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A COMPARISON OF
THE FOLIAGE PROJECTED COVER
OF FOUR FYNBOS COMMUNITIES
OCCURRING ALONG A MOISTURE GRADIENT

BY

FRANCES PRESSINGER.

Q: Rainfall distribution annually
at each site more important
than total annual rainfall.
Importance of alternative sources
of precipitation (mist) need to
be considered also!

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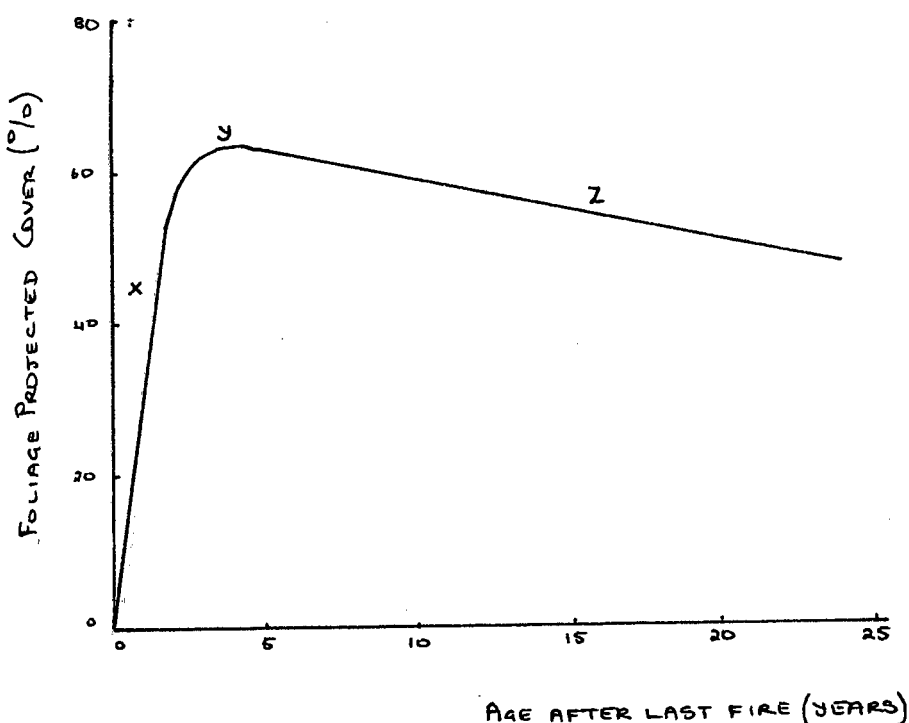
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Introduction

During a fire many species are either completely or partially destroyed. Regrowth occurs in the time following the burn. During this time there is an initial surge in the Foliage Projected Cover (F.P.C.) of the community as shown in Figure 1. F.P.C. is a measure of the proportion of the area of ground covered by foliage (or photosynthetic tissue) held vertically above it (Specht 1980). This initial increase in F.P.C. reaches a maximum value soon after a fire, and remains constant despite floristic changes. Thus, even though the dominant species may change, the F.P.C. remains constant.

Investigations have been made by Specht and Moll (unpub.) into the nature of the F.P.C. of fynbos communities in the Western Cape. They found that when F.P.C. (%) was plotted against time (years after fire), a characteristic curve developed. Figure 1 illustrates a generalised curve. It can be seen that there is an initial rapid increase in F.P.C. (X) which reaches a peak (Y), after which the F.P.C. slowly decreases (Z).

Figure 1: Generalised curve showing Foliage Projected Cover (F.P.C.)(%) versus time (years after burn) for fynbos sites in the Western Cape.



Further analysis of the data collected by Specht and Moll (unpub.) revealed that the curves formed by plotting F.P.C. (%) against time after burning for different sites in the Western Cape were not identical. The major differences lay in the gradient of the initial rise in F.P.C. (X) and in the value of the peak (Y).

When studying the Australian heath, Specht (1980) noted that the density of the foliage of the over-storey (expressed as F.P.C.) decreased with increasing water stress. It is postulated that the differences in the F.P.C. of the sites sampled in the Western Cape by Specht and Moll (unpub.) may be due to differences in water availability.

It was proposed that an investigation of a selection of sites occurring along a moisture gradient should be made in the fynbos areas of the Western Cape. The sites chosen for study were in Algeria, Silvermine, Bainskloof and Jonkershoek which occur along a moisture gradient from relatively arid to relatively moist, respectively.

METHOD AND APPARATUS.

The plant communities were described in terms of Foliage Projected Cover (F.P.C.). Methods involving the measurement of the foliage projected cover are superior to those that measure ^{or estimate} the canopy projected cover ^{ref?} in that the former allow for gaps in the canopy itself, and for irregularities in its outline. This means that a more realistic estimate of the foliage density is made.

The apparatus used to measure the F.P.C. in these experiments was a cross-wired sighting tube suspended on gimbals. This apparatus was first developed by Winkworth and Goodall (1962) and has since been used by Specht (1973, 1980) and Specht and Moll (unpub.). Figure 2 illustrates the apparatus.

INSET FIG 2.

Procedure.

In each community, 6 - 10 line transects of \pm 25m were randomly placed. Samples were taken at 25cm intervals along the transect, using the cross-wired sighting tube. At each interval, the tube was held vertically above the transect line. The vegetation sighted beneath the crossed wires was recorded. Only the uppermost vegetation was recorded.

The results from the transects were averaged together as shown in Figure 3. The results were then plotted as F.P.C. (%) versus number of sample points. (In a 25m transect there are 100 25cm intervals, and therefore 100 sample points). Once the curve levelled it was judged that sufficient samples had been taken. This is shown in Figure 4.

This method has been used by Specht (1980) and Specht and Moll (unpub.). It has been found to be a suitable method for estimating the total foliage cover in all but the most dense vegetation.

Specht (1980), in his studies of the Australian heathland communities measured both the F.P.C. of the over- and under-storey. This was necessary because there is a characteristic tree element in the Australian heath. The trees form a distinct over-storey, with the smaller shrubs comprising the under-storey. Trees are lacking

at Fig?

Figure 2: Diagram illustrating the cross-wired sighting tube used to measure the Foliage Projected Cover (actual size). The tube is held at positions A and B. The vegetation sighted beneath the two sets of cross-wires is recorded.

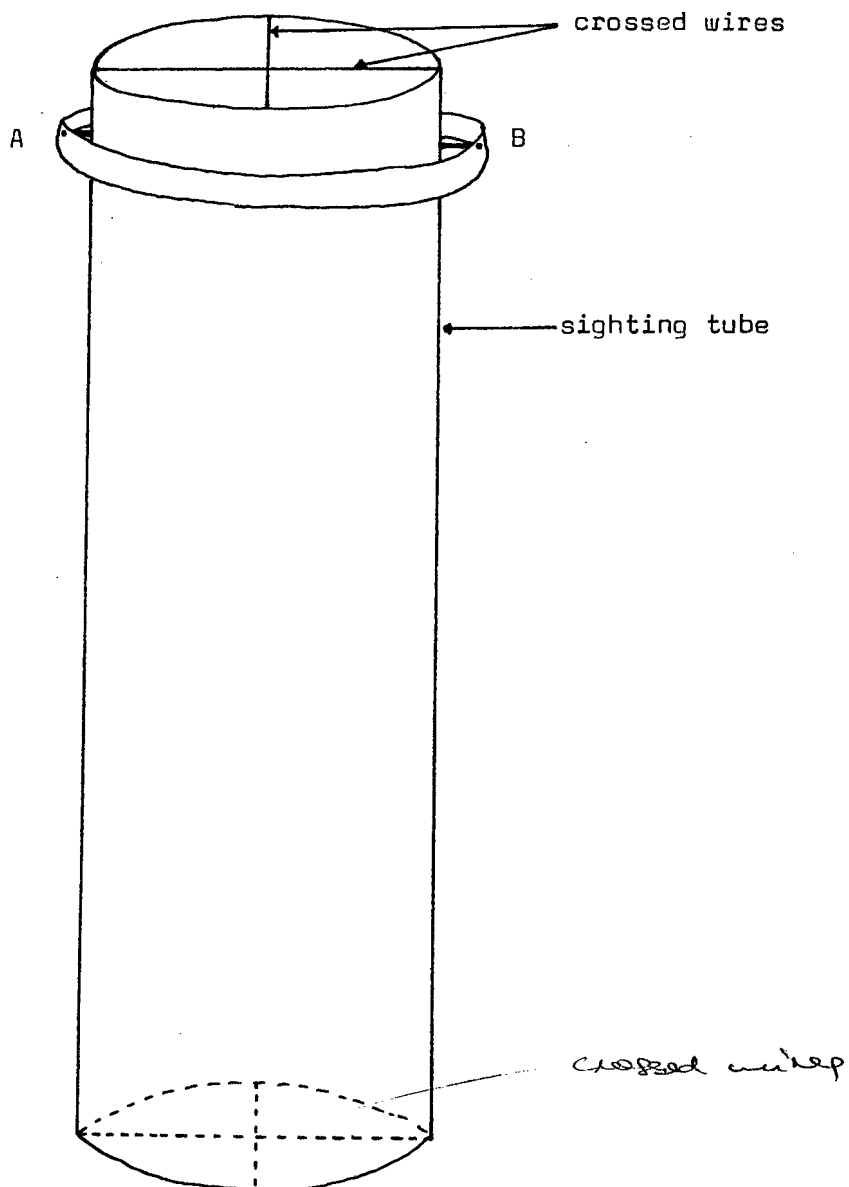
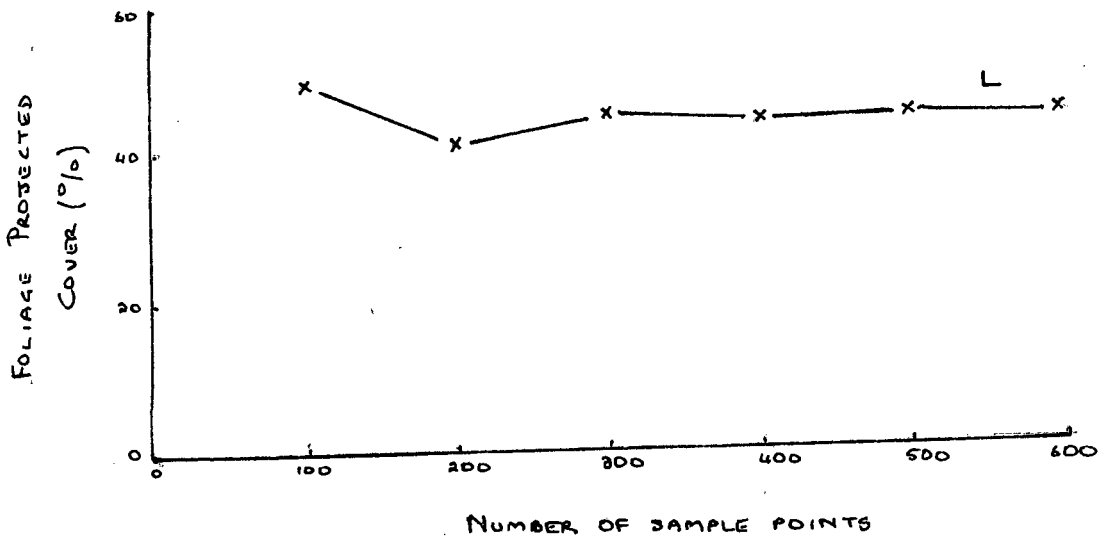


Figure 3: Example of recording method.

Column identification	a	b	c	d	e
	$\dot{\Sigma}$	%	$\dot{\Sigma}$	$\dot{\Sigma}$	%
Standing dead material (S/D)	5	5	6	11	5,5
Litter	10	10	12	22	11
Bare ground (B/G)	5	5	4	9	4,5
Protea	12	12	14	26	13
Restios	50	50	52	102	51
Miscellaneous	18	18	12	30	15
Total number of points in transect.	100		100		
Cumulative total no. of points in transect.	100		200		

where: a = number of points in first transect,
 b = % of cumulative total,
 c = number of points in second transect,
 d = number of points in first and second transects together,
 e = % of cumulative total.

Figure 4: Graph showing ^{FL}Foliage Projected Cover (F.P.C.) (%) versus number of sample points. Note: when the curve levels (L) sufficient sample points had been collected.



in the fynbos of the Western Cape (Taylor 1978), and there is no clear-cut over- and under-storey comparable to that which occurs in the Australian heath. It was decided that experiments should be made to determine the relative importance of the over- and under-storey in the fynbos of the Western Cape. Sites in Silvermine and Bainskloof were chosen for study.

Procedure for measuring the over- and under-storey of fynbos communities.

In each community, 6 - 10 line transects of \pm 25m were randomly placed. Samples were taken at 25cm intervals using the cross-wired sighting tube (see Figure 2). At each interval the tube was held vertically above the transect line. The material (living or dead) sighted immediately below the cross-wires was recorded as over-storey. If the point fell into the centre of the plant, then this was included in the over-storey count. Thus the term "over-storey" in this context refers to the upper stratum. In contrast, the term "under-storey" refers to the material (living or dead) which occurs underneath some other material. This concept is depicted in Figure 5.

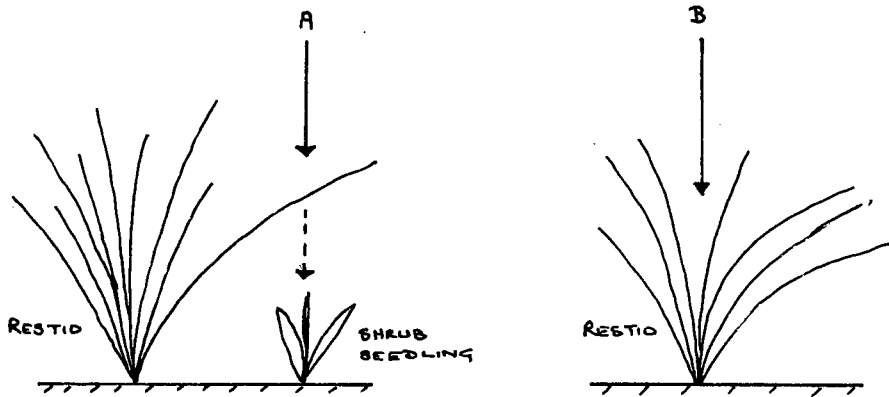
It must be noted that the terms "over-storey" and "under-storey" used in this context differ from those used by Specht (1980). Specht (1980) recorded the potential over-storey species as being "over-storey", and the potential under-storey species as being "under-storey", even if at the time of sampling they were not physically in an over- or under-storey position. In contrast, ⁱⁿ the experiments performed in this study, the terms "over-storey" and "under-storey" refer to the actual position at the time of sampling. This is illustrated in Figure 5.

The results of the experiments that measured both over- and under-storey F.P.C. suggest that the under-storey F.P.C. in the fynbos, and especially in the younger communities, plays a relatively lesser rôle as compared with that of the upper stratum. This will be discussed further in the Results section. For these reasons, it seems reasonable to only measure the F.P.C. of the upper stratum.

One of the disadvantages of using this method to describe the vegetation is the fact that it is open to subjective bias. Comparisons of data

According to Specht
an incorrect
interpretation
(pers. comm).

Figure 5: Pictorial illustration of method of recording used in this study, and a comparison with that used by Specht (1980). A and B are different positions of the cross-wired sighting tube.



Recording example:

(i) Used in this study.

A) Restio

Restio over-storey, 1

Restio under-storey,

Shrub

Shrub over-storey,

Shrub under-storey. 1

B) Restio

Restio over-storey, 1

Restio under-storey.

(ii) Used by Specht (1980).

A) Restio (potentially understory) 1

Shrub (potentially over-storey) 1

B) Restio (potentially under-storey) 1

collected by Specht and Moll (unpub.) with data collected in the same sites for this project reveals that there is a consistent $\pm 10\%$ discrepancy between the estimates made by Specht and Moll (unpub.) and Pressinger. The fact that the discrepancy is constant means that the relative values can be compared despite the difference in absolute values. It does mean, however, that any one series of comparisons must be made by the same recorder.

The main advantage of using this method is that it is relatively quick and simple. The equipment required is minimal and easily portable. The fact that it is a relatively fast method - as compared with methods involving a more detailed measurement of the vegetation, means that a larger sample, and hence a better estimate of the community population, can be made in the time that a smaller, more detailed study would accomplish.

Choice of sites.

Four fynbos sites were chosen in the Western Cape: Algeria, Silvermine, Bainskloof and Jonkershoek. These sites differed from each other in the amount of rainfall received. Within each area at least three different aged sites were sampled so as to construct a curve of F.P.C. (%) versus time (years after burning). Figure 6 shows the ages of the sites sampled in each of the four areas. Unfortunately it was not possible to sample from sites of exactly the same age in each of the four areas.

Figure 6: The ages of the sites sampled at Algeria, Bainskloof, Silvermine and Jonkershoek.

Area	Age after last burn (m = months, y = years)
Jonkershoek	20m, 30m, 6y, 23y 2m, 38y 4m,
Bainskloof	19m, 8y, 20y,
Silvermine	6m, 11m, 15m, 22m, 5y 3m, 5y 10m, 40y,
Algeria	24m, 5y, 21y,

(ages supplied by Forestry Dept.)

Statistical Analyses.

Since the ages of the communities sampled in each area differed, it was not possible to correlate all the data statistically. Where suitably aged sites occurred, statistical analyses were made to compare the F.P.C. values, using the Scheffé Multiple Contrast Test. The Scheffé test is not a very powerful statistical test, but was most suited for comparing the results in this situation.

Floristic Analyses.

The dominant species occurring in each area were identified and recorded. The results of these analyses are found in Appendix 5.

Site Descriptions.

A brief description of each of the areas sampled was made. This included a description of the general appearance of the community, the angle of slope, and any outstanding physical features. The results are included in Appendix 6.

Rainfall Data.

Unfortunately, there is a lack of detailed information concerning the plant-water relationships in the fynbos communities of the Western Cape. Very little is known about the actual amounts of water available to the communities (Fuggel, pers. comm.). An important variable which will affect the moisture availability is the amount of precipitation received in an area (Specht 1973).

A limited amount of reliable information concerning the precipitation is available for fynbos communities. Relevant values are shown in Figure 17. Various factors will either enhance or detract from these absolute input amounts to affect the moisture available to the plant communities. These include aspect, slope, soil type (Fuggel, pers. comm.), stem flow (Specht et al 1958), the structure of the vegetation (Specht 1972), and the time and duration of the rainfall. Thus the rainfall figures quoted in this project can only be used as a broad indication of the relative amounts of moisture available to the plant communities.

Perhaps not sufficiently critical.

- 1) Soil drainage
- 2) water etc.

RESULTS.

1. Preliminary investigations.

Preliminary experiments were performed to compare different methods of sampling. The two methods tested involved either measuring both the over- and under-storey F.P.C., or measuring only the over-storey F.P.C. Figure 7 summarises the findings of investigations made on fynbos communities at Silvermine. It shows the relative proportions of over- and under-storey F.P.C. (%) plotted against time after the last fire (years).

It can be seen that the F.P.C. comprises of mainly over-storey (plants that act actually as over-storey to others, and those with nothing below them), with the under-storey (only those plants that occur under other plants) playing a relatively minor rôle.

In Figure 8 the over and under-storey is divided into living (photosynthetic living tissue) and non-living (litter, standing dead material, and bare ground) material. Initially the non-living part of the over-storey predominates, but 20 - 30 weeks after the burn the situation is reversed with most of the over-storey comprising of living plant material. The reason for the initially relatively high amount of dead material is due to the charred remains of old shrubs which have been burnt and killed by the fire but which remain standing and dominate the landscape. Once the new plant material grows and increases in height, the effect of this standing dead material is reduced. When the community becomes older this non-living component increases in importance once again (not shown in Figure 8) as the community approaches senescence.

