PROPOSALS FOR REHABILITATION ASSESSMENT PROCEDURES AND CRITERIA FOR MINERAL SANDS MINES AT ENEABBA, WESTERN AUSTRALIA

S3/77

1. OBJECTIVES FOR REHABILITATION

The general objective of both companies mining at Eneabba is to re-establish a rich, diverse and stable plant community consisting of species indigenous to the mining area. It is the view of the Mineral Sands Agreements Rehabilitation Co-ordinating Committee that some quantitative measures of the plant community will be required as a guide for assessment of rehabilitation.

2. PROCEDURES FOR SAMPLING

Each rehabilitation Block will be sampled at the rate block will be sampled at the rate of four quadrats per hectare, with a minimum of four quadrats for small blocks.

Each quadrat will be 10 m x 10 m square and randomly located within the block. Where it is elected to subsample this can be done using 10, 1 m^2 quadrats randomly located within the main quadrat.

3. CRITERIA

It is recognised at the outset that regenerating vegetation is dynamic and thus that any criteria will need a time component. Two sets of quantitative standards will be provided: one to be used when it is considered that rehabilitation is complete and the land is to be handed back to the State (Completion Criteria) and the other to provide some indication as to whether any particular block is on a path of regeneration that, if projected in time, will attain the Completion Criteria. This second set of standards are thus Interim Criteria

3.1 Measures to be used

It is desirable that measures used for assessment are straight forward and easily used but, at the same time, effective.

Three measures of the plant community selected are:

- species richness or number of species per unit area;
- total canopy cover per cent or 100 - per cent of ground not overlapped by any plant canopy (i.e. bare ground);
- abundance expressed as number of individual plants per unit area.

(It may be necessary to specify a mix of plant reproductive strategy types too.)

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3.2 Completion Criteria

It is proposed that blocks be regarded as complete when mean values for sampled quadrats within that block equal (or exceed) 60 per cent of pre-mining vegetation values, provided that certain minimum values are also met in each quadrat and that the trajectory of values over time looks satisfactory.

Values proposed are:

Species richness: 50 indigenous heath species per 100 m^2 quadrat, 65 per hectare with a minimum value of 25 species in any one quadrat per block.

Per cent total canopy cover: 50 per cent per quadrat with a minimum value of 30 per cent in any one quadrat per block.

Abundance: 20 individuals of perennial native plant species per square metre, with a minimum value of 10 m^{-2} in any one sub-quadrat.

Data used to develop these values are given in Attachment 1.

3.3 Interim Criteria

Results from monitoring the Allied Eneabba SE Factorial Experiment suggest that rates of increase in species richness and abundance tend to taper off after three to four years whereas cover continues to increase (Figure 1). It would not be appropriate to provide interim values for observations before three years even though it may be possible to do so using Figure 1.

The following mean values are for observations made at around 3.3 years; values are those that, with the passage of time should eventually lead to attainment of the completion criteria.

Species richness: 55 species per 100 m^2 quadrat

Per cent total canopy cover: 20 per cent per quadrat

Abundance: 35-40 individuals per square metre

ATTACHMENT 1 BASE DATA

1. DATA ON SPECIES RICHNESS

A great variety of species richness data have been assembled for communities of native plants in the Eneabba region; these are included in accounts by George et al. (1979). Griffin and Hopkins (1982), Griffin et al. (1983), Hopkins and Hnatiuk Hnatiuk (1981) and in unpublished reports from the mining companies. Many different sample sizes are involved but it is possible to standardise values to some extent by drawing appropriate species-area curves. A typical curve is given in Figure 2.

The data show a substantial variation in richness over the range of communities sampled in the Eneabba region. This variability is particularly well illustrated in Figure 11 of Hopkins and Hnatiuk (1981): richness values for of c. 0.1 ha range from 13 in a wetland site to 129 at a site transitional between Banksia/Xylomelum shrubland, Eucalyptus todtiana woodland and a swale heath. However, because the mining has the effect of reducing the natural variability in soils and topography, it is proposed that a single average value should be adopted to provide a rehabilitation standard. The value chosen, and that illustrated in Figure 2, is 100 species in 0.1 ha. This curve gives a value of about 76 species for 100 m^2 and about 55 species for 20 m^2. Note that the best treatment in the Allied Eneabba SE Factorial Experiments fresh topsoil with cut brush applied, has a mean value of 52.7 for 20 m^2 quadrats in 1983.

2. DATA ON ABUNDANCE

There are few data on abundance for Eneabba. Lamont (1976) includes six figures showing spatial distribution of plants in 2 m^2 quadrats: these show between 34 and 73 individuals in quadrats ($\bar{x}$ = 57.5). The figures do not include any geophytic species (e.g. Drosera erythrorrhiza, orchids, Haemodorum spp.); species that were most likely to have been present in quadrats but that may have been in a dormant phase at the time of sampling. Thus Lamont figures probably represent an underestimate of real abundance.

