Mr J.J.Havel,
Forests Department,
54 Barrack St.,
Perth, W.A. 6000.

April 21st, 1980.

Dear Mr Havel,

Please find attached the revised report on "Monitoring the Effects of Groundwater Extraction on Native Vegetation on the Northern Swan Coastal Plain". I have not included aerial photos for Lake Joondalup and West Gironde transects or the location of transects on Wanneroo 80 in the Forests Department copy.

At the moment I will be in Perth in May- 5th and 9th - prior to flying to Adelaide for A.N.Z.A.A.S. and for carrying out the re-monitoring of my pyric succession study in the Adelaide Hills. If there are any queries re-this report I will probably be at D.C.E. the majority of May 4th working on System 6 queries. Please note the need for access to some equipment of Forests Department, Como for months of September and possibly October. I am looking foward to carrying out the trenching in October. Early in September I will approach the Forests Department re- need for approval of location of the trenching. I am sure the results of this detailed work on the roots will be of interest to the Forests Department.

Yours sincerely,

Libby Mattiske

Dr. E.H.Mattiske,
P.O.Box 44,
Kim Price, W.A. 6751.
Ph 891568(or c/-Mr T. Mattiske 891300).

Introduction

Earlier studies recognised that the soil moisture levels and the degree of leaching were the two main determinants of plant species distribution on the northern Swan Coastal Plain. The withdrawal of underground water from the Gnangara and Wanneroo mounds could lead to changes in soil moisture levels, and consequently the plant communities.

As conservation of flora and fauna is a recognised land use - in 1976 the Forests Department and the Metropolitan Water Supply, Sewerage and Drainage Board (M.W.B.) financed the monitoring program established to study the effect of ground water extraction on the native plant communities of the northern Swan Coastal Plain.

The initial investigation in 1976 involved re-establishing transects used in an earlier study in 1966 by Mr J.J.Havel, and also establishing two additional transects at Lake Jandabup and Lake Joondalup. These earlier results were collected to follow the changes in the native plant communities in response to natural climatic fluctuations (prior to the withdrawal of underground water). As pumping of the Wanneroo mound did not commence until after the results were collected in September, 1976; the findings collected reflected the influence of these fluctuations. These results are presented by Heddle in the Forests Department Bulletin (1980). This report summarizes some of the findings in the spring of 1978 and 1979. The location of the six transects are on the accompanying Wanneroo 80. All transects except West Gironde are some distance from existing pumping bores.

Summary

Results presented by Heddle in the Forests Department Bulletin illustrate a clear difference in response to moisture stress at the four transects (West Gironde, South Kendall, Tick Flat and Neaves) where the ten year comparison was possible (1966-1976).

1. In 1978 and 1979 these differences were not as marked; with similar responses becoming evident at all four transects.
2. The response of plants to water stress at all four transects would support the idea that the stress is mainly due to the exceptional series of below average rainfall years.
3. The degree of changes in the plant communities is expected to further increase in 1980 as many of the plants in 1979 were unhealthy (severe loss of leaves) and on the point of dying.
4. This lag in response at the latter three transects (S.K., T.F., N.) appears to be related to the "age" of the plant community ; as defined in relation to the last advent of fire (i.e. the greater the number of plants and the total biomass - the greater the competition for water).

The difficulty of following the influence of the withdrawal of underground water on the native vegetation depends on the ability to understand those plant communities and their relationship to existing environmental conditions. The recent years of below average rainfall years presents an extreme water stress situation (based on the rainfall data available for Perth). As such this experiment provides valuable information for understanding the plant communities.

Summary(cont.)

The difficulty of separating the changes resulting from natural and man-made(pumping) at this stage in the monitoring only re-inforces the need to continue the monitoring on the six transects. Further it would be desirable to expand the monitoring and experimental work. As already discussed this could be in part done by the services of Dr.E.M.Mattiske(nee Heddle)-see attached proposal and costing for 1980;and in part by detailed work of Mr J.Dodd. The latter would expand and investigate detail which time did not allow Dr Mattiske to follow during employment with the Forests Department,and as such would be invaluable to the M.W.B..

Recommendations and Future Needs

1.‡ The security of West Gironde and Lake Joondalup need urgent attention - see Urgent Needs on front page.
2. The soil moisture levels will need to be collected in 1980(and possibly annually in future years).
3. The vegetation on the six transects will need to be monitored in 1980(and possibly future years).
4. The trenching program discussed with Mr Caldwell and Mr Pollett will need to be carried out in 1980.
5. The detailed work proposed and currently being discussed with J.Dodd be supported.

‡ The security of the other four transects is relatively protected as they occur on either Fisheries' and Wildlife reserves,National Parks or State Forest.

Needs in 1980 and Costs

As discussed with Mr Caldwell the soil moisture and vegetation monitoring should be carried out in September-October,1980. The following is an estimate of costs involved.

I/ 20 field days for vegetation and soil moisture monitoring by Dr.E.M.Mattiske.
15 field days for trenching program-following the root structures in relation to water table.
15 days writing up results and report for M.W.B..
Total of 50 days of Dr.Mattiske services.

---Costing--

20 days @ $85.00 a day(to cover vehicle costs also).
15 days @ $85.00 a day(to cover vehicle costs also).
15 days @ $70.00 a day.

Total = $4,025.00

II/ Access to the Veihmeyer tubes of the Forests Department ,Como,W.A..

III/Access to the soil tins ,Forests Department, Como,W.A.

IV/Access to the ovens at Como for the purpose of drying the soils,Forests Department,W.A.