From Figure 8 it can be seen that most of the under-storey is composed of non-living material. By referring to the actual data collected (see Appendix 4) it can be seen that most of this non-living material is litter. In the initial stages immediately after a fire the litter content is relatively high due to the ashes and charred remains of the burnt vegetation. The litter content decreases slightly with time after a fire, as shown in Figure 8, because some of the ashes and charred remains become broken down and are blown out of the area by wind. Later the true litter,

Figure 7 : Graph showing the relative amounts of over- and under-storey Foliage Projected Cover (FPC) in sites of fynbos vegetation at Silvermine.

Black curve = FPC of over-storey,
Red curve = FPC of under-storey.

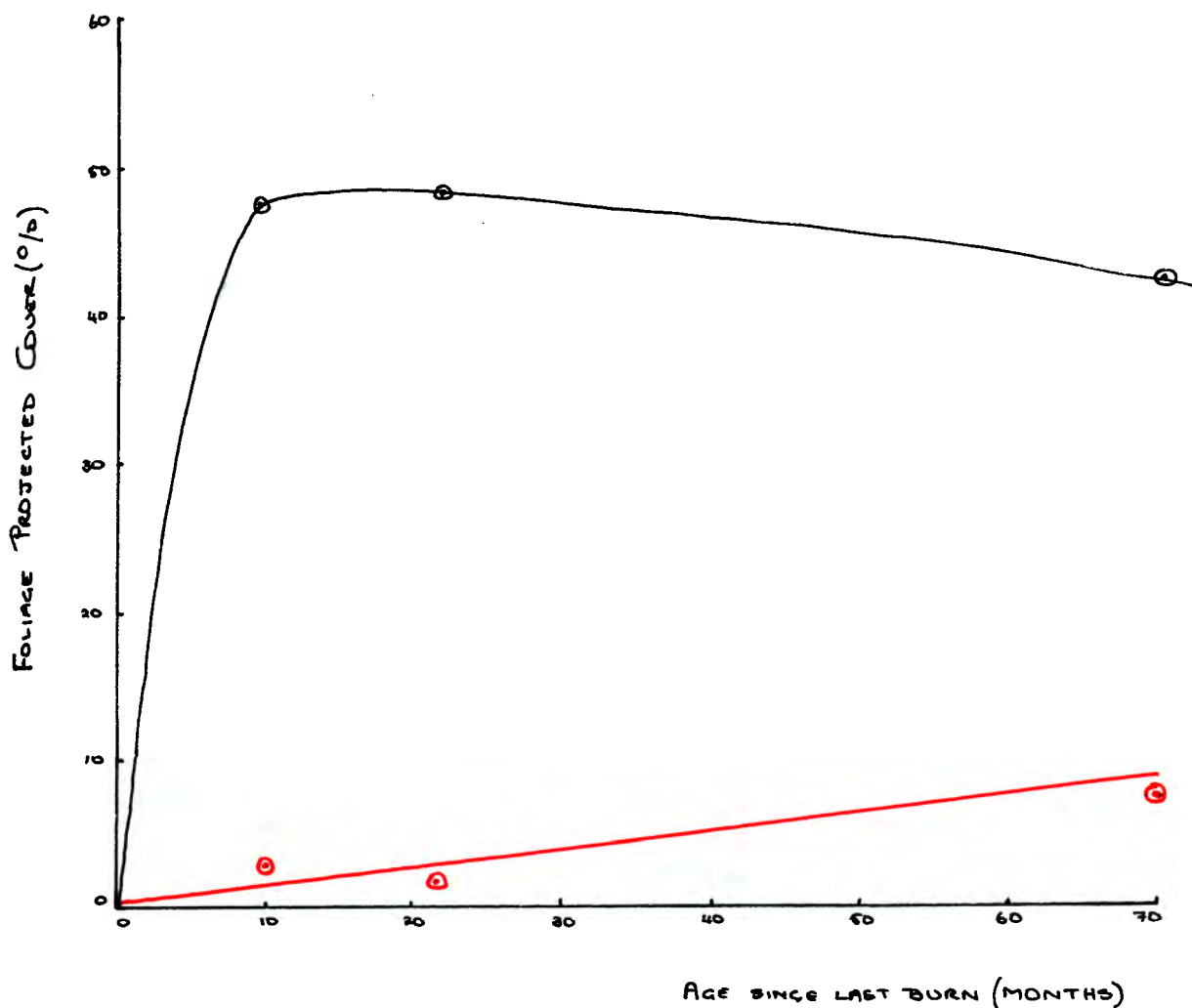
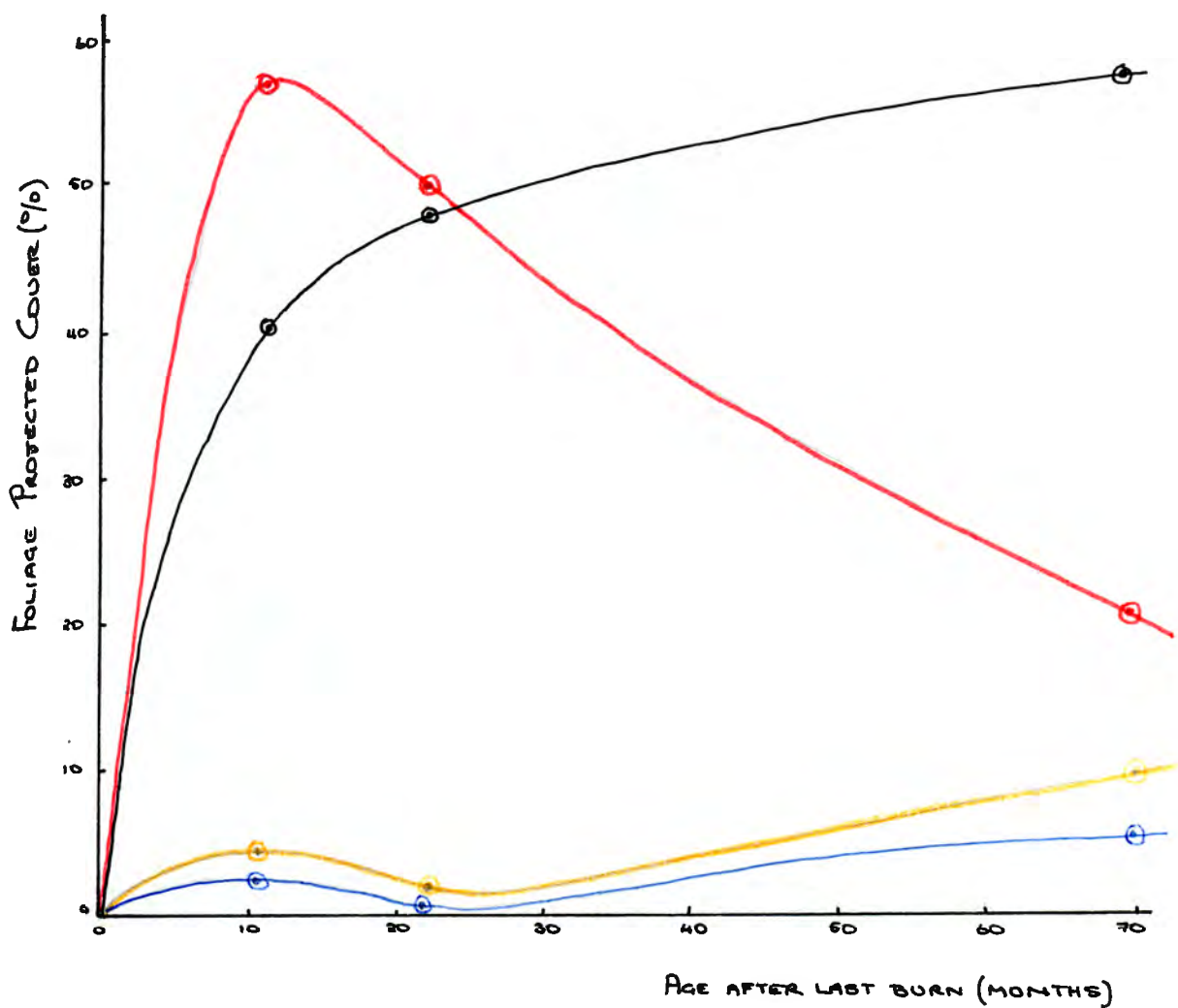


Figure 8 : Graph showing the proportion of living plant material and non-living material in the over- and under-storey of fynbos communities at Silvermine.

Black curve = FPC of living material in over-storey,
Red curve = FPC of non-living material in over-storey,
Blue curve = FPC of living material in under-storey,
Orange curve = FPC of non-living material in under-storey.
Note: the relatively small contribution of the under-storey. There is a higher amount of non-living material in the under-storey than there is living material.



that is, dead material as opposed to ashes, increases. This is reflected in Figure 8 where the non-living component of the under-storey increases.

The living part of the under-storey also increases with time after a burn. The reason for this phenomenon is that the shrubs, which comprise most of the over-storey, take some time to develop and grow. For example, at Silvermine in the initial stages after a fire, the restios dominate the upper stratum and there is little under-storey. Later once the shrub component has become established, a true over-storey situation develops with the restios dominating the living part of the under-storey, and the shrubs dominating the over-storey.

A similar study was made on a site at Bainskloof (20 years old) where both the over- and under-storey was measured. The results are summarised in Figure 9.

Figure 9: The relative proportions of over- and under-storey living and non-living (litter, standing dead material, and bare ground) material in a 20 year old site at Bainskloof.

	Living material (%)	Non-living material (%)
Over-storey	81	19
Under-storey	13	87

It can be seen that most of the under-storey comprised of non-living material, with relatively little living plant material occurring.

On the basis of the results for this experiment and that at Silvermine, it was concluded that the living material in the under-storey plays a relatively small rôle. It was concluded that the upper canopy only should be measured as this would be sufficiently representative of the living material of the community as a whole.

2. Results of Investigations made at Jonkershoek, Bainskloof, Silvermine and Algeria.

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DISCUSSION.

1. SILVERMINE.

Seven relatively young communities were sampled at Silvermine. The results were plotted as Foliage Projected Cover (F.P.C.) (%) versus time after burning. By sampling so many closely aged communities, it was possible to estimate the rate of change of the F.P.C. fairly accurately and hence to draw a relatively accurate graph.

On comparing the resultant graph (Figure 10) with the curves estimated by Specht and Moll (unpub.), it was found that the general shape of the curves was similar. Closer analysis of Figure 10 reveals that the F.P.C. initially increases rapidly during the first 2 - 3 years after a burn (I). In Figure 11, the rate of increase in F.P.C. has been estimated using the graph in Figure 10.

Figure 11: Estimated rate of increase in Foliage Projected Cover (F.P.C.) of the fynbos vegetation at Silvermine.

Where σ = standard deviation from the mean
 n = number of samples.

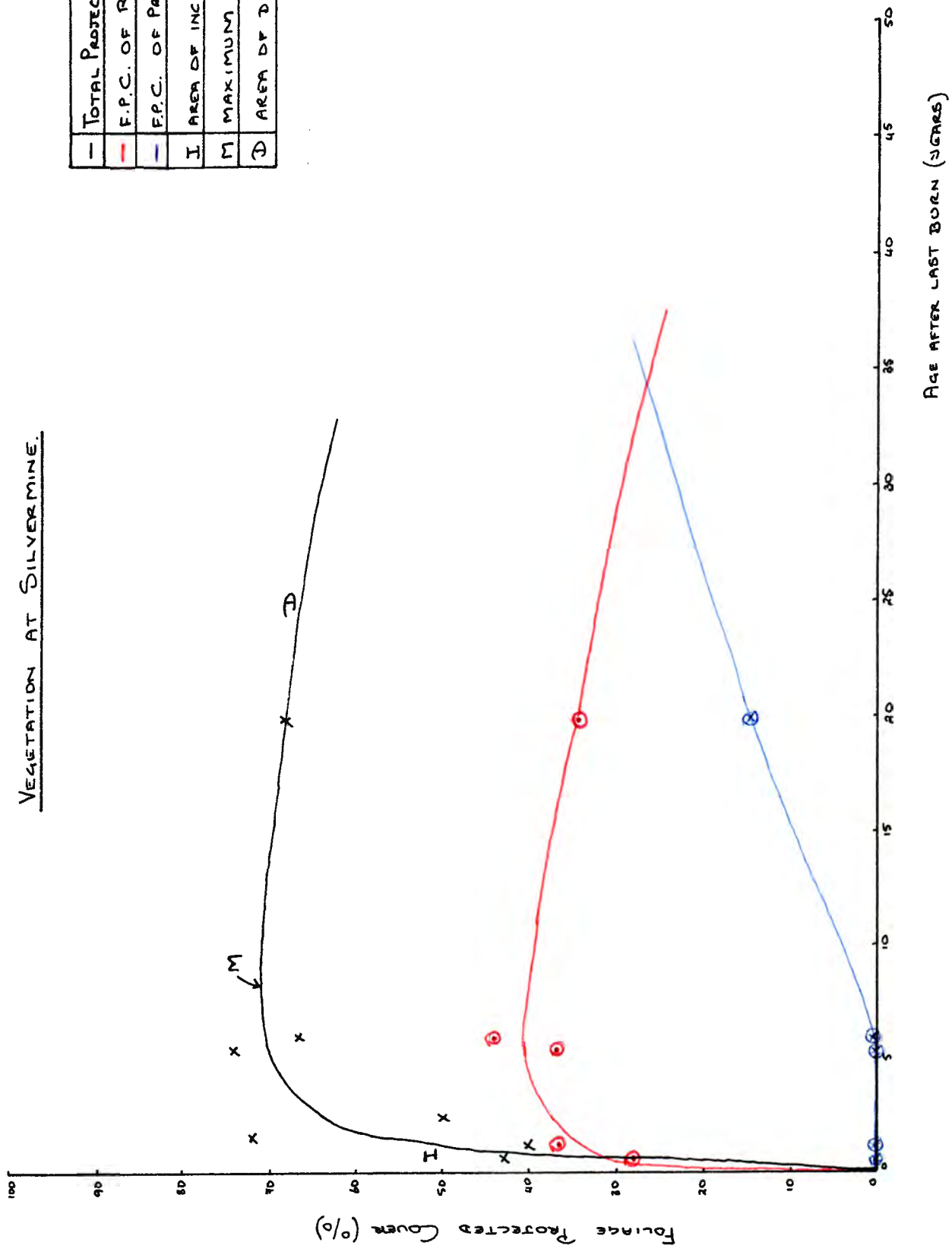
Age (years after fire))	0 - 2	2 - 6
Rate of increase of	9,63	12,13
F.P.C. (% Year ⁻¹)	($\sigma = 0,47$ n = 4)	($\sigma = 0,52$ n = 4)

The maximum F.P.C. is attained approximately 8 years after a burn (M). This peak F.P.C. was estimated to be 71%. Having reached this peak, the F.P.C. then decreases (D). The rate of decrease

$$(0,35\% \text{ y}^{-1} ; \sigma = 0,32 \quad n = 6)$$

is much more gradual than the initial increase (I). The decrease in F.P.C. (D) reflects the increasing amount of non-living material in the community. This non-living material includes standing dead material and litter. This increase in the non-living material is shown in Figure 12.

FIGURE 10 : THE FOLIAGE PROTECTED COVER OF HEATHLAND
VEGETATION AT SILVERMINE.



—	TOTAL PROTECTED FOLIAGE COVER F.P.C.
—	F.P.C. OF RESTIOS.
—	F.P.C. OF PROTEA + LEUCODENDRON.
I	AREA OF INCREASING F.P.C.
M	MAXIMUM F.P.C.
D	AREA OF DECREASING F.P.C.

Figure 12. Proportion of non-living material in fynbos communities at Silvermine at different times after a fire.

Age (months after fire)	Total F.P.C. (%)	Total non-living material (%)	Proportion of bare ground/rock (%)	Proportion of dead material, (%) (litter and standing dead.)
11	43	57	37	20
22	49	51	30	21
70	70	30	9	21
240	68	32	4	28*

* Estimated from data collected by Specht and Moll (unpub.).

It can be seen that as the age of the community increases, so the amount of dead material accumulates. This dead material represents potential fuel for the next fire. As the amount of fuel increases, so the fire hazard increases. Another fire would result in a repetition of the cycle seen in Figure 10.

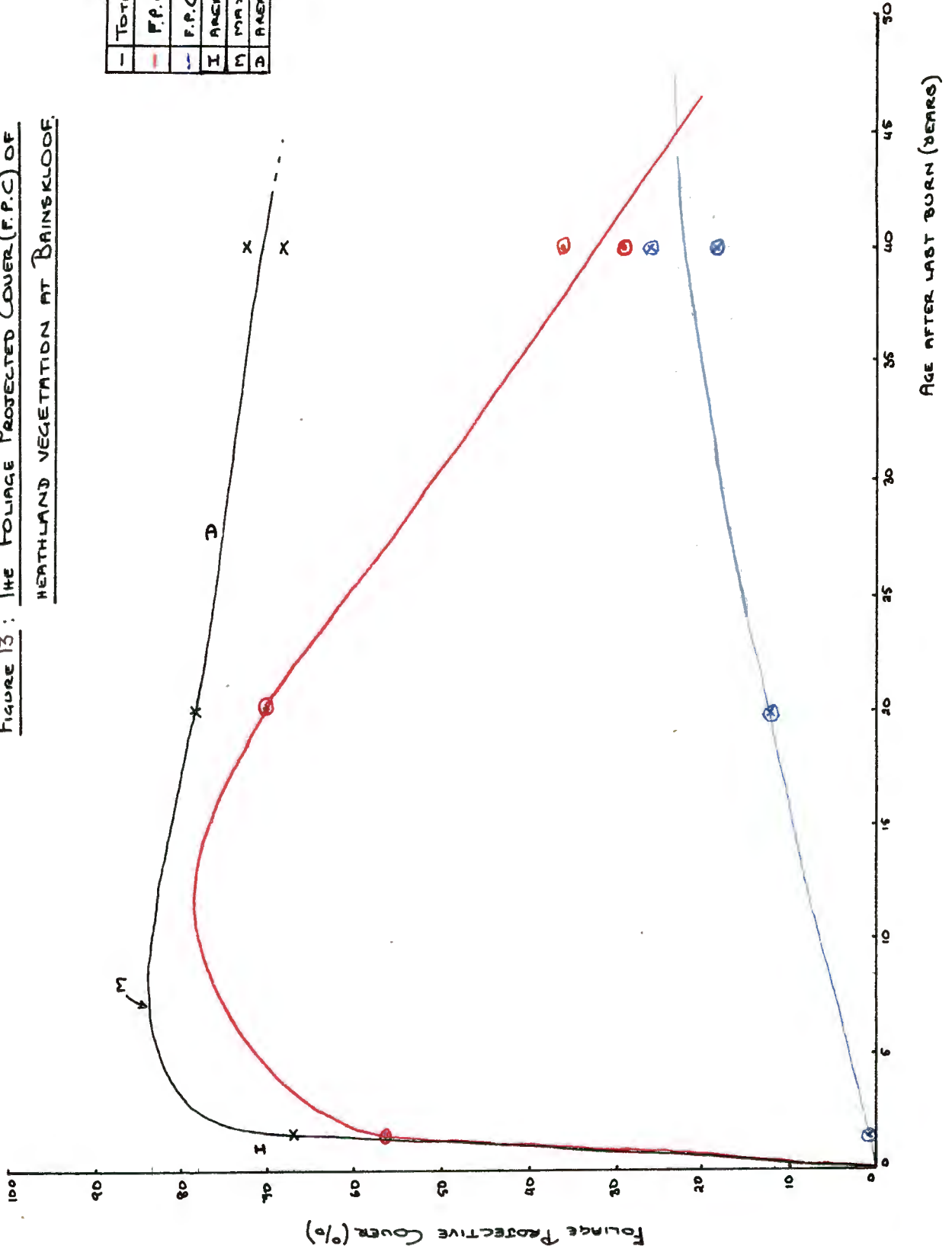
2. BAINSKLOOF.

