SOIL LOSS AND RUN-OFF IN UMFOLOZI GAME RESERVE AND THE IMPLICATIONS FOR GAME RESERVE MANAGEMENT

VOLUME 2

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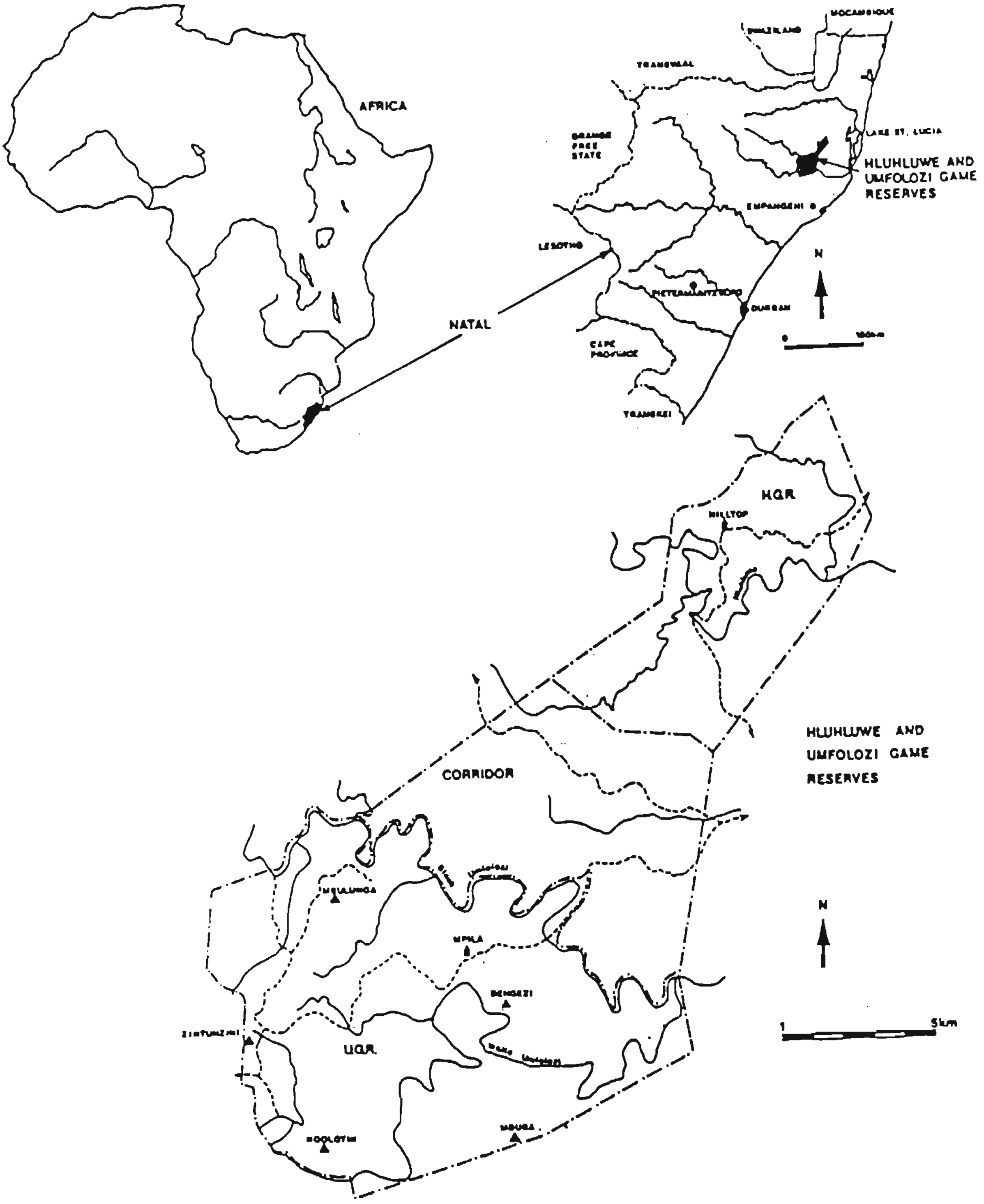

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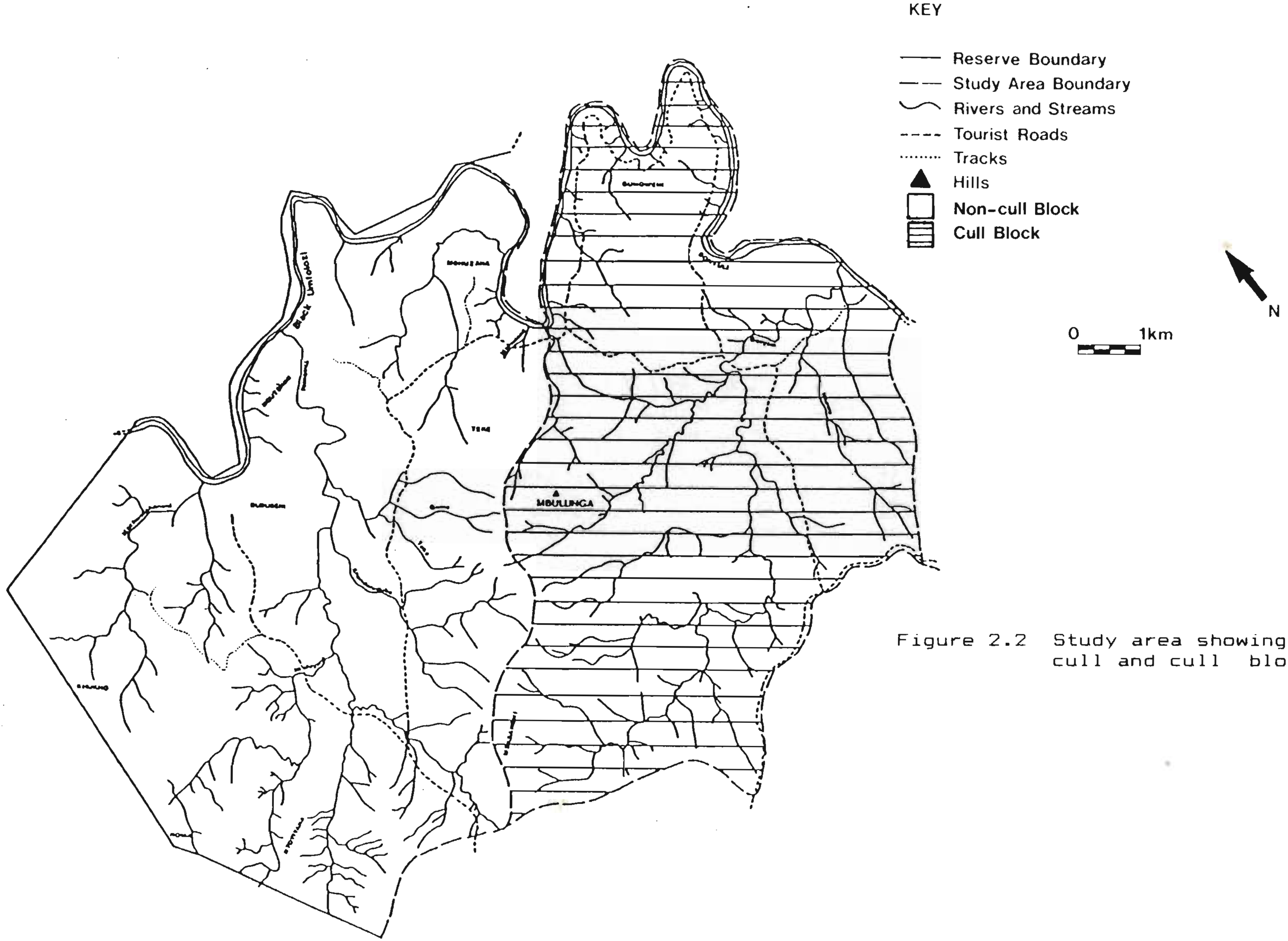

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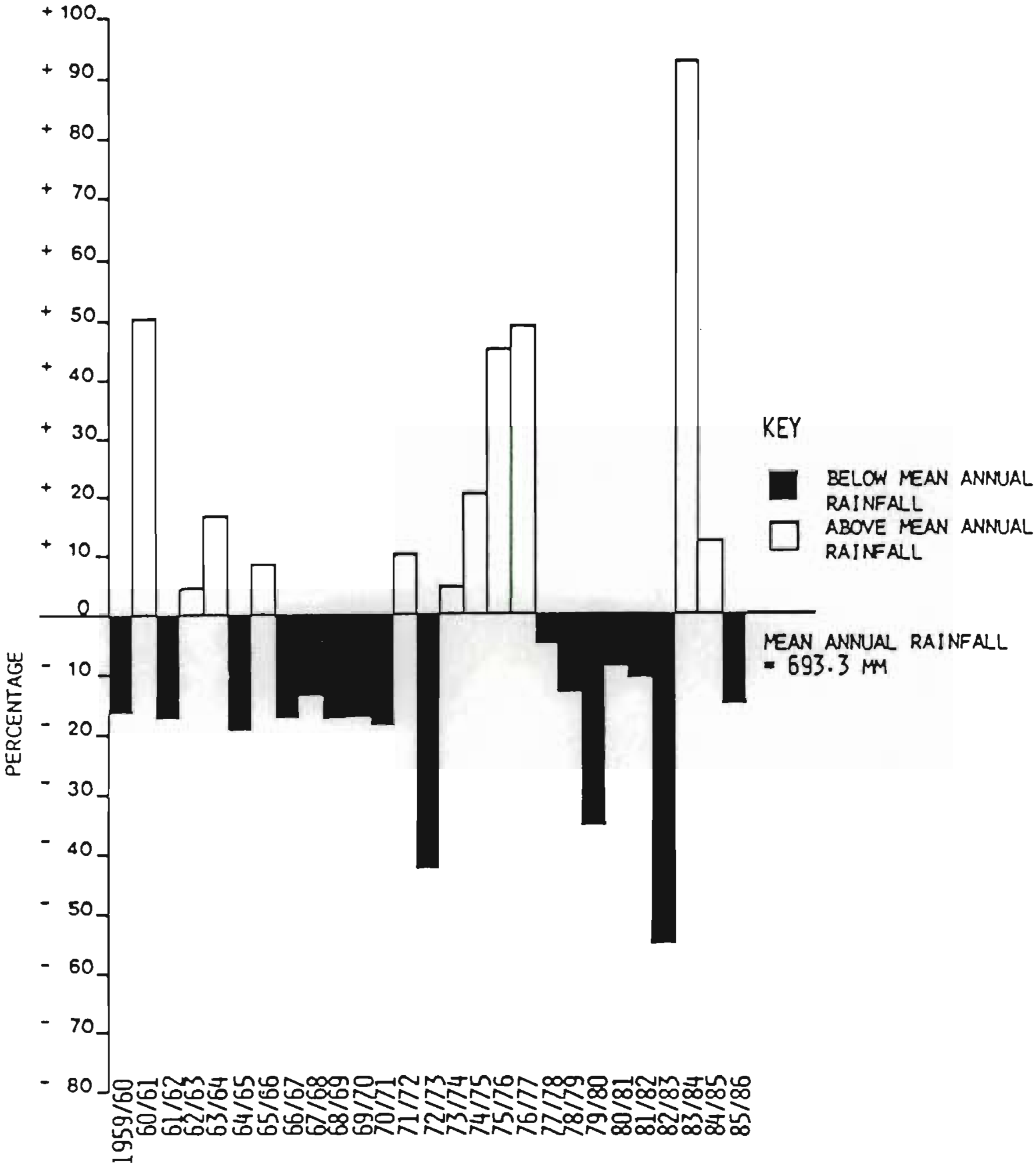

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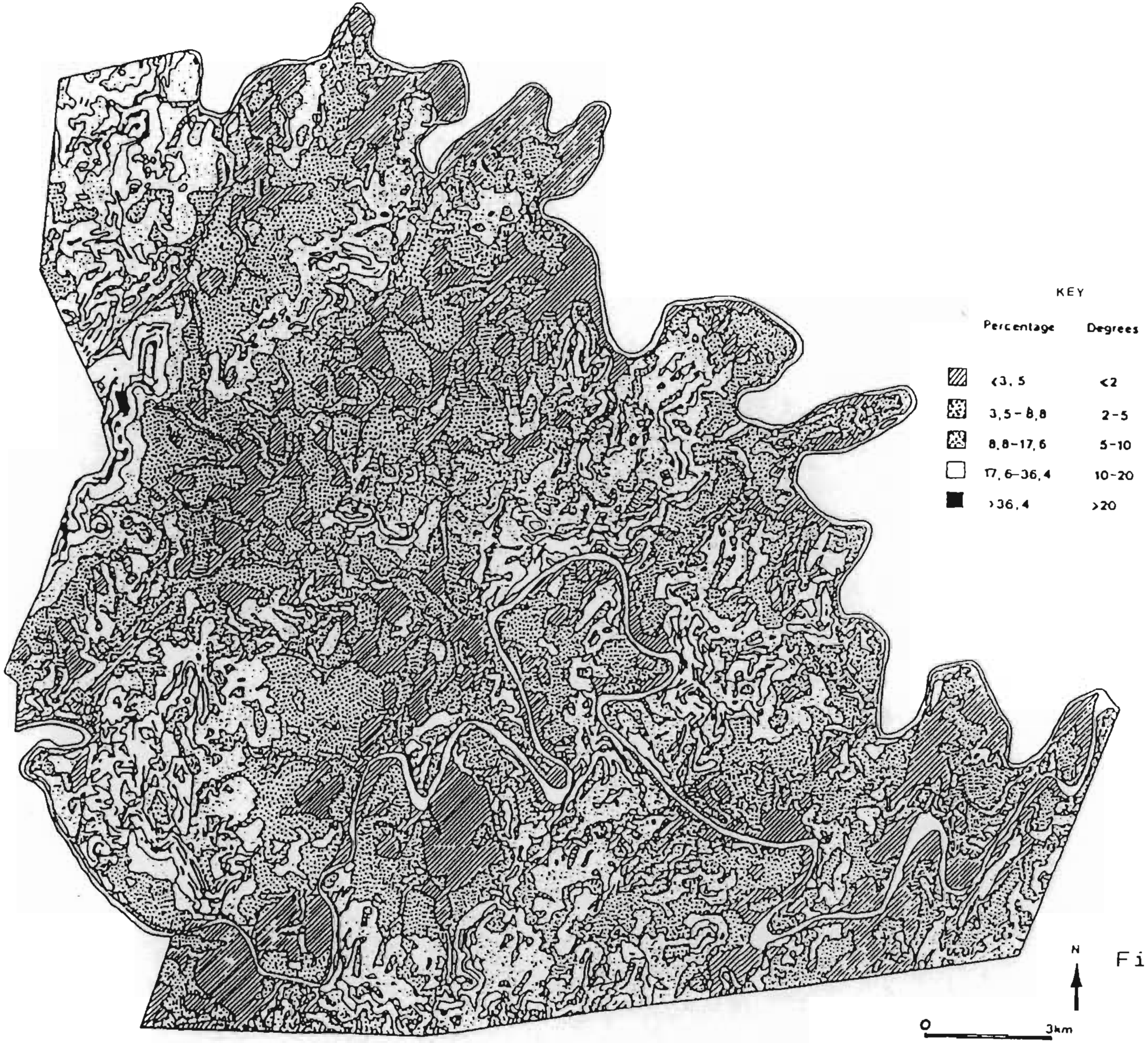

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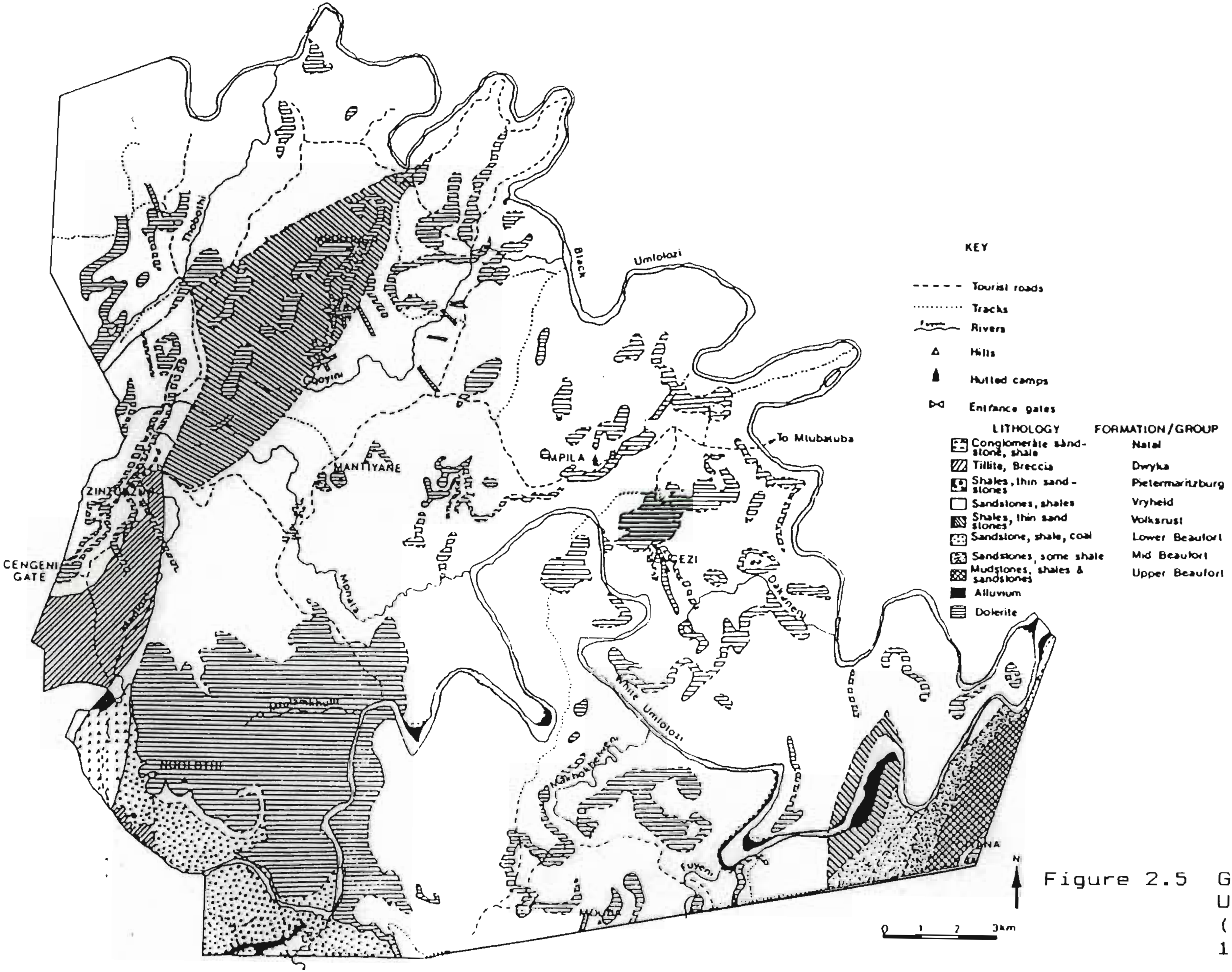

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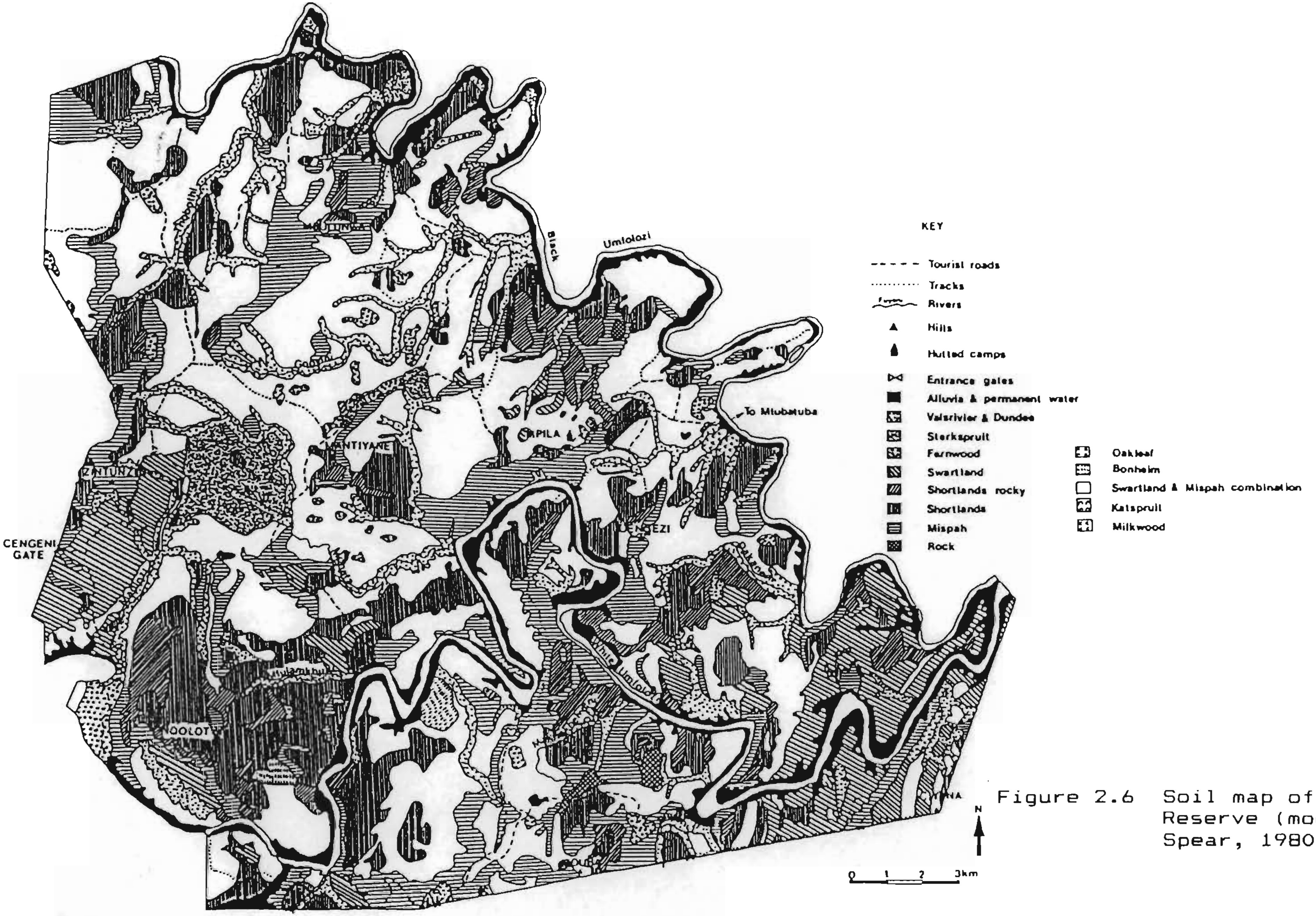

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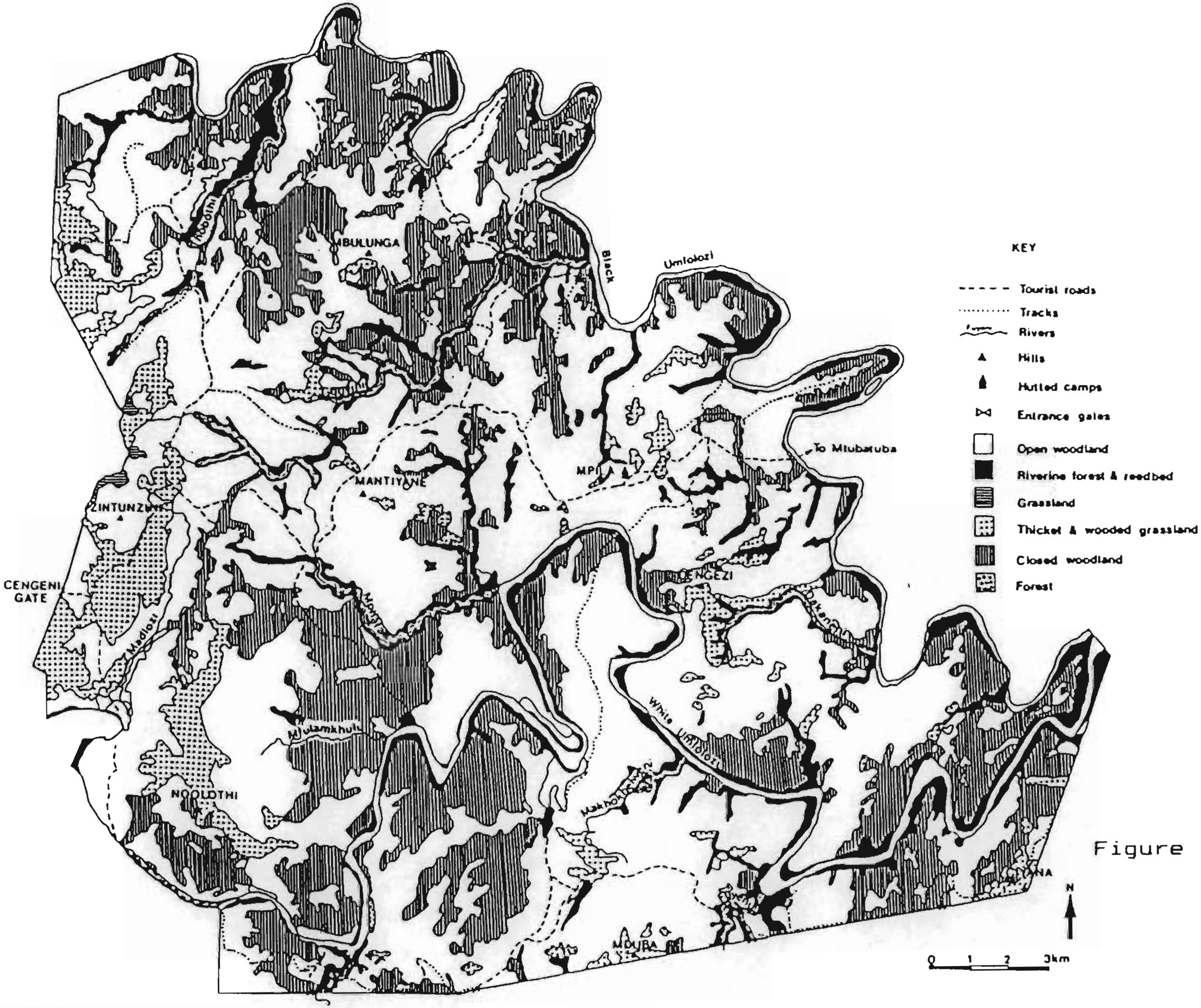

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MONTH	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE
MAXIMUM MEAN	25,3	26,8	26,8	28,4	29,4	30,7	32,6	32,9	29,9	27,6	26,7	25,3
MINIMUM MEAN	13,2	14,8	17,3	18,2	18,5	19,9	21,8	21,6	20,3	17,4	15,7	13,2

Table 2.2 Maximum, minimum and mean monthly rainfall (mm) measured at Mpila from July 1959 to June 1986

MONTH	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE
MAXIMUM	352.5	78.2	172.1	196.8	204.4	302.8	507.3	373.7	222.5	118.6	156.6	86.5
MINIMUM	0	0	6.1	8.5	22.5	14.6	6.1	10.3	0	8.9	0	0
MEAN	25.8	25.7	43.6	78.2	88.5	76.3	101.5	101.0	70.9	43.2	27.9	19.5

Table 2.3 Annual rainfall (mm) measured at Mbhuzana from July 1981 to June 1986

RAINFALL YEAR	ANNUAL RAINFALL (mm)
1981/82	620.4
1982/83	333.1
1983/84	1123.6
1984/85	752.7
1985/86	593.1

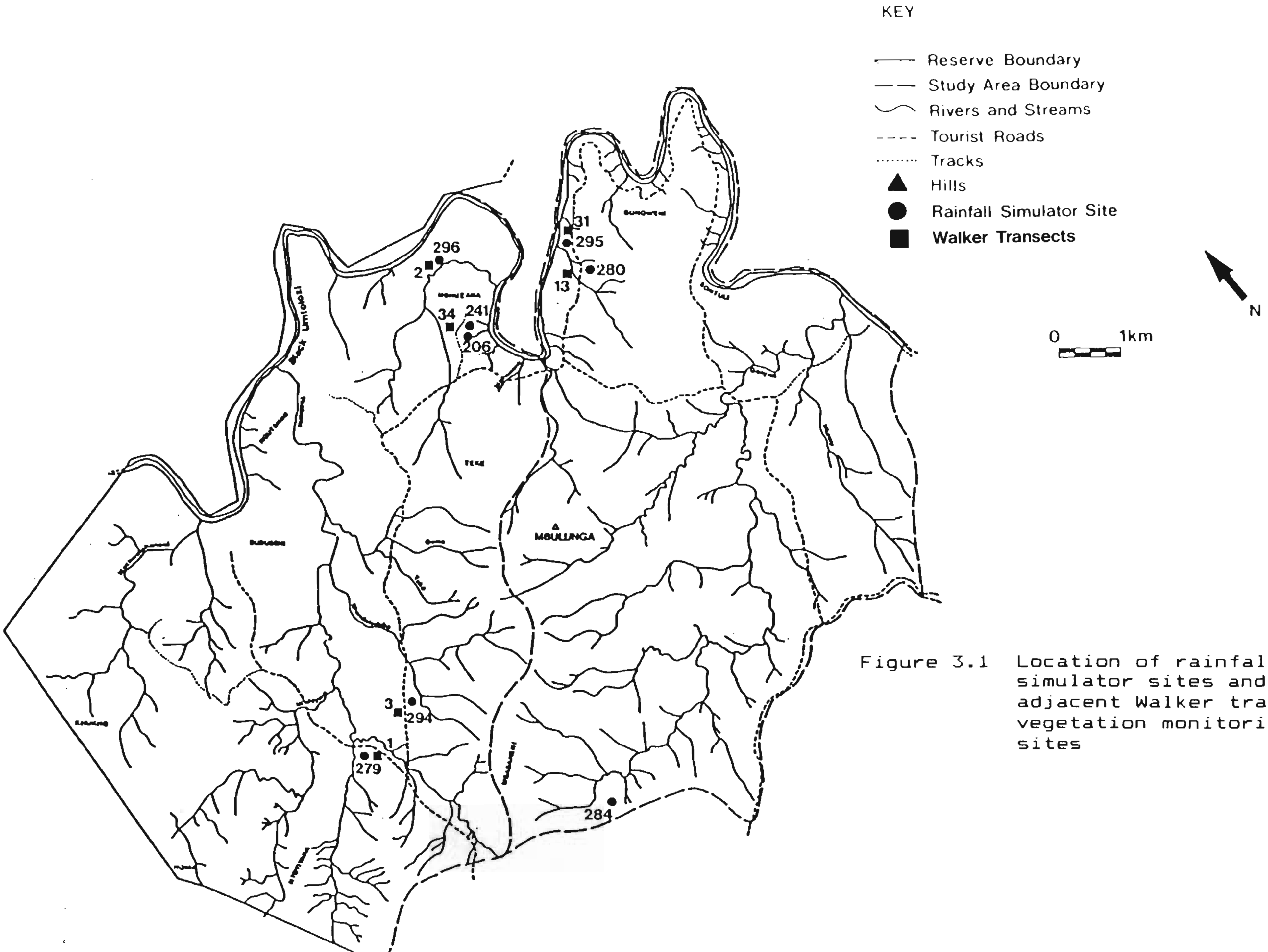
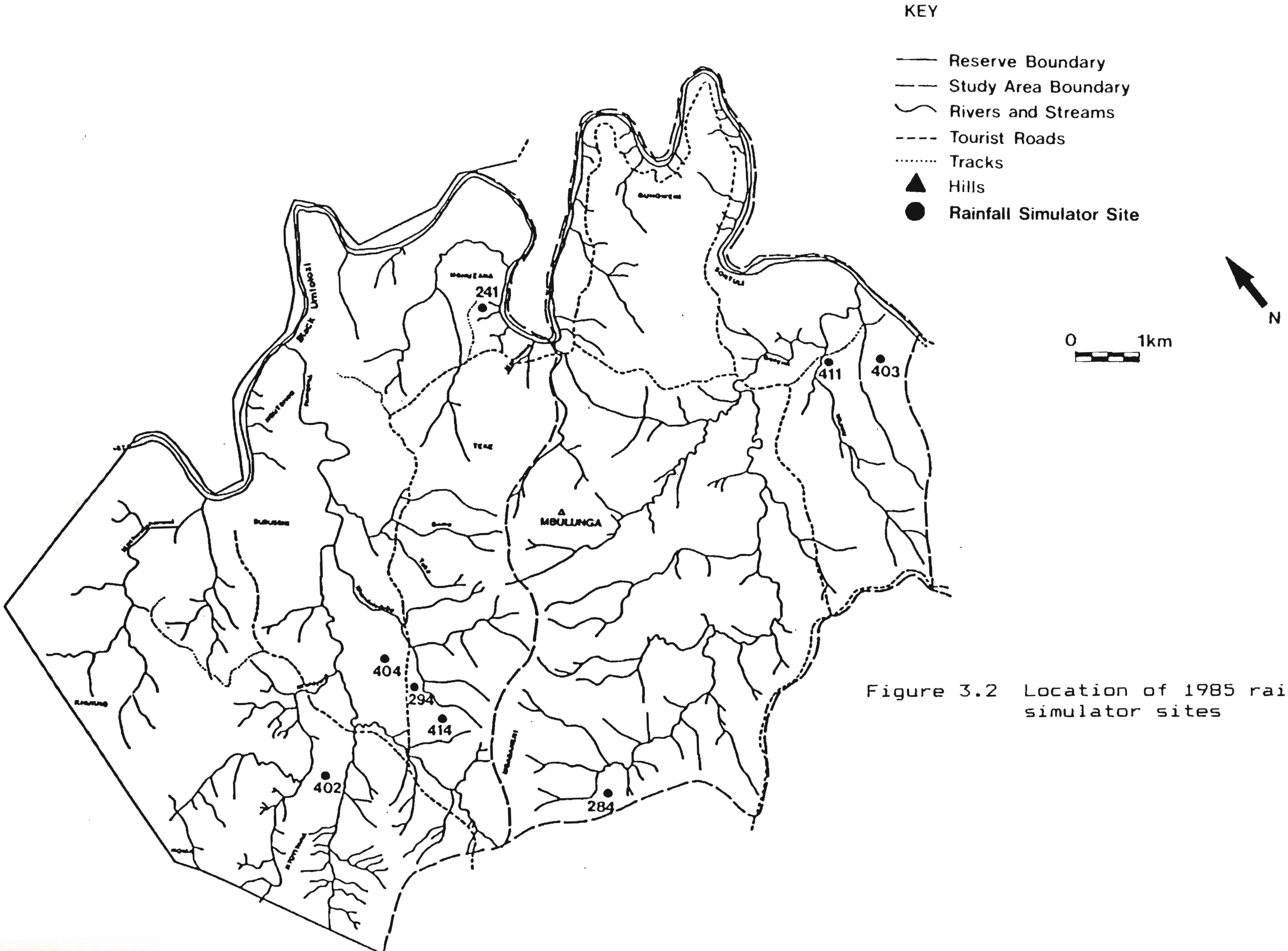


