SOUTH FLORIDA RESEARCH CENTER

REPORT SFRC-86/05

Response of a Muhlenbergia Prairie to Repeated Burning: Changes in Above-ground Biomass

NATIONAL PARK SERVICE
DEPARTMENT OF THE INTERIOR

Everglades National Park, South Florida Research Center, P.O. Box 279, Homestead, Florida 33030

Response of a *Muhlenbergia* Prairie to Repeated Burning: Changes in Above-ground Biomass

Report SFRC-86/05

Alan Herndon and Dale Taylor

National Park Service
South Florida Research Center
Everglades National Park
Homestead, Florida 33030

1986

Herndon, Alan, and Dale Taylor. 1986. Response of a *Muhlenbergia* Prairie to Repeated Burning: Changes in Above-ground Biomass. South Florida Research Center Report SFRC-86/05.

TABLE OF CONTENTS

LIST OF TABLES

Tables | Page

LIST OF APPENDICES

Appendix

LIST OF FIGURES

INTRODUCTION

Muhlenbergia prairie is one of the most extensive plant communities in the Taylor Slough region of Everglades National Park (Olmsted et al. 1980). This community occupies higher ground than any other prairie type in the Everglades and is consequently the most frequently burned. In the past, many fires that started outside the park have crossed into the park through the extensive *Muhlenbergia* prairies along the eastern boundary of the Taylor Slough region and some fires that started in the park crossed in the other direction (Taylor 1981). This led to the establishment of a regular burning program along the park boundary (Fire Management Plan, 1977). *Muhlenbergia* prairies along the northern and eastern park boundaries were scheduled for frequent burning to reduce fuel loads and lessen the chance of fires crossing the boundaries. Similar fuel reduction burns were also scheduled at several locations well within the boundaries to protect structures or natural sites deemed to be of special importance. These prescribed fuel-reduction burns have generally been carried out during the dry, relatively cool, months from November through March while available evidence indicates that the prairies historically burned during the summer months (Taylor 1981).

A fire-ecology study was established in December 1978 to investigate the effects of repeated boundary burns on the structure and vegetational composition of the *Muhlenbergia* prairie type. In particular, the effect of season of burn and burning frequency on subsequent vegetative recovery; and the long-term structural changes associated with different burning regimes were the major concerns of the study. Another question of particular concern involved the effect of different fire regimes on the endangered Cape Sable Seaside Sparrow (*Ammospiza maritima mirabilis*). A large percentage of the extant populations of this sparrow live in *Muhlenbergia* prairies (Werner 1975; Bass and Kushlan 1981). Cover, which is strongly influenced by recent fire history at least, seems to be the most important factor determining the suitability of any particular prairie site for use by this species (Werner 1975; Kushlan et al. 1982; Taylor 1984). The entire study included vegetation analysis, mammal trapping, arthropod sampling, and studies on the Cape Sable Seaside Sparrow. In this report, one aspect of the vegetation analysis, the response of above ground biomass (fuel load), is discussed.

We report the results of the first six year cycle in the experiment. First, we discuss the sampling requirements for the biomass measurements at length to provide a basis for future analyses. Then, we report some results concerning the short-term recovery of above-ground biomass in our study sites. Finally, we are able to discuss some factors which lead to the observed heterogeneity in the pattern of biomass distributed on the prairie surface.

MATERIALS AND METHODS

Description of the Study Site

Muhlenbergia prairie is characterized by the co-dominance of the clump-forming grass *Muhlenbergia filipes* and small plants of the rhizomatous sedge, *Cladium jamaicense*. Other important members of this vegetation type are the sedge, Rhynchospora tracyi, and the grass, Schizachyrium rhizomatum. Many other species of graminoids and herbs are also found growing in this prairie type, and some may even be locally dominant (Olmsted et al. 1980). Typically, the vegetative cover is uneven with plants appearing to be randomly distributed. Sinkholes, often containing tall tussocks of Cladium, are scattered irregularly throughout the prairie. These sinkholes may have much higher or lower biomass per unit area than the surrounding level prairie. For a more detailed description of this vegetation type see Olmsted et al. (1980).

Plots for the Muhlenbergia prairie fire ecology study were set up in prairie north of the Main Park Road (US 27) about 2.5 kilometers (1 mile) west of Taylor Slough Bridge (Figure 1). This site differs from the prairie area discussed by Olmsted et al. (1980) in occupying higher ground and being less subject to inundation. The average period of inundation (defined as standing water covering at least 50% of the prairie surface) at this site is approximately 45 days per year (see below). Records indicated that no fires had occurred within the study site for at least ten years prior to the start of the experiment. We assumed the site was no longer changing under the influence of a previous fire.

Experimental Design

The overall experimental design is factorial with season of burn and frequency of burn as factors. Seasons chosen for burning correspond to distinct biological periods, during which plants might be expected to show different responses to burning. December-January burn plots are scheduled for burning in late December or early January. This represents the early part of the dry season and the middle of the cool season. Most plant species in the prairie are not actively growing at this time; very few are flowering or fruiting. February-March burns are scheduled for late February or early March, the middle of the dry season. Many plant species in the prairie are actively growing at this time despite continued drying of the soil. Flowering and fruiting activity is again common following the winter lull. July burns are scheduled for early July. This month normally corresponds to the beginning of the wet season and is characterized by warm temperatures and active plant growth. Frequent, unpredictable, rainstorms make burns difficult to carry out in this month. A control plot was also included in the design to allow us to determine whether seasonal or long-term trends in fuel accumulation were present.

Season of burn was chosen as a factor because there has apparently been a substantial difference between the natural fire season and the times of years most prescribed burns have been carried out. Over 80% of all prescribed burns in Everglades National Park have been carried out in the months from November through March (Taylor 1981). This is due to difficulties encountered in carrying out a prescribed burning program during the summer months. Still, natural fires are set most frequently and burn the greatest acreage at the end of the dry season (Taylor 1981).

Fire frequency was chosen as a factor although no historical information on fire recurrence rates in the Everglades was available for comparison to boundary burning practices. There was adequate biological precedent to suggest that burning frequency would have a major effect on plant recovery.

Table 1 shows the designations given to the various combinations of treatments in this experiment. No six-year burn treatment was planned for July due to concerns about the manageability of such a fire. Each treatment was applied to a single area of approximately 35 ha (50 acres) which contained three vegetation sampling plots (30 X 50 m) and one mammal trapping grid (50 X 90 m).

Fuel Sampling

Above-ground biomass was sampled primarily to determine the fuel available for burning in the prairie and is often called fuel load in the remainder of this study. Fuel loads were sampled at irregular intervals in each treatment area between December 1978 and July 1982 (Appendix 1). Fuel loads were again sampled in all plots between December 1984 and July 1985, six years after the start of the experiment. The treatment areas are scheduled to be burned at the seasons and intervals specified in Table 1 for the next several years. This will make it possible to study the intermediate and long-term effects of these burning schedules on the *Muhlenbergia* prairie.

An individual fuel sample consisted of all plant material above the surface of the ground which was contained in a vertical column defined by a one meter square frame resting on the surface. Standing plant material was clipped at the surface and loose material laying on the ground was collected. In some cases plant litter on the ground was thickly covered by a layer of periphyton. Since periphyton does not burn under current prescription burning practices, such litter was not collected. This involved a subjective decision concerning what to collect, but it is unlikely to have influenced our results very much. Loose litter made only a minor contribution to the total biomass at our study site. We have also observed that there is never a thick layer of loose plant litter on the ground in other *Muhlenbergia* prairie sites.

Fuel samples were collected near the vegetation plots and the mammal plot in each treatment area. Individual collection sites were chosen by throwing a meter-square frame in the vicinity of these fixed plots. Such a non-random placement of sample sites was chosen to insure that samples were spread out over the entire area. The lack of randomization at this level is not expected to create any difficulties since most important changes within the prairie seemed to occur on scales different from the spacing between the permanent plots. Another nonrandom factor in our fuel collection was the decision to not collect samples from sinkhole areas. These sinkholes often contain luxuriant stands of *Cladium* and have a much greater biomass of plant material per unit area than the level prairie surface, but they are scattered and have no significant influence on fire behavior. Prediction of fire behavior was one of our primary aims, so we decided to concentrate on sampling the level prairie. Inclusion of sinkhole samples in the study would probably lead to little or no change in the mean values obtained, but would greatly increase the variance of the mean.

Three fuel samples were collected in treatment areas C, D1, D3, D6, F1, F3, and F6 (see Figure 1) before the initial burns in those areas. Unfortunately, three samples proved to be too few to characterize pre-burn fuel conditions in those areas. The number of pre-burn samples was increased to ten in treatment areas F1 and F3, but loss of samples during processing reduced the number of available measurements. An attempt was made to collect ten fuel samples from each treatment area during sampling periods from July 1979 through June 1980. Starting in July 1981, an attempt was made to collect twelve samples from each treatment area during sampling periods. Losses of samples during processing and time constraints imposed by other ongoing projects led to a reduction in the number of samples collected during some of the sampling periods. More than twelve samples were collected from two treatment areas during one sampling period. It was also necessary to modify sampling in the C treatment area after December 1980 when a prescribed burn in the D1 area escaped and burned approximately one-quarter of C. The burned area of C was sampled independently of the unburned area thereafter.

Fuel load sampling periods were originally scheduled at four month intervals following burns. During the wet season (June-October), however, water levels were often high enough to interfere with or even preclude fuel sample collection. This and time limitations led to the sampling dates recorded in Appendix 1.

Following collection, most of the fuel samples were separated into live and dead components. Sawgrass (Cladium jamaicense) was also separated from the remainder of the sample in most cases. The resulting groups were oven-dried at either 90 °C (from December 1978 through June 1980) or 70 °C (during the remainder of the project) and weighed to the nearest 0.1 gram. Only graminoids and herbs were encountered during our fuel sampling, so all of our figures refer to fine fuels. Samples collected at the end of the study were dried and weighed without separating live and dead components.

Soil Depth and Hydroperiod Measurements

Soil depths were measured concurrently with fuel sample collection from July 1980 through July 1981. Depths were measured by pushing a small-diameter rod (approximately 4 mm) through the soil to bedrock. Five measurements were made at each square-meter sampling site: one at each of the corners and one in the middle.

Average hydroperiod was calculated for the different treatment areas using measurements of water depths in the vegetation plots from 7 to 11 June 1982. During this period, a continuous sheet of surface water covered the prairie from our experimental plots to Taylor Slough Bridge. We calculated the number of subplots which would be flooded for any given stage at Taylor Slough Bridge by assuming that any drop in water level at the Bridge would correspond to an identical drop in water level in our experimental plots. Then, using the record of stage from Taylor Slough Bridge for the period 1961 to 1982, we calculated the average number of days per year 25%, 50%, and 75% of the vegetation subplots would have been flooded.

RESULTS

Statistical Properties of Fuel Sample Data and Analysis Methods

Data for all fuel samples collected during the course of this study are given in Appendix 1. We calculated means and standard deviations for each set of samples and plotted these values against each other (Figure 2). The standard deviation of a sample generally increases with the mean. This is characteristic of values that follow a log-normal distribution. Such a departure from normality is commonly encountered in biomass measurements (Green 1979) and is serious enough to invalidate most parametric tests applied to such data. We transformed the raw data to obtain an approximately normal distribution by adding one to each raw value and taking the natural logarithm of the sum (Sokol and Rohlf 1969; Green 1979). A probit analysis (Bliss 1967) confirmed that the transformed data followed a near-normal distribution (Figure 3). These analyses were carried out on one-year post burn and two-year post burn data because all treatment areas (control excepted) were the same age post-fire, and were all presumably at the same stage of regrowth from the initial burns. In probit analysis, departures from normality show up as departures from a straight line on the graph. Data from both data sets produce fairly straight lines although the data for two-year post burn samples shows a slight tendency towards leptokurtosis.

We used transformed (normalized) fuel values and parametric statistical tests, principally factorial or one-way ANOVA routines, for all comparisons between different treatment areas. The means and variances of the transformed values for each set of samples are given in Appendix 2.

It is possible to estimate the number of observations needed to test for a given level of true difference between the mean fuel loads of two treatment areas with controlled probabilities for the acceptance of an incorrect null hypothesis (α) and the rejection of a correct null hypothesis (β). We used the iterative method given in Sokol and Rohlf (1969) for this purpose on our data. Samples from all treatment areas at three corresponding stages (preburn, one year post-burn, two year post-burn) were pooled to estimate the necessary population means and variances. Results are given in Table 2. The number of samples needed to detect a given difference between two treatment areas depends on which pooled group of samples is used. This is expected since the mean fuel loads at the various stages is different, but it does point out that comparisons between treatment areas should be made at corresponding stages with respect to burning. In all cases, the detection of a 5% difference in log-transformed mean fuel loads between two areas requires a more intensive sampling program than we used. It appears that 10% differences in log-transformed mean fuel loads between areas are efficiently detected by our sampling program. The 10% difference in log-transformed fuel loads corresponds to a 30-50% difference in untransformed fuel loads, so the only changes we are able to detect by collecting 12 samples per treatment area are quite large. Changes of this magnitude are obvious on visual inspection of the sites.

Fire Behavior

Our first major finding was that one-year fuel accumulations would not carry fires in our plots. With two years of accumulated fuel in the plots, fires burned, but left large patches of unburned fuel throughout the treatment area. In treatment areas with three-year fuel accumulations, fires burned nearly all above-ground plant material and left no unburned patches. These results held regardless of the season of year during which burning was attempted.

Spatial Heterogeneity in Fuel Loads

Statistical analysis of the results based on the experimental design is valid only if there is no systematic spatial heterogeneity in average fuel loads of the treatment areas. Spatial homogeneity in fuel loads is not required, but if the fuel loads are heterogenous, they must be randomly distributed with respect to the factors in the experimental design. This is especially critical because we did not replicate treatments.

We first tested for homogeneity of the treatment areas with respect to fuel load using the pre-burn data. A single-classification ANOVA with unequal replications was used for this test. The results are shown in Table 3. A similar single-classification ANOVA was used to test the homogeneity of the treatment areas (excluding C) with respect to fuel load at one-year post burn (Table 3) and two years post-burn (Table 3). Significant inhomogeneity among treatment areas with respect to total fuel load was noted in all cases, indicating that there were significantly different average fuel loads in some of the treatment areas. Spatial heterogeneity of fuel loads on the scale of our treatment areas must, therefore, be considered as a possible source of difficulty in the analysis of our data.

Homogeneous groupings of the treatment areas with respect to fuel load were determined using the Duncan multiple range test for one year post-burn and two years post-burn samples (Table 4). As can be seen, the significant differences in mean fuel loads occur mostly between treatment areas with extreme values and a homogeneous group of treatment areas with medial values. There appears to be a correlation between the factor season-of-burn and mean fuel load in the results two-year post-burn (Fig. 4), but this correlation is not corroborated by the results one-year post-burn or results from later years (Fig. 4, discussed in detail below). Changes in the positions of treatment areas with respect to each other suggest that the apparent correlation is an artifact of sampling. No correlation is evident between frequency of burn and mean fuel load for treatment areas at the same age post-fire. We interpret this as evidence that the spatial heterogeneity in fuel loads is randomly distributed with respect to both factors in our experimental design.

Temporal Stability of Fuel Loads

Our unburned control area (C) allowed us to check on the stability of total fuel load with time in the absence of fire. Figure 8 shows transformed total fuel load at each sampling period for the unburned area (see also Appendix 2). There was evident variability in means at different times. The significance of this variability was tested using a single-classification ANOVA with sample period as the variable of classification. As shown in Table 5, this test revealed no significant differences among samples.

The fuel load samples tested above were collected during all seasons over the course of the six years. The lack of significant differences shows that fuel loads in the control plot were at equilibrium (in the sense of not changing with time). It also suggests that no significant seasonal changes in fuel load occur in Muhlenbergia prairie under conditions of equilibrium.

Effects of Treatments

Treatment effects were investigated using fuel loads collected two years, three years, and six years after the start of the burning cycles in each area. These samples were collected at different seasons, but they provide the only series of samples for which all of the treatment areas are at comparable ages post-fire. Since no evidence was found for seasonal changes in fuel loads in the control plot (see above), the differing seasons of collection should not alter our results.

A three-way ANOVA, using season of burn, fire frequency, and year of data collection as factors, confirms that significant differences in fuel load exist among the treatment areas in the different years (Table 6). As expected, fire frequency has the strongest effect, followed by year of data collection. Season of burn has a significant but lesser effect. We cannot separate season of burn effects from the effect of initial inhomogeneities, so it is possible that the apparent effect due to season is actually a reflection of site differences. Interactions between factors can not be tested since the experimental design is not balanced (there is no plot corresponding to a July, six-year cycle burn).

Two years after the start of the burning, all burned treatment areas were at the same stage of post-fire recovery. The total above-ground biomass at two years is about two-thirds of that in the control area (Figure 4). Identification of homogeneous groupings in this set of data using the Duncan multiple range test shows that areas burned in different seasons were clustered in a non-random fashion (Table 4). This clustering seems to be a reflection of sampling errors and site inhomogeneities rather than a true season of burn effect (see Spatial Heterogeneity in Fuel Loads and below).

Three years after the start of the experiment (Fig. 4), the annual burn treatment areas had been growing one year since burning. The three- and six-year burn areas had all been growing for three years since burning. Fuel loads in the annual burn plots were now distinctly lower than fuel loads in the three- and six-year areas. Average fuel loads in the three- and six-year areas had not increased much from that found at two years, and were still significantly lower than that in the control area. The Duncan multiple range test confirmed the separation of the annual burn areas from the others (Table 4). No clustering of treatment areas according to season of burn was found in this series of samples.

In year six of the experiment (Figure 4), the annual burn plots were a patchwork of one- and two-year roughs. Roughly half of each annual burn plot burned each year with the burned areas usually taking the form of long strips through the plot. Three year burn plot had been growing for three years since last burned, and six year plots had remained unburned for six years. As expected, the annual burn plots had the lowest average fuel loads. No difference was found between the average fuel loads in the three-year, six-year, or control (sixteen years since last burned) plots despite the differences in the period of fuel accumulation (Table 4).

An unexpected result of this experiment was the effect frequent burning was found to have on Cladium jamaicense, sawgrass. During fuel sample collection in year six, it became obvious that Cladium was much less abundant than expected in the annual burn plots. A large drop in Cladium abundance was recorded between years two and three (Figure 5 and Table 7). Low levels of Cladium biomass were found again in year six.

The pattern of Cladium biomass changes shown in Figure 5 is similar to the changes seen in total biomass (Figure 4), but Cladium recovery in the annual burn plots seems to be proportionately lower than total biomass recovery. In year six, total above-ground biomass in the annual burn areas was about 35% of the value in the three-year, six-year, and control areas. At the same time, above-ground Cladium biomass in the annual burn plots was about 20% of the value in the other plots.

Cladium biomass in the annual burn areas was plotted to look for evidence of progressive reduction with time (Figure 6). After the drop in biomass between year two and year three, no change was seen from year three to year six. The drastic drop in Cladium biomass in treatment area J1 was the result of flooding in this treatment area (by Tropical Storm Dennis) shortly after the prescribed burn in year two. This flooding submerged the regrowing Cladium and killed it. However, no obvious explanations are available for the poor recovery of Cladium in treatment areas D1 and F1.

Physical Determinants of Fuel Load

We studied two physical factors which were expected to affect the distribution of plants on a small scale; soil depth and average yearly inundation (hydroperiod). The purpose was to see how well we could use knowledge of the physical factors to replace the time-consuming direct measurement of fuel loads.

Soil depth seemed to correlate well with fuel load in the field; heavier plant growth was found on deeper soils and sparse growth occurred on very shallow soils. To check the strength of the relationship quickly, we plotted total fuel in a one meter square sample against the median of five soil depth measurements made in that square meter. An encouraging relationship was found in only one case (Figure 7). More typical were the results shown in Figure 8. The use of mean, as opposed to median, soil depths was tried in a few cases and found to give no better results. We had to conclude that soil depth could not help predict fuel loads in individual meter-square samples. There remained the possibility that fuel load was correlated with soil depth over a larger scale, so we sought to explain the differences in mean fuel loads between the treatment areas by differences in soil depth. To do this, the mean of soil depths for all meter-square samples from each treatment area at one year post-burn and two years post-burn were plotted against the mean fuel load for that treatment area (Figure 9). No relationship was found between soil depth and fuel load on this scale either.