Figure 13 is a graph showing the F.P.C. (%) versus time after burning (years) at Bainskloof. Initial analysis of Figure 13 reveals that there is a similar trend to that shown by the fynbos communities at Silvermine (c.f. Figure 10). Closer analysis and comparison shows that the initial increase (I) in F.P.C. is very similar. The rate of increase (I) at Bainskloof was estimated to be $49,10\% \text{ y}^{-1}$ ($\sigma = 0,84$; $n = 5$) whilst that at Silvermine was estimated to be $48,40\% \text{ y}^{-1}$ ($\sigma = 3,75$; $n = 5$).

The actual maximum F.P.C. value (M) differed considerably. The Silvermine vegetation achieved a maximum estimated F.P.C. value of 71%, approximately 8 years after the fire. In contrast, the vegetation at Bainskloof achieved a maximum estimated F.P.C. value of 83%, 9 years after burning.

The difference in the maximum F.P.C. (M) attained in the two areas may be due to differences in the moisture availability. Silvermine receives 1214 mm per annum whereas Bainskloof receives 1400 mm per annum. In both

Figure 13: The Foliage Protective Cover (F.P.C.) of Heathland Vegetation at Bainskloof.



-	TOTAL F.P.C.
-	F.P.C. OF RESTIOS
-	F.P.C. OF PROTEA + LEUCODENDRON
I	AREA OF INCREASING F.P.C.
M	MAXIMUM F.P.C.
D	AREA OF DECREASING F.P.C.

cases, most of the rainfall occurs in the winter. However, it is important to note that the absolute amount of rainfall in an area may not all be available to the vegetation. Various factors enhance or reduce the moisture availability. These include the evaporative potential of the atmosphere, slope and run-off.

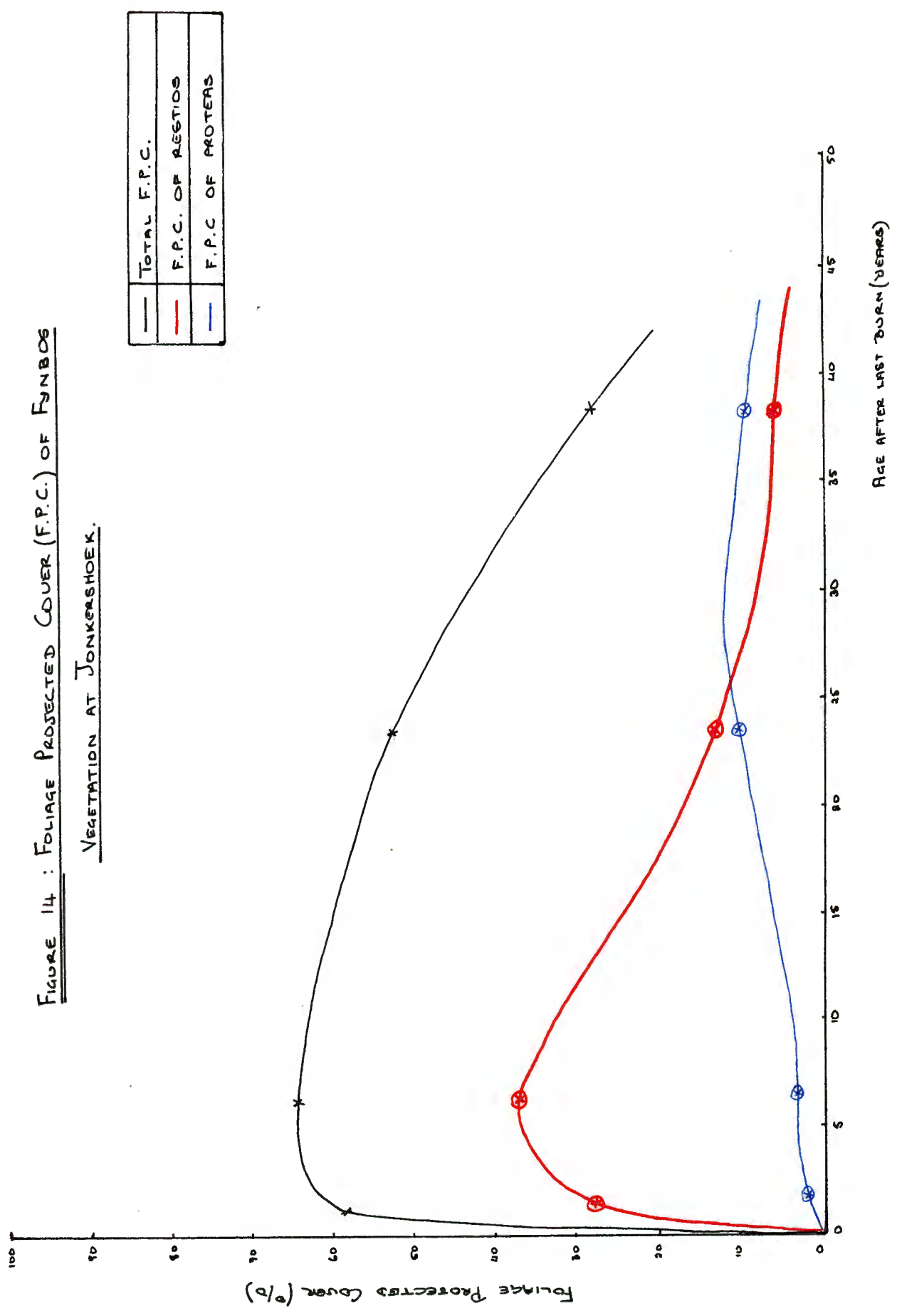
A factor that may be influential in increasing the moisture availability at Bainskloof is the fact that the communities - and especially the younger communities, occur on west facing slopes, (c.f. site descriptions in Appendix 6). These relatively steep west-facing slopes are shaded from much of the early morning sun. This reduced radiation decreases the vapour losses and makes more moisture available to the plants. This loss of water by evaporation would be particularly important during the summer months when droughts are likely to occur. Under drought conditions, small factors such as vapour losses become significant and important, when calculating the total water available to a community (Wicht et al 1969, Specht 1972). At Silvermine most of the communities sampled occurred on relatively flat areas which received full sunshine all day long.

The two communities show similar rates of decrease (D) once the maximum F.P.C. (M) has been achieved. The rate of decrease was estimated to be approximately $0,35 \% y^{-1}$ ($\sigma = 0,32$; $n = 6$) at Silvermine, whereas at Bainskloof it was estimated to be $0,38 \% y^{-1}$ ($\sigma = 0,14$; $n = 6$).

3. JONKERSHOEK.

Figure 14 illustrates the changes in F.P.C. (%) of fynbos communities that occur after a fire at Jonkershoek. Figure 15 compares the changes in F.P.C. with that at Silvermine, Bainskloof and Algeria. It can be seen that the shape of the curve found at Jonkershoek is very similar to that of the other areas. The initial rate of increase in F.P.C. is, however, somewhat lower than that of the communities at Bainskloof and Silvermine. This is shown in Figure 16.

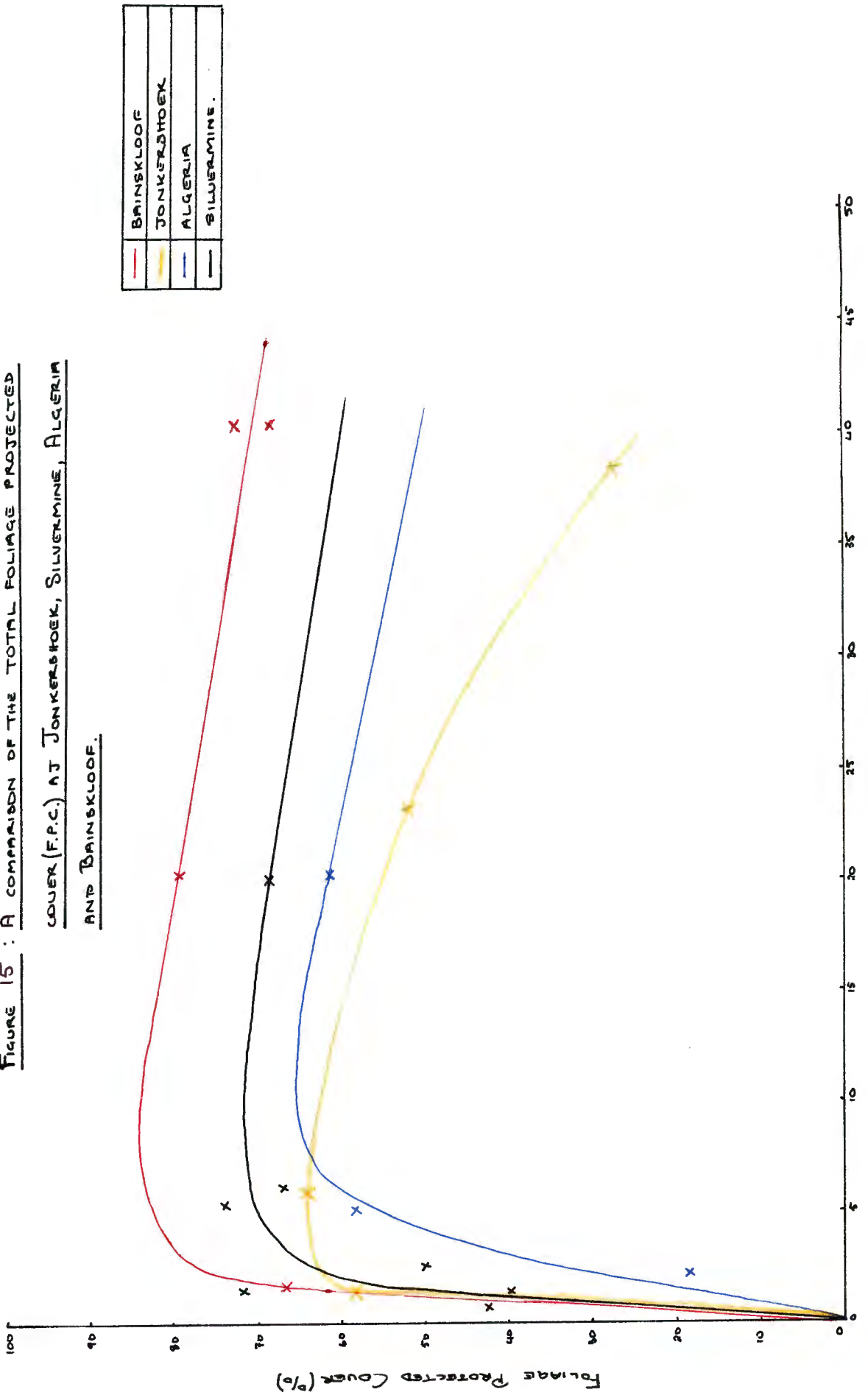
FIGURE 14 : FOLIAGE PROJECTED COVER (F.P.C.) OF FYNBOS
VEGETATION AT JONKERSHOEK.



—	TOTAL F.P.C.
—	F.P.C. OF RESTIOS
—	F.P.C. OF PROTEAS

AGE AFTER LAST BURN (YEARS)

FIGURE 15 : A COMPARISON OF THE TOTAL FOLIAGE PROJECTED COVER (F.P.C.) AT JONKERBOSKOEK, SILVERMINE, ALGERIA AND BAINSKLOOF.



—	BAINSKLOOF
—	JONKERBOSKOEK
—	ALGERIA
—	SILVERMINE

AGE AFTER LAST BURN (YEARS)

Figure 16: Comparison of the rate of increase of F.P.C. (% y⁻¹) at Silvermine, Bainskloof and Jonkershoek during the first 18 months after a fire.

Site	Rate (% y ⁻¹)
Bainskloof	49,10 (σ = 0,84 n=5)
Silvermine	48,40 (σ = 3,75 n=5)
Jonkershoek	45,38 (σ = 5,09 n=9)

Not only is the rate of increase less than that at the two other sites, but the maximum F.P.C. (M) is also considerably lower. This is illustrated in Figure 17.

Figure 17. Comparison of the maximum F.P.C. value achieved at Jonkershoek, Silvermine, Bainskloof and Algeria, and the annual rainfall.			
Area	Max. F.P.C. (%)	Time to achieve max. F.P.C. (years)	Annual rainfall (mm)
Silvermine	71	8	1 214
Bainskloof	83	9	1 400
Jonkershoek	65	4,5	1 600
Algeria	64	10,5	500

If the rainfall is compared (Figure 17) then it can be seen that the area receiving the most rainfall is Jonkershoek, followed by Bainskloof, Silvermine and Algeria respectively. The results found at Jonkershoek are rather unexpected. It was expected that the F.P.C. would increase with increasing moisture availability, (Specht 1980). Jonkershoek receives the most annual rainfall of the four sites sampled. It is possible, however, that although the area may receive a relatively large amount of rainfall, it may not all be available to the plants.

↑
 explanation P10
 not really adequate.

A closer investigation was made into the pattern of rainfall occurrence at Jonkershoek. Figure 18 is a map of the Jonkershoek Valley showing the position of the various communities sampled. The Jonkershoek area is in the form of a cul-de-sac with the opening occurring in the north west. Jonkershoek receives most of its rainfall from cyclonic winds of the westerly wind system that blow from the north-west into the cul-de-sac, (Wicht et al 1969). These winds bring warm, moisture laden air into the valley. They blow down the valley until they are forced upwards over the crest of the Dwarsberg and up the valleys of the tributaries in the north-east and south-west. This upward movement of the air causes heavy orographic rainfall. Wicht et al (1969) made an extensive study on the effectiveness of the rainfall at various points in the Jonkershoek Valley. They found that one of the major contributing factors was that of shading during the day. Shading during part of the day increases the effectiveness of the rainfall by reducing the amount of radiation and hence the vapour losses in an area.

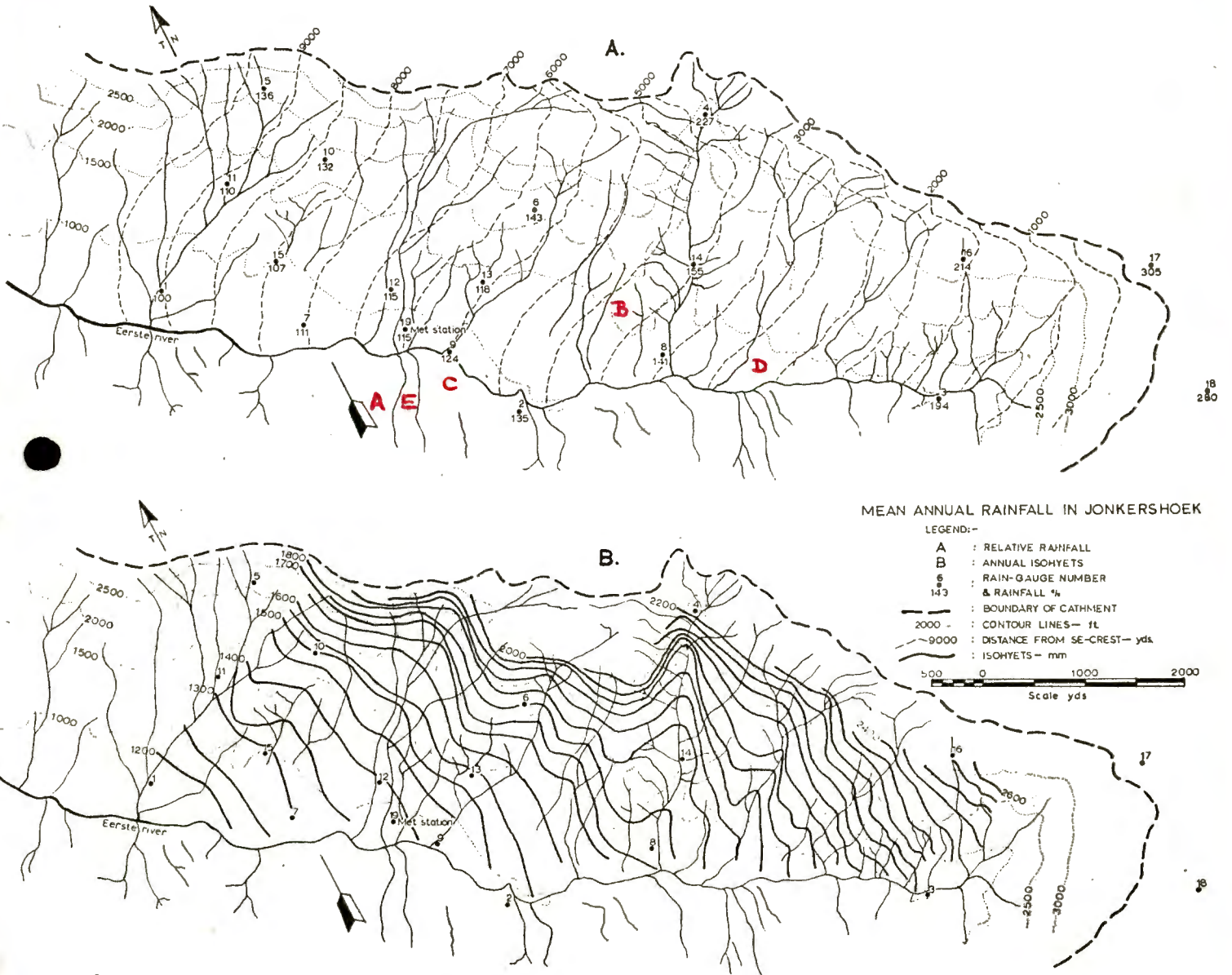
Maximum shading occurs on the upper slopes of the valley where the mountain ridges shield the areas for part of the day. It is these areas that gain maximum benefit from the rainfall. By referring to Figure 18, it can be seen that most of the sites sampled occurred on the bottom slopes of the valley. This means that the shading effect would be reduced. Thus the effectiveness of the rainfall in these areas would be reduced by the evaporational losses (Wicht et al 1969). This reduced water availability may be a factor influencing the F.P.C. (Specht 1972, 1980). It seems unlikely, however, that this would be the sole reason for causing the considerable difference in maximum F.P.C. between Jonkershoek and Bainskloof or Silvermine.

By referring to Figure 15, it can be seen that although the maximum F.P.C. value at Jonkershoek is relatively low, the time taken to achieve it is relatively short. The reason for this may be due to the fact that the rainfall at Jonkershoek occurs for a longer period of time than that at Silvermine, Bainskloof and Algeria. In the latter three areas, most of the rainfall occurs during winter (Forestry Department personnel comment) whereas at Jonkershoek there are often mists occurring in autumn and

Figure 18: a. Contour map of Jonkershoek Valley showing position of sites sampled.

- A = 20 months
- B = 6 years
- C = 23 years 2 months
- D = 38 years 4 months
- E = fire-break

b. Isohyets of Annual Rainfall received in the Jonkershoek Valley. (after Wicht et al 1969)



Maps: III. A. Distribution of Annual Rainfall Relative
B. Isohyets of Annual Rainfall.

spring which may increase the growing period of the communities. If in fact this is so, then a longer growing period would enable faster plant growth, and hence be the reason for the relative^{ly} fast achievement of the maximum F.P.C. (M).

Figure 15 shows that there is a relatively rapid decline in the F.P.C. at Jonkershoek. This means that the cycle of F.P.C. is relatively short as compared with that observed in the other areas. This is as expected for an area with a relatively high rainfall since the vegetation is able to grow rapidly, mature, and enter senescence.