Figure 3.1 Location of rainfall simulator sites and adjacent Walker transect vegetation monitoring sites



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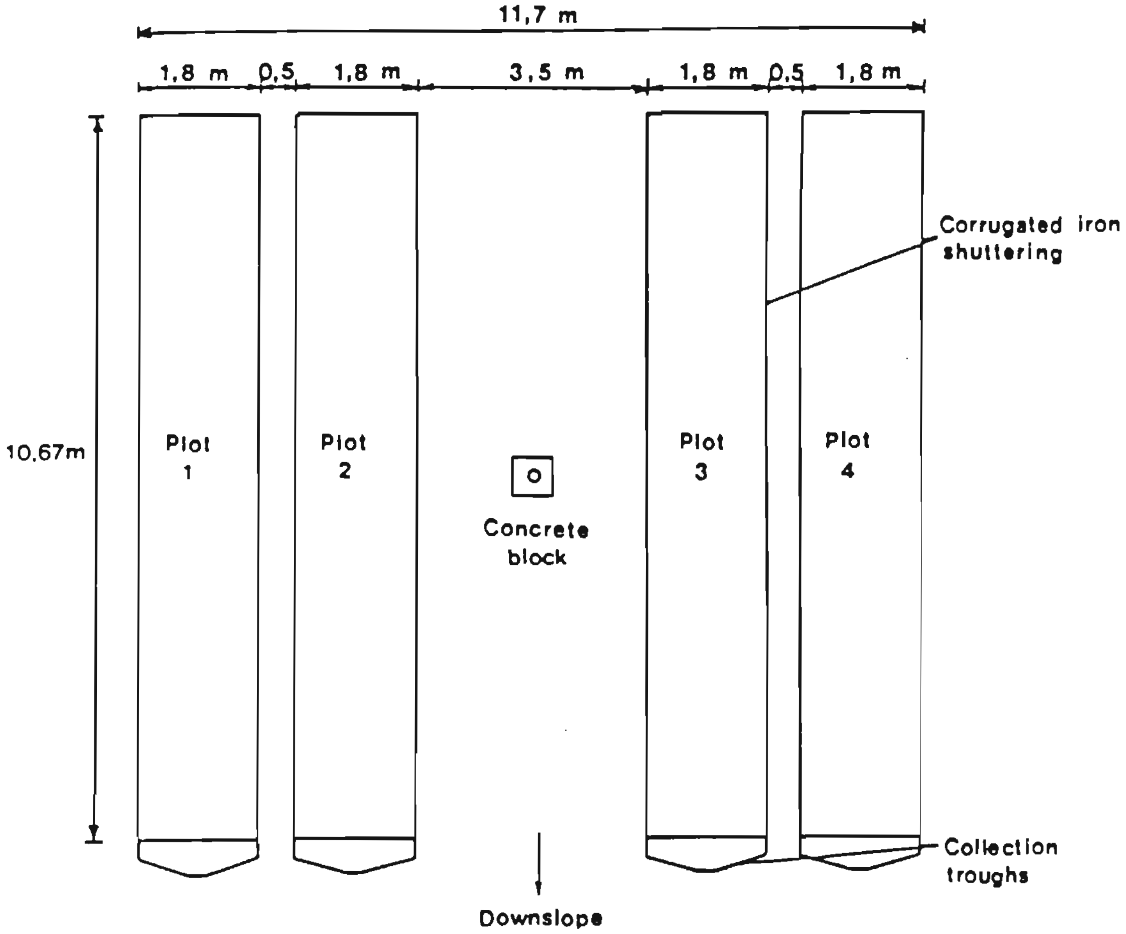

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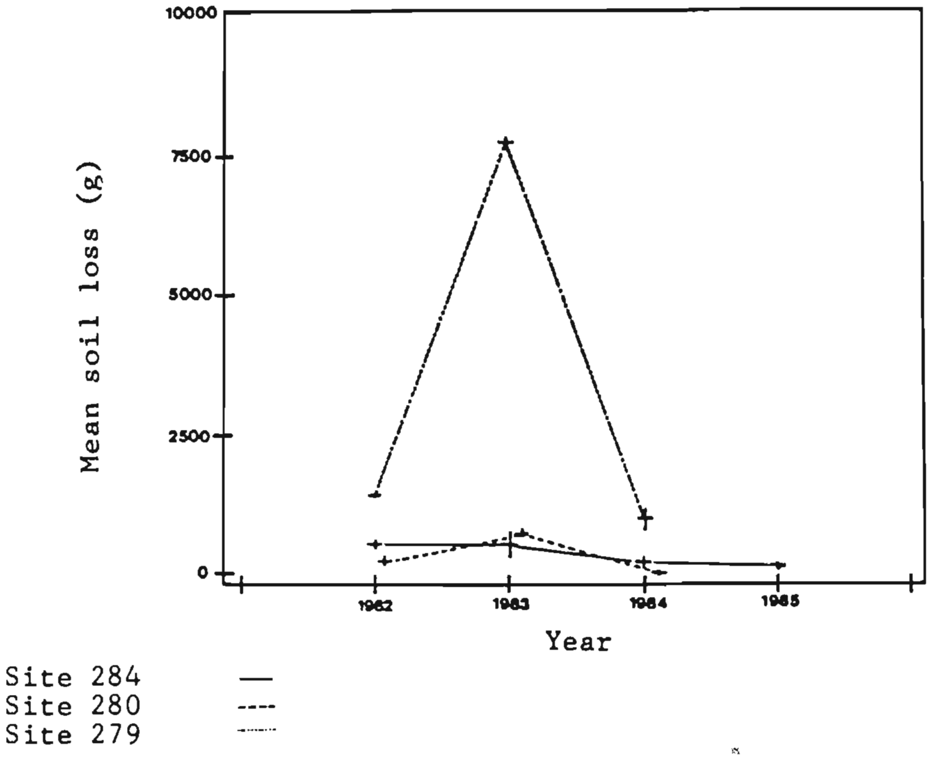

Figure 3.4 Mean soil loss (g) from fixed sites located in *Acacia tortilis* woodland. The mean is depicted by a crossbar and the range by a vertical line

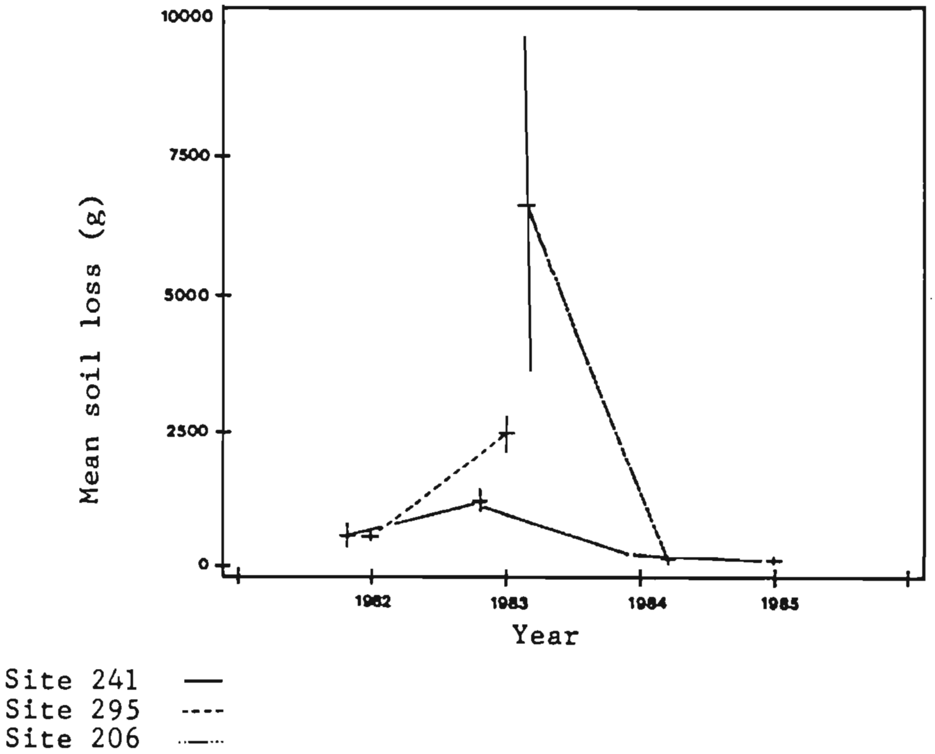

Figure 3.5 Mean soil loss (g) from fixed sites located in *Acacia nigrescens* woodland. The mean is depicted by a crossbar and the range by a vertical line

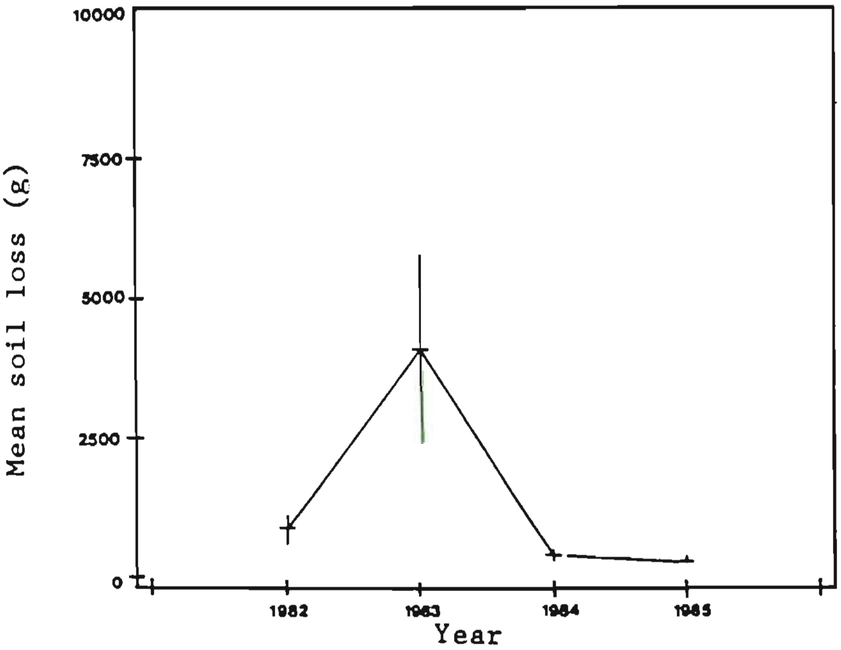

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Figure 3.6 Mean soil loss (g) from a fixed site located in *Acacia nilotica/Acacia gerrardii* woodland. The mean is depicted by a crossbar and the range by a vertical line

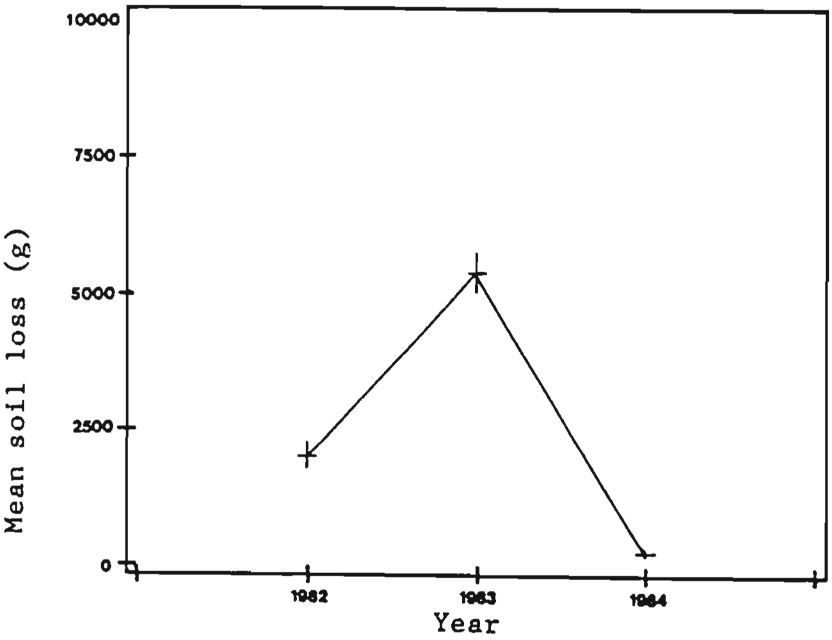

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Figure 3.7 Mean soil loss (g) from a fixed site located in *Spirostachys africana* woodland. The mean is depicted by a crossbar and the range by a vertical line

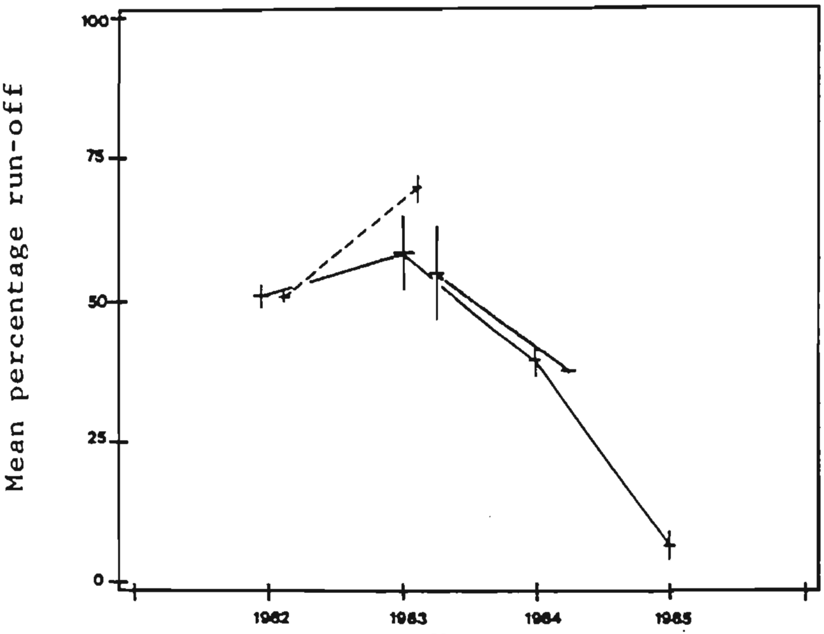

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Figure 3.8 Mean percentage run-off from fixed sites located in *Acacia nigrescens* woodland. The mean is depicted by a crossbar and the range by a vertical line

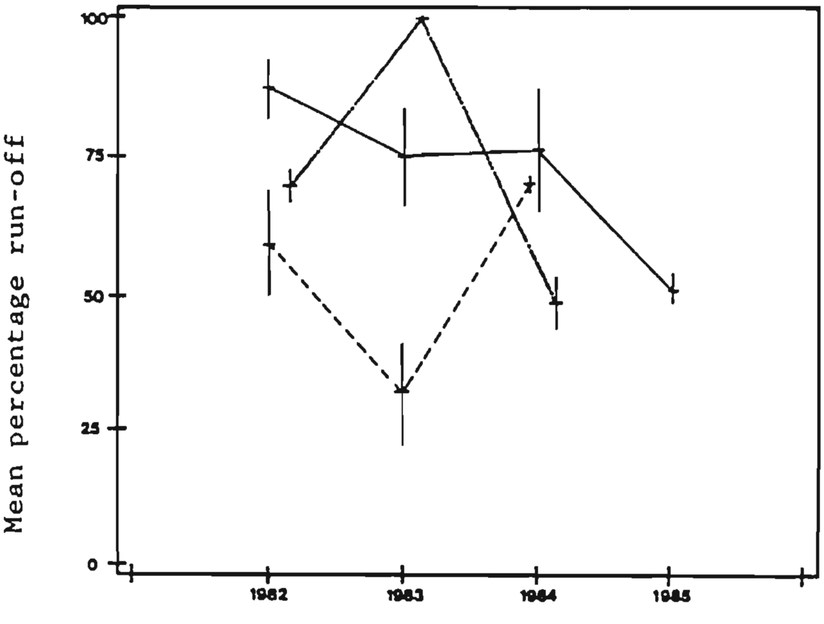

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Figure 3.9 Mean percentage run-off from fixed sites located in *Acacia tortilis* woodland. The mean is depicted by a crossbar and the range by a vertical line

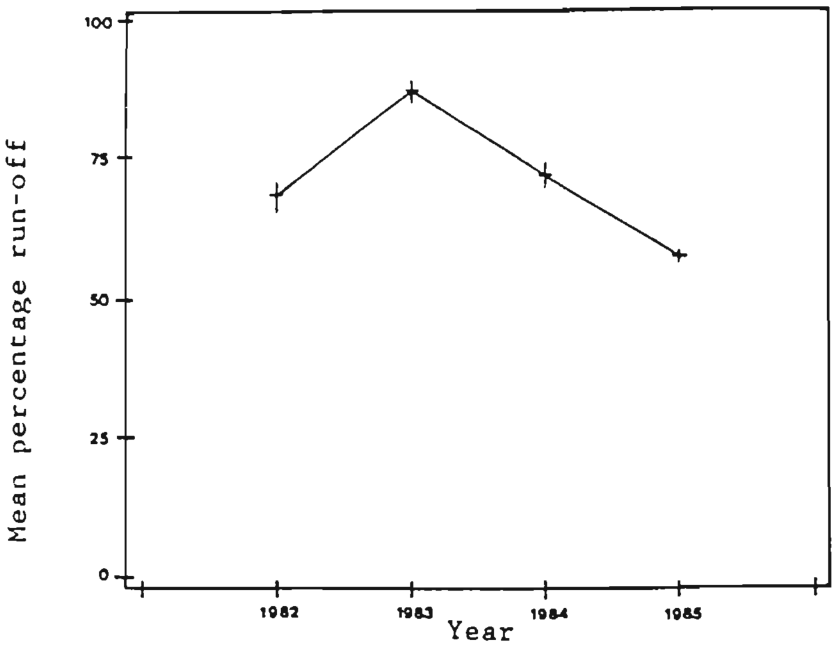

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Figure 3.10 Mean percentage run-off from a fixed site located in *Acacia nilotica/Acacia gerrardii* woodland. The mean is depicted by a crossbar and the range by a vertical line

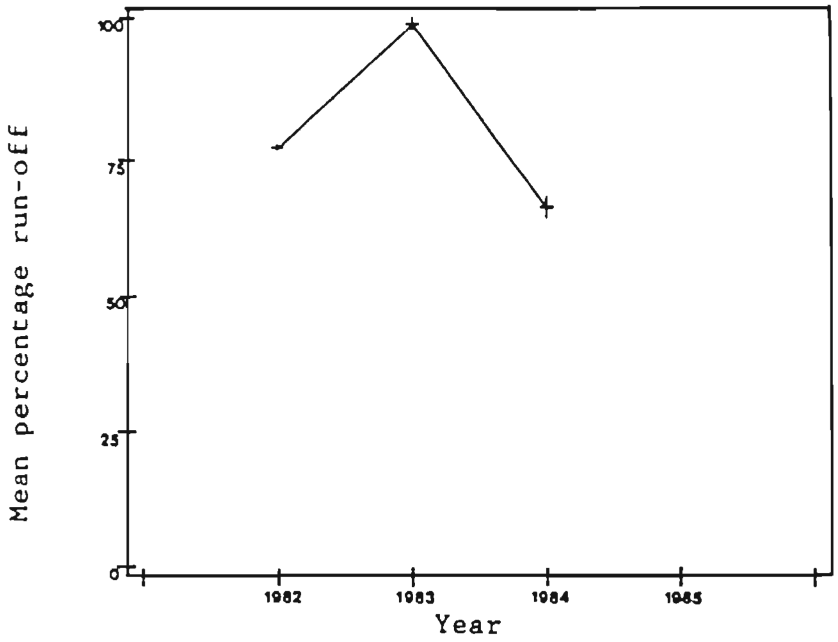

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Figure 3.11 Mean percentage run-off from a fixed site located in *Spirostachys africana* woodland. The mean is depicted by a crossbar and the range by a vertical line

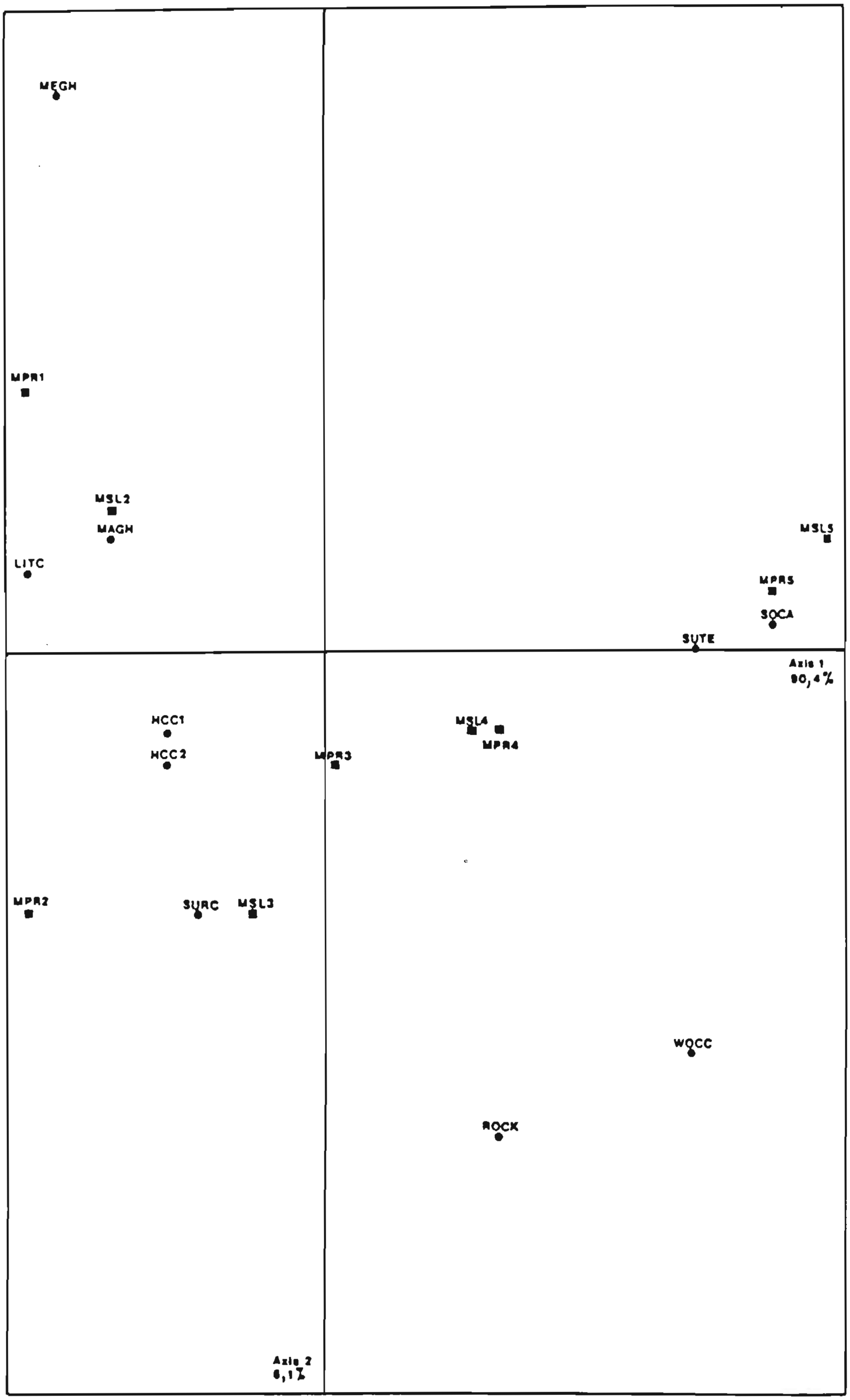

Figure 3.12 Two-dimensional display, obtained by correspondence analysis, of 1983 rainfall simulator trial data

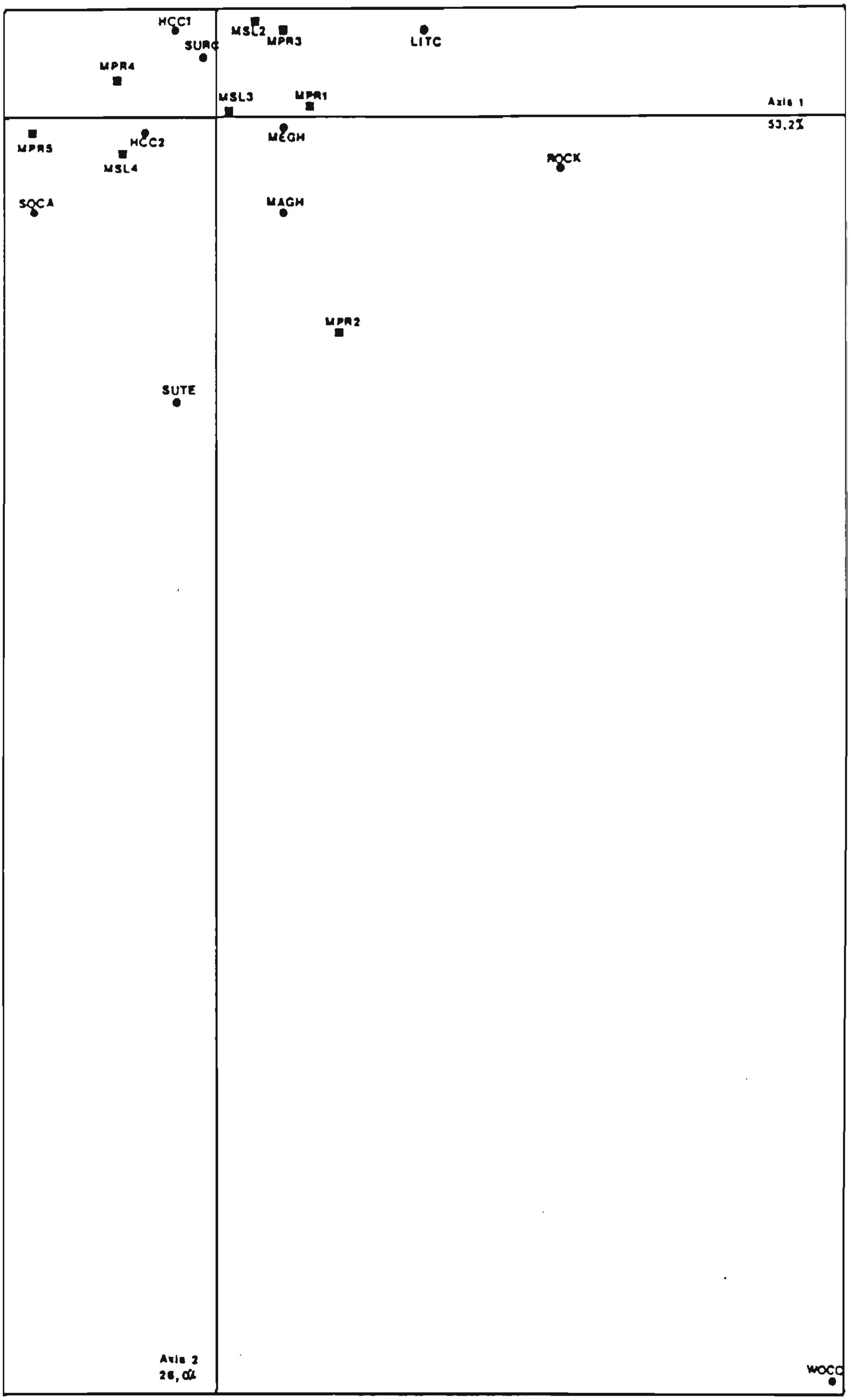

Figure 3.13 Two-dimensional display, obtained by correspondence analysis, of 1982 rainfall simulator trial data

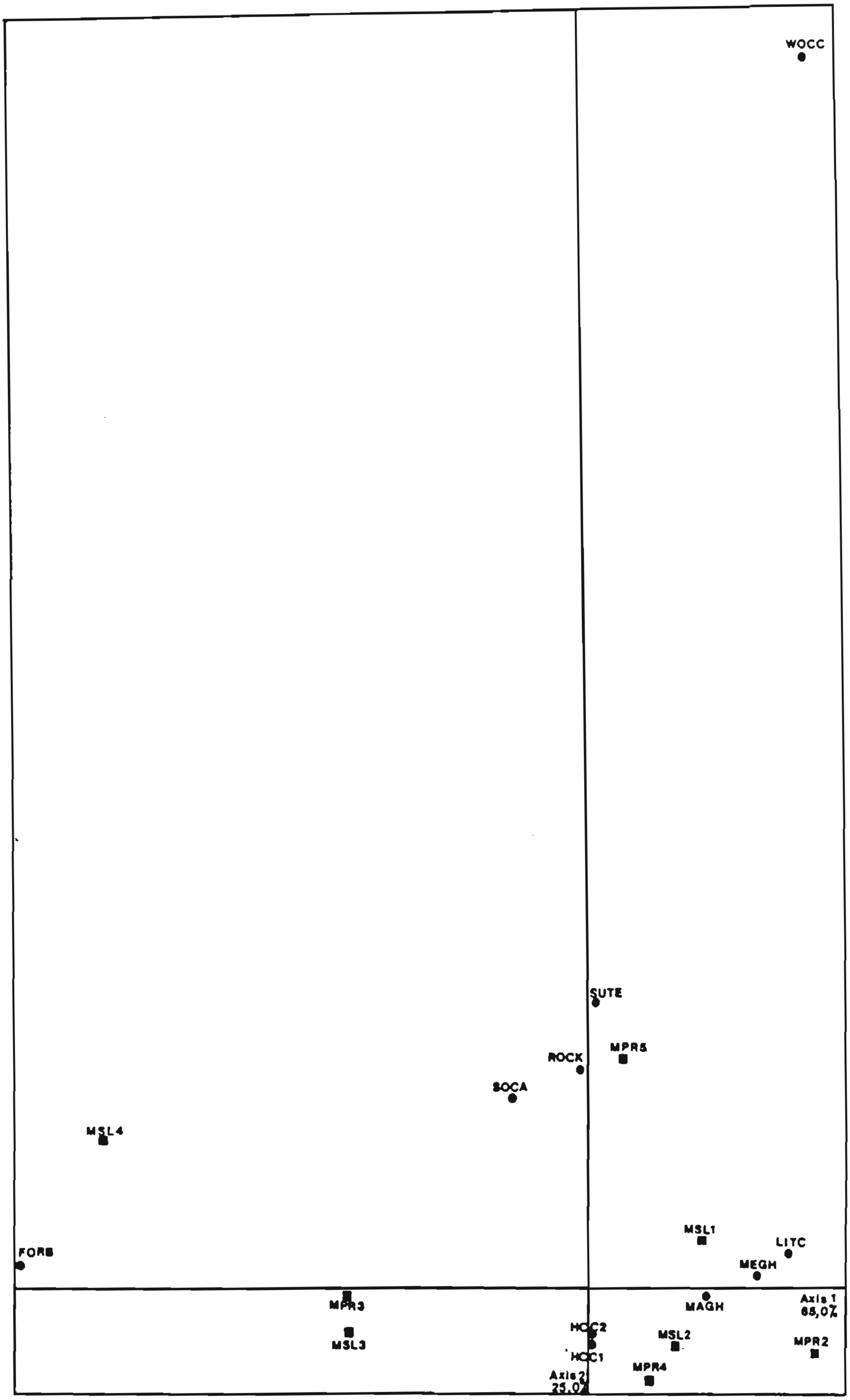

Figure 3.14 Two-dimensional display, obtained by correspondence analysis, of 1984 rainfall simulator trial data

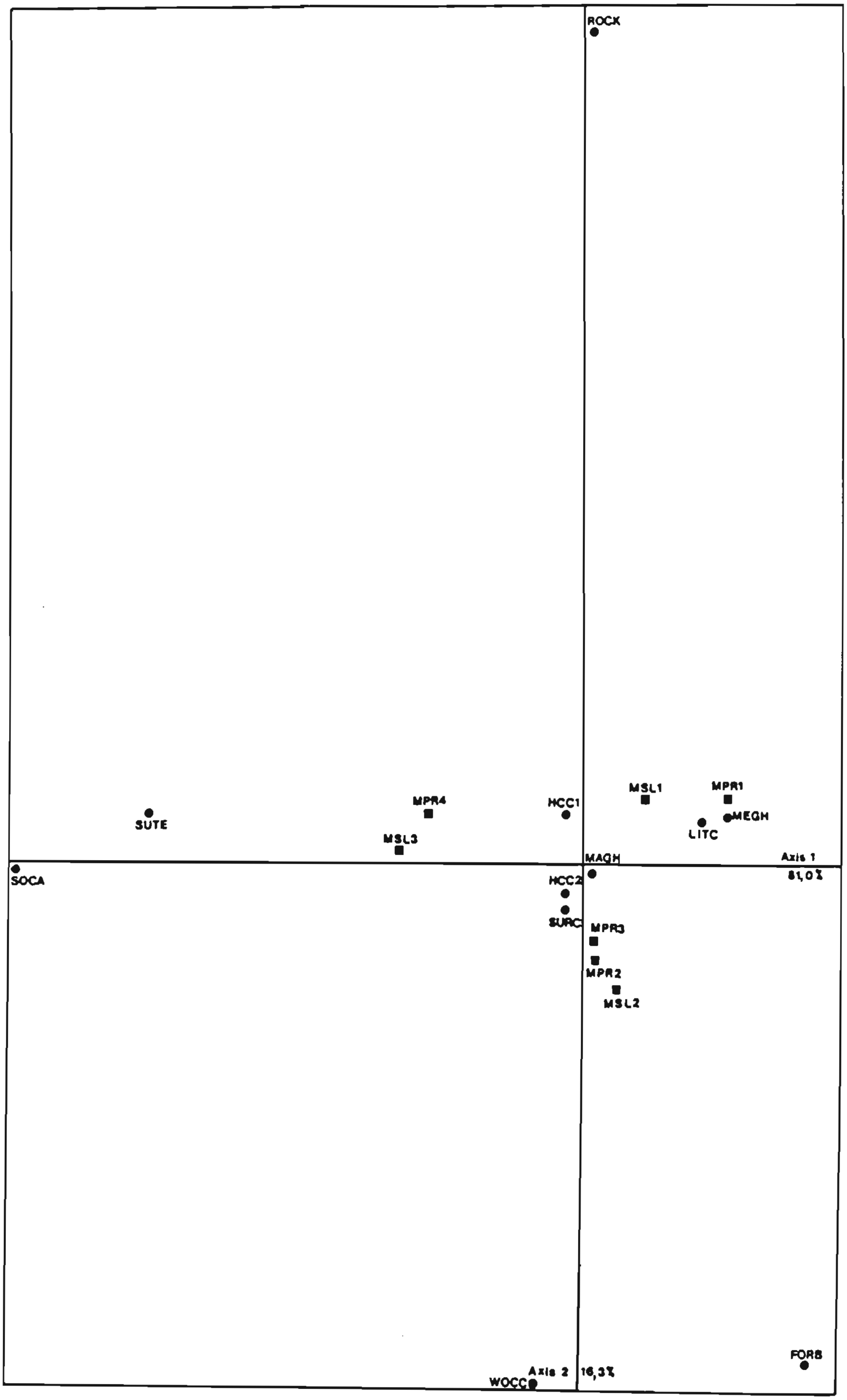

Figure 3.15 Two-dimensional display, obtained by correspondence analysis, of 1985 rainfall simulator trial data

