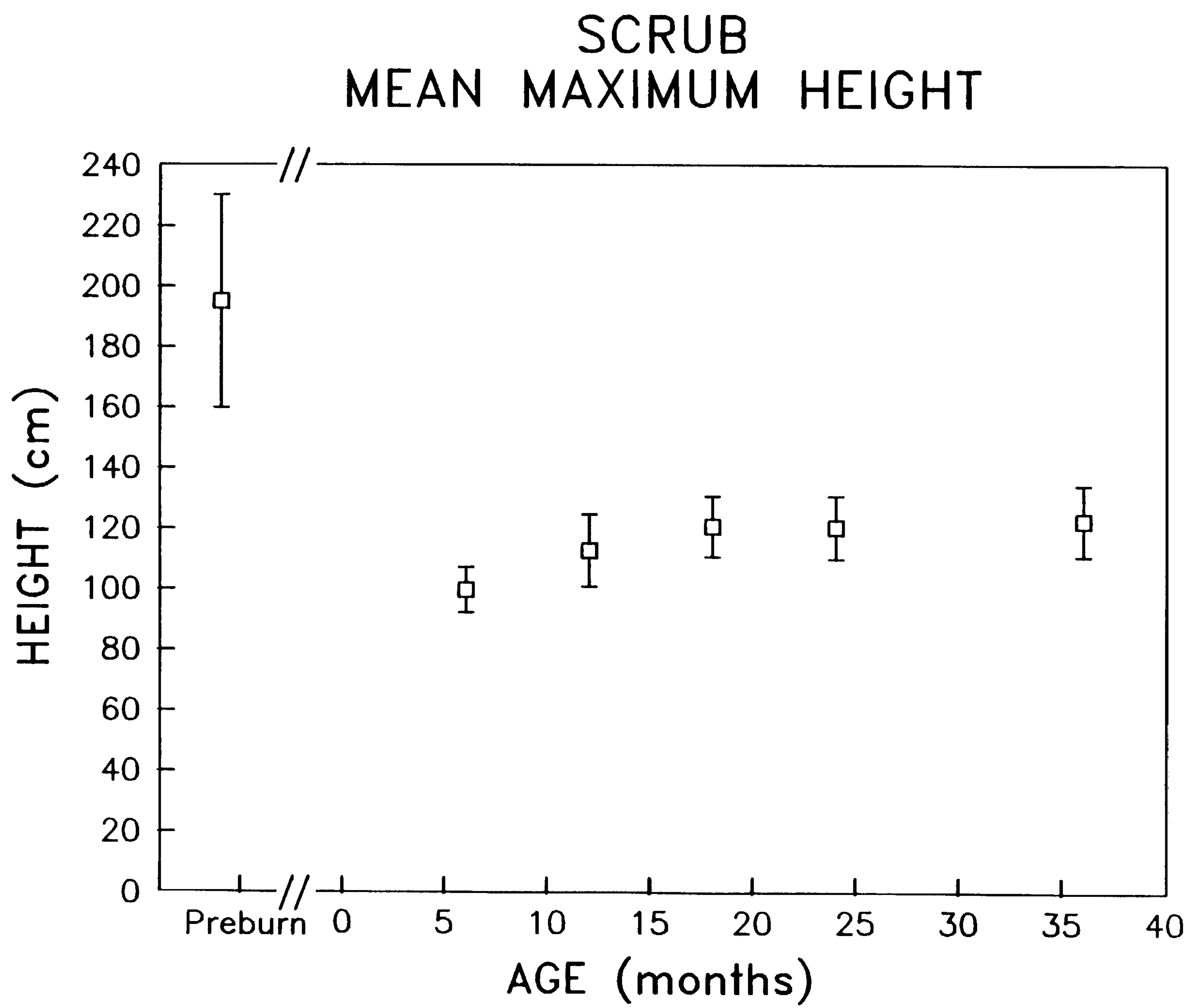
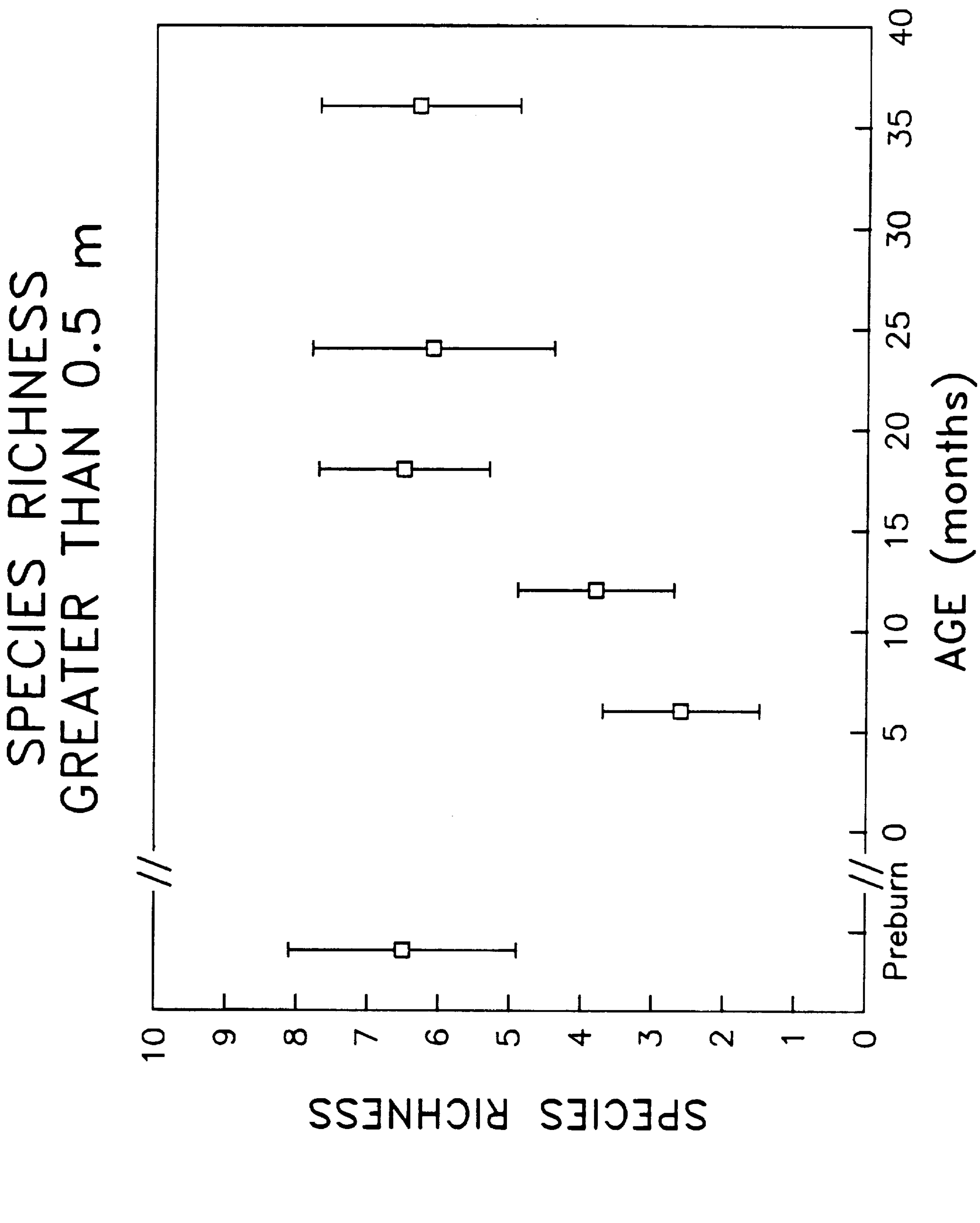

SCRUB
MEAN MAXIMUM HEIGHT
HEIGHT (cm)
240
220
200
180
160
140
120
100
80
60
40
20
0
Preburn
0
5
10
15
20
25
30
35
40
AGE (months)

Figure 23. Species richness (mean number of species per transect) preburn and through 36 months postburn of the > 0.5 m layer of scrub transects that burned in December 1986. Shown are means and 95% confidence intervals.



SPECIES RICHNESS
GREATER THAN 0.5 m
SPECIES RICHNESS
0
1
2
3
4
5
6
7
8
9
10
Preburn
0
5
10
15
20
25
30
35
40
AGE (months)

Figure 24. Species richness (mean number of species per transect) preburn and through 36 months postburn of the < 0.5 m layer of scrub transects that burned in December 1986. Shown are means and 95% confidence intervals.

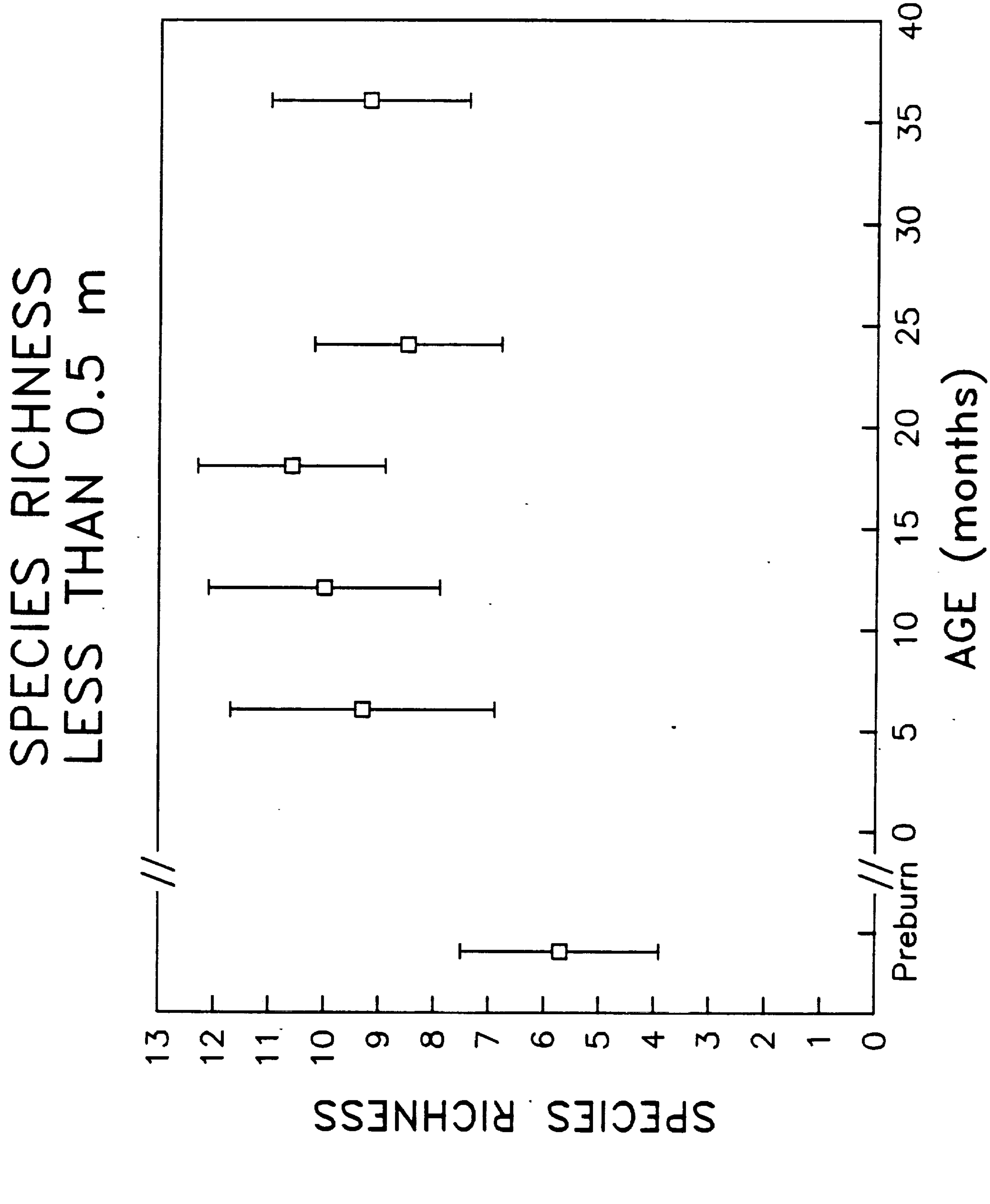
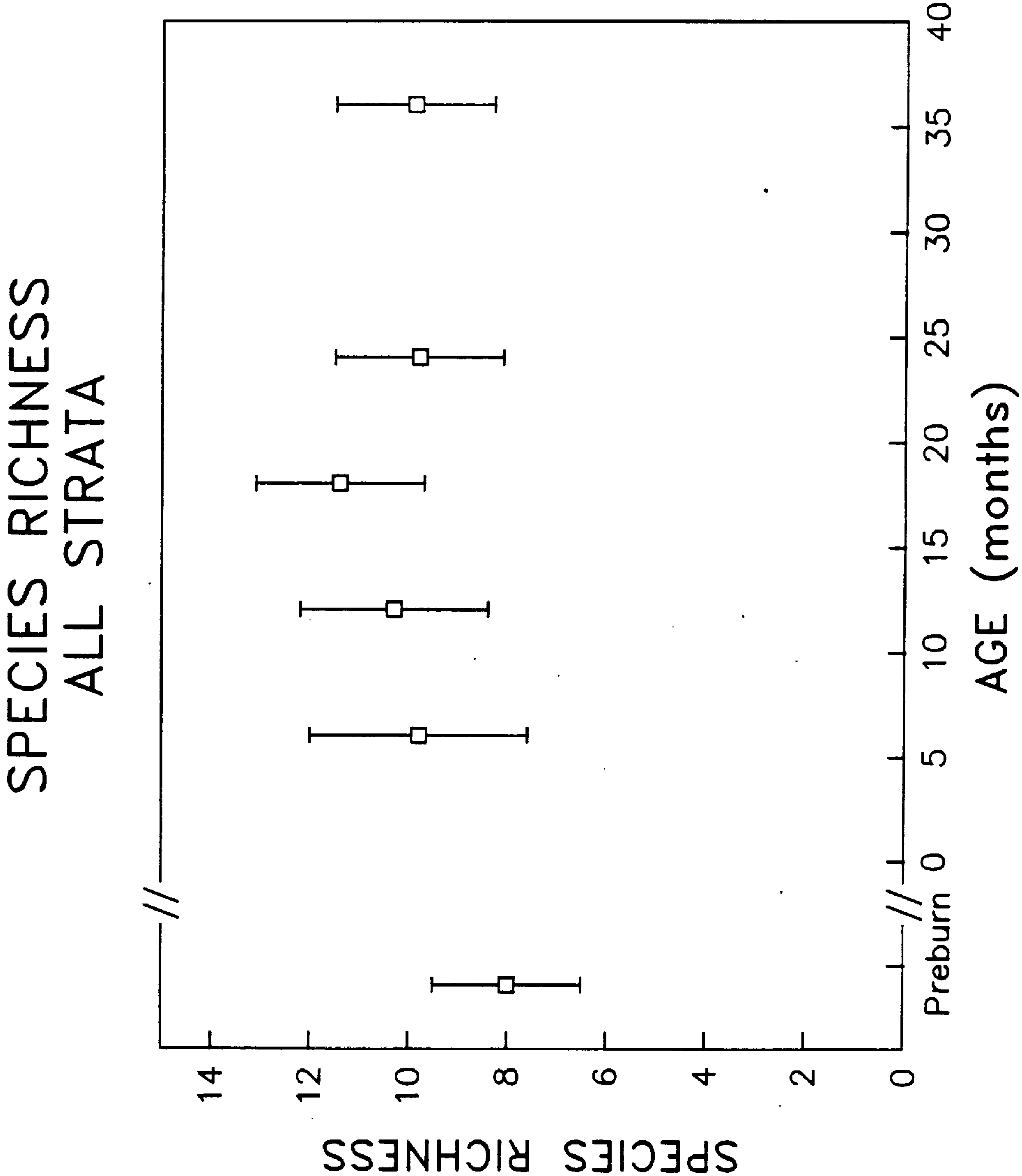