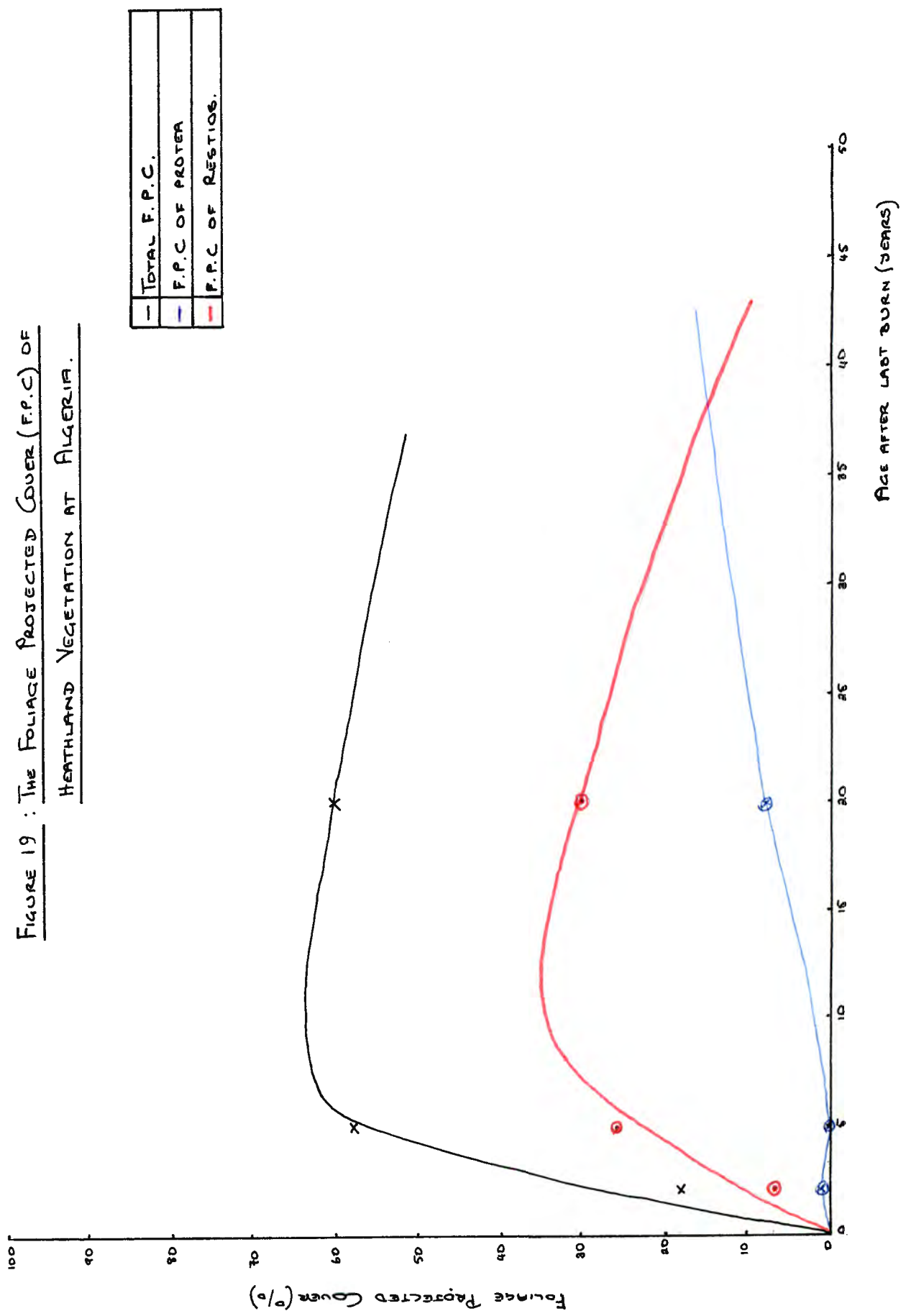
4. ALGERIA.

Figure 15 compares the F.P.C. of Algerian fynbos communities with that of communities in Silvermine, Bainskloof and Jonkershoek. Once again, there is a similar basic pattern, but in this case, the initial rate of increase of F.P.C. ($\% y^{-1}$) is much less rapid than that at the other 3 sites, (c.f. Figure 15). The maximum F.P.C. (M) is estimated to be 64% and is achieved 10-11 years after burning. This means that the vegetation at Algeria takes a much longer time to fully recover from a burn in comparison with the other three sites. The rate of decrease (D) is similar to that of Silvermine and Bainskloof, ($0,35 \% y^{-1}$; $\bar{\sigma} = 0,12$; $n = 3$)

If the annual rainfall is considered it will be seen that Algeria receives the least amount of rainfall (Figure 17). There seems to be a trend in the amount of rainfall, and the maximum F.P.C. value achieved. If the amount of rainfall is plotted against the maximum F.P.C., a close relationship develops, with the maximum F.P.C. increasing with increasing rainfall. (The maximum F.P.C. at Jonkershoek being an exception to this.)

It must be stressed, however, that the use of annual rainfall amounts as an indicator of moisture availability is a very rough index. Considerable variations in moisture availability will occur depending upon the evaporative potential of the atmosphere, run-on /run-off (Specht 1973), slope and aspect (Fuggel, pers. comm.), stem flow (Specht et al, 1957), duration of rainfall period, and other factors.

FIGURE 19 : THE FOLIAGE PROJECTED COVER (F.P.C.) OF HEATHLAND VEGETATION AT ALGERIA.



-	TOTAL F.P.C.
-	F.P.C. OF PROTEA
-	F.P.C. OF RESTIOS.

Comparison of the dominant species composition.

Figures 10, 13, 14 and 19 show the relative proportion of the total F.P.C. that the restios and members of the Proteaceae (Protea and Leucodendrons) contribute. Figure 20 compares the relative contribution to the total F.P.C. of these components at the Silvermine, Bainskloof, Jonkershoek and Algeria.

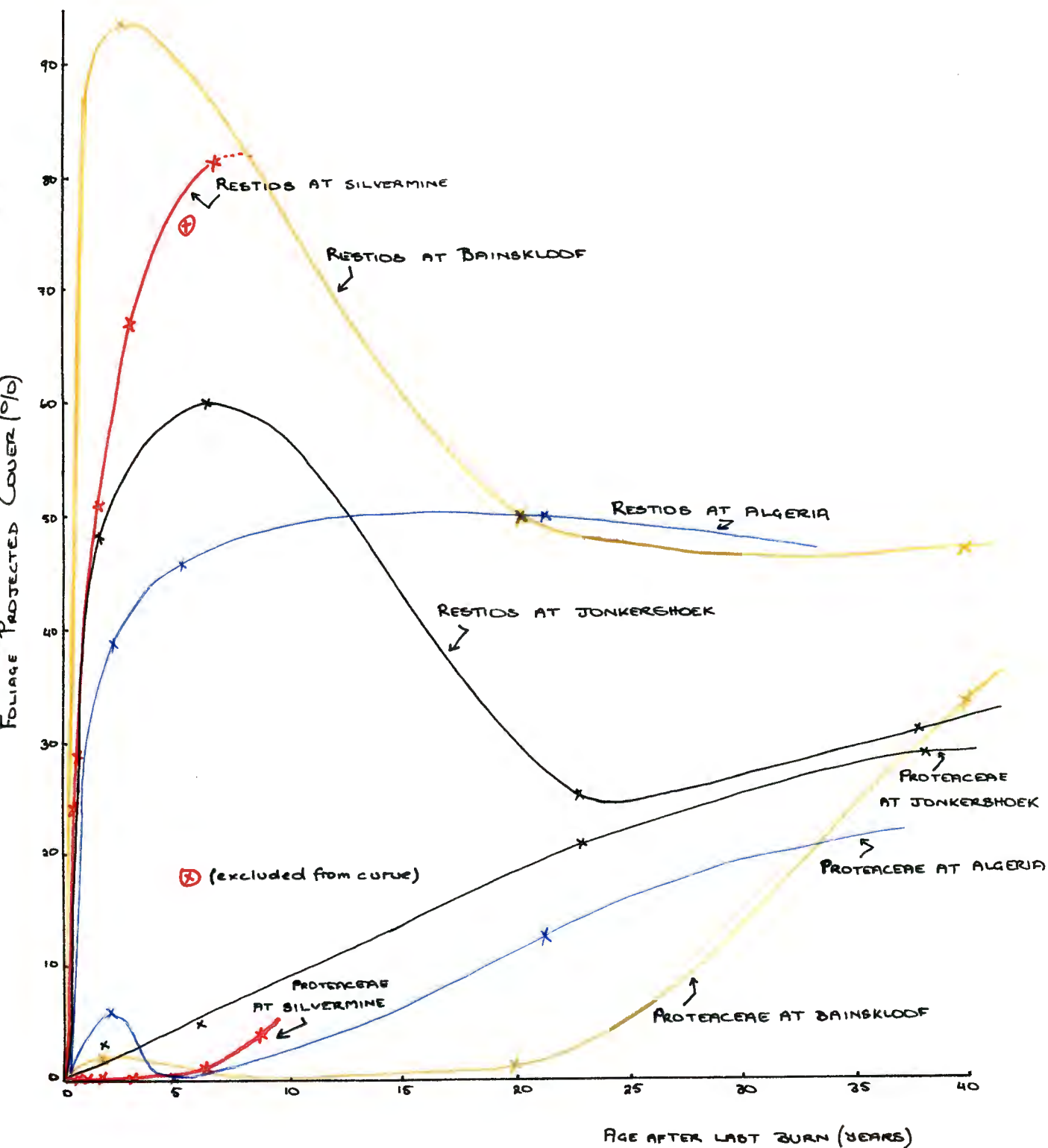
By comparing the curves in Figure 20 with those in Figures 10, 13, 14 and 19, it can be seen that the graph of Restio-F.P.C. resembles that of the Total-F.P.C. In the first years after a fire, the Restio-F.P.C. increases, reaches a peak, and then gradually decreases. At a certain time after burning, the level of Restio-F.P.C. levels off. This is clearly depicted in the case of the Restio-F.P.C. at Bainskloof. At Jonkershoek, the Restio-F.P.C. shows a slight increase in the later years after a fire.

At Algeria, the Restio-F.P.C. did not reach an obvious peak. By comparing Figure 19 with Figure 20, it can be seen that the Total-F.P.C. did not reach a peak at Algeria either.

In Figure 20, the relative importance of the members of the Proteaceae (Protea and Leucodendrons) is included. Generally, the F.P.C. of the Proteaceae is much lower than that of the Restio-F.P.C., especially in the initial stages after a fire. The reason for this is because the rate of growth of these shrubs is relatively slower than that of the restios. Once the shrubs have reached maturity, they tend to overshadow the other plants, and the proportion of F.P.C. of these shrubs is increased.

Closer analysis of the curves in Figure 20 shows that there is a small peak in the F.P.C. of the Proteaceae during the first 4 - 5 years after a burn. This peak may be due to shrubs that have survived the fire, or due to resprouting species. It is only in the very earliest stages after a fire that they are important because it is at this stage that there is much low vegetation and thus even small fire-reduced shrubs will dominate the newly developing vegetation. The young vegetation grows relatively rapidly in comparison with the shrubs and thus the shrubs soon lose their initial dominance.

Figure 20: A comparison of the relative contribution to the total FPC of the Restios and Proteaceae at the four sites. Red curves = Silvermine; black curves = Jonkershoek; blue curves = Algeria; orange curves = Bainskloof. Note: values calculated as percentages of the total FPC of each individual site.



Comparison of the non-living components.

Figures 21a, b, c, and d show the relative contribution of the various non-living components. These non-living components include litter, standing dead material, bare ground and rock. Initially after a fire there is little litter, since this is burnt in the fire. That which is present is mainly in the form of ashes. With time, after the fire, litter accumulates.

A similar situation occurs with the standing dead material. Initially, there is little standing dead material after a fire, but the proportion gradually increases with time after a fire. At Algeria there is a seemingly anomalous situation where at 2 years there is a higher proportion of standing dead material than at 5 years. The reason for this is because there were many large dead shrubs which dominated the landscape and which tended to give an atypical result. The past fire-history is useful to know when interpreting the results of such data. This aspect will be discussed further at a later stage.

The shape of the curve for the bare ground was difficult to determine. It appeared to depend upon the amount of litter present. For example, at Algeria when there was a relatively large amount of litter present, there was relatively little bare ground. In contrast, at Silvermine, there was relatively little litter and much bare ground. Generally speaking there was an inverse relationship between the amount of bare ground and the amount of litter present.

Variations in F.P.C. within a single community.

At Bainskloof two adjacent 40-year old fynbos communities were sampled independently. It was found that there was a significant difference in the F.P.C. in the two areas, (See Appendix 2.5 and 2.6).

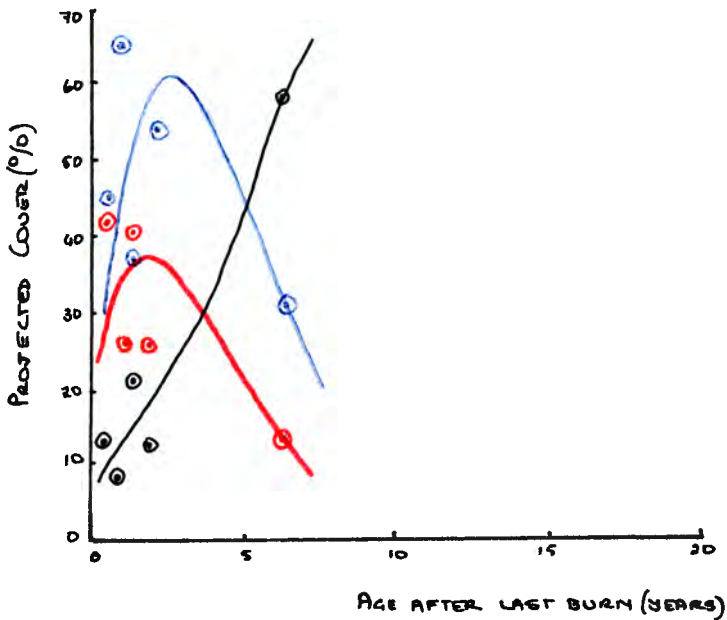
By referring to the descriptions in Appendix 5 it can be seen that the one community occurred on relatively flat ground, whereas the other occurred on a slope. The community occurring on the flatter site had a relatively higher F.P.C. of 72% as compared with that on the slope which had a F.P.C. of 68%.

Figure 21: Graphs showing the relative proportion of litter, standing dead material, and bare ground at a) Silvermine, b) Algeria, c) Bainskloof, and d) Jonkershoek.

Note: values calculated as a percentage of the total non-living proportion of the community.

Litter = red curve; Standing dead material = black curve; Bare ground = blue curve.

a) Silvermine.



b) Algeria.

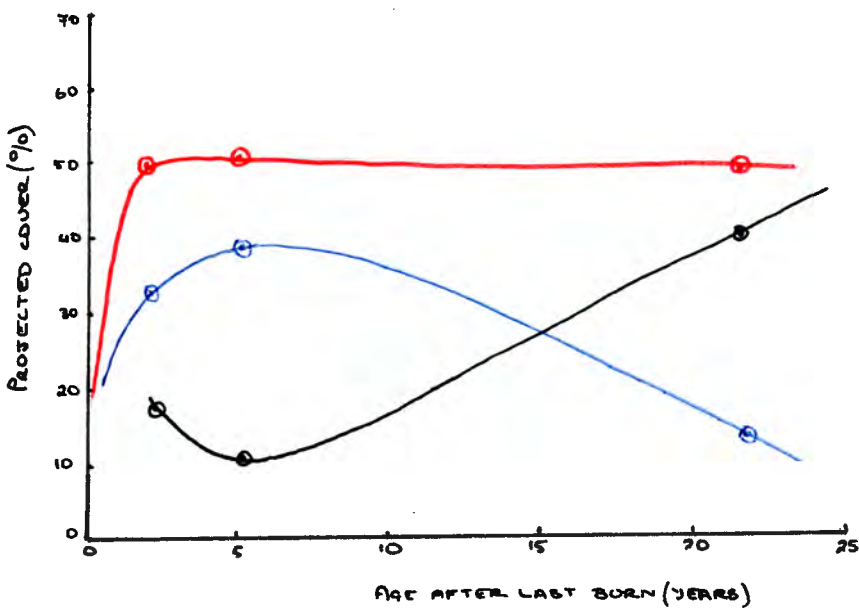
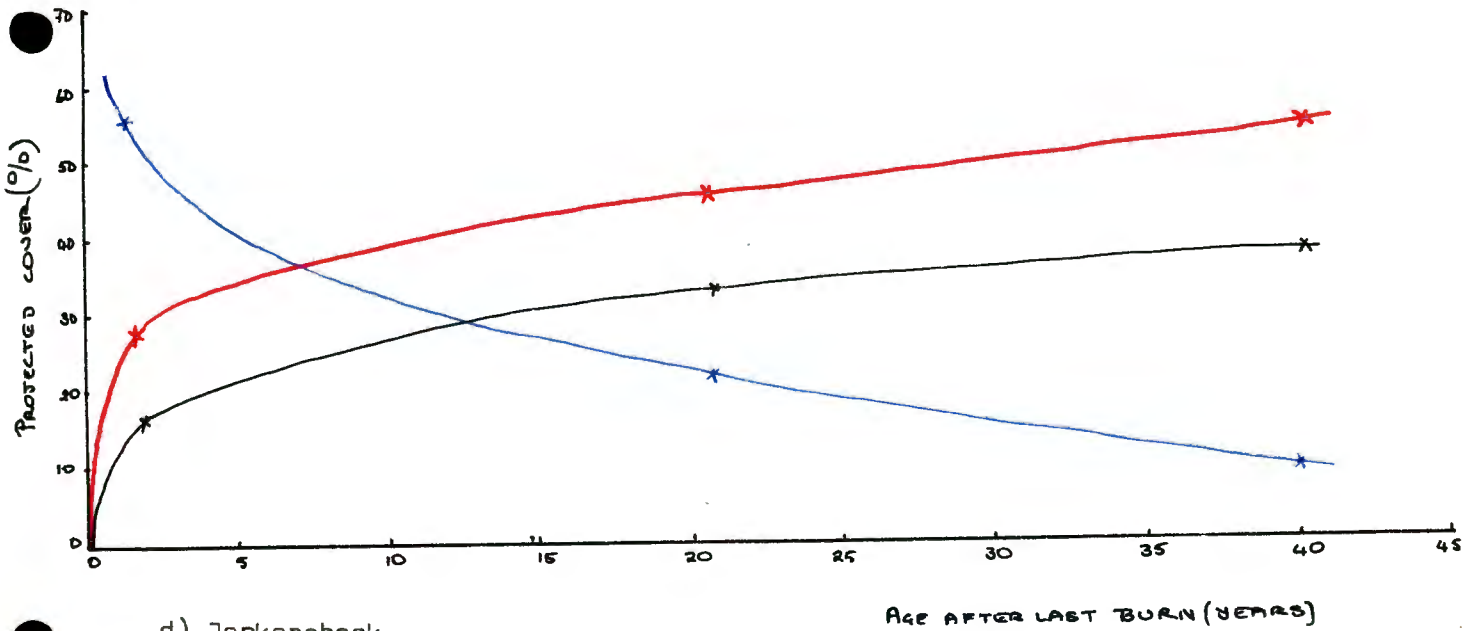


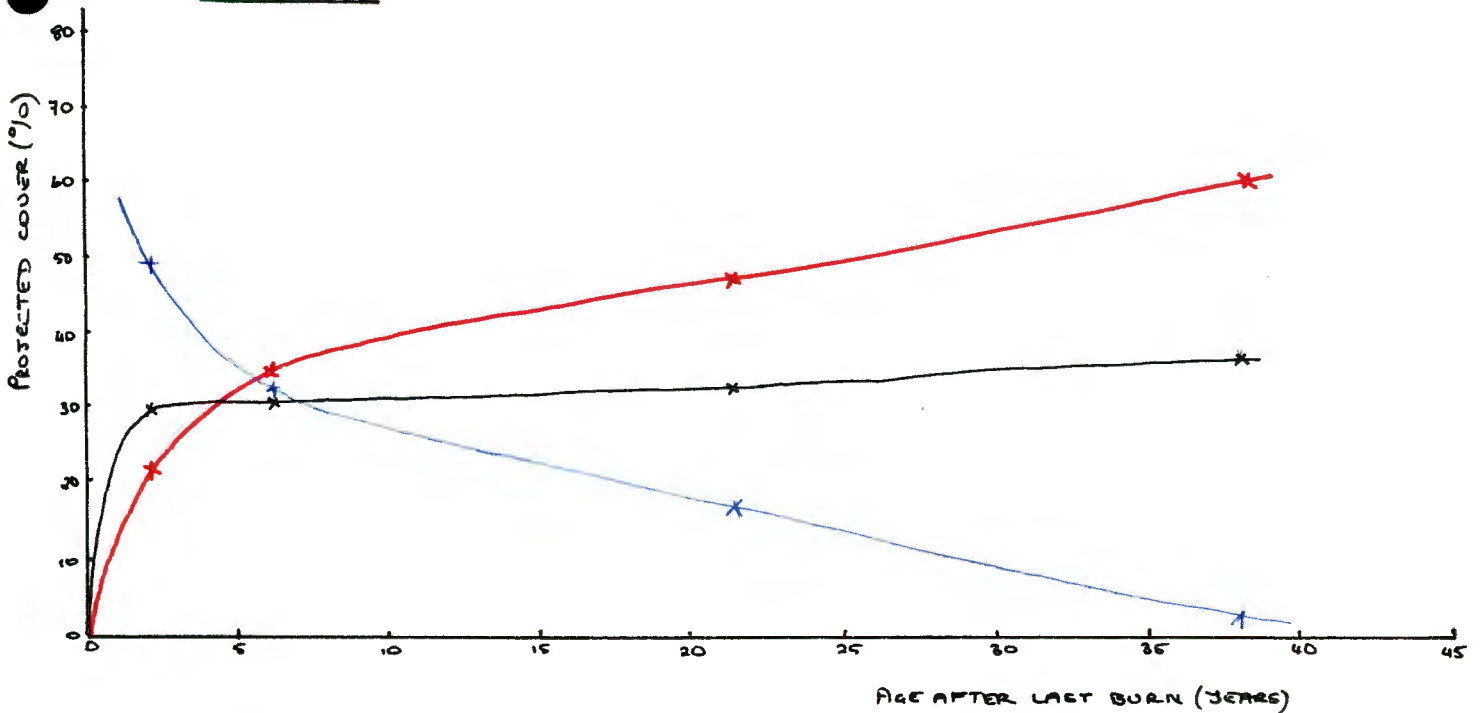
Figure 2) (continued): Graphs showing the relative proportions of litter, standing dead material, and bare ground at c) Bainskloof, d) Jonkershoek.