We were also able to investigate the effect of average yearly inundation (hydroperiod) on mean fuel loads in the treatment areas. Using methods described above, we could estimate the number of days for which 25%, 50%, and 75% of the vegetation subplots in a given treatment area were under water (Table 8). These estimates are crude because local rainstorms can alter the relationship between water levels at Taylor Slough Bridge and our study site, but the relative hydroperiods of the treatment areas should be correctly indicated. If the vegetation subplots provide a representative sample of the treatment area, 50% of the treatment area surface will be under water when 50% of the vegetation plots are under water. We define a treatment area as flooded when 50% of the subplots it contains are under water, and plot the average number of days per year a treatment area is flooded against the mean total fuel load at two years post-burn in the area (Figure 10). Mean fuel load within a treatment area is positively correlated with the hydroperiod of the area, with a correlation coefficient of .825. This correlation is significantly different from zero (p less than .005 that the sample could have been chosen from a population with a correlation coefficient of zero). It appears that a knowledge of the inundation periods in different parts of the Muhlenbergia prairie could be useful in determining the spatial distribution of mean fuel loads which could lead to improvements in the prediction of fire behavior in this vegetation type.

DISCUSSION

Fire Behavior and Fuel Buildup

Since the major aim of the boundary burning program is hazard reduction through the reduction of fuel loads, it is useful to determine the rate of fuel buildup in Muhlenbergia prairie following a prescribed burn.

Examples of fuel recovery in our treatment areas are given in Figure 11 which shows the change in mean total fuel loads with time for treatment areas D1 and D3. These graphs are plotted on the same scale to facilitate comparison. Figure 11 also shows the mean total fuel loads in the unburned control (C) with time for comparison. The buildup of fuel following fire is quite rapid in all cases. Total fuel load is near pre-burn levels by two years post-burn (Figure 11).

There is a difference in the patterns of recovery shown by the live and dead components of the fuel load. The live component increases even more rapidly than the total fuel (see Fig. 12 for an example). It recovers to approximately 90% of its pre-burn value within one year. There is a slight, but significant, increase in its value during the second year of recovery (Table 9). A constant level, presumably reflecting the equilibrium value of the site, is reached within the second year. Dead fuel increases relatively slowly, and appears to be accumulating steadily throughout the first two years post-fire. The difference between mean dead fuel accumulations at one and two years post-fire is highly significant (Table 9). During the third year post-fire, dead fuel accumulation starts to level off. It reaches a constant value (where the production of dead fuel is balanced by decomposition) approximately three years after burning. Since total fuel load is the sum of live fuel and dead fuel, it also reachs a constant value at approximately three years post-fire.

Comparing fire behavior in the treatment areas with mean fuel loads, we see that fires burned cleanly only when fuel loads were near the carrying capacity for the area. It can be seen, further, that the minimum total fuel load required to burn this Muhlenbergia prairie area lies between 130 and 180 gm/m^2. Perhaps more relevant is the observation that the minimum dead fuel load required to carry a fire lies between 76 and 112 gm/m^2. Without doubt, the minimum fuel load required to carry a fire depends on weather conditions, but the values given above provide limits that can be used to guide further studies.

Live/Dead Fuel Relationship

Differing rates of recovery for live and dead fuels leads to a change in the ratio of live/dead fuel with time post-fire. The significance of this change and the means of testing differences in the ratios is not clear at this time, so only a preliminary discussion is given. First, the use of live/dead ratios or proportions in parametric tests is not desirable (Green 1979; Sokol and Rohlf 1969). Even if the original variables are normally distributed, the distribution function of a ratio or proportion is usually not normal. It is more likely to be highly skewed, in fact. As an alternative to using these ill-defined variables, it is suggested by Green (1979) that regression lines between the variables of interest be determined, and that tests be run on the slopes or coefficients of the regression lines.

The three examples in Figure 13 show that the relationship between live fuel and total fuel is reasonably linear, so a regression approach to testing hypotheses concerning the proportion of live fuel is possible. Also, from Figure 13, it is evident that the slope of the regression lines does not change much between sampling periods. In fact, regression line slopes are relatively uniform (with a value near 1) for all treatment areas and sampling periods checked.

A test for uniformity of slopes between regression lines from treatment area D6 samples collected in March 1981 and samples from the same area collected in May 1981 revealed no significant differences, although these particular lines were chosen because their slopes, 1.483 and .870, respectively, represented rather extreme differences for our samples.

Significant differences in the regression slopes on these lines would presumably represent differences in the relative rates of net live fuel production and net dead fuel production. Such differences might be expected to occur in comparisons involving different vegetation types, but they appear to be insignificant within our experimental area. From the standpoint of fire management practice, live/dead fuel ratios are unimportant since they change most rapidly in the first few months post-burn. By the time sufficient fuel has accumulated for fire to carry, the live/dead ratio has stabilized.

Hydroperiod and Fuel Load

The observed correlation between fuel load and average hydroperiod may be due to the influence of nitrogen-fixing blue-green algae on nutrient cycles in the prairie. It is possible that sites with a longer hydroperiod, that is, a longer growing season for the blue-green algae, would benefit from a greater overall input of fixed nitrogen into the soil.

Cladium Response to Frequent Burning

The apparent reduction in *Cladium* biomass in the annual burn treatment areas needs further study. Proportionately lower recovery rates for *Cladium* than other species in the *Muhlenbergia* prairie may be responsible for our observations. If so, the gradual displacement of *Cladium* by more swiftly recovering species would be likely under conditions of frequent burning.

CONCLUSIONS

1. Above ground biomass data from *Muhlenbergia* prairie has a log-normal distribution and should be transformed if parametric statistical methods are to be used for analysis.

2. Approximately 10 meter-square samples are needed to estimate the log-transformed mean fuel load of a 35 ha area with 10% accuracy.

3. Mean above-ground biomass values are heterogeneous on the scale of the 35 ha treatment areas in *Muhlenbergia* prairie.

4. Fuel loads in the unburned control area did not change over the six years of sampling. There seems to be a constant equilibrium value of fuel load for each area of the prairie. Once this value is attained, no further significant change in fuel load occurs until the area is burned again.

5. Live fuel recovers quickly, reaching nearly 85% of preburn values within one year post-fire. It reaches equilibrium by the end of two years post-fire.

6. Total fuel reaches or approaches equilibrium by the end of the third year post-fire.

7. A two year accumulation of fuel is necessary to carry fire in our experimental area. In terms of fuel loads, between 130 and 180 gm/m^2 total fuel or 76 and 112 gm/m^2 dead fuel is necessary.

8. Fuel carrying capacity in a given area is not strongly influenced by soil depth.

9. Fuel carrying capacity in a given area is strongly influenced by the hydroperiod of that area.

10. Frequent burning reduces the above-ground biomass of Cladium jamaicense, sawgrass, in Muhlenbergia prairie, and possibly leads to its displacement by competing species.

ACKNOWLEDGEMENTS

Most of the technicians associated with the Fire Ecology program at Everglades National Park spent a great deal of time and effort gathering the data upon which this report is based. Jim Craig, Lynette McLamb, and Ken Vernick helped set up the permanent plots and collected much of the data during the first two years of the study. Later, Todd Steiner, Barbara Lenczewski, Donna Blake, Anthony Caprio, and Lewis Sharman continued the process of data collection. Their efforts are much appreciated.

Burning of the treatment areas was planned and carried out by the Resources Management staff. Phil Koepp was responsible for all burning during the first year of the project. Since then, Bob Doren has supervised all burns in our experimental area.

LITERATURE CITED

Bass, O. L., and Kushlan, J. A. 1982. Status of the Cape Sable Sparrow. Report T-672. Homestead, FL: Everglades National Park, South Florida Research Center.

Bliss, C. I. 1967. Statistics in Biology, Vol. 1. New York, New York: McGraw-Hill.

Everglades National Park. 1977. Fire Management Plan. Homestead, FL: Everglades National Park.

Green, R. H. 1979. Sampling design and statistical methods for environmental biologists. New York, New York: J. Wiley.

Kushlan, J. A., Bass, O. L., Loope, L. L., Robertson, W. B., Rosendahl, P. C., and Taylor, D. L. 1982. Cape Sable Sparrow Management Plan. Report M-660. Homestead, FL: Everglades National Park, South Florida Research Center.

Olmsted, I. L., Loope, L. L., and Rintz, R. E. 1980. A Survey and Baseline Analysis of Aspects of the Vegetation of Taylor Slough, Everglades National Park. Report T-586. Homestead, FL: Everglades National Park, South Florida Research Center.

Sokol, R. R., and Rohlf, F. J. 1969. Biometry. San Francisco: Freeman.

Taylor, D. L. 1981. Fire History and Fire Records for Everglades National Park, 1948-1979. Report T-586. Homestead, FL: Everglades National Park, South Florida Research Center.

Taylor, D. L. 1984. Fire management and the Cape Sable Seaside Sparrow. In Seaside Sparrows, E. Potter, ed. Proc. of North Carolina Biological Survey. North Carolina State Museum.

Werner, H. W. 1975. The Biology of the Cape Sable Sparrow. Report to the United States Fish and Wildlife Service. Homestead, FL: Everglades National Park.

Table 1. Designations and treatments for study areas.

Season of Burning	Treatments: Burned annually	Burned on a 3 year cycle	Burned on a 6 year cycle	Unburned
December-January Burn	D1	D3	D6	C
February-March Burn	F1	F3	F6	--
July Burn	J1	J3	--	--

Table 2. Estimated number of samples needed from each treatment area to detect the tabulated differences in the means between two treatment areas with a detection probability of 95% at a significance level of 5%. Samples from all treatment areas at the same stage of recovery from burning were pooled to determine the overall variability in the fuel load data. Log-transformed values of fuel load are used.

Pooled Group	Detectable difference in means			
	5%	10%	15%	20%
Preburn	50	14	7	5
One year post-burn	38	10	6	4
Two years post-burn	24	7	4	3

Table 3. ANOVA tables for test of homogeneity in initial, one year post-burn, and two year post-burn mean fuel loads between treatment areas. Log-transformed values of total fuel load used.

	SS	df	MS	F
Initial fuel loads				
Between Areas	3.63	8	.454	2.89*
Within Areas	3.93	25	.157	
Total	7.56	33		
One year post-burn				
Between Areas	2.54	7	.363	2.91*
Within Areas	6.98	74	.129	
Total	9.56	81		
Two years post-burn				
Between Areas	2.86	7	.409	5.91*
Within Areas	6.09	88	.069	
Total	8.95	95		

Table 4. Homogeneous groupings of the treatment areas with respect to mean fuel loads as determined by the Duncan multiple range test (Sokol & Rohlf 1969). Groups of means determined to be homogeneous are underlined. Log-transformed values of total fuel are used.

Year one

Treatment area	C	F3	D3	F1	J1	F6	D1	D6	J3
Mean fuel load	5.85	5.01	4.97	4.85	4.80	4.79	4.74	4.66	4.43

Year two

Treatment area	C	F3	F1	F6	D3	D1	D6	J1	J3
Mean fuel load	5.99	5.65	5.50	5.49	5.45	5.31	5.26	5.20	5.09

Year three

Treatment area	C	J3	D3	F3	F6	D6	F1	D1	J1
Mean fuel load	5.80	5.62	5.46	5.41	5.34	5.32	4.70	4.65	4.42

Year six

Treatment area	D3	C	F6	F3	D6	J3	J1	F1	D1
Mean fuel load	6.03	5.94	5.89	5.89	5.80	5.69	4.95	4.95	4.93

Table 5. ANOVA test for homogeneity among collection periods with respect to mean total fuel in unburned treatment area (C). Log-transformed values of total fuel used.

	SS	df	MS	F
Between periods	1.39	5	.278	1.43 ns
Within periods	11.48	59	.195	
Total	12.84	63		

Table 6. Three-way ANOVA of two-, three-, and six-year fuel loads in the burned treatment areas. Log-transformed values of total above-ground biomass were used.

	Sum of Squares	DF	Mean Squares	F
MAIN EFFECTS	40.50	6	6.75	42.5
Year	7.90	2	3.95	24.9
Season	1.59	2	.79	5.0
Frequency	27.05	2	13.53	85.1
RESIDUAL	46.08	290	.16	
TOTAL	86.58	296	.29	

Table 7. Homogeneous groupings of treatment areas with respect to above-ground *Cladium* biomass determined by the Duncan multiple range test.

Year two

Treatment area	C	D6	F1	F3	F6	D3	J3	D1	J1
Cladium biomass	4.31	4.21	3.96	3.75	3.73	3.62	3.57	3.50	3.34

Year three

Treatment area	D6	C	F6	F3	D3	J3	F1	D1	J1
Cladium biomass	4.33	4.19	4.03	3.89	3.75	3.45	3.32	2.69	1.61

Year six

Treatment area	D6	F3	C	D3	F6	J3	F1	D1	J1
Cladium biomass	4.88	4.44	4.37	4.35	4.33	4.17	3.41	2.79	1.73

Table 8. Average number of days per year the listed percentage of vegetation subplots in the listed treatment areas were inundated during the period 1961 to 1982.

Treatment area	25% of subplots inundated	50% of subplots inundated	75% of subplots inundated
D1	51.2	44.0	38.3
D3	62.5	53.6	47.0
D6	51.2	38.8	31.8
F1	53.6	46.2	38.8
F3	62.5	53.6	44.0
J1	60.2	44.0	38.8
J3	44.0	41.9	36.0

Table 9. ANOVA table for test of homogeneity between one year and two year post-burn mean fuel for all treatment areas. Log-transformed fuel values are used.

	SS	df	MS	F
Live fuel				
Among years post-burn	.711	1	.711	9.75
Within years	1.021	14	.073	
Total	1.731	15		
Dead fuel				
Among years post-burn	1.956	1	1.956	39.24
Within years	.698	14	.050	
Total	2.654	15		

Appendix 1. Above-ground biomass measured in meter square samples for all treatment areas and sampling periods. All measurements are given in units of gm per m^2.

Treatment area C, December 1979

Sample	Total Live	Total Dead	Date
V1-1	227.5	643.0	Dec 78
V2-1	87.5	180.5	"
V3-1	90.5	353.5	"

Treatment area C, February 1980

Sample	Cladium Live	Cladium Dead	Other Live	Other Dead	Date
V1-1	16.4	31.2	142.5	580.1	13 Feb 80
V1-2	7.6	18.9	114.0	495.1	"
V1-3	17.6	21.2	196.2	708.5	"
V2-1	16.1	46.2	50.5	160.2	"
V2-2	18.6	42.1	18.2	85.4	"
V2-3	36.1	57.8	35.2	108.7	"
V3-1	14.5	8.3	63.8	222.2	6 Dec 79
V3-2	4.4	9.3	31.8	138.8	"
V3-3	7.1	65.9	38.5	340.6	"
M-1	19.9	51.1	24.6	101.7	13 Feb 80

Treatment area C, April 1980

Sample	Cladium Live	Cladium Dead	Other Live	Other Dead	Date
V1-1	0	0	27.4	120.0	22 Apr 80
V1-2	18.0	35.4	48.2	172.5	"
V1-3	28.4	37.6	18.6	87.8	"
V2-1	30.0	63.8	22.1	82.9	"
V2-2	42.5	35.1	25.3	108.8	"
V2-3	18.8	36.7	45.2	146.5	"
V3-1	47.8	375.2	76.2	199.2	"
V3-2	25.8	36.7	32.5	118.2	"
V3-3	28.0	54.9	28.3	156.0	"
M-1	57.5	292.7	67.8	103.7	"

Appendix 1. Continued.

Treatment area C, August 1980

Sample	Cladium Live	Cladium Dead	Other Live	Other Dead	Date
V1-1	65.9	140.7	26.8	111.6	21 Aug 80
V1-2	50.0	90.7	59.9	183.5	"
V1-3	25.1	50.4	35.5	119.6	"
V2-1	20.0	73.8	31.4	111.4	"
V2-2	24.0	34.2	42.0	148.8	26 Aug 80
V2-3	24.1	61.8	46.4	169.4	"
V3-1	22.9	77.1	91.1	462.7	"
V3-2	2.9	24.6	79.6	362.7	"
V3-3	16.3	25.3	90.2	496.5	"
M-1	16.3	33.5	27.5	77.9	"
M-2	58.6	160.9	32.6	156.5	"
M-3	72.5	294.7	47.0	250.8	"

Treatment area C, December 1980

Sample	Cladium Live	Cladium Dead	Other Live	Other Dead	Date
V1-1	16.1	51.1	102.1	505.2	10 Dec 80
V1-2	18.7	40.5	125.7	334.0	"
V1-3	24.4	31.7	84.7	285.4	"
V2-1	0.1	3.3	88.7	222.7	18 Dec 80
V2-2	28.9	31.9	176.9	431.9	"
V2-3	4.5	50.5	75.1	200.9	"
V3-1	116.4	245.7	31.9	191.0	15 Dec 80
V3-2	17.8	50.2	41.0	120.2	"
V3-3	16.3	53.2	31.7	93.7	"
M-1	32.0	129.1	56.6	252.9	"
M-2	45.0	97.2	37.5	112.3	"
M-3	56.8	134.0	44.6	126.2	"

Treatment area C (unburned), February 1981

Sample	Cladium Live	Cladium Dead	Other Live	Other Dead	Date
V2-1	20.0	90.3	34.6	424.9	6 Feb 81
V2-2	15.5	48.0	68.9	354.9	"
V2-3	14.4	65.5	67.7	232.8	"
V3-1	29.1	82.9	24.4	121.9	"
V3-2	14.5	69.5	41.9	211.7	"
V3-3	24.3	151.2	19.8	215.3	"
M-1	26.7	42.1	51.7	243.6	"
M-2	63.9	229.8	45.8	422.4	10 Feb 81
M-3	17.9	75.5	45.7	272.4	"

Appendix 1. Continued.

Treatment area C (unburned), May 1981

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V2-1	26.7	131.2	64.4	217.0	4 May 81
V2-2	33.7	93.6	46.6	184.5	"
V2-3	32.2	34.4	51.9	190.2	"
V3-1	18.0	48.2	38.9	106.9	3 May 81
V3-2	24.4	104.7	37.7	110.3	"
V3-3	37.1	174.8	44.6	180.7	"
V3-4	8.7	36.8	30.9	164.4	"
M-1	18.5	92.0	29.4	119.5	"
M-2	29.3	97.4	46.1	211.4	"
M-3	34.5	118.3	31.2	79.0	"
M-4	96.0	219.4	59.0	195.1	"

Treatment area C (unburned), December 1981

Sample	Cladium		Other	Date
	Live	Dead		
V2-1	7.5	11.9	249.0	29 Dec 81
V2-2	12.0	51.7	271.6	"
V2-3	24.0	38.5	292.8	30 Dec 81
V2-4	46.6	111.3	251.6	"
V3-1	16.0	59.1	160.3	29 Dec 81
V3-2	26.1	62.5	314.0	"
V3-3	21.7	81.7	158.2	"
V3-4	19.2	60.6	209.7	"
M-1	20.5	61.7	269.1	30 Dec 81
M-2	12.7	41.9	383.7	"
M-3	2.3	32.4	274.8	"
M-4	5.3	44.3	365.5	"

Treatment area C (unburned), January 1985

Sample	Cladium		Other	Date
	Live	Dead		
V2-1	21.4	69.8	218.1	18 Jan 85
V2-2	11.2	16.3	609.6	"
V2-3	7.1	26.9	424.8	"
V2-4	4.6	16.2	914.6	"
V3-1	38.4	197.2	392.6	"
V3-2	17.6	54.4	218.0	"
V3-3	14.8	87.7	231.7	"
V3-4	26.0	125.2	209.8	"
M-1	16.3	152.5	360.0	"
M-2	23.6	77.2	138.0	"
M-3	14.3	69.4	183.6	"
M-4	24.4	61.9	69.1	"

Appendix 1. Continued.