SPECIES RICHNESS
LESS THAN 0.5 m
SPECIES RICHNESS
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Preburn
0
5
10
15
20
25
30
35
40
AGE (months)

Figure 25. Species richness (mean number of species per transect) preburn and through 36 months postburn of both strata of scrub transects that burned in December 1986. Shown are means and 95% confidence intervals.



SPECIES RICHNESS
ALL STRATA
SPECIES RICHNESS
AGE (months)
Preburn
0
5
10
15
20
25
30
35
40
0
2
4
6
8
10
12
14

Figure 26. Hydrogen ion concentration of well drained scrub soils preburn and through 24 months postburn of scrub transects that burned in December 1986. Shown are means and 95% confidence intervals for the 0-15 cm layer (A) and the 15-30 cm layer (B).

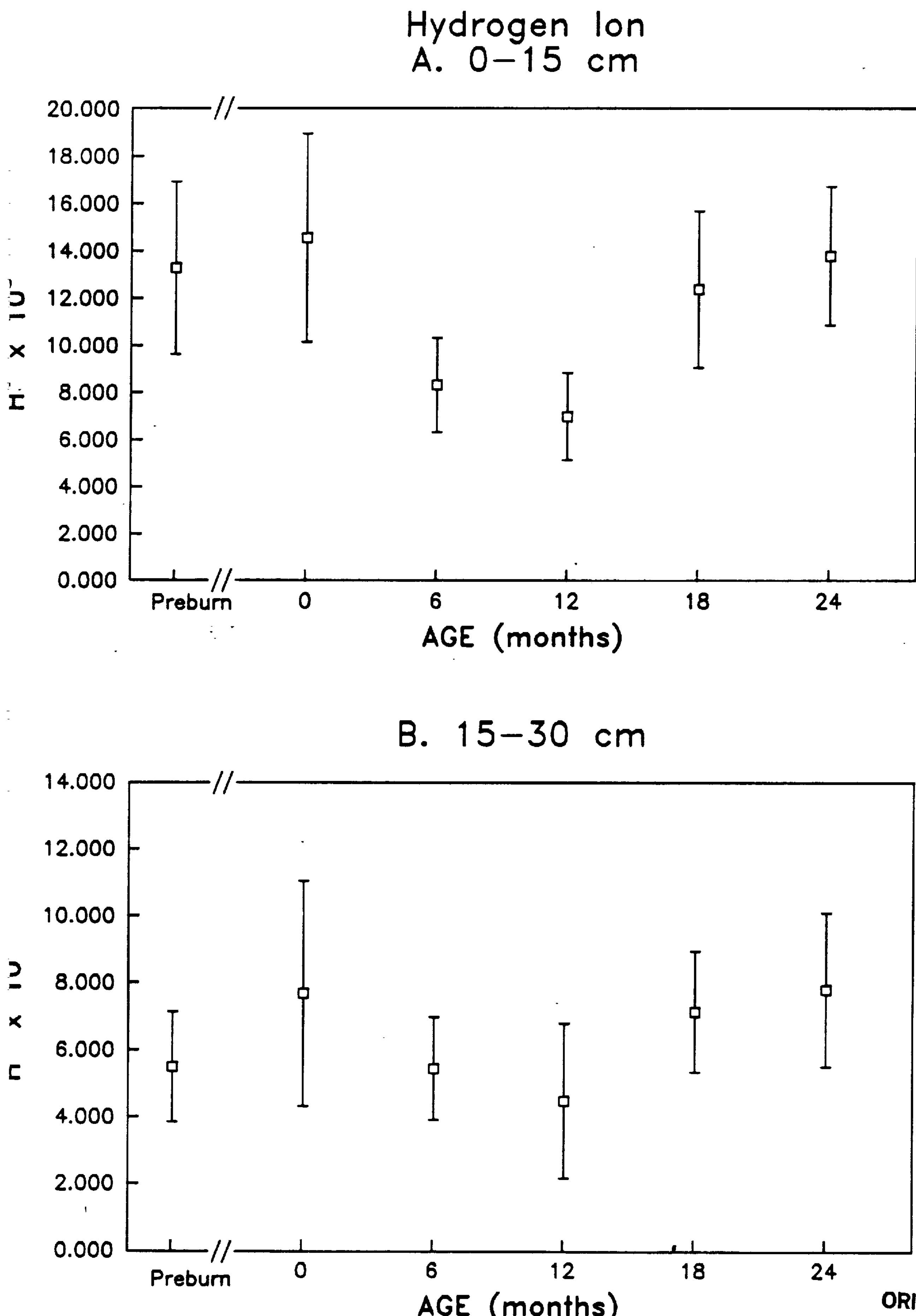

Hydrogen Ion
A. 0–15 cm
20.000
18.000
16.000
14.000
12.000
10.000
8.000
6.000
4.000
2.000
0.000
Preburn
0
6
12
18
24
AGE (months)
B. 15–30 cm
14.000
12.000
10.000
8.000
6.000
4.000
2.000
0.000
Preburn
0
6
12
18
24
AGE (months)

Figure 27. pH of well drained scrub soils preburn and through 24 months postburn of scrub transects that burned in December 1986. Shown are means and 95% confidence intervals for the 0-15 cm layer (A) and the 15-30 cm layer (B).

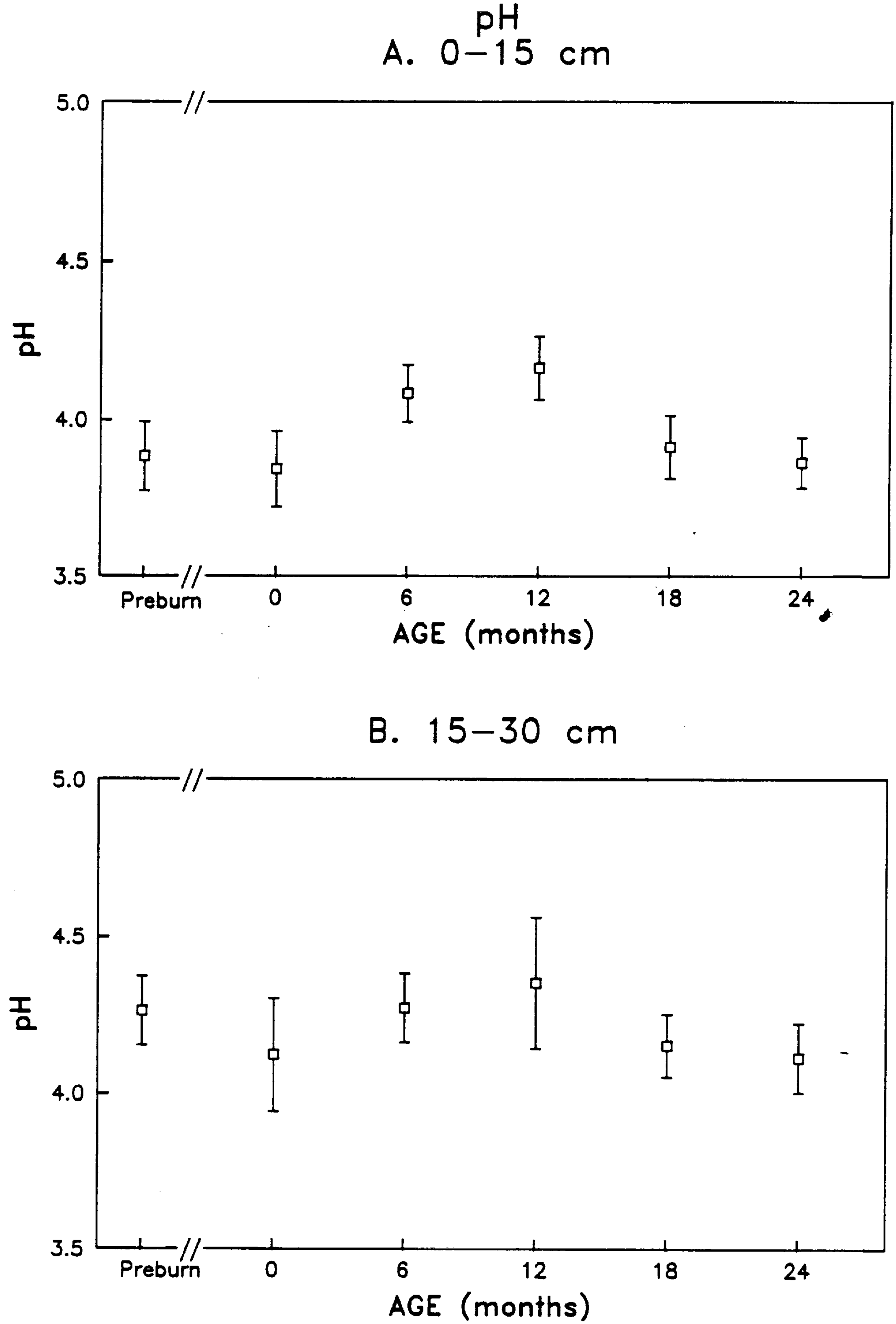

pH
A. 0–15 cm
5.0
4.5
4.0
3.5
pH
Preburn
0
6
12
18
24
AGE (months)
B. 15–30 cm
5.0
4.5
4.0
3.5
pH
Preburn
0
6
12
18
24
AGE (months)

Figure 28. Conductivity of well drained scrub soils preburn and through 24 months postburn of scrub transects that burned in December 1986. Shown are means and 95% confidence intervals for the 0-15 cm layer (A) and the 15-30 cm layer (B).