Litter = red curve;
Standing dead material = black curve;
Bare ground = blue curve.

c) Bainskloof.



d) Jonkershoek.



It was proposed that there may be local differences in the moisture availability within a single community. This was investigated experimentally at Bainskloof in a 19-month old fynbos. The community was spread over a very large area: both at the top of the Bainskloof Pass and continued down the mountain pass in the direction of Worcester. Initially two sites were chosen, one at the top of the pass and one down in the valley. The two sites had been burnt within 2 days of each other (Forestry Dept. pers. comm.). Samples were taken on slopes of approximately equal gradient. It was found that the F.P.C. of the two sites differed significantly (0,01% confidence level). This difference in F.P.C. could be related to differences in the moisture content. The site at the top of the pass occurred at a higher altitude than did the site in the valley. The higher site was on the windward side of the mountain whereas the other site was on the leeward side. Both these factors would mean that the higher site would receive relatively more rainfall than would the lower site. The moisture availability at the higher site is also likely to be greater than that of the lower site, because being higher up, the area is more often in cloud. The cloud would reduce the amount of radiation received by the area, and thus the evaporation losses would be less (Wicht et al 1969).

Further investigations were made to see whether there were differences within the vegetation at each of the two sites. It was hypothesised that a single community could be divided into sections depending upon the relative water availability. The main criterion causing variations in moisture availability could be the amount of run-on and run-off. Three major categories were proposed: Areas A, B and C.

Ideally an A type area would occur on top of a ridge. It would only receive water from precipitation (P). It would, however, lose some of this by run-off losses (R). A certain amount would also be lost by evaporation but this factor will be considered as a constant in this argument. Thus the total moisture available to the vegetation on an A slope would be $(P - R) \text{mm}^3$.

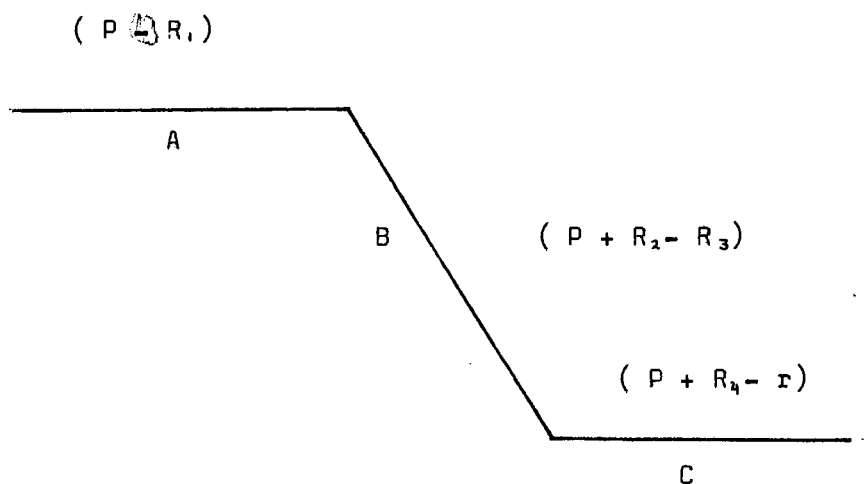
A second area B was identified as theoretically occurring below a ridge. In this case the area would receive water from precipitation (P) plus

run-off water from the ridge above it (R_2). It would, however, lose some water by run-off (R_3). Thus the water available for the vegetation in such an area would be $(P + R_2 - R_3) \text{mm}^3$.

A third area, C, was identified which theoretically occurs at the bottom of a slope. Its position in relation to the others is shown in Figure 22.

Figure 22: The hypothetical siting of the A, B and C slopes -

- where
- P = precipitation
 - R_1 = run-off of A area
 - R_2 = run-on water of B area
 - R_3 = run-off water of B area
 - R_4 = run-on water of C area
 - r = seepage loss



In a C area, water would be gained from precipitation (P), plus run-off water from the slopes above it (R_4). Theoretically, being at the bottom of a slope, it should not lose water from run-off. However, in reality, it is likely to do so through underground seepage (r). Thus the total amount of water available to a C area community would be $(P + R_4 - r) \text{mm}^3$.

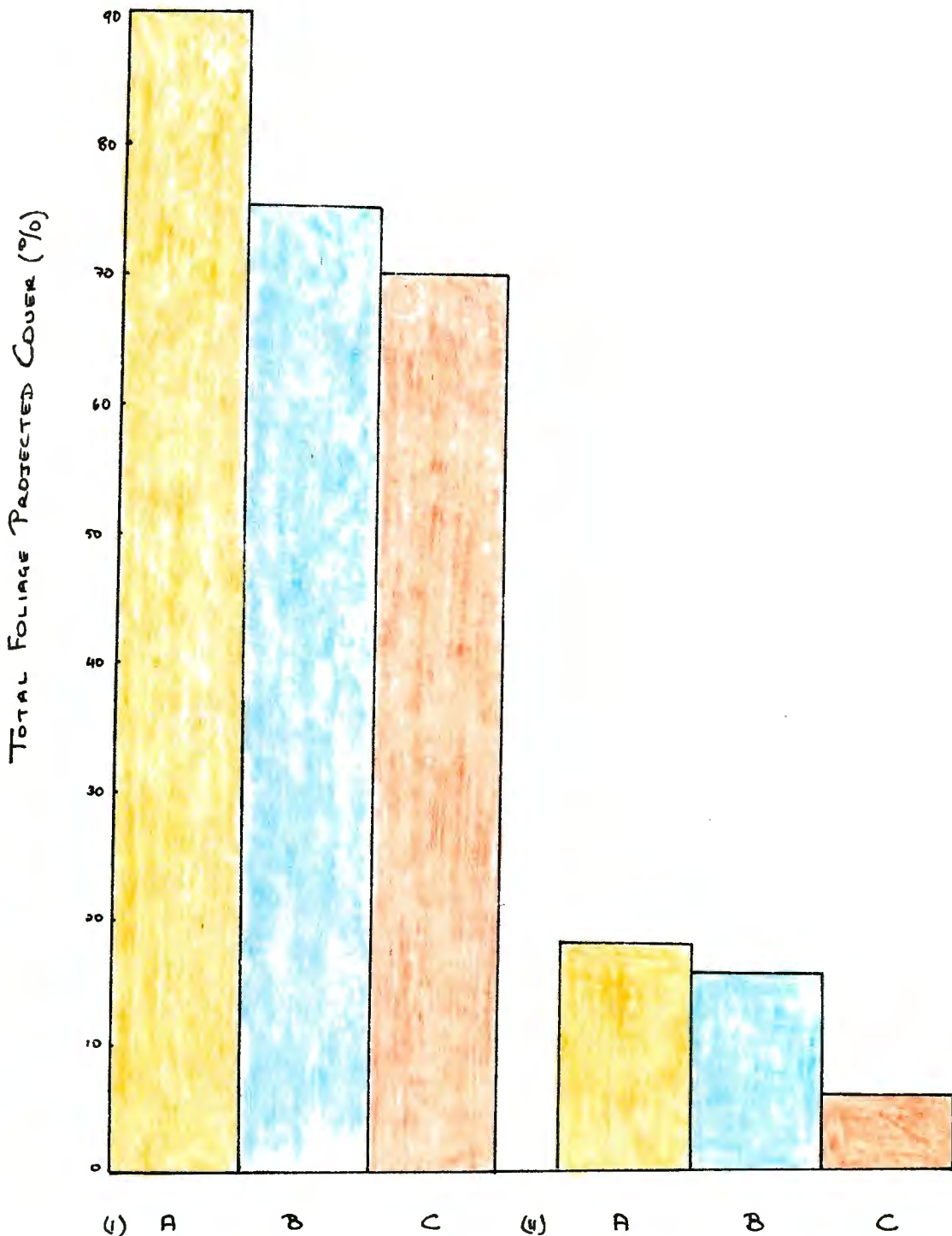
It was hypothesised that if there was a significant difference in the moisture availability on the A, B and C type slopes, then there would be a significant difference in the Foliage Projected Cover (F.P.C.). This hypothesis was based on the findings of earlier experimental work comparing the F.P.C. at Algeria, Bainskloof, Silvermine and Jonkershoek, where a relationship between the F.P.C. and the amount of rainfall was found. It was expected that if there was a significant difference in the F.P.C. of the three area types, then the highest F.P.C. would occur on the C area which has the highest moisture availability and the lowest F.P.C. would occur on the A area which hypothetically has the lowest moisture availability.

The results of these investigations are shown in Figure 23. It can be seen that there is a significant difference (at 0,01% confidence level) between the F.P.C. occurring on an A type, B type and C type slopes in the community at the top of the Bainskloof Pass, and in the valley. In both cases the highest F.P.C. value was obtained from the C type area, whilst the lowest F.P.C. value was obtained from an A type area. The B type area had an intermediate F.P.C. value.

It can be concluded from these experiments that there is a significant difference in the F.P.C. of the vegetation within a single community. These differences in F.P.C. may be related to local differences in the moisture availability.

Specht (1973) found that within any one climatic region the F.P.C. of the upper stratum of the Australian evergreen plant communities remained constant. Local variations of the water availability tended to only change the physical appearance of the vegetation - with stunted communities occurring in areas with decreased water availability, and with taller communities occurring on areas with increased water availability. Specht (1972) stresses, however, that the F.P.C. remains constant. These results do not correspond with those found in the heathland sites at Bainskloof where significant differences in the F.P.C. were found within a single community. The reason for this difference is not clear. It may be due to the fact that the upper stratum in the Australian heath consists

Figure 23: Bar graph comparing the total F.P.C. in A (orange), B (blue), and C (red) type areas
i. at the top of the Bainskloof Pass
ii. in the valley below the Bainskloof Pass.
For definitions of area types see text.



of trees, whereas in the fynbos it consists mainly of shrubs.

It seems therefore, that this variation within a single community must be taken into consideration when sampling an area. Random selection of transect line sites does allow for a variety of slope types (A, B and C) to be included in the sample. It may be advantageous to reduce the length of the transect line from 25m to 10 - 15 m. By doing this, a greater selection of areas can be sampled in the same length of time. This would enable a better average estimate of the community as a whole, to be made.

Apparent Anomalies.

1. Fire Breaks.

At Bainskloof there is a site which was used as a firebreak and was burnt regularly every 3 - 5 years. Today, the area is apparently no longer used as a fire break and has not been burnt for 8 years.

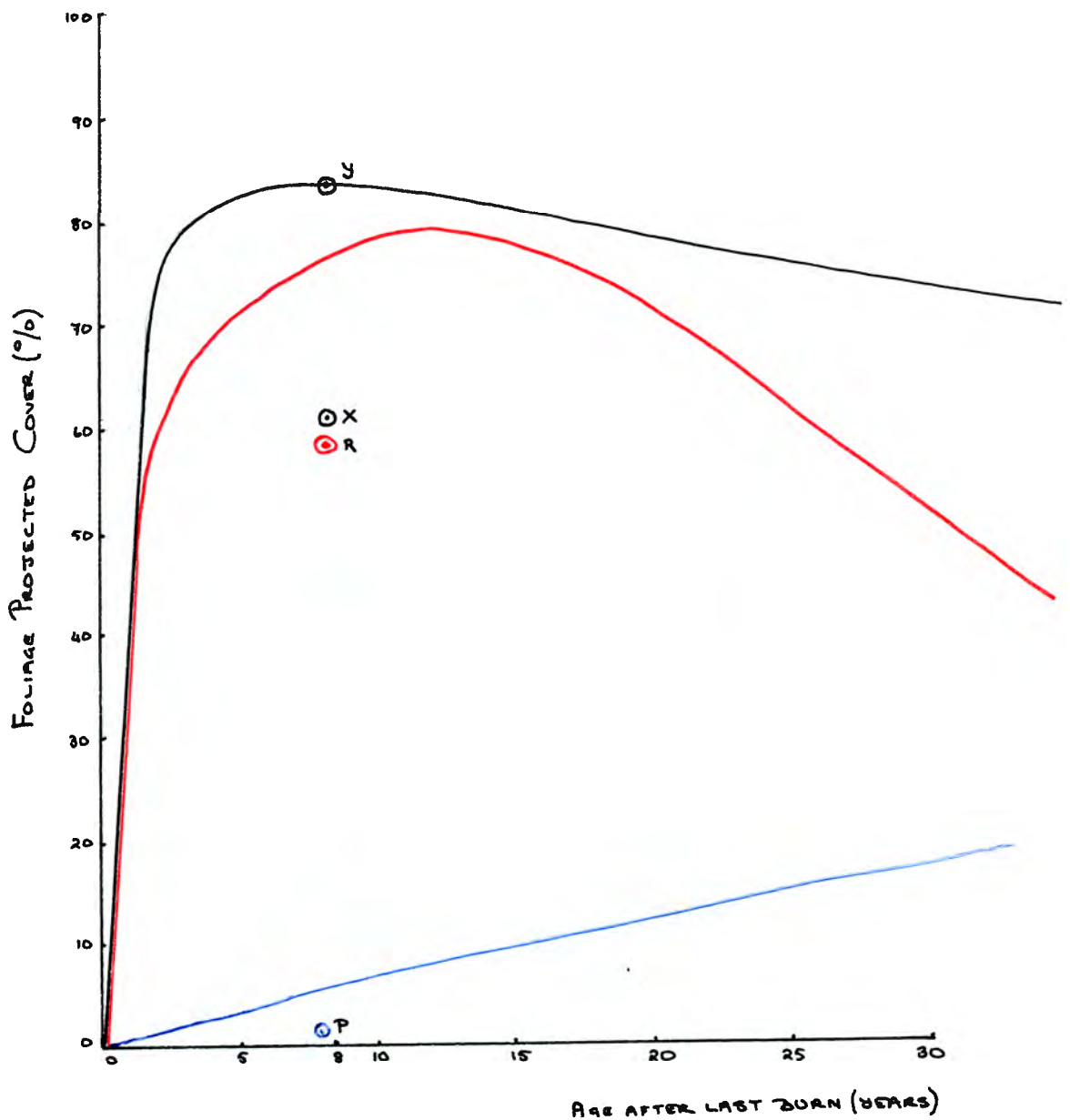
This site was sampled to test whether regular burning affects the F.P.C. of the community. Figure 24 shows the generalised curve of F.P.C. (%) versus time (years) after burning for the Bainskloof area. Superimposed upon this curve, is the F.P.C. estimated from the fire break site. It can be seen that the firebreak vegetation has a lower F.P.C. (61%) value to that predicted by the curve (82,5%).

Figure 24 also shows the proportion of dominant species occurring at Bainskloof. It can be seen that in the fire break site there is a relatively large proportion of Restionaceae present as compared with the proportion of Proteaceae. This is shown in Figure 25.

Figure 25: Comparison of the relative proportions of F.P.C. of Restionaceae and Proteaceae actually recorded in the firebreak site, and those predicted by the generalised curve of the Bainskloof area.

	Total F.P.C. (%)	F.P.C. of <u>Restionaceae</u> (%)	F.P.C. of <u>Proteaceae</u> (%)	F.P.C. of others. (%)
Predicted value	82,5	23,0	2,0	57,5
Recorded value	61,0	57,0	1,0	3,0

Figure 24: Graph showing the Foliage Projected Cover (FPC) versus time after burning at Bainskloof. The curve shows the FPC of an ex-fire break (X) which was 8 years old when sampled. It can be seen that the value for this site is less than that predicted by the curve (Y). Red curve = FPC of restios, blue curve = FPC of protea and leucodendrons, R = FPC of restios in fire break, P = FPC of protea and leucodendrons in fire break.



The relatively low proportion of members of the Proteaceae (*Protea* and *Leucodendrons*) may be due to the fact that many of these species are seed regenerators. Many of these species require several years to mature, flower, and produce seeds. In fact a young *Protea neriifolia* shrub in a neighbouring stand exhibited its first flower scar only after its seventh year. (The age was estimated using a method by which the annual foliage scars are counted). Frequent burning, as occurs in a fire break area, may have eliminated many of the seed-regenerating shrub species.

A similar situation occurs at Jonkershoek where there are various fire breaks in between the plant communities. These areas are burnt regularly. Figure 26 shows the generalised curve of F.P.C. (%) versus time (years) after burning at Jonkershoek. Superimposed upon it is the F.P.C. value of the fire break site. When sampled, the fire break was 30 months old (For. dept, pers. comm.). It can be seen that the F.P.C. of the fire break vegetation does not fit the generalised curve. It has a lower F.P.C. value (54%) than that predicted by the generalised curve (59,5%).