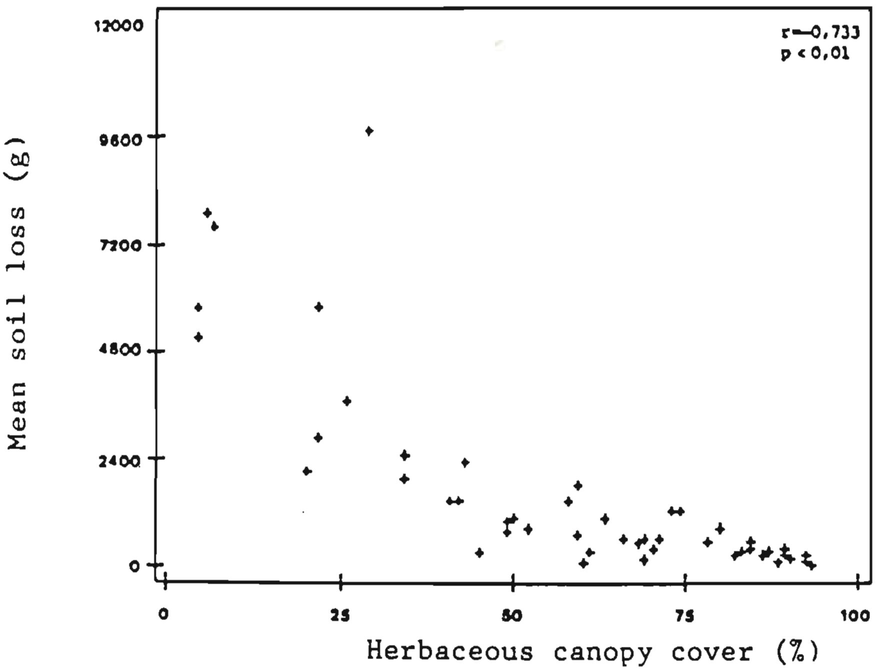

Figure 3.16 Scattergram of mean soil loss (g) against percentage herbaceous canopy cover

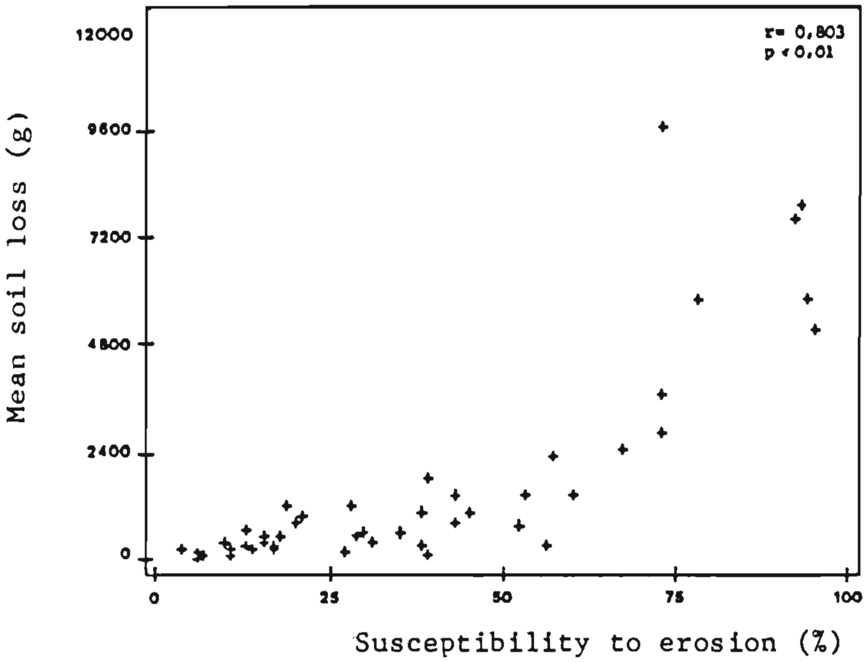

Figure 3.17 Scattergram of mean soil loss (g) against percentage susceptible to erosion

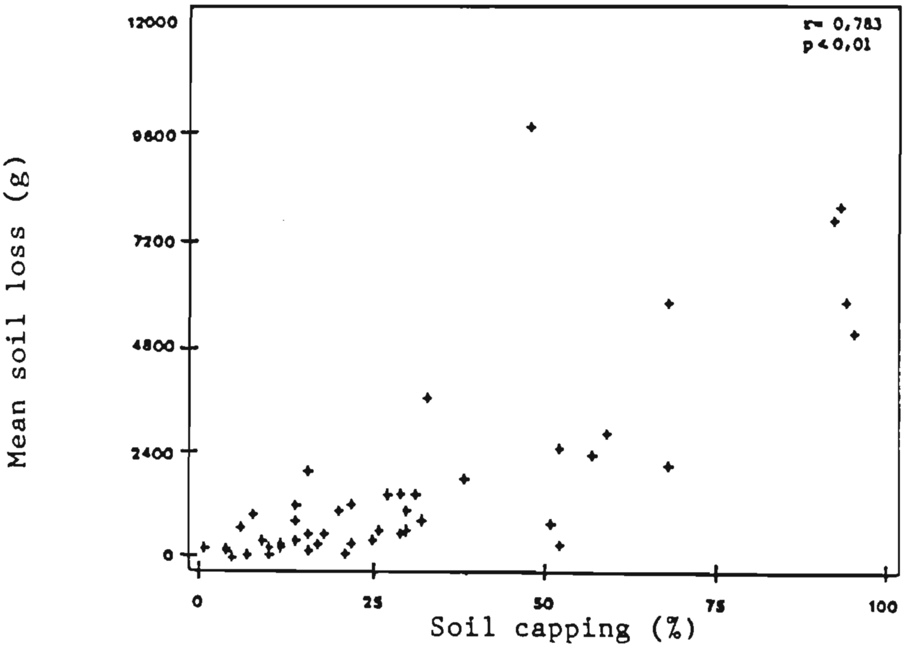

Figure 3.18 Scattergram of mean soil loss (g) against percentage soil capping

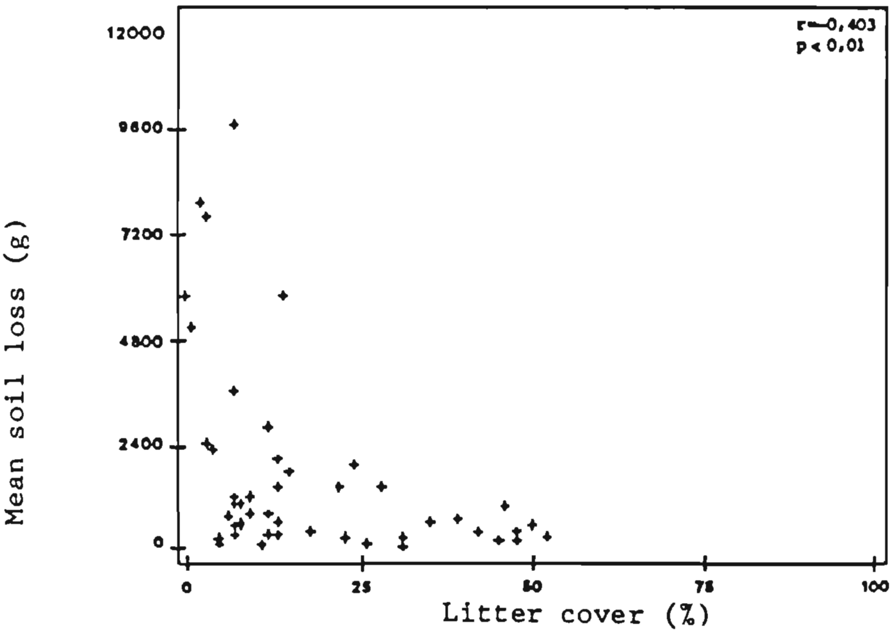

Figure 3.19 Scattergram of mean soil loss (g) against percentage litter cover

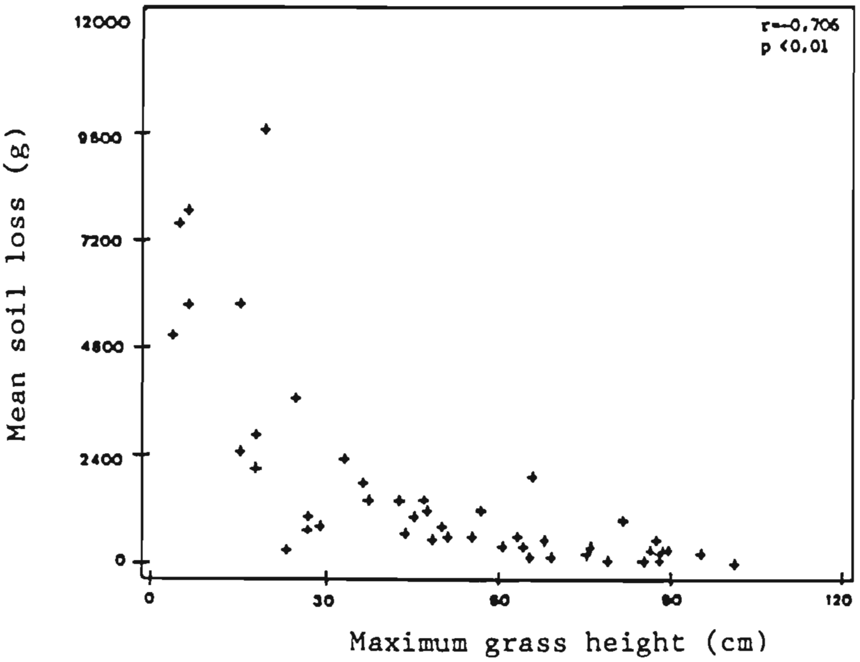

Figure 3.20 Scattergram of mean soil loss (g) against maximum grass height (cm)

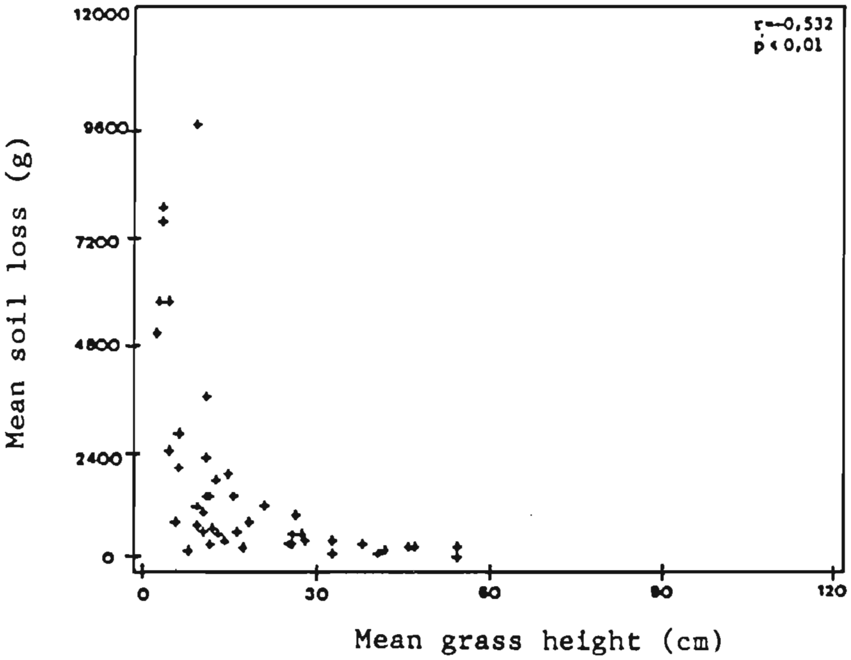

Figure 3.21 Scattergram of mean soil loss (g) against mean grass height (cm)

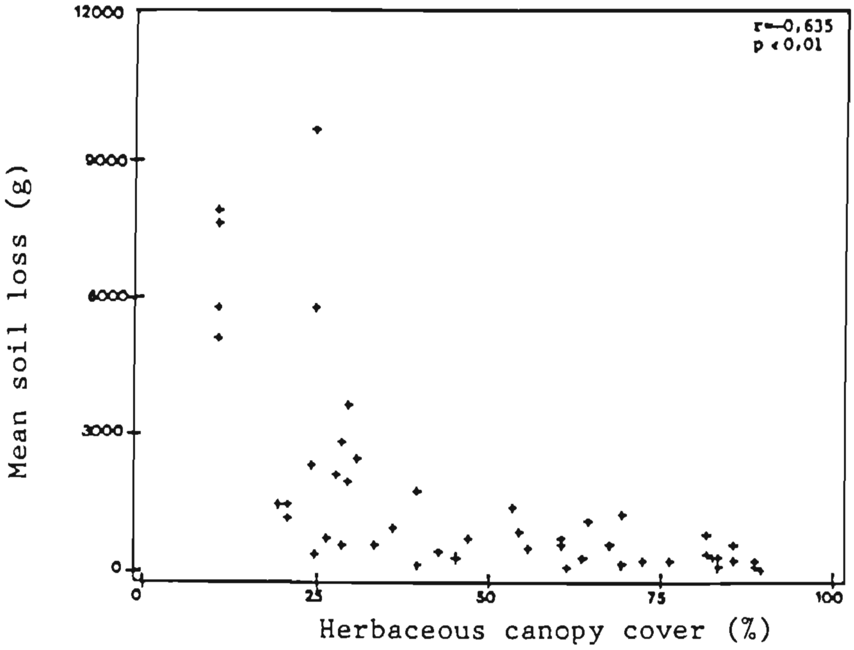

Figure 3.22 Scattergram of mean soil loss (g) against percentage herbaceous canopy cover, determined by the USLE method

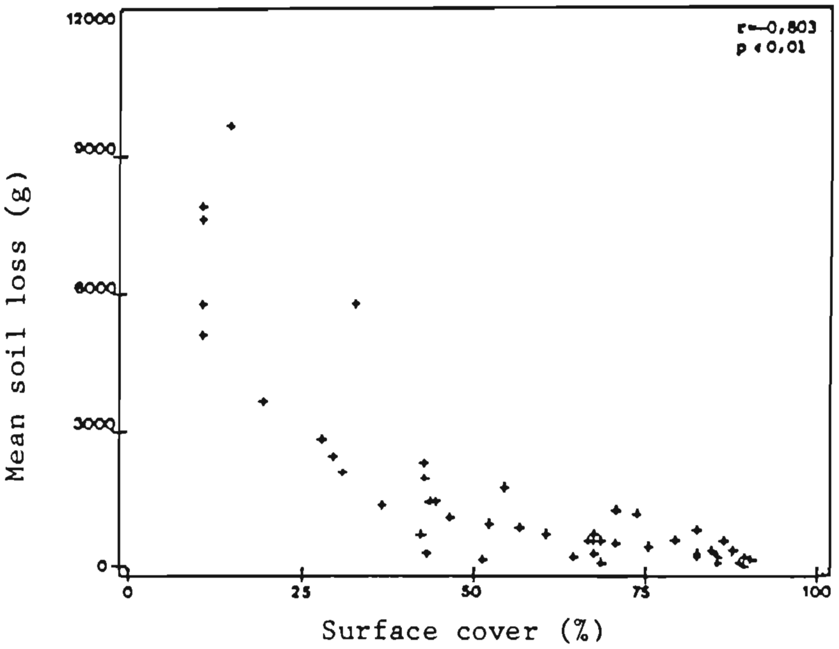

Figure 3.23 Scattergram of mean soil loss (g) against percentage surface cover

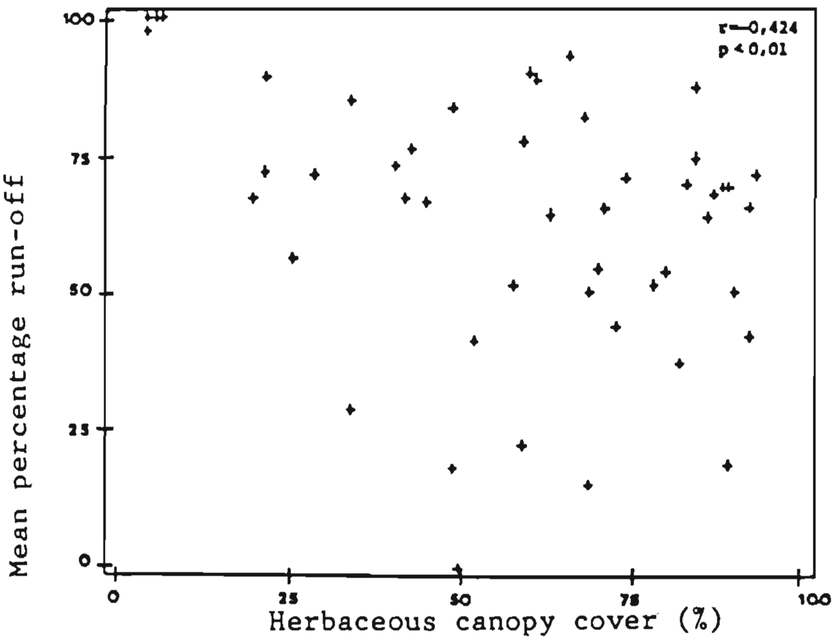

Figure 3.24 Scattergram of mean percentage run-off against percentage herbaceous canopy cover

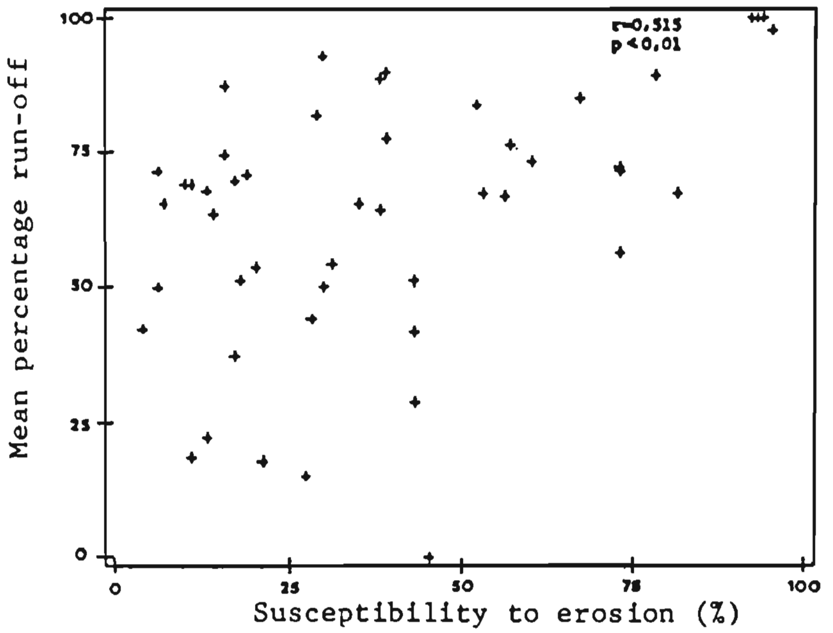

Figure 3.25 Scattergram of mean percentage run-off against percentage susceptible to erosion

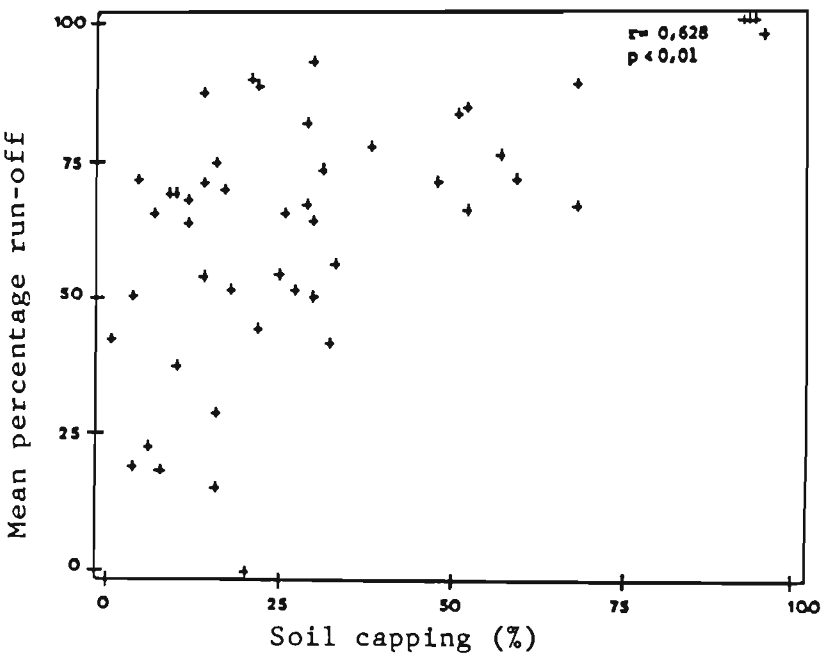

Figure 3.26 Scattergram of mean percentage run-off against percentage soil capping

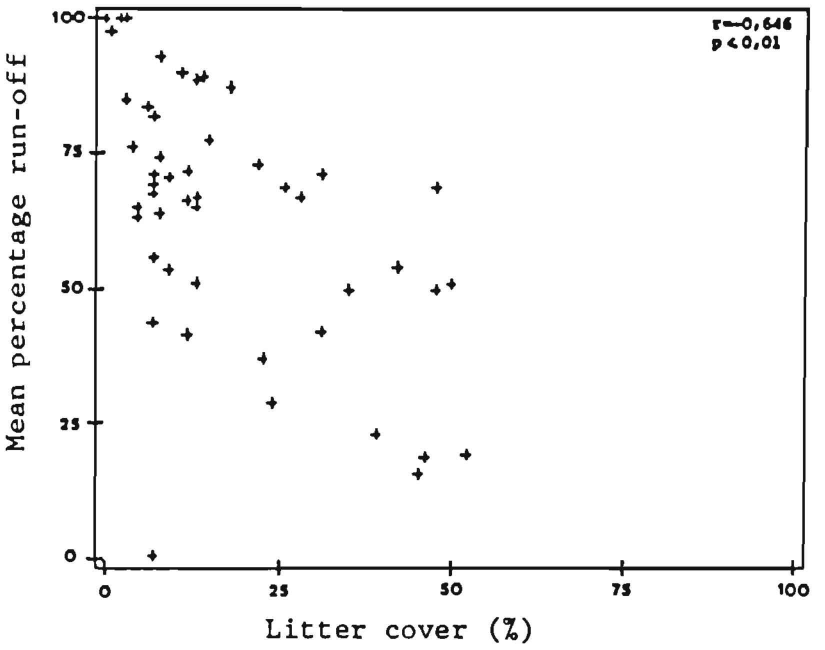

Figure 3.27 Scattergram of mean percentage run-off against percentage litter cover

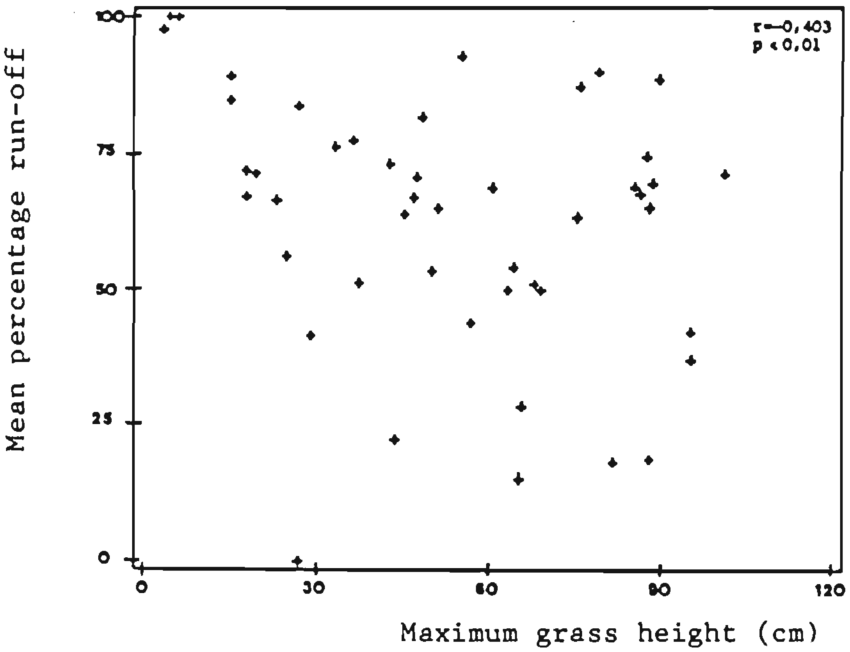

Figure 3.28 Scattergram of mean percentage run-off against maximum grass height (cm)

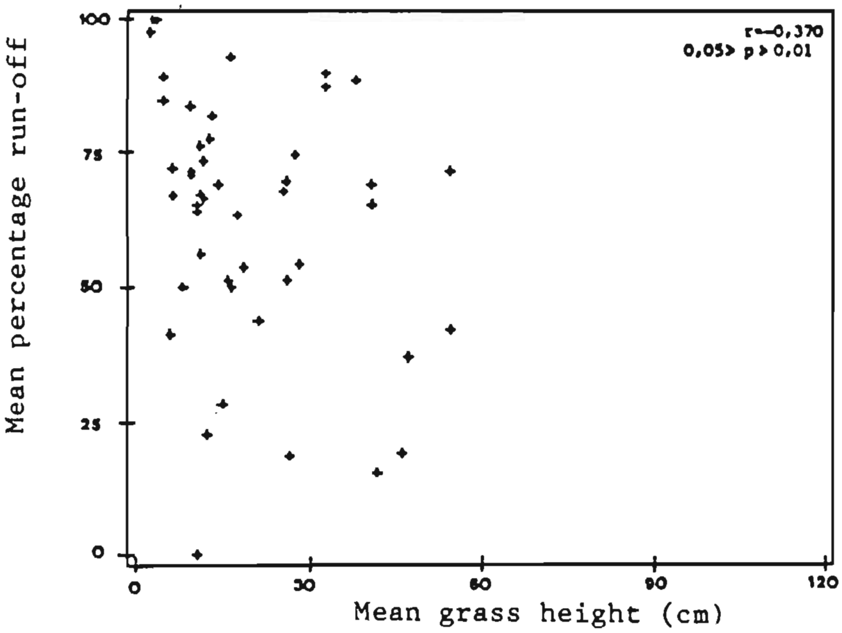

Figure 3.29 Scattergram of mean percentage run-off against mean grass height (cm)

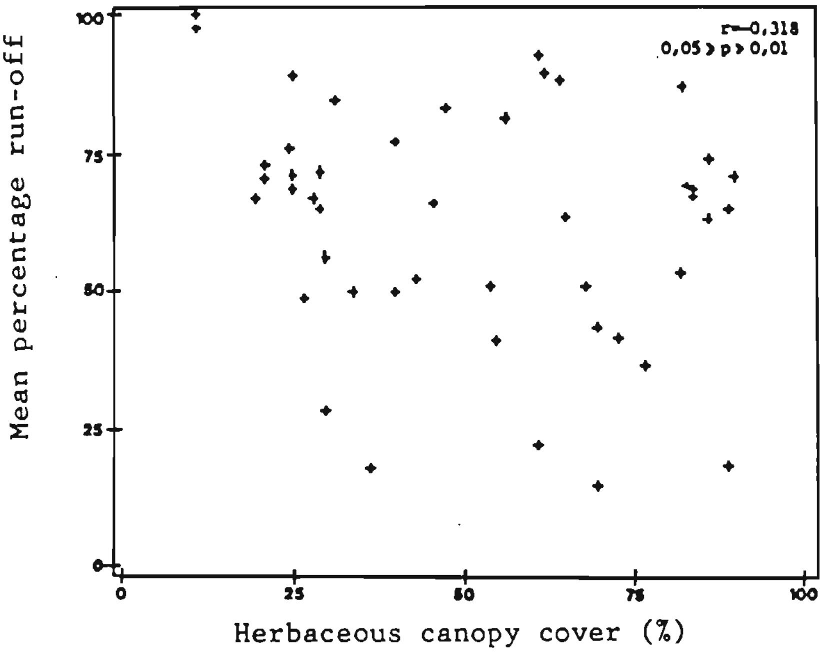

Figure 3.30 Scattergram of mean percentage run-off against percentage herbaceous canopy cover, determined by the USLE method

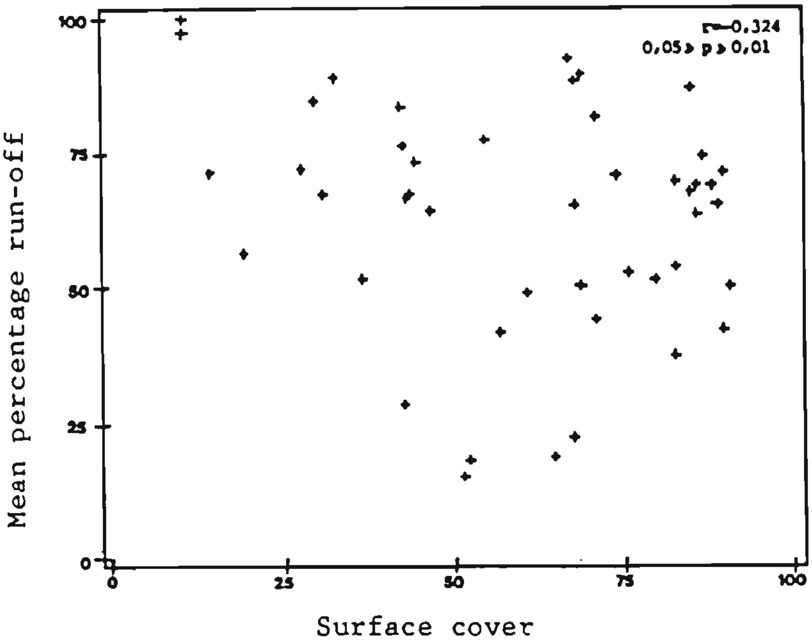

Figure 3.31 Scattergram of mean percentage run-off against percentage surface cover

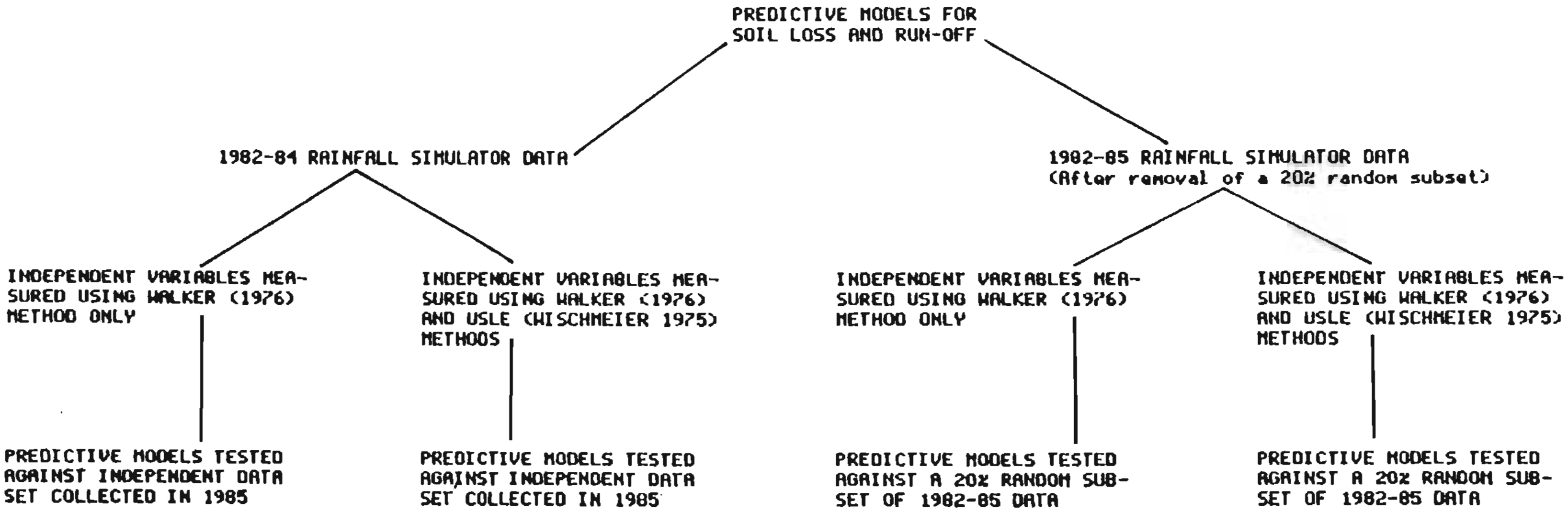

Figure 3.32 Diagram showing which rainfall simulator data sets were used in the construction and testing of the various predictive models

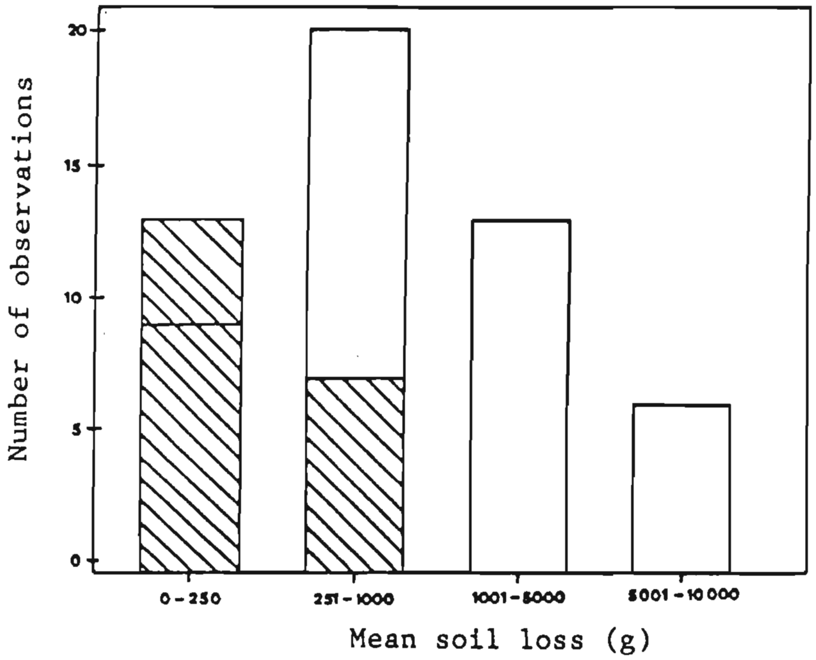

Figure 3.33 Frequency of occurrence of observations in various soil loss classes for the 1985 independent data set (▧) and the 1982-84 data set (☐)