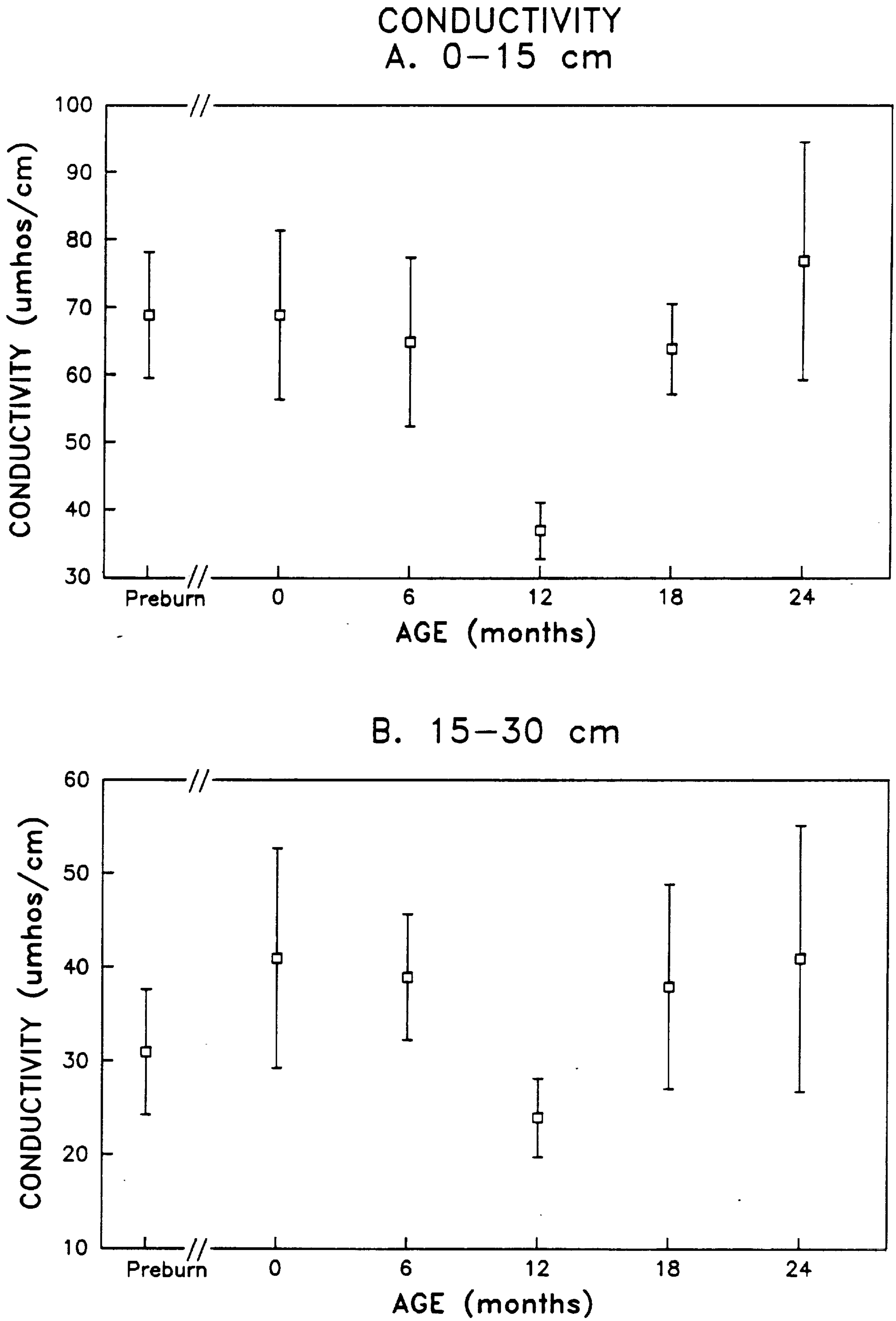
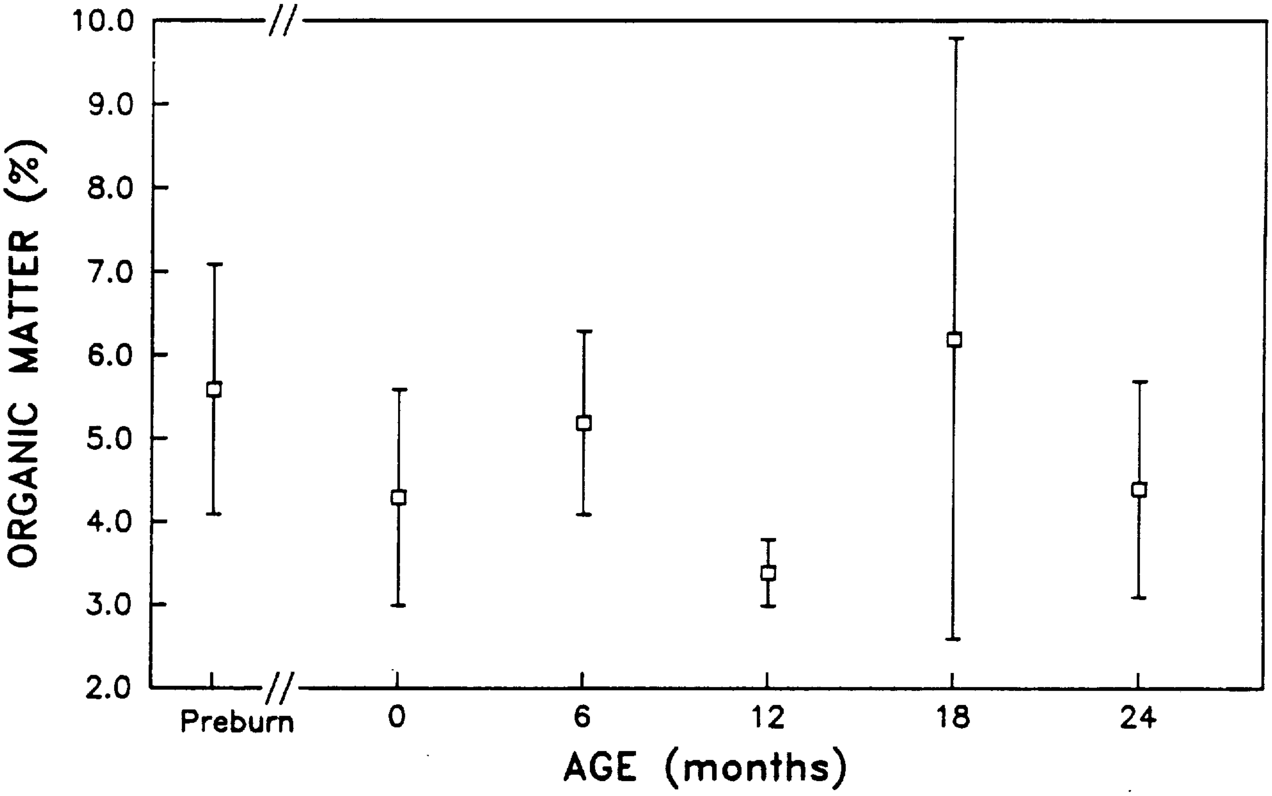

CONDUCTIVITY
A. 0–15 cm
CONDUCTIVITY (umhos/cm)
100
90
80
70
60
50
40
30
Preburn
0
6
12
18
24
AGE (months)
B. 15–30 cm
CONDUCTIVITY (umhos/cm)
60
50
40
30
20
10
Preburn
0
6
12
18
24
AGE (months)

Figure 29. Organic matter of well drained scrub soils preburn and through 24 months postburn of scrub transects that burned in December 1986. Shown are means and 95% confidence intervals for the 0-15 cm layer (A) and the 15-30 cm layer (B).

ORGANIC MATTER
A. 0–15 cm



B. 15–30 cm

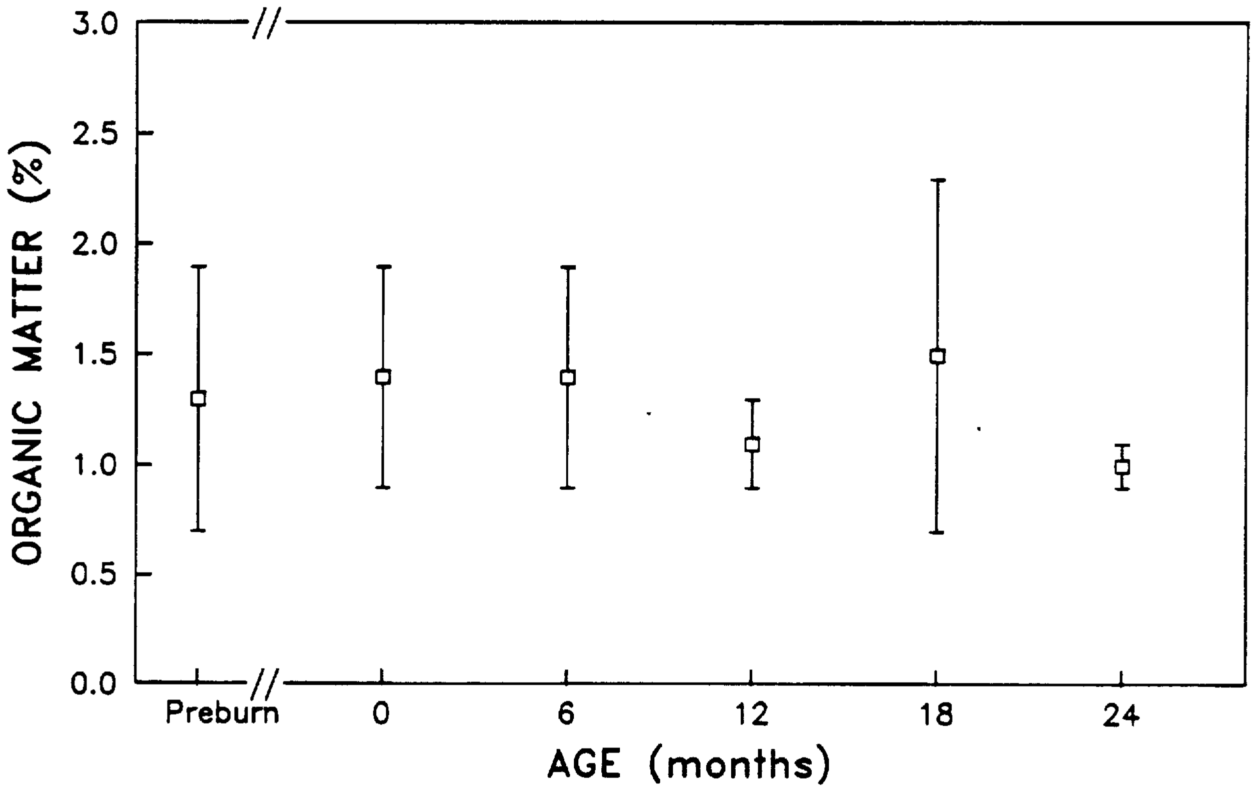
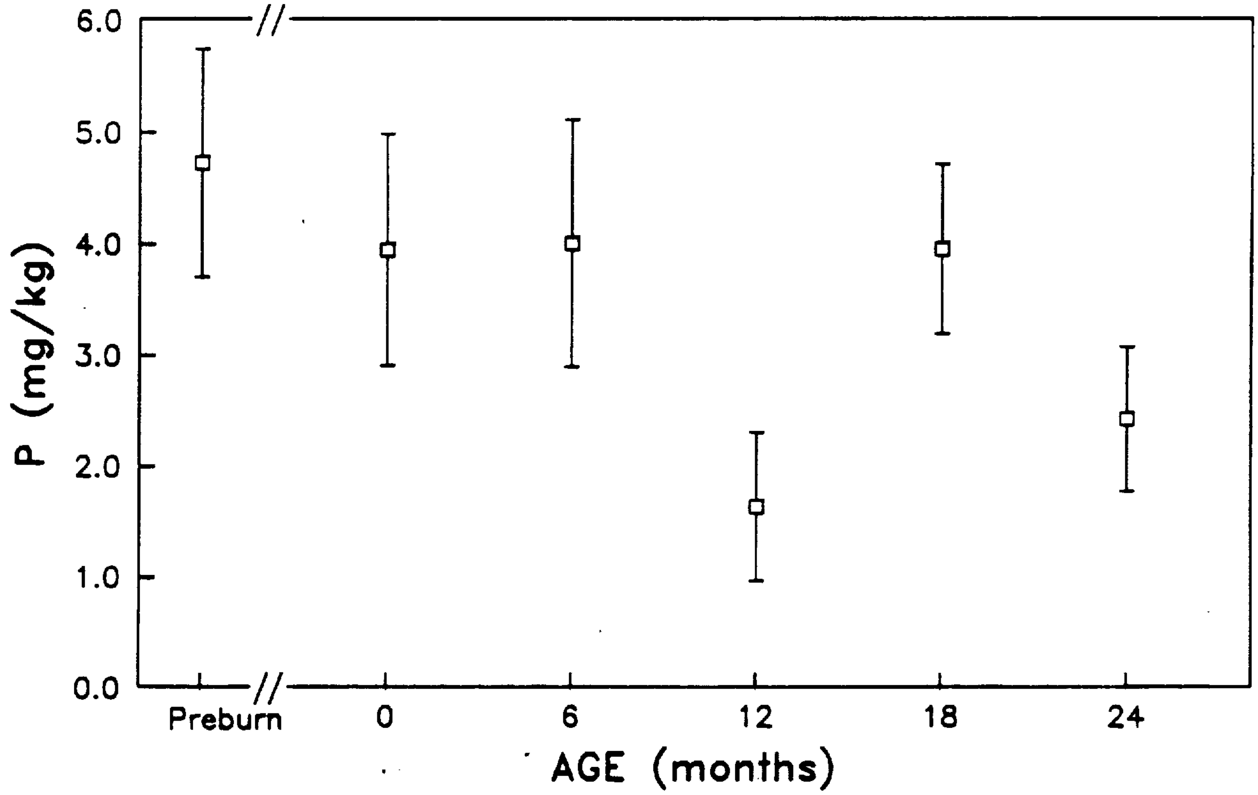


Figure 30. Available phosphorus of well drained scrub soils preburn and through 24 months postburn of scrub transects that burned in December 1986. Shown are means and 95% confidence intervals for the 0-15 cm layer (A) and the 15-30 cm layer (B).