V/ A field assistant to help to collect the soil (heavy work of 4-5 days).(M.W.B.to supply.)

VI/Provision of equipment and man-power to assist in trenching(estimate 10 days of trenching, washing roots down etc. and 5 days pre- and post botanical work including selection of site). Equipment and man-power to be supplied by M.W.B..

6/ Timing

I/20 field days on vegetation and soil moisture to be carried out during September and October, 1980.

15 field days on trenching to be carried out in October, 1980.

Final dates of machinery and man-power will be determined closer to dates of work.

II/Access to Forests Department equipment in September -early October.

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Results

General Observations

In the results presented on accompanying tables the health of the plants is indicated for the trees, so the decrease in some plants under-emphasises the degree of stress already apparent in the plant communities. To counteract this decrease in numbers there is in some areas an increase in the numbers of young seedlings and saplings. Observations have also shown the ability of many plants to regenerate from root-stocks with the onset of more favourable moisture conditions (some of the shrubs which were extremely unhealthy -as defined by the number of dead leaves -reacted by the production of new growth after a series of wet days at West Gironde).

7/ Results(cont.)

The soil moisture levels were still low when compared with the results for 1966. In 1979 there was a slight fall in level of the water table at the four transects;when compared with the 1978 results. The soil moisture levels at the four transects differed slightly with falls at Neaves and Tick Flat and rises at West Gironde and South Kendall. The latter results at West Gironde and South Kendall can in part be explained by rainfall prior to the soil collections.

Findings in 1978 and 1979 support the need to continu the monitoring in coming years and to carry out more detailed work on the root structures(where do the roots occur in relation to the water table - to enable one to differentiate between those species dependent on the water table and those dependent on the upper soil moisture levels)and physiology of individual plant species.

The results are summarized briefly in the following pages for the four areas. The additional transects at Lakes Jandabup and Joondalup are currently being reviewed and details will be fowarded in due course. It is hoped that another publication will be forth coming to include these results.

Results(cont.)

South Kendall

Soil Moisture(Fig.1.1)

Water table - slight rise in 1978(compared with 1977)
- slight fall in 1979(compared with 1978)

Soil Moisture Levels

-slight rise in 1978(compared with 1977)
-slight rise‡ in 1979(compared with 1978)
(‡ in part due to rainfall immediately prior to collection of soil)

Tree Species(Table 1.1)

Percentage Frequency

-results for Banksia ilicifolia, B.attenuata, B.menziesii and Nuytsia floribunda of note.

Total Numbers(of stems at breast height)

-increase in M.preissiana numbers
-increase in numbers dying of M.preissiana

-decrease in numbers of B.ilicifolia
-large numbers of saplings of B.ilicifolia

-after initial drop an increase in B.attenuata and B.menziesii. in 1978 and 1979.
-large numbers of saplings of both species.

-slight increase in Nuytsia floribunda

Perennial Plant Species (Table 2.1)

- most species in the (a) and (b) categories changed only slighty

Results (cont.)

South Kendall(cont.)

Perennial Plant Species(cont.)

- decrease in category (c) species; Leucopogon conostephioides, Boronia purdieana and Leucopogon strictus.

- decrease in two of category (d) species; Hibbertia subvaginata and Conostephium pendulum

- increase in Lyginia barbata

Neaves

Soil Moisture(Fig.1.2)

Water table - slight rise in 1978(compared with 1977

- slight fall in 1979(compared with 1978

Soil Moisture Levels

- slight rise in 1978(compared with 1977

- slight fall in 1979(compared with 1978

Tree Species(Table 1.2)

Percentage Frequency

-results for percentage frequency, other than early ones for Banksia littoralis, do not reflect the stress so apparent from the total numbers and dying numbers.

Total Numbers (of stems at breast height)

-category (a) illustrate increase in no. of stems(also seen at S.K.), with significant no. of young saplin of M.preissiana.
No young B.littoralis since 1966.

- category (b) ,E.marginata were mostly dying from insect attack--

Does water stress increase susceptibilityof jarrah to insect attack???

- note increase in young saplings of B.ilicifolia.

- category (c) -increase no. of two species dying. This is

Results(cont.)

Heaves(cont.)

Tree Species(cont.)

Total Numbers

counteracted by an increase in no. of young saplings.

-category (d) little change.

Perennial Plant Species(Table 2.2)

- category (a) further decrease in Regelia ciliata. Slight increase in Leptospermum and Pultenaea.

- category (b) slight decrease in Melaleuca seriata and slight increase in Phlebocarya ciliata

- Category (c) slight increases in Hibbertia helianthemoides, Leucopogon constephioides, Scholtzia involucrata, Oxylobium capitatum, Boronia purdieana, and Leucopogon strictus.

Slight decrease in Jacksonia floribunda.

- category (d) decreases in Hibbertia subvaginata and Lyginia barbata. Increases in remaining three species.

Tick Flat

Soil Moisture(Fig 1.3)

Water table - slight rise in 1978(compared with 1977)

- slight fall in 1979(compared with 1978)

Soil Moisture Levels

-slight rise in 1978(compared with 1977)

-slight fall in 1979(compared with 1978)

Tree Species(Table 1.3)

Percentage Frequency

- category (a) little change.

- category (b) decrease in Banksia ilicifolia and increase in Banksia prionotes

Results(cont.)

Tick Flat(cont.)

Tree Species

Percentage Frequency(cont.)

- category (c) little change.
- category (d) increase in Casuarina fraserana and decrease in Nuytsia floribunda.