Treatment area C (burned), May 1981

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	6.8	1.8	16.5	0.9	3 May 81
V1-2	2.0	1.3	25.8	2.9	"
V1-3	3.6	0.9	20.2	2.5	"
V1-4	2.4	0.4	23.0	2.4	"
V1-5	12.0	2.0	11.5	1.3	"
V1-6	16.1	9.4	15.2	3.1	"
V1-7	1.7	0.2	38.6	4.2	"
V1-8	4.7	0.6	41.2	3.7	"
V1-9	4.2	1.5	31.5	6.9	"

Treatment area C (burned), January 1982

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	19.7	17.9	60.9	64.6	6 Jan 82
V1-2	3.4	8.3	27.6	55.3	"
V1-3	6.9	9.8	41.3	63.6	"
V1-4	11.1	10.1	45.0	57.0	"
V1-5	5.9	15.8	14.2	30.1	"
V1-6	13.2	33.9	16.8	29.1	"
V1-7	4.7	7.6	14.9	35.2	"
V1-8	1.1	1.2	25.6	51.1	"
V1-9	6.2	7.4	98.9	125.9	"
V1-10	13.6	57.4	53.0	114.6	"
V1-11	7.9	18.5	70.4	108.3	"
V1-12	24.3	43.0	56.9	97.2	"

Treatment area C (burned), June 1985

Sample	Cladium		Other	Date
	Live	Dead		
V1-1	12.7	45.9	412.2	6 June 85
V1-2	34.2	107.8	204.4	"
V1-3	51.8	132.4	139.1	"
V1-4	13.1	71.0	295.5	"
V1-5	10.1	43.9	515.5	"
V1-6	45.4	122.4	720.1	"
V1-7	62.0	180.3	430.0	"
V1-8	30.0	78.5	481.0	"
V1-9	0.0	21.3	341.1	11 June 85
V1-10	28.4	113.8	468.1	"
V1-11	8.0	8.7	179.1	"
V1-12	27.8	77.5	320.6	"

Appendix 1. Continued.

Treatment area D1, December 1978

Sample	Total		Date
	Live	Dead	
V1-1	41.0	81.5	Dec 78
V2-1	81.0	120.5	"
V3-1	111.5	207.5	"

Treatment area D1, July 1979

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	0	0	32.5	12.1	9 Jul 79
V1-2	14.4	18.4	31.2	18.5	"
V1-3	1.1	1.1	37.4	19.6	"
V2-1	4.2	0.2	30.2	7.0	"
V2-2	8.4	6.8	48.4	9.6	"
V2-3	5.1	2.9	48.0	9.8	"
V3-1	2.3	3.3	77.4	14.3	"
V3-2	2.8	1.6	38.1	13.4	"

Treatment area D1, December 1979

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	4.2	3.8	9.9	43.8	4 Dec 79
V1-2	13.8	14.5	26.2	59.5	"
V1-3	3.6	3.0	95.1	94.0	"
V2-1	4.6	5.2	31.7	44.3	"
V2-2	12.8	9.1	19.3	47.0	"
V2-3	1.9	1.6	47.4	88.3	"
V3-1	0.8	8.1	87.3	77.9	"
V3-2	1.6	1.9	40.1	79.6	"
V3-3	15.3	7.4	28.4	65.3	"
M-1	2.1	1.1	44.2	50.0	"

Appendix 1. Continued.

Treatment area D1, April 1980

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	4.5	6.0	13.4	46.5	8 Apr 80
V1-2	20.2	2.0	20.2	63.6	"
V1-3	6.3	5.7	57.7	87.4	"
V2-1	10.0	10.0	23.0	54.4	"
V2-2	17.7	30.6	22.5	45.6	"
V2-3	38.0	17.6	27.1	77.9	"
V3-1	20.3	29.0	47.9	91.2	"
V3-1	10.4	16.4	75.5	88.9	"
V3-3	3.5	4.0	116.4	250.6	"
M-1	10.7	14.1	84.9	97.5	"

Treatment area D1, August 1980

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	44.1	31.4	22.5	58.9	8 Aug 80
V1-2	10.9	15.1	30.2	69.2	"
V1-3	14.0	14.4	29.4	49.7	"
V2-1	6.9	8.6	25.1	68.4	"
V2-2	5.0	4.2	46.0	72.2	"
V2-3	2.6	6.4	64.3	95.6	"
V3-1	20.8	18.7	97.5	133.6	"
V3-2	22.2	26.7	38.9	74.2	"
V3-3	4.6	12.7	61.8	87.6	14 Aug 80
M-1	15.2	14.8	38.4	67.4	8 Aug 80
M-2	0.3	0.2	46.2	63.4	"
M-3	17.6	25.8	32.8	52.6	"

Treatment area D1, December 1980

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	9.1	10.1	76.1	90.4	2 Dec 80
V1-2	16.1	19.6	32.3	72.7	"
V1-3	3.0	4.6	61.5	94.3	"
V2-1	12.0	7.7	78.6	104.6	3 Dec 80
V2-2	97.1	36.5	45.6	113.3	"
V2-3	7.1	12.6	55.2	70.7	"
V3-1	6.4	12.5	109.0	156.1	4 Dec 80
V3-2	7.3	16.0	129.8	141.1	"
V3-3	24.3	29.5	61.5	105.0	"
M-1	71.5	72.4	61.2	82.8	3 Dec 80
M-2	10.4	7.7	39.8	67.2	"
M-3	32.8	38.2	47.6	70.1	"

Appendix 1. Continued.

Treatment area D1, April 1981

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	3.8	5.6	12.1	20.3	10 Apr 81
V1-2	5.8	12.8	15.6	16.1	"
V1-3	4.9	2.2	9.6	18.8	"
V2-1	3.5	8.4	10.4	13.9	"
V2-2	6.5	22.8	13.9	11.0	"
V2-3	3.2	5.0	9.4	12.4	"
V3-1	3.8	6.4	14.5	14.0	8 Apr 81
V3-2	8.3	12.6	15.2	27.7	"
V3-3	4.7	9.1	22.2	8.7	"
M-1	0.9	2.6	10.4	18.6	"
M-2	1.2	0.7	14.2	24.7	"
M-3	3.0	2.1	22.5	22.3	"

Treatment area D1, November 1981

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	9.4	12.7	44.3	56.7	30 Nov 81
V1-2	0	1.7	41.7	87.9	"
V1-3	5.7	4.2	70.7	72.3	"
V2-1	2.3	1.7	31.4	37.5	"
V2-2	5.1	4.9	30.5	38.2	"
V2-3	2.5	4.0	24.7	35.9	"
V3-1	14.0	17.9	56.9	62.7	"
V3-2	24.3	34.3	26.9	38.5	"
V3-3	11.3	18.4	51.5	43.4	"
M-1	4.3	12.5	26.1	43.9	"
M-2	4.7	9.2	32.8	55.0	"
M-3	7.6	12.8	31.7	41.7	"

Treatment area D1, December 1982

Sample	Cladium		Other	Date
	Live	Dead		
V1-1	9.3	35.4	299.3	26 Dec 82
V1-2	1.9	0.9	150.2	"
V1-3	7.9	15.6	143.1	"
V2-1	1.3	5.8	163.3	"
V2-2	1.7	7.9	197.2	"
V2-3	57.2	5.0	414.6	"
M-1	9.3	11.0	157.4	"
M-2	3.1	5.9	112.5	"
M-3	28.2	49.1	163.7	"

Appendix 1. Continued.

Treatment area D1, December 1984

Sample	Cladium		Other	Date
	Live	Dead		
V1-1	7.6	5.6	137.4	7 Dec 84
V1-2	5.1	7.5	90.8	"
V1-3	12.0	18.4	201.0	"
V2-1	0.4	0.8	76.2	"
V2-2	4.9	11.5	201.6	"
V2-3	15.1	28.3	84.0	"
V3-1	4.9	4.3	155.9	"
V3-2	1.9	6.2	137.7	"
V3-3	9.1	8.5	137.5	"
M-1	9.2	17.5	63.5	"
M-2	8.3	16.3	87.5	"
M-3	8.0	20.4	123.1	"

Treatment area D3, December 1978

Sample	Total		Date
	Live	Dead	
V1-1	114.5	220.5	Dec 78
V2-1	116.5	271.5	"
V3-1	116.5	357.5	"

Treatment area D3, July 1979

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	11.4	1.7	27.1	22.4	10 Jul 79
V1-2	16.8	0	51.0	10.8	"
V1-3	0	0	7.4	32.4	"
V2-1	10.5	0	51.1	14.4	"
V2-2	21.4	0	15.3	15.5	"
V2-3	23.0	0	39.4	15.4	"
V3-1	15.5	1.3	44.2	22.1	"
V3-2	4.9	2.6	37.8	45.3	"
V3-3	0	0	29.6	47.4	"

Appendix 1. Continued.

Treatment area D3, December 1979

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	32.0	24.1	41.9	61.4	4 Dec 79
V1-2	4.1	3.7	50.2	65.9	"
V2-1	16.9	9.6	14.4	23.9	"
V2-2	21.2	22.1	25.5	28.6	"
V3-1	3.6	8.3	45.2	103.0	"
V3-2	41.9	56.7	56.7	61.7	"
V3-3	5.7	5.7	45.9	142.2	"
M-1	9.6	12.1	66.1	84.9	"
M-2	15.9	11.6	71.7	65.4	5 Dec 79

Treatment area D3, April 1980

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	12.9	12.0	66.4	92.9	15 Apr 80
V1-2	6.1	8.9	55.2	87.7	"
V1-3	15.8	12.2	24.0	50.6	"
V2-1	34.3	27.1	91.4	78.9	"
V2-2	18.9	29.6	25.7	40.1	"
V2-3	14.0	22.4	16.3	35.1	"
V3-1	23.3	16.4	82.0	56.9	"
V3-2	10.3	16.2	93.2	67.1	"
V3-3	33.3	34.2	34.9	53.1	"
M-1	33.9	32.4	40.0	57.1	"

Treatment area D3, August 1980

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	16.3	12.9	42.7	69.6	4 Aug 80
V1-2	2.4	2.1	47.2	85.1	"
V1-3	1.6	1.6	81.2	130.9	"
V2-1	19.9	32.5	21.4	42.6	"
V2-2	33.7	59.7	32.4	49.0	"
V2-3	14.8	14.0	16.5	22.5	"
V3-1	6.4	9.6	28.4	43.1	"
V3-2	20.7	36.8	30.3	37.3	"
V3-3	13.3	20.3	27.0	46.9	"
M-1	19.4	30.6	49.4	77.1	"
M-2	6.7	8.6	38.8	48.6	"
M-3	18.6	26.8	35.0	59.7	"

Appendix 1. Continued.

Treatment area D3, December 1980

Sample	Cladium Live	Cladium Dead	Other Live	Other Dead	Date
V1-1	14.7	15.7	55.3	101.8	8 Dec 80
V1-2	7.9	10.5	68.6	83.9	"
V1-3	13.2	18.7	68.8	107.7	"
V2-1	29.3	39.9	43.4	77.2	9 Dec 80
V2-2	31.0	41.7	36.0	68.7	"
V2-3	52.8	71.8	51.7	98.9	"
V3-1	14.5	8.9	103.8	144.5	"
V3-2	21.1	23.9	54.2	129.6	"
V3-3	14.3	3.6	88.9	178.0	"
M-1	8.8	8.0	108.6	126.1	8 Dec 80
M-2	18.5	17.0	83.0	145.7	"
M-3	25.3	12.9	123.4	161.9	"

Treatment area D3, May 1981

Sample	Cladium Live	Cladium Dead	Other Live	Other Dead	Date
V1-1	8.0	20.5	48.3	150.2	11 May 81
V1-2	6.1	19.4	81.1	192.1	"
V1-3	19.7	41.6	63.8	139.9	"
V2-1	11.9	49.9	83.5	196.4	"
V2-2	16.5	39.6	107.5	147.9	"
V2-3	11.2	31.7	90.4	202.3	"
V3-1	26.7	66.7	101.0	205.7	"
V3-2	7.9	7.8	75.6	147.1	"
V3-3	10.9	36.9	62.3	198.0	"
M-1	40.7	106.0	117.0	234.6	"
M-2	16.9	60.6	66.1	154.2	"
M-3	18.6	44.2	56.7	133.9	"

Treatment area D3, December 1981

Sample	Cladium Live	Cladium Dead	Other Live	Other Dead	Date
V1-1	24.4	48.1	27.1	71.8	8 Dec 81
V1-2	7.2	22.9	37.2	103.4	"
V1-3	10.6	47.4	37.6	83.4	"
V2-1	25.2	41.1	58.3	170.6	7 Dec 81
V2-2	21.0	47.8	29.0	79.8	"
V2-3	13.0	31.9	44.9	103.8	"
V3-1	18.9	34.0	134.5	349.7	"
V3-2	15.3	48.1	98.3	62.3	"
V3-3	3.2	10.4	60.5	220.8	"
M-1	13.8	17.8	50.8	107.5	"
M-2	1.2	18.0	37.5	110.9	"
M-3	14.6	26.2	48.8	138.3	"

Appendix 1. Continued.

Treatment area D3, December 1984

Sample	Cladium Live	Cladium Dead	Other	Date
V1-1	51.5	93.0	259.1	5 Dec 84
V1-2	2.9	23.5	253.8	"
V1-3	42.8	104.1	342.0	"
V2-1	17.3	62.9	219.4	"
V2-2	63.5	123.1	279.2	"
V2-3	30.6	73.1	176.8	"
V3-1	15.6	22.9	581.6	"
V3-2	18.5	25.4	661.0	"
V3-3	10.3	15.8	572.2	"
M-1	26.2	90.9	188.0	"
M-2	32.3	67.6	310.3	"
M-3	32.4	61.1	258.8	"

Treatment area D6, December 1978

Sample	Total Live	Total Dead	Date
V1-1	120.5	309.0	Dec 78
V2-1	67.0	291.0	"
V3-1	65.5	86.5	"

Treatment area D6, July 1979

Sample	Cladium Live	Cladium Dead	Other Live	Other Dead	Date
V1-1	21.7	10.3	38.4	21.6	12 Jul 79
V1-2	9.4	1.8	17.2	9.1	"
V1-3	7.9	0.5	31.0	14.3	"
V2-1	7.4	2.6	8.7	15.5	"
V2-2	18.3	10.4	12.0	12.0	"
V3-1	6.7	11.0	11.0	10.8	11 Jul 79

Appendix 1. Continued.

Treatment area D6, December 1979

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	6.7	6.2	50.8	71.0	5 Dec 79
V1-2	12.3	12.1	6.5	47.3	"
V2-1	23.8	23.1	39.9	47.9	6 Dec 79
V2-2	2.8	4.9	21.7	35.3	"
V2-3	8.4	24.8	20.0	40.0	"
V3-1	8.2	4.1	30.1	41.7	"
V3-2	11.9	10.4	20.7	33.3	"
V3-3	67.5	93.5	12.1	21.8	"
M-1	26.7	19.2	37.7	60.6	"

Treatment area D6, April 1980

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	25.3	22.5	60.8	75.6	24 Apr 80
V1-2	8.3	7.5	49.9	77.8	"
V1-3	9.1	3.3	45.4	60.0	"
V2-1	26.1	27.8	36.6	72.0	"
V2-2	12.9	17.5	10.7	40.2	"
V2-3	13.3	23.6	8.6	16.4	"
V3-1	34.0	33.9	19.2	29.3	"
V3-2	20.6	34.5	23.5	36.6	"
V3-3	39.0	29.0	33.1	34.3	"
M-1	14.1	12.5	25.2	48.8	"

Treatment area D6, August 1980

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	26.1	34.0	24.2	56.2	6 Aug 80
V1-2	4.3	6.2	53.1	16.5	"
V1-3	7.1	9.8	22.1	46.4	"
V2-1	9.7	5.5	23.4	34.4	"
V2-2	12.2	18.9	22.0	38.1	"
V2-3	7.0	12.9	18.5	27.5	"
V3-1	27.2	28.6	36.9	50.3	"
V3-2	18.5	24.6	28.5	38.2	"
V3-3	9.9	17.9	14.2	30.0	"
M-1	21.4	29.4	21.0	36.3	"
M-2	25.3	24.1	20.6	47.9	"
M-3	16.7	22.1	27.1	54.3	"

Appendix 1. Continued.

Treatment area D6, March 1981

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	20.7	54.4	19.7	77.3	5 Mar 81
V1-2	7.7	23.5	31.4	104.7	"
V1-3	9.0	24.6	50.9	129.8	"
V2-1	27.2	50.2	32.1	105.4	6 Mar 81
V2-2	14.7	32.1	17.0	66.0	"
V2-3	26.6	51.6	31.4	122.5	"
V3-1	14.1	39.9	14.5	80.1	5 Mar 81
V3-2	33.9	80.8	30.4	80.7	"
V3-3	17.6	45.4	38.2	107.9	6 Mar 81
M-1	22.9	59.0	16.7	65.0	"
M-2	42.3	77.1	33.2	83.7	"
M-3	26.1	63.1	40.0	98.6	"

Treatment area D6, May 1981

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	7.9	12.5	33.2	117.0	8 May 81
V1-2	20.8	63.2	41.3	128.5	"
V1-3	22.8	62.4	27.1	5.2	"
V2-1	24.1	77.5	23.2	51.7	"
V2-2	17.7	85.9	39.1	65.4	"
V2-3	2.2	15.8	20.4	47.3	"
V3-1	9.1	33.2	12.3	45.4	"
V3-2	30.4	53.2	32.8	63.4	"
V3-3	18.7	31.1	27.7	78.3	"
M-1	16.7	63.8	11.4	33.3	"
M-2	21.1	54.9	25.3	7.0	"
M-3	15.5	40.3	25.4	81.9	"

Treatment area D6, December 1981

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	5.0	21.0	22.7	66.4	23 Dec 81
V1-2	18.5	45.9	17.6	74.0	"
V1-3	17.3	39.2	53.6	140.8	"
V2-1	29.2	91.4	33.1	102.2	"
V2-2	13.7	37.5	56.5	104.1	"
V2-3	35.0	118.2	32.0	80.4	"
V3-1	35.8	73.9	40.9	128.1	"
V3-2	15.7	20.4	26.5	59.2	"
V3-3	40.0	82.5	53.9	77.0	"
M-1	19.7	56.9	14.1	49.7	28 Dec 81
M-2	22.4	37.9	41.8	123.5	"
M-3	44.5	103.4	29.2	89.2	"

Appendix 1. Continued.

Treatment area D6, December 1984

Sample	Cladium		Other	Date
	Live	Dead		
V1-1	19.8	39.0	140.6	3 Dec 84
V1-2	6.3	37.2	127.2	"
V1-3	11.3	46.3	152.2	"
V2-1	84.3	311.6	141.5	"
V2-2	39.1	121.8	224.1	"
V2-3	40.4	84.1	174.9	"
V3-1	32.5	145.1	95.7	"
V3-2	40.6	125.1	104.1	"
V3-3	53.6	239.7	130.0	"
M-1	38.8	101.6	409.2	"
M-2	62.3	198.6	448.7	"
M-3	9.3	50.5	214.3	"

Treatment area Fl, March 1979

Sample	Total		Date
	Live	Dead	
V1-1	84.2	299.3	7 Mar 79
V2-1	77.7	313.7	"
V3-1	72.8	311.2	"

Treatment area Fl, August 1979

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	3.4	2.5	32.2	24.4	30 Aug 79
V1-2	5.7	5.8	42.1	9.7	"
V2-1	32.9	4.2	28.6	20.0	"
V2-2	9.8	0.8	17.5	14.0	"
V2-3	9.9	1.5	14.4	14.1	"
V3-1	17.4	2.1	16.4	25.4	"
V3-2	11.1	5.9	21.3	27.2	"
V3-3	14.1	15.5	61.1	23.5	"

Appendix 1. Continued.

Treatment area F1, October 1979

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	14.2	3.0	46.0	40.8	25 Oct 79
V1-2	19.2	18.9	33.1	44.8	"
V2-1	62.2	26.8	66.6	54.2	"
V2-2	11.3	15.9	47.7	51.6	30 Oct 79
V2-3	19.0	8.8	57.3	39.0	"
V3-1	10.9	5.6	8.7	12.1	"
V3-2	38.4	14.3	27.3	53.7	"
V3-3	8.0	5.8	24.6	26.1	"
M-1	33.9	22.7	35.7	33.2	"

Treatment area F1, February 1980

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	20.5	40.3	26.0	60.8	13 Feb 80
V1-2	36.6	42.4	16.6	25.6	"
V1-3	19.9	16.6	30.9	53.3	"
V2-1	6.5	6.9	21.7	64.0	12 Feb 80
V2-2	22.0	27.7	52.0	70.3	"
V2-3	30.9	48.5	19.8	23.4	"
V3-1	34.3	37.3	14.8	33.3	"
V3-2	18.0	35.5	19.7	37.7	"
V3-3	11.6	15.9	60.1	79.8	"
M-1	10.4	14.0	45.3	40.1	"

Treatment area F1, June 1980

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	12.4	13.8	41.8	66.6	25 Jun 80
V2-1	25.6	16.8	26.9	30.6	"
V2-2	14.8	13.7	30.0	56.0	"
V2-3	27.6	33.0	40.8	79.5	"
V3-1	35.2	41.0	28.8	84.2	26 Jun 80
V3-2	18.9	21.9	40.6	107.4	"
V3-3	17.4	12.4	54.3	95.8	"
M-1	10.6	16.1	32.7	78.0	25 Jun 80

Appendix 1. Continued.