PHOSPHORUS

A. 0–15 cm



B. 15–30 cm

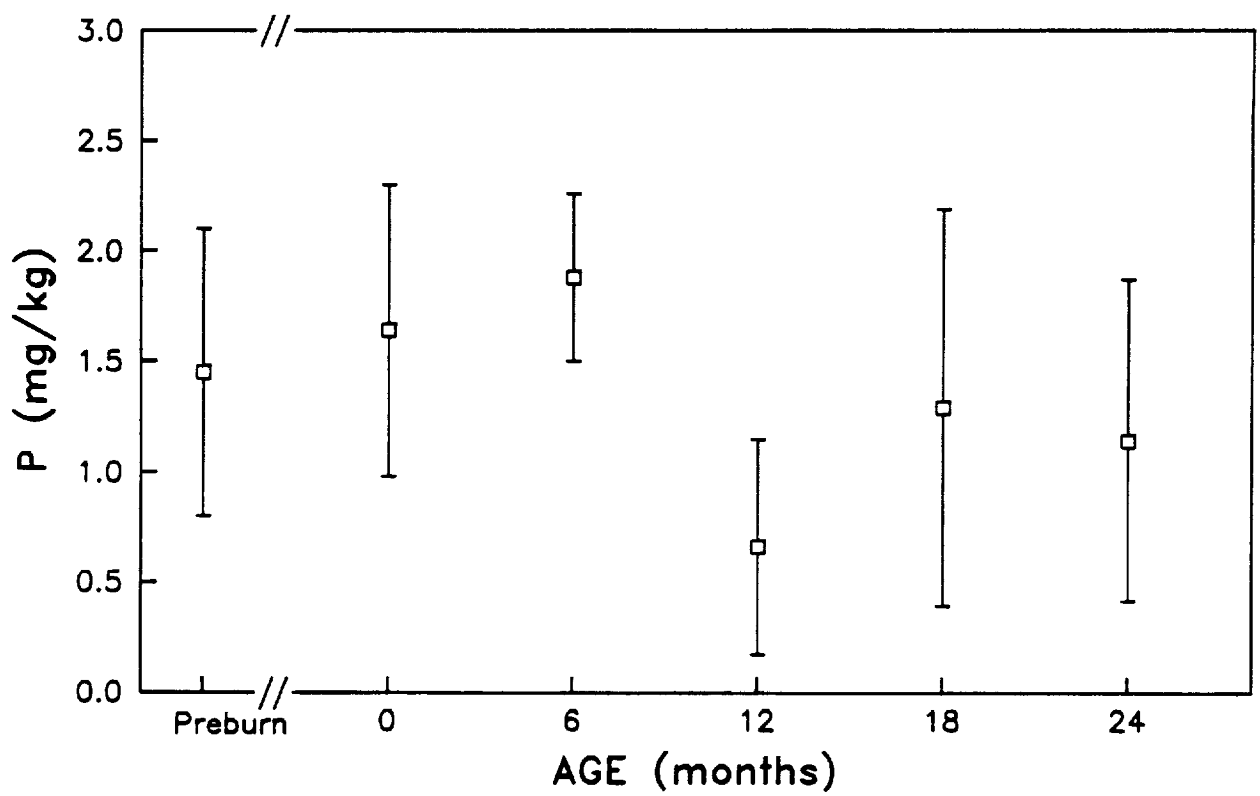
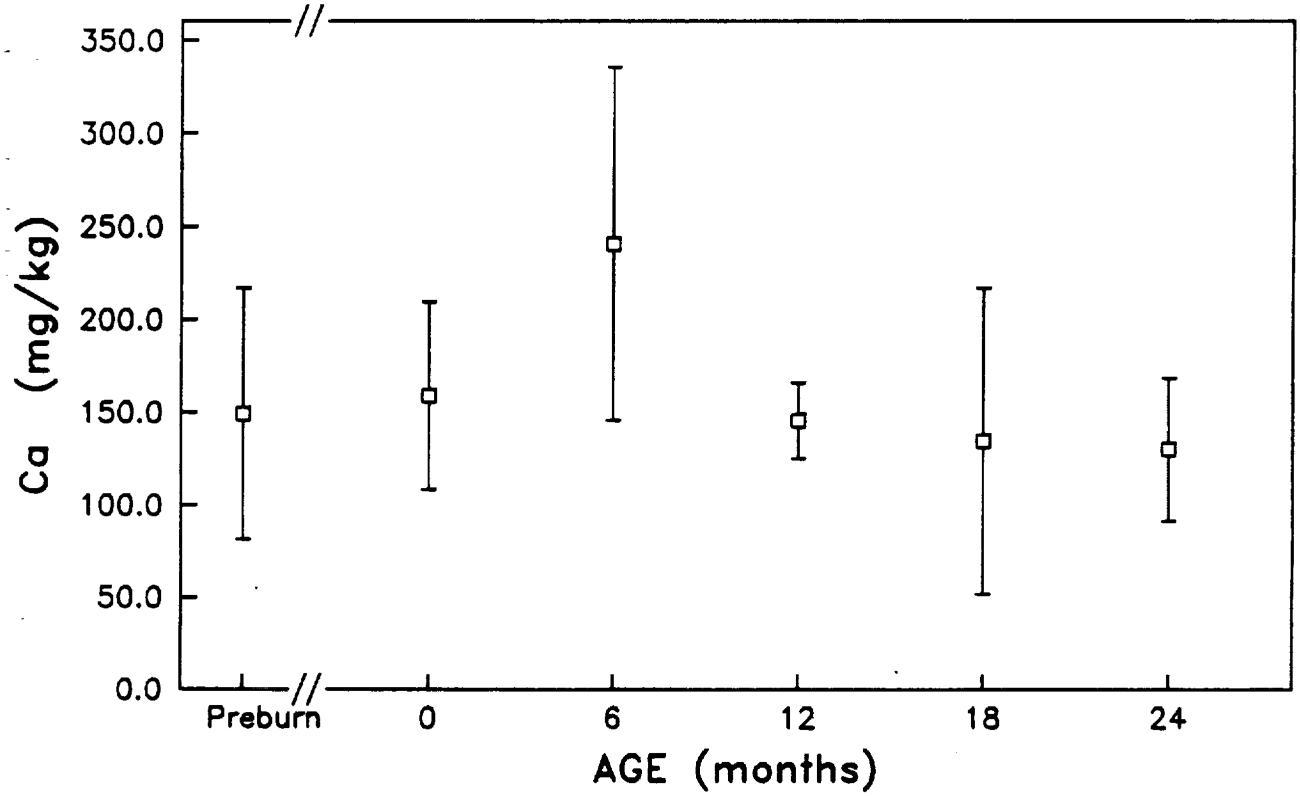


Figure 31. Exchangeable calcium of well drained scrub soils preburn and through 24 months postburn of scrub transects that burned in December 1986. Shown are means and 95% confidence intervals for the 0-15 cm layer (A) and the 15-30 cm layer (B).

CALCIUM

A. 0–15 cm



B. 15–30 cm

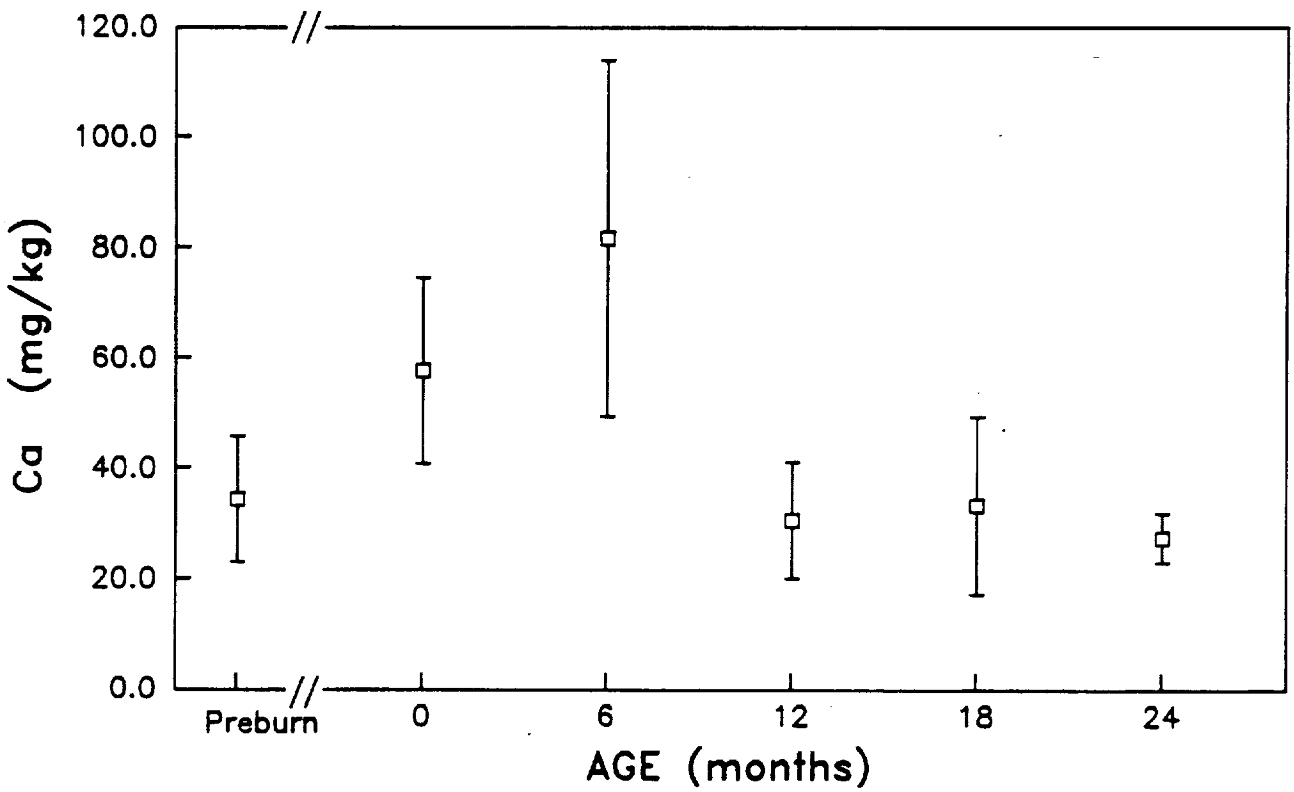
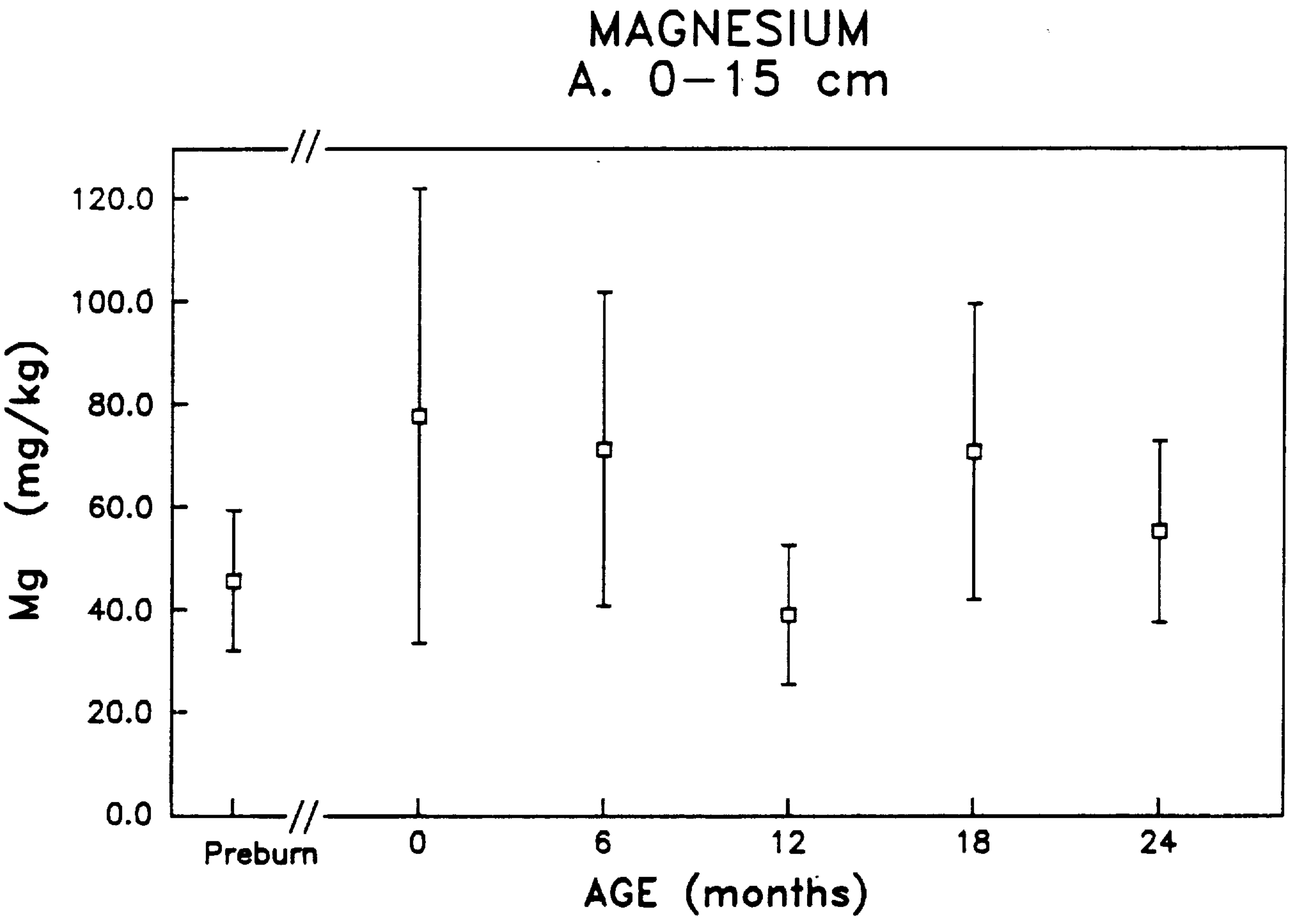


Figure 32. Exchangeable magnesium of well drained scrub soils preburn and through 24 months postburn of scrub transects that burned in December 1986. Shown are means and 95% confidence intervals for the 0-15 cm layer (A) and the 15-30 cm layer (B).


MAGNESIUM
A. 0–15 cm
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Mg (mg/kg)
Preburn
0
6
12
18
24
AGE (months)