Some of the other data are available from a low closed heath near Albany (rainfall c. 800 mm per annum) regenerating after fire (AJMH unpubl.); these are included merely as a guide. Seedlings and resprouting individuals were present in quadrats. For the few quadrats tallied here, total abundances ranged from 176 to 280 total plants m^{-2} including between 60-70 seedlings m^{-2} three years after fire.

A value of 30 plants m^{-2} would appear to represent an average abundance for the Eneabba heathlands.

3. DATA ON COVER

As discussed in detail in MacDonald et al. (1984), estimates of cover vary considerably from observer to observer. It may

be necessary to develop a standardised sampling method to minimise observer error in this case - a line intercept method would probably be simplest.

The main vegetation types recognised by Hopkins and Hnatiuk (1981) using photo-interpretation were in the open cover category: 30-70 per cent foliage projective cover. Values for FPC are generally lower than those for Canopy Cover for the same piece of vegetation.

As an alternative measure, Hopkins and Hnatiuk (1981) estimated per cent bare ground in all the 4 x 4 m quadrats sampled in that survey. For the 169 samples tallied ranging from 50 per cent bare ground to five per cent bare ground, the average value was 21.3. It has already been suggested that a useful surrogate for canopy cover is 100- per cent bare ground; this would indicate average canopy cover values of 78 per cent.

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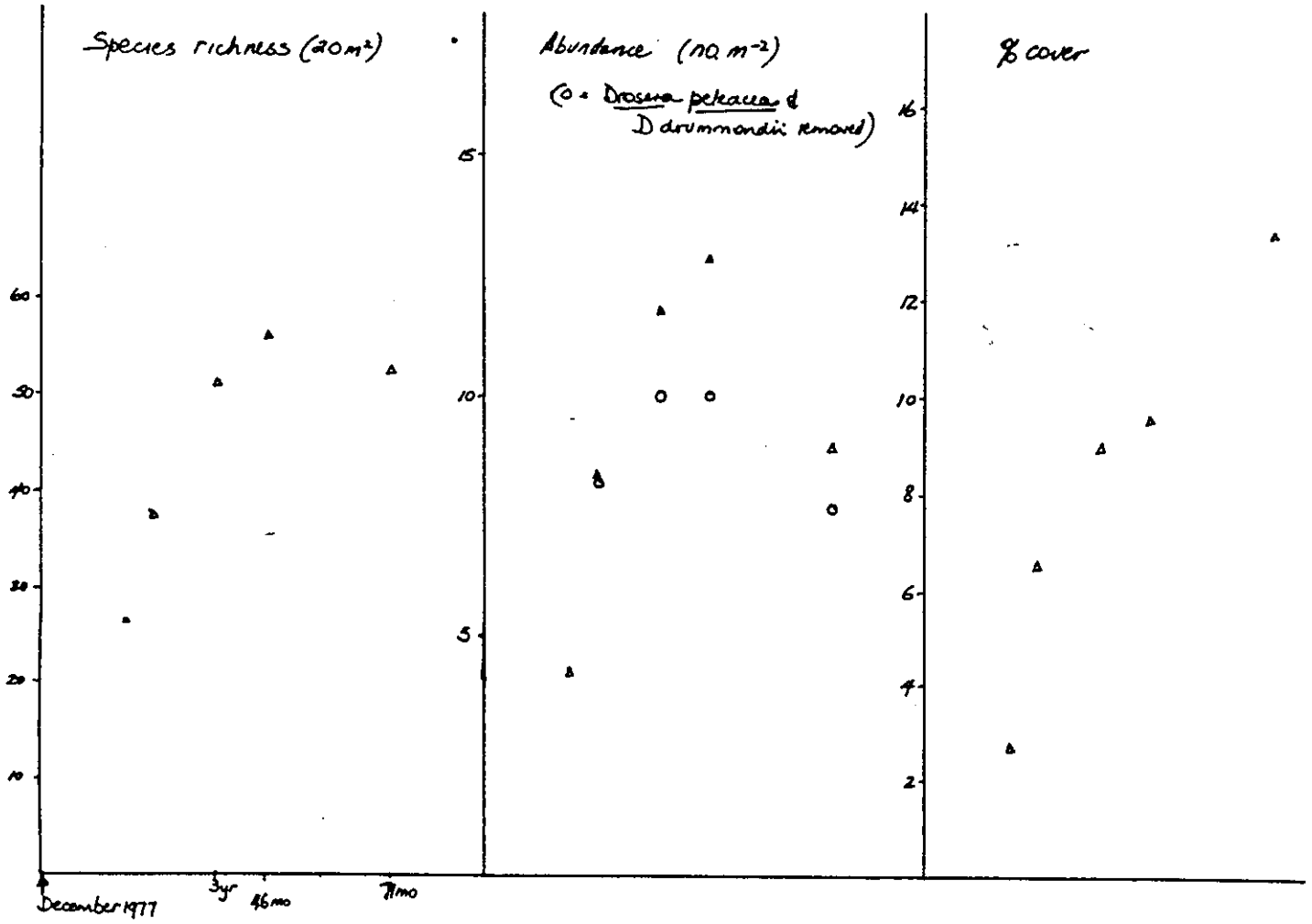
Figure 1