Total Numbers(of stems at breast height)

- category (a) decrease in M.preissiana and B.littoralis. Note large no. of dying trees.
- category (b) decrease in no. of B.ilicifolia (large no. of dying trees);increase in B.prionotes (note young saplings).
- Category (c) note large no. of both dying and young saplings for two banksia's.
- category (d) increase in C.fraserana; decrease in N.floribunda and E.todtiana.

Perennial Plant Species(Table 2.3)

- category (a) slight increases in Leptospermum and Regelia in 1978, followed by decreases in 1979. Astarten and Hypocalymma decreased in 1979.
- category (b) slight increase in Phlebocarya in 1978;decreases in Xanthorrhoea and Phlebocarya in 1979.
- category (c) Leucopogon decreased in percentage frequency.
- category (d) decreases in Hibbertia subvaginata and Bossiaea eriocarpa. Slight changes in other species.

Results(cont.)

West Gironde

Soil Moisture(Fig. 1.4)

Water table - rise in 1978(compared with 1977)
- fall in 1979(compared with 1978)

Soil Moisture Levels
- rise in 1978(compared with 1977)
- rise in 1979‡(compared with 1978)

(‡in part due to rainfall immediately prior to soil collection)

Tree Species(Table 1.4)

Percentage Frequency

- category (a) B.littoralis tree died in 1979.
- category (b) B.ilicifolia decrease in 1978 and again in 1979.
- category (c) slight increase in B.menziesii in 1979.
- category (d) slight decrease in M.floribunda in 1979.

Total Numbers(of stems at breast height)

- decrease in no. of stems of M.preissiana(category a) B.littoralis died in 1979.
- decrease in B.ilicifolia;note increase in dying trees and increase in saplings.
- slight fall then slight increase in banksia's in category (c). Note both dying trees and saplings
- category (d) decrease in E.todtiana and N.floribunda(1979 only)

Perennial Plant Species(Table 2.4)

- slight increases in several of category (a) plants .
- category (b) slight decreases in all but Dasypogon.
- category (c) slight increases in Beaufortia elegans,Leucopogon conostephioides,Boronia purdieana.

Results(cont.)

West Gironde(cont.)

Perennial Plant Species(cont.)

-category (c) decreases in Conostephium minus, Hibbertia helianthemoides, Oxylobium capitatum, and M. scabra.

- category (d) decreases in Hibbertia subvaginata and Lyginia barbata. Increase in Conostephium pendulum.

Notes - Explanation of Tables 1.1-1.4

Total Numbers = Total number of stems at breast height regardless of condition of health.

Dying Numbers = Number of trees illustrating signs of dying(e.g.loss of leaves).

Sapling numbers = Number of saplings greater than 1.5 m high without defined stem at breast height.

Example; $\frac{5}{25}$ $_{30}$

This shows there are 25 trees, of which 5 are dying; there are 30 young saplings.

Table 1.1

Summary of tree species at South Kendall

Groups(+)	Percentage Frequency				Total Numbers			
	1966	1976	1978	1979	1966	1976	1978	1979
Species tolerant of excessive wetness								
Melaleuca preissiana	35	35	35	35	39^{3}_{-}	47^{2}_{5}	47^{4}_{2}	69^{7}_{-}
Banksia littoralis	-	-	-	-	-	-	-	-
Eucalyptus rudis	-	-	-	-	-	-	-	-
Species of optimum moist sites intolerant of extremes in moisture conditions								
Eucalyptus marginata	26	32	29	29	29^{-}_{-}	30^{1}_{4}	27^{-}_{-}	27^{-}_{-}
Eucalyptus calophylla	15	18	21	21	11^{-}_{-}	16^{1}_{1}	15^{4}_{2}	17^{-}_{3}
Banksia ilicifolia	73	24	53	59	109^{38}_{-}	23^{-}_{50}	44^{2}_{26}	64^{-}_{25}
Banksia prionotes	-	-	-	-	-	-	-	-
Banksia grandis	9	6	6	9	3^{-}_{-}	2^{-}_{-}	2^{-}_{2}	4^{-}_{2}
Species with wide tolerance but with maximum development on dry sites								
Banksia attenuata	79	68	74	74	111^{3}_{46}	80^{5}_{46}	128^{5}_{27}	117^{-}_{31}
Banksia menziesii	68	59	71	65	75^{3}_{-}	75^{-}_{15}	94^{-}_{8}	95^{-}_{18}
Species without clearcut site preference								
Eucalyptus todtiana	6	6	6	6	5^{-}_{-}	5^{-}_{-}	6^{-}_{-}	5^{-}_{-}
Casuarina fraseriana	-	-	-	-	-	-	-	-
Kunzea floribunda	21	21	24	24	11^{-}_{-}	12^{-}_{-}	13^{-}_{-}	14^{-}_{-}

Total Numbers $\frac{\text{Dying Numbers}}{\text{Sapling Numbers}}$

(+Groups as defined by Havel 1968)