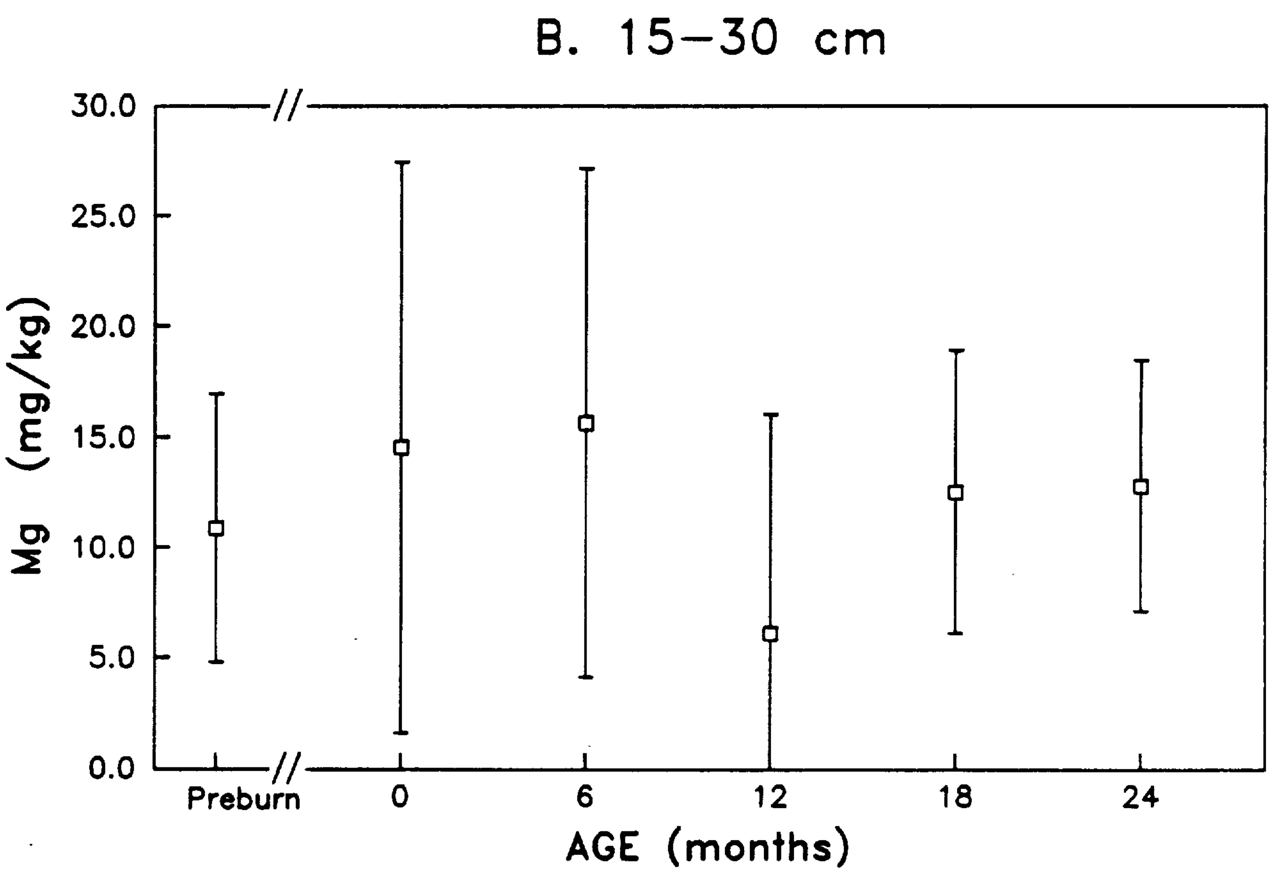
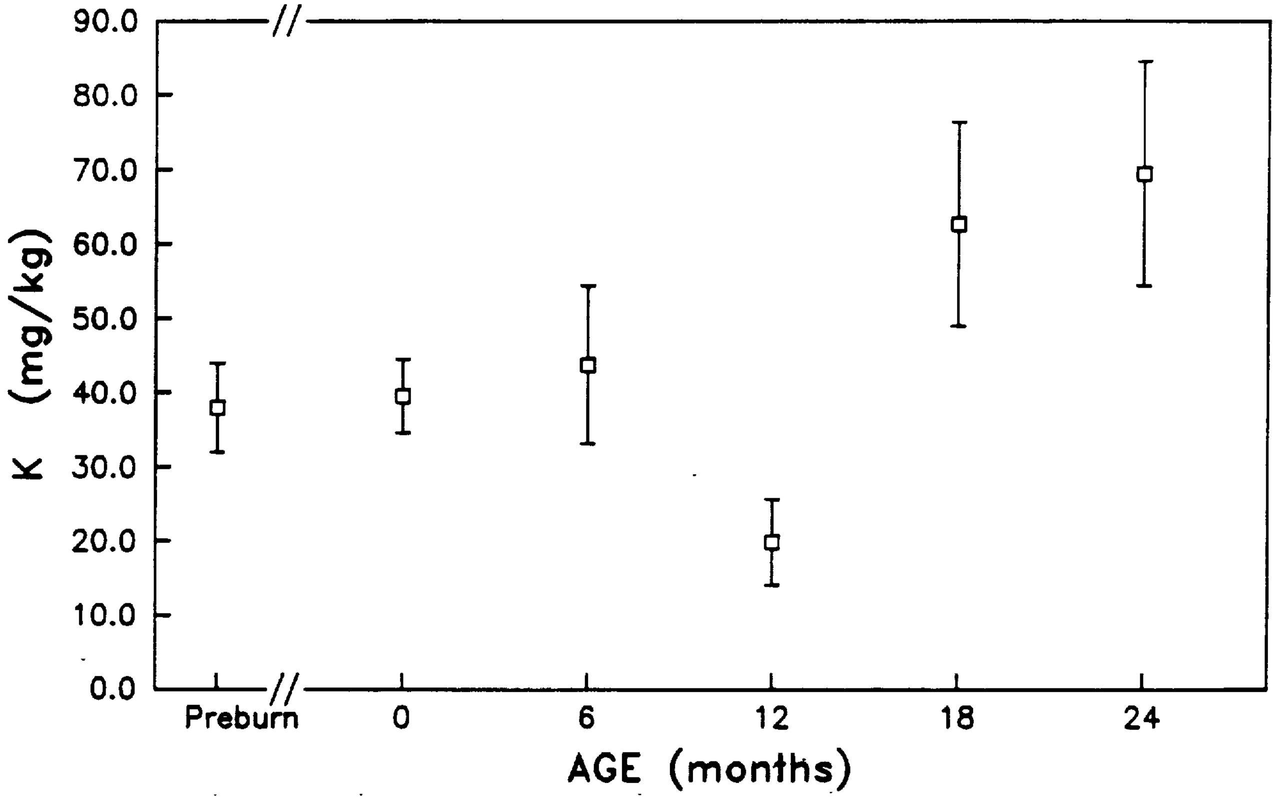

B. 15–30 cm
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Mg (mg/kg)
Preburn
0
6
12
18
24
AGE (months)

Figure 33. Exchangeable potassium of well drained scrub soils preburn and through 24 months postburn of scrub transects that burned in December 1986. Shown are means and 95% confidence intervals for the 0-15 cm layer (A) and the 15-30 cm layer (B).

POTASSIUM

A. 0–15 cm



B. 15–30 cm

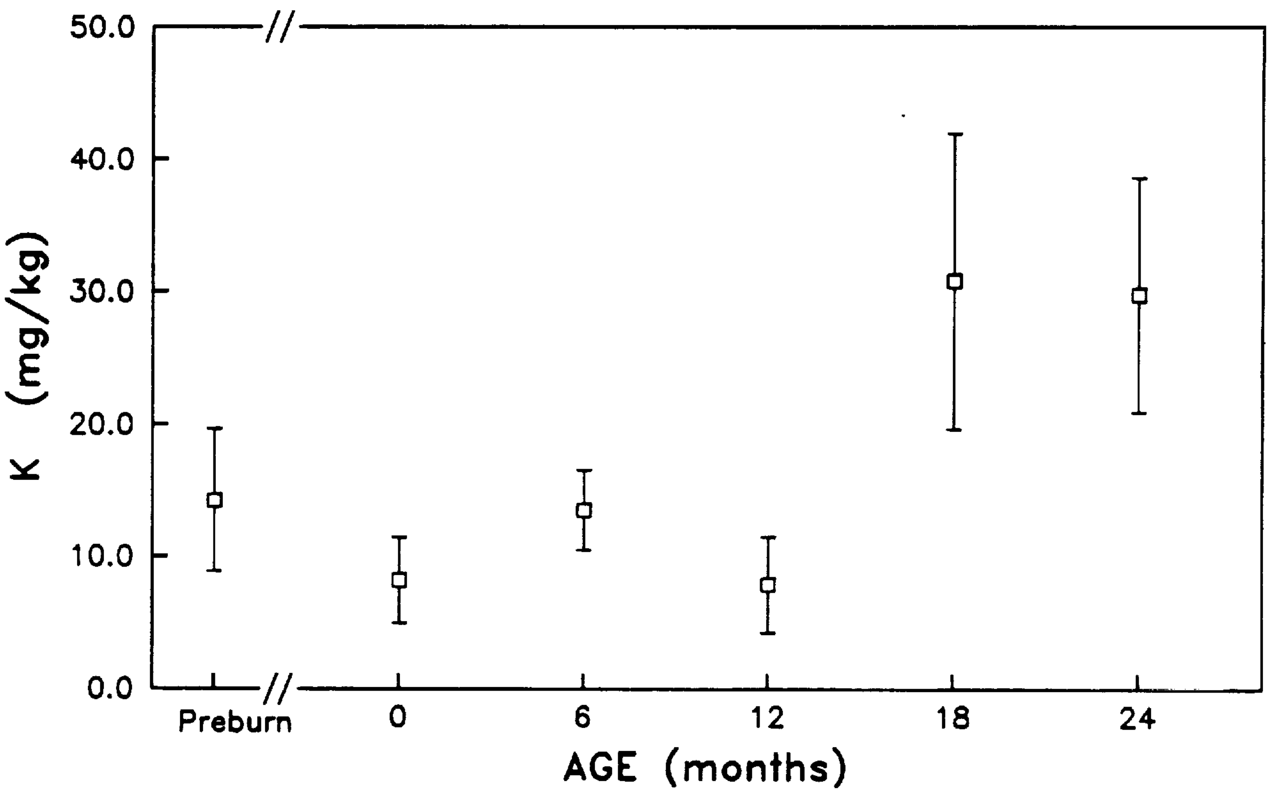
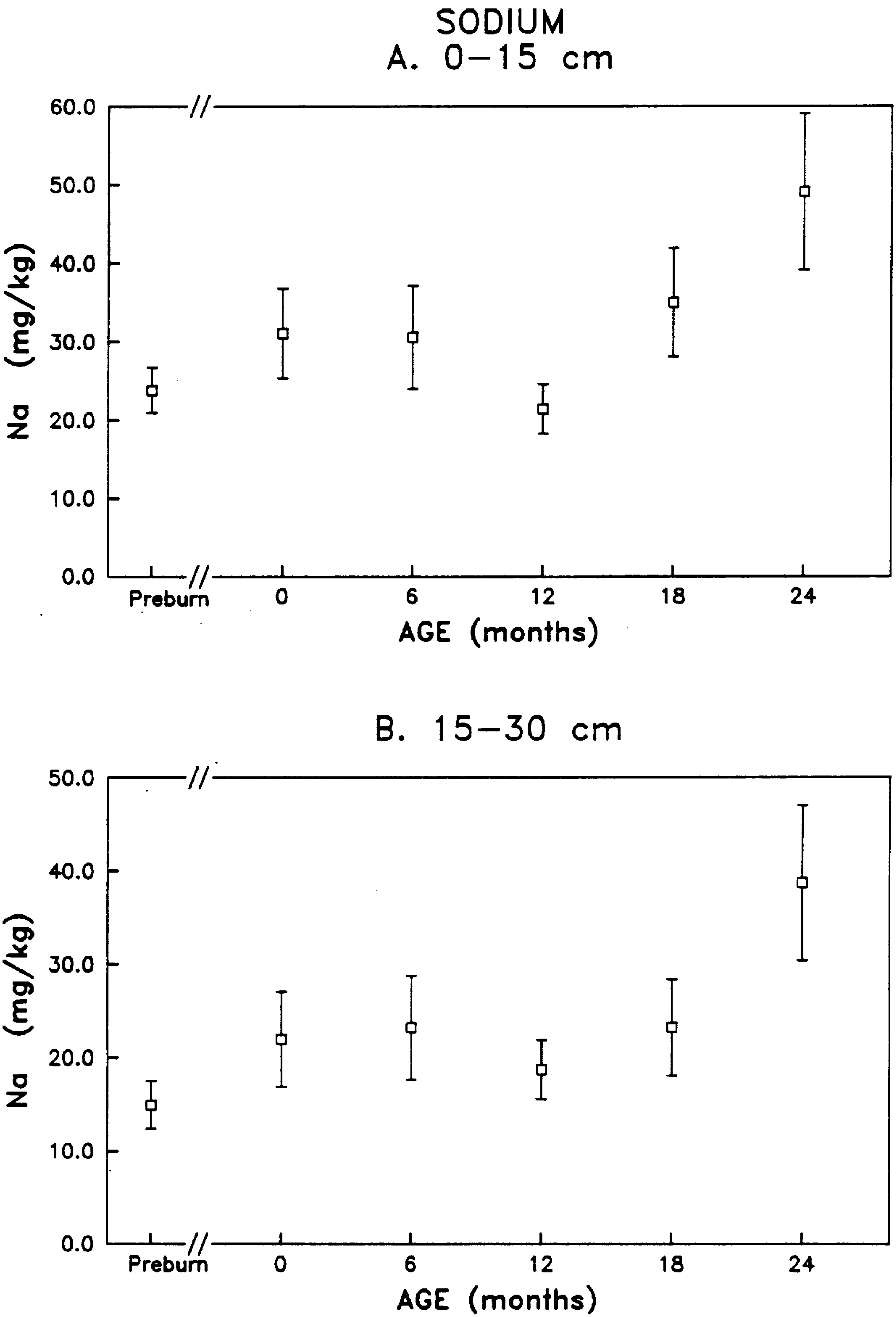


Figure 34. Exchangeable sodium of well drained scrub soils preburn and through 24 months postburn of scrub transects that burned in December 1986. Shown are means and 95% confidence intervals for the 0-15 cm layer (A) and the 15-30 cm layer (B).



SODIUM
A. 0-15 cm
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Na (mg/kg)
Preburn
0
6
12
18
24
AGE (months)
B. 15-30 cm
50.0
40.0
30.0
20.0
10.0
0.0
Na (mg/kg)
Preburn
0
6
12
18
24
AGE (months)

Figure 35. Exchangeable nitrate-nitrogen of well drained scrub soils preburn and through 24 months postburn of scrub transects that burned in December 1986. Shown are means and 95% confidence intervals for the 0-15 cm layer (A) and the 15-30 cm layer (B).