Treatment area F1, February 1981

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	13.3	31.7	59.8	131.5	3 Feb 81
V1-2	28.8	58.0	99.8	190.0	"
V1-3	27.5	42.1	40.3	111.5	"
V2-1	5.8	16.5	27.1	165.3	2 Feb 81
V2-2	8.9	41.5	26.8	177.0	"
V2-3	46.0	93.8	72.3	197.7	"
V3-1	6.0	21.3	51.9	151.8	27 Jan 81
V3-2	29.2	45.9	77.5	136.2	"
V3-3	15.6	22.8	68.8	147.3	"
M-1	24.4	50.0	52.7	123.5	"
M-2	14.4	32.5	37.2	82.0	"
M-3	6.5	20.7	18.2	93.6	2 Feb 81

Treatment area F1, June 1981

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	1.4	3.0	22.9	12.8	10 Jun 81
V1-2	4.0	3.8	25.6	11.0	"
V1-3	3.6	3.1	42.7	6.0	"
V2-1	10.6	12.7	13.7	6.4	"
V2-2	8.5	18.6	7.9	3.8	"
V2-3	11.3	19.6	16.4	12.8	"
V3-1	5.7	5.2	55.1	19.8	12 Jun 81
V3-2	6.0	8.0	42.1	14.3	"
V3-3	10.0	11.1	31.1	11.4	"
M-1	12.9	15.8	36.0	12.1	"
M-2	2.1	5.7	16.3	10.2	"
M-3	9.3	21.6	20.5	24.3	"

Treatment area F1, November 1981

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	9.6	5.8	45.6	37.5	9 Nov 81
V1-2	11.0	5.9	69.0	42.0	"
V1-3	3.1	1.7	50.2	42.1	"
V2-1	5.2	2.6	18.3	14.9	"
V2-2	34.3	21.8	39.9	28.1	"
V2-3	5.3	2.2	27.1	6.5	"
V3-1	15.2	23.7	47.2	60.7	12 Nov 81
V3-2	13.9	12.5	55.7	43.3	"
V3-3	16.0	13.5	38.4	40.6	"
M-1	30.5	20.5	38.3	31.9	"
M-2	5.8	13.6	31.0	26.0	"
M-3	7.7	4.3	28.9	18.5	"

Appendix 1. Continued.

Treatment area F1, March 1982

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	3.3	8.7	34.4	42.1	4 Mar 82
V1-2	3.8	8.9	36.0	53.7	"
V1-3	15.5	14.5	82.9	84.1	"
V2-1	4.2	7.4	9.6	22.4	"
V2-2	13.6	14.2	28.2	46.0	"
V2-3	12.5	20.5	19.8	23.8	"
V3-1	5.4	35.5	70.7	53.7	24 Feb 82
V3-2	9.4	26.1	73.3	66.7	"
V3-3	20.5	49.7	43.6	42.9	"
M-1	8.8	12.8	44.5	42.4	"
M-2	3.9	10.2	15.6	36.7	"
M-3	27.2	41.3	34.8	41.5	"

Treatment area F1, February 1985

Sample	Cladium		Other	Date
	Live	Dead		
V1-1	16.2	42.5	74.0	16 Feb 84
V1-2	30.6	53.1	105.6	"
V1-3	11.6	32.1	70.6	"
V2-1	6.8	21.4	70.3	"
V2-2	25.4	49.2	102.3	"
V2-3	8.6	14.4	94.9	"
V3-1	2.7	5.2	206.5	"
V3-2	6.1	9.3	259.1	"
V3-3	13.8	19.5	172.4	"
M-1	6.6	10.4	70.2	"
M-2	3.7	6.0	60.7	"
M-3	15.6	39.0	61.3	"

Appendix 1. Continued.

Treatment area F3, March 1979

Sample	Total		Date
	Live	Dead	
V1-1	154.0	379.4	7 Mar 79
V2-1	207.6	503.9	"
V3-1	112.2	517.8	"

Treatment area F3, August 1979

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	49.0	9.6	106.1	95.6	24 Aug 79
V1-2	3.4	11.5	64.5	46.6	"
V2-1	33.9	14.8	34.5	29.8	"
V2-2	30.3	4.5	51.5	33.9	"
V2-3	20.2	6.2	18.4	45.1	"
V3-1	9.2	0	45.0	35.3	"
V3-2	5.3	0	36.5	28.4	"
V3-3	0	0	42.0	47.5	"

Treatment area F3, October 1979

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	16.1	7.6	60.6	30.3	31 Oct 79
V1-2	19.6	8.9	55.2	61.0	"
V2-1	29.4	16.4	52.9	77.0	"
V2-2	17.3	9.9	45.1	73.3	"
V2-3	16.5	10.2	54.4	53.1	"
V3-1	10.2	2.4	57.3	40.0	30 Oct 79
V3-2	7.0	5.9	30.2	32.6	"
V3-3	19.6	11.1	42.9	44.6	"
M-1	8.6	15.4	60.3	84.4	"
M-2	6.7	2.9	24.5	32.5	31 Oct 79

Appendix 1. Continued.

Treatment area F3, March 1980

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	7.0	6.4	124.	103.2	21 Mar 80
V1-2	9.8	7.8	62.1	61.2	"
V1-3	27.3	26.5	66.3	56.9	"
V2-1	22.5	29.9	57.8	115.0	"
V2-2	17.9	31.0	97.6	37.0	"
V2-3	21.7	25.1	39.0	57.6	"
V3-1	19.6	26.4	22.4	36.4	12 Feb 80
V3-2	15.5	11.7	47.9	40.1	"
V3-3	17.1	12.6	40.2	61.0	"
M-1	10.2	7.6	35.7	44.3	"

Treatment area F3, July 1980

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	21.1	17.9	54.9	84.3	15 Jul 80
V1-2	19.9	17.2	45.0	68.0	"
V1-3	17.0	17.9	37.3	58.1	"
V2-1	4.6	4.7	34.8	65.3	"
V2-2	19.7	19.5	34.6	66.1	"
V2-3	10.7	15.2	78.9	99.6	"
V3-1	10.0	7.7	62.8	107.3	"
V3-2	0	0	59.3	98.8	17 Jul 80
V3-3	0	0	32.3	99.8	"
M-1	7.8	11.0	21.3	31.7	"
M-2	16.1	23.0	31.5	52.0	"
M-3	39.2	32.4	21.9	46.8	"

Treatment area F3, March 1981

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	14.4	30.5	102.5	238.1	14 Mar 81
V1-2	13.9	27.2	175.5	275.4	"
V1-3	14.2	24.4	92.8	180.3	"
V2-1	45.6	75.5	15.3	87.7	"
V2-2	15.4	68.8	88.0	182.5	"
V2-3	20.3	47.9	65.3	221.7	"
V3-1	25.6	78.8	18.1	79.5	15 Mar 81
V3-2	3.2	12.6	45.6	153.9	"
V3-3	11.4	28.6	95.6	227.4	"
M-1	14.3	17.4	75.0	99.0	"
M-2	0.8	14.5	74.7	118.3	"
M-3	7.6	7.7	62.6	152.1	"

Appendix 1. Continued.

Treatment area F3, July 1981

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	18.6	54.3	37.0	106.5	7 Jul 81
V1-2	29.3	55.8	91.1	191.7	"
V1-3	13.7	36.6	55.3	180.5	"
V2-1	25.0	41.4	87.2	242.9	28 Jun 81
V2-2	57.0	144.5	77.8	176.1	7 Jul 81
V2-3	26.8	98.4	56.0	108.6	"
V3-1	12.3	40.1	64.0	153.6	28 Jun 81
V3-2	17.5	24.8	43.4	109.0	"
V3-3	12.9	21.8	20.2	62.9	"
M-1	32.4	78.6	69.3	158.0	7 Jul 81
M-2	16.8	13.0	47.7	127.2	"
M-3	26.8	48.9	56.1	128.1	"

Treatment area F3, November 1981

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V3-1	12.8	43.8	34.5	111.9	2 Nov 81
V3-2	13.1	51.2	51.5	176.2	"
V3-3	3.1	8.4	44.4	143.4	"
M-1	42.5	93.9	42.6	122.8	"
M-2	17.3	24.3	72.1	199.5	"
M-3	10.2	25.7	37.6	152.5	"

Treatment area F3, February 1982

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	24.5	34.0	30.5	86.7	23 Feb 82
V1-2	31.0	93.8	86.8	215.1	"
V1-3	21.9	81.6	66.4	140.9	"
V2-1	11.3	32.8	25.3	56.1	"
V2-2	8.0	33.6	15.5	36.6	"
V2-3	13.5	49.7	28.4	59.7	"
V3-1	21.9	41.7	47.7	161.7	"
V3-2	3.4	23.1	47.2	116.0	"
V3-3	4.0	12.5	87.7	193.4	"
M-1	3.9	4.3	78.0	199.9	"
M-2	11.4	45.7	81.3	142.2	"
M-3	23.4	83.9	40.4	123.7	"

Appendix 1. Continued.

Treatment area F3, February 1985

Sample	Cladium		Other	Date
	Live	Dead		
V1-1	34.3	165.8	297.2	11 Feb 85
V1-2	21.8	98.7	347.7	"
V1-3	26.4	78.5	201.4	"
V2-1	15.8	62.9	236.9	"
V2-2	17.8	55.0	135.9	"
V2-3	19.0	50.2	191.9	"
V3-1	7.5	19.0	248.9	"
V3-2	34.0	131.3	348.0	"
V3-3	12.0	29.1	329.8	"
M-1	21.8	52.9	396.4	8 Feb 85
M-2	20.9	74.6	352.3	"
M-3	21.0	82.3	279.1	"

Treatment area F6, March 1979

Sample	Total		Date
	Live	Dead	
V1-1	160.5	472.0	7 Mar 79
V2-1	110.4	254.8	"
V3-1	82.5	227.4	"

Treatment area F6, August 1979

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	6.0	4.7	46.1	32.2	24 Aug 79
V1-2	3.7	9.1	56.3	27.0	29 Aug 79
V1-3	0.3	0.6	50.6	23.6	"
V2-1	24.5	4.1	50.6	20.4	"
V2-2	7.1	0.5	25.7	57.0	"
V2-3	1.9	0	13.4	11.4	"
V3-1	7.2	0.9	18.3	22.4	"
V3-2	0.3	0	48.6	35.1	"

Appendix 1. Continued.

Treatment area F6, November 1979

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	15.1	9.9	65.9	41.9	7 Nov 79
V1-2	22.1	5.9	57.4	72.6	"
V1-3	13.2	11.7	54.8	50.1	"
V2-1	7.3	8.3	21.6	24.8	"
V2-2	5.2	9.6	35.8	58.6	"
V2-3	15.8	24.8	20.4	45.9	"
V3-1	12.1	9.8	59.8	58.5	"
V3-2	8.0	4.7	38.7	43.0	"
V3-3	2.1	3.0	39.1	64.5	"
M-1	2.9	3.9	97.7	131.9	"

Treatment area F6, March 1980

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	2.6	1.3	30.5	77.4	21 Mar 80
V1-2	11.0	8.9	48.9	71.2	"
V1-3	3.6	3.5	37.1	62.0	"
V2-1	26.9	22.6	40.8	46.0	"
V2-2	23.1	33.1	48.7	76.0	"
V2-3	17.7	24.0	20.1	46.1	"
V3-1	0	0	53.1	76.9	"
V3-2	10.6	8.0	15.9	42.7	"
V3-3	4.1	8.6	24.2	73.8	"
M-1	6.4	6.8	29.6	72.2	"

Treatment area F6, July 1980

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	10.9	13.5	27.6	41.6	17 Jul 80
V1-2	8.7	5.6	65.7	107.7	"
V1-3	8.3	15.7	34.8	62.4	"
V2-1	27.8	68.9	31.7	55.3	"
V2-2	16.5	31.4	52.1	95.0	"
V2-3	15.4	22.5	27.1	84.7	"
V3-1	7.1	6.4	45.0	80.1	"
V3-2	2.8	5.4	74.2	113.3	"
V3-3	27.8	21.1	78.0	140.0	"
M-1	20.5	30.5	30.6	48.4	"
M-2	29.5	37.9	36.4	61.0	"
M-3	29.6	42.1	14.4	52.4	"

Appendix 1. Continued.

Treatment area F6, March 1981

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	22.1	49.0	57.9	175.0	11 Mar 81
V1-2	11.6	21.3	92.5	224.4	"
V1-3	7.7	30.4	78.4	124.3	"
V2-1	17.2	20.7	22.7	102.3	12 Mar 81
V2-2	12.2	27.1	25.2	73.7	"
V2-3	15.2	31.5	27.1	83.9	"
V3-1	6.5	16.5	90.0	137.6	15 Mar 81
V3-2	6.3	12.3	46.8	136.6	"
V3-3	11.3	36.4	67.2	237.4	"
M-1	27.8	67.9	21.9	76.1	"
M-2	25.7	55.5	53.5	179.1	"
M-3	9.0	13.6	75.5	298.6	"

Treatment area F6, June 1981

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	8.3	8.8	84.9	163.1	12 Jun 81
V1-2	20.2	54.2	68.3	146.9	"
V1-3	13.0	20.0	38.1	104.4	"
V2-1	22.2	64.5	40.4	73.6	"
V2-2	47.4	87.6	42.6	66.4	"
V2-3	15.3	30.9	35.8	70.6	"
V3-1	5.2	14.0	37.6	102.3	"
V3-2	6.0	18.7	40.9	113.0	"
V3-3	9.3	20.6	76.0	173.3	"
M-1	5.6	6.3	118.9	353.9	"
M-2	6.3	13.0	128.7	278.4	"
M-3	10.8	23.9	120.3	275.4	"

Treatment area F6, October 1981

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	48.2	112.1	23.0	64.9	27 Oct 81
V1-2	14.9	43.6	49.9	117.7	"
V1-3	23.9	63.5	26.2	91.6	"
V2-1	20.5	36.3	56.1	154.3	"
V2-2	24.0	23.9	77.5	213.5	"
V2-3	14.1	23.2	51.3	149.6	"
V3-1	21.4	36.5	47.6	139.8	"
V3-2	23.0	38.1	85.0	245.2	"
V3-3	32.2	43.4	67.2	221.3	"
M-1	15.2	14.0	145.0	304.2	"
M-2	13.8	22.5	85.8	204.8	"
M-3	12.1	21.1	102.2	236.3	"

Appendix 1. Continued.

Treatment area F6, March 1982

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	13.4	37.9	98.7	246.9	24 Mar 82
V1-2	9.2	31.8	34.0	123.6	"
V1-3	8.8	50.1	58.5	192.7	"
V2-1	9.4	26.1	33.0	56.4	"
V2-2	16.9	57.7	22.3	63.6	"
V2-3	24.3	66.8	22.0	53.9	"

Treatment area F6, February 1985

Sample	Cladium		Other	Date
	Live	Dead		
V1-1	35.6	123.2	604.8	1 Feb 85
V1-2	14.2	72.1	236.1	"
V1-3	7.8	36.3	178.5	"
V2-1	45.4	210.2	198.1	"
V2-2	8.5	26.2	172.3	"
V2-3	10.7	103.1	116.5	"
V3-1	23.7	86.7	349.5	"
V3-2	6.6	34.9	134.6	"
V3-3	18.6	81.8	408.6	"
M-1	7.6	32.6	572.9	"
M-2	18.5	38.7	365.1	"
M-3	10.1	39.9	396.7	"

Treatment area J1, July 1979

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	12.7	16.4	10.8	112.1	13 Jul 79
V1-2	38.3	22.4	23.6	62.3	"
V1-3	54.9	28.2	22.6	101.6	"
V2-1	34.0	34.1	205.5	424.7	"
V3-1	9.0	16.6	6.9	147.2	"

Appendix 1. Continued.

Treatment area J1, November 1979

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	10.4	8.4	15.7	14.4	28 Nov 79
V1-2	8.4	1.9	15.2	15.8	"
V1-3	9.7	2.7	27.8	12.1	"
V2-1	0	1.4	33.6	36.6	"
V2-2	18.7	13.5	43.0	35.4	"
V2-3	0	3.2	39.8	39.6	"
V3-1	2.4	0.5	20.4	11.6	"
V3-2	13.0	6.7	17.3	31.4	"
V3-3	11.1	4.4	25.7	18.9	"
M-1	5.7	3.8	40.2	28.3	"

Treatment area J1, March 1980

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	24.5	34.3	25.6	44.9	30 Mar 80
V1-2	8.8	5.9	12.9	19.7	"
V1-3	9.0	11.2	13.6	17.8	"
V2-1	21.0	21.4	15.5	42.5	"
V2-2	7.2	6.3	24.7	42.5	"
V2-3	12.2	7.6	39.2	52.0	"
V3-1	6.4	3.9	18.9	38.5	"
V3-2	5.7	5.1	23.0	29.4	"
V3-3	5.1	5.3	26.5	37.0	"
M-1	4.9	2.4	18.6	46.5	"

Treatment area J1, July 1980

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	2.4	5.1	21.8	25.6	4 Jul 80
V1-2	10.3	9.8	19.9	21.5	"
V1-3	12.7	10.9	42.0	37.0	"
V2-1	9.6	7.6	42.9	50.8	2 Jul 80
V2-2	26.5	30.0	69.7	52.0	"
V2-3	32.6	25.9	49.7	46.2	"
V3-1	9.3	8.3	61.9	68.3	4 Jul 80
V3-2	0	0	67.6	90.0	"
V3-3	10.0	6.2	42.1	71.4	"
M-1	15.1	11.3	63.2	69.6	"
M-2	10.2	7.9	63.0	30.0	"
M-3	11.9	7.8	55.8	59.0	"

Appendix 1. Continued.

Treatment area J1, January 1981

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	6.4	7.8	20.1	32.5	2 Jan 81
V1-2	13.0	17.8	36.2	50.1	5 Jan 81
V1-3	6.4	10.6	35.7	93.4	2 Jan 81
V2-1	3.0	0	34.5	145.3	5 Jan 81
V2-2	8.5	5.7	31.8	128.3	"
V2-3	31.0	40.1	65.5	54.4	"
V3-1	14.5	17.7	46.0	81.8	7 Jan 81
V3-2	7.3	5.1	46.9	104.2	"
V3-3	4.3	7.9	60.6	120.7	"
M-1	0	0	23.4	64.9	"
M-2	9.6	8.0	61.0	75.6	"
M-3	2.7	0	34.7	82.5	"

Treatment area J1, February 1981

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V2-1	6.1	5.5	28.5	68.3	3 Feb 81
V2-2	1.4	2.7	35.2	78.9	"
V2-3	59.9	37.9	23.1	74.9	"
V3-1	2.1	3.3	23.9	129.6	"
V3-2	2.5	1.8	42.2	131.7	"
V3-3	4.7	6.4	39.7	122.7	"
M-1	11.9	19.0	49.1	95.4	"
M-2	1.4	5.7	28.6	67.2	"
M-3	6.6	6.1	36.2	79.5	"

Treatment area J1, July 1981

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	17.8	27.2	40.6	66.6	5 Jul 81
V1-2	22.7	47.9	42.1	72.2	"
V1-3	11.5	10.7	47.3	93.5	"
V2-1	14.1	23.0	55.3	97.3	"
V2-2	13.1	18.5	70.2	97.0	"
V2-3	13.5	20.2	56.3	107.8	"
V3-1	12.2	20.9	83.3	122.0	"
V3-2	6.4	11.8	42.9	86.4	"
V3-3	3.8	13.6	47.6	88.9	"
M-1	12.2	22.8	71.8	79.4	"
M-2	13.1	19.3	69.5	94.6	"
M-3	2.3	2.5	52.4	109.8	"

Appendix 1. Continued.