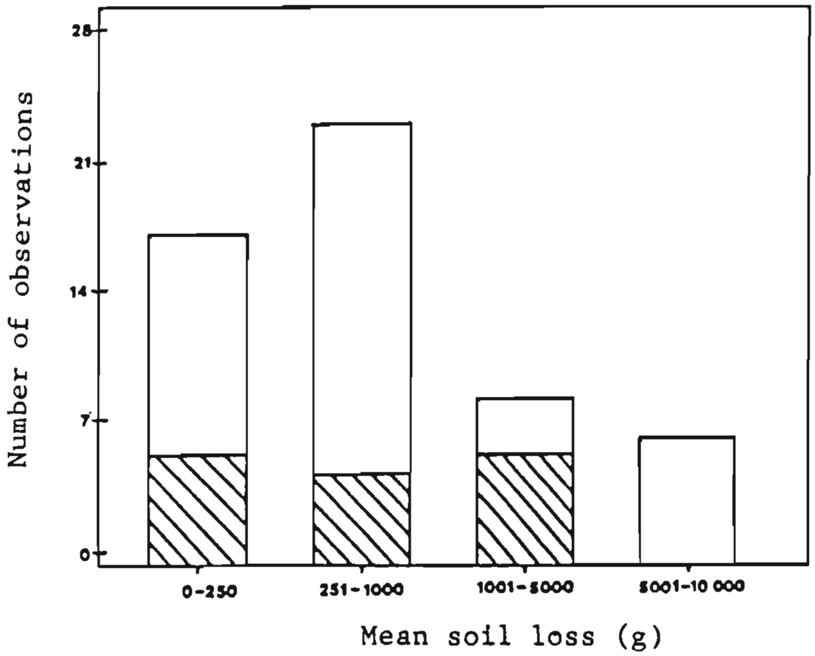

Figure 3.34 Frequency of occurrence of observations in various soil loss classes for the 1982-85 random data subset (▧) and the remainder of the 1982-85 data set (☐)

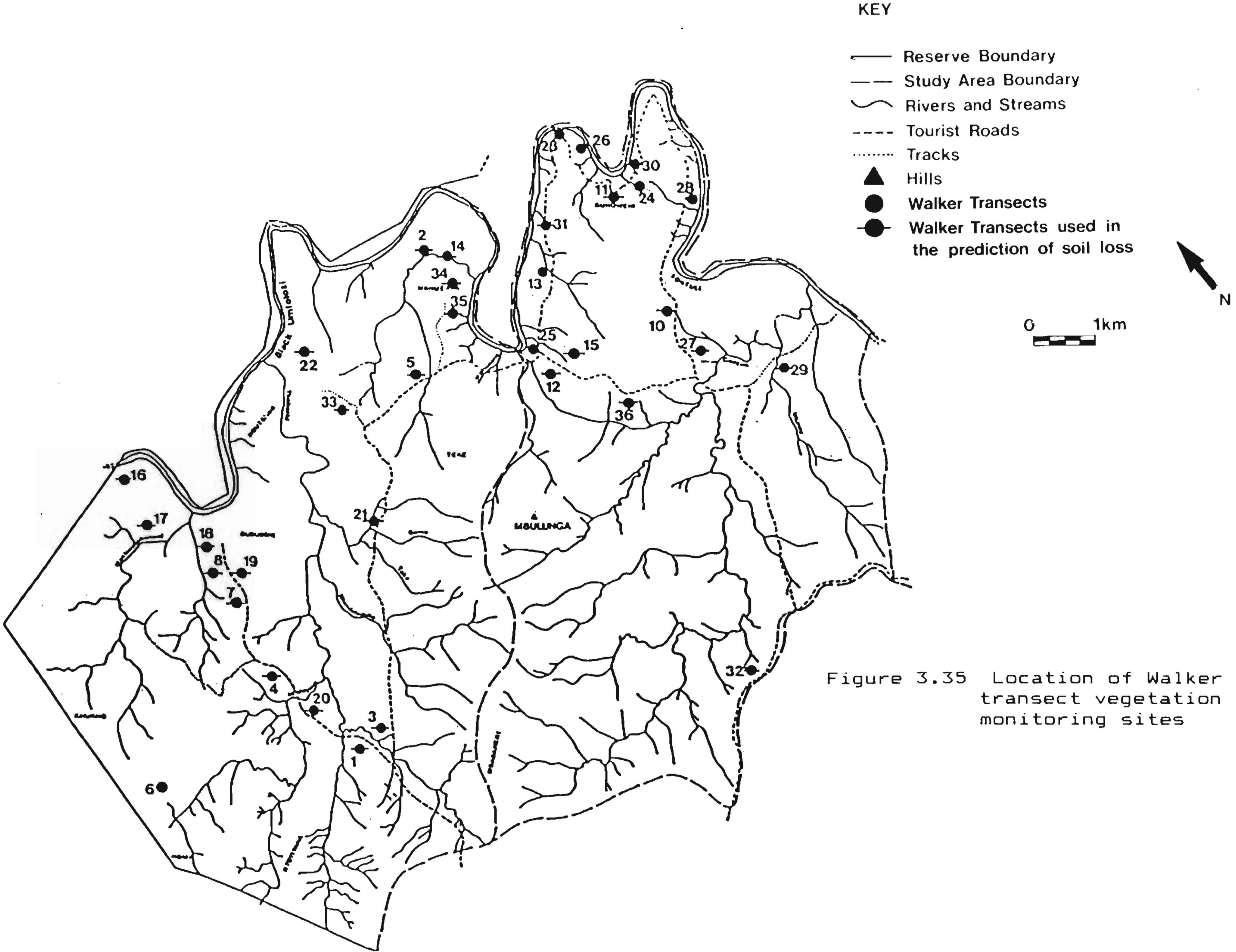

Figure 3.35 Location of Walker transect vegetation monitoring sites

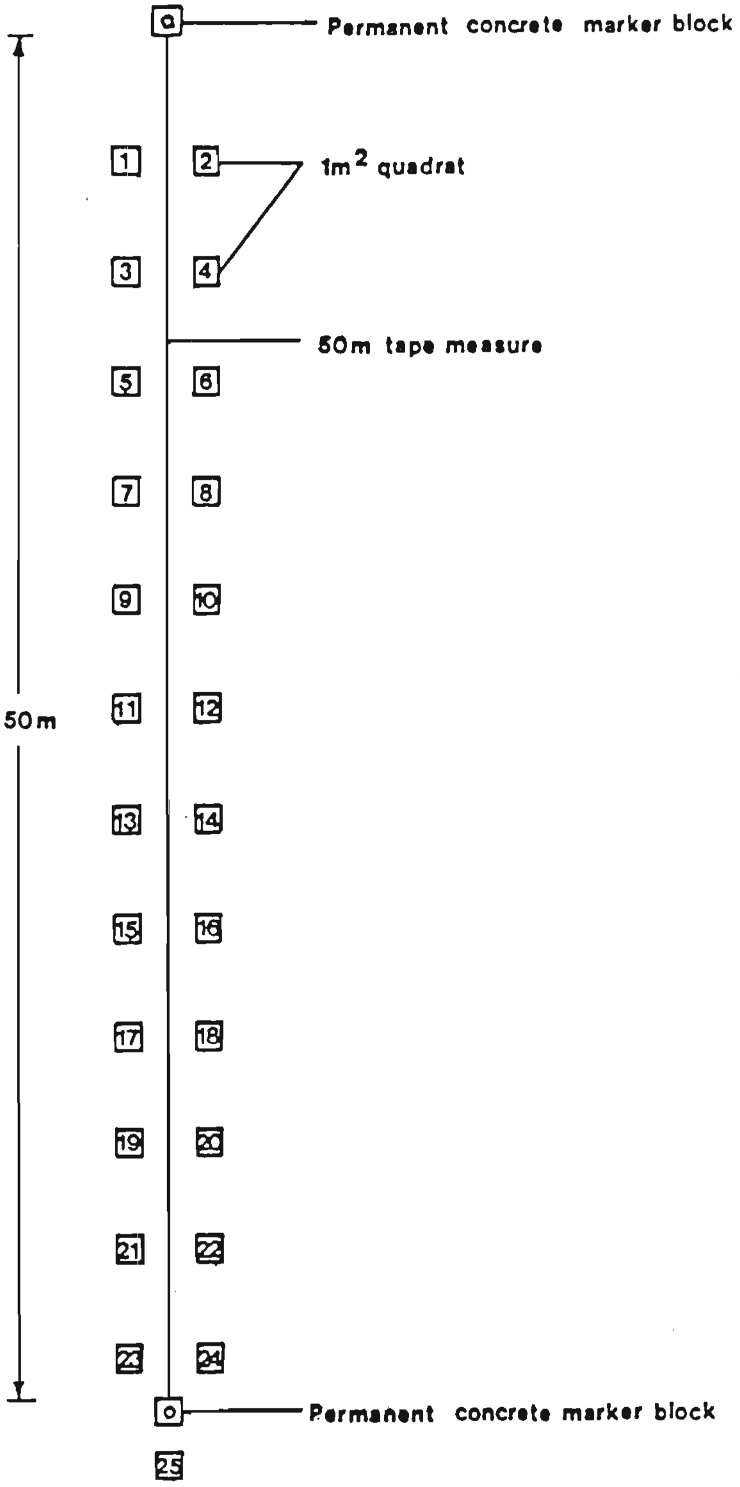

Figure 3.36 Dimensions and layout of a typical Walker transect vegetation monitoring site

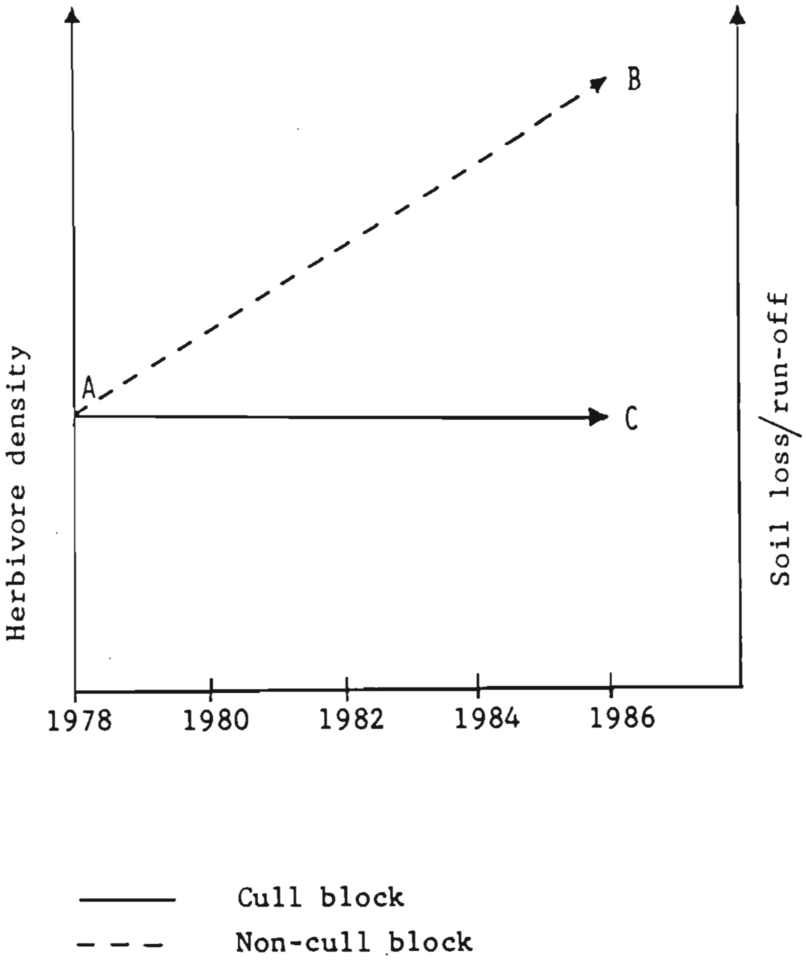

Figure 3.37 Conceptual model of the reaction of the non-cull and cull blocks to differing herbivore densities with respect to soil loss and run-off

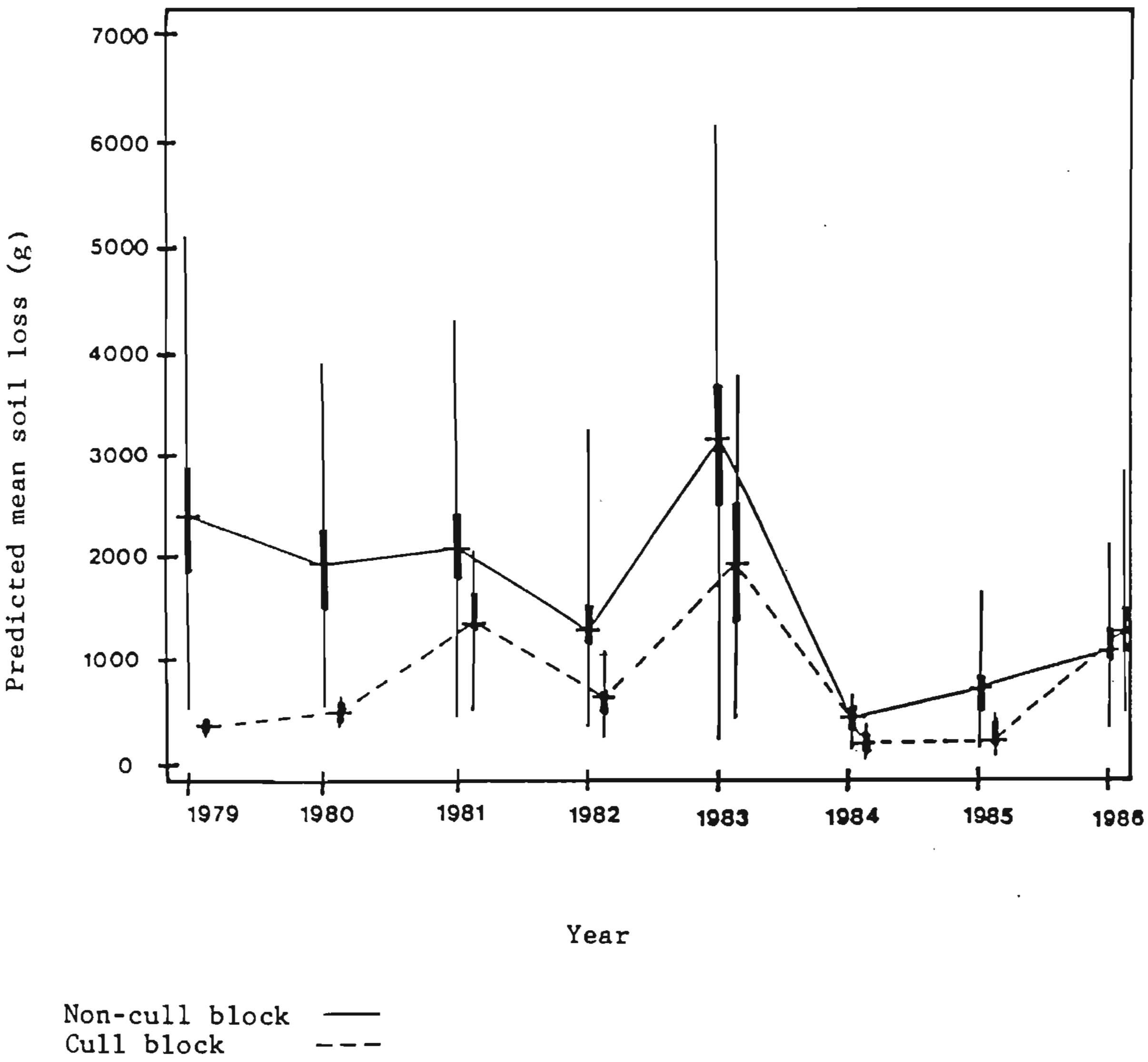

Figure 3.38 Trend in predicted mean soil loss from Walker transect vegetation monitoring sites in the non-cull and cull blocks. The mean is depicted by a crossbar, the standard error by a vertical bar and the range by a vertical line

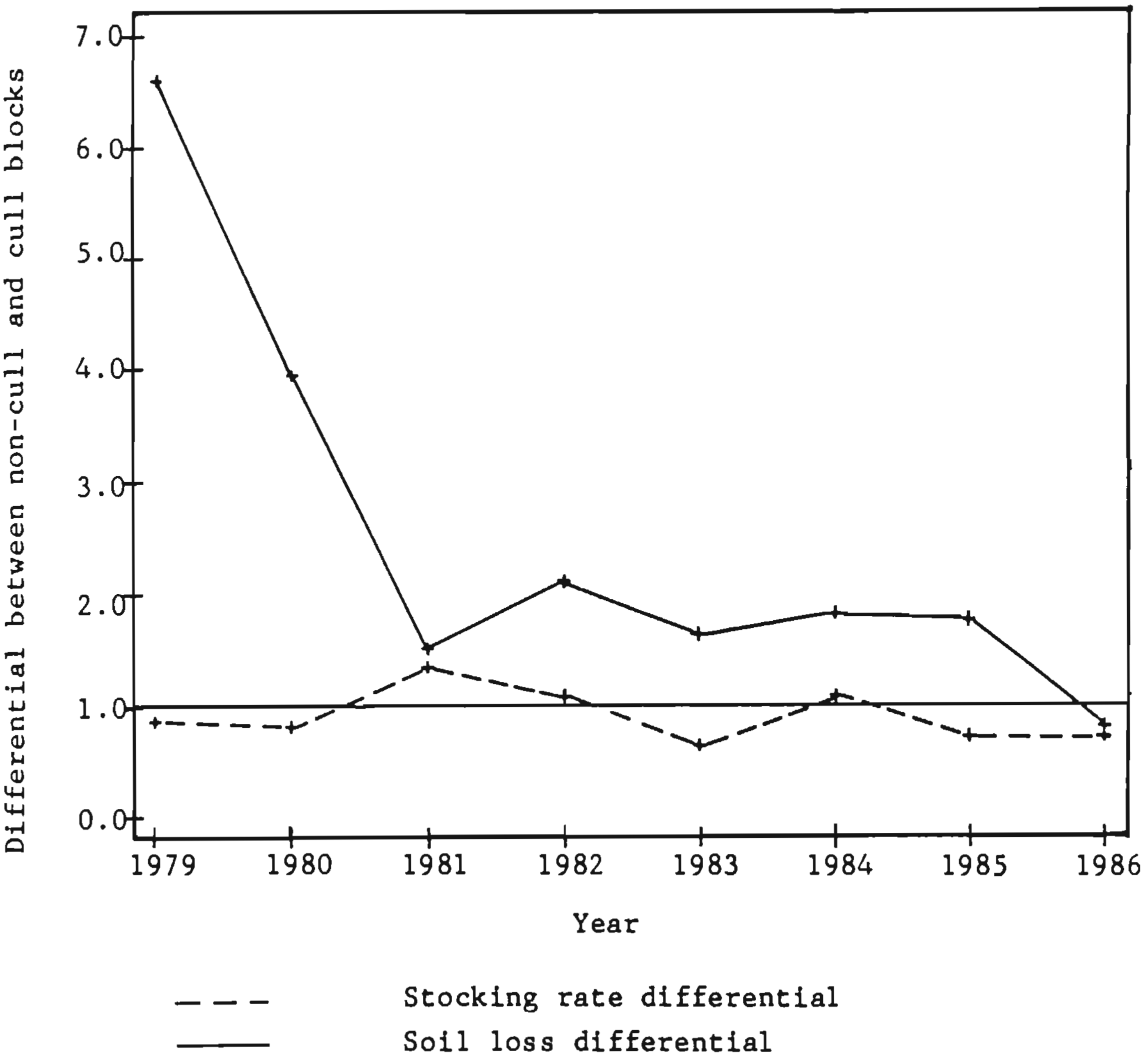

Figure 3.39 Relationship between actual stocking rate differential and predicted soil loss differential in the study area

Table 3.1 Physical characteristics of rainfall simulator sites

SITE	EXPERIMENTAL BLOCK		WOODY VEGETATION	SOIL CLASSIFICATION		SLOPE
NUMBER	NON-CULL	CULL	COMMUNITY	FORM	SERIES	(%)
296	X		Spirostachys africana	Shortlands	Sun valley	4,0
279	X		Acacia tortilis	Shortlands	Glendale	8,8
241	X		Acacia nigrescens	Mayo	Tshipise	9,6
206	X		Acacia nigrescens	Mayo	Tshipise	9,5
294	X		Acacia nilotica/Acacia gerrardii	Valsrivier	Lindley	8,6
295		X	Acacia nigrescens	Mayo	Pafuri	7,9
280		X	Acacia tortilis	Swartland	Omdraai	3,6
284		X	Acacia tortilis	Swartland	Swartland	10,3

Table 3.2 Sites on which rainfall simulator trials were done from March 1982 to March 1985

RAINFALL SIMULATOR TRIAL SITES			
MARCH 1982	APRIL 1983	MARCH 1984	MARCH 1985
296	296	296	-
279	279	279	-
241	241	241	241
-*	206	206	-
294	294	294	294
295	295	-**	-**
280	280	280	-
284	284	284	284

* Site 206 started in 1983
** Site 295 destroyed by Cyclone Domoina in January 1984

Table 3.3 Soil loss potentials of fixed sites within key woody vegetation communities in the non-cull and cull blocks. Values given are mean and standard error and, in parentheses, range

WOODY VEGETATION COMMUNITY	SITE NUMBER	DURATION OF TRIALS (YEARS)	MEAN SOIL LOSS (g)	
			NON-CULL BLOCK	CULL BLOCK
Acacia tortilis	279	3	3402.7±1375.4 (803.3-7878.6)	-
	280	3	-	365.5±138.5 (32.6-853.9)
	284	3	-	437.4±93.0 (109.1-764.4)
Acacia nigrescens	241	3	696.0±193.2 (231.6-149.4)	-
	206	2	3422.9±2245.3 (71.2-9687.9)	-
	295	2	-	1522.9±567.2 (558.8-2823.2)
Acacia nilotica/Acacia gerrardii	294	3	1808.6±852.9 (285.7-5764.4)	-
Spirostachys africana	296	3	2575.4±972.0 (200.5-5800.9)	-

Table 3.4 Run-off potentials of fixed sites within key woody vegetation communities in the non-cull and cull blocks. Values given are mean and standard error and, in parentheses, range

WOODY VEGETATION COMMUNITY	SITE NUMBER	DURATION OF TRIALS (YEARS)	MEAN PERCENTAGE RUN-OFF	
			NON-CULL BLOCK	CULL BLOCK
Acacia tortilis	279	3	73.1±9.5 (44.0-100.0)	-
	280	3	-	53.8±7.9 (22.8-71.1)
	284	3	-	79.3±4.6 (65.0-92.5)
Acacia nigrescens	241	3	49.3±3.8 (37.4-64.2)	-
	206	2	76.5±8.1 (55.9-89.9)	-
	295	2	-	60.2±5.6 (49.9-72.1)
Acacia nilotica/Acacia gerrardii	294	3	75.7±3.8 (65.4-89.0)	-
Spirostachys africana	296	3	80.5±6.2 (63.7-100.0)	-

Table 3.5 Data matrix for 1983 rainfall simulator trials used in correspondence analysis ‡

DEPENDENT VARIABLES (COLUMNS)		INDEPENDENT VARIABLES (ROWS)									
		HCC1 (%)	LITC (%)	SOCA (%)	SUTE (%)	ROCK (%)	MAGH (cm)	MEGH (cm)	HCC2 (%)	SURC (%)	WOCC (%)
MEAN SOIL LOSS	MSL1 (0-100g)	-	-	-	-	-	-	-	-	-	-
	MSL2 (101-500g)	67,4	36,3	24,0	31,4	0,2	58,7	33,0	67,7	53,0	0,0
	MSL3 (501-1 000g)	53.4	19,0	29,6	35,9	0,4	33,1	9,2	54,0	55,3	0,2
	MSL4 (1 001-5 000g)	37,2	9,2	44,8	62,6	1,0	26,4	9,1	39,0	31,7	1,6
	MSL5 (5 001-10 000g)	12,2	5,6	81,7	87,7	0,3	9,4	4,5	15,2	14,8	1,5
MEAN PERCENTAGE RUN-OFF	MPR1 (0-20%)	78,7	48,6	10,2	18,9	0,2	76,5	43,8	79,0	58,0	0,0
	MPR2 (21-40%)	59,0	38,7	6,3	12,6	0,2	43,7	12,1	60,5	67,5	0,5
	MPR3 (41-60%)	45,5	10,6	30,7	53,2	0,8	30,3	10,8	45,8	37,5	1,2
	MPR4 (61-80%)	35,6	10,2	51,4	64,4	1,0	24,7	8,8	38,0	32,4	2,8
	MPR5 (81-100%)	18,3	5,1	77,7	81,6	0,2	11,2	4,6	20,6	20,9	0,2

‡ For explanation of codes see Table 3.6

Table 3.6 Explanation of codes used in tables, figures and text

MEAN SOIL LOSS	MSL1 (very low)
	MSL2 (low)
	MSL3 (moderate)
	MSL4 (high)
	MSL5 (very high)
MEAN PERCENTAGE RUN-OFF	MPR1 (very low)
	MPR2 (low)
	MPR3 (moderate)
	MPR4 (high)
	MPR5 (very high)
VEGETATION VARIABLES	HCC1 Herbaceous canopy cover (%) measured by Walker's (1976) method
	LITC Litter cover (%)
	MAGH Maximum grass height (cm)
	MEGH Mean grass height (cm)
	HCC2 Herbaceous canopy cover (%) measured by USLE method (WISCHMEIER, 1975)
	SURC Surface cover (%)
	WOCC Woody canopy cover (%)
SOIL SURFACE VARIABLES	SOCA Soil capping (%)
	SUTE Susceptibility to erosion (%)
	ROCK Rock (%)

Table 3.7 Results of the correspondence analysis of the 1983 rainfall simulator trial data

VARIABLES	QLT	PRINCIPAL AXIS 1			PRINCIPAL AXIS 2		
		K=1	COR	CTR	K=2	COR	CTR
HCC1	962	-290	930	53	-54	32	28
LITC	863	-524	845	78	78	18	26
SOCA	988	807	984	361	53	4	24
SUTE	992	670	992	312	1	0	0
ROCK	312	304	153	1	-309	160	9
MAGH	989	-372	932	68	93	57	63
MEGH	988	-451	549	43	404	439	514
HCC2	971	-260	929	44	-55	42	29
SURC	963	-245	616	35	-184	347	292
WOCC	370	644	313	5	-275	57	14
MSL2	925	-358	834	74	119	91	123
MSL3	759	-150	326	10	-173	433	202
MSL4	744	246	720	25	-45	24	12
MSL5	977	924	968	308	93	9	47
MPR1	967	-541	869	188	183	98	321
MPR2	912	-522	815	128	-180	97	227
MPR3	221	40	40	1	-82	181	42
MPR4	779	300	759	38	-48	20	15
MPR5	961	783	958	229	45	3	11

Table 3.8 Results of the correspondence analysis of the 1982 rainfall simulator trial data

VARIABLES	QLT	PRINCIPAL AXIS 1			PRINCIPAL AXIS 2		
		K=1	COR	CTR	K=2	COR	CTR
HCC1	961	-62	287	39	96	674	195
LITC	941	306	856	408	97	85	84
SOCA	749	-281	644	298	-113	105	99
ROCK	699	487	685	23	-69	14	1
MAGH	987	96	367	89	-123	620	302
MEGH	645	113	632	36	-15	13	1
HCC2	251	-91	213	54	-38	38	20
SURC	842	-33	226	12	56	616	69
WOCC	927	916	250	41	-1505	677	229
*SUTE	0	-78	0	34	-332	0	1241
MSL2	613	68	148	33	120	465	210
MSL3	44	22	40	4	8	4	1
MSL4	467	-148	422	106	-48	45	23
MPR1	498	118	498	75	4	0	0
MPR2	903	188	332	174	-246	571	608
MPR3	652	112	405	95	88	247	119
MPR4	344	-122	325	80	30	19	10
MPR5	717	-261	695	432	-46	22	28

* Supplementary point

TABLE 3.9 Results of the correspondence analysis of the 1984 rainfall simulator trial data

VARIABLES	QLT	PRINCIPAL AXIS 1			PRINCIPAL AXIS 2		
		K=1	COR	CTR	K=2	COR	CTR
HCC1	933	-4	5	0	-57	928	55
LITC	459	199	447	50	33	12	4
SOCA	793	-73	98	6	197	695	107
SUTE	909	-9	1	0	291	908	332
ROCK	256	-21	2	0	226	254	2
FORB	983	-592	982	767	25	1	4
MAGH	974	113	972	86	-5	2	0
MEGH	786	171	777	84	19	9	3
HCC2	557	-8	21	0	-45	536	34
SURC	795	-5	24	0	-35	771	22
WOCC	918	230	34	7	1165	884	437
MSL1	723	115	590	69	55	133	41
MSL2	790	66	470	22	-54	320	38
MSL3	944	-238	917	283	-41	27	22
MPR2	929	230	859	269	-65	70	56
MPR3	890	-258	890	338	-6	0	1
MPR4	785	53	146	15	-110	639	160
MPR5	247	29	15	4	232	940	682
*MSL4	960	-506	882	1259	151	78	294

* Supplementary point

Table 3.10 Results of the correspondence analysis of the 1985 rainfall simulator trial data

VARIABLES	QLT	PRINCIPAL AXIS 1			PRINCIPAL AXIS 2		
		K=1	COR	CTR	K=2	COR	CTR
HCC1	951	-20	241	6	36	710	94
LITC	884	107	843	86	24	41	21
SOCA	997	-544	997	433	-5	0	0
SUTE	998	-407	993	281	31	5	8
ROCK	711	21	0	0	559	711	51
FORB	940	232	310	28	-330	630	281
MAGH	705	23	683	9	-3	22	1
MEGH	983	152	941	149	32	42	34
HCC2	898	-11	286	2	-17	612	20
SURC	979	-18	671	5	-12	308	12
WOCC	965	-40	13	1	-347	952	477
MSL1	728	70	685	67	43	256	125
MSL2	964	37	152	18	-83	812	457
MSL3	984	-174	978	369	14	6	12
MPR1	990	154	909	328	46	81	149
MPR3	825	18	85	5	-53	740	183
MPR4	971	-131	911	213	34	60	73
*MPR2	91	6	1	1	-58	90	219

* Supplementary point

Table 3.11 Correlation matrix of vegetation and soil surface variables against mean percentage run-off, mean soil loss and $\log_e$ of mean soil loss

DEPENDENT	COEFFICIENT OF CORRELATION (r)										
VARIABLES	HCC1	LITC	SOCA	SUTE	AIZ	MAGH	MEGH	ROCK	HCC2	SURC	WOCC
MEAN PERCENTAGE RUN-OFF	-0.424 **	-0.646 **	0.628 **	0.515 **	-0.227 n.s.	-0.403 **	-0.370 *	-0.248 n.s.	-0.318 *	-0.324 *	0.155 n.s.
MEAN SOIL LOSS	-0.733 **	-0.403 **	0.783 **	0.803 **	-0.159 n.s.	-0.706 **	-0.532 **	0.073 n.s.	-0.635 **	-0.803 **	0.263 n.s.
LOGe OF MEAN SOIL LOSS	-0.776 **	-0.429 **	0.761 **	0.821 **	-0.013 n.s.	-0.832 **	-0.770 **	0.220 n.s.	-0.761 **	-0.832 **	0.036 n.s.