Table 2.1

Summary of percentage frequency of perennial plant species for South Kendall

	1966	1976	1978	1979
(a) Species tolerant of excessive wetness				
Patersonia xanthina	-	-	-	-
Hibbertia stellaris	-	-	-	-
Calothamnus lateralis	-	-	-	-
Leptospermum ellipticum	-	-	-	-
Astartea fascicularis	-	-	-	-
Pultenaea reticulata	-	-	-	-
Regelia ciliata	16	1	1	1
Euchilopsis linearis	7	6	7	6
Hypocalymma angustifolium	16	7	6	6
(b) Species of optimum moist sites				
Adenanthos obovatus	-	-	-	-
Melaleuca seriata	31	28	28	28
Dasypogon bromeliaefolius	84	82	84	84
Xanthorrhoea preissii	76	75	75	75
Phlebocarya ciliata	47	38	43	43
(c) Species with maximum development on dry sites				
Beaufortia elegans	-	-	-	-
Conostephium minus	-	-	-	-
Hibbertia helianthemoides	-	-	-	-
Leucopogon conostephioides	1	7	4	3
Scholtzia involucrata	4	4	4	4
Oxylobium capitatum	-	-	-	-
Boronia purdieana	-	9	3	3
Eremaea pauciflora	-	-	-	-
Melaleuca scabra	-	-	-	-
Jacksonia floribunda	-	-	4	3
Astroloma xerophyllum	-	-	-	-
Leucopogon strictus	-	3	1	1
(d) Species without clearcut site preference				
Hibbertia subvaginata	22	47	43	38
Lyginia barbata	22	54	62	66
Conostephium pendulum	47	49	44	44
Bossiaea eriocarpa	50	51	51	49
Calytrix flavescens	12	4	4	4

Table 1.2

Summary of tree species at Neaves

Groups(+)	Percentage Frequency				Total Numbers			
	1966	1976	1978	1979	1966	1976	1978	1979
(a)Species tolerant of excessive wetness								
Melaleuca preissiana	25	30	30	30	37^{-}_{-}	44^{-}_{33}	58^{-}_{19}	59^{-}_{9}
Banksia littoralis	5	-	-	-	2^{-}_{-}	-	-	-
Eucalyptus rudis	-	-	-	-	-	-	-	-
(b)Species of optimum moist sites intolerant of extremes in moisture conditions								
Eucalyptus marginata	25	30	30	30	13^{-}_{-}	14^{2}_{-}	13^{5}_{-}	12^{9}_{-}
Eucalyptus calophylla	-	-	-	-	-	-	-	-
Banksia ilicifolia	60	60	60	60	37^{-}_{-}	36^{-}_{5}	40^{-}_{13}	39^{1}_{13}
Banksia prionotes	-	-	-	-	-	-	-	-
Banksia grandis	-	-	-	-	-	-	-	-
(c)Species with wide tolerance but with maximum development on dry sites								
Banksia attenuata	80	80	80	80	103^{-}_{-}	108^{-}_{19}	120^{1}_{22}	113^{8}_{22}
Banksia menziesii	70	70	70	70	122^{-}_{-}	142^{-}_{30}	155^{4}_{49}	151^{7}_{47}
(d)Species without clearcut site preference								
Eucalyptus todtiana	20	20	20	20	13^{-}_{-}	12^{-}_{-}	13^{1}_{-}	12^{1}_{-}
Casuarina fraserana	-	-	-	-	-	-	-	-
Nuytsia floribunda	25	30	30	30	10^{-}_{-}	10^{-}_{-}	10^{-}_{-}	10^{-}_{-}

Dying numbers

Total Numbers

Sapling numbers

(+Groups as defined by Havel 1968)

Table 2.2

Summary of percentage frequency of perennial plant species at Neaves

Groups(+)	1966	1976	1978	1979
(a)Species tolerant of excessive wetness				
Patersonia xanthina	5	3	3	3
Hibbertia stellaris	8	8	8	8
Calothamnus lateralis	18	18	18	18
Leptospermum ellipticum	25	25	30	33
Astartea fascicularis	20	18	18	18
Pultenaea reticulata	-	-	3	3
Regelia ciliata	20	25	23	20
Euchilopsis linearis	13	18	18	20
Hypocalymma angustifolium	13	10	10	10
(b)Species of optimum moist sites				
Adenanthos obovatus	25	28	25	28
Melaleuca seriata	18	20	18	18
Dasypogon bomeliaefolius	45	45	45	45
Xanthorrhoea preissii	48	43	43	43
Phlebocarya ciliata	40	38	43	40
(c)Species with maximum development on dry sites				
Beaufortia elegans	50	43	43	43
Conostephium minus	35	28	28	28
Hibbertia helianthemoides	30	18	20	20
Leucopogon conostephioides	53	43	53	53
Scholtzia involucrata	45	25	30	28
Oxylobium capitatum	35	18	23	25
Boronia purdieana	33	20	25	25
Eremaea pauciflora	43	38	38	38
Melaleuca scabra	43	43	45	45
Jacksonia floribunda	50	45	43	43
Astroloma xerophyllum	18	15	15	15
Leucopogon strictus	20	15	18	18
(d)Species without clearcut site preference				
Hibbertia subvaginata	80	83	70	70
Lyginia barbata	58	58	58	53
Conostephium pendulum	63	58	58	63
Bossiaea eriocarpa	58	58	60	60
Calytrix flavescens	45	55	63	63

(+ Groups as defined by Havel 1968)