Treatment area J1, July 1982

Sample	Cladium Live	Cladium Dead	Other	Date
V1-1	2.3	5.2	54.4	2 Aug 82
V1-2	0	2.9	83.3	"
V1-3	0	3.2	72.3	"
V2-1	6.6	7.7	88.5	27 Jul 82
V2-2	10.0	6.0	80.3	"
V2-3	9.1	46.8	110.8	"
V2-4	0	0.8	58.4	"
V2-5	2.2	2.7	59.1	"
V2-6	0	1.7	56.4	"
V3-1	2.4	1.4	79.2	"
V3-2	1.1	1.7	90.9	"
V3-3	1.3	3.5	90.6	"
V3-4	3.7	2.7	109.6	28 Jul 82
V3-5	1.6	1.8	71.8	"
V3-6	1.1	5.6	146.9	"
M-1	0	0	86.5	"
M-2	3.5	1.9	63.3	"
M-3	1.6	1.5	70.9	"
M-4	0	0.2	86.4	2 Aug 82
M-5	0	1.0	51.9	"
M-6	1.4	2.7	63.1	"

Treatment area J1, July 1985

Sample	Cladium Live	Cladium Dead	Other	Date
V1-1	18.6	20.2	98.6	27 Jun 85
V1-2	3.8	5.9	45.3	"
V1-3	7.6	5.8	62.7	"
V2-1	1.4	1.2	259.9	"
V2-2	0.2	0.6	348.8	1 Jul 85
V2-3	0	1.4	381.4	"
V3-1	1.8	2.0	131.1	"
V3-2	9.4	17.8	104.0	"
V3-3	0.9	2.2	127.3	"
M-1	1.6	0.6	101.4	"
M-2	0.6	2.1	149.7	"
M-3	0.5	0.2	85.5	"

Appendix 1. Continued.

Treatment area J3, July 1979

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	44.0	191.4	19.4	94.8	13 Jul 79
V1-2	25.3	27.2	30.6	417.8	"
V2-1	35.9	8.4	84.2	261.4	11 Jul 79
V2-2	17.0	33.9	46.8	199.7	"
V2-3	71.4	41.3	55.5	140.4	"
V3-1	23.2	37.0	35.8	165.8	"
V3-2	13.4	4.9	61.1	265.7	"
V3-3	9.6	27.8	66.9	281.5	"

Treatment area J3, November 1979

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	18.2	10.0	16.1	20.5	25 Oct 79
V1-2	20.0	4.3	22.2	13.1	"
V1-3	7.9	3.2	10.3	8.1	26 Oct 79
V2-1	7.6	4.7	20.1	9.4	"
V2-2	8.2	4.5	33.5	12.0	"
V2-3	14.0	4.5	22.9	14.0	"
V3-1	4.2	1.2	33.0	32.6	27 Nov 79
V3-2	0.7	0.4	44.3	23.4	"
V3-3	0.8	0.4	36.5	19.6	"
M-1	5.3	8.3	17.6	18.2	"

Treatment area J3, March 1980

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	10.2	9.3	18.3	16.5	30 Mar 80
V1-2	6.8	4.6	15.9	17.1	"
V1-3	3.4	3.6	12.2	21.8	"
V2-1	7.1	5.5	34.2	49.4	"
V2-2	4.6	2.9	12.5	26.5	"
V2-3	8.8	3.9	25.5	49.8	"
V3-1	3.7	2.2	24.1	68.9	"
V3-2	10.7	8.9	32.0	65.4	"
V3-3	6.5	5.5	16.3	25.3	"
M-1	6.0	5.7	25.9	29.5	"

Appendix 1. Continued.

Treatment area J3, July 1980

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	5.8	10.6	19.1	20.2	4 Jul 80
V1-2	6.9	3.4	27.0	24.4	"
V1-3	6.4	6.9	36.9	20.6	"
V2-1	15.1	8.7	38.2	39.7	"
V2-2	10.0	5.6	30.8	27.9	"
V2-3	9.0	6.7	39.9	33.6	"
V3-1	6.2	5.0	28.6	42.3	"
V3-2	1.3	3.0	42.3	36.2	"
V3-3	6.8	9.6	32.6	43.7	"
M-1	7.3	8.9	33.5	46.2	16 Jul 80
M-2	2.7	1.9	29.9	45.0	"
M-3	5.9	2.3	48.6	73.6	"

Treatment area J3, January 1981

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	17.2	19.4	21.1	36.6	22 Jan 81
V1-2	12.8	22.7	16.2	54.5	"
V1-3	13.1	23.4	21.8	49.7	"
V2-1	0	0	39.5	71.9	9 Jan 81
V2-2	2.3	0	50.5	106.4	"
V2-3	12.8	13.2	44.1	72.0	"
V3-1	2.5	2.3	50.9	48.8	8 Jan 81
V3-2	2.0	4.2	61.0	72.3	"
V3-3	7.2	10.1	73.0	125.4	"
M-1	15.5	15.4	37.8	61.4	"
M-2	2.6	2.1	28.7	50.6	"
M-3	30.5	43.8	33.1	52.7	"

Treatment area J3, February 1981

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V2-1	3.4	9.6	61.1	129.7	4 Feb 81
V2-2	4.7	5.6	37.3	70.0	"
V2-3	10.4	16.4	23.1	58.1	"
V3-1	4.4	5.2	21.3	81.4	3 Feb 81
V3-2	15.6	13.7	35.0	96.2	"
V3-3	1.0	0.7	35.9	117.1	"
M-1	10.0	24.6	35.7	54.4	4 Feb 81
M-2	6.4	12.8	42.4	111.5	"
M-3	3.7	4.1	29.5	85.4	"

Appendix 1. Continued.

Treatment area J3, July 1981

Sample	Cladium Live	Cladium Dead	Other Live	Other Dead	Date
V1-1	22.4	28.8	34.0	42.3	17 Jul 81
V1-2	16.2	15.0	34.5	60.9	"
V1-3	10.0	18.1	35.7	59.7	"
V2-1	6.5	9.7	43.9	92.9	"
V2-2	34.1	59.4	70.8	105.6	"
V2-3	9.2	19.0	59.2	91.2	"
V3-1	6.7	7.0	54.7	102.9	12 Jul 81
V3-2	12.4	27.6	47.1	86.7	"
V3-3	11.8	12.4	54.3	103.5	"
M-1	21.0	45.6	30.5	76.3	"
M-2	13.5	41.2	35.2	61.2	"
M-3	19.6	17.8	46.2	63.3	"

Treatment area J3, July 1982

Sample	Cladium Live	Cladium Dead	Other	Date
V1-1	9.5	21.4	254.3	13 Jul 82
V1-2	31.1	39.3	194.7	"
V1-3	13.7	16.4	231.7	"
V2-1	4.5	22.7	188.2	12 Jul 82
V2-2	14.9	22.7	252.1	"
V2-3	6.6	20.8	239.1	"
V3-1	8.1	13.5	231.2	"
V3-2	9.1	16.0	120.9	"
V3-3	5.9	15.0	191.6	"
V3-4	0.6	3.1	258.7	8 Jul 82
V3-5	0.9	2.9	263.9	"
V3-6	5.5	5.4	317.0	"
M-1	15.7	29.3	215.9	6 Jul 82
M-2	20.6	59.6	290.9	"
M-3	30.3	24.9	252.6	"
M-4	42.8	81.1	365.0	"
M-5	21.6	47.2	277.6	"
M-6	12.7	46.6	240.5	"

Appendix 1. Continued.

Treatment area J3, June 1985

Sample	Cladium Live	Cladium Dead	Other	Date
V1-1	27.4	68.7	180.2	20 Jun 85
V1-2	40.5	97.9	359.4	"
V1-3	27.0	75.2	291.9	"
V2-1	3.1	17.2	275.5	"
V2-2	25.1	78.3	145.8	"
V2-3	23.8	68.6	185.6	"
V3-1	18.9	32.8	169.5	"
V3-2	4.6	15.2	207.6	"
V3-3	15.9	24.8	215.8	"
M-1	16.1	32.1	244.0	"
M-2	28.9	38.2	272.6	"
M-3	45.0	79.3	189.7	"

Appendix 2. Means and variances of log-transformed above ground biomass values (fuel loads) obtained in the treatment areas.

Treatment area C, Unburned

Date of Samples	Number of Samples	Total fuel mean variance	Live fuel mean variance	Dead fuel mean variance
Dec 1978	3	6.1543 .3478	4.8103 .2897	5.8466 .3997
Feb 1980	10	5.8512 .3938	4.3028 .3743	5.6058 .4211
Apr 1980	10	5.5686 .2274	4.1603 .1910	5.2877 .2514
Aug 1980	12	5.8833 .2161	4.3973 .1064	5.6238 .2591
Dec 1980	12	5.9762 .1632	4.6105 .1586	5.6830 .1720
Feb 1981	9	6.0493 .0975	4.2213 .0804	5.8689 .1194
May 1981	11	5.7914 .0931	4.2875 .1266	5.5392 .0932
Dec 1981	12	5.8112 .0416	---- ----	---- ----

Treatment area C (Vegetation plot 1), Burned December 1980

Date of Samples	Number of Samples	Months Post-fire	Total fuel mean variance	Live fuel mean variance	Dead fuel mean variance
May 1982	9	5	3.5777 .0678	3.4311 .0597	1.7143 .1874
Jan 1982	12	12	4.8550 .2452	3.8582 .3313	4.3949 .2133

Appendix 2. Continued.

Treatment area D1, December-January burn, annual cycle

Date of Samples	Number of Samples	Months Post-fire	Total fuel mean variance	Live fuel mean variance	Dead fuel mean variance
Dec 1978	3	preburn	5.2983 .2280	4.2890 .2547	4.8510 .2147
Jul 1979	8	7	4.1532 .0820	3.8462 .0844	2.8199 .1939
Dec 1979	10	12	4.7404 .1162	3.7967 .2712	4.2394 .0705
Apr 1980	10	16	5.0213 .2195	4.0340 .3098	4.0827 .1911
Aug 1980	12	20	4.9662 .0669	4.0278 .1035	4.4762 .0553
Dec 1980	12	24	5.3133 .0947	4.4626 .1386	4.7600 .0726
Apr 1981	12	4	3.7668 .0472	2.9269 .0725	3.2264 .0575
Nov 1981	12	11	4.6659 .0782	3.8183 .1080	4.1158 .0734

Treatment area D3, December-January burn, 3 year cycle

Date of Samples	Number of Samples	Months Post-fire	Total fuel mean variance	Live fuel mean variance	Dead fuel mean variance
Dec 1978	3	preburn	5.9813 .0305	4.7607 .0006	5.6300 .0576
Jul 1979	9	7	4.2477 .0670	3.6951 .4244	3.1666 .2615
Dec 1979	9	12	4.9683 .1426	4.1071 .1268	4.4058 .2015
Apr 1980	10	16	5.0195 .0907	4.2200 .2040	4.4128 .0424
Aug 1980	12	20	4.8503 .1010	3.9339 .0792	4.3501 .1210

Appendix 2. Continued.

Dec 1980	12	24	5.4484 .0442	4.5321 .0630	4.9392 .0453
May 1981	12	28	5.7311 .0497	4.5354 .0773	5.3700 .0488
Dec 1981	12	36	5.4035 .1169	4.1748 .1543	5.0487 .1320

Treatment area D6, December-January burn, 6 year cycle

Date of Samples	Number of Samples	Months Post-burn	Total fuel mean variance	Live fuel mean variance	Dead fuel mean variance
Dec 1978	3	preburn	5.6597 .3028	4.4057 .1152	5.2950 .5095
Jul 1979	6	7	3.9052 .1235	3.3880 .2267	2.9932 .1266
Dec 1979	9	12	4.6633 .1350	3.7332 .2397	4.1594 .1114
Apr 1980	10	16	4.7678 .1023	3.8842 .1911	4.2352 .0814
Aug 1980	12	20	4.5895 .0689	3.7059 .0931	4.0404 .1400
Mar 1981	12	27	5.2613 .0400	3.9201 .0941	4.9618 .0275
May 1981	12	29	4.9953 .1018	3.7503 .1264	4.6504 .1285
Dec 1981	12	36	5.3150 .1081	4.0492 .1428	4.9848 .1070

Appendix 2. Continued.

Treatment area F1, February-March burn, annual cycle

Date of Samples	Number of Samples	Months Post-fire	Total fuel mean variance	Live fuel mean variance	Dead fuel mean variance
Mar 1979	3	preburn	5.9590 .0005	4.3706 .0054	5.7333 .0008
Aug 1979	8	5	4.1660 .1132	3.6985 .1491	3.1870 .1273
Oct 1979	6	7	4.7697 .1419	4.1792 .1991	3.9668 .0999
Feb 1980	10	11	4.8529 .0337	3.9331 .0764	4.3439 .0373
Jun 1980	8	15	5.0123 .0613	4.0511 .0324	4.5280 .1140
Feb 1981	12	23	5.4990 .0893	4.1732 .2633	5.1757 .0736
Jun 1981	12	3	4.0259 .0922	3.5011 .1608	3.0965 .1573
Nov 1981	12	8	4.5117 .1897	3.9476 .1393	3.6627 .3520
Mar 1982	12	12	4.7035 .1977	3.8256 .3234	4.1637 .1342

Treatment area F3, February-March burn, 3 year cycle

Date of Samples	Number of Samples	Months Post-fire	Total fuel mean variance	Live fuel mean variance	Dead fuel mean variance
Mar 1979	3	preburn	6.4323 .0221	5.0377 .0934	6.1390 .0300
Aug 1979	8	5	4.7161 .1548	4.1433 .2062	3.8812 .1482
Oct 1979	8	7	4.9059 .0804	4.1961 .0590	4.1742 .1336
Mar 1980	10	12	5.0130 .0943	4.2844 .1355	4.3437 .0992

Appendix 2. Continued.

Jul 1980	12	16	4.9478 .0830	4.0527 .0949	4.4329 .0752
Mar 1981	12	24	5.6478 .0959	4.4526 .1596	5.2795 .0984
Jul 1981	12	28	5.5922 .1356	4.3665 .1458	5.2482 .1328
Nov 1981	6	32	5.5310 .0426	4.1317 .0866	5.2502 .0330
Feb 1982	12	35	5.4052 .1909	4.1449 .2068	5.0763 .1873

Treatment area F6, February-March burn, 6 year cycle

Date of Samples	Number of Samples	Months Post-fire	Total fuel mean variance	Live fuel mean variance	Dead fuel mean variance
Mar 1979	3	preburn	6.0313 .1395	5.7115 .1094	4.7408 .1534
Aug 1979	8	5	4.2756 .1980	3.7329 .2540	3.3848 .2081
Nov 1979	10	8	4.8041 .1196	4.0298 .1663	4.1790 .1288
Mar 1980	10	12	4.7869 .0484	3.7838 .1221	4.3285 .0379
Jul 1980	12	16	5.0702 .0775	4.0388 .1077	4.6155 .0778
Mar 1981	12	24	5.4906 .1247	4.9520 .1317	5.1691 .1343
Jun 1981	12	27	5.5402 .1616	4.3620 .1669	5.1749 .1648
Oct 1981	12	31	5.7028 .0693	4.4639 .1001	5.3642 .0581
Mar 1981	6	35	5.3444 .1897	4.0103 .1583	5.0395 .2161

Appendix 2. Continued.

Treatment area J1, July-August burn, annual cycle

Date of Samples	Number of Samples	Months Post-fire	Total fuel mean variance	Live fuel mean variance	Dead fuel mean variance
Jul 1979	5	preburn	5.4236 .4205	4.0027 1.0919	5.0869 .4031
Nov 1979	10	4	4.0810 .1308	3.5481 .1130	3.2121 .2103
Mar 1980	10	8	4.3454 .1006	3.4637 .0909	3.8269 .1198
Jul 1980	12	12	4.7984 .1466	4.0879 .1588	4.1210 .1689
Jan 1981	12	18	4.9502 .1064	3.8647 .1593	4.5238 .1263
Feb 1981	9	19	4.9847 .0572	3.7671 .1200	4.6269 .0634
Jul 1981	12	24	5.1970 .2143	4.2210 .0453	4.7281 .0148
Jul 1982	21	12	4.4307 .0878	---- ----	---- ----

Treatment area J3, July-August burn, 3 year cycle

Date of Samples	Number of Samples	Months Post-burn	Total fuel mean variance	Live fuel mean variance	Dead fuel mean variance
Jul 1979	8	preburn	5.8570 .0393	4.3493 .0969	5.5858 .0750
Nov 1979	10	4	4.0086 .0665	3.5321 .0801	3.0538 .1078
Mar 1980	10	8	4.2087 .1409	3.3364 .1072	3.6772 .1936
Jul 1980	12	12	4.4278 .0501	3.7144 .0470	3.7613 .0890
Jan 1981	12	18	4.8390 .0690	3.8823 .0954	4.3556 .0797

Appendix 2. Continued.

Feb 1981	9	19	4.9403	3.7368	4.5870
			.0472	.0723	.0531
Jul 1981	12	24	5.0886	4.0993	4.6272
			.0451	.0478	.0574
Jul 1982	18	36	5.6264	----	----
			.0626	----	----

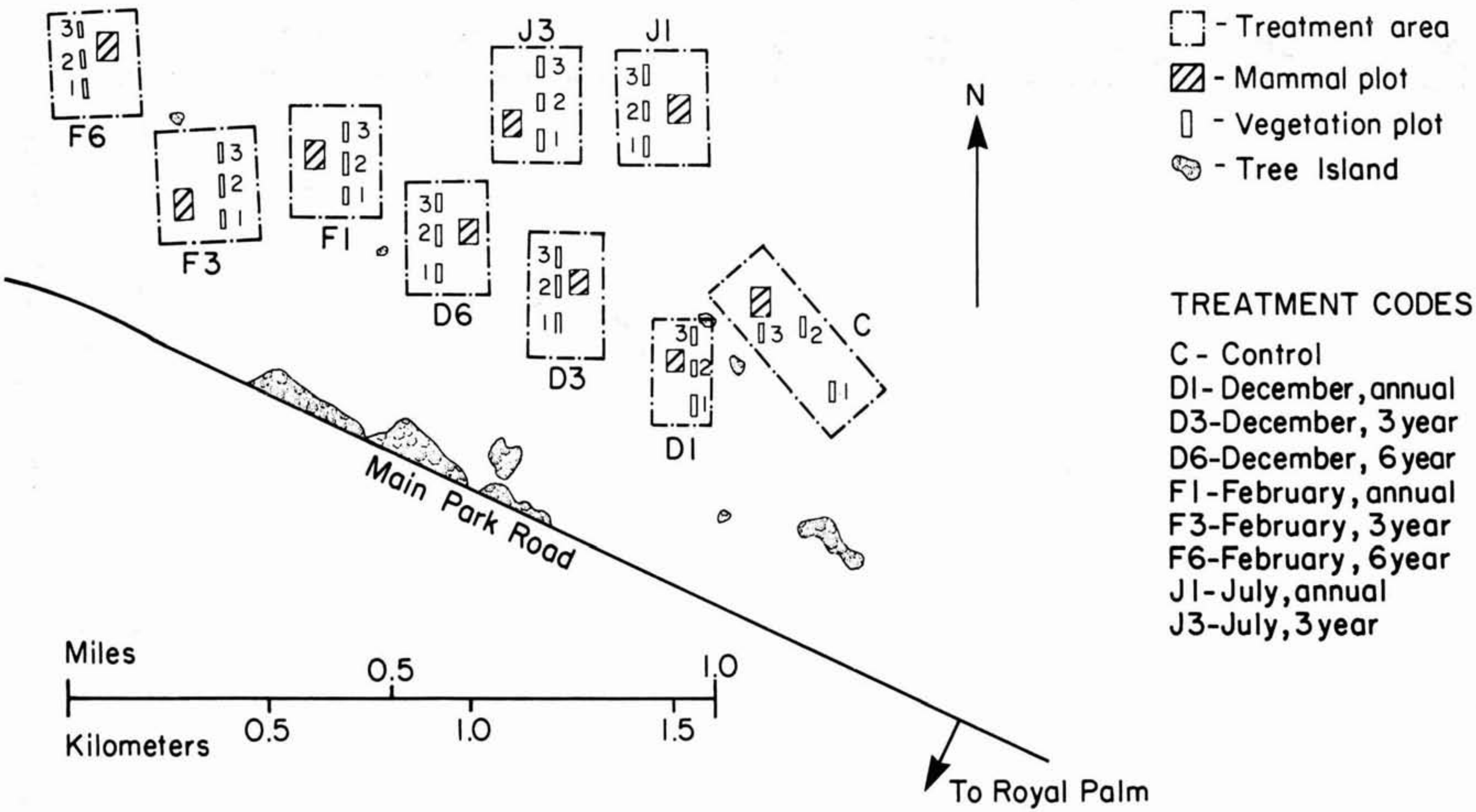


Figure 1. Base map showing treatment area locations.