Key

n.s.= not significant
* = significant at 5% probability level
** = significant at 1% probability level
degrees of freedom = 46

Table 3.12 Results of the stepwise multiple regression analysis of 1982-84 rainfall simulator data for the prediction of soil loss

METHOD/S USED TO MEASURE INDEPENDENT VARIABLES	INDEPENDENT VARIABLE	BETA COEFFICIENT	CONFIDENCE LIMITS		PARTIAL F-TEST	SIGNIFICANCE	PERCENTAGE VARIATION EXPLAINED BY R-SQ
			UPPER	LOWER			
WALKER (1976) METHOD	CONSTANT	8.9141					
	MAGH	-0.0266	-0.01508	-0.03807	23.055	p<0.01	69,2
	HCC1	-0.0160	0.00466	-0.03672	7.777	p<0.01	73,7
						(d.f.n1=2,n2=45)	
WALKER (1976) & USLE (WISCHMEIER 1975) METHODS	CONSTANT	9.0603					
	SURC	-0.0301	-0.02137	-0.03873	40.340	p<0.01	69,2
	MEGH	-0.0371	-0.02146	-0.05271	19.525	p<0.01	78,5
						(d.f.n1=2,n2=45)	

Table 3.13 Results of the stepwise multiple regression analysis of 1982-85 rainfall simulator data, excluding a 20% random subsample, for the prediction of soil loss

METHOD/S USED TO MEASURE INDEPENDENT VARIABLES	INDEPENDENT VARIABLE	BETA COEFFICIENT	CONFIDENCE LIMITS		PARTIAL F-TEST	SIGNIFICANCE	PERCENTAGE VARIATION EXPLAINED BY R-SQ
			UPPER	LOWER			
WALKER (1976) METHOD	CONSTANT	5.9383					
	SUTE	0.0300	0.03926	0.02065	41.294	p<0.01	75,4
	MEGH	-0.0211	-0.00840	-0.03387	7.731	p<0.01	78,6
						(d.f.n1=2,n2=51)	
WALKER (1976) & USLE (WISCHMEIER 1975) METHODS	CONSTANT	9.0025					
	SURC	-0.0319	-0.02372	-0.04006	52.120	p<0.01	76,1
	MEGH	-0.0238	-0.01257	-0.03494	12.667	p<0.01	80,9
						(d.f.n1=2,n2=51)	

Table 3.14 Results of the stepwise multiple regression analysis of 1982-84 rainfall simulator data for the prediction of run- off

METHOD/S USED TO MEASURE INDEPENDENT VARIABLES	INDEPENDENT VARIABLE	BETA COEFFICIENT	CONFIDENCE LIMITS		PARTIAL F-TEST	SIGNIFICANCE	PERCENTAGE VARIATION EXPLAINED BY R-SQ
			UPPER	LOWER			
WALKER (1976) METHOD	CONSTANT	36.1376					
	LITC	-0.6493	-0.46613	-0.83250	15.517	p<0.01	41,8
	SOCA	0.6796	1.22218	0.13710	17.565	P<0.01	53,0
	MAGH	0.3626	0.67331	0.05199	6.805	p<0.01	59,3
						(d.f.n1=3,n2=44)	
WALKER (1976) & USLE (WISCHMEIER 1975) METHODS	CONSTANT	-2.0964					
	LITC	-0.4850	-0.32303	-0.64692	11.076	p<0.01	41,8
	SOCA	0.9995	1.52584	0.47323	40.372	p<0.01	53,0
	SURC	0.7323	1.02550	0.43908	24.306	p<0.01	66,1
	WOCC	2.3597	2.50555	2.21389	6.276	p<0.01	70,4
						(d.f.n1=4,n2=43)	

Table 3.15 Results of the stepwise multiple regression analysis of 1982-85 rainfall simulator data, excluding a 20% random subsample, for the prediction of run-off

METHOD/S USED TO MEASURE INDEPENDENT VARIABLES	INDEPENDENT VARIABLE	BETA COEFFICIENT	CONFIDENCE LIMITS		PARTIAL F-TEST	SIGNIFICANCE	PERCENTAGE VARIATION EXPLAINED BY R-SQ
			UPPER	LOWER			
WALKER (1976) METHOD	CONSTANT	56.0545					
	HCC1	0.5440	0.79650	0.29141	16.094	p<0.01	46,4
	LITC	-0.4000	-0.06035	-0.73964	5.548	p<0.01	52,2
	ROCK	-10.0248	-9.82151	-10.22800	3.532	0.05>p>0.01	55,3
						(d.f.n1=3,n2=50)	
WALKER (1976) & USLE (WISCHMEIER 1975) METHODS	CONSTANT	5.5126					
	SOCA	0.9777	1.36081	0.59452	22.588	p<0.01	46,4
	SURC	0.5852	1.07934	0.09105	8.989	p<0.01	52,6
	LITC	-0.4692	-0.21575	-0.72273	8.436	p<0.01	59,5
						(d.f.n1=3,n2=50)	

Table 3.16 Actual and predicted values for soil loss based on multiple regression analysis

1985 RAINFALL SIMULATOR TRIAL INDEPENDENT DATA SET			RESERVE DATA SUBSET FROM 1982-85 RAINFALL SIMULATOR TRIALS		
ACTUAL LOGe SOIL LOSS (g)	PREDICTED LOGe SOIL LOSS (g)		ACTUAL LOGe SOIL LOSS (g)	PREDICTED LOGe SOIL LOSS (g)	
	EQUATION 3.1	EQUATION 3.2		EQUATION 3.3	EQUATION 3.4
5.1411	4.7344	4.6870	5.4873	5.8514	5.8169
5.0562	4.7610	4.6425	5.6265	5.6217	5.6130
4.8645	5.0454	4.7372	5.2231	5.6658	5.6872
5.2781	5.0321	4.9932	6.6887	6.1501	5.9328
6.0640	4.7900	4.9232	4.6923	5.2980	5.2202
5.4289	5.0990	5.2555	6.3108	5.8412	5.5910
5.2591	4.7136	4.7543	3.4843	4.9705	4.8527
5.8816	4.4738	4.1371	5.6791	7.3757	7.3571
4.7933	4.5960	4.5823	7.8109	7.8470	7.9472
4.6131	4.6306	4.5942	7.9456	7.9954	7.9753
5.4566	4.3964	4.3259	7.2791	7.4935	7.3069
5.4476	4.8195	4.7241	7.0682	6.3057	6.4294
6.7191	5.5435	5.7868	5.0888	5.9474	5.9228
5.6626	4.7237	5.1305	7.4776	6.8467	6.9688
5.4873	5.3304	5.7235			
6.1738	5.7166	6.1867			
5.5880	4.9101	5.3882			
5.6265	5.0589	5.4554			
5.2231	5.1681	5.4723			
5.1659	5.3307	5.6591			
Coefficient of determination:	D = 0.188	D = 0.216	Coefficient of determination:	D = 0.682	D = 0.680
Coefficient of efficiency:	E = 0.955	E = 0.809	Coefficient of efficiency:	E = 0.639	E = 0.652

Table 3.17 Actual and predicted values for run-off based on multiple regression analysis

1985 RAINFALL SIMULATOR TRIAL INDEPENDENT DATA SET			RESERVE DATA SUBSET FROM 1982-85 RAINFALL SIMULATOR TRIALS		
ACTUAL RUN-OFF (%)	PREDICTED RUN-OFF (%)		ACTUAL RUN-OFF (%)	PREDICTED RUN-OFF (%)	
	EQUATION 3.5	EQUATION 3.6		EQUATION 3.7	EQUATION 3.8
3.6	49.6	48.7	46.1	88.9	53.1
9.4	47.9	43.4	69.1	85.4	45.6
54.2	28.0	35.8	49.2	87.4	47.0
48.5	25.7	32.7	53.8	94.0	63.3
56.2	43.6	49.8	65.0	104.1	61.8
58.4	53.7	53.5	74.3	98.6	68.0
24.0	67.5	58.1	71.1	92.2	48.2
29.5	51.6	61.9	66.2	75.7	75.9
5.2	32.8	39.7	84.8	73.4	72.2
6.7	38.4	53.5	72.1	49.2	73.7
44.4	41.4	64.2	73.4	59.5	51.5
70.2	38.7	52.1	70.9	92.7	58.0
32.0	61.8	62.1	50.0	75.8	39.9
21.0	57.1	54.1	77.5	82.2	67.5
46.1	57.3	57.6			
67.7	70.2	83.0			
54.3	54.8	129.8			
69.1	49.9	52.7			
49.2	52.8	62.9			
46.7	58.7	64.8			
Coefficient of determination:	D = 0.005	D = 0.075	Coefficient of determination:	D = 0.062	D = 0.273
Coefficient of efficiency:	E = 0.417	E = 1.074	Coefficient of efficiency:	E = 4.495	E = 0.326
Error function:	F1= 0.412	F1= 0.999	Error function:	F1= 4.433	F1= 0.053

Table 3.18 Details of Walker vegetation monitoring sites located in the study area and used in the prediction of soil loss

WOODY VEGETATION COMMUNITY	NUMBER OF SITES	
	CULL BLOCK	NON-CULL BLOCK
Acacia grandicornuta/Spirostachys africana	4	9
Acacia tortilis	3	5
Acacia nigrescens	3	3

Table 3.19 Predicted soil loss from Walker transect vegetation monitoring sites in the study area. Values given are mean and standard error and, in parentheses, range

YEAR	PREDICTED MEAN SOIL LOSS (g)	
	NON-CULL BLOCK	CULL BLOCK
1979	2374.4±502.2 (532-5066) n=10	357.9±19.2 (307-399) n=4
1980	1902.9±318.6 (577-3927) n=10	483.3±58.1 (376-575) n=3
1981	2064.9±300.4 (439-4311) n=17	1345.9±208.8 (509-2000) n=8
1982	1256.7±147.6 (317-3220) n=29	591.3±59.4 (253-1059) n=17
1983	3129.6±655.2 (200-6233) n=12	1910.1±501.1 (434-3772) n=6
1984	399.0±47.1 (136-612) n=10	218.9±34.1 (144-308) n=4
1985	633.7±101.5 (167-1590) n=17	356.7±47.7 (149-651) n=10
1986	1052.5±149.3 (286-2057) n=17	1250.5±214.0 (460-2812) n=10

Table 3.20 Stocking rates of grazers and mixed feeders in the study area for the period 1978 to 1986, as determined by various counts

COUNT DATE	COUNT TYPE	STOCKING RATE (kg/ha)		STOCKING RATE DIFFERENTIAL (x)/(y)
		NON-CULL (x)	CULL (y)	
JULY 1978	HELICOPTER	61.1	85.5	0.71
AUG 1979	HELICOPTER	59.8	69.3	0.86
JULY 1980	HELICOPTER	54.5	67.1	0.81
AUG 1981	HELICOPTER	42.4	30.2	1.40
AUG 1981	HELICOPTER	49.7	37.4	1.33
SEPT 1981	HELICOPTER	34.6	26.6	1.30
AUG 1982	HELICOPTER	37.5	35.1	1.07
AUG 1983	HELICOPTER	26.8	40.4	0.67
JULY 1984	TOTAL GROUND	71.9	70.2	1.02
SEPT 1984	HELICOPTER	42.2	36.6	1.15
JUNE 1985	FIXED-WING	21.3	37.4	0.57
OCT 1985	FIXED-WING	23.0	20.9	1.10
FEB 1986	FIXED-WING	15.2	25.3	0.60
JULY 1986	FIXED-WING	30.6	39.0	0.79
NOV 1986	FIXED-WING	26.6	31.9	0.84

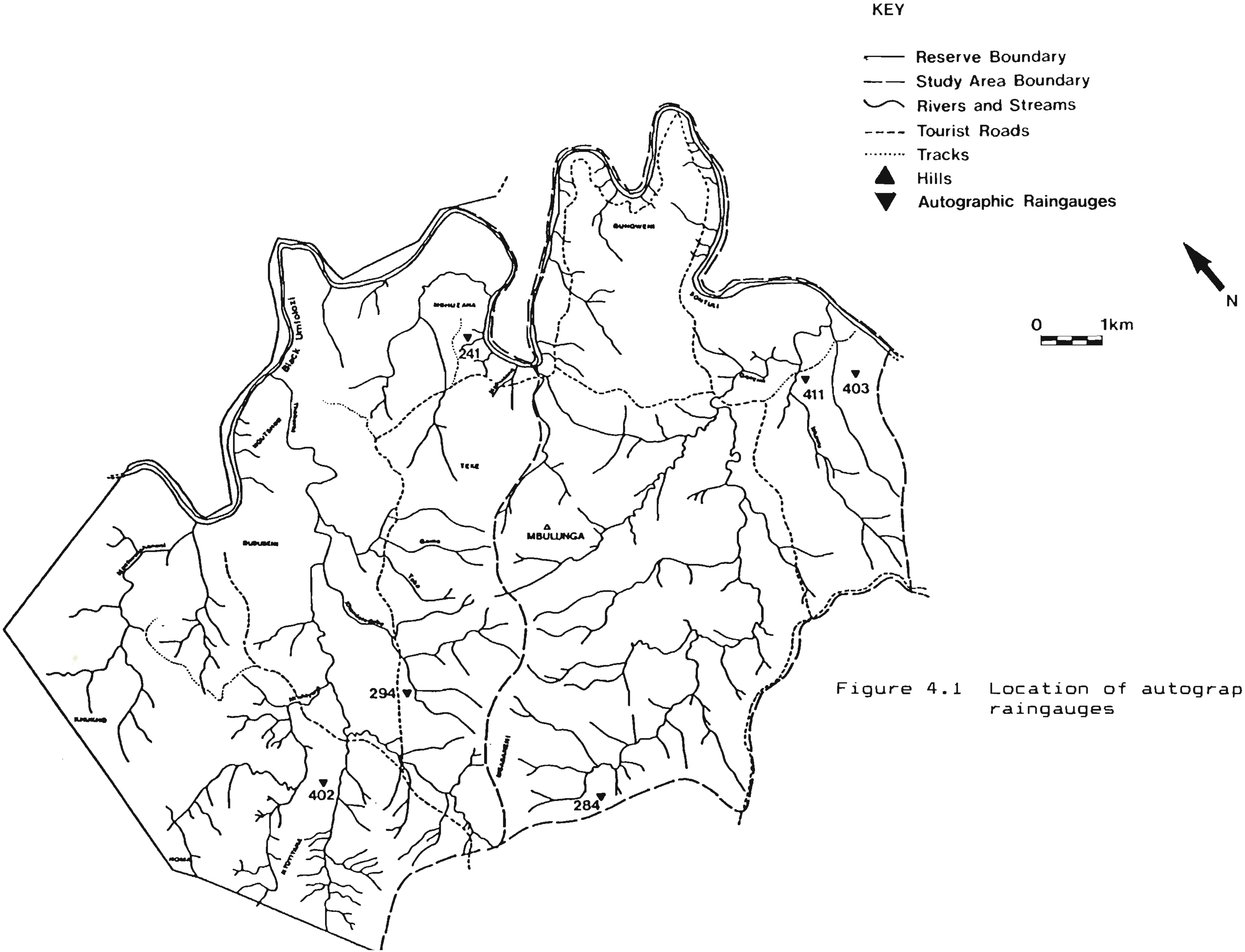

Figure 4.1 Location of autographic raingauges

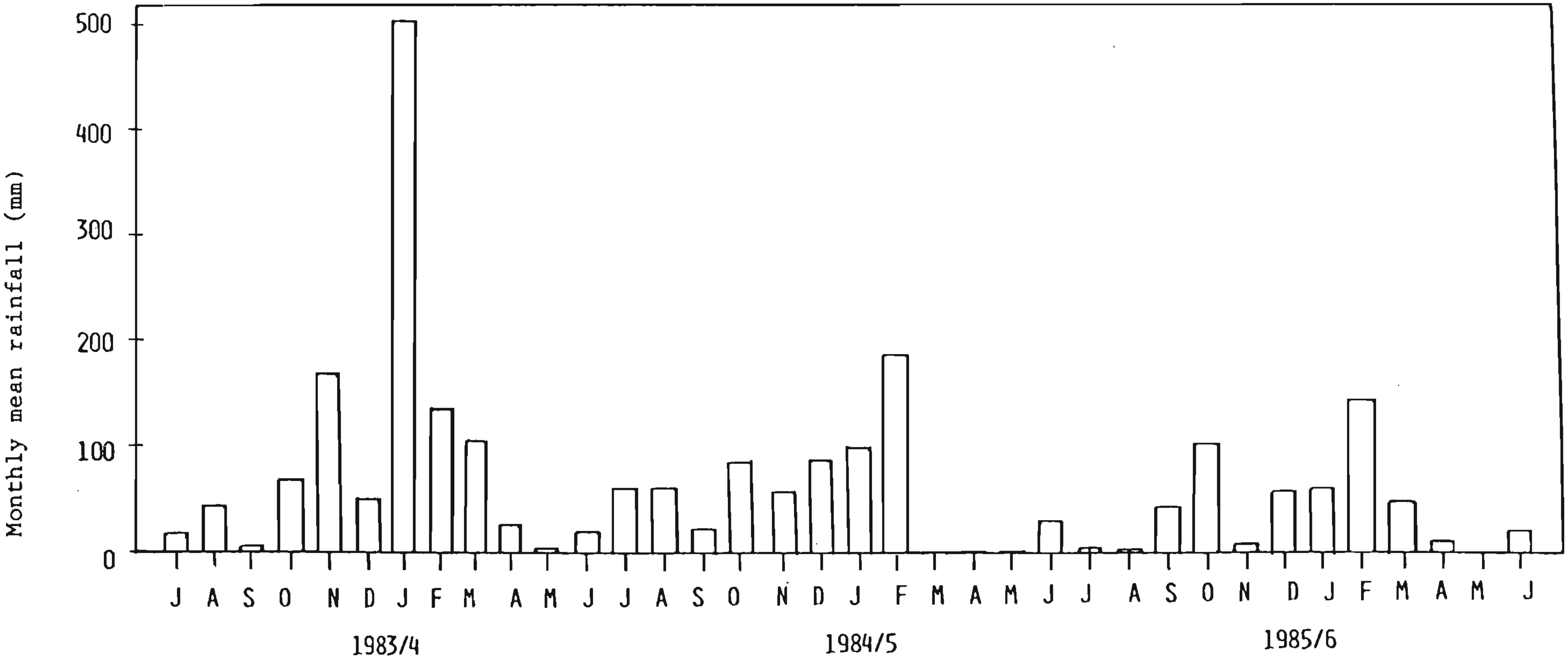

Figure 4.2 Monthly mean rainfall (mm) measured at six sites in the study area for the period July 1983 to June 1986

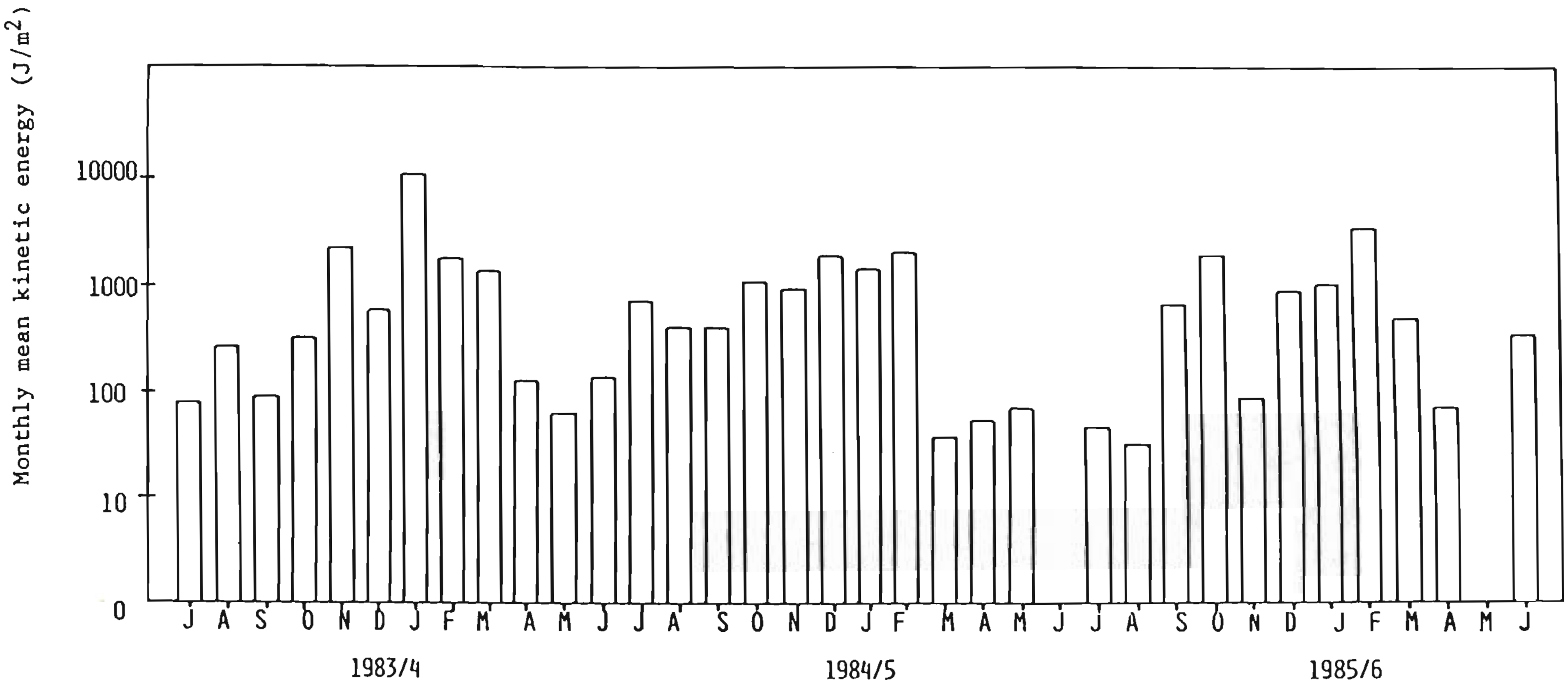

Figure 4.3 Monthly mean rainfall kinetic energy (J/m^2) measured at six sites in the study area for the period July 1983 to June 1986

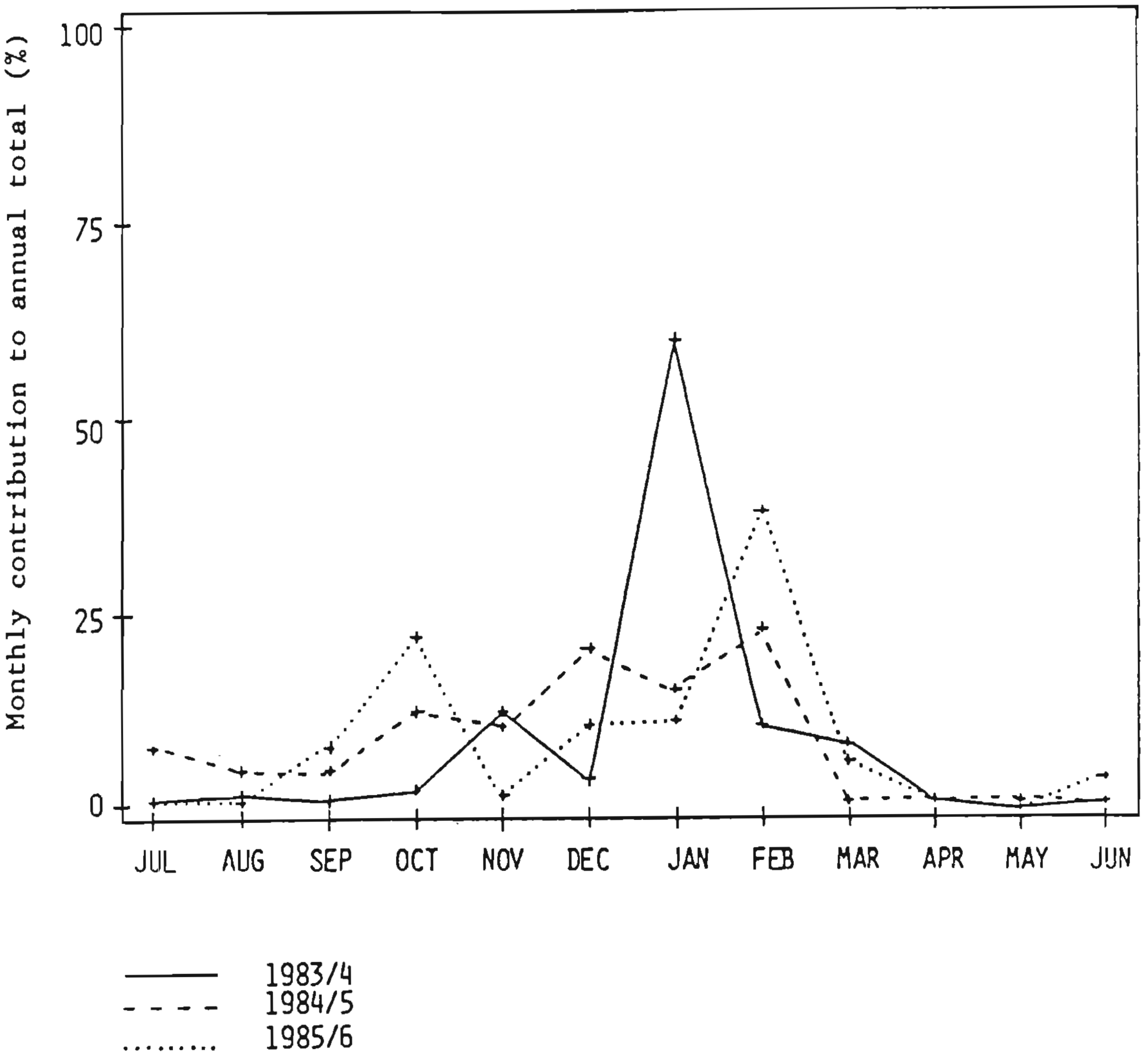

Figure 4.4 Monthly mean rainfall kinetic energy (J/m²) expressed as a percentage of annual mean values for the 1983/84, 1984/85 and 1985/86 rainfall years

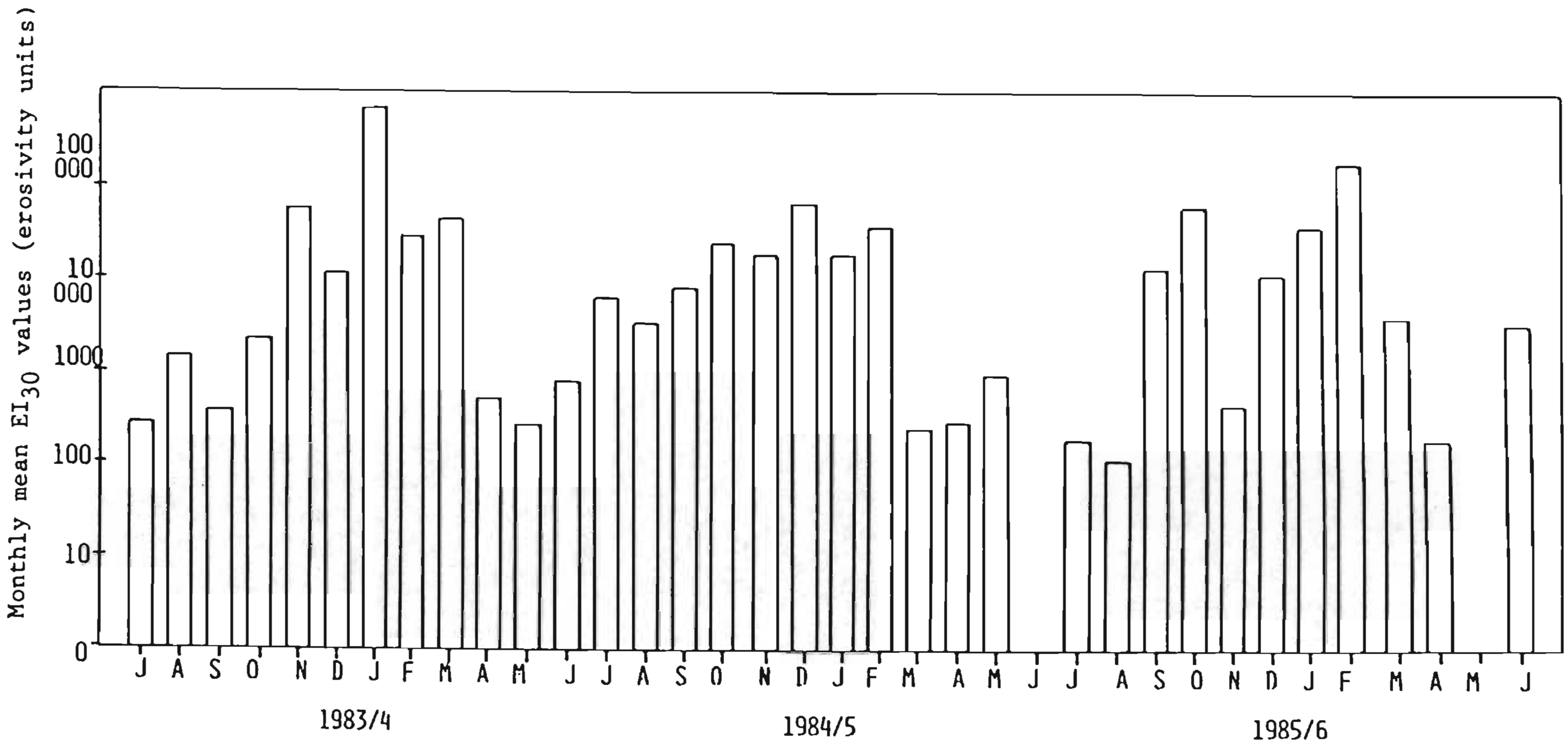

Figure 4.5 Monthly mean EI_{30} values measured at six sites in the study area for the period July 1983 to June 1986

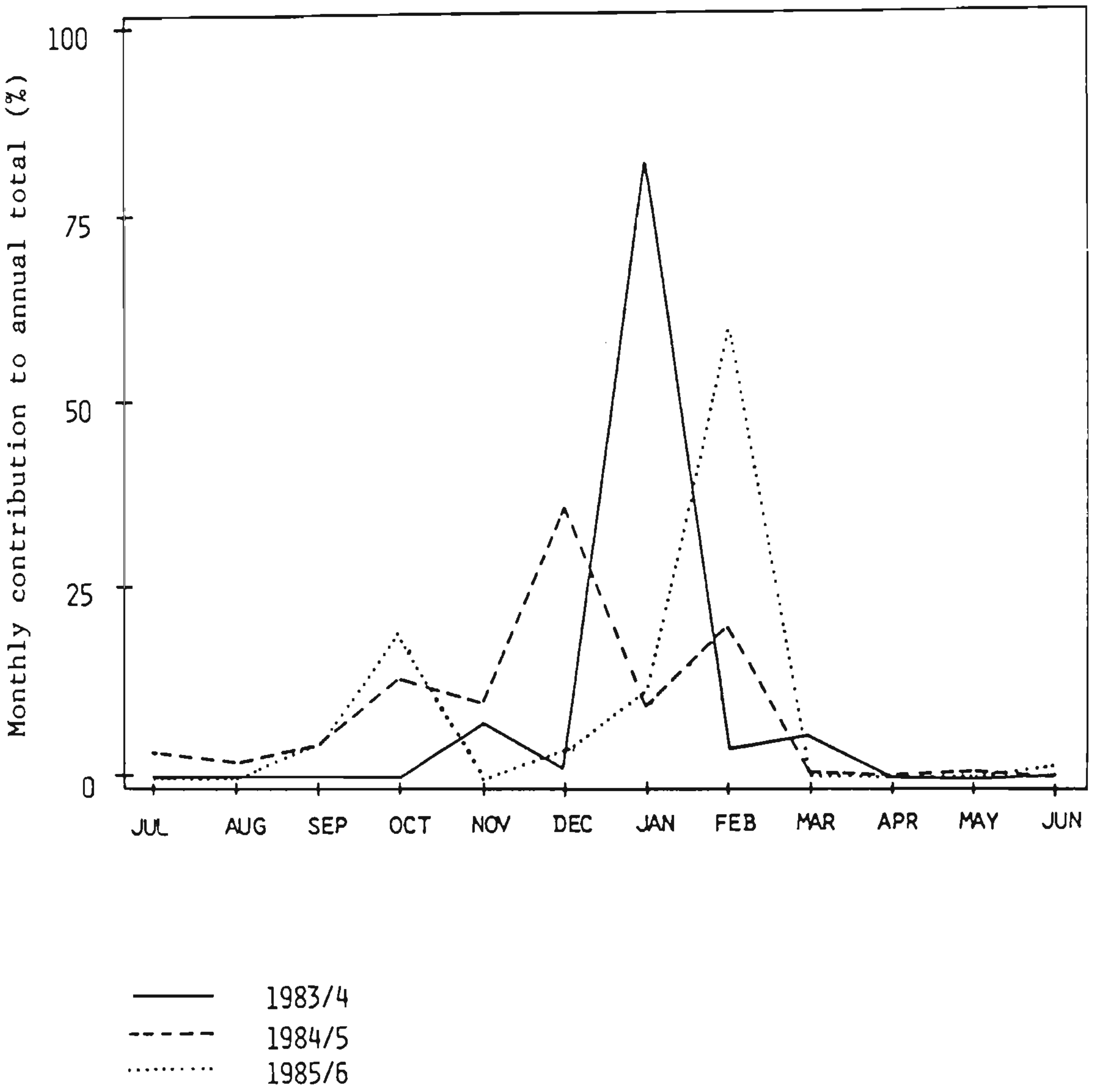

Figure 4.6 Monthly mean EI$_{30}$ values expressed as a percentage of annual mean values for the 1983/84, 1984/85 and 1985/86 rainfall years