Table 1.3

Summary of tree species at Tick Flat

Groups(+)	Percentage Frequency				Total Numbers			
	1966	1976	1978	1979	1966	1976	1978	1979
Species tolerant of excessive wetness								
Melaleuca preissiana	17	17	17	17	35^{-}_{-}	54^{-}_{4}	39^{-}_{-}	46^{-}_{-}
Banksia littoralis	25	25	25	25	178^{-}_{-}	193^{16}_{-}	92^{48}_{6}	91^{19}_{5}
Eucalyptus rudis	15	15	17	15	30^{-}_{-}	32^{4}_{-}	44^{7}_{2}	39^{9}_{2}
Species of optimum moist sites intolerant of extremes in moisture conditions								
Eucalyptus marginata	-	-	-	-	-	-	-	-
Eucalyptus calophylla	-	-	-	-	-	-	-	-
Banksia ilicifolia	31	37	35	33	120^{-}_{-}	142^{26}_{22}	127^{16}_{19}	120^{11}_{36}
Banksia prionotes	-	10	17	21	-	8^{-}_{4}	15^{-}_{2}	18^{-}_{2}
Banksia grandis	10	8	10	8	16^{-}_{-}	7^{1}_{-}	9^{-}_{-}	6^{-}_{1}
Species with wide tolerance but with maximum development on dry sites								
Banksia attenuata	65	73	73	73	195^{-}_{-}	361^{23}_{79}	328^{22}_{81}	326^{11}_{74}
Banksia menziesii	31	40	40	42	98^{-}_{-}	152^{4}_{20}	153^{9}_{33}	146^{-}_{32}
)Species without clearcut site preference								
Eucalyptus todtiana	8	10	8	10	7^{-}_{-}	15^{-}_{-}	11^{-}_{-}	10^{-}_{1}
Casuarina fraserana	8	10	17	17	11^{-}_{-}	23^{-}_{-}	25^{-}_{1}	26^{-}_{8}
Nuytsia floribunda	12	21	17	17	8^{-}_{-}	16^{-}_{-}	13^{-}_{1}	13^{-}_{4}

Dying Numbers

Total Numbers

Sapling Numbers

(+Groups as defined by Havel 1968)

Table 2.3

Summary of percentage frequency of perennial plant species for Tick Flat

Groups (+)	1966	1976	1978	1979
(a) Species tolerant of excessive wetness				
Patersonia xanthina	–	–	–	–
Hibbertia stellaris	–	–	–	–
Calothamnus lateralis	–	–	–	–
Leptospermum ellipticum	21	28	29	27
Astartea fascicularis	1	3	2	1
Pultenaea reticulata	–	–	–	–
Regelia ciliata	26	30	32	29
Euchilopsis linearis	–	–	–	–
Hypocalymma angustifolium	6	12	12	10
(b) Species of optimum moist sites				
Adenanthos obovatus	–	–	–	–
Melaleuca seriata	–	–	–	–
Dasypogon bromeliaefolius	–	1	1	1
Xanthorrhoea preissii	17	16	16	14
Phlebocarya ciliata	35	36	38	35
(c) Species with maximum development on dry sites				
Beaufortia elegans	–	–	–	–
Conostephium minus	–	1	2	2
Hibbertia helianthemoides	–	–	–	–
Leucopogon conostephioides	19	21	19	16
Scholtzia involucrata	1	2	2	2
Oxylobium capitatum	–	1	–	–
Boronia purdieana	–	–	–	–
Eremaea pauciflora	3	3	3	3
Melaleuca scabra	–	–	–	–
Jacksonia floribunda	–	–	–	–
Astroloma xerophyllum	–	–	–	–
Leucopogon strictus	–	–	–	–
(d) Species without clearcut site preference				
Hibbertia subvaginata	31	29	29	25
Lyginia barbata	49	39	44	41
Conostephium pendulum	13	11	10	10
Bossiaea eriocarpa	22	22	19	13
Calytrix flavescens	7	2	4	3

(+ Groups as defined by Havel 1968)

Table 1.4

Summary of tree species at West Gironde

Groups+	Percentage Frequency				Total Numbers			
	1966	1976	1978	1979	1966	1976	1978	1979
)Species tolerant of excessive wetness								
Melaleuca preissiana	53	53	53	53	381^{-}	548^{-}_{27}	503^{3}_{38}	487^{-}_{22}
Banksia littoralis	13	-	3	-	4^{-}	-	1^{-}	-
Eucalyptus rudis	-	-	-	-	-	-	-	-
)Species of optimum moist site intolerant of extremes in moisture conditions								
Eucalyptus marginata	-	-	--	-	-	-	-	-
Eucalyptus calophylla	-	-	-	-	-	-	-	-
Banksia ilicifolia	63	50	38	34	122^{-}	66^{2}_{13}	55^{6}_{19}	55^{11}_{24}
Banksia prionotes	-	-	-	-	-	-	-	-
Banksia grandis	-	-	-	-	-	-	-	-
)Species with wide tolerance but with maximum de elopment on dry sites								
Banksia attenuata	78	72	72	72	226^{-}	237^{11}_{41}	233^{16}_{73}	246^{7}_{98}
Banksia menziesii	69	59	59	66	140^{-}	191^{5}_{20}	154^{9}_{52}	157^{1}_{48}
)Species without clearcut site preference								
Eucalyptus todtiana	19	13	13	13	15^{-}	24^{-}	18^{-}	16^{-}
Casuarina fraserana	-	-	-	-	-	-	-	-
Nuytsia floribunda	38	34	34	31	25^{-}	29^{-}_{2}	31^{-}_{2}	25^{-}_{1}

Dying Numbers

Total Numbers

Sapling Numbers

(+Groups as defined by Havel 1968)