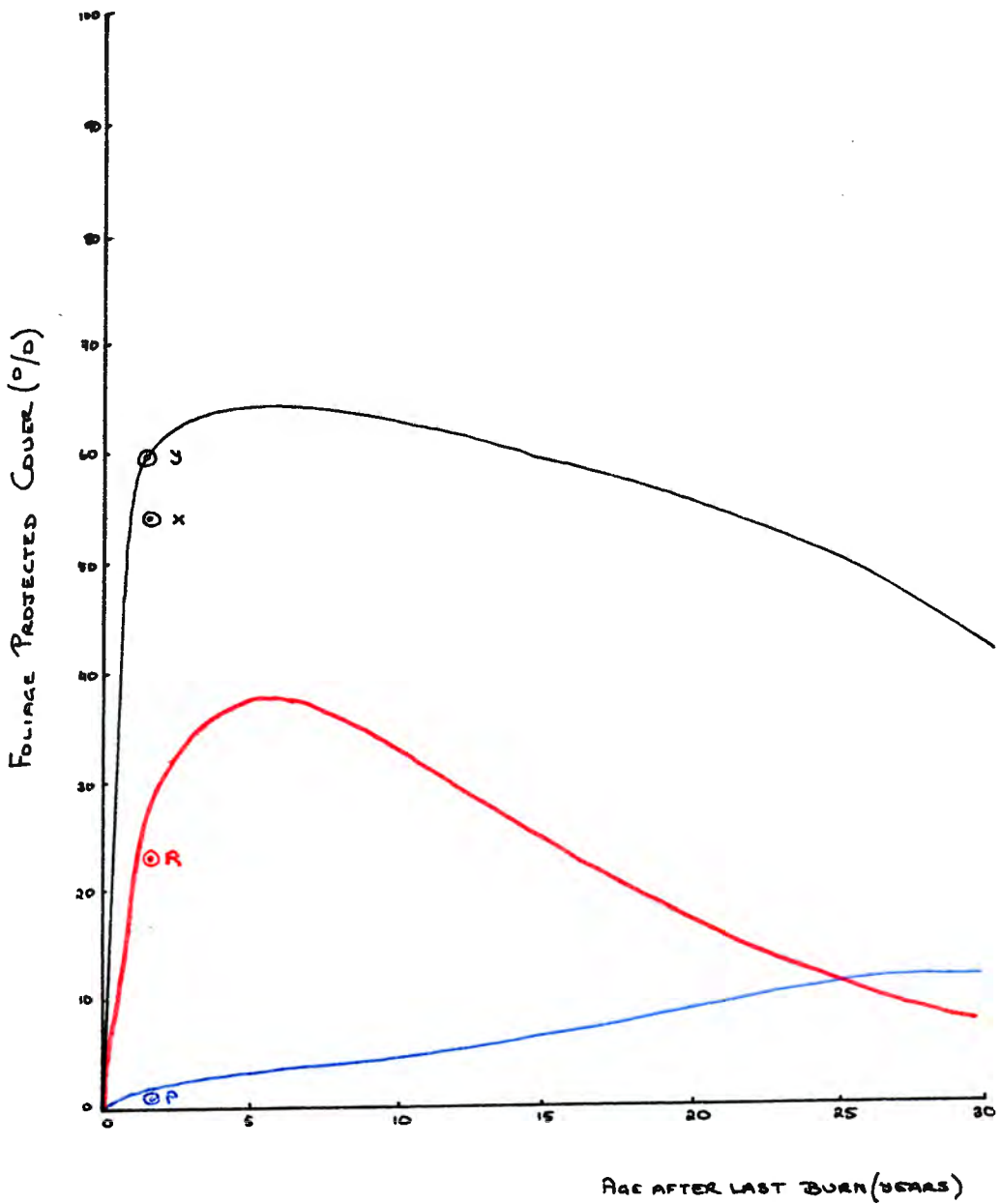
Figure 26 shows the relative proportion of members of the Restionaceae and Proteaceae. In both cases the F.P.C. was lower than that predicted by the generalised curve. The relative proportion of shrubs is somewhat higher than that found at Bainskloof. The reason for this may be that the fire break at Jonkershoek was very narrow - only about 50 - 75m wide. Adjacent to it was a stand that had been very old and mature (23 years 4 months old), but which had recently been burnt. This means that there were well-established, flowering shrubs next to the fire break site which could have replenished the seed stock in the fire break, by windblown seeds. This, then, may explain the relatively high proportion of shrubs in the fire break.

In general, the results of the fire break sites are rather surprising in that it might be reasoned that regular fires would increase the nutrient turnover and thus increase the growth rate of plants.

2. Samples from very old sites.

A problem that arose in the field, and later when analysing the data was the question of sampling stands that had been burnt very rarely. An example

Figure 26: Graph showing the Foliage Projected Cover (FPC) versus time after burning at Jonkershoek. The curve shows the FPC of a fire break which is burnt frequently (X) which was 30 months old when sampled. It can be seen that the value obtained for this site is less than that predicted by the curve (Y). Red curve = FPC of restios, blue curve = FPC of protea and leucodendrons, R = FPC of restios in fire break, P = FPC of protea and leucodendrons in fire break.

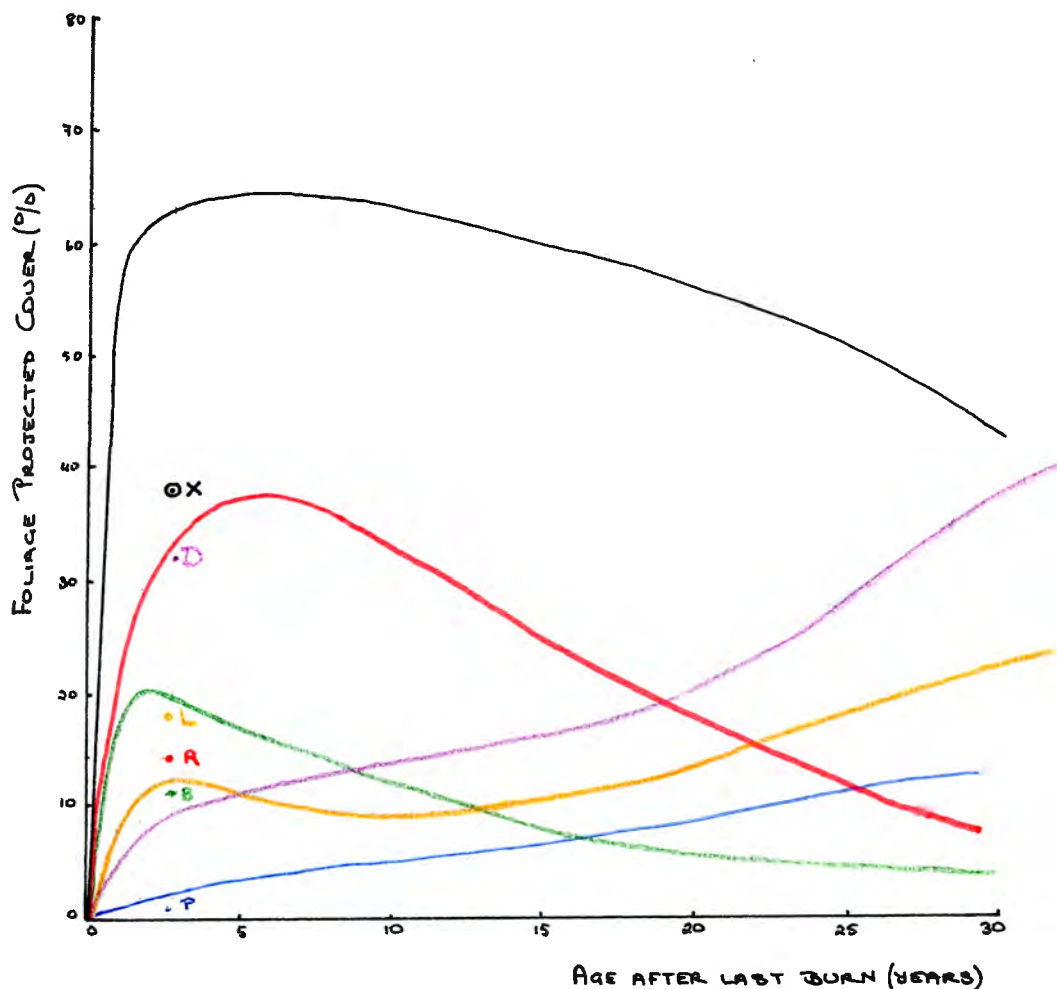


of such a situation occurred^f at Jonkershoek. A stand that had not been burnt for 23 years 4 months, was burnt. It was sampled 32 months after burning. Figure 27 shows the result of this experiment superimposed upon the generalised curve of F.P.C. (%) versus time (years) after burning at Jonkershoek. It can be seen that the F.P.C. (38%) of the experimental site was considerably lower than that predicted by the curve (63%). Closer analysis of the different components recorded revealed that the value for the standing dead material (32%) was far higher than that predicted by the curve (9%). The reason for this is because the large shrubs that had occurred in the very old community were killed by the fire but remained standing. By measuring the upper stratum, these large dead shrubs were included, whilst the newly developing undergrowth was disregarded. This is a problem which could lead to atypical results. It did not cause a severe problem in the experimental work for this study because most of the sites sampled were under the management of the Forestry Department. The fire history of these areas was obtainable, and such areas as these were avoided where possible.

It must be stressed that this could lead to important misinterpretations of the true F.P.C. It would, therefore, appear better to modify the method somewhat and to measure both the over- and under-storey foliage projected cover when the fire history is unknown.

Figure 27: Graph showing the Foliage Projected Cover (FPC) versus time after burning at Jonkershoek. The FPC of a 32 month old stand is shown (X). This stand had been 23 years 4 months old prior to burning, and was dominated by the charred remains of large shrubs many of which were over 1,5 - 2 meters tall.

Total FPC = black curve; FPC of restios = red curve; FPC of protea and leucodendrons = blue curve; percentage of standing dead material = purple curve; percentage of litter = orange curve; percentage of bare ground = green curve; FPC of restios in 32 month stand = R; FPC of protea and leucodendrons in 32 month stand = P; percentage standing dead in 32 month stand = D; percentage litter in 32 month stand = L; percentage bare ground in 32 month stand = B.



CONCLUSIONS.

1. Analysis of the Foliage Projected Cover (F.P.C.) of fynbos communities occurring along a moisture gradient revealed that the maximum F.P.C. value tended to increase with increasing rainfall. Deviations from this trend may be due to local differences in moisture availability.
2. The time taken to achieve the maximum F.P.C. appears to be related to the moisture availability. Areas with a relatively high moisture availability achieved their maximum F.P.C. before those areas with relatively low moisture availability.
3. The rate of decline in F.P.C. appears to be related to the moisture availability, with the greatest rate occurring in the area with the most rainfall (Jonkershoek) and the lowest rate occurring in the area with the least rainfall (Algeria).
4. There are local variations in the F.P.C. within a single fynbos community. It is postulated that these differences may be due to micro-variations in the moisture availability within the community. These findings do not correspond with those of Specht (1973) who found that the F.P.C. within a single area remained constant. This difference may be related to the structure of communities since the Australian heath has a distinct tree element in the upper strata, which is lacking in the fynbos.
5. It was found that the F.P.C. of fire breaks was considerably lower than that predicted by the generalised curve of F.P.C. (%) versus time (years) after burning. It is thought that this might be due to the elimination of seed - regenerating shrubs.
6. Considerable deviations were found in the F.P.C. values of sites that are burnt rarely. It was found that in these sites an atypically high amount of standing dead material occurred due to the upper stratum of the community. It is suggested that when the fire history is unknown, that both over- and under-storey F.P.C. be measure. By doing this, a more realistic estimation of the F.P.C. may be found.

Appendix 1.1 ALGERIA - 2 years old

STANDING DEAD (S/D)	27	28	40	67	34	55	122	41	38	160	41	39	199	40	15	241	40	37	278	40
BARE GROUND (B/G)	36	38	29	65	33	19	84	29	31	115	30	20	135	27	28	158	27	29	188	27
LITTER	10	10	12	22	11	14	36	12	9	45	12	19	64	13	44	108	18	60	104	15
LITTER and S/D and B/G	73	76	81	154	78	88	242	82	78	320	83	78	398	80	87	507	85	126	570	82
RESTIO	1	1	8	9	5	4	13	4	10	23	6	11	34	7	10	44	7	5	59	7
PROTEA	3	3	0	3	2	0	3	1	1	4	1	0	4	1	0	4	1	3	7	1
ERICOID	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0,5	0	3	0
HERBS	3	3	8	11	6	4	15	5	4	19	2	14	33	7	1	34	3			
BUSHES < 1m	2	2	2	4	2	3	7	2	0	7	2	3	10	2	0	10	2	4	14	2
BUSHES > 1m	14	15	0	14	7	0	14	5	2	16	4	0	16	3	0	16	3	5	21	3
Total no. of points in transect	96		99			99			95			106			101			99		
Cumulative total no. of points	96		195			294			389			495			596			695		

Herbs included: Hermannia, Senecis, Selago, Oxalis, Aizoaceae sp., Selaginaceae sp., Ursinia.

Bush < 1m : Aspalathus, Phyllica, Pelargonium, Montinia

PROJECTED FOLIAGE COVER = 18%

Appendix 1.2 ALGERIA - 5 years old

LITTER	3	3	6	9	4	4	13	4	3	16	4	9	25	5	4	29	5	5	34	5
STANDING DEAD (S/D)	29	32	17	44	22	20	64	22	14	78	20	24	102	21	23	125	21	27	152	22
BARE GROUND (B/G)	20	22	20	40	20	19	59	20	15	74	19	13	87	18	15	102	17	10	112	17
LITTER and S/D and B/G	52	57	43			43			32			46		42			47			
RESTIO	14	15	26	40	20	33	73	25	23	96	24	23	119	24	35	154	26	22	176	26
CLIFFORTIA	0	0	5	5	2	7	12	4	5	17	4	1	18	4	11	29	5	0	29	4
PERENNIAL GRASS	19	21	21	40	20	2	42	14	0	42	11	1	43	9	10	53	9	0	53	8
HERBS	2	2	4	6	3	8	14	5	21	35	9	20	55	11	8	23	4	24	47	7
SHRUBS > 1m	0	0	6	6	3	1	7	2	1	8	2	0	8	2	2	10	2	0	10	2
SHRUBS < 1m	4	4	4	8	4	3	11	4	14	25	6	3	28	6	1	29	5	1	30	4
Total no. of points in transect	91		109			97			96			94			109			94		
Cumulative no. of points	91		200			297			393			487			596					

PROJECTED FOLIAGE COVER = 56%

APPENDIX 1.3: ALGERIA - 21 years old.

STANDING DEAD (S/D)	22	19	20	42	19	22	64	19	25	25	20	25	114	20	19	133	20	18	151	19
LITTER	21	18	25	46	20	17	63	19	26	89	20	21	110	20	6	116	17	12	128	16
BARE GROUND (B/G)	8	7	6	14	6	6	20	6	6	26	6	5	31	6	3	34	5	8	42	5
S/D, LITTER and B/G	51	44	51		45	45		44	57		46	51		46	28		42	38		40
PROTEA	2	2	6	8	3,5	12	20	6	3	23	5	7	30	5	14	44	6	16	60	8
RESTIO	50	43	36	86	38	41	127	28	18	145	32	32	177	32	32	209	31	26	235	30
PHYLICA	3	3	6	9	4	1	10	3	10	20	4	2	22	4	18	40	6	13	53	7
ELYTROPAPPUS	2	2	0	2	1	0	2	0,5	2	4	1	0	4	1	0	4	0,5	0	4	0,5
MISCELLANEOUS	2	2	0	2	1	0	2	0,5	0	2	0,5	0	2	0,5	0	2	<0,5	0	2	<0,5
SHRUB < 1m	5	4	2	7	3	6	13	4	18	31	7	7	38	7	7	45	7	5	50	6
SHRUB > 1m	0	0	9	9	4	5	14	4	8	22	5	10	32	6	18	50	7	13	63	8
Total no. of points in transect	115		110			110			116			109			117			111		
Cumulative total no. of points	115		225			335			457			560			677			788		

FOLIAGE PROJECTED COVER = 60%

Appendix 2.1: BAINSKLOOF: A SLOPE 19 months (7.6.1980)

STANDING DEAD (S/D)	13	13	19	32	16	7	39	13	12	51	13	5	56	11	8	64	11	10	74	11
LITTER	2	2	1	3	2	2	5	2	2	7	2	2	9	2	2	11	2	0	11	2
BARE GROUND (B/G)	20	21	13	33	17	19	52	18	23	75	19	25	100	20	26	126	21	25	151	21
LITTER, S/D and B/G		36			35			33			34			33			33			34
HERBS: (COMPOSITE)	6	6	8	14	7	5	19	7	5	24	6	7	31	6	5	36	6	14	50	7
MISCELLANEOUS HERBS	5	5	2	7	4	0	7	2	0	7	2	0	7	1	0	7	2	0	7	1
SHRUBS < 1m	7	7	2	9	5	2	11	4	10	21	5	1	22	4	3	25	4	3	28	4
SHRUBS > 1m	0	0	3	3	2	0	3	1	0	3	1	0	3	1	0	3	0,5	0	3	0,5
MONOCOTS.	4	4	7	11	6	12	23	8	2	27	6	6	31	6	8	39	6,5	5	44	6
RESTIOS	40	41	42	82	42	57	133	46	48	181	46	58	239	48	50	289	48	47	336	48
Total no. of points in transect	97		97			98			102			104			102			104		
Cumulative total no. of points	97		194			292			394			498			600			704		

PROJECTED FOLIAGE COVER = 66%

Appendix 2.2: BAINSKLOOF: C SLOPE 19 months (7.6.1980)

STANDING DEAD (S/D)	4	4	3	7	3	2	9	3	1	10	3	2	12	2	2	14	2
LITTER	0	0	1	1	0,5	0	1	0,5	2	3	1	2	5	1	0	5	1
BARE GROUND (B/G)	10	10	5	15	7	4	19	6	7	26	6,5	9	35	7	8	43	7
LITTER, S/D and B/G		14			10,5			9,5			10,5			10			10
HERBS: COMPOSITAE	5	5	4	9	4	3	12	4	2	14	4	3	17	3	3	20	3
MISCELLANEOUS HERBS	0	0	3	3	1	4	7	2	6	13	3	4	17	3	3	20	3
SHRUBS < 1m	1	1	2	3	1	2	5	2	2	7	2	1	8	2	1	9	2
MONOCOTS.	13	13	14	23	13	13	40	13	13	53	13	5	58	12	15	73	13
RESTIOS	70	68	75	145	69	64	209	69	62	271	68	75	350	70	65	415	70
Total no. of points in transect	103		107			92			95			101			96		
Cumulative total no. of points	103		210			302			397			498			594		

PROJECTED FOLIAGE COVER = 90%

Appendix 2.3 BAINSKLOOF: "B" SLOPE 19 months (7.6.1980)

STANDING DEAD (S/D)	2	2	12	14	7	9	23	7	11	34	8	11	45	8	3	48	7	7	55	7
LITTER	2	2	3	5	2	4	9	3	4	13	3	5	18	3	4	22	3	5	27	3,5
BARE GROUND (B/G)	25	24	20	45	21	20	65	20	12	77	17	4	81	15	14	95	15	12	107	14
LITTER, S/D and B/G		28			30			30			28			26			25			24,5
HERBS																				
COMPOSITE	5	5	9	14	7	21	35	11	21	56	13	12	68	12	6	74	11	10	84	11
MISCELLANEOUS HERBS	0	0	1	1	0,5	1	2	0,5	0	2	0,5	1	3	0,5	2	5	1	4	9	1
SHRUBS < 1m	3	3	1	4	2	4	8	2	3	11	2	1	12	2	0	12	2	3	15	2
SHRUBS > 1m	0	0	0	0	0	1	1	0,5	0	1	0	0	1	0	0	1	0	0	1	0
MONOCOTS.	21	20	15	36	17	11	47	14	22	69	16	15	84	15	25	109	17	14	123	16
RESTIOS	46	44	49	95	44	40	135	42	47	182	41	62	244	44	35	279	43	60	299	39
Total no. of points in transect	104		110			111			120			111			89			115		
Cumulative total no. of points	104		214			325			445			556			645			760		