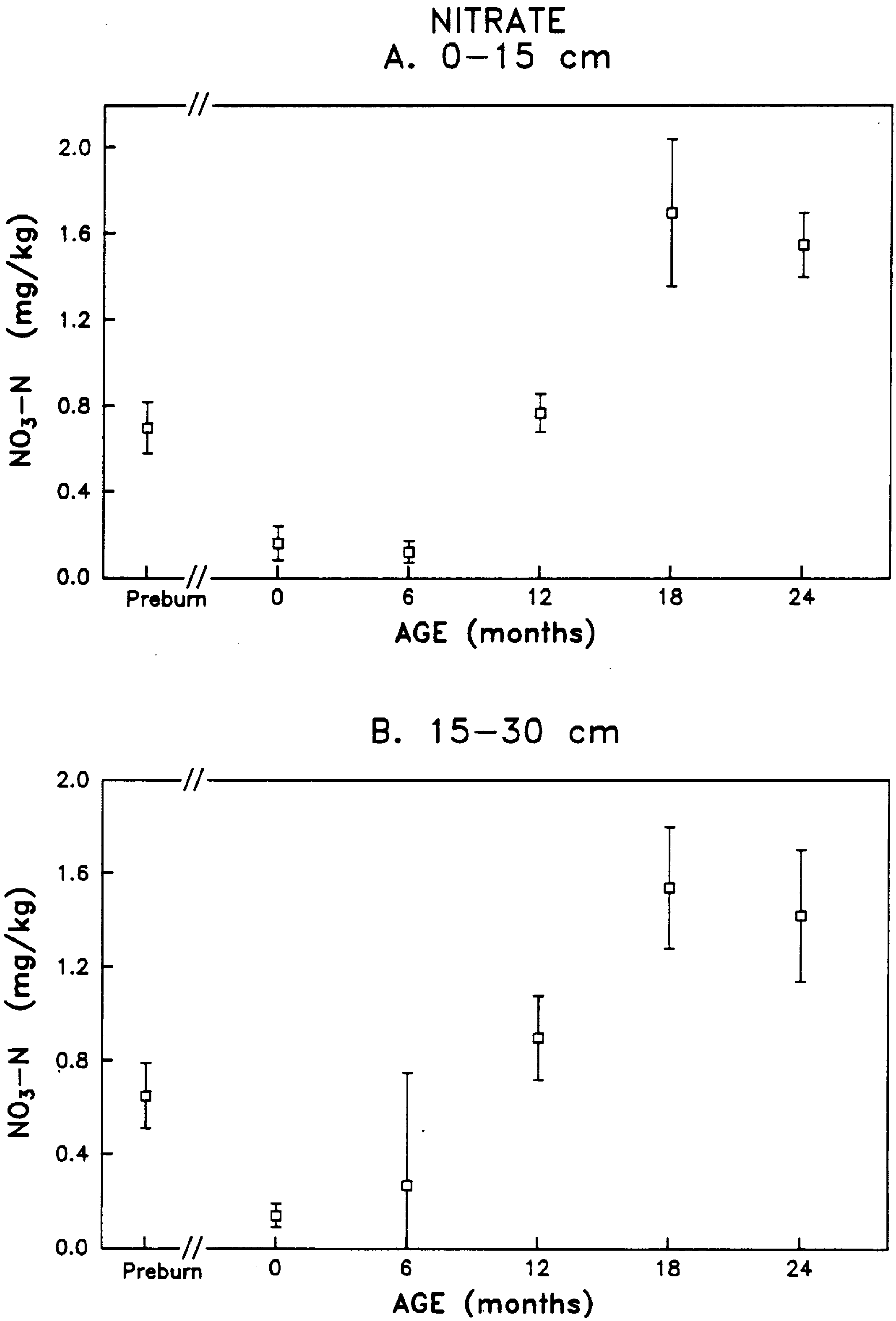

NITRATE
A. 0–15 cm
NO3–N (mg/kg)
2.0
1.6
1.2
0.8
0.4
0.0
Preburn
0
6
12
18
24
AGE (months)
B. 15–30 cm
NO3–N (mg/kg)
2.0
1.6
1.2
0.8
0.4
0.0
Preburn
0
6
12
18
24
AGE (months)

Figure 36. Exchangeable ammonium-nitrogen of well drained scrub soils preburn and through 24 months postburn of scrub transects that burned in December 1986. Shown are means and 95% confidence intervals for the 0-15 cm layer (A) and the 15-30 cm layer (B).

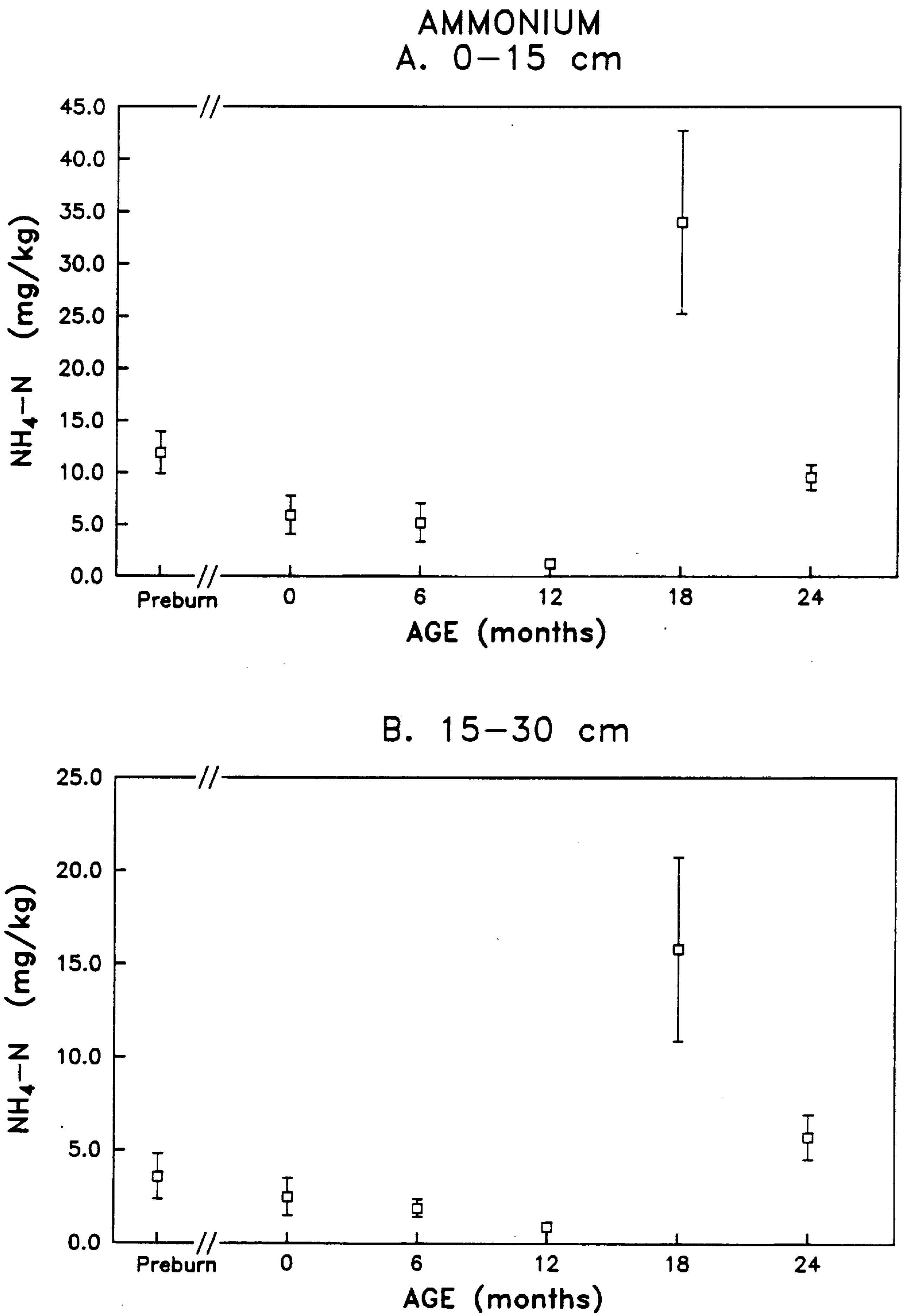

AMMONIUM
A. 0–15 cm
NH4–N (mg/kg)
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Preburn
0
6
12
18
24
AGE (months)
B. 15–30 cm
NH4–N (mg/kg)
25.0
20.0
15.0
10.0
5.0
0.0
Preburn
0
6
12
18
24
AGE (months)

Figure 37. Exchangeable aluminum of well drained scrub soils preburn and through 24 months postburn of scrub transects that burned in December 1986. Shown are means and 95% confidence intervals for the 0-15 cm layer (A) and the 15-30 cm layer (B).

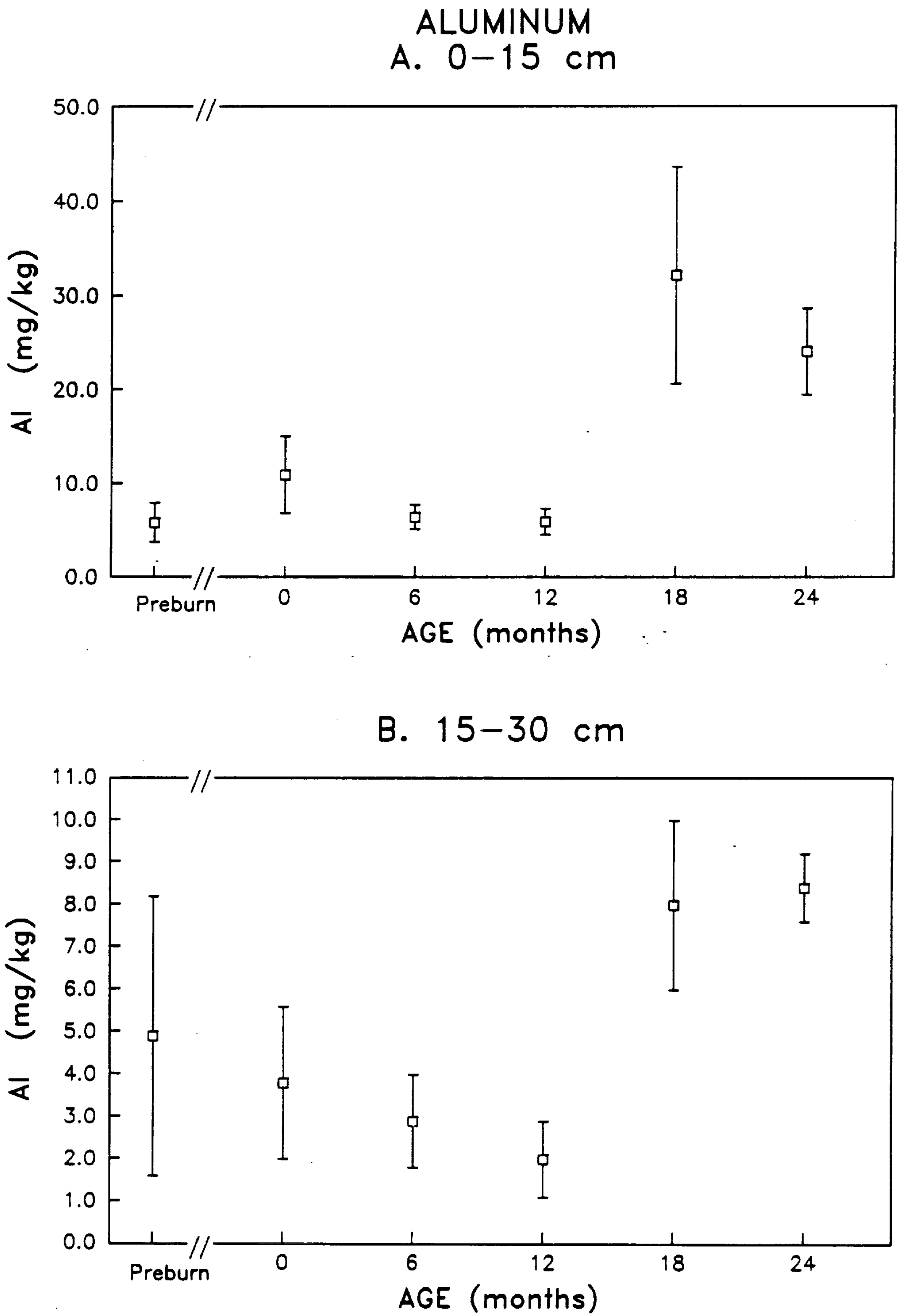
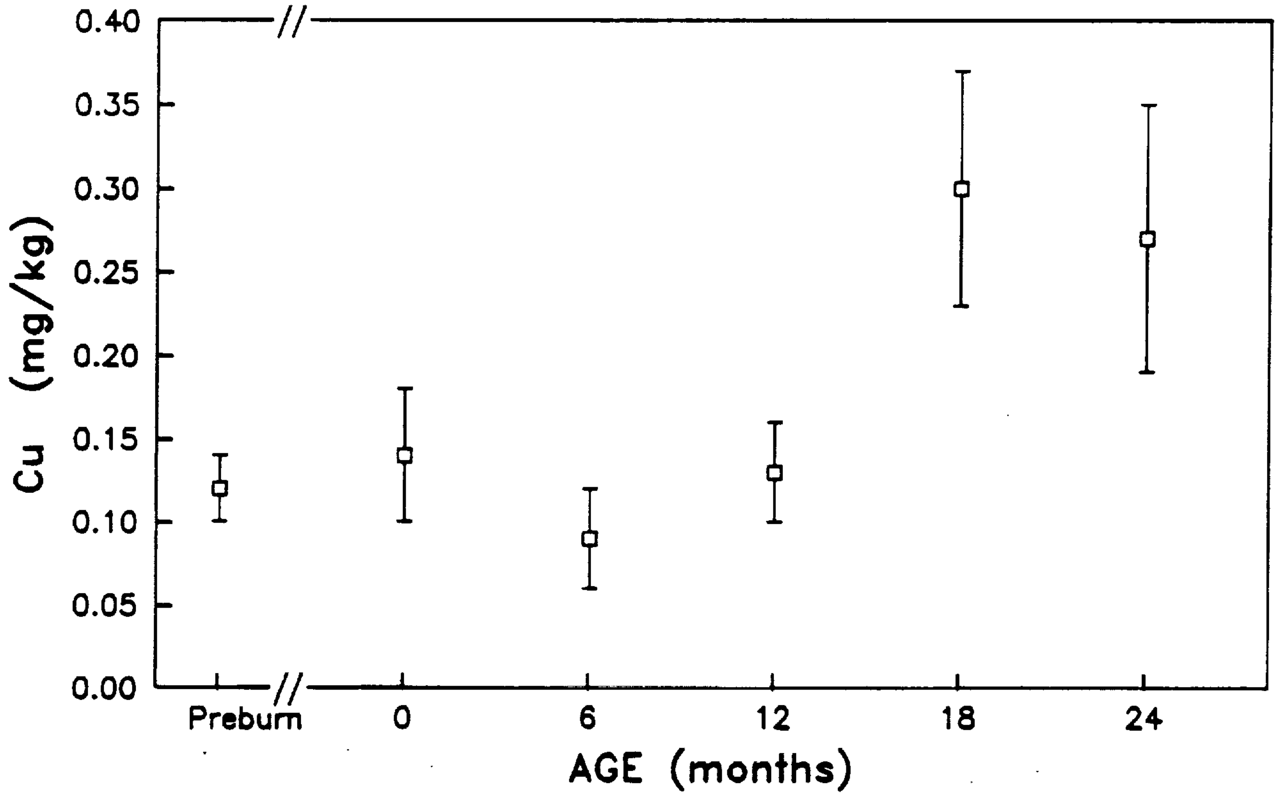

ALUMINUM
A. 0–15 cm
Al (mg/kg)
50.0
40.0
30.0
20.0
10.0
0.0
Preburn
0
6
12
18
24
AGE (months)
B. 15–30 cm
Al (mg/kg)
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Preburn
0
6
12
18
24
AGE (months)

Figure 38. Available copper of well drained scrub soils preburn and through 24 months postburn of scrub transects that burned in December 1986. Shown are means and 95% confidence intervals for the 0-15 cm layer (A) and the 15-30 cm layer (B).