Table 2.4

Summary of percentage frequency of perennial plant species at West Gironde

Groups (+)	1966	1976	1978	1979
(a) Species tolerant of excessive wetness				
Patersonia xanthina	2	–	–	–
Hibbertia stellaris	2	–	8	11
Calothamnus lateralis	–	–	–	–
Leptospermum ellipticum	42	28	28	27
Astartea fascicularis	27	8	13	13
Pultenaea reticulata	22	3	3	3
Regelia ciliata	23	14	14	16
Euchilopsis linearis	27	9	11	11
Hypocalymma angustifolium	27	9	11	13
(b) Species of optimum moist sites				
Adenanthos obovatus	19	19	17	19
Melaleuca seriata	20	14	13	13
Dasypogon bromeliaefolius	44	42	44	44
Xanthorrhoea preissii	70	77	73	73
Phlebocarya ciliata	31	36	33	34
(c) Species with maximum development on dry sites				
Beaufortia elegans	48	28	33	31
Conostephium minus	3	6	5	5
Hibbertia helianthemoides	31	41	36	38
Leucopogon conostephioides	45	50	64	67
Scholtzia involucrata	27	22	22	22
Oxylobium capitatum	34	38	31	28
Boronia purdieana	–	2	8	13
Eremaea pauciflora	41	34	36	34
Melaleuca scabra	47	47	47	45
Jacksonia floribunda	44	44	47	47
Astroloma xerophyllum	3	–	–	–
Leucopogon strictus	–	–	–	–
(d) Species without clearcut site preference				
Hibbertia subvaginata	89	98	94	94
Lyginia barbata	17	42	42	39
Conostephium pendulum	33	28	30	30
Bossiaea eriocarpa	34	45	45	45
Calytrix flavescens	31	39	39	39

(+Groups as defined by Havel 1968)

Dear Joe,

Atlas Galley Proof Corrections

Table 3.1. > 30 m

Table 3.2. Synaphea
Type P + H. muscifolia → 0 (not -)

Table 3.3. E. loxophlega
M. rhaphiophylla
Shift in symbols on 10 +? Symbols of 13 + 14

Complex 11 "are D (Plate 3.4), E and W;"
(nb. Plate 3.4 refers to D not E.)
Complex 27 "Ranges" → replace with "Plateau"

Table 3.5 ⊕ Not clear
Complex 45 Synaphea
" 48 Synaphea
" 51 triplinervium
" 58 ? tense of occurs or occur
" 59 ? Table 3.6 // nor bracket?

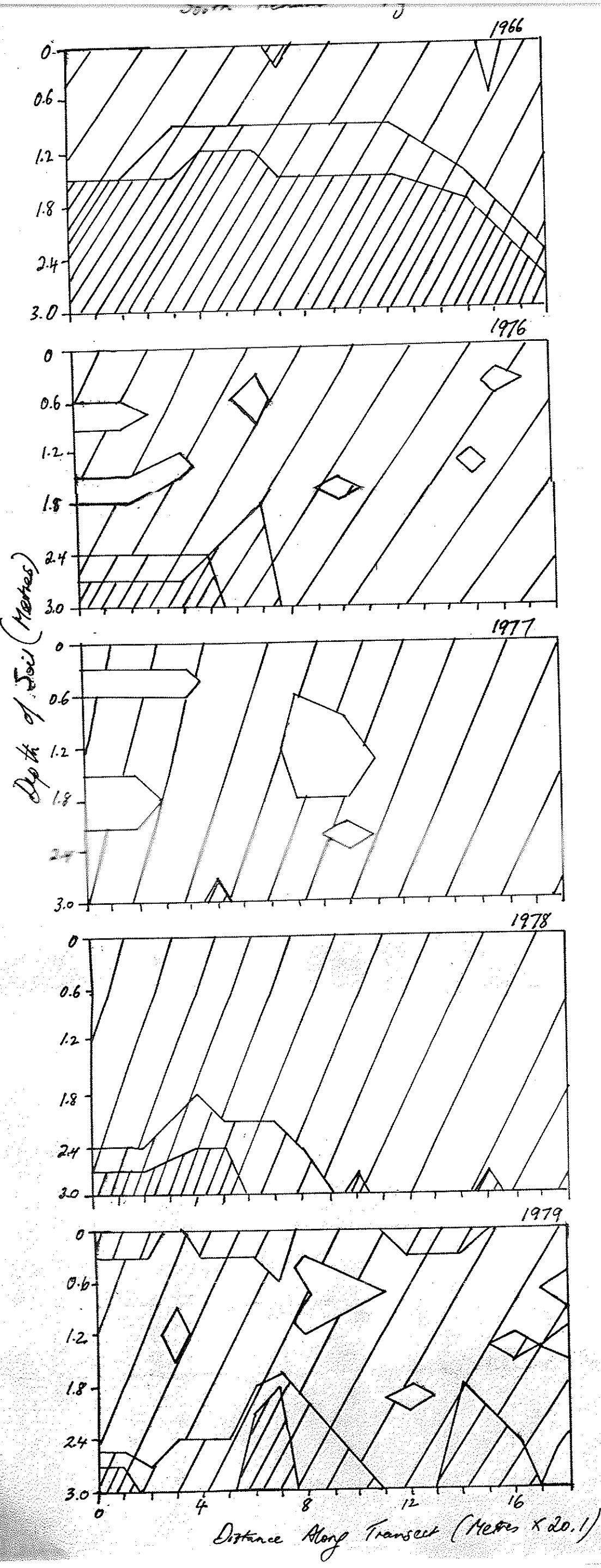
Table 3.6. take out (+) by Unnamed
" " (+ Swamp complex associated with swamps).
(n.b. "Swamp complex" owned by low shrubland of Melaleucas + sedgelands).