ALLIED ENERGY SE FACTORIAL STUDY Block B4 Best Treatment (fresh topsoil + brush)

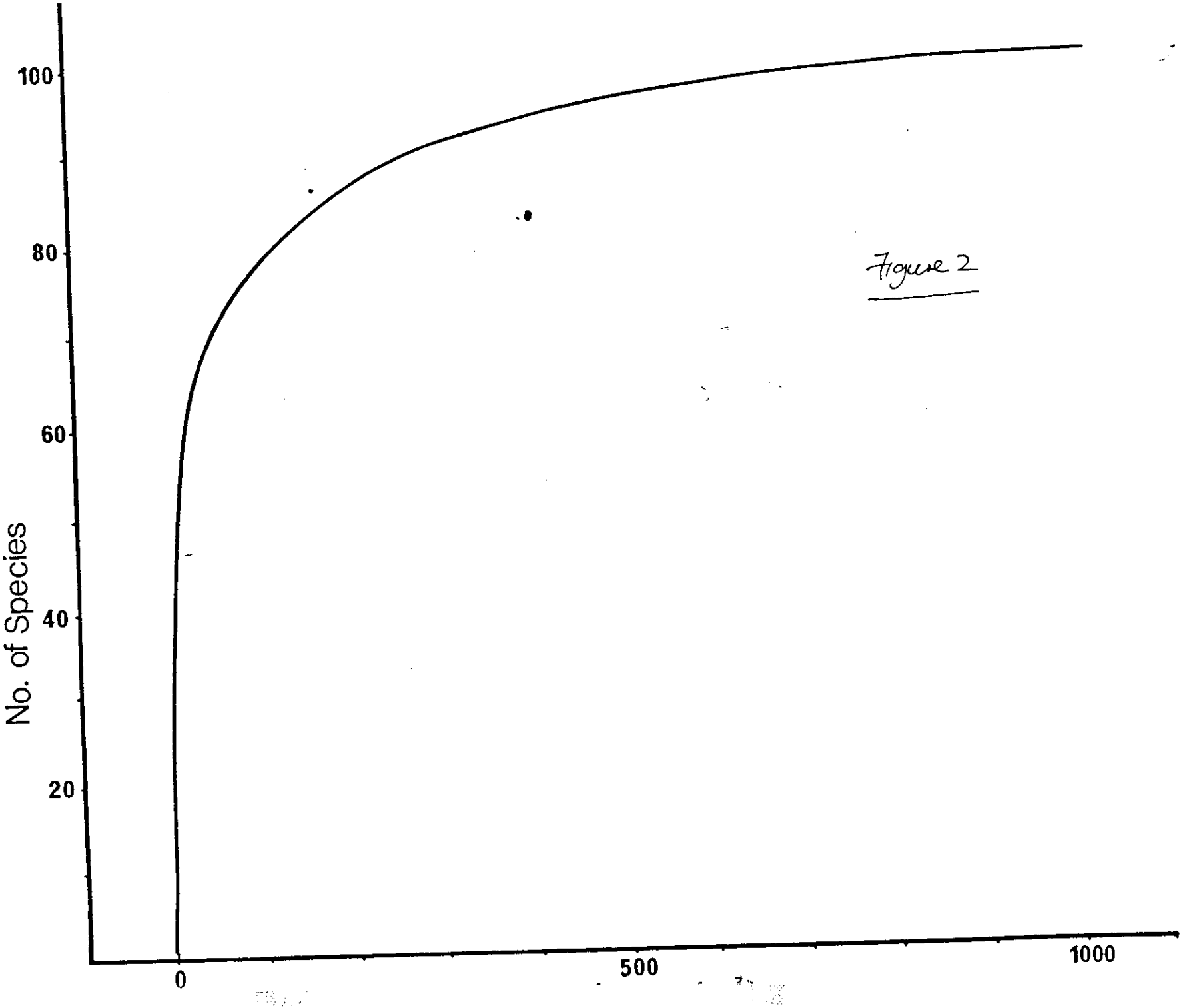


Figure 2