PROJECTED FOLIAGE COVER = 75%

Appendix 2.4: BAINSKLOOF - 8 years

BARE GROUND (B/G)	24	29	22	46	28	20	66	27	15	81	25	20	101	25	21	122	25	21	143	25	17	160	25	16	176	24
LITTER	14	17	8	22	13	6	28	11	8	36	11	5	41	10	5	46	9	6	52	9	7	59	9	8	67	9
STANDING DEAD (S/D)	2	2	3	5	3	1	6	2	5	11	3	8	19	5	5	24	5	6	30	5	7	37	6	6	43	6
LITTER, S/D and B/G	40	48	33	73	44	27	100	41	28	128	39	33	161	39	31	192	39	33	225	39	31	256	39	30	286	39
PROTEA	5	6	0	5	3	0	5	2	3	8	2	0	8	2	2	10	2	0	10	2	0	10	1	0	10	1
RESTIO	34	41	49	83	50	53	138	56	50	188	57	45	233	57	40	279	57	46	319	56	48	367	56	48	415	56,5
DIOSPORYRUS: (leaves 0,5 - 2cm)	1	1	0	1	0,5	0	1	0,5	0	1	0,5	3	4	1	0	4	1	0	4	1	0	4	0,5	0	4	0,5
HELIPTERUM (leaves < 0,5cm)	2	2	0	2	1	1	3	1	1	4	1	0	4	1	0	4	1	3	7	1	0	7	0,5	0	7	0,5
ERICOID LEAVED	1	1	1	2	1	0	2	1	0	2	0,5	4	6	1	3	9	2	1	10	1	1	11	2	1	12	1
Total no. of points in transect	83		82			80			82			85			76			83			80			80		
Cumulative total no. of points	83		165			245			327			412			488			571			651			731		

PROJECTED FOLIAGE COVER = 61%

Appendix 2.5: BAINSKLOOF (2) 40 years

BARE GROUND (B/G)	4	6	1	5	3	0	5	2	1	6	2	3	9	2	4	13	3	2	15	3	4	19	3	1	20	3	1	21	3	
LITTER	11	15	16	27	18	11	38	17	9	47	15	12	59	15	5	64	14	6	70	13	7	77	12	13	90	13	1	91	12	
STANDING DEAD (S/D)	8	11	4	12	8	9	21	9	10	31	10	15	46	12	10	56	12	11	67	12	11	78	12	17	95	13	11	106	13	
LITTER, S/D and B/G		32			29			28			27			29			29			28			27			29			28	
PROTEAS	25	35	16	41	27	16	57	25	22	79	26	21	100	26	27	127	27	19	146	27	17	163	26	18	181	26	26	207	26	
RESTIOS	16	23	42	58	38	25	83	37	26	109	36	20	129	34	35	164	35	33	197	36	37	234	37	32	266	38	16	282	36	
ERICA	7	10	0	7	5	8	15	7	8	23	8	7	30	8	0	30	6	6	36	7	6	42	7	1	43	6	17	60	8	
WOODY SHRUBS	0	0	1	1	0,5	7	8	3	1	9	3	0	9	2	1	10	2	3	13	2	0	13	2	0	13	2				
<u>CLIFFORTIA ruscifolia</u>																							0	13	2		5	18	2	
<u>D. glabra</u>																												1	1	<0,5
CLIFFORTIA																											2	2	<0,5	
Total no. of points in transect	71		80			76			77			78			82			80			82			82			80			
Cumulative total no. of points	71		151			227			304			382			464			544			626			708			788			

PROJECTED FOLIAGE COVER = 72%

Appendix 2.6: BAINSKLOOF (1) 40 years

BARE GROUND (B/G)	4	5	2	7	4	1	8	3	0	8	3	5	13	3	1	14	3	3	17	3	0	17	3	1	18	2	1	19	2
LITTER	10	12	8	20	12	7	27	11	7	34	10	6	40	10	10	50	10	2	52	9	12	64	10	6	70	10	4	74	9
STANDING DEAD (S/D)	10	12	11	23	14	17	40	17	9	49	15	18	67	17	19	86	18	9	95	17	14	109	17	11	120	17	16	136	17
LITTER, S/D and B/G	24	29	21	50	30	25	75	31	16	91	28	29	120	30	30	150	31	14	164	29	26	190	30	18	208	29	21	219	28
PROTEA	14	18	22	40	25	11	51	21	23	74	23	12	86	21	9	75	15	21	76	13	22	98	15	25	124	17	28	152	19
LEUCADENDRON salignum	0	0	0	0	0	2	2	0,5	3	5	1	0	5	1	0	5	1	0	5	1	0	5	1	0	8	1	0	8	1
CLIFFORTIA ruscifolia	8	10	3	13	8	0	13	5	1	14	4	0	14	3	0	14	3	0	14	2		14	2	0	14	2		14	2
<u>D. glabra</u>			2	2	1	2	4	1	0	4	1	0	4	1	1	5	1	0	5	1		5	1		5	1		5	0,5
ERICA	14	18	10	28	17	15	43	18	13	56	17	12	68	17	21	89	18	17	106	19	11	117	18	11	128	18	11	139	17
RESTIOS	20	24	23	47	29	25	72	30	27	99	31	27	126	31	21	147	30	26	173	31	20	193	30	24	217	30	18	235	29
Total no. of points in transect	80		81			80				83		80			82			78			79			81			78		
Cumulative total no. of points	80		161			241				324		404			486			564			643			724			802		

PROJECTED FOLIAGE COVER = 68%

Appendix 2.7: BAINSKLOOF - in valley below Bainskloof Pass, A slope -
19 months old.

STANDING DEAD (S/D)	33	33	47	80	40	38	118	40	42	160	40	43	203	42	50	248	42
LITTER	17	17	15	32	16	21	53	18	14	67	17	11	78	16	10	102	17
BARE GROUND (B/G) }	22	21	17	39	20	19	58	20	24	82	21	15	97	20	20	117	20
ROCK	15	15	14	29	15	16	45	15	14	59	15	14	73	15	13	86	15
LITTER, S/D and B/G	87	86	93	180	91	94	274	93	94	368	93	83	451	93	95	553	94
RESTIO	6	6	1	7	4	1	8	3	2	10	3	4	14	3	0	15	3
SHRUBS	4	4	0	4	2	1	5	2	2	7	2	0	7	2	1	8	1
MISCELLANEOUS	0	0	0	0	0	1	1	0,5	0	1	0,5	0	1	<0,5	0	1	<0,5
MONOCOTS.	0	0	1	1	0,5	0	1	0,5	0	1	0,5	1	2	<0,5	2	4	0,5
HERBS < 5cm	4	4	2	6	3	2	8	3	1	9	3	1	10	2	1	11	2
HERBS > 5cm	0	0	0	0	0	0	0	0	1	1	0,5	0	1	<0,5	1	2	<0,5
Total no. of points in transect	101		97			99			100			89			98		
Cumulative total no. of points	101		198			297			397			486			584		

PROJECTED FOLIAGE COVER = 6%

Appendix 2.8: BAINSKLOOF - in valley below Bainskloof Pass, B slope -
19 months old.

STANDING DEAD (S/D)	26	24	30	56	27	43	99	32	33	132	32	35	167	32	43	200	32
LITTER	19	18	15	34	16	11	45	14	12	57	14	6	63	12	6	71	12
BARE GROUND (B/G)	35	33	35	70	34	34	104	33	35	139	33	36	175	34	30	205	33
ROCK	3	3	8	11	5	5	16	5	10	26	6	8	34	7	8	42	7
LITTER, S/D and B/G	83	78	88	171	82	93	264	84	90	354	85	85	439	85	87	518	84
RESTIO	10	9	6	16	8	8	24	8	12	36	9	10	46	9	3	49	8
BUSH > 1m	4	4	0	4	2	2	6	2	0	6	1	1	7	1	2	9	1
BUSH < 1m	1	1	0	1	<0,5	0	1	<0,5	0	1	<0,5	1	2	<0,5	1	3	<0,5
MONOCOT.	0	0	1	1	<0,5	0	1	<0,5	1	2	<0,5	1	3	<0,5	5	6	<0,5
HERBS	9	8	6	15	7	2	17	5	1	18	4	0	18	3	3	21	3
Total no. of points in transect	107		101			105			104			98			101		
Cumulative total no. of points	107		208			313			417			515			616		

PROJECTED FOLIAGE COVER = 16%

Appendix 2.9: BAINSKLOOF - in valley below Bainskloof Pass, C slope -
19 months old.

STANDING DEAD (S/D)	33	33	29	62	32	52	114	39	42	156	40	36	192	40	35	230	40
LITTER	19	19	17	36	18	14	50	17	14	64	16	14	78	16	20	95	16
BARE GROUND (B/G)	16	16	10	26	13	10	36	12	8	44	11	8	52	11	9	61	11
ROCK	16	16	19	35	18	8	43	15	11	54	14	23	77	16	17	94	16
LITTER, S/D and B/G	84	84	75	159	81	84	243	83	75	318	81	81	399	83	81	480	83
RESTIO	4	4	13	17	9	3	20	7	7	27	7	5	32	7	4	36	6
BUSHES > 1m	6	6	0	6	3	0	6	2	3	9	2	3	12	2	2	14	2
MISCELLANEOUS	1	1	3	4	2	0	4	1	4	8	2	2	10	2	1	11	2
MONOCOTS.	0	0	1	1	0,5	5	6	2	1	7	2	3	10	2	2	12	2
HERBS < 5cm	4	4	5	9	3	7	16	5	3	19	5	1	20	4	4	24	4
HERBS > 5cm	0	0	0	0	0	0	0	0	1	1	0,5	0	1	<0,5	1	2	<0,5
Total no. of points in transect	99		97			99			94			94			95		
Cumulative total no. of points	99		196			295			389			483			578		

PROJECTED FOLIAGE COVER = 17%

Appendix 2.10: BAINSKLOOF - ± 20 years.

BARE GROUND (B/G)	8	8	4	12	6	10	22	7	2	24	6	3	27	5	2	29	5
LITTER	11	11	11	22	11	11	33	11	5	38	10	8	48	10	13	59	10
STANDING DEAD (S/D)	7	7	10	17	9	4	21	7	4	25	6	11	36	7	8	44	7
LITTER, S/D and B/G	26		25			25			11			22			23		
RESTIO	62	64	59	121	62	64	185	63	66	251	63	68	316	64	58	377	63
PROTEA	4	4	9	13	7	9	23	8	19	42	11	6	48	10	10	58	10
ERICA	1	1	2	3	2	1	4	1	3	7	2	0	8	2	4	11	2
BUSH < 1m	4	4	3	7	4	1	8	3	1	9	2	1	10	2	5	15	3
MISCELLANEOUS	0	0	0	0	0	1	1	<0,5	1	2	0,5	0	2	<0,5	0	2	<0,5
Total no. of points in transect	97		98			101			101			97			100		
Cumulative total no. of points	97		195			296			397			494			594		

PROJECTED FOLIAGE COVER = 78%

Appendix 3.1: JONKERSHOEK - 20 months

BARE GROUND (B/G)	20	21	11	31	16	19	50	18	21	71	19	20	91	19	16	107	18	18	125	19	26	151	20
STANDING DEAD (S/D)	8	9	18	26	14	5	31	11	7	38	10	8	46	10	5	51	9	11	62	9	4	66	9
LITTER	15	16	11	26	14	7	33	12	14	47	12	11	58	12	11	69	12	9	78	12	14	92	12
LITTER, S/D and B/G	43	46	40	83	44	31	114	40	42	156	42	39	195	41	32	227	39	38	265	39	44	309	40
SHRUBS																							
BROAD LEAVES > 10cm			2	2	1	2	4	1	3	7	2	3	10	2	2	12	2	5	17	3	1	18	2
5 - 10cm	8	9	9	17	9	6	23	8	5	28	7	8	36	8	6	42	7	8	50	7	4	54	7
2 - 5cm	3	3	4	7	4	6	13	4,5	5	18	5	3	21	5	6	27	5	4	31	4	8	39	5
VERY NARROW	1	1	0	1	0,5		1	0,5		1	<0,5		1	<0,5		1	<0,5		1	<<0,5		1	0+
ERICOID	3	3	4	7	4	6	13	4,5	8	21	6	4	25	5	6	31	5	11	42	6	9	51	7
NEEDLELIKE > 10cm long	3	3	4	7	4	4	11	4	4	15	4	3	18	4	4	22	4	2	24	4	1	25	3
RESTIOS	27	29	26	53	28	35	88	31	28	116	31	38	154	32	39	193	33	23	216	32	34	220	29
<i>R. curviformis</i>			1	1	0,5	1	2	1		2	0,5		2	0,5		2	0,5		2	<0,5		2	0,25
HERBS - PERENNIALS	6	6	4	10	5	1	11	4		11	3		11	23	1	22	4	4	26	4		26	3
GRASS						3	3	1	1	4	1	2	6	1	3	9	1		9	1		9	1
Totql no. of points in transect	94		94			95			96			100			99			95			101		
Cumulative total no. of points	94		188			283			379			479			578			673			774		

PROJECTED FOLIAGE COVER = 60%

Appendix 3.2: JONKERSHOEK - 6 years

BARE GROUND (B/G)	13	13	11	24	12	16	40	14	7	47	12	13	60	12	13	73	12	13	86	12
STANDING DEAD (S/D)	11	11	11	22	11	8	30	10	14	44	11	15	59	12	20	79	13	10	89	13
LITTER	13	13	6	19	9	11	30	10	10	40	10	8	48	10	14	62	10	14	76	11
LITTER, S/D and B/G	37	37	28	65	32	27	92	31	38	130	33	38	168	34	54	222	37	34	256	37
SHRUBS:																				
LEAVES ≥ 10cm	4	4	4	8	4	3	11	4	2	13	3	2	15	3	4	19	3	2	21	3
5 - 10	12	12	7	19	9,5	6	25	9	7	32	8	8	40	8	11	51	9	13	64	9
0,5 - 1m	6	6	3	9	4,5	6	15	5	17	32	8	13	45	9	5	50	8	10	60	9
ERICOID: 0,5m			2	2	1		2	1		2	0,5		2	0,5		2	0,5		2	0,5
NEEDLE-LIKE 10cm									2	2	0,5		2	0,5	1	3	0,5	1	4	1
GEOPHYTES	1	1	3	4	2	5	9	3	5	14	4	3	17	3	5	22	4		22	3
RESTIOS	38	37	54	92	45	35	127	43	36	163	41	38	201	40	27	228	38	32	260	37
<u>R. curviformis</u>	3	3		3	1,5		3	1		3	1		3	1	2	5	1	1	6	1
HERBS: PERENNIALS			1	1	0,5	1	2	1	1	3	1	2	5	1	1	6	1		6	1
Total no. of points in transect	101		102			91			101			102			103			96		
Cumulative total no. of points	101		203			294			395			497			600			696		

PROJECTED FOLIAGE COVER = 63%

Appendix 3.3: JONKERSHOEK - FIREBREAK

BARE GROUND (B/G)	26	27	21	47	24	27	74	27	26	100	26	30	130	28	24	154	28	26	180	28
LITTER	13	13	9	22	11	8	30	11	5	35	9	9	44	9	8	52	9	5	57	9
STANDING DEAD (S/D)	11	11	15	26	13	9	35	13	10	45	12	8	53	11	8	61	11	9	70	11
RESTIO	32	33	15	47	24	16	63	23	25	88	23	19	107	23	22	129	23	23	152	23
LEUCODENDRON	1	1	5	6	3	2	8	3	3	11	3	4	15	3	4	19	3	1	20	3
PROTEA	0	0	0	0	0	3	3	1	1	4	1	3	7	1	3	10	2	1	11	2
ERICOID TYPE	3	3	6	9	5	5	14	5	8	22	6	8	30	6	7	57	10	7	44	7
MONOCOT.	2	2	3	5	3	0	5	2	1	6	2	1	7	1	4	11	2	7	18	3
MISCELLANEOUS	9	9	5	14	7	6	20	7	8	28	7	5	23	7	7	40	7	7	47	7
COMPOSITE	1	1	2	3	2	0	3	1	0	3	0,5	0	3		0	3		0	3	
GRASS	0	0	16	16	8	7	23	8	6	29	8	1	30	6	4	34	6	3	37	6
Total no. of points in transect	98		97			83			103			88			91			89		
Cumulative total no. of points	98		195			278			381			469			560			649		

PROJECTED FOLIAGE COVER = 54%

Appendix 3.4: JONKERSHOEK - 23 years 2 months

BARE GROUND (B/G)	11	11	10	21	11	7	28	10	7	35	9	6	41	9	12	53	9
LITTER	19	20	15	34	18	15	49	17	18	67	17	12	79	16	15	94	16
STANDING DEAD (S/D)	19	20	24	43	24	27	70	24	17	87	23	27	114	24	21	135	23
LITTER, S/D and B/G	47	49	49	96	50	49	145	50	42	187	49	45	232	48	48	280	48
SHRUBS																	
LEAVES > 10cm	12	13	10	22	11	6	28	10	16	44	11	7	51	11	10	61	11
5 - 10cm	5	5	3	8	4	2	10	3		10	3		10	2		10	2
1 - 2m tall			5	5	3	13	18	6	5	23	6	8	31	6	14	45	8
< 2cm	1	1	2	3	1	7	10	3	4	14	4	1	15	3		15	3
ERICOID LEAVES	8	8	3	11	6	1	12	4	7	19	5	10	29	6	14	43	7
HERBS PERENNIALS	6	6	6	12	6	10	22	8	6	28	7	12	40	8	6	46	8
RESTIOS	15	16	18	33	17	10	43	15	16	59	15	12	71	15	5	76	13
Total no. of points in transect	96		96			98			96			95			97		
Cumulative total no. of points	96		192			290			386			481			578		

PROJECTED FOLIAGE COVER = 52%

Appendix 3.5: JONKERSHOEK - 38 years 4 months

BARE GROUND (B/G)			3	3	2		3	1	1	4	1	1	5	1
STANDING DEAD (S/D)	42	43	47	89	46	39	128	43	34	162	41	51	213	44
LITTER	25	26	20	45	23	31	76	26	38	114	29	18	132	27
LITTER and S/D	67	68	67	134	69	70	204	69	72	276	70	69	345	71
LITTER, S/D and B/G	67	68	70	137	71	70	207	70	73	280	71	70	350	72
TREES			1	1	0,5		1	0,5		1	0,5		1	<0,5
SHRUBS												3	44	9
LEAVES ≥ 10cm	8	8	3	11	6	15	36	12	5	41	10		3	0,5
2 - 5cm	2	2	1	3	2		3	1		3	0,5		3	0,5
1 - 2m						3	3	1		3	0,5	7	23	5
VERY NARROW LEAVES	3	3	3	6	3		6	2	10	16	4		6	1
ERICOID LEAVES	1	1	2	3	2	1	4	1	2	6	1		3	0,5
NEEDLE-LIKE >10cm long			3	3	2		3	1		3	0,5	4	19	4
GEOPHYTES	6	6	3	9	5	4	13	4	2	15	4	2	5	1
HERBS - PERENNIALS	1	1		1	0,5		1	<0,5	2	3	1	9	39	8
RESTIOS	10	10	6	16	8	9	25	8	5	30	8			
Total no. of points in transect	98		95			102			99			95		
Cumulative total no. of points	98		193			295			394			489		

PROJECTED FOLIAGE COVER = 28,6%

Appendix 4.1 SILVERMINE - 6 months old

STANDING DEAD (S/D)	5	5	7	12	6	11	23	7
LITTER	27	27	19	46	23	27	73	24
BARE GROUND (B/G)	27	27	30	57	28	22	79	26
LITTER and S/D								
LITTER, S/D and B/G								
RESTIO	28	28	28	56	28	30	86	28
BROAD LEAF MONOCOT.	7	7	5	12	6	2	14	5
ASPALATHUS	0	0	7	7	3	2	9	3
NON-WOODY MISCELLANEOUS	6	6	4	10	5	3	13	4
WOODY MISCELLANEOUS	1	1	0	1	1,5	1	2	1
Total no. of points in transect	101		100			98		
Cumulative no. of points	101		201			299		

PROJECTED FOLIAGE COVER = 41%

Appendix 4.2: SILVERMINE - 11 months

BARE GROUND (B/G)	37	35	49	86	41	35	121	39	31	152	37
LITTER	14	13	12	26	13	14	40	13	22	62	15
STANDING DEAD (S/D)	8	7	0	8	4	7	15	5	4	19	5
LITTER, S/D AND B/G	59	57	61	120	58	56	176	57	67	233	57
RESTIO	39	35	34	73	35	37	110	36	40	150	37
ASPALATHUS	6	5	0	6	3	2	8	3	2	10	2
LEAFY MONOCT.	3	3	0	3	<1	0	3	<1	0	3	<1
MISCELLANEOUS HERBS.	3	3	3	6	2	4	10	2	2	12	2
Total no. of points in transect.	110		98			99			101		
Cumulative total no. of points.	110		208			307			408		

PROJECTED FOLIAGE COVER = 43%

Appendix 4.3: SILVERMINE † 15 months

BARE GROUND (B/G)	9	12	21	10	3	24	8	14	38	9	12	50	10	10	60	10
LITTER	12	13	25	12	9	34	11	10	44	11	11	55	11	17	72	12
STANDING DEAD (S/D)	5	7	12	5	5	15	5	8	23	6	12	35	7	1	36	6
LITTER, S/D and B/G	26	32	58	27	15	73	24	32	105	26	35	140	28	28	168	28
RESTIO and SEDGE	23	39	62	30	56	118	38	32	140	34	31	171	34	55	226	37
ASPALATHUS	35	25	60	29	23	82	27	29	111	27	11	122	24	5	127	21
HELIOPHYLLIS	15	7	22	10	8	30	10	9	39	9	17	56	11	9	65	11
EURYOPSIS	1	1	2	1	-	2	0,6	-	2	0,5	0	2	0,4	-	2	0,3
MISCELLANEOUS	-	1	1	0,5	-	1	0,3	-	1	0,25	3	4	0,8	3	7	1
Total no. of points in transect	100		105		104				102					97		100
Cumulative total no. of points	100		205		309				411					508		608

PROJECTED FOLIAGE COVER = 72%

Appendix 4.4: SILVERMINE - 22 months.