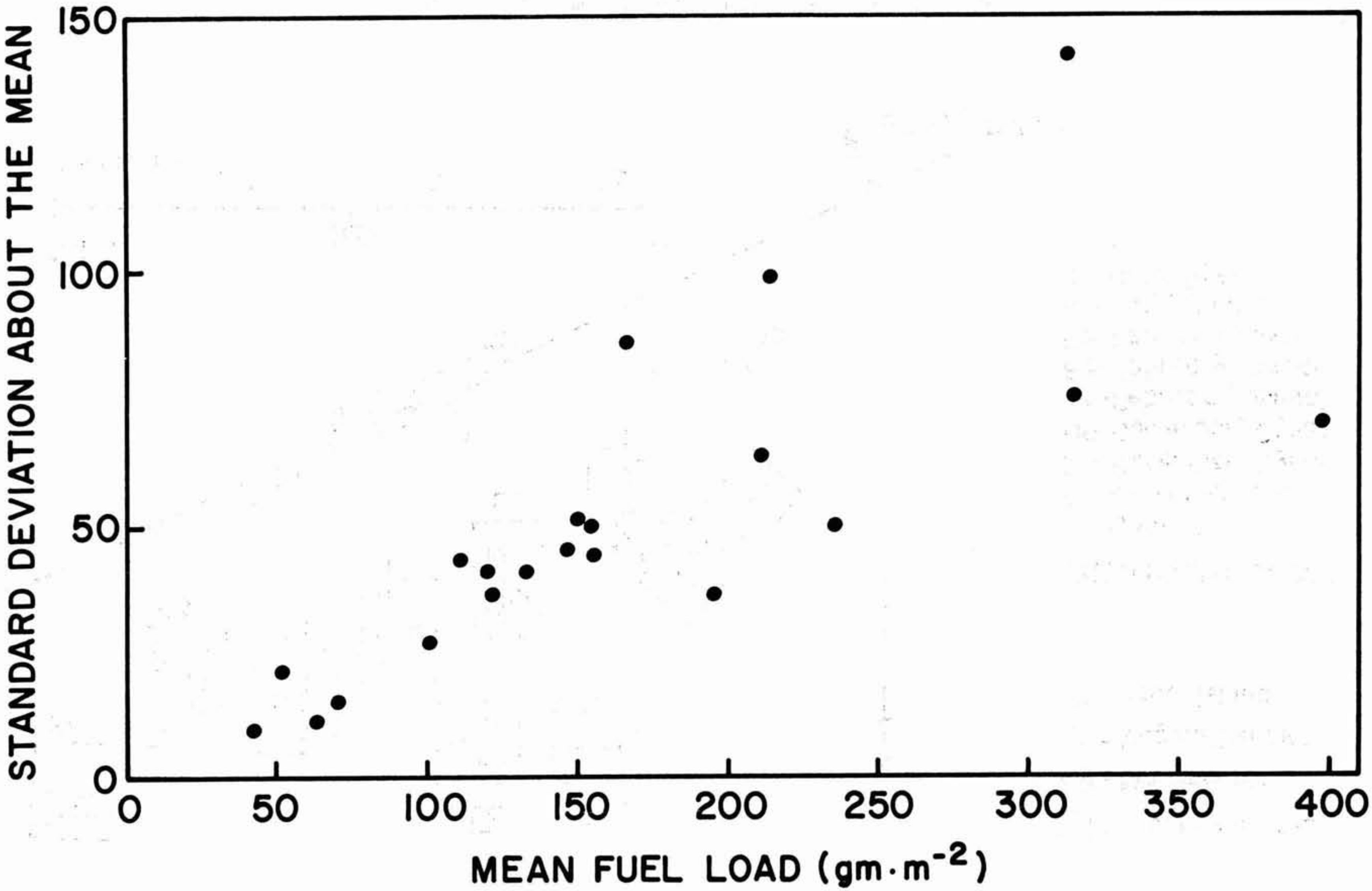


Figure 2. Scatter diagram showing relationship between mean and standard deviation for untransformed fuel samples.

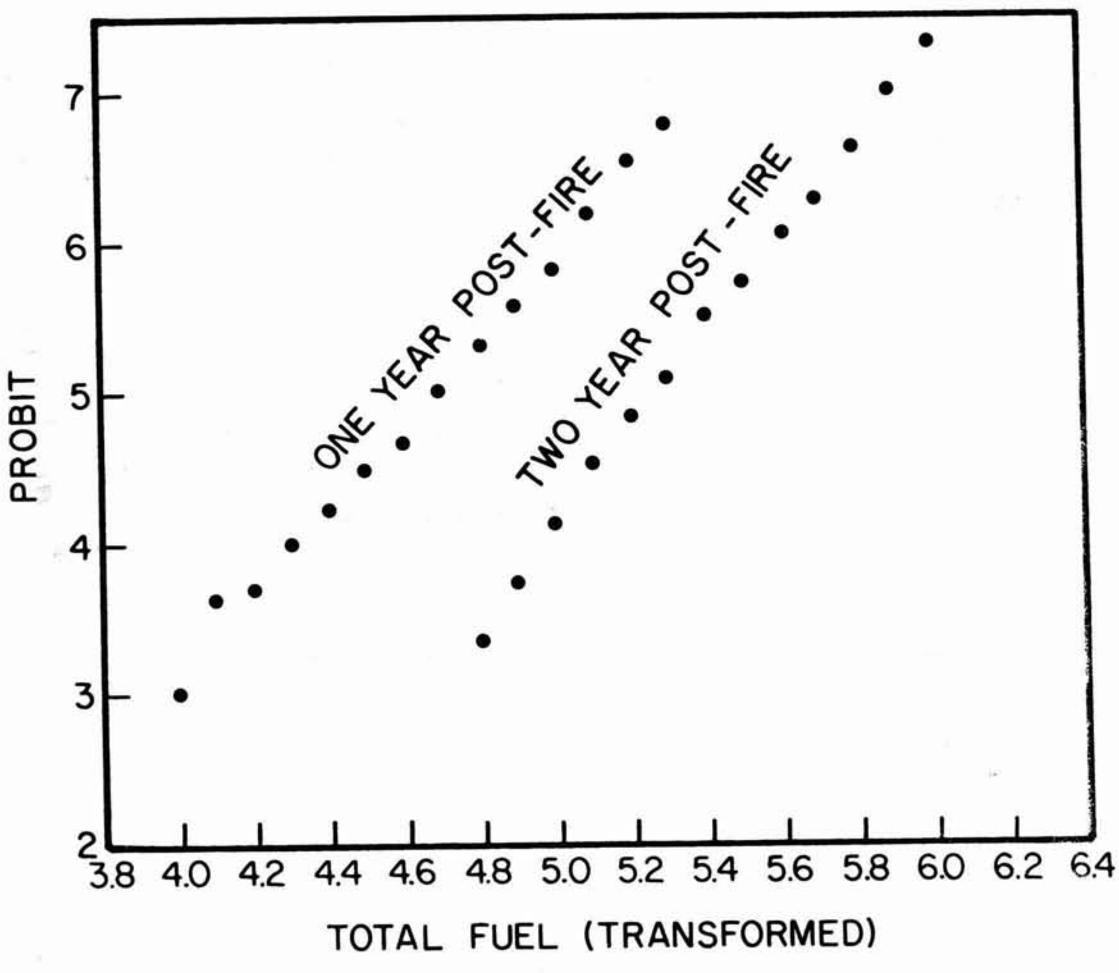
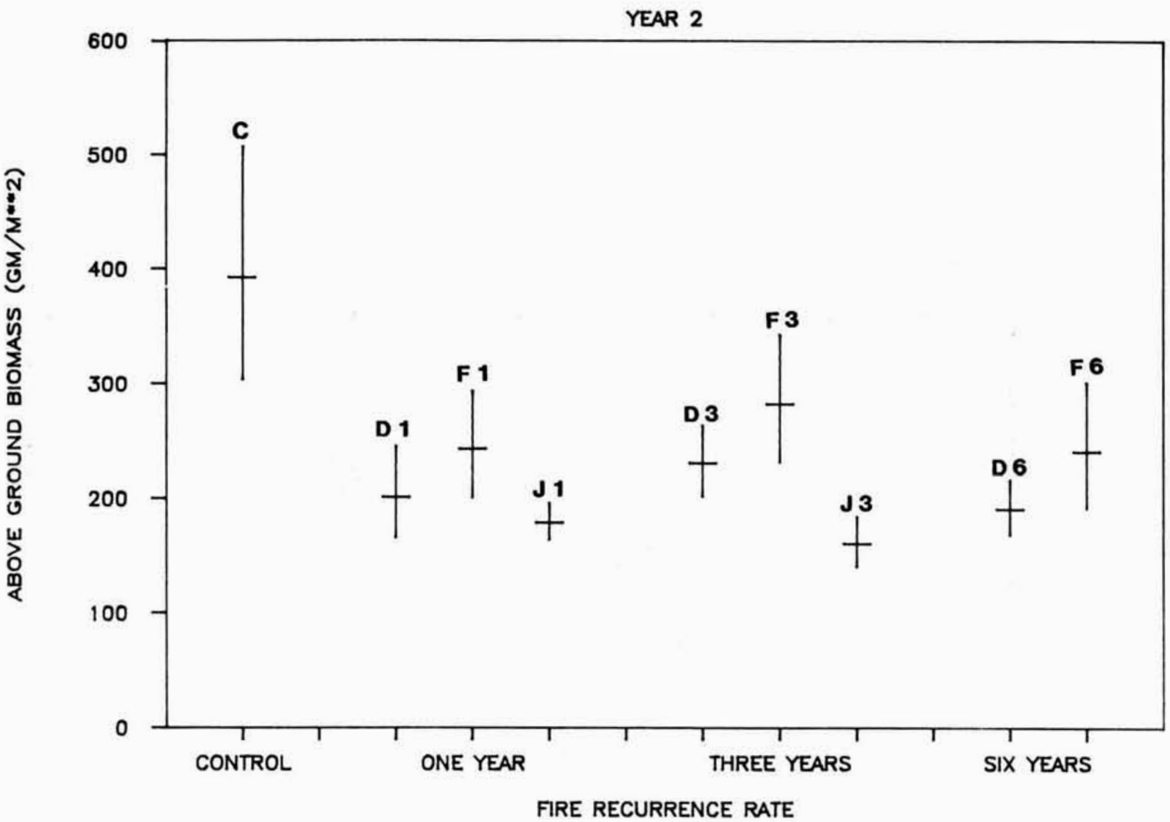


Figure 3. Probit graph of transformed total fuel in meter square samples. These demonstrate that the log-transformed fuel values follow an approximately normal distribution.



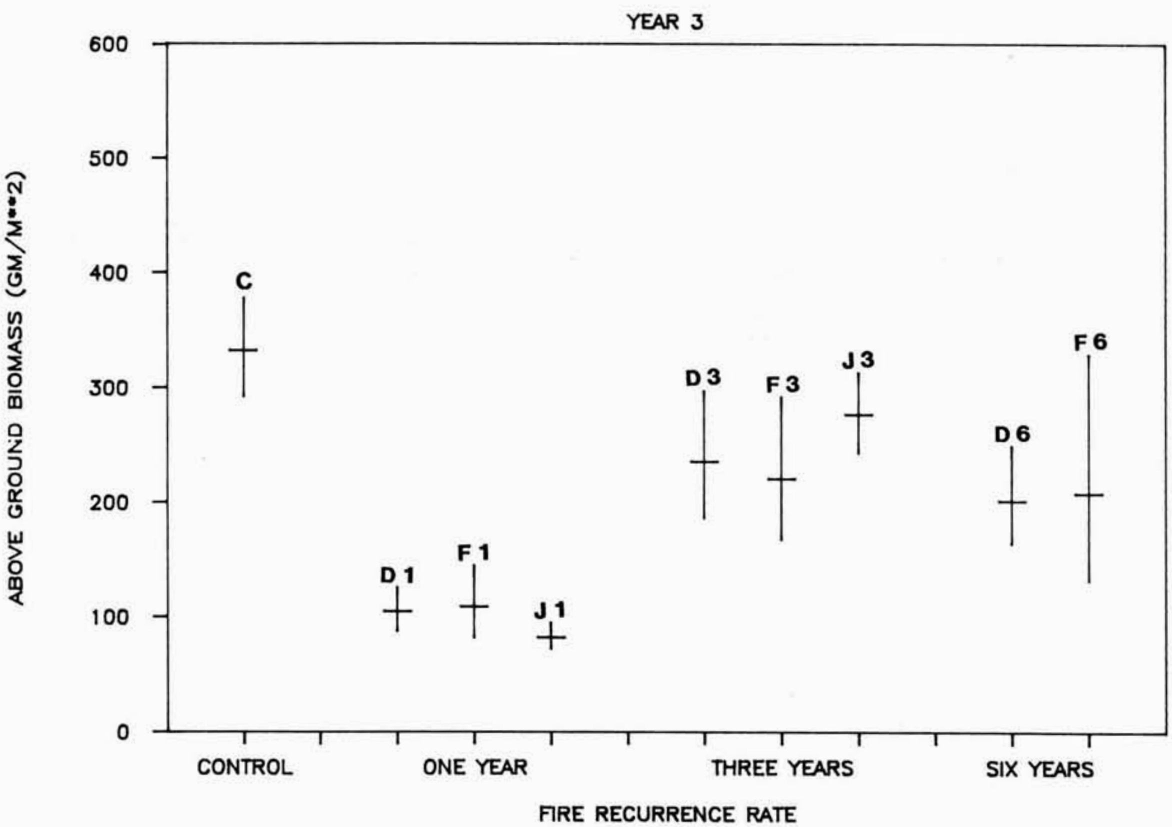


Figure 4. Means and 95% confidence intervals for above-ground biomass samples at two-years, three-years, and six-years after the start of the experiment.

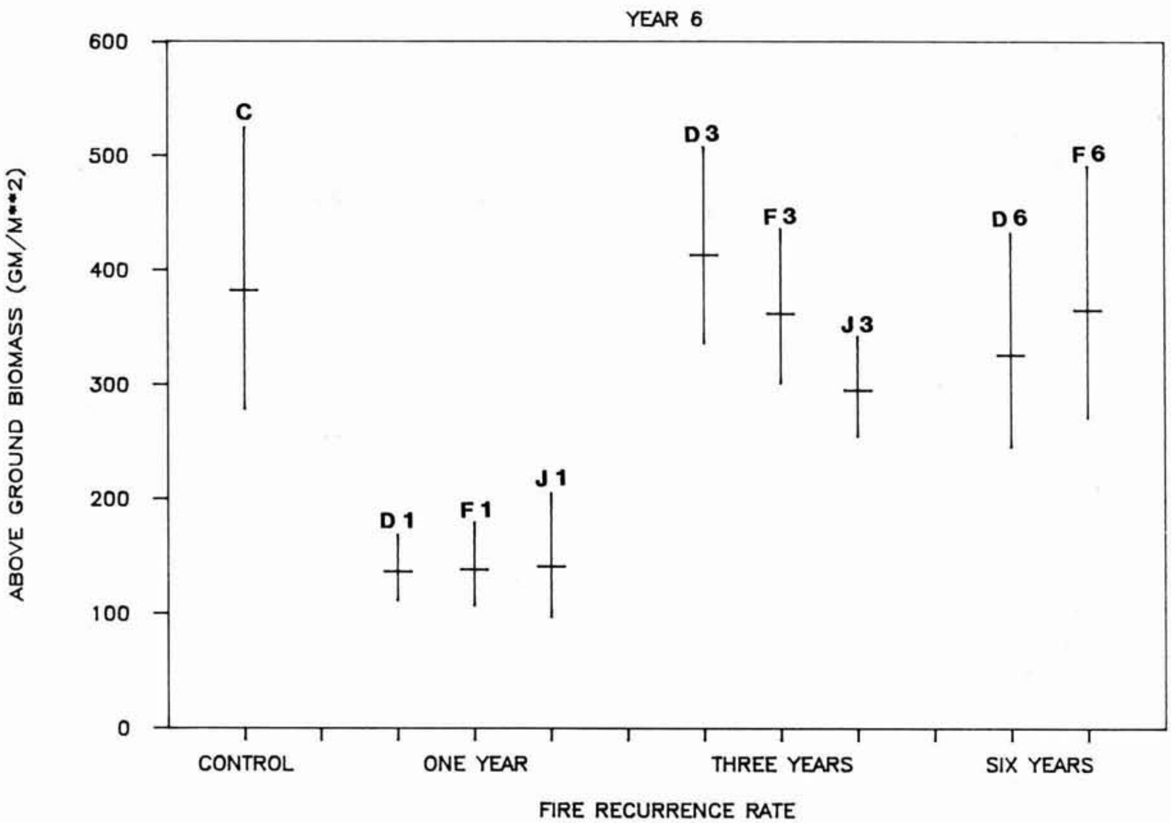


Figure 4. Continued.

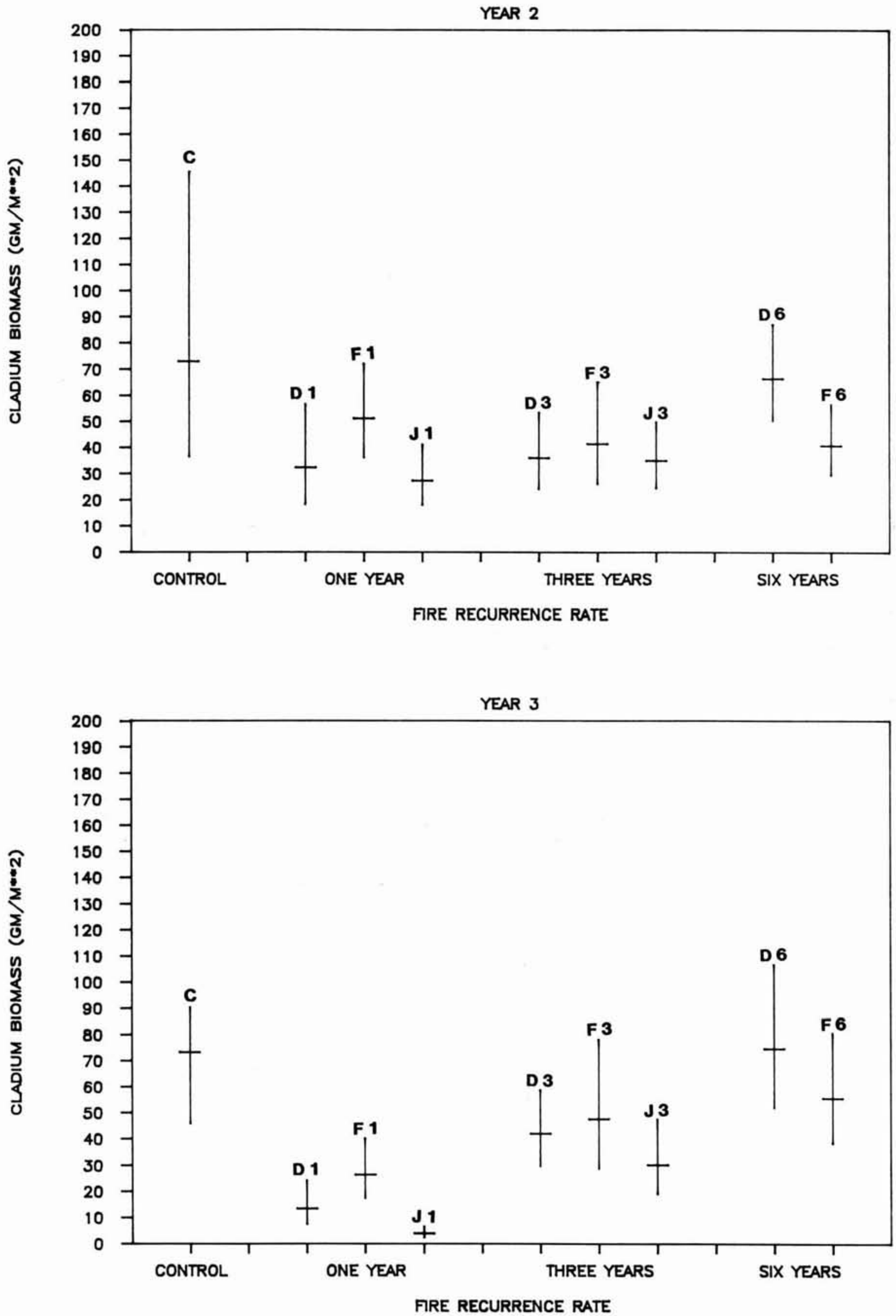


Figure 5. Means and 95% confidence intervals for Cladium biomass samples at two-years, three-years, and six-years after the start of the experiment.