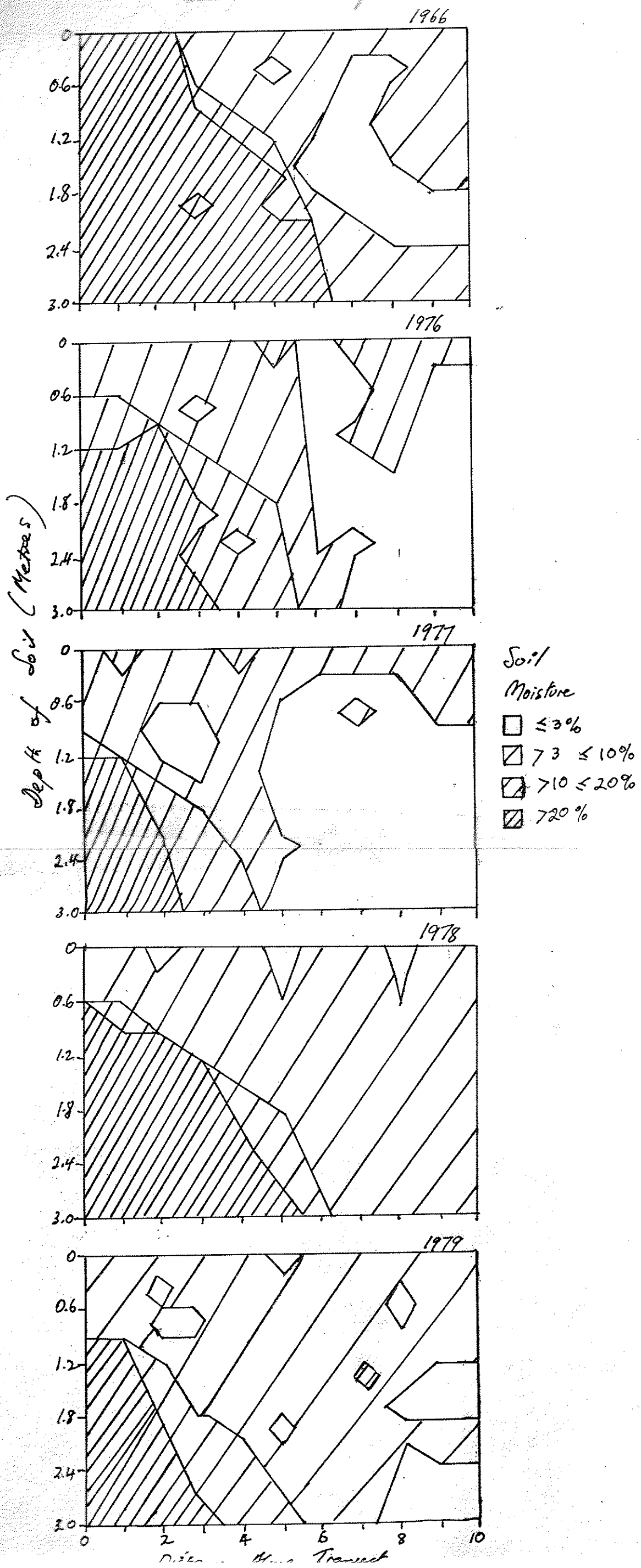
Complex 63 - replace ~~the~~ sentence beginning
"Minor components ...."
with
"A minor component is the sedgelands associated with the areas subject to inundation (Table 3.6)."

Complex 71 no number.

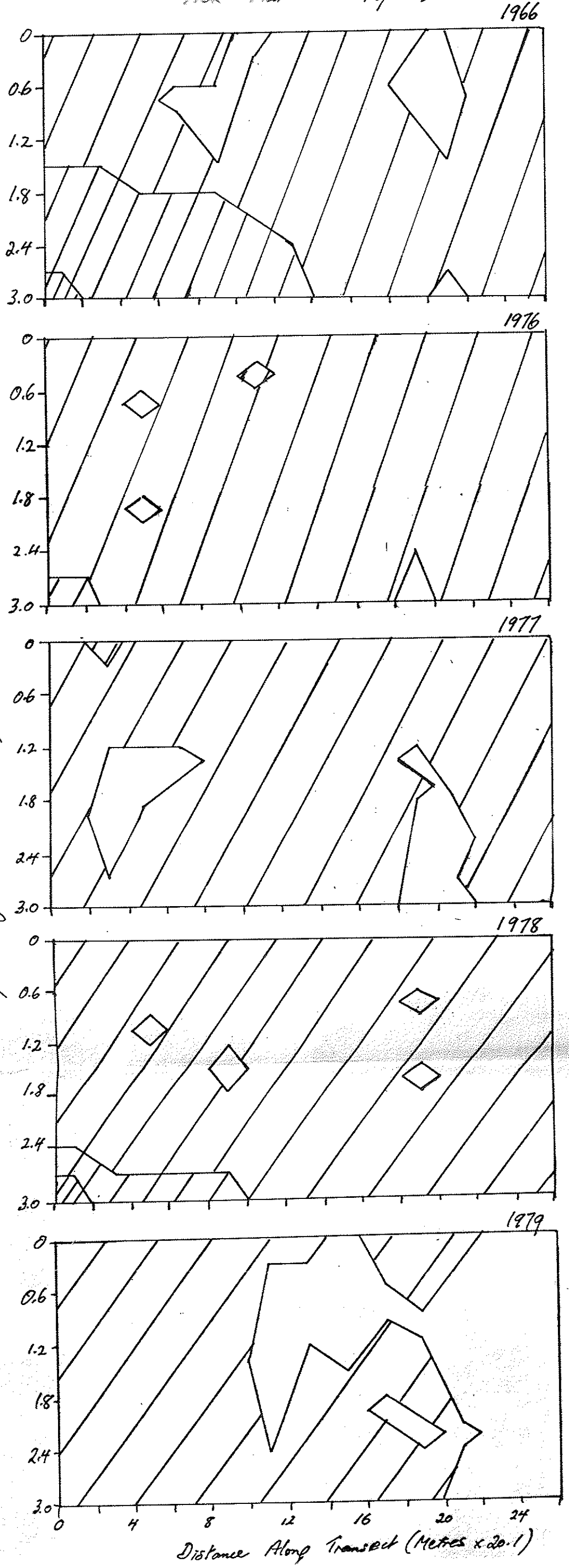
Regards,
Libby M.