STANDING DEAD (S/D)	11	13	8	19	7	0	19	44	10	29	51	5	34	5	6	40	5
LITTER	12	14	28	40	14	19	59	14	9	68	12	8	76	11	10	86	10
BARE GROUND (B/G)	22	25	42	64	23	33	97	23	30	127	22	29	156	22	27	183	21
LITTER, S/D and B/G	45	52	78	113	40	52	175	41	49	224	39	42	266	37	43	309	36
RESTIOS	25	29	23	48	17	30	78	18	36	114	20	48	162	23	41	203	24
ASPALATHUS	1	1	0	1	<1	0	1	<1	0	1	<1	1	2	<1	4	6	<1
LEAFY MONOCOTS	3	3	1	4	3	0	4	1	2	6	2	2	8	1	2	10	1
MISCELLANEOUS HERBS	13	15	16	29	10	15	44	10	6	59	10	10	67	10	13	82	10
Total no. of points in transect	87		196			149			142			145			146		
Cumulative total no. of points	87		283			432			574			719			865		

PROJECTED FOLIAGE COVER = 35%

Appendix 4.5 SILVERMINE - 5 years 3 months

BARE GROUND (B/G)	2	2	2	4	2	0	4	1	1	5	1	6	5	1	0	5	1
STANDING DEAD (S/D)	16	16	13	29	15	32	61	20	20	81	20	27	108	21	24	132	21
LITTER	6	6	3	9	5	5	14	5	4	18	4	4	22	4	1	23	4
LITTER, S/D and B/G	24	24															
RESTIO	60	60	60	120	60	49	169	56	47	216	53	53	269	53	58	327	54
ERICOID TYPES	4	4	3	7	3,5	1	8	3	3	11	3	0	11	2	2	13	2
PROTEA	10	10	17	27	13,5	13	40	13	21	61	15	9	70	14	10	80	13
BROAD LEAFED MONOCOT. LEPTOPHYLLOUS TYPES	2	2	1	3	2	1	4	1	0	4	1	3	7	1	1	8	1
	0	0	1	1	0,5	3	4	1	4	8	2	3	11	2	4	15	2
Total no. of points in transect	100		100			104			100			99			100		
Cumulative total no. of points	100		200			304			404			503			603		

PROJECTED FOLIAGE COVER = 74%

Appendix 4.6: SILVERMINE - 5 years 10 months.

STANDING DEAD (S/D)	7	7	21	28	15	24	52	18	8	60	16	21	82	17	18	99	17
LITTER	3	3	4	7	4	2	9	3	2	11	3	6	17	4	8	25	4
BARE GROUND (B/G)	2	2	5	7	4	2	9	3	8	17	5	4	21	4	1	22	4
ROCK	9	9	5	14	7	3	17	6	3	20	5	8	28	6	3	31	5
LITTER, S/D and B/G	21	21	35	56	30	31	87	30	21	108	29	39	142	31	30	177	30
PROTEA	5	5	0	5	3	0	5	2	0	5	1	0	5	1	0	5	1
RESTIO	57	59	52	109	56	54	163	56	60	223	59	56	279	58	51	330	57
ERICA	2	2	0	2	1	0	2	1	0	2	4	0	2	<1	2	4	<1
LEUCODENDRON	1	1	8	9	5	11	20	7	2	22	6	6	28	6	9	37	6
MISCELLANEOUS	10	10	2	12	6	3	15	15	3	18	4	20	4	5	5	25	3
Total no. of points in transect	96		97			97			86			103			96		
Cumulative total no. points in transect	96		193			290			376			479			575		

PROJECTED FOLIAGE COVER = 70%

Appendix 4.7: MEASUREMENT OF OVER STOREY AND UNDER STOREY F.P.C.
AT SILVERMINE - 11 months.

STANDING DEAD MATERIAL	8	7	0	8	3	7	15	5	4	19	5
(S/D) OVER STOREY											
S/D UNDER STOREY	1	1	0	1	1	0	1	<1	0	1	<1
LITTER	14	12	12	26	12	14	40	13	22	62	15
LITTER UNDER STOREY	5	4	2	7	3	5	12	4	7	19	4
BARE GROUND (B/G)	37	32	49	86	39	35	121	39	31	152	36
B/G UNDER STOREY	0	0	1	1	<1	0	1	<1	0	1	<1
RESTIOS OVER STOREY	39	34	34	75	34	37	110	36	40	140	35
RESTIOS UNDER STOREY	0	0	4	4	2	0	4	1	0	4	1
ASPALATHUS OVER STOREY	6	5	0	6	3	2	8	3	2	10	2
ASPALATHUS UNDER STOREY	0	0	0	0	0	0	0	0	0	0	0
MISCELLANEDUS OVER STOREY	6	6	3	9	3	4	13	3	2	15	3
MISCELLANEDUS UNDER STOREY.	0	0	0	0	0	0	0	0	0	0	0
Total no. points in transect.	114		104			104			112		
Cumulative total no. points in transect.	114		210			314			426		

FOLIAGE PROJECTED COVER over-storey = 40%
under -storey = 1%

Appendix 4.8: MEASUREMENT OF OVER - STOREY AND UNDER - STOREY F.P.C.
AT SILVERMINE - 22 months.

BARE GROUND B/G	22	22	42	64	29	33	97	31	30	127	30	29	156	30	27	183	29
BARE GROUND - UNDER-STOREY	4	4	0	4	2	0	4	1	0	4	1	0	4	<1	0	4	<1
STANDING DEAD, OVER-STOREY	11	11	8	19	8,5	0	19	6	10	29	6	5	34	6	6	40	6
S/D - UNDER - STOREY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LITTER	12	12	28	40	18	19	59	19	9	68	16	8	76	15	10	86	14
LITTER, UNDER-STOREY	5	5	0	5	2	1	6	2	0	6	1	0	6	1	0	6	1
RESTIOS, OVER - STOREY	25	25	23	48	22	30	78	25	36	114	27	48	162	31	41	203	33
RESTIOS, UNDER - STOREY	3	3	1	4	2	0	4	1	0	4	1	0	4	1	0	4	<1
ASPALATHUS, OVER - STOREY	1	1	0	1	<1	0	1	<1	0	1	<1	1	2	<1	4	6	1
ASPALATHUS, UNDER - STOREY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HERBS, OVER - STOREY	16	16	15	32	15	15	47	13	16	63	14	11	73	14	15	88	14
HERBS, UNDER - STOREY	1	1	0	1	<1	0	1	<1	1	2	<1	1	3	<1	0	3	<1
Total no. of points in transect	100		119			98			102			103			103		
Cumulative total no. of points in transect	100		219			317			419			522			625		

FOLIAGE PROJECTED COVER over - storey = 48%
under - storey = 1%

Appendix 4.9: MEASUREMENT OF OVER - STOREY AND UNDER - STOREY F.P.C.
AT SILVERMINE - 5 years 10 months.

STANDING DEAD (S/D) OVER-STOREY	7	6	21	28	12	24	50	14	8	58	13	21	79	14	18	97	14
S/D UNDER - STOREY	2	2	3	5	2	7	12	3	8	20	4	1	21	4	11	32	5
LITTER	3	3	4	7	3	2	9	3	2	11	2	6	17	3	8	22	3
LITTER UNDER - STOREY	3	3	5	8	4	1	9	3	5	14	3	0	14	3	17	3	4
BARE GROUND (B/G)	2	2	5	7	3	2	9	3	8	17	4	4	21	4	1	22	3
BARE GROUND UNDER - STOREY	0	0	0	0	0	1	1	<1	0	1	<1	1	2	<1	0	2	<1
ROCK	9	8	5	14	6	3	17	5	3	20	4	8	28	5	3	31	4
ROCK UNDER - STOREY	0	0	0	0	0	0	0	0	0	0	0	1	1	<1	<1	2	<1
PROTEA OVER - STOREY	5	3	0	5	2	0	5	<1	0	5	<1	0	5	<1	0	5	<1
PROTEA UNDER - STOREY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RESTIO OVER - STOREY	57	47	52	109	47	54	163	47	60	223	49	56	279	49	51	330	48
RESTIO UNDER - STOREY	9	8	9	18	8	8	26	7	3	29	6	2	31	6	3	34	5
LEUCODENDRON OVER-STOREY	1	1	8	9	4	11	20	5	2	22	4	6	28	5	9	34	5
LEUCODENDRON UNDER - STOREY	7	6	0	7	3	0	7	2	0	7	2	0	7	1	0	7	1
MISCELLANEOUS OVER - STOREY	12	11	2	14	5	14	37	9	3	20	4	2	22	6	7	29	5
MISCELLANEOUS UNDER - STOREY	1	1	0	1	<1	0	1	<1	3	4	<1	0	4	<1	3	7	<1
Total no. of points in transect	118		114			116			104			108			132		
Cumulative total no. of points in transect	118		232			348			452			560			692		

FOLIAGE PROJECTED COVER -

over - storey = 58%

under - storey = 7%

APPENDIX 5: Identification of dominant species.

1. ALGERIA

2 year: Protea arborea, Hermannia cuneifolia, H. hyssopifolia,
Senecio maritimus, Selago sp., Oxalis sp., Aspalathus
astroites, Ursinia sp., Phylica buxifolia, Pelargonium sp.,
Montinia caryophyllacea.

5 year: Cliffortia ruscifolia, Elytopappus sp., Phylica buxifolia,
Stoebe sp., grass sp.

21 year: Protea arborea, Cliffortia ruscifolia, Phylica buxifolia,
Dodonea sp., Anthospermum sp.

2. BAINSKLOOF.

19 months, at top of Bainskloof Pass.

A area: Thamnochortus dichotimus, Staberhoa cernua, Watsonia sp.,
Coryonisium, Heeria argentea, Cliffortia juniperia, Stoebe,
Protea laurifolia, Metalasia muncata, Diosma hirsta,
Senecio maritimus, Felicia sp., Ursinia sp., Pelargonium sp.,
Thesium sp., Leontonyx sp., miscellaneous ericoid leafed type.

B area: Thamnochortus dichotimus, Chondropetalum paniculatum,
Widdenhovia lucaena, Staberhoa cernua, Restio curviramus,
Watsonia sp., Cliffortia juniperia, Leucodendron salignon,
Senecio sp., Othonna quinquedentata, Helipterum canescens,
Oxalis sp., Hermaas villosa, grass sp.

C area: Thamnochortus dichotimus, Staberhoa cernua, Watsonia sp.,
Coryonisium, Grass sp., Widdringtonia cupressoides, Stoebe sp.,
Leucodendron salignon, Protea laurifolia, Cliffortia
juniperia, Metalasia muncata, Senecio sp., Othonna
quinquedentata, Thesium sp., Heliptera canescens, Schizaea pectinata.

19 months, in valley below Bainskloof Pass.

A area: Cliffortia ruscifolia, Asparagus sp, Pelargonium sp., Babiana
2 miscellaneous grass species.

B area: Cliffortia ruscifolia, Leucodendron salignon, Asparagus sp.,
Babiana sp., grass sp., various restios.

C area: Montinia sp., Cliffortia ruscifolia, Senecio sp., Anthospermum aethiopica, Clutia alabanooides, grass sp., various restios.

8 year: Leucodendron salignon, Restio curviramus, R. staberhoa, Thamnochortus dichotimus, Staberhoa cernua, Cyperaceae sp.

20 year: Protea laurifolia, Erica hispidula, E. pinea, Cliffortia ruscifolia, Diospyros glabra, Eramia totta, Clutia ababanooides, Restio curviramus, R. staberhoa, various other restios.

40 year: Protea laurifolia, Erica pinea, E. hispidula, Cliffortia ruscifolia, Staberhoa cernua, various restio sp.

3. SILVERMINE

6 month : Aspalathus astroites, Euryops, Helichrysum vestitum, various restios.

10 month: Aspalathus astroites, Euryops, Metalasia muricata, Senecio elegans, Selago sp., various restios.

15 month: Aspalathus astroites, Euryops, Helichrysum sp., Erepsia sp., Metalasia muricata, various restios.

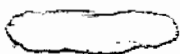
22 month: Metalasia muricata, Helichrysum sp., Euryops sp., Senecio elegans, Erepsia sp., Ericaceae, various restios.

5 years 3 months: Erica hispidula, E. plukenetii, Leucodendron salignon, Stoebe plumosa, Peneae sp., Leucospermum conocarpodendron.

5 years 10 months: Stoebe plumosa, Erica plukenetii, Penea sp., Leucodendron salignon, Leucospermum conocarpodendron.

4. JONKERSHOEK.

20 month: Leucodendron salignon, Protea laurifolia, Elegia capensis, Thymelaeaceae sp., Centella capensis, Psoralea decumbens, various restios, grass sp., miscellaneous ericoid-leafed herbs.



30 month: Leucodendron salignon, Elegia capensis, Anthospermum aethiopicum,
Chrysanthemoides monilifera, various restios, miscellaneous herbs.

6 year: L. salignon, Protea laurifolia, P. arborea, Elegia capensis,
Thymelaeaceae sp., Aristea thyrsoflora, Bobartia indica,
Anthospermum aethiopicum, various restios.

23 year 2 month: Protea arborea, P. laurifolia, Leucodendron salignon,
Elegia capensis, Phylica pubescens, grass sp., Bobartia indica,
Aristea thyrsoflora, various restios.

38 year 4 month: Protea arborea, P. laurifolia, Brunia nodiflora, Bobartia
indica, Rhus lucida, Widdringtonia sp., Leucospermum lineare,
Agathosma sp., various restios.

Fire break site: Protea arborea, Leucodendron salignon, Thymelaeaceae sp.,
Psoralea decumbens, Centella capensis, 2 grass sp., various restios,
miscellaneous herbs.

Appendix 6.

Site Descriptions.

1. ALGERIA.

2 year. Area fairly flat with a few granite outcrops (very large $\pm 2 \text{ m}^3$)
The vegetation was generally very low ($\pm 50 \text{ cm}$ maximum)
and consisted mainly of herbs. Several large charred
protea stumps occurred in the area.

5 year. Relatively steep slope (6°) with many rocks (20 - 50 cm.)
A few granite outcrops occurred.
The vegetation was fairly tall (50 - 100 cm) and very
dry and prickly in nature.

21 year. Fairly flat. Vegetation dominated by scattered protea
shrubs.

2. BAINSKLOOF.

i. 19 months, at top of Bainskloof Pass:

A area: Fairly steep slope (5°) with a few large T.M.S.
boulders.

Vegetation relatively tall with a few dead
shrubs occurring.

B area: Fairly flat, with many small rocks (10 - 30 cm³)
scattered throughout the area and a few large
T.M.S. boulders.

The vegetation was generally fairly low (< 1m)
with many composites in flower.

C area: Fairly flat, with many small rocks (10 - 30 cm³)
scattered throughout the area. There were more
rocks in this area than there were in the B area.
The vegetation was relatively low (< 1 m).

ii. 19 months, in valley below Bainskloof Pass.

A area: Slope of 6° . Many rocks ranging in size from 50 cm^3 to large boulders.

A few large shrubs which were vegetatively sprouting, were sparsely scattered.

B area: Fairly flat with many rocks ($\pm 30\%$ rock cover) ranging in size from 20 cm^3 to large boulders.

C area: Fairly flat. Occurred in a valley approximately 150 m from a river. Site covered with rocks (15% cover). Size ranging from 20 cm^3 to 50 cm^3 . A few large boulders were scattered throughout the area.

8 year (fire break); Fairly flat with few rocks.

Vegetation fairly low ($< 1 \text{ m}$) and dominated by restios and low shrubs.

20 year:

Very small community, stretching over an area of $\pm 200 \text{ m}$. Fairly flat, with small rocks ($< 5 \text{ cm}^3$) scattered throughout. A few T.M.S. outcrops.

Vegetation 50 - 150 cm tall.

40 year:

i. Fairly flat with few large T.M.S. outcrops. Vegetation dominated by large shrubs (1,5 - 2,5 m tall).

ii. Fairly steep (4°) with more rocky outcrops than in i. Vegetation similar in appearance but less dense.

3. JONKERSHOEK.

- 20 month : Slope $\pm 3^\circ$; few rocks.
Vegetation generally fairly low (<1m).
- 30 month (fire break); Slight slope; few rocks.
Vegetation <1m.
- 6 year: Slope $\pm 3^\circ$; a few rocky outcrops.
Vegetation fairly low (< 1m).
- 23 year 2 month: Fairly flat; few large rocky outcrops.
Vegetation dominated by large shrubs (1,5 to 3m).
- 38 year 4 month: Slight slope (3°).
Vegetation very dense; in parts impenetrable.
Much standing dead material. Height of shrubs,
1,5 - 3m.

4. SILVERMINE.

- 6 month: Fairly flat.
Vegetation < 50cm.
- 10 month: As in 6 month.
- 15 month: Fairly flat; few rocky outcrops.
Vegetation < 1m.
- 22 month: As in 15 month site.
- 5 year 3 month: Slight slope, with several large rocky outcrops.
Vegetation < 2m.
- 5 year 10 month: As in 5 year 3 month.

Appendix 7: Statistical comparison of suitably aged sites.

* = F.P.C. significantly different (0,1% confidence level)

Area	Age after last burn (m = months, y = years)
Jonkershoek	20m*, 30m, 6y, 23y 2m*, 38y 4m*,
Bainskloof	19m*, 8y, 20y*,
Silvermine	6m, 11m, 15m, 22m*, 5y 3m*, 5y 10m, 40y*,
Algeria	24m*, 5y*, 21y*,

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