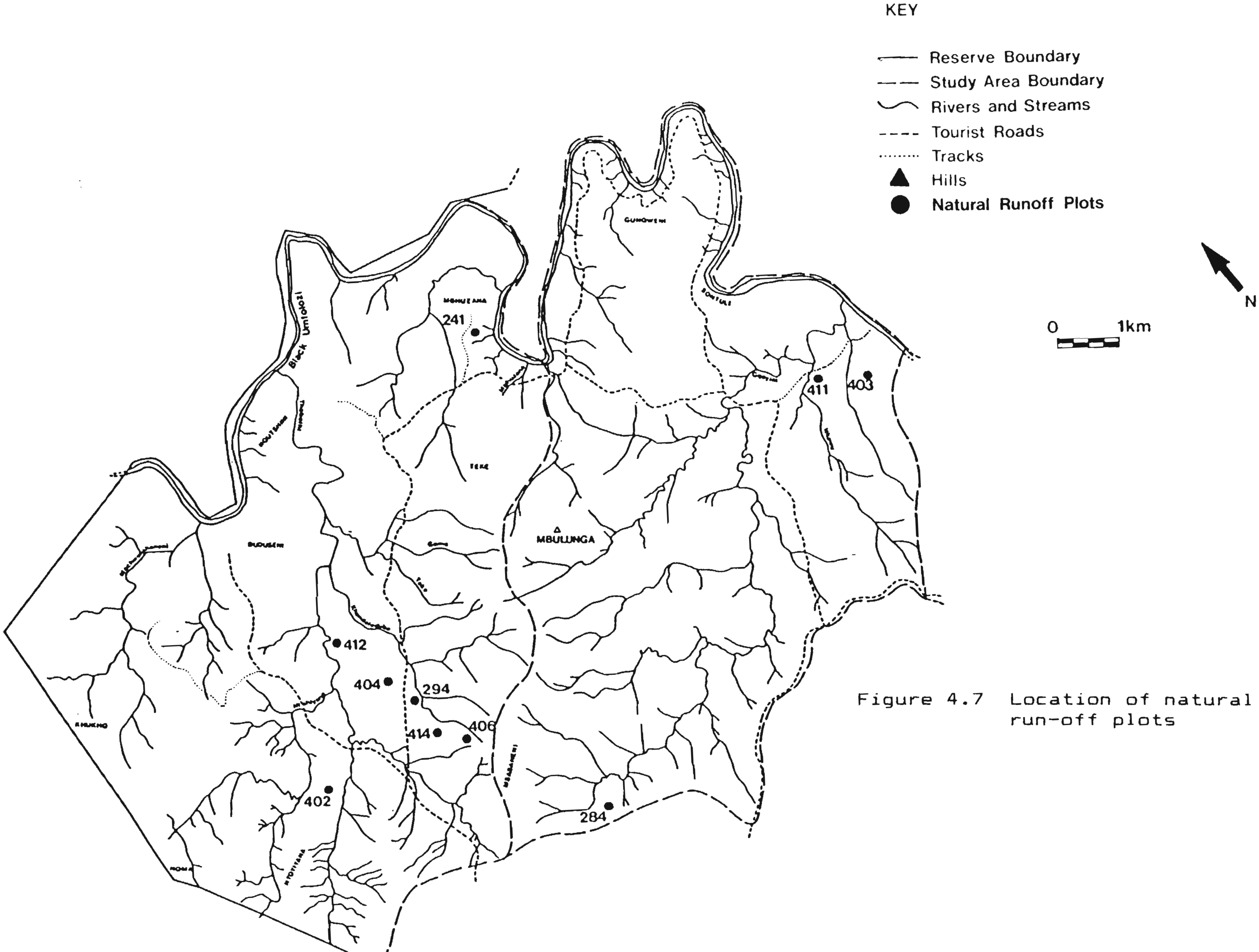

Figure 4.7 Location of natural run-off plots

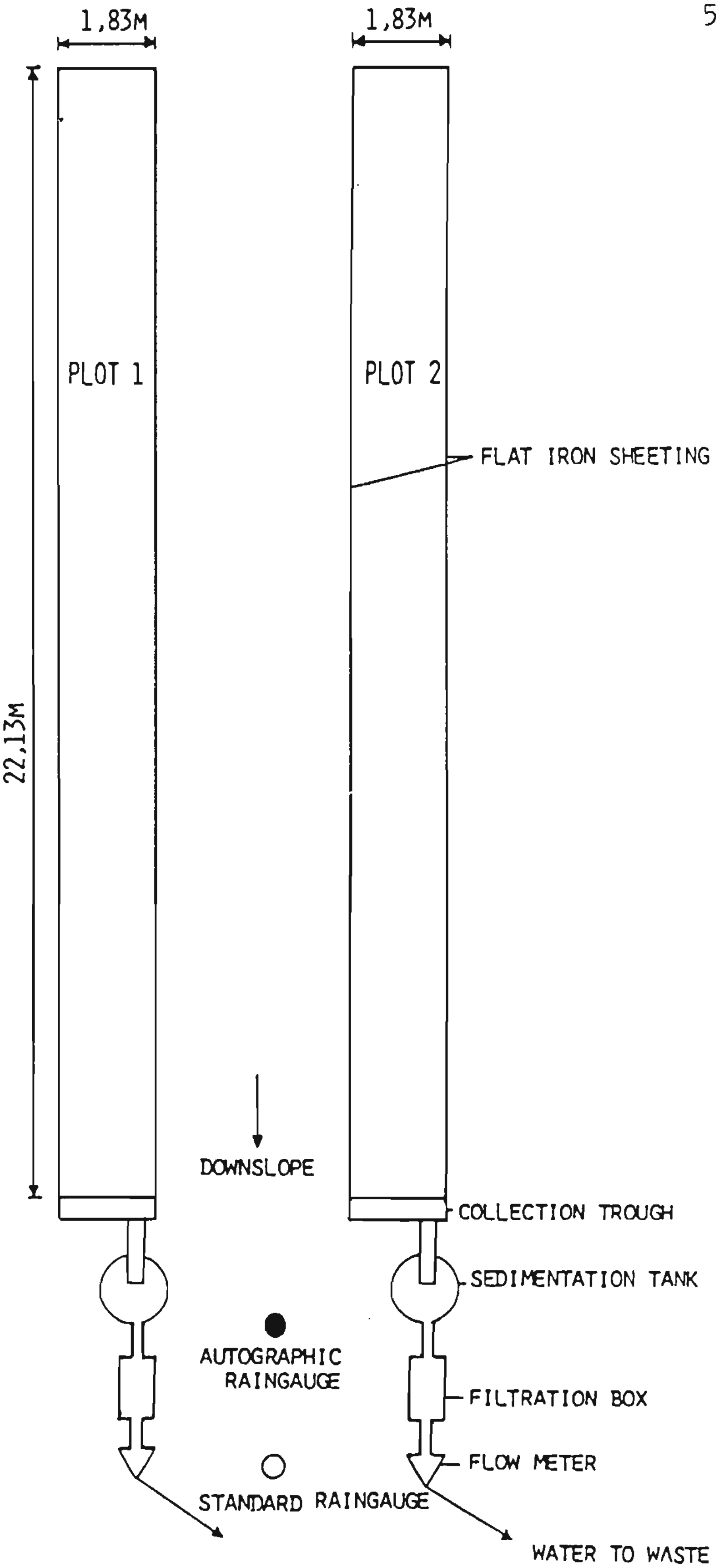

Figure 4.8 Dimensions and layout of a typical natural run-off site in Umfolozi Game Reserve

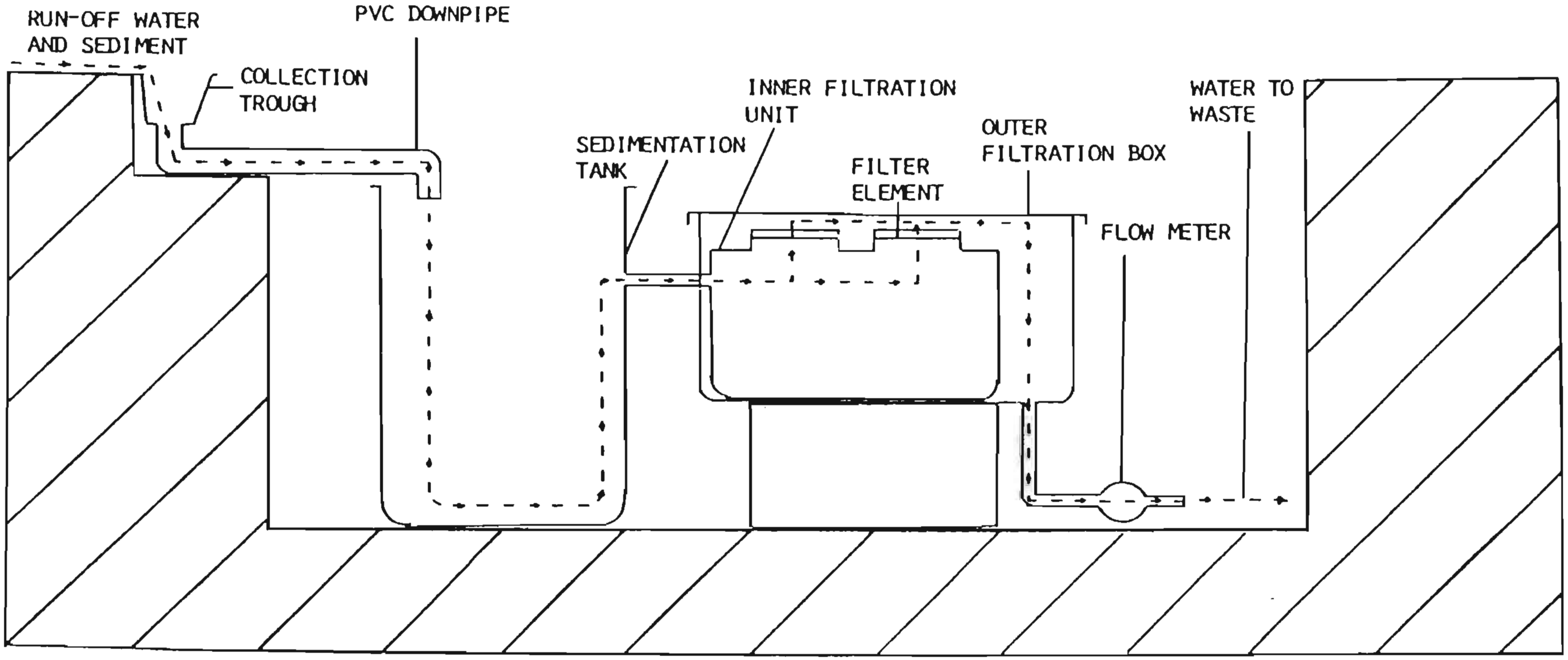

Figure 4.9 Vertical plan of sediment and run-off collecting apparatus used in Umfolozi Game Reserve

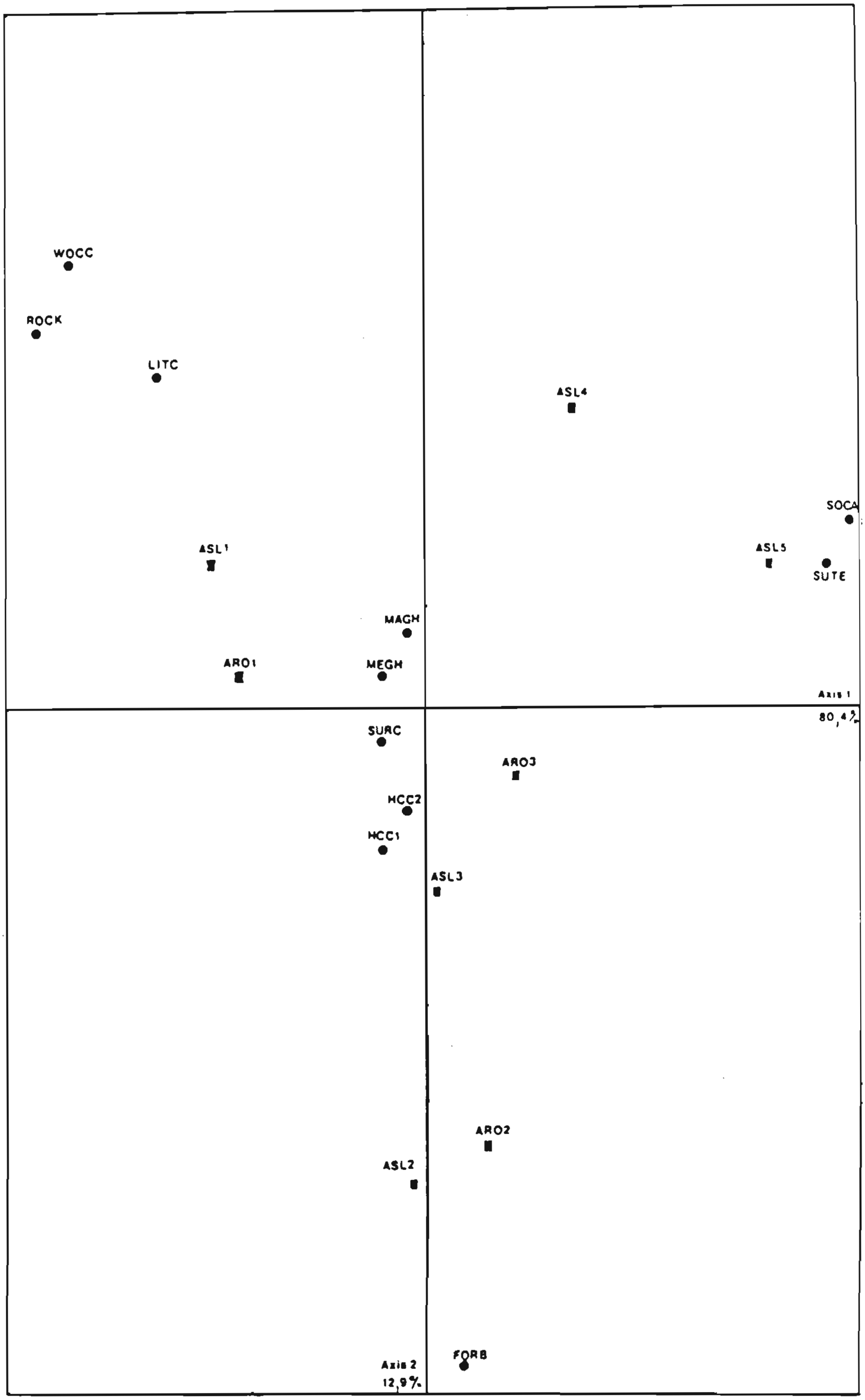

Figure 4.10 Two-dimensional display, obtained by correspondence analysis, of 1983/4 natural run-off plot data

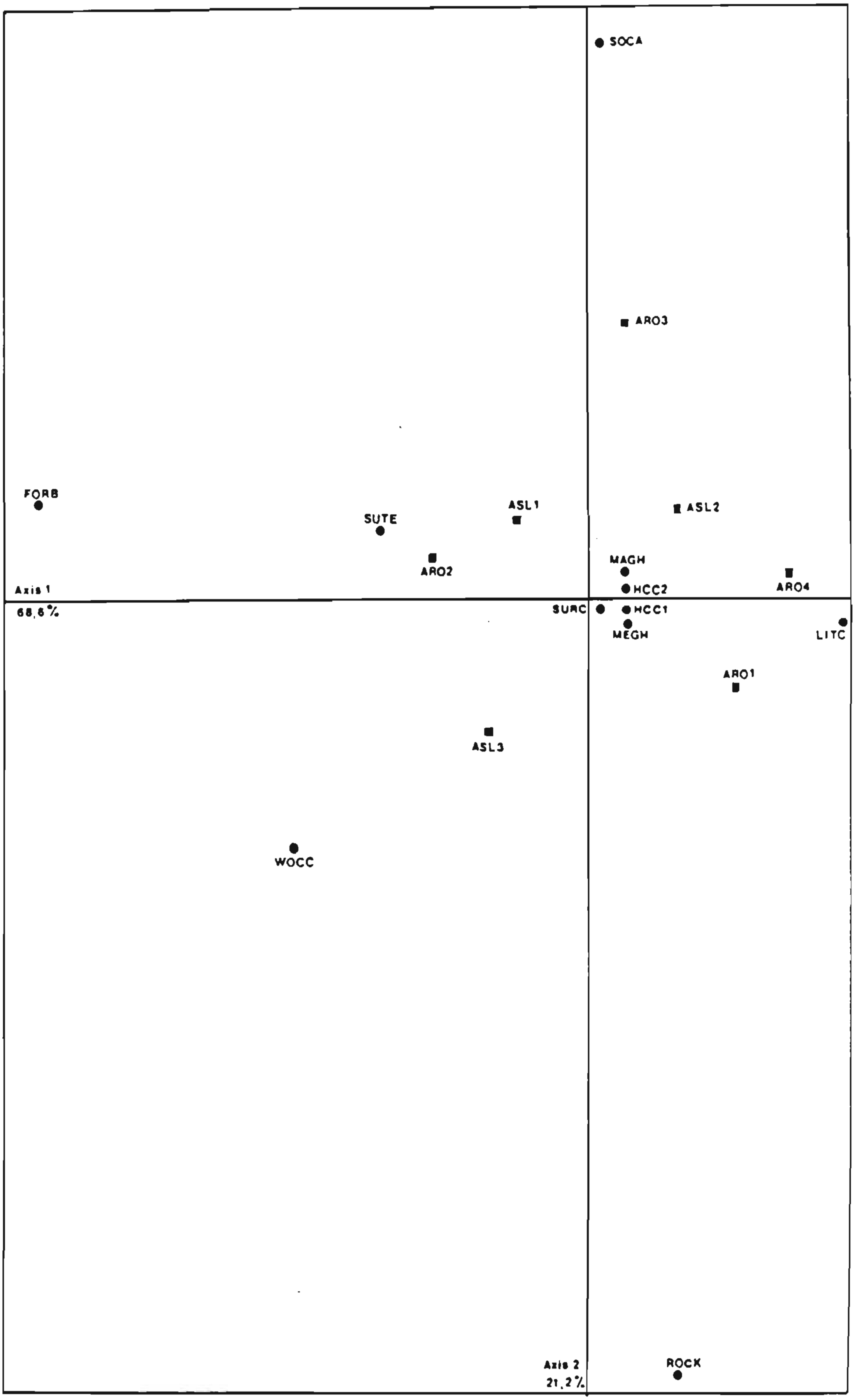

Figure 4.11 Two-dimensional display, obtained by correspondence analysis, of 1984/5 natural run-off plot data

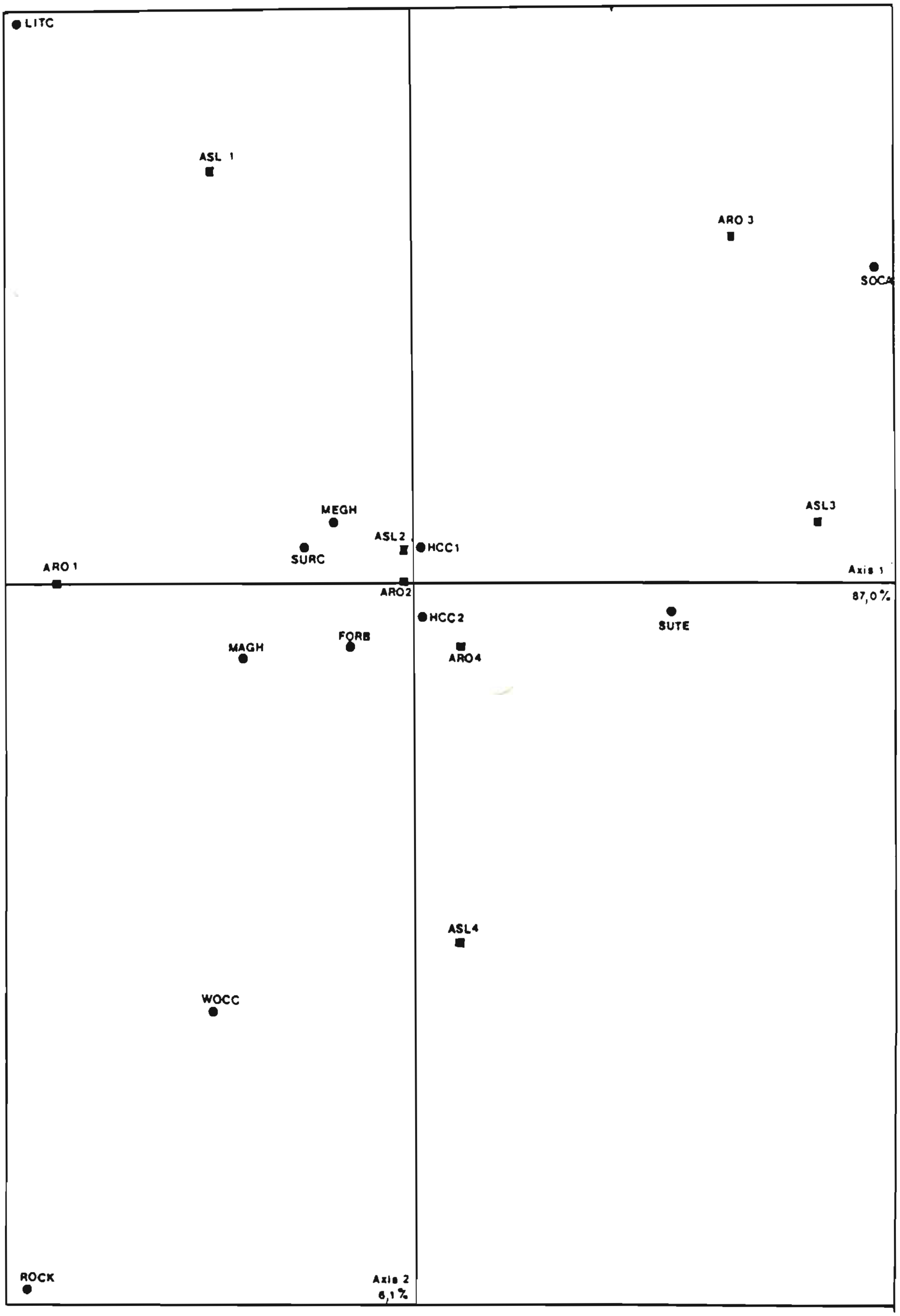

Figure 4.12 Two-dimensional display, obtained by correspondence analysis, of 1985/6 natural run-off plot data

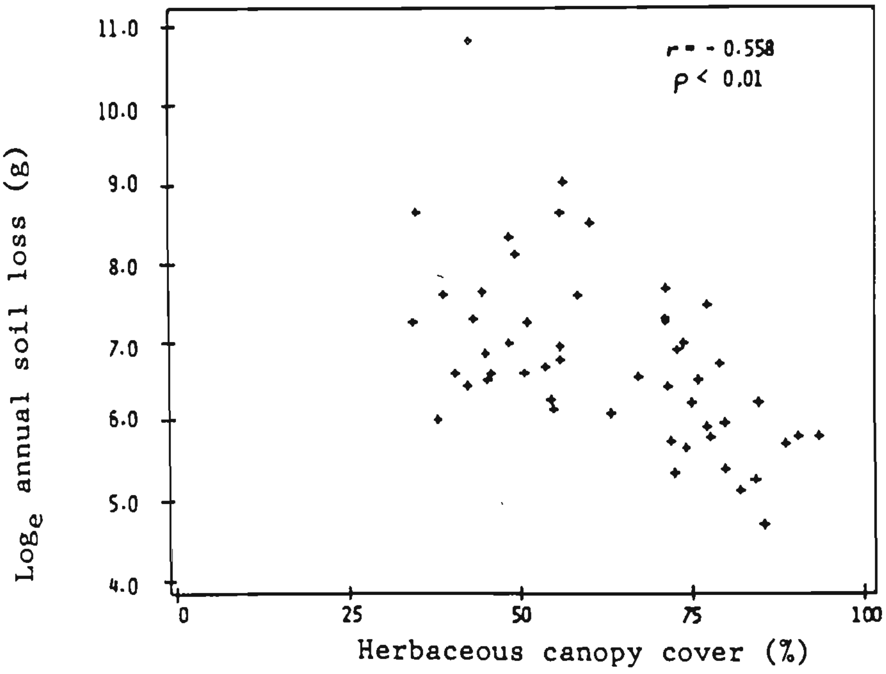

Figure 4.13 Scattergram of $\log_e$ annual soil loss (g) against percentage herbaceous canopy cover

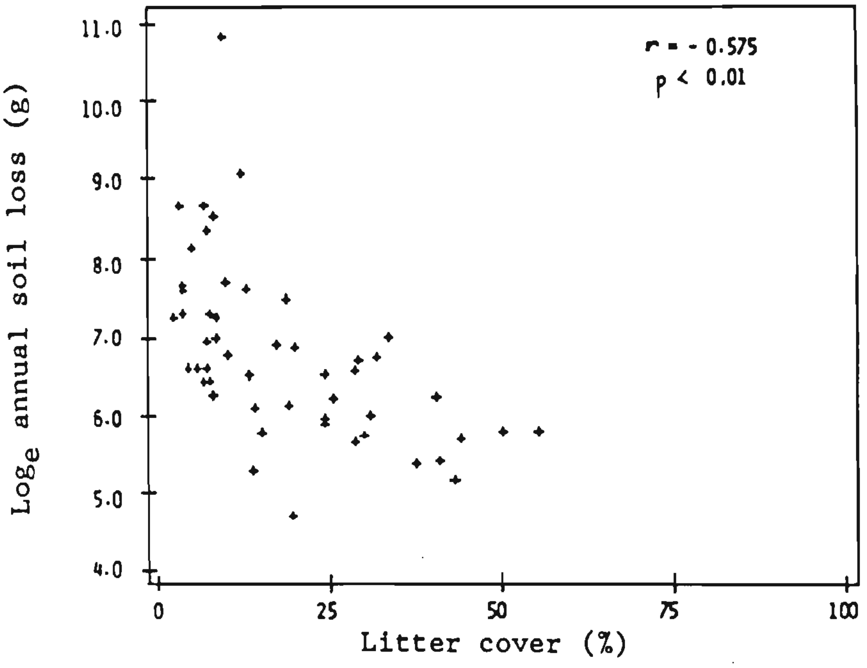

Figure 4.14 Scattergram of $\log_e$ annual soil loss (g) against percentage litter cover

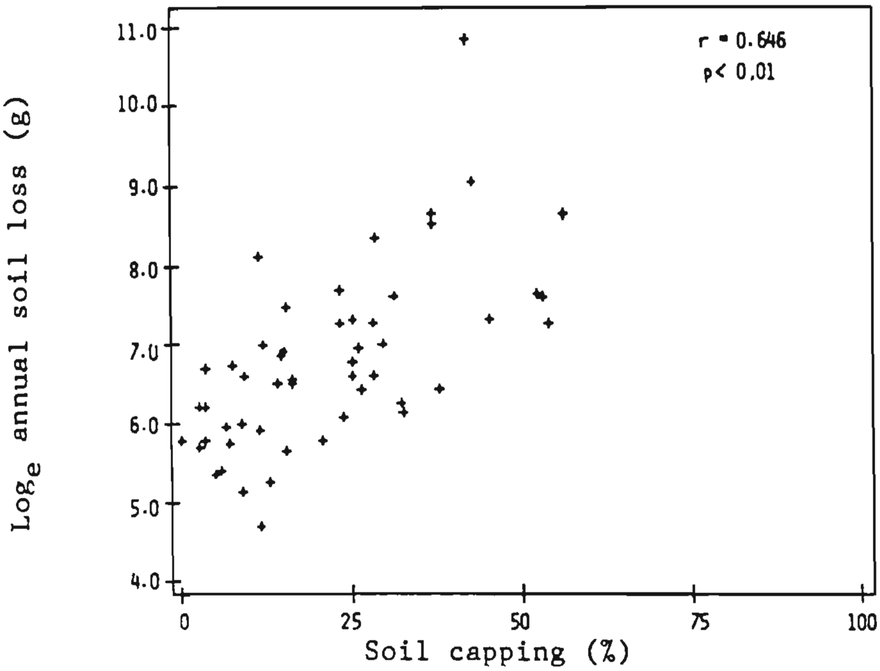

Figure 4.15 Scattergram of log$_e$ annual soil loss (g) against percentage soil capping

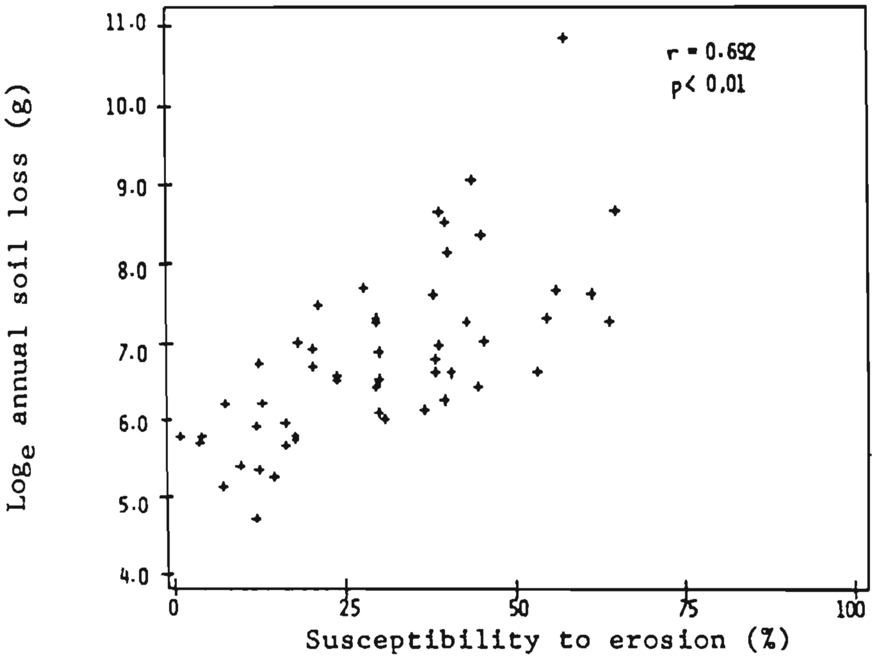

Figure 4.16 Scattergram of log$_e$ annual soil loss (g) against percentage susceptible to erosion

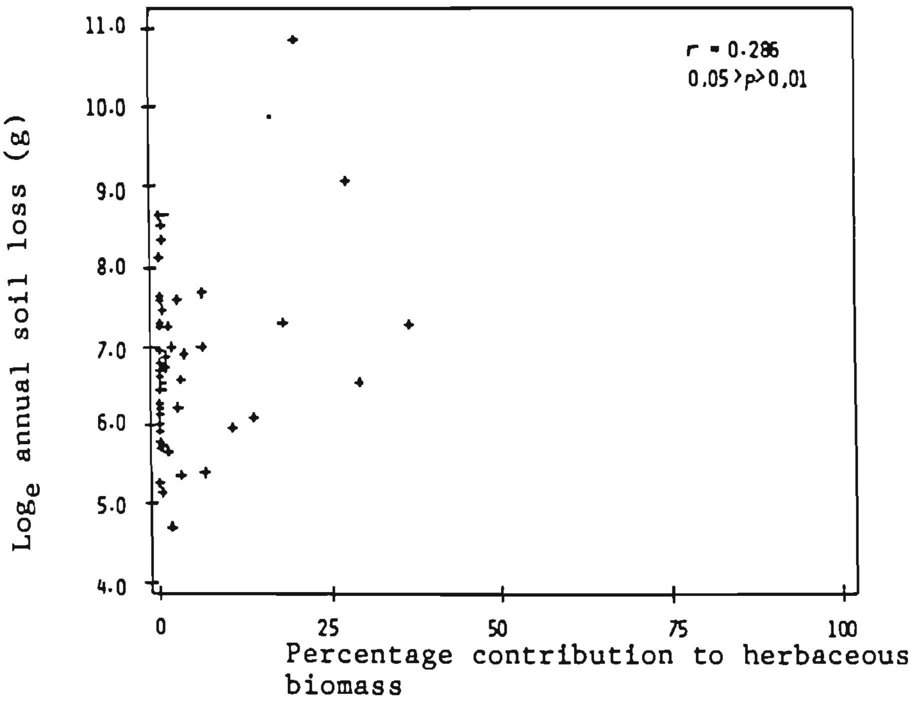

Figure 4.17 Scattergram of log$_e$ annual soil loss (g) against percentage contribution to herbaceous biomass of *Aizoon glinoides*

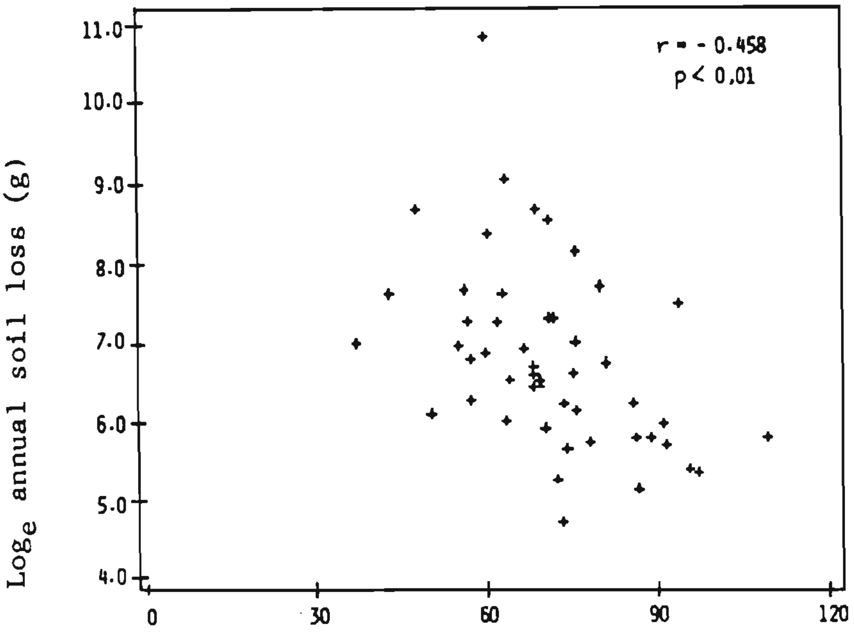

Figure 4.18 Scattergram of log$_e$ annual soil loss (g) against maximum grass height (cm)

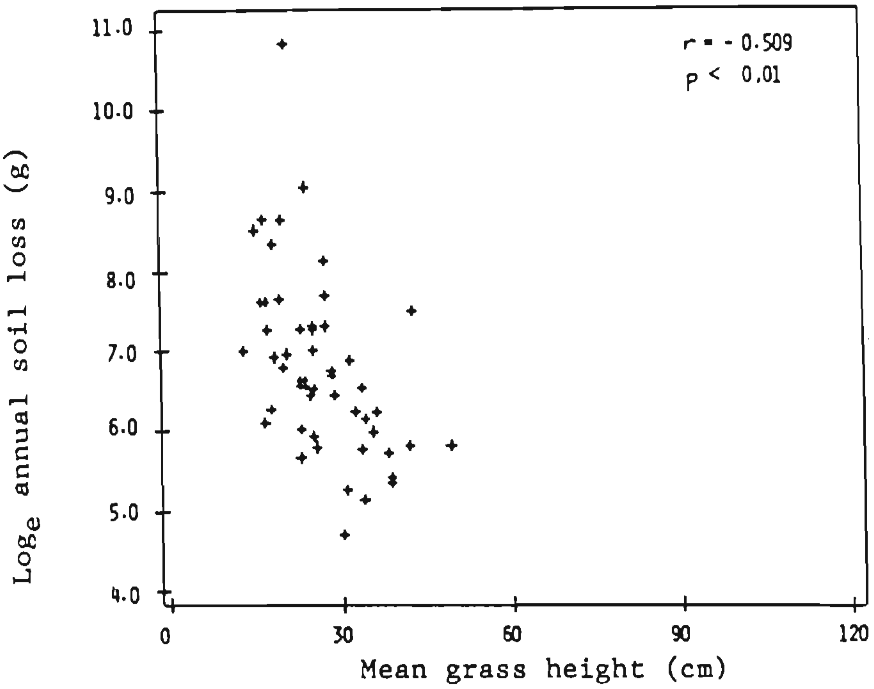

Figure 4.19 Scattergram of $\log_e$ annual soil loss (g) against mean grass height (cm)

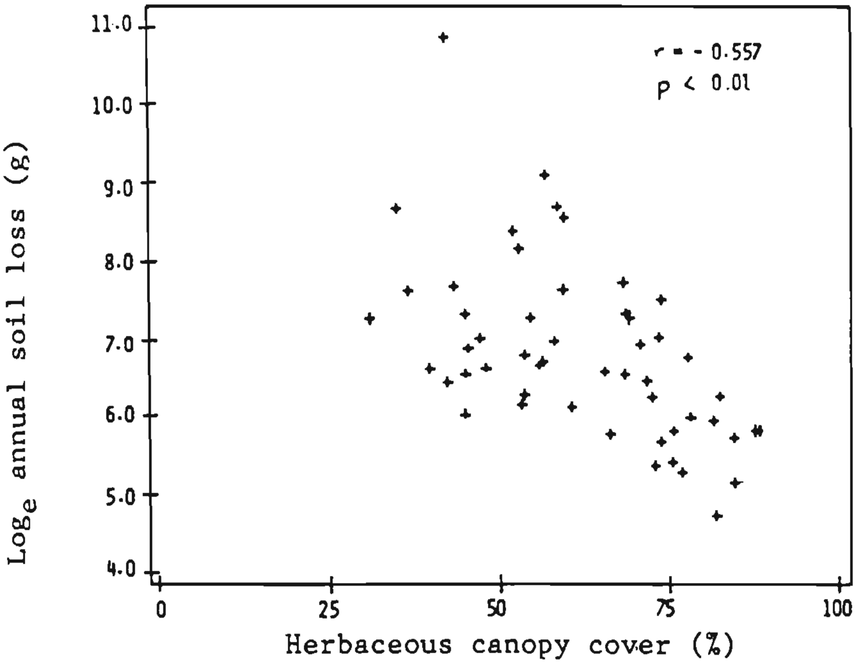

Figure 4.20 Scattergram of $\log_e$ annual soil loss (g) against percentage herbaceous canopy cover, determined by the USLE method