COPPER
A. 0–15 cm



B. 15–30 cm

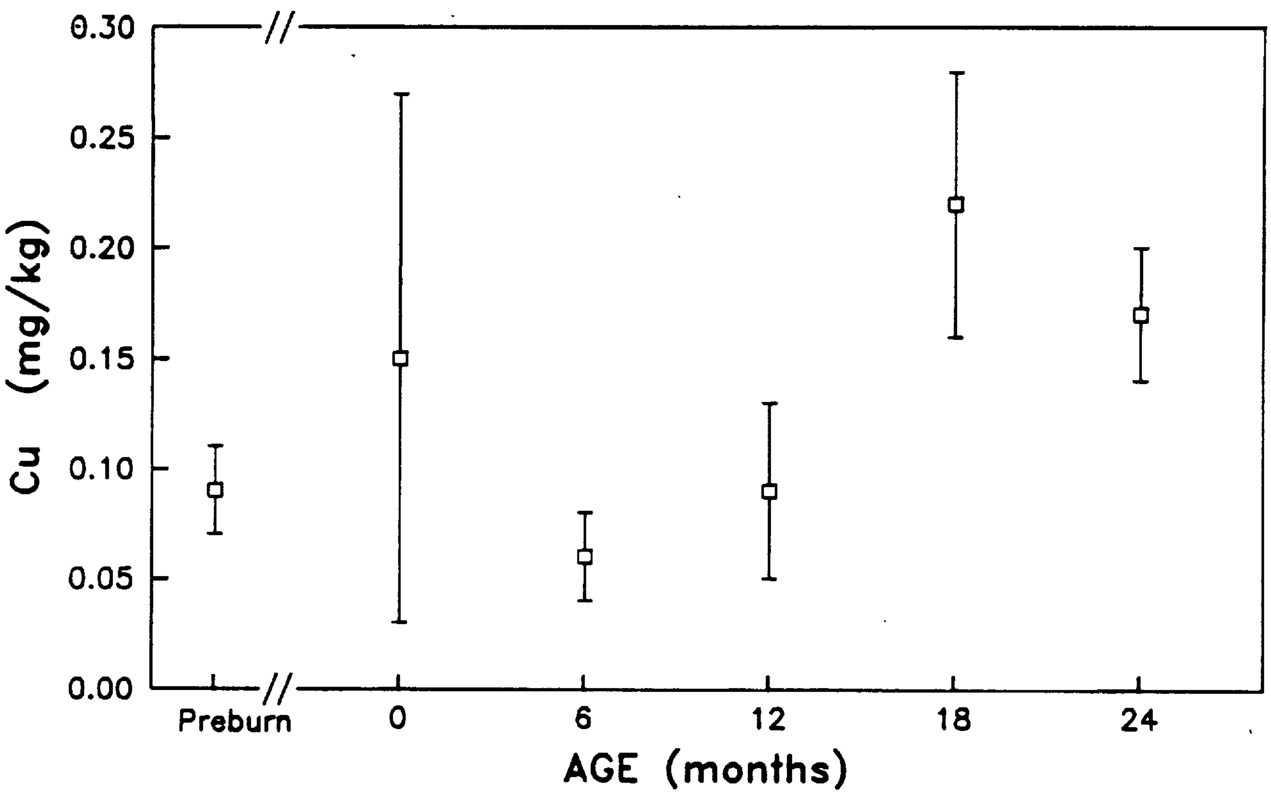


Figure 39. Available iron of well drained scrub soils preburn and through 24 months postburn of scrub transects that burned in December 1986. Shown are means and 95% confidence intervals for the 0-15 cm layer (A) and the 15-30 cm layer (B).

IRON

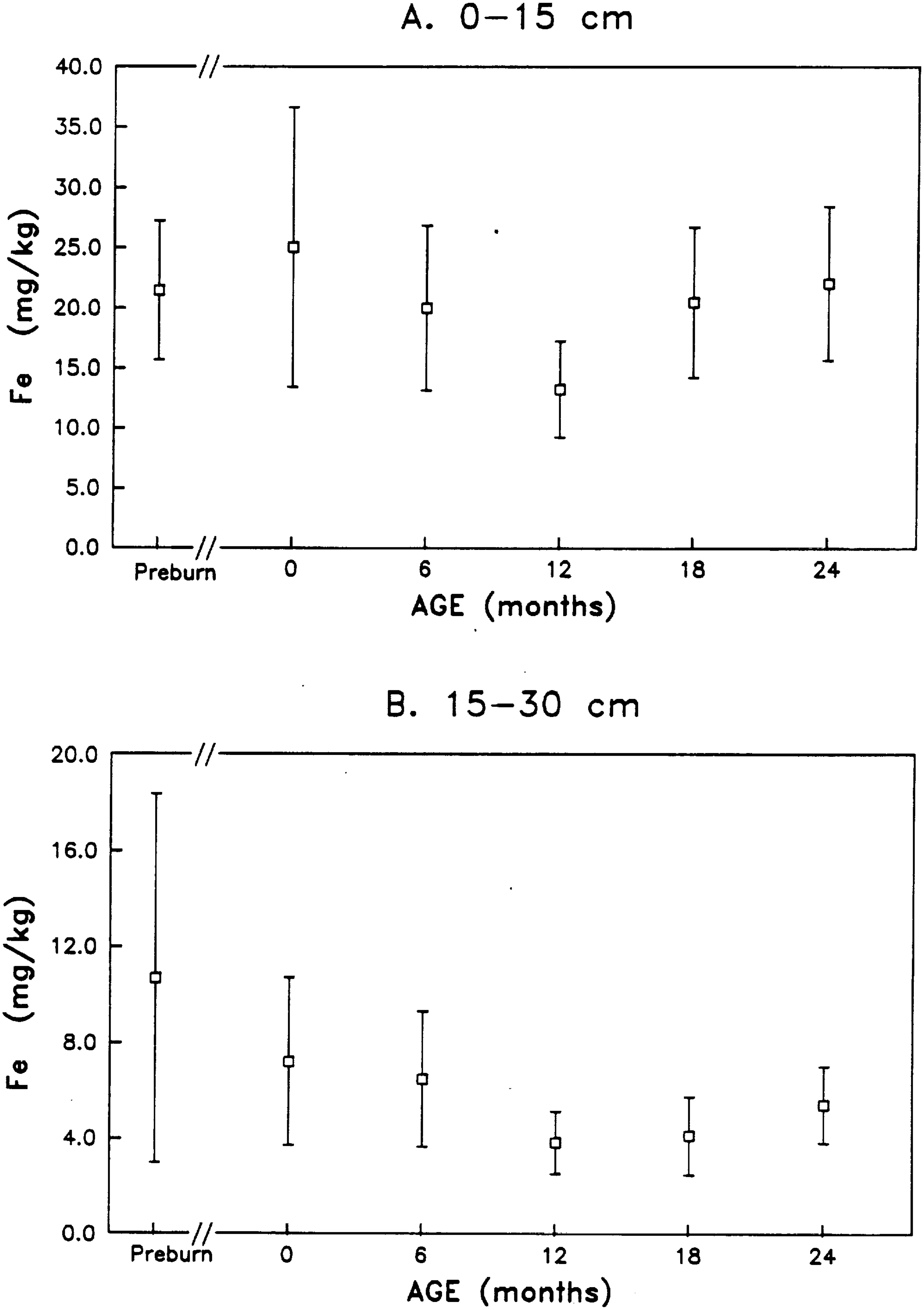
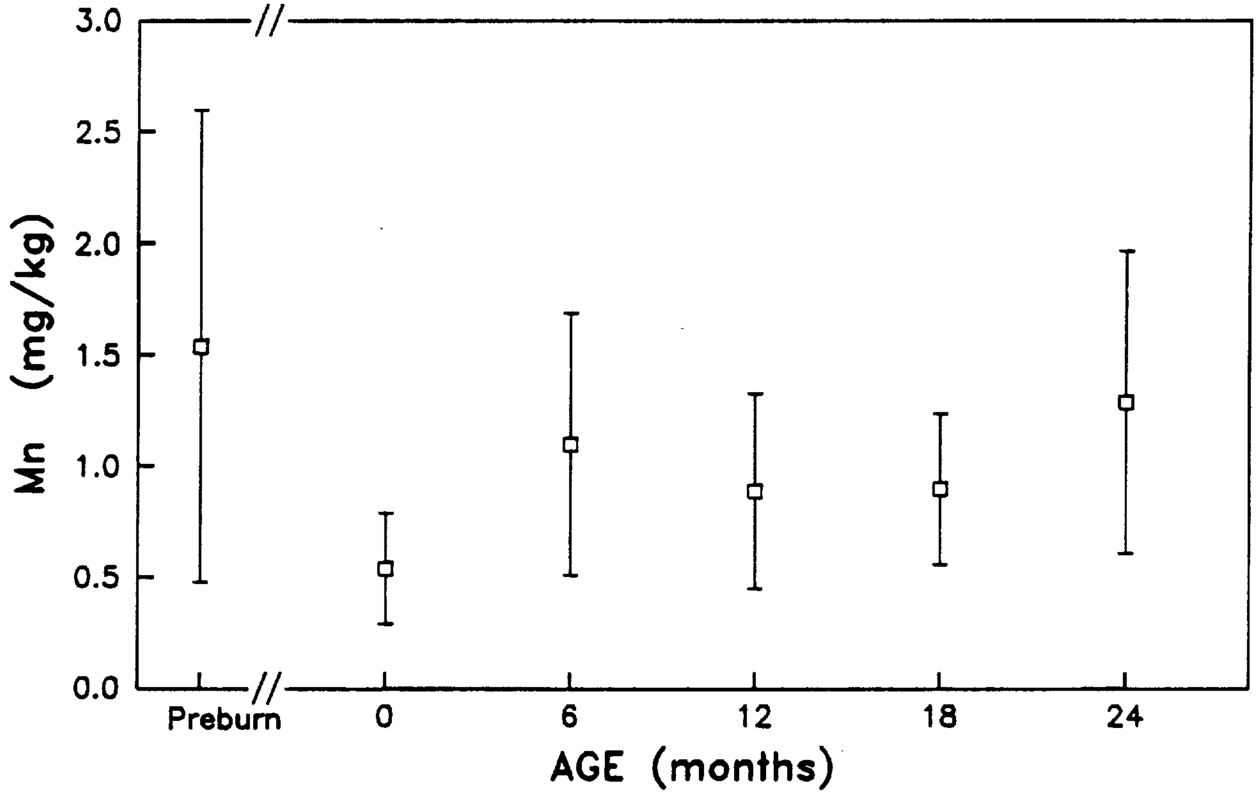

A. 0–15 cm
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Fe (mg/kg)
Preburn
0
6
12
18
24
AGE (months)
B. 15–30 cm
20.0
16.0
12.0
8.0
4.0
0.0
Fe (mg/kg)
Preburn
0
6
12
18
24
AGE (months)

Figure 40. Available manganese of well drained scrub soils preburn and through 24 months postburn of scrub transects that burned in December 1986. Shown are means and 95% confidence intervals for the 0-15 cm layer (A) and the 15-30 cm layer (B).