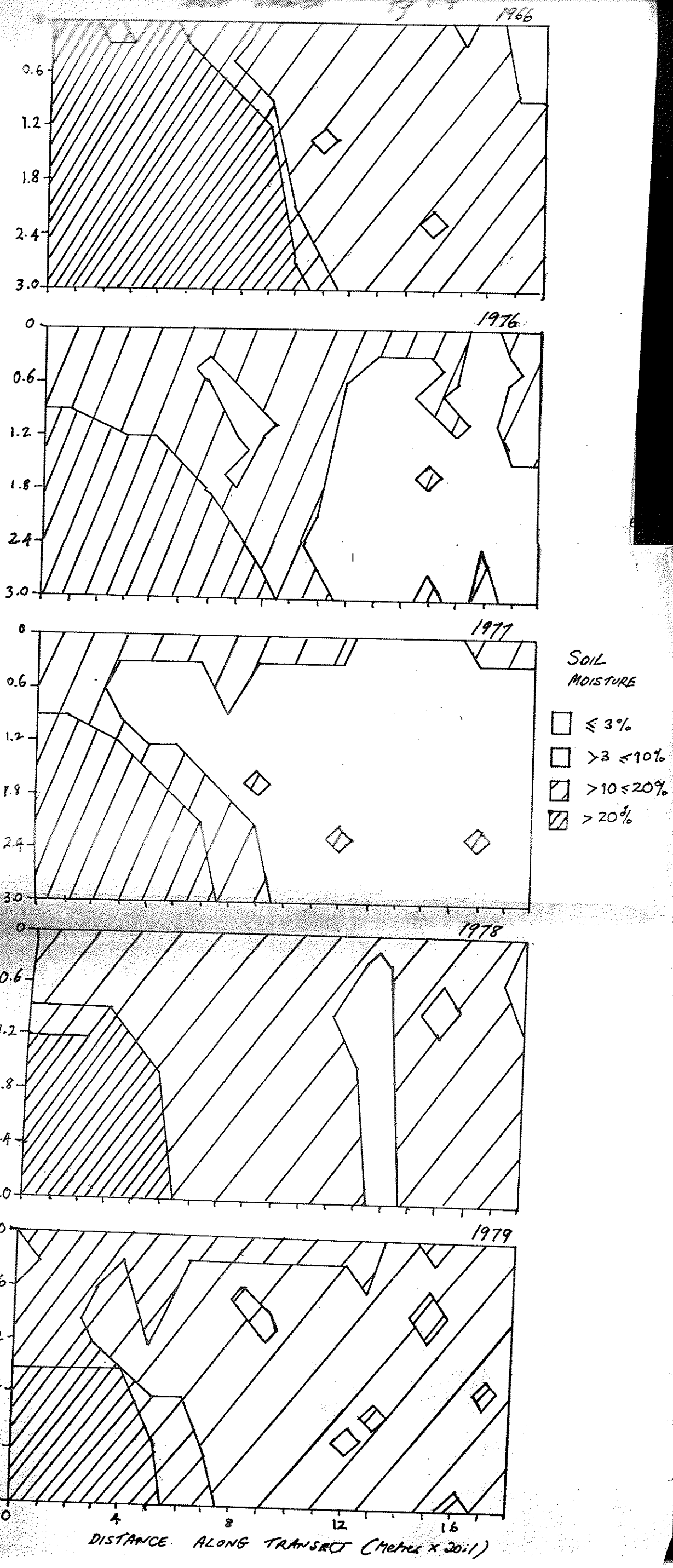
P.S. Sent corrections to B. Stewart + a list as above to O.W.L.


1966
1976
1977
1978
1979
0
0.6
1.2
1.8
2.4
3.0
Depth of Soil (Metres)
Soil Moisture
≤3%
>3%
>10%
>20%
0
4
8
12
16
Distance Along Transect (Metres x 20.1)


1966
1976
1977
1978
1979
0
0.6
1.2
1.8
2.4
3.0
Depth of Soil (Metres)
Soil Moisture
≤ 3%
> 3 ≤ 10%
> 10 ≤ 20%
> 20%
0
2
4
6
8
10
Distance Along Transect

Tick Flat Tq 1-3




1966
0.6
1.2
1.8
2.4
3.0
0
1976
0.6
1.2
1.8
2.4
3.0
0
1977
0.6
1.2
1.8
2.4
3.0
1978
0
0.6
1.2
1.8
2.4
3.0
1979
0
0.6
1.2
1.8
2.4
3.0
0
4
8
12
16
DISTANCE ALONG TRANSECT (Metres x 20:1)
SOIL MOISTURE
≤ 3%
>3 ≤10%
>10 ≤20%
> 20%