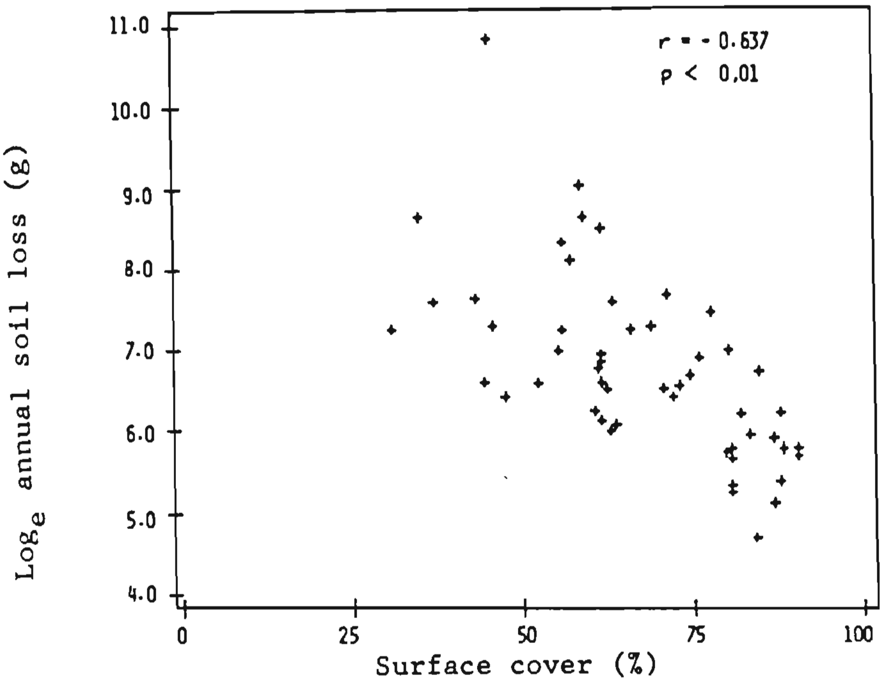

Figure 4.21 Scattergram of log$_e$ annual soil loss (g) against percentage surface cover

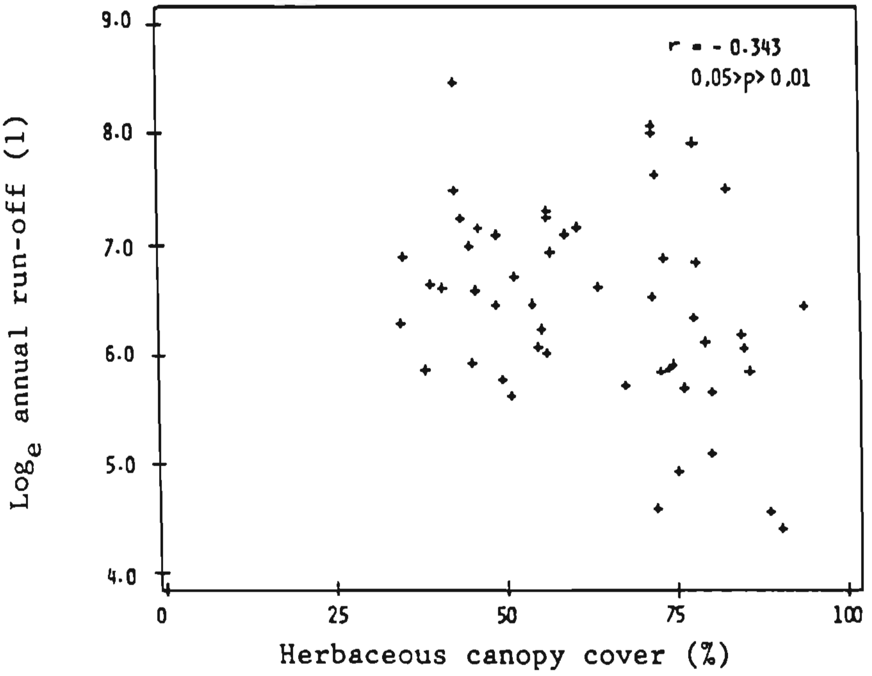

Figure 4.22 Scattergram of log$_e$ annual run-off (l) against percentage herbaceous canopy cover

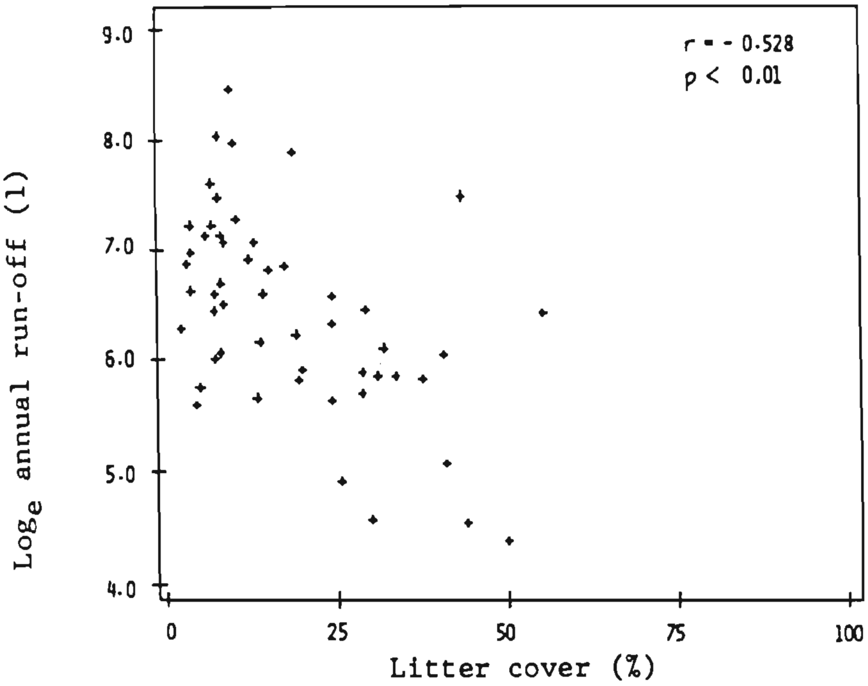

Figure 4.23 Scattergram of $\log_e$ annual run-off (l) against percentage litter cover

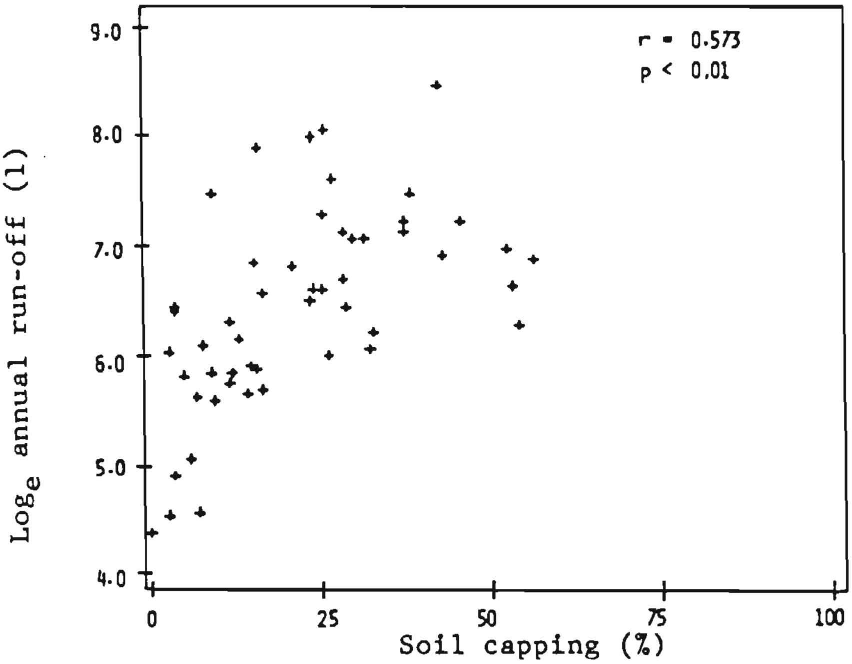

Figure 4.24 Scattergram of $\log_e$ annual run-off (l) against percentage soil capping

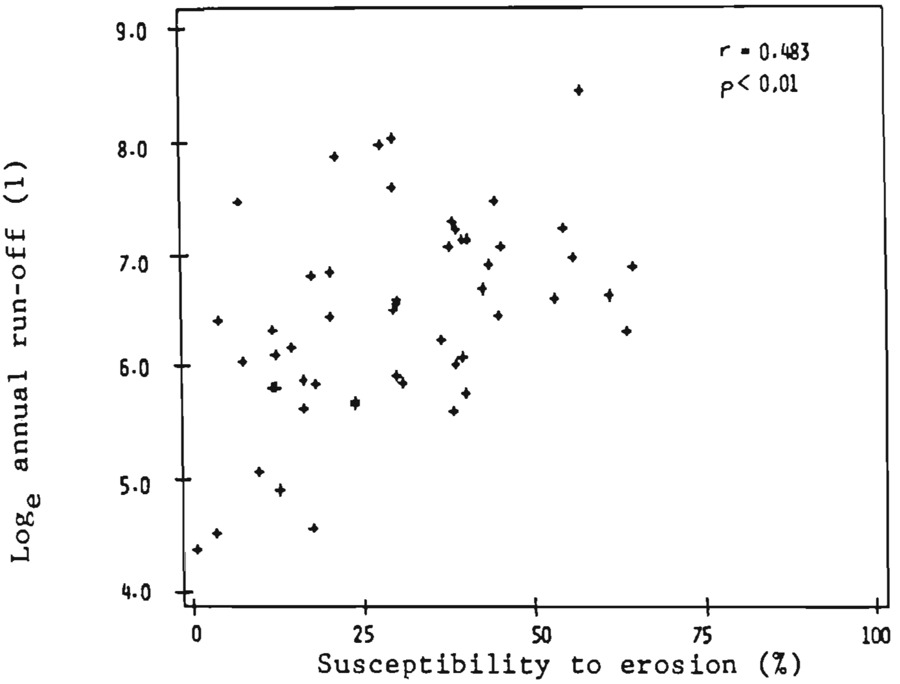

Figure 4.25 Scattergram of log$_e$ annual run-off (1) against percentage susceptible to erosion

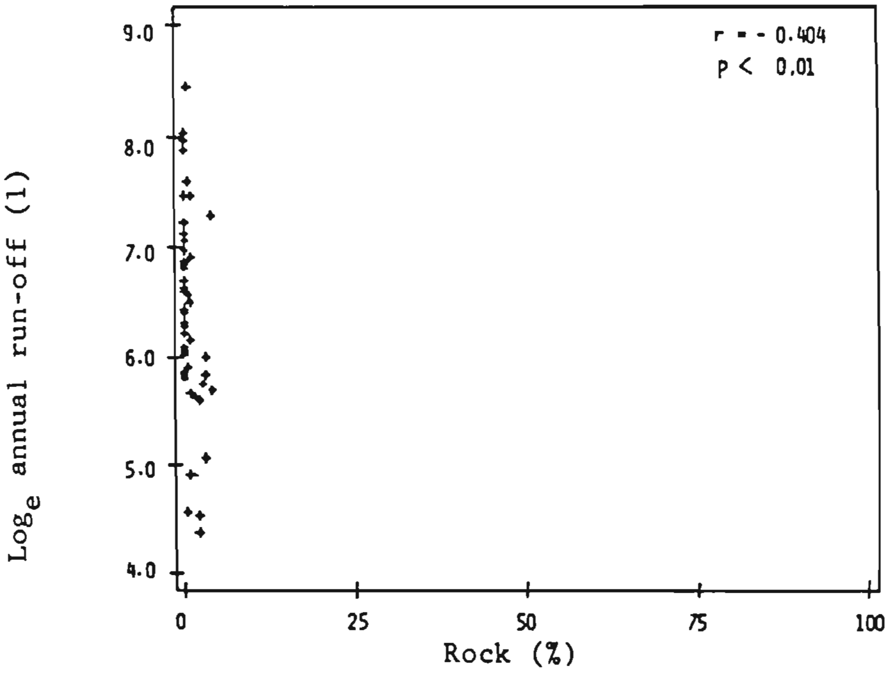

Figure 4.26 Scattergram of log$_e$ annual run-off (1) against percentage rock

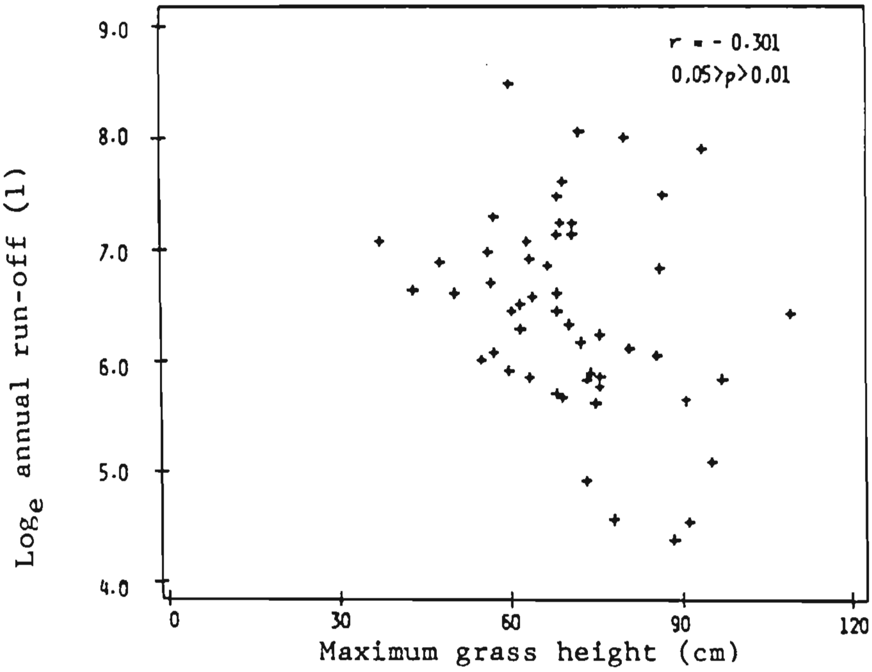

Figure 4.27 Scattergram of log$_e$ annual run-off (1) against maximum grass height (cm)

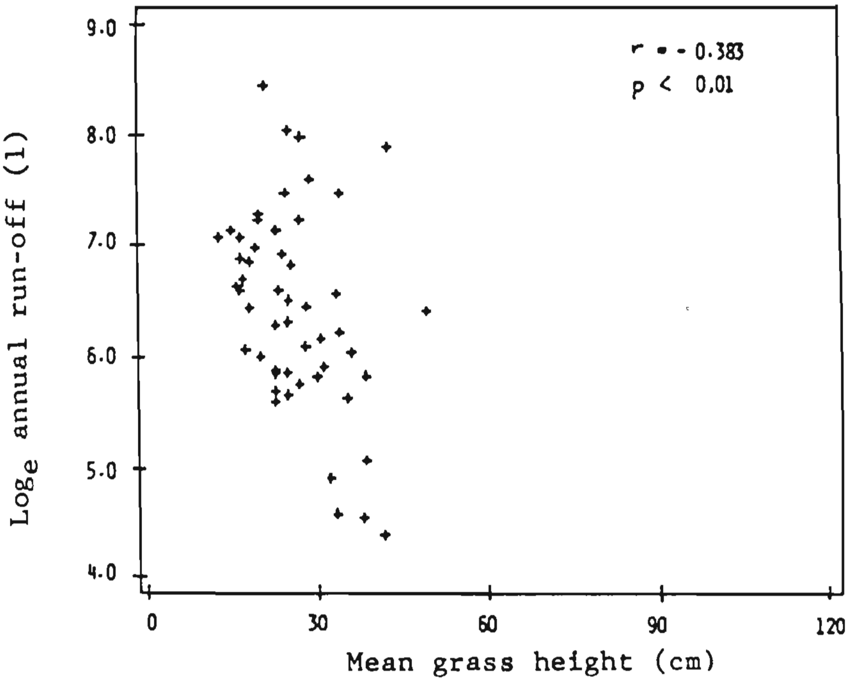

Figure 4.28 Scattergram of log$_e$ annual run-off (1) against mean grass height (cm)

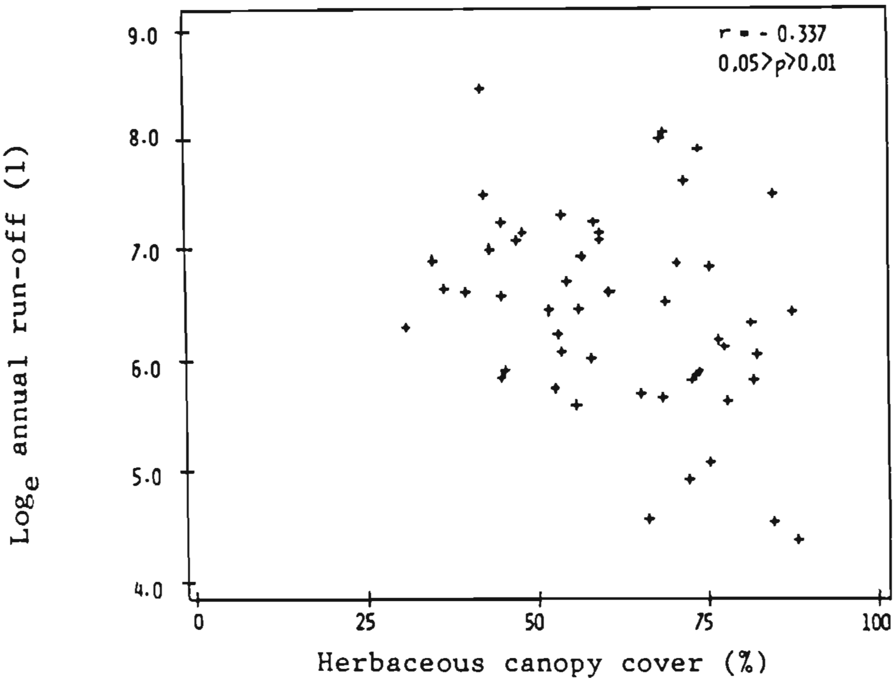

Figure 4.29 Scattergram of log$_e$ annual run-off (1) against percentage herbaceous canopy cover, determined by the USLE method

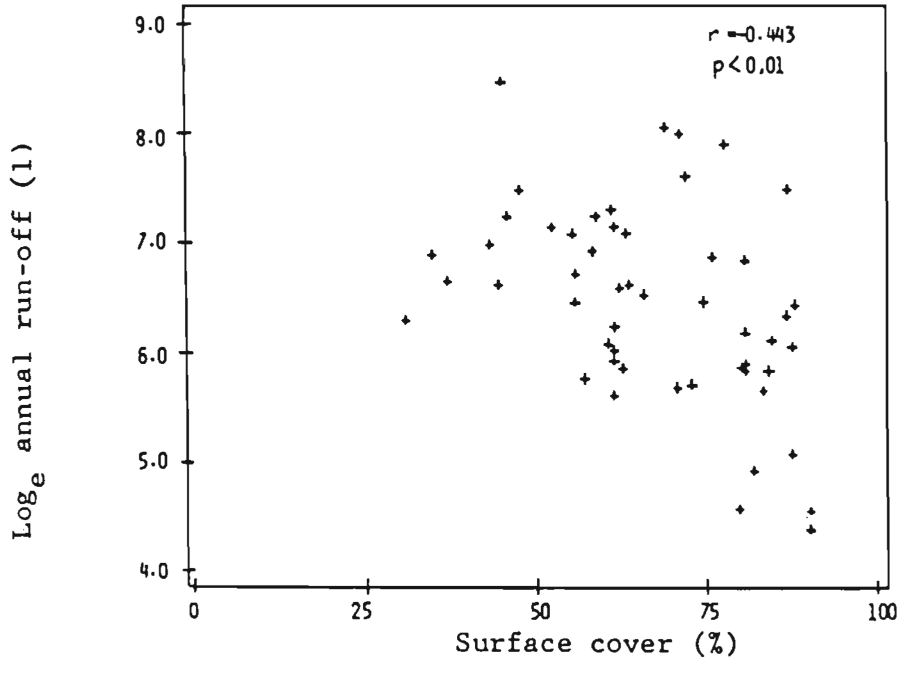

Figure 4.30 Scattergram of log$_e$ annual run-off (1) against percentage surface cover

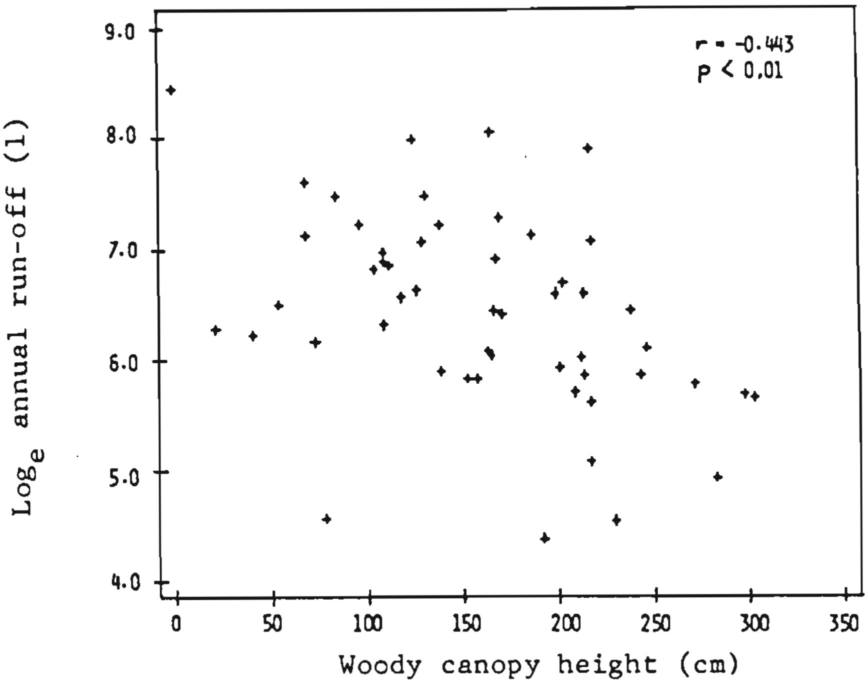

Figure 4.31 Scattergram of log$_e$ annual run-off (l) against woody canopy height (cm)

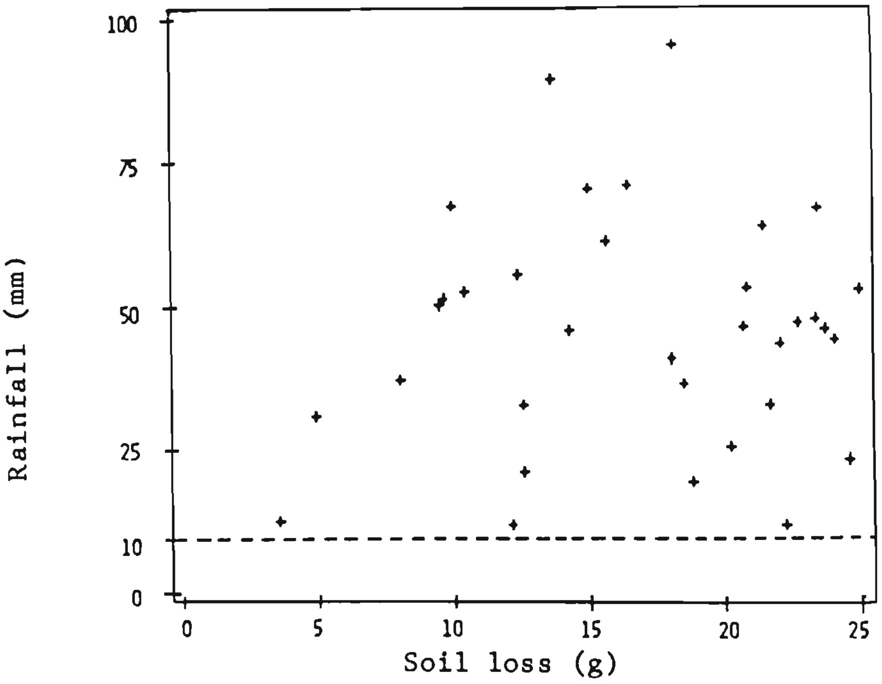

Figure 4.32 Scattergram of rainfall (mm) against soil loss (g) from erosion events where 25g or less of soil was lost

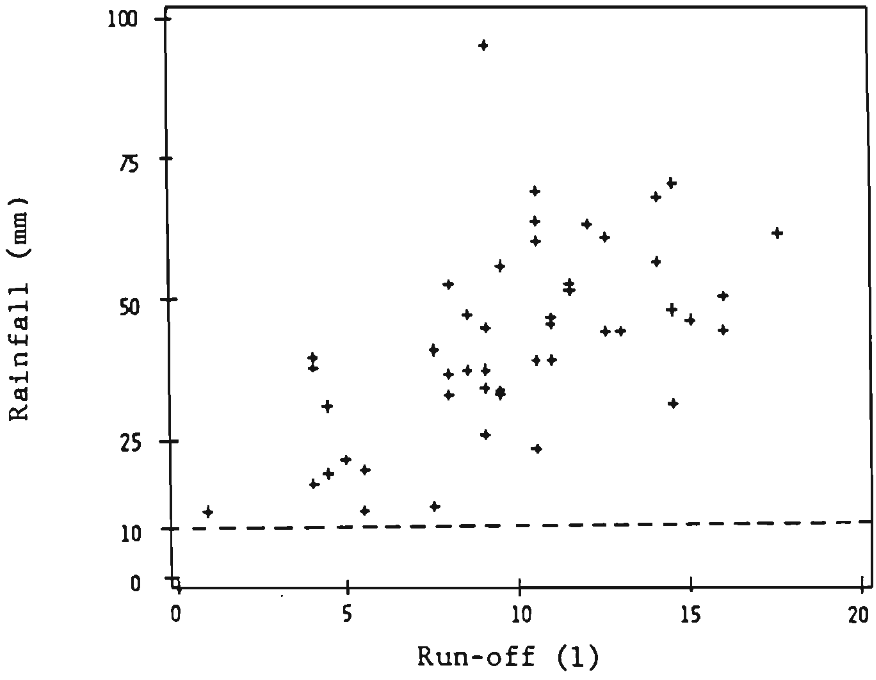

Figure 4.33 Scattergram of rainfall (mm) against run-off (l) from run-off events where 20l or less of run-off was measured

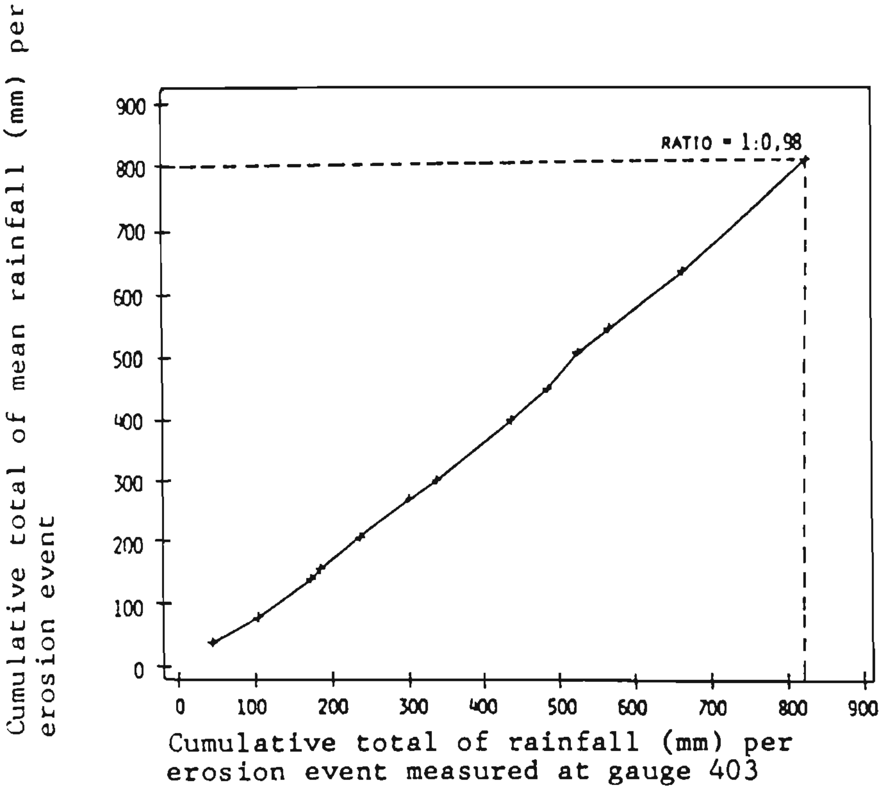

Figure 4.34 Scattergram of cumulative total of mean rainfall (mm) against cumulative total of rainfall per erosion event (mm) measured at gauge 403

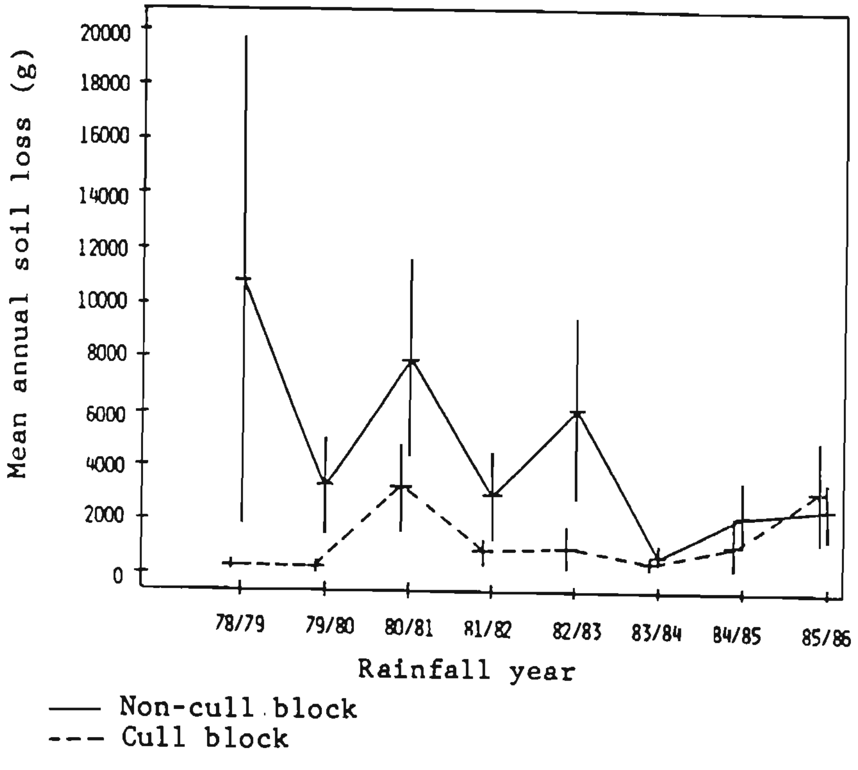

Figure 4.35 Trend in predicted annual mean soil loss from Walker transect vegetation monitoring sites in the study area. The mean is depicted by a crossbar and 95% confidence limits by a vertical line

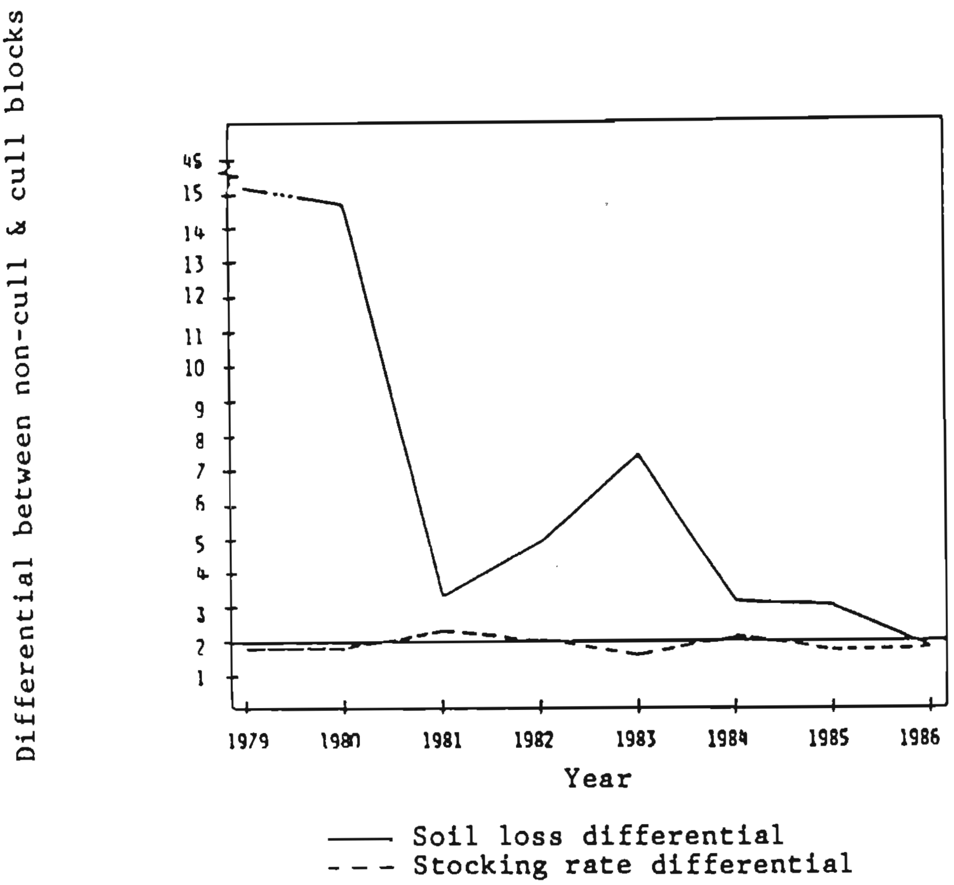

Figure 4.36 Relationship between actual stocking rate differential and predicted soil loss differential in the study area