MANGANESE

A. 0-15 cm



B. 15-30 cm

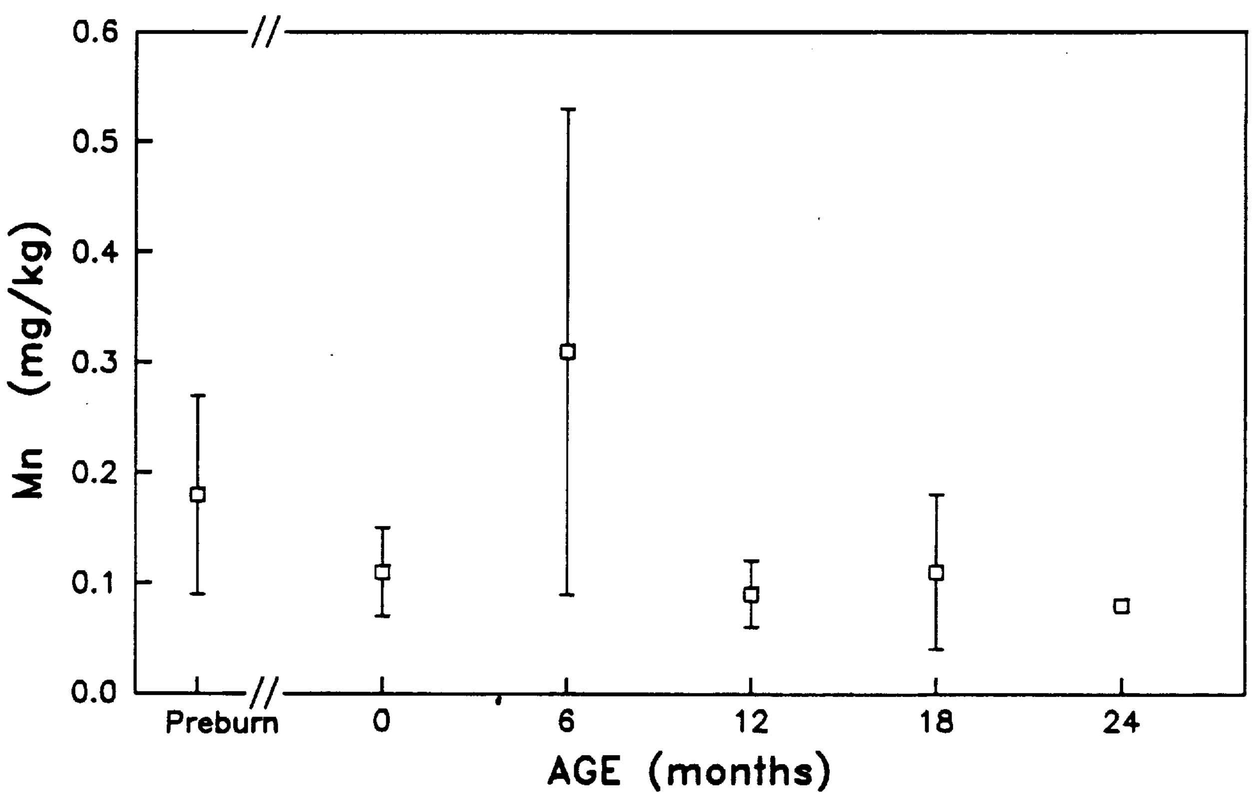
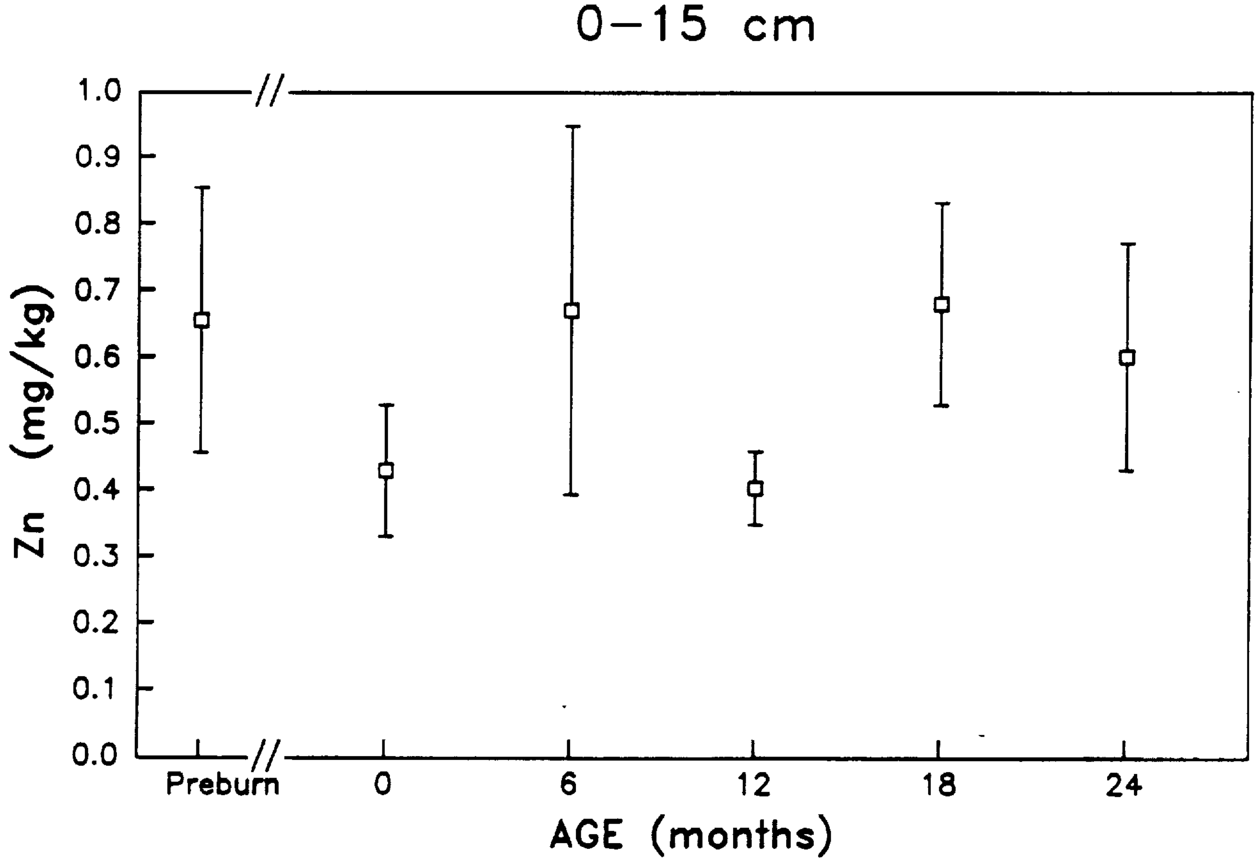


Figure 41. Available zinc of well drained scrub soils preburn and through 24 months postburn of scrub transects that burned in December 1986. Shown are means and 95% confidence intervals for the 0-15 cm layer (A) and the 15-30 cm layer (B).

ZINC


0-15 cm
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Zn (mg/kg)
Preburn
0
6
12
18
24
AGE (months)

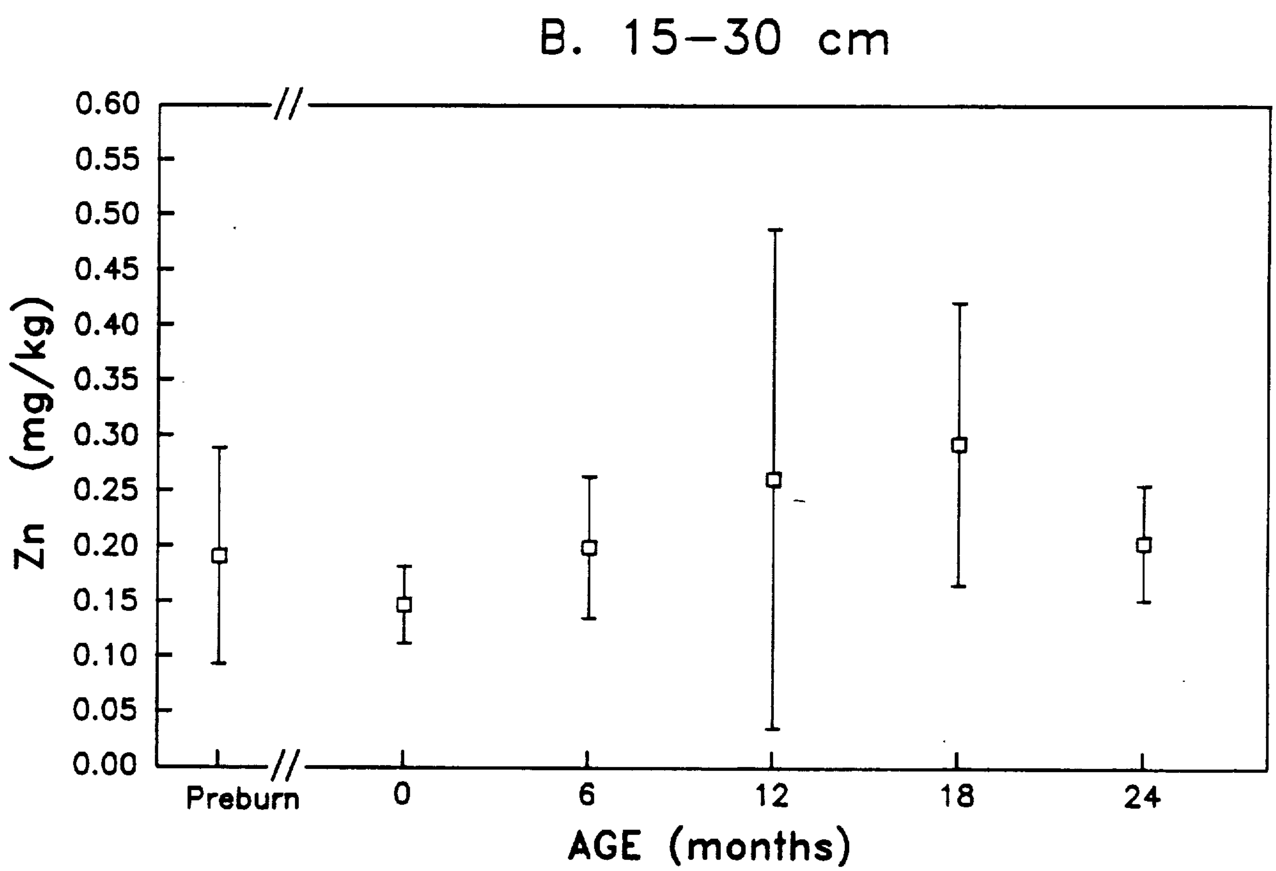
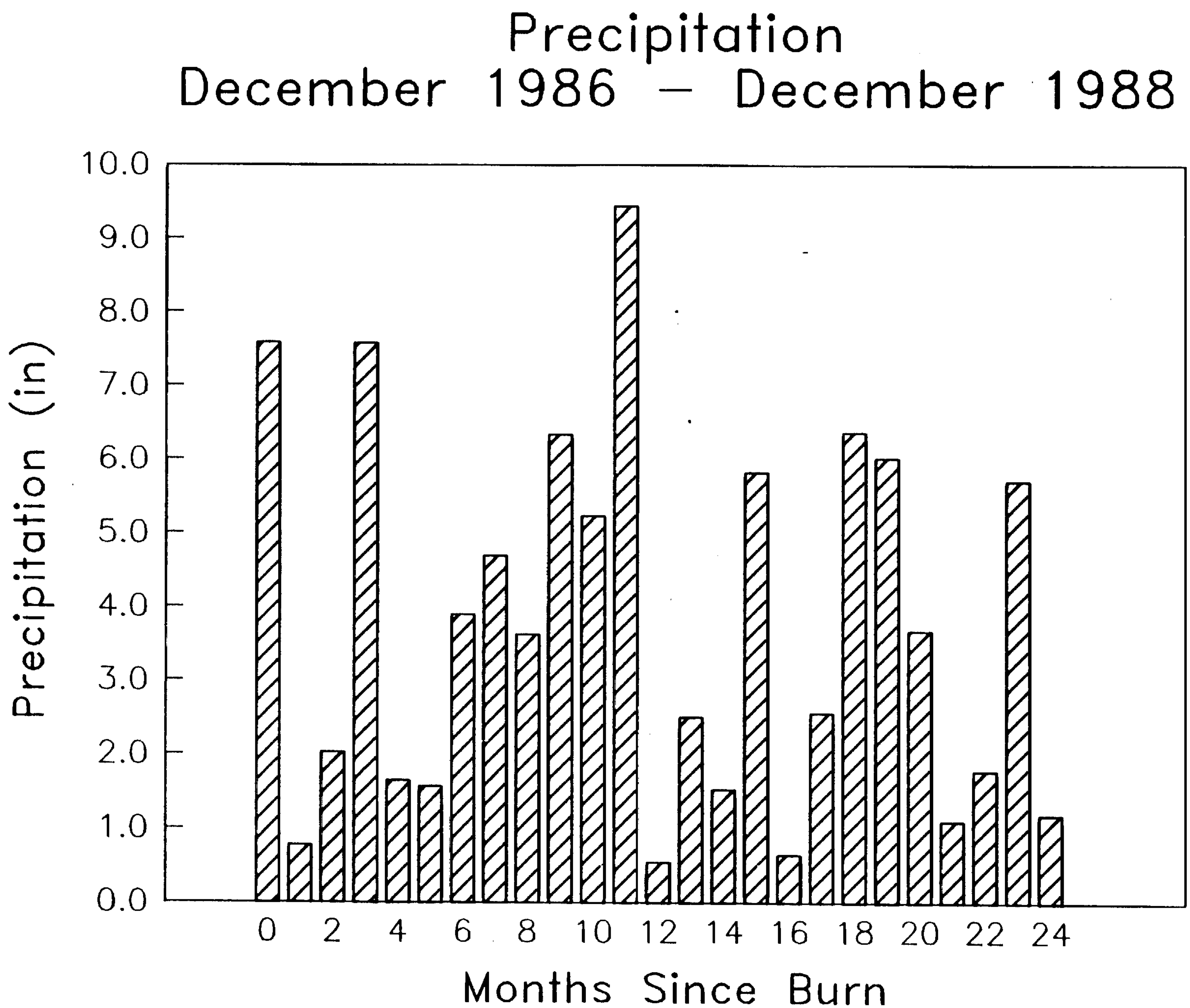

B. 15-30 cm
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Zn (mg/kg)
Preburn
0
6
12
18
24
AGE (months)

Figure 42. Precipitation from December 1986 to December 1988 during the course of the scrub soil study. Data are monthly precipitation values from a National Atmospheric Deposition Program rain station ca. 9.3 km south of the study area.


Precipitation
December 1986 – December 1988
Precipitation (in)
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
0
2
4
6
8
10
12
14
16
18
20
22
24
Months Since Burn

NASA
National Aeronautics and Space Administration

Report Documentation Page

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	6. Performing Organization Code: BIO-2
7. Author(s): Paul A. Schmalzer, C. Ross Hinkle	8. Performing Organization Report No.
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12. Sponsoring Agency Name and Address: NASA/John F. Kennedy Space Center, FL 32899	14. Sponsoring Agency Code: MD

15. Supplementary Notes

16. Abstract

Ten permanent 15 m transects previously established in two oak/saw palmetto scrub stands burned in December 1986, while two transects remained unburned. We sampled vegetation in the > 0.5 m and < 0.5 m layers on these transects at 6, 12, 18, 24, and 36 months postburn and determined structural features of the vegetation (height, % bare ground, total cover). We analyzed vegetation data from each sampling by height layer using detrended correspondence analysis ordination. Vegetation data for the > 0.5 m layer for the entire time sequence were combined and analyzed using detrended correspondence analysis ordination. Soils were sampled at 6, 12, 18, and 24 months postburn and analyzed for pH, conductivity, organic matter, exchangeable cations (Ca, Mg, K, Na), NO_3-N, NH_4-N, Al, available metals (Cu, Fe, Mn, Zn), and PO_4-P.

Shrub species recovered at different rates postfire with saw palmetto reestablishing cover >0.5 m within one year, but the scrub oaks had not returned to preburn cover >0.5 m in 3 years after fire. These differences in growth rates resulted in dominance shifts after fire with saw

17. Key Words (Suggested by Author(s))	18. Distribution Statement
Fire, Florida, Scrub Vegetation, Soil	Unlimited, NTIS

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