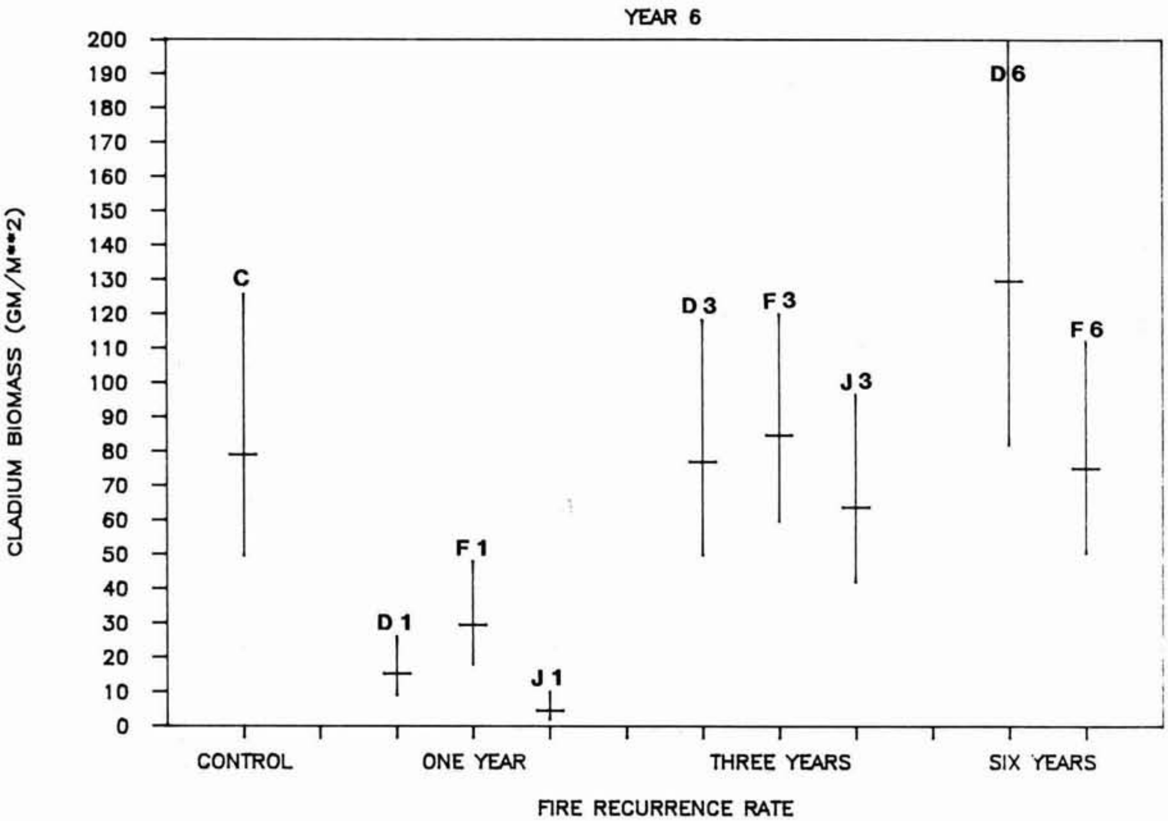
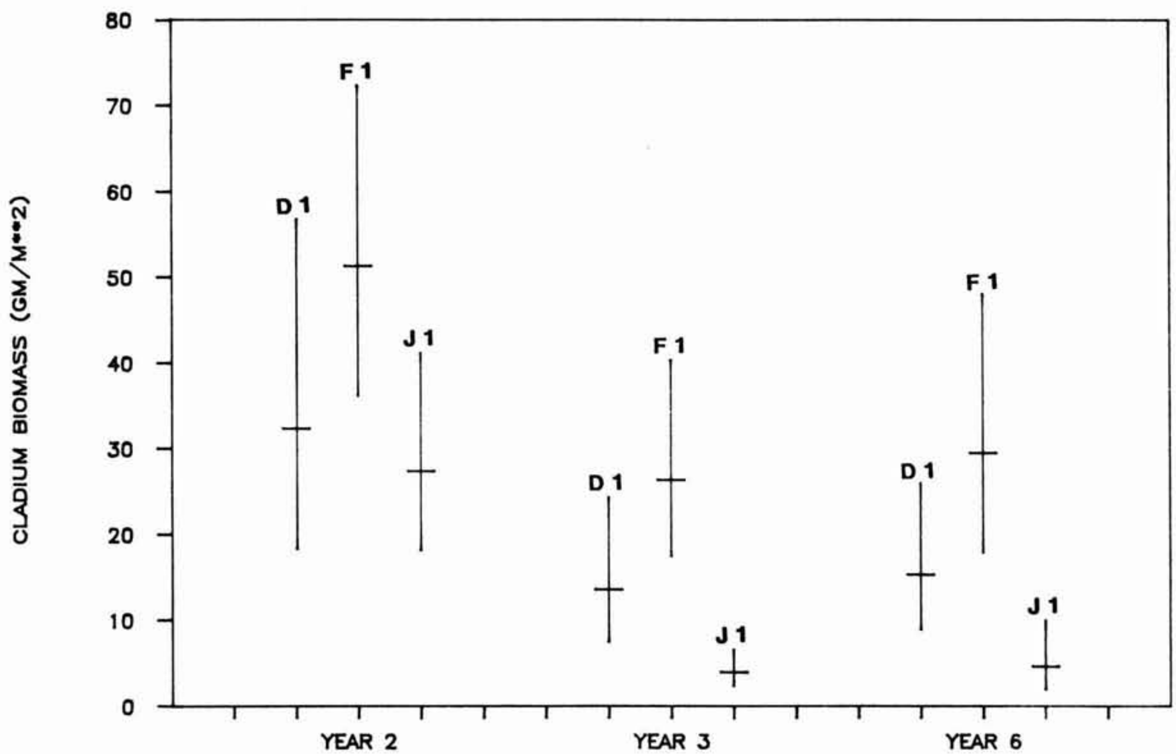


Figure 5. Continued.



igure 6. Change in Cladium biomass with time in the annual burn treatment areas.

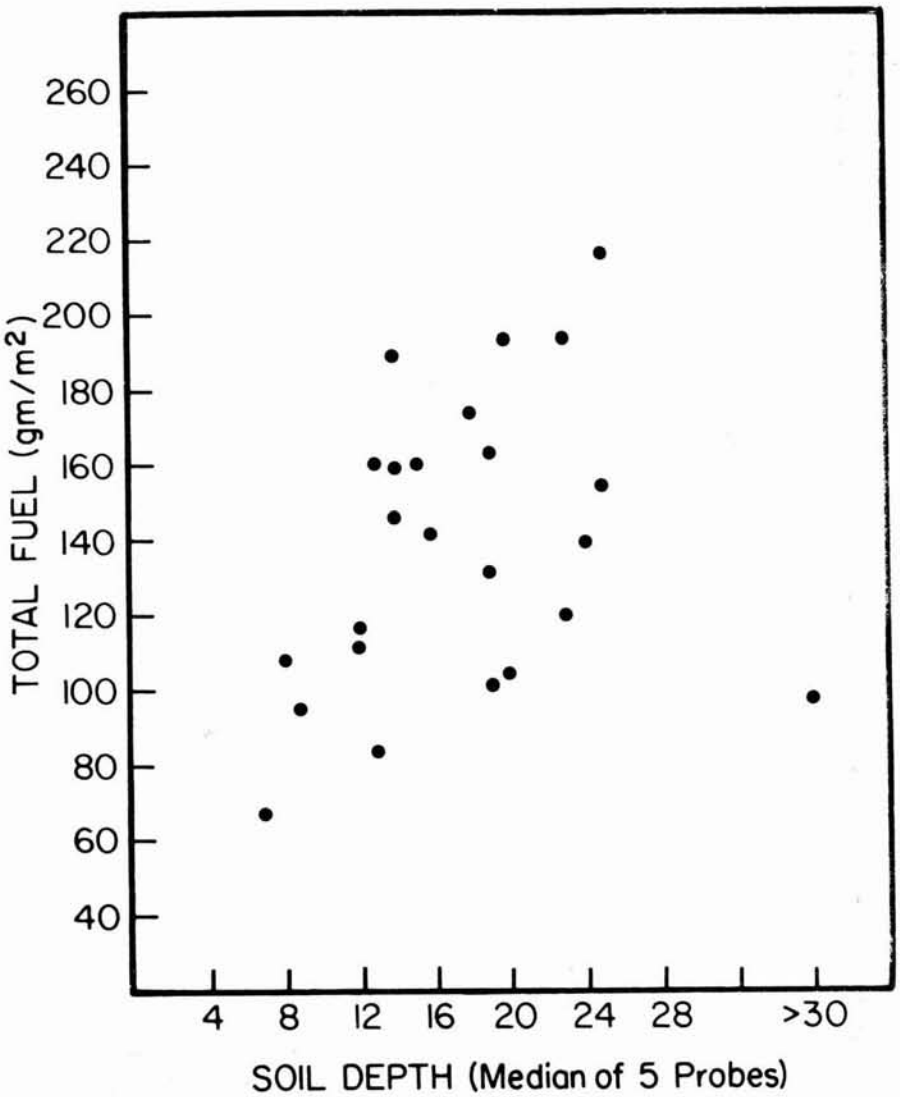


Figure 7. Scatter diagram of fuel load in meter square samples plotted against soil depth at the sample site. This shows the strongest relationship between soil depth and fuel load.

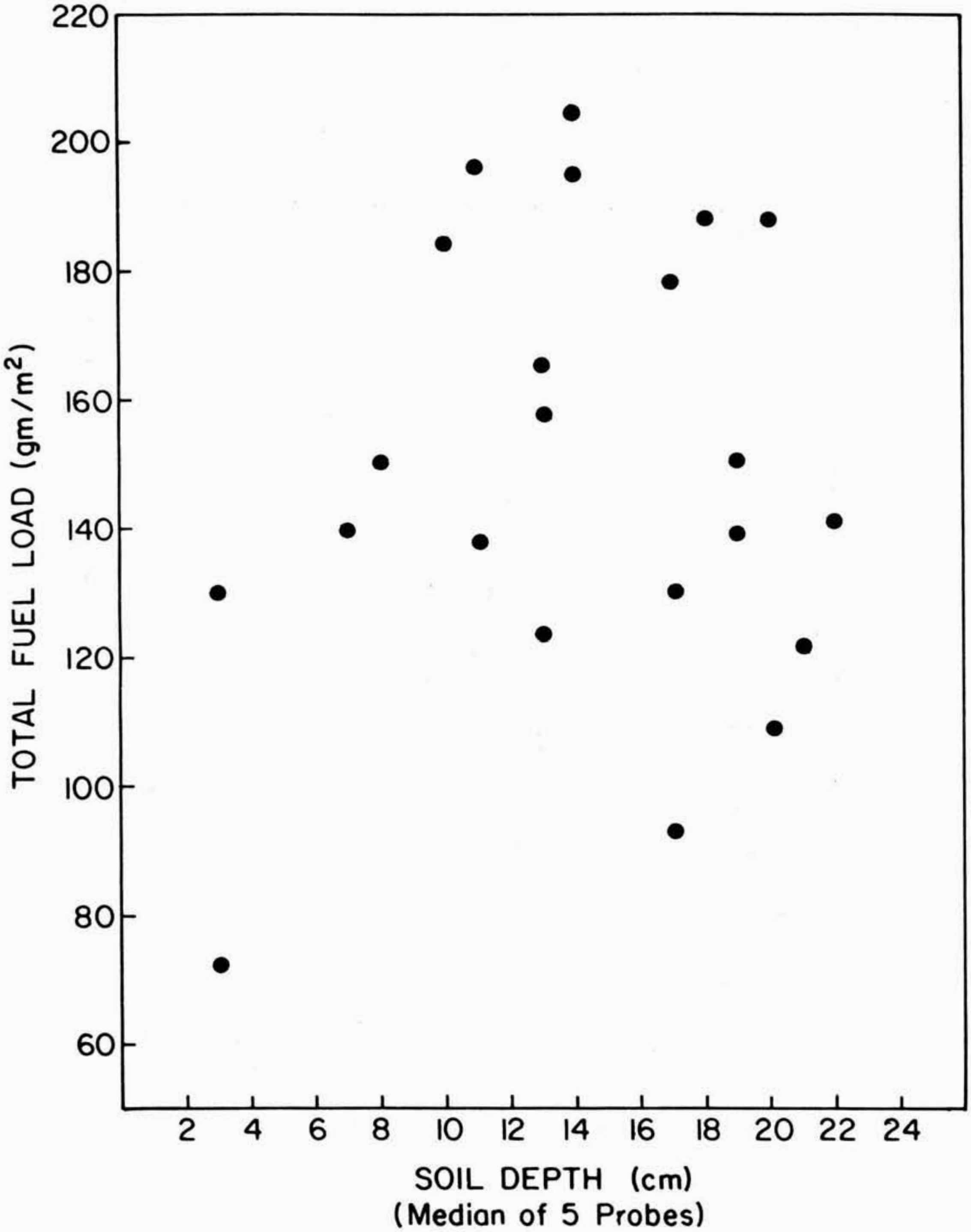


Figure 8. Scatter diagram of fuel load in meter square samples plotted against soil depth at the sample site. This shows a typical relationship between soil depth and fuel load.

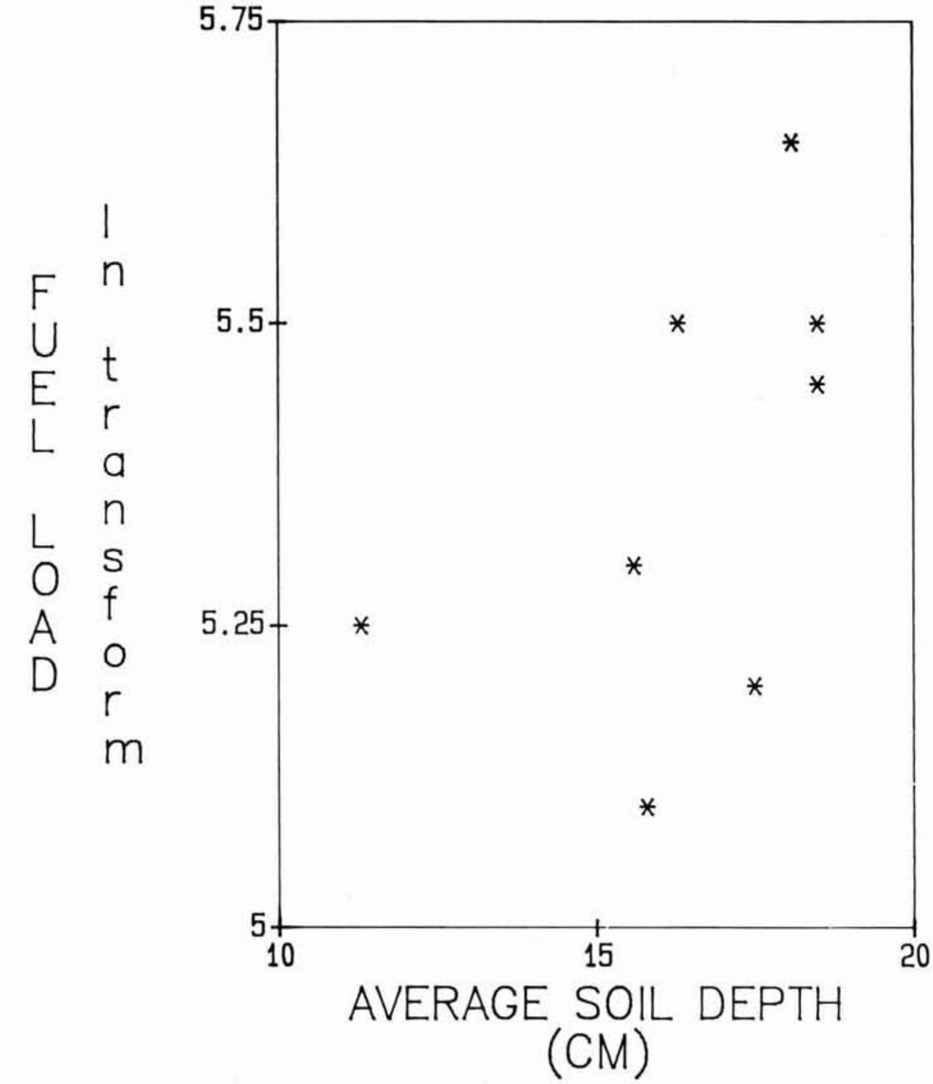


Figure 9. Scatter diagram showing relationship between transformed fuel load and average soil depth in treatment areas.

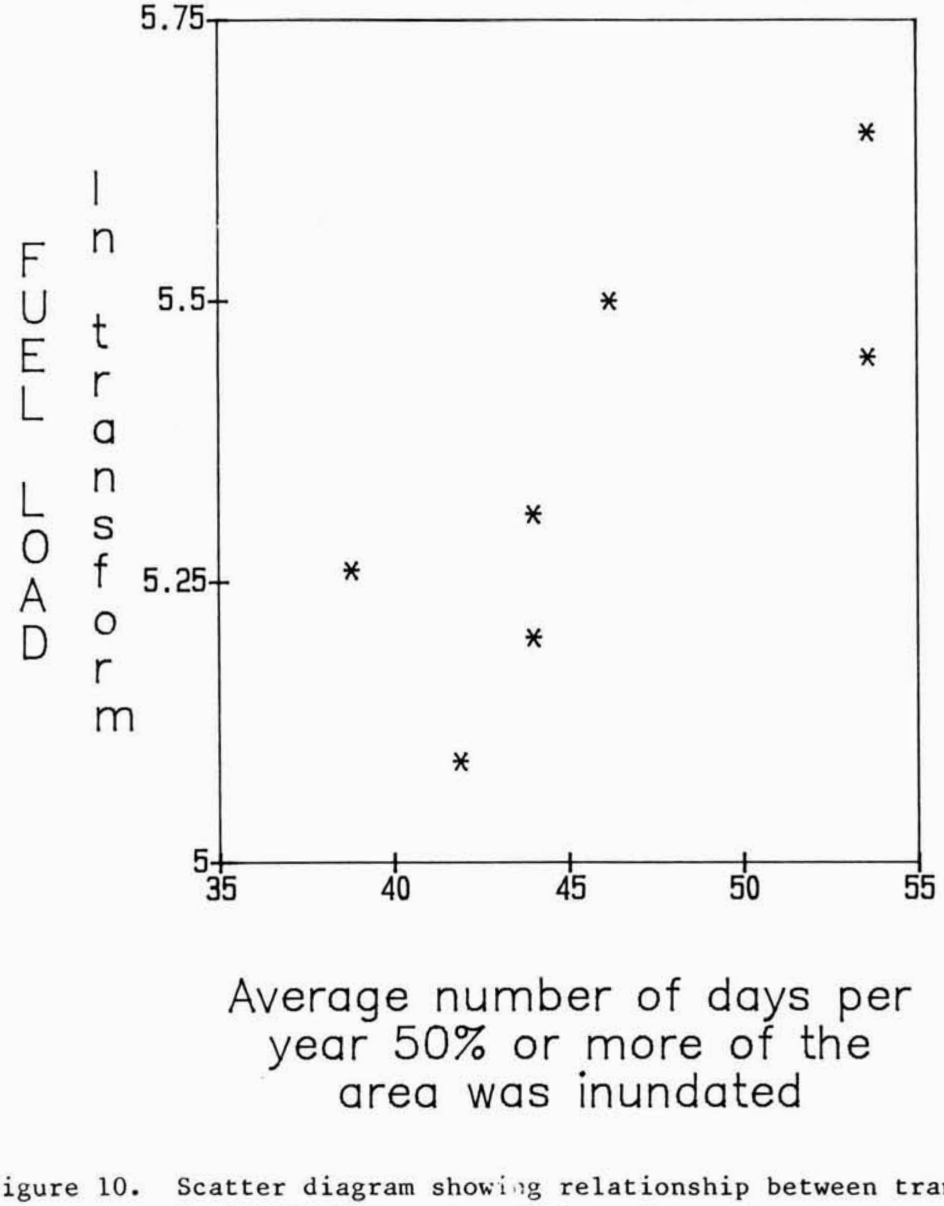


Figure 10. Scatter diagram showing relationship between transformed fuel load and average inundation of treatment areas.

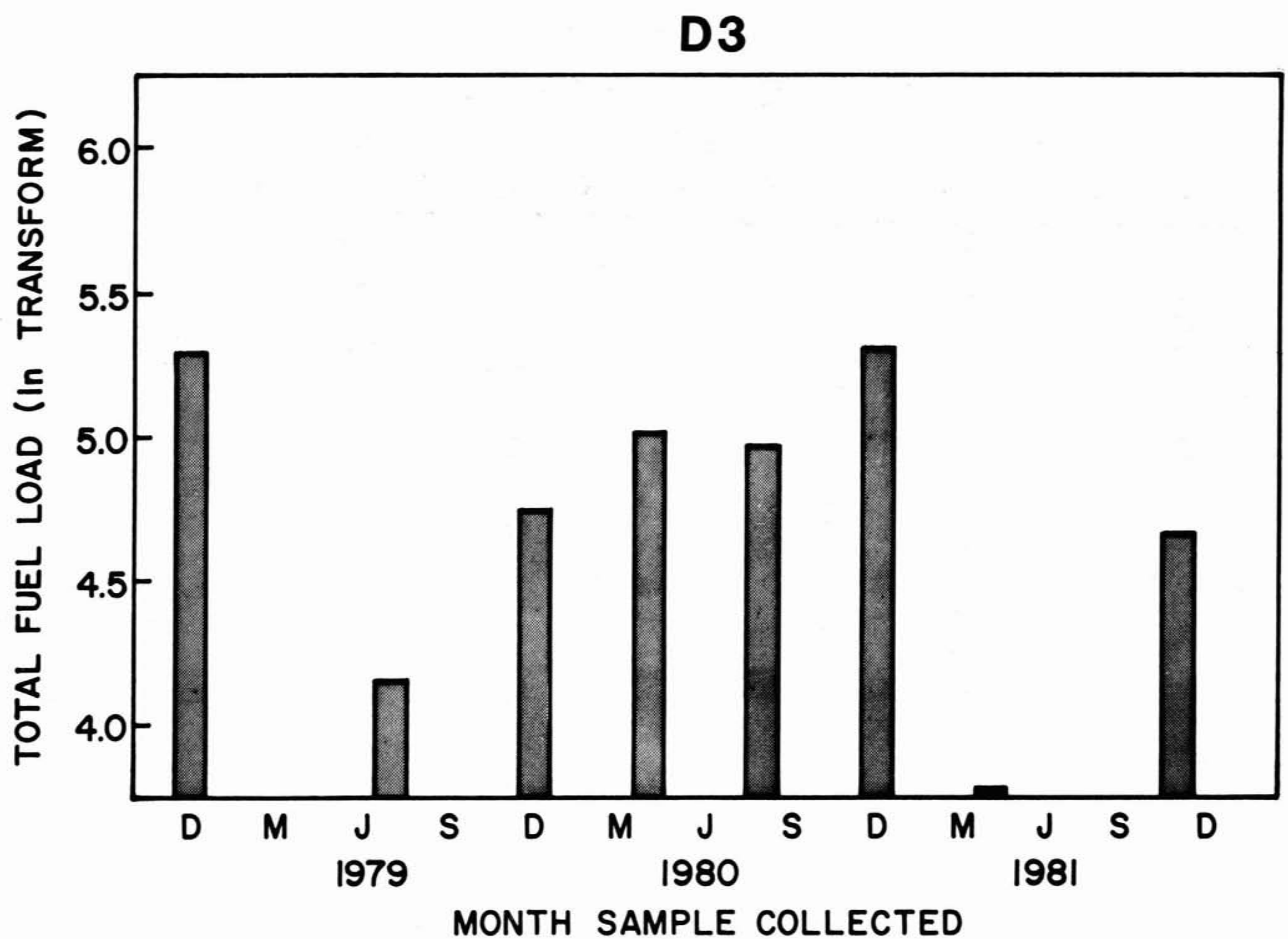


Figure 11. Variation in mean fuel load with time for treatment areas D1, D3, and C.

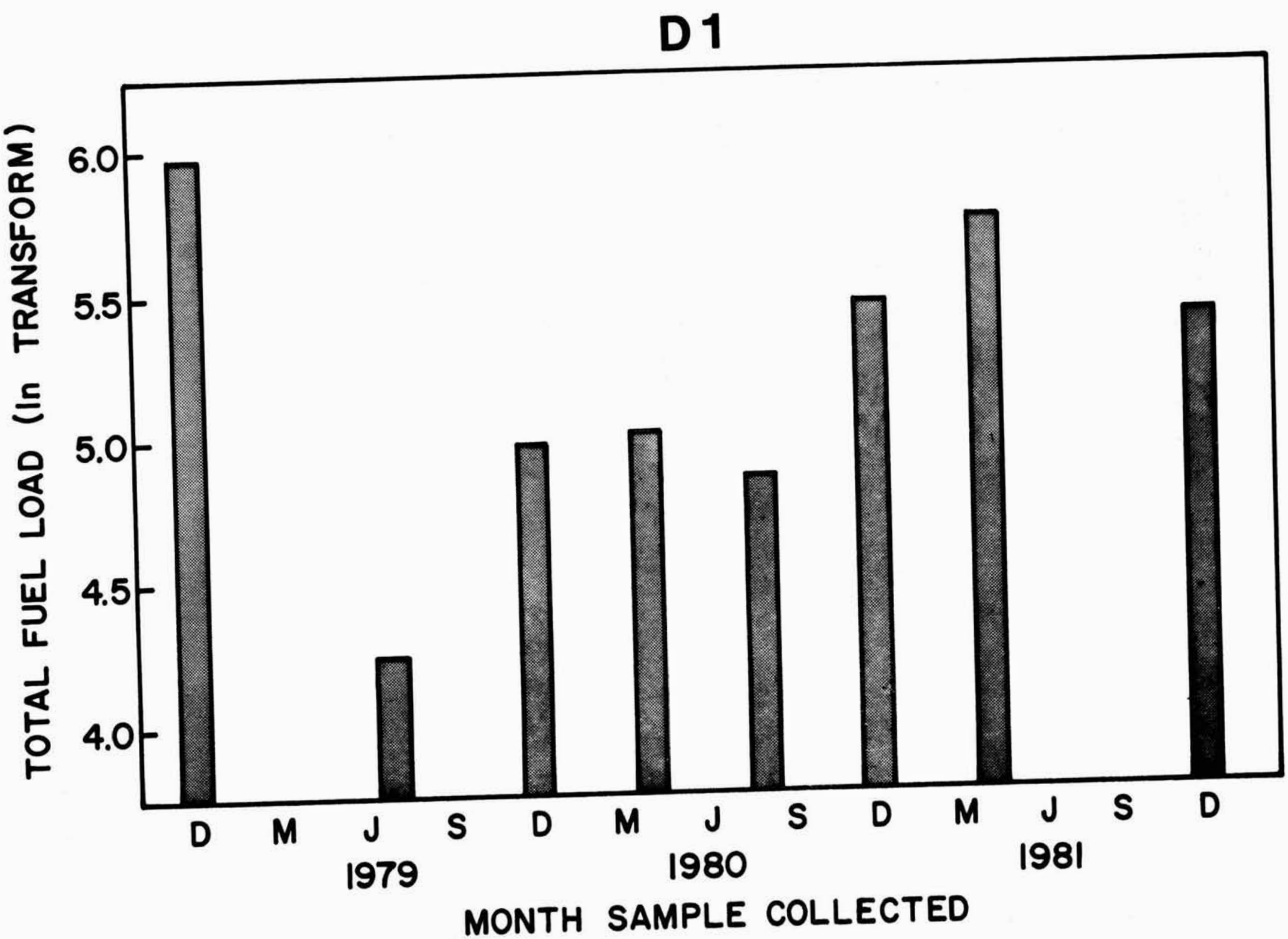


Figure 11. Continued.

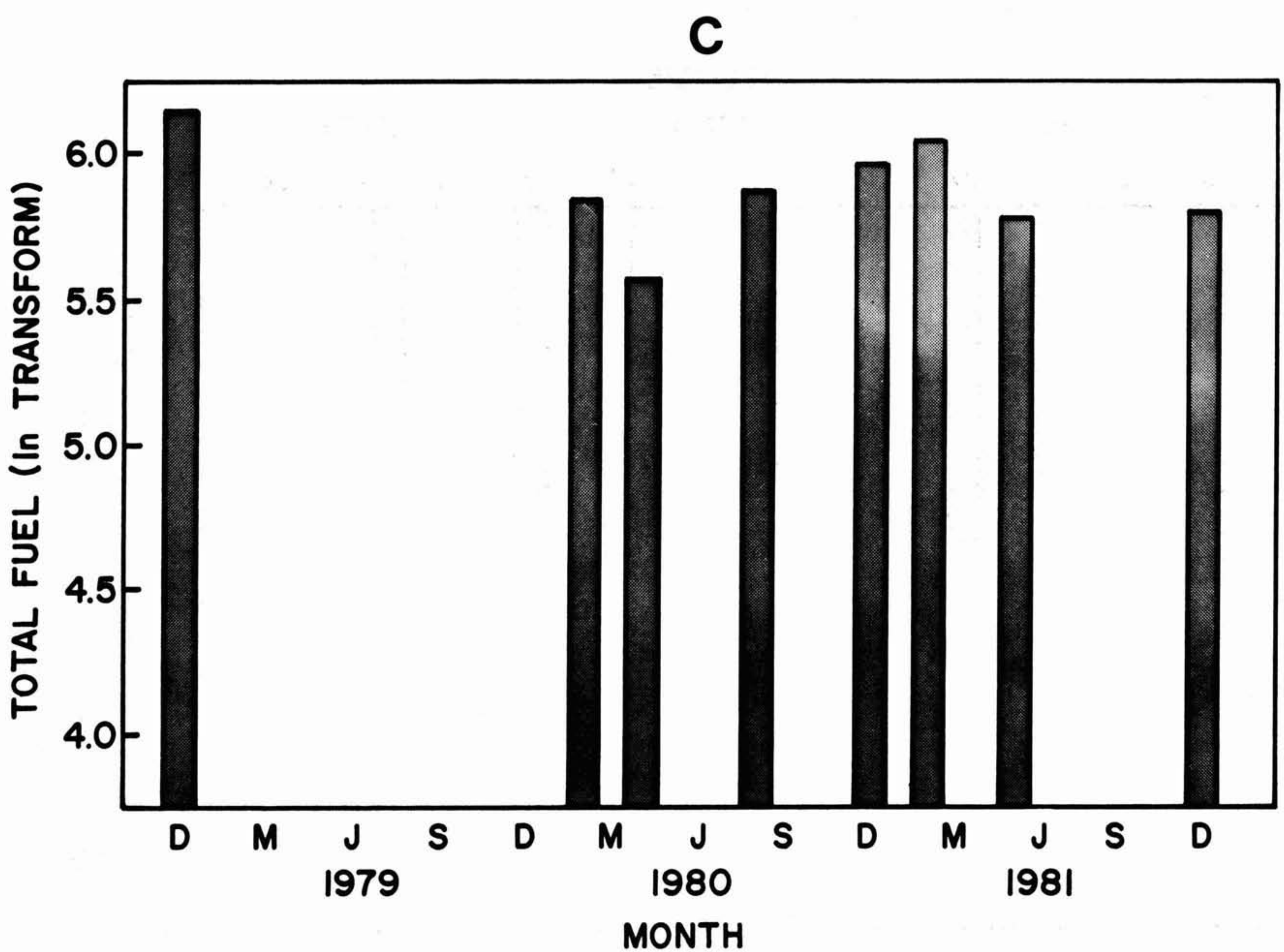


Figure 11. Continued.

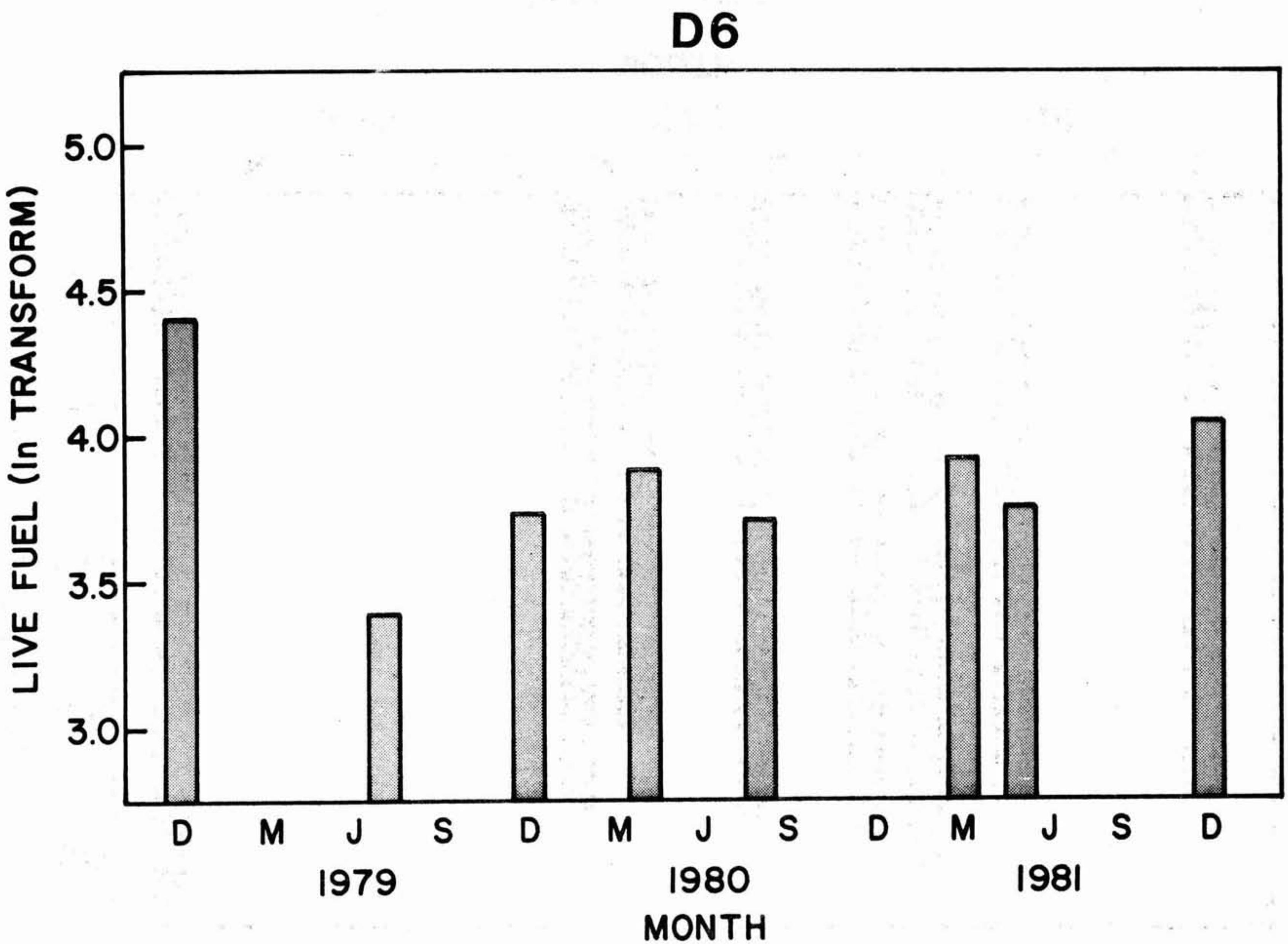


Figure 12. Variation in live fuel with time for treatment area D6.

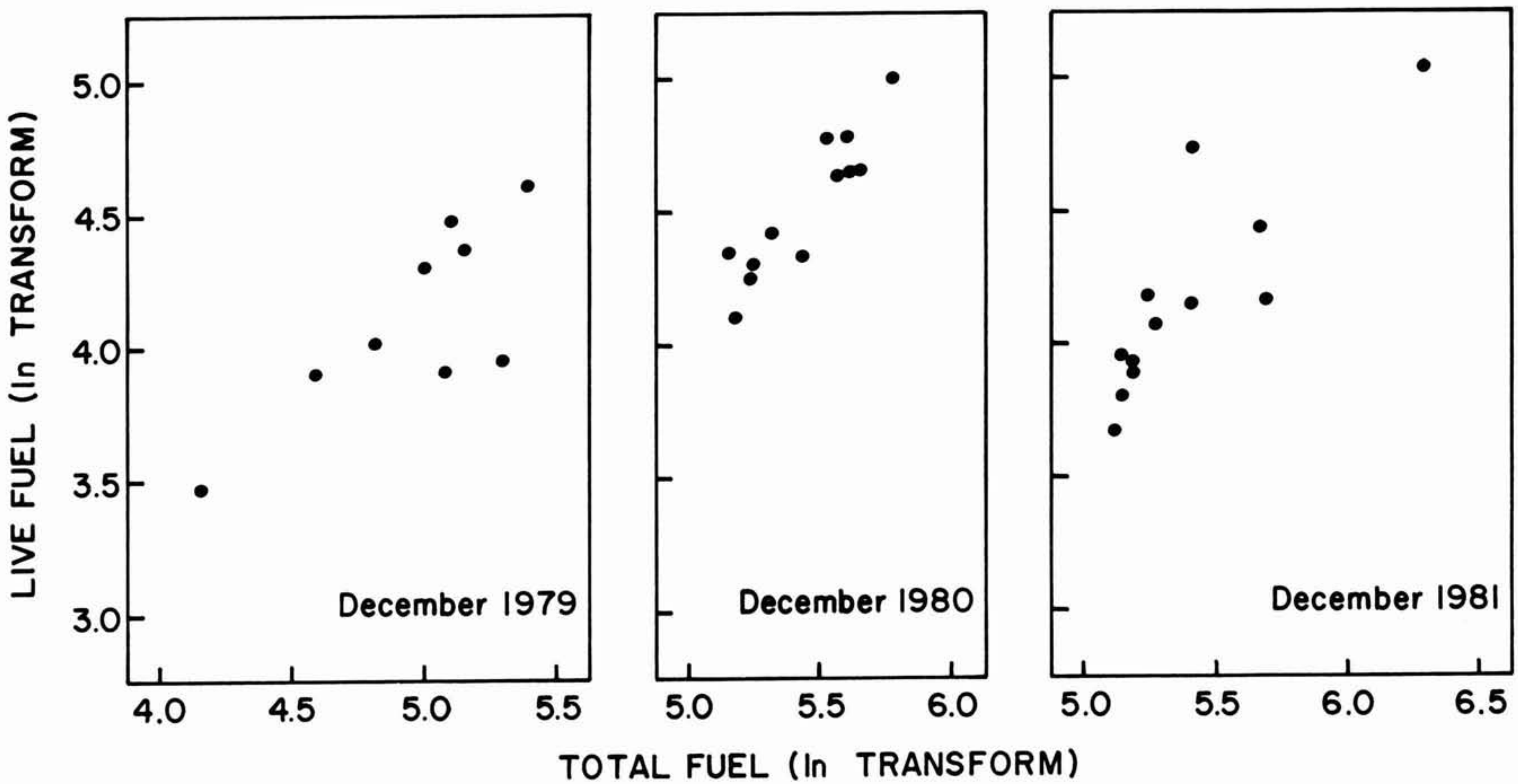


Figure 13. Scatter diagram showing linear relationship between transformed live fuel and total fuel, treatment area D1.

ERRATA

On page 23, the table headings were incorrectly placed. The page should have appeared as follows:

Appendix 1. Above-ground biomass measured in meter square samples for all treatment areas and sampling periods. All measurements are given in units of gm per m^2.

Treatment area C, December 1979

Sample	Total		Date
	Live	Dead	
V1-1	227.5	643.0	Dec 78
V2-1	87.5	180.5	"
V3-1	90.5	353.5	"

Treatment area C, February 1980

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	16.4	31.2	142.5	580.1	13 Feb 80
V1-2	7.6	18.9	114.0	495.1	"
V1-3	17.6	21.2	196.2	708.5	"
V2-1	16.1	46.2	50.5	160.2	"
V2-2	18.6	42.1	18.2	85.4	"
V2-3	36.1	57.8	35.2	108.7	"
V3-1	14.5	8.3	63.8	222.2	6 Dec 79
V3-2	4.4	9.3	31.8	138.8	"
V3-3	7.1	65.9	38.5	340.6	"
M-1	19.9	51.1	24.6	101.7	13 Feb 80

Treatment area C, April 1980

Sample	Cladium		Other		Date
	Live	Dead	Live	Dead	
V1-1	0	0	27.4	120.0	22 Apr 80
V1-2	18.0	35.4	48.2	172.5	"
V1-3	28.4	37.6	18.6	87.8	"
V2-1	30.0	63.8	22.1	82.9	"
V2-2	42.5	35.1	25.3	108.8	"
V2-3	18.8	36.7	45.2	146.5	"
V3-1	47.8	375.2	76.2	199.2	"
V3-2	25.8	36.7	32.5	118.2	"
V3-3	28.0	54.9	28.3	156.0	"
M-1	57.5	292.7	67.8	103.7	"