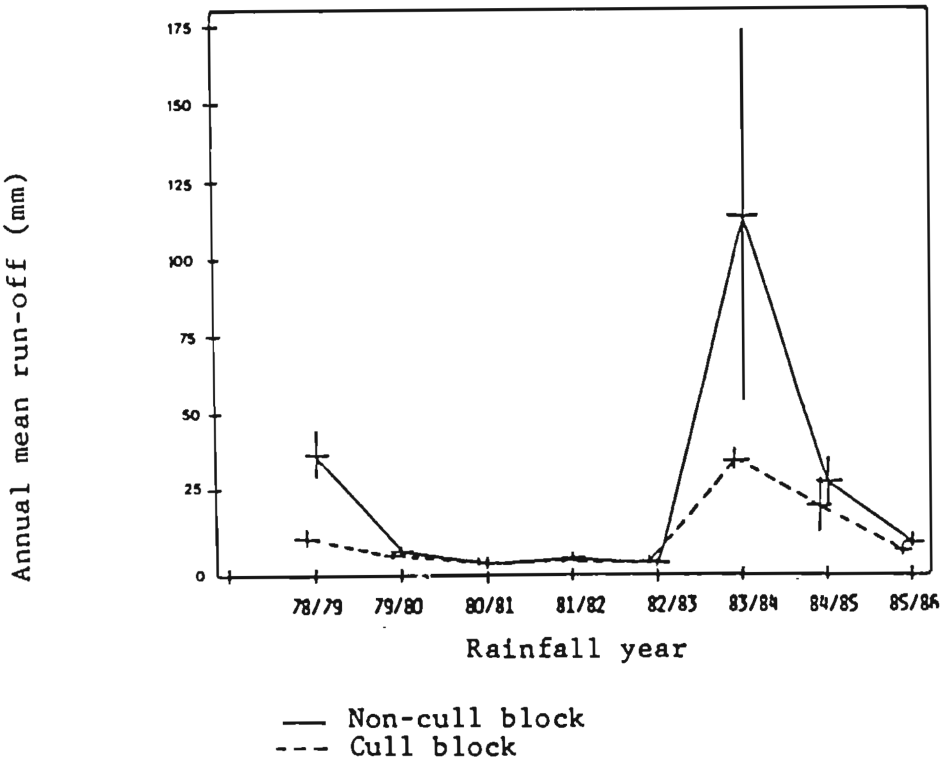

Figure 4.37 Trend in predicted annual mean run-off from Walker transect vegetation monitoring sites in the study area. The mean is depicted by a crossbar and 95% confidence limits by a vertical line

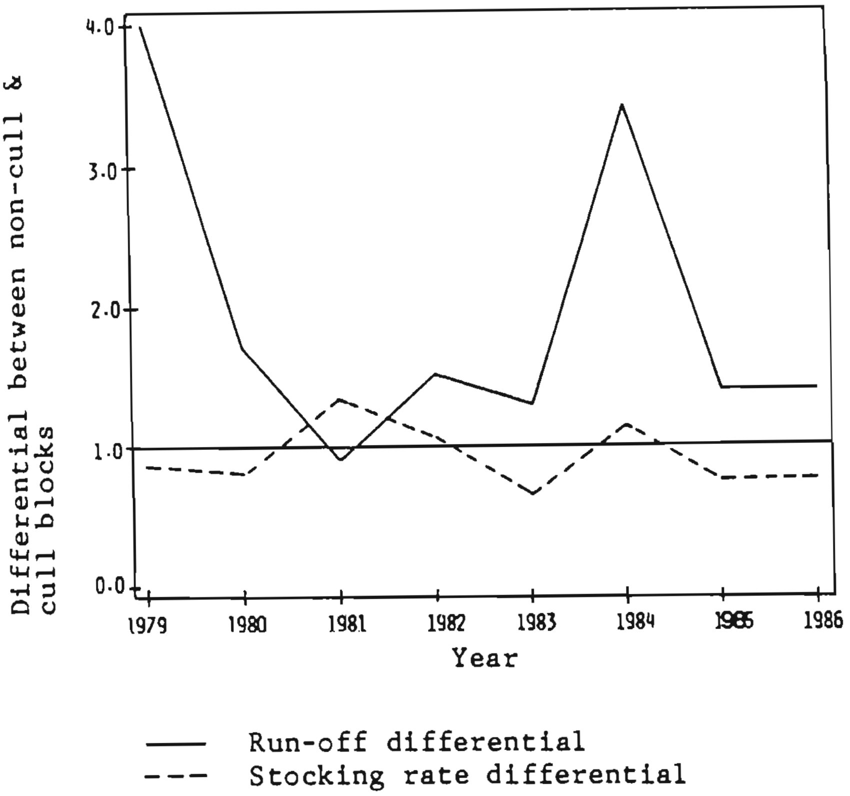

Figure 4.38 Relationship between actual stocking rate differential and predicted run-off differential in the study area

Table 4.1 Monthly rainfall variables measured at six sites in the study area for the 1983/4 rainfall year. Values given are mean and standard error and, in parentheses, range

MONTH	YEAR	TOTAL RAIN (mm)	TOTAL KINETIC ENERGY (J/sq.m)	EI30 INDEX (erosivity units)	SAMPLE SIZE
JUL	1983	17.9‡	81‡	282‡	1
AUG	1983	42.7‡	266‡	1 497‡	1
SEP	1983	6.9‡	95‡	407‡	1
OCT	1983	69.8±1.2 (67.9-71.9)	336±156 (42-576)	2 411±1 328 (102-4 702)	3
NOV	1983	168.7±10.0 (142.3-189.9)	2 296±260 (1 639-2 851)	58 773±16 269 (19 270-93 095)	4
DEC	1983	50.6±3.0 (43.7-58.7)	603±74 (411-765)	11 980±2 936 (4 432-19 275)	5
JAN	1984	504.2±19.1 (456.8-549.4)	11 383±1 117 (10 032-12 528)	683 886±99 811 (534 567-798 488)	5
FEB	1984	137.1±3.1 (134.0-140.1)	1 949±101 (1 848-2 051)	29 707±746 (28 962-30 453)	2
MAR	1984	106.6±15.6 (73.2-134.0)	1 462±313 (840-2 095)	44 920±17 303 (9 989-80 299)	4
APR	1984	28.1±1.8 (25.1-31.2)	130±18 (95-152)	543±104 (341-683)	3
MAY	1984	5.0±1.1 (1.5-7.5)	62±19 (8-103)	273±124 (5-703)	5
JUN	1984	22.7±1.2 (19.8-26.5)	138±25 (50-189)	850±202 (214-1 370)	5

‡ only one data point

Table 4.2 Monthly rainfall variables measured at six sites in the study area for the 1984/5 rainfall year. Values given are mean and standard error and, in parentheses, range

MONTH	YEAR	TOTAL RAIN (mm)	TOTAL KINETIC ENERGY (J/sq.m)	EI30 INDEX (erosivity units)	SAMPLE SIZE
JUL	1984	63.5±4.0 (44.5-72.6)	724±80 (403-924)	6 358±1 219 (2 887-10 085)	6
AUG	1984	63.7±6.2 (39.2-71.3)	429±31 (324-489)	3 741±271 (2 798-4 309)	5
SEP	1984	23.9±1.2 (21.2-28.0)	414±36 (310-559)	8 795±1 540 (5 655-14 611)	6
OCT	1984	86.7±4.2 (73.8-99.6)	1 164±83 (949-1 406)	25 627±3 497 (15 369-36 166)	5
NOV	1984	59.1±3.4 (48.1-69.8)	1 010±89 (747-1 365)	19 931±3 020 (10 644-30 150)	6
DEC	1984	91.2±6.5 (79.8-112.3)	1 995±208 (1 605-2 715)	69 793±18 563 (32 625-134 499)	5
JAN	1985	103.9±0.1 (103.8-104)	1 486±31 (1 454-1 517)	19 412±248 (19 164-19 660)	2
FEB	1985	109.7±8.8 (181.9-199.5)	2 259±197 (2 063-2 456)	38 918±11 207 (27 712-50 125)	2
MAR	1985	3.9±1.4 (0.6-8.9)	37±24 (0-129)	248±209 (0-1 077)	5
APR	1985	3.6±1.1 (1.3-5.7)	54±21 (18-103)	301±174 (30-764)	4
MAY	1985	4.3±2.1 (1.8-8.4)	75±60 (8-195)	987±953 (8-2 893)	3
JUN	1985	*	*	*	0

* missing data

Table 4.3 Monthly rainfall variables measured at six sites in the study area for the 1985/6 rainfall year. Values given are mean and standard error and, in parentheses, range

MONTH	YEAR	TOTAL RAIN (mm)	TOTAL KINETIC ENERGY (J/sq.m)	EI30 INDEX (erosivity units)	SAMPLE SIZE
JUL	1985	7.7±1.6 (5.0-10.7)	49±9 (36-67)	193±53 (138-299)	3
AUG	1985	4.6±1.2 (2.8-8.2)	33±15 (15-79)	118±91 (15-391)	4
SEP	1985	42.6±14.1 (27.7-70.8)	699±295 (363-1 288)	13 623±8 853 (3 784-31 290)	3
OCT	1985	103.6±18.7 (77.8-140.0)	2 038±224 (1 776-2 485)	63 233±2 610 (58 756-67 794)	3
NOV	1985	9.8±0.9 (7.2-12.4)	93±20 (31-153)	452±154 (38-1 023)	6
DEC	1985	56.3±1.5 (54.8-57.7)	947±19 (928-966)	11 929±880 (11 049-12 808)	2
JAN	1986	58.0±4.3 (41.1-65.3)	1 051±64 (917-1 278)	38 451±7 167 (20 268-55 259)	5
FEB	1986	145.2*	3540*	201 594*	1
MAR	1986	47.1±1.6 (44.3-51.4)	503±24 (451-568)	3 806±490 (3 061-5 220)	4
APR	1986	11.8±1.2 (8.6-14.4)	68±18 (39-122)	177±41 (120-297)	4
MAY	1986	0.6±0.1 (0.5-0.7)	0 (0-2)	0 (0-1)	4
JUN	1986	23.2±4.8 (5.3-31.1)	341±63 (93-431)	3 402±655 (840-4 255)	5

* only one data point

able 4.4 Annual values for rainfall variables measured at six sites in the study area during the 1983/4, 1984/5 and 1985/6 rainfall years

AINFALL YEAR	RAINFALL (mm)						RAINFALL KINETIC ENERGY (J/sq.m)						EI 30 INDEX					
	241	284	294	402	403	411	241	284	294	402	403	411	241	284	294	402	403	411
1983/4*	576.5	717.7	642.5	631.7	667.6	667.0	5 878	8 886	7 360	6 920	7 637	7 593	84 281	228 906	149 960	122 854	143 834	138 726
1984/5	633.6	729.8	714.9	607.1	689.1	696.1	8 295	9 728	10 521	9 665	8 876	7 939	190 229	196 885	290 168	187 638	139 591	154 209
985/6	490.4	537.6	498.2	538.8	570.6	543.9	9 343	8 705	8 417	9 296	10 372	9 625	301 128	340 738	336 154	307 613	364 185	333 732
	(F-test = 20.7; p<0.01; d.f.= 2, 15)						(F-test = 8.6; p<0.01; d.f.= 2, 15)						(F-test = 30.1; p<0.01; d.f.= 2, 15)					

excludes rainfall from Cyclone Domoina in January 1984

Table 4.5 Physical characteristics of natural run-off plots

PLOT	EXPERIMENTAL BLOCK		AUTOGRAPHIC RAINGAUGE		WOODY VEGETATION	SOIL CLASSIFICATION		SLOPE
NUMBER	NON-CULL	CULL	PRESENT	ABSENT	COMMUNITY	FORM	SERIES	(%)
241	X		X		Acacia nigrescens	MAYO	TSHIPISE	9.5
294	X		X		Acacia nilotica/A.gerrardii	VALSRIVIER	LINDLEY	6.8
402	X		X		Acacia tortilis	SWARTLAND	ROSEHILL	11.0
284		X	X		Acacia tortilis	SWARTLAND	SWARTLAND	10.1
403		X	X		Acacia nigrescens	MAYO	TSHIPISE	8.3
411		X	X		Acacia nilotica/A.gerrardii	GLENROSA	TREVANIAN	6.6
404*	X			X	Acacia tortilis	VALSRIVIER	WATERVAL	5.2
406*	X			X	Acacia tortilis	MAYO	MSINSINI	7.2
412*	X			X	Acacia grandicornuta	VALSRIVIER	ARNISTON	4.9
414*	X			X	Acacia tortilis	SWARTLAND	OMDRAAI	4.7

* plots installed during 1984/5 rainfall year

Table 4.6 Annual soil loss values for fixed sites within key woody vegetation communities in the non-cull and cull blocks. Values given are mean and standard error for the entire monitoring period. The range is given in parentheses

WOODY VEGETATION COMMUNITY	SITE NUMBER	MONITORING PERIOD (YEARS)	ANNUAL SOIL LOSS (g)	
			NON-CULL BLOCK	CULL BLOCK
Acacia tortilis	402	3	10 126±8 001 (137-49 611)	-
	284	3	-	1 327±37 (135-2 209)
	404	2	2 184±718 (1 023-4 241)	-
	406	2	936±91 (709-1 110)	-
	414	2	590±183 (279-1 117)	-
Acacia nigrescens	241	3	758±157 (306-1 403)	-
	403	3	-	900±509 (215-3 415)
Acacia nilotica/Acacia gerrardii	294	3	3 199±1 065 (322-5 805)	-
	411	3	-	624±199 (110-1 476)
Acacia grandicornuta	412	2	640±110 (403-842)	-

Table 4.7 Annual run-off values for fixed sites within key woody vegetation cummunities in the non-cull and cull blocks. Values given are mean and standard error for the entire monitoring period. The range is given in parentheses

WOODY VEGETATION COMMUNITY	SITE NUMBER	MONITORING PERIOD (YEARS)	RUN-OFF (mm)	
			NON-CULL BLOCK	CULL BLOCK
Acacia tortilis	402	3	31.4±16.5 (7.6-113.1)	-
	284	3	-	42.2±9.0 (14.4-70.4)
	404	2	21.7±2.9 (15.3-28.8)	-
	406	2	15.3±6.7 (7.4-35.5)	-
	414	2	16.4±4.5 (8.8-28.4)	-
Acacia nigrescens	241	3	9.3±2.6 (2.4-17.5)	-
	403	3	-	4.9±1.0 (2.0-7.8)
Acacia nilotica/Acacia gerrardii	294	3	23.9±3.1 (13.5-33.6)	-
	411	3	-	36.4±10.3 (8.1-75.5)
Acacia grandicornuta	412	2	11.3±1.4 (8.4-15.2)	-

Table 4.8 Explanation of codes used in tables, figures and text

ANNUAL SOIL LOSS	ASL1	(very low)
	ASL2	(low)
	ASL3	(moderate)
	ASL4	(high)
	ASL5	(very high)
ANNUAL RUN-OFF	ARO1	(very low)
	ARO2	(low)
	ARO3	(moderate)
	ARO4	(high)
	ARO5	(very high)
VEGETATION VARIABLES	HCC1	Herbaceous canopy cover (%) measured by Walker's (1976) method
	LITC	Litter cover (%)
	MAGH	Maximum grass height (cm)
	MEGH	Mean grass height (cm)
	FORB	Contribution forbs make to total herbaceous biomass (%)
	HCC2	Herbaceous canopy cover (%) measured by USLE method (WISCHMEIER, 1975)
	SURC	Surface cover (%)
	WOCC	Woody canopy cover (%)
SOIL SURFACE VARIABLES	SOCA	Soil capping (%)
	SUTE	Susceptibility to erosion (%)
	ROCK	Rock (%)

Table 4.9 Results of the correspondence analysis of the 1983/4 natural run-off plot data

VARIABLES	QLT	PRINCIPAL AXIS 1			PRINCIPAL AXIS 2		
		K=1	COR	CTR	K=2	COR	CTR
HCC1	908	-79	585	17	-59	323	57
LITC	864	-421	701	106	204	163	156
SOCA	986	601	967	360	86	19	47
SUTE	980	533	962	360	74	18	44
ROCK	661	-589	614	13	164	47	6
FORB	855	34	10	1	-295	845	412
MAGH	826	-43	445	5	41	381	31
MEGH	846	-95	826	10	15	20	2
HCC2	756	-62	454	10	-51	302	41
SURC	946	-86	919	20	-14	27	3
WOCC	862	-517	651	99	295	211	202
ASL1	971	-340	925	302	76	46	96
ASL3	517	0	0	0	-68	517	69
ASL4	847	204	601	87	131	246	224
ASL5	939	448	919	379	67	20	54
ARO1	976	-283	971	204	21	5	7
ARO2	932	57	69	7	-200	863	542
ARO3	768	96	722	21	-24	46	8
ASL2*	638	-46	31	5	-205	607	630

* Supplementary point

Table 4.10 Results of the correspondence analysis of the 1984/5 natural run-off plot data

VARIABLES	QLT	PRINCIPAL AXIS 1			PRINCIPAL AXIS 2		
		K=1	COR	CTR	K=2	COR	CTR
HCC1	520	20	444	5	-7	76	2
LITC	993	221	982	255	-23	11	9
SOCA	964	-14	1	0	389	963	583
SUTE	692	-207	660	75	46	32	12
ROCK	504	56	5	0	-543	499	96
FORB	945	-507	930	478	66	15	26
MAGH	840	25	565	9	17	275	14
MEGH	325	15	119	1	-19	206	7
HCC2	188	9	103	1	8	85	3
SURC	850	1	1	0	-14	849	10
WOCC	906	-283	639	175	-183	267	237
ASL1	899	-84	631	85	56	268	120
ASL2	721	57	270	38	73	451	205
ASL3	916	-104	452	121	-106	464	404
ARO1	871	118	614	166	-75	257	221
ARO2	974	-158	945	284	28	29	30
ARO4	904	159	888	305	22	16	19
ARO3*	729	9	1	1	189	728	1342

* Supplementary point

Table 4.11 Results of the correspondence analysis of the 1985/6 natural run-off plot data

VARIABLES	QLT	PRINCIPAL AXIS 1			PRINCIPAL AXIS 2		
		K=1	COR	CTR	K=2	COR	CTR
HCC1	164	-4	49	0	8	115	2
LITC	992	-517	835	181	224	156	484
SOCA	997	522	991	441	44	6	45
SUTE	993	258	991	169	-12	2	6
ROCK	585	-474	402	8	-320	183	51
FORB	164	-109	151	9	-32	13	11
MAGH	983	-232	936	96	-51	47	68
MEGH	886	-134	860	11	24	26	5
HCC2	463	-28	402	2	-10	61	3
SURC	968	-141	951	47	19	17	13
WOCC	843	-246	524	36	-192	319	311
ASL1	170	-252	152	120	88	18	207
ASL2	7	-49	7	5	11	0	3
ASL3	373	451	372	348	25	1	15
ASL4	69	34	3	2	-155	66	657
ARO1	338	-417	338	337	-3	0	0
ARO2	3	-35	3	2	17	0	8
ARO3	242	326	235	185	59	7	87
ARO4	3	26	1	1	-29	2	22

Table 4.12 Correlation matrix of vegetation and soil surface variables against $\log_e$ annual soil loss (g) and $\log_e$ annual run-off (l)

DEPENDENT VARIABLES	COEFFICIENT OF CORRELATION (r) HCC1	LITC	SOCA	SUTE	ROCK	FORB	AIZ	MAGH	MEGH	HCC2	SURC	WOCC	WOCH
LOGe ANNUAL SOIL LOSS	-0.558 ‡‡	-0.575 ‡‡	0.646 ‡‡	0.692 ‡‡	-0.091 n.s.	-0.049 n.s.	0.286 ‡	-0.458 ‡‡	-0.509 ‡‡	-0.557 ‡‡	-0.637 ‡‡	-0.135 n.s.	-0.204 n.s.
LOGe ANNUAL RUN-OFF	-0.343 ‡	-0.528 ‡‡	0.573 ‡‡	0.483 ‡‡	-0.404 ‡‡	0.206 n.s.	0.153 n.s.	-0.301 ‡	-0.383 ‡‡	-0.337 ‡	-0.443 ‡‡	-0.266 n.s.	-0.443 ‡‡

Key

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n.s.= not significant
‡ = significant at 5% probability level
‡‡ = significant at 1% probability level
degrees of freedom = 50

Table 4.13 Results of the stepwise multiple regression analysis of the 1983/4, 1984/5 and 1985/6 natural run-off plot data, excluding a 25% random subsample, for the prediction of soil loss

METHOD/S USED TO MEASURE INDEPENDENT VARIABLES	INDEPENDENT VARIABLE	BETA COEFFICIENT	CONFIDENCE LIMITS UPPER	CONFIDENCE LIMITS LOWER	PARTIAL F-TEST	SIGNIFICANCE	PERCENTAGE VARIATION EXPLAINED BY R-SQ
WALKER (1976) METHOD	CONSTANT	2.8715					
	SUTE	0.0582	0.07891	0.03740	31.267	p<0.01	46,5
	TOT.RAIN	0.0036	0.02896	-0.02184	3.442	p<0.05	51,2
						(d.f.n1=2,n2=36)	
WALKER (1976) & USLE (WISCHMEIER, 1975) METHODS	CONSTANT	-3.6286					
	SUTE	0.1346	0.22645	0.04271	8.544	p<0.01	46,5
	SURC	0.0953	0.20771	-0.01717	3.874	p<0.05	51,7
						(d.f.n1=2,n2=36)	

Table 4.14 Results of the stepwise multiple regression analysis of the 1983/4, 1984/5 and 1985/6 natural run-off plot data, excluding a 25% random subsample, for the prediction of run-off

METHOD/S USED TO MEASURE INDEPENDENT VARIABLES	INDEPENDENT VARIABLE	BETA COEFFICIENT	CONFIDENCE LIMITS		PARTIAL F-TEST	SIGNIFICANCE	PERCENTAGE VARIATION EXPLAINED BY R-SQ
			UPPER	LOWER			
WALKER (1976) METHOD	CONSTANT	-2.1043					
	SOCA	0.0254	0.03967	0.01107	9.318	p<0.01	32,5
	FORB	0.0244	0.03928	0.00954	9.673	p<0.01	40,8
	RAIN-WET SEAS.	0.025	0.08039	-0.03029	16.851	p<0.01	46,1
	RAIN-EFFECTIVE	-0.01	0.04016	-0.06008	13.463	p<0.01	61,4
						(d.f.n1=2,n2=36)	
WALKER (1976) & USLE (WISCHMEIER, 1975) METHODS	CONSTANT	-2.1043					
	SOCA	0.0254	0.03967	0.01107	9.318	p<0.01	32,5
	FORB	0.0244	0.03928	0.00954	9.673	p<0.01	40,8
	RAIN-WET SEAS.	0.025	0.08039	-0.03029	16.851	p<0.01	46,1
	RAIN-EFFECTIVE	-0.01	0.04016	-0.06008	13.463	p<0.01	61,4
						(d.f.n1=2,n2=36)	

Table 4.15 Actual and predicted values for annual soil loss and annual run-off based on multiple regression analysis

RESERVE DATA SUBSET FROM 1983/4, 1984/5 AND 1985/6 NATURAL RUN-OFF PLOT DATA SET				
ACTUAL LOGe ANNUAL SOIL LOSS (g)	PREDICTED LOGe ANNUAL SOIL LOSS (g)		ACTUAL LOGe ANNUAL RUN-OFF (mm)	PREDICTED LOGe ANNUAL RUN-OFF (mm)
	EQUATION 4.1	EQUATION 4.2		EQUATION 4.4
7.2464	6.6696	6.6263	2.7926	2.1810
8.6665	7.4252	7.1571	3.5155	3.1400
9.0438	7.6831	7.7864	3.2086	3.3204
5.1358	5.9178	5.6126	3.7832	1.8448
5.3327	5.7729	5.6986	2.1247	1.9077
5.7071	5.5560	5.4386	0.8206	1.5340
6.9305	6.6091	6.2871	3.1393	2.6249
6.0913	7.1911	6.4895	2.8863	3.2094
7.2828	7.9846	8.0567	3.5206	3.4864
8.6572	8.4247	8.3544	3.1833	3.2022
6.4213	7.4078	6.8609	3.7695	3.5518
5.9994	6.4459	6.4464	2.1335	2.6184
6.2596	6.9697	7.4672	2.3556	2.5390
Coefficient of determination:	D = 0.616	D = 0.617	Coefficient of determination:	D = 0.406
Coefficient of efficiency:	E = 0.598	E = 0.612	Coefficient of efficiency:	E = 0.337
Error function:	F1= 0.018	F1= 0.005	Error function:	F1= 0.069

Table 4.16 Rainfall variables calculated from daily rainfall records kept at Mpila and Mbhuzana outpost

RAINFALL YEAR	RAINFALL VARIABLES		
	TOTAL RAINFALL (mm)	WET SEASON RAINFALL (mm)	EFFECTIVE RAINFALL (mm)
1978/79*	599.2	454.7	404.7
1979/80*	450.6	346.3	225.0
1980/81*	635.5	359.6	400.3
1981/82	635.4	428.0	516.9
1982/83	333.1	250.2	208.7
1983/84**	624.7	529.0	428.2
1984/85	745.7	563.8	606.9
1985/86	593.1	467.8	490.7

* Daily rainfall records from Mpila
** Rainfall recieved during Cyclone Domoina not included

Table 4.17 Predicted annual soil loss from Walker transect vegetation monitoring sites in the study area. Values given are mean and standard error and, in parentheses, range

RAINFALL YEAR	PREDICTED ANNUAL SOIL LOSS (g)	
	NON-CULL BLOCK	CULL BLOCK
1978/79	10 765±4 551 (376-36 295)	244±30 (183-324)
1979/80	3 201±915 (337-11 948)	219±37 (158-285)
1980/81	7 911±1 831 (360-25 664)	3 163±774 (455-6 203)
1981/82	2 854±884 (237-13 369)	684±169 (188-1 684)
1982/83	6 082±1 691 (109-14 337)	899±309 (122-1 552)
1983/84	680±156 (213-1 601)	308±41 (232-417)
1984/85	2 171±610 (306-8 551)	1 056±415 (273-4 604)
1985/86	2 333±538 (190-7 550)	2 954±891 (436-10 101)

Table 4.18 Predicted annual run-off from Walker transect vegetation monitoring sites in the study area. Values given are mean and standard eror and, in parentheses, range

RAINFALL	PREDICTED ANNUAL RUN-OFF (mm)			
YEAR	NON-CULL BLOCK		CULL BLOCK	
1978/79	35.2 ± 7.6	(19.5 - 66.2)	8.8 ± 1.6	(5.5 - 13.0)
1979/80	4.4 ± 0.6	(2.4 - 7.5)	2.7 ± 0.4	(2.0 - 3.4)
1980/81	0.5 ± 0.02	(0.3 - 0.9)	0.6 ± 0.05	(0.4 - 0.9)
1981/82	2.1 ± 0.3	(0.9 - 6.5)	1.4 ± 0.1	(0.9 - 2.1)
1982/83	0.7 ± 0.1	(0.1 - 1.2)	0.5 ± 0.07	(0.3 - 0.7)
1983/84	111.9 ± 30.2	(26.4 - 266.9)	33.1 ± 1.8	(29.9 - 36.8)
1984/85	25.7 ± 3.8	(11.5 - 58.8)	18.4 ± 4.5	(9.7 - 57.9)
1985/86	6.6 ± 0.9	(3.3 - 18.5)	4.6 ± 0.7	(2.9 - 8.3)

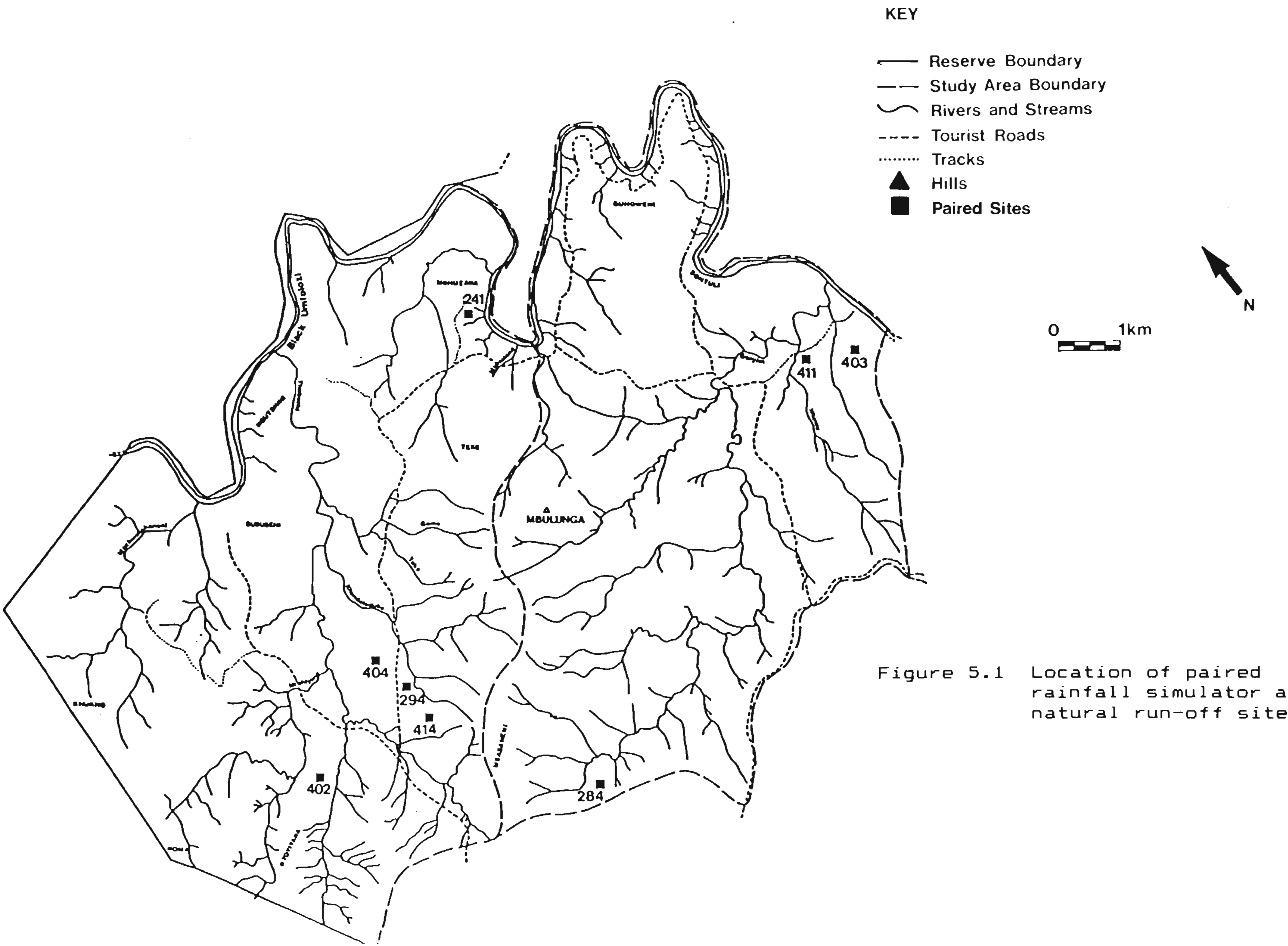

Figure 5.1 Location of paired rainfall simulator and natural run-off sites

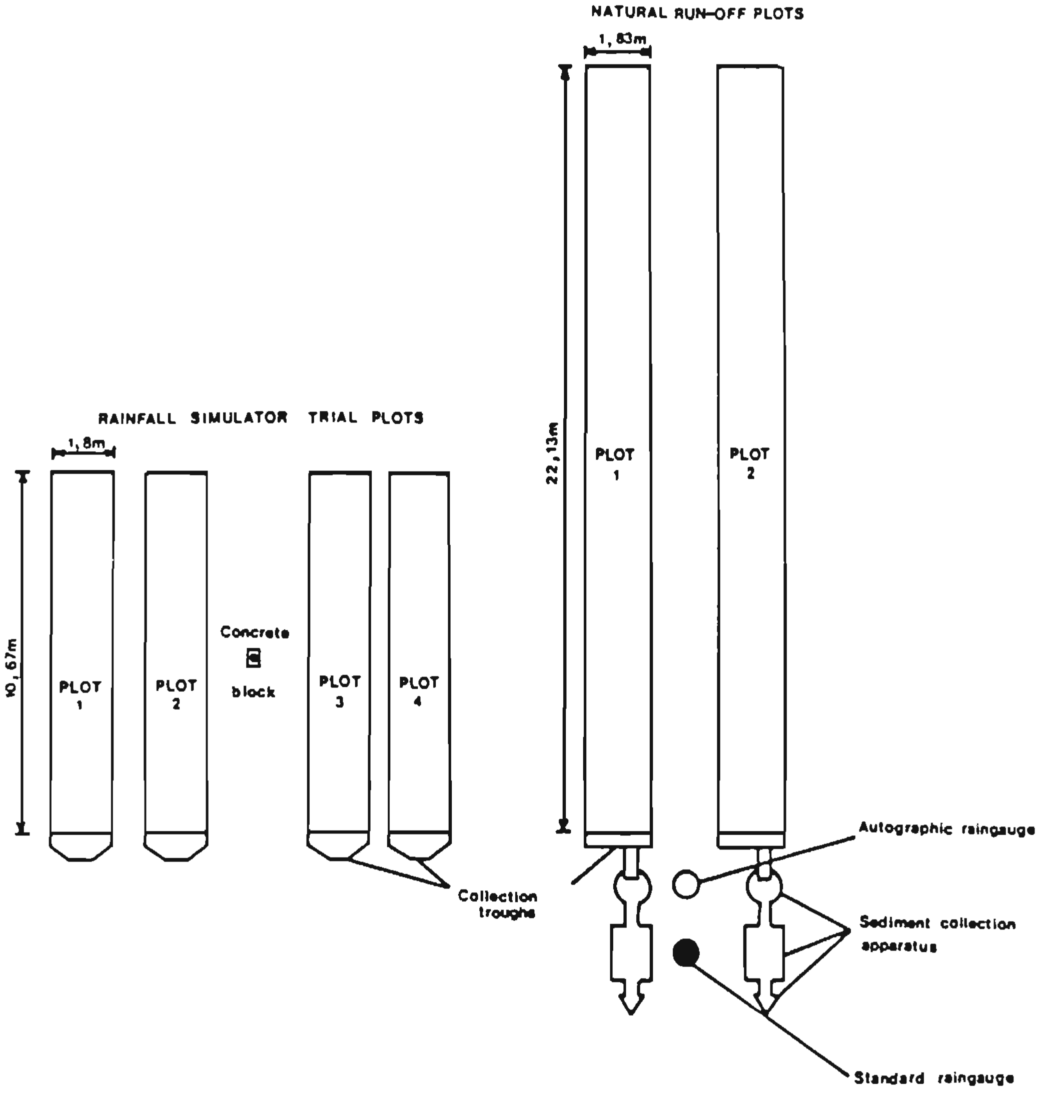

Figure 5.2 Dimensions and layout of a typical paired rainfall simulator and natural run-off site in Umfolozi Game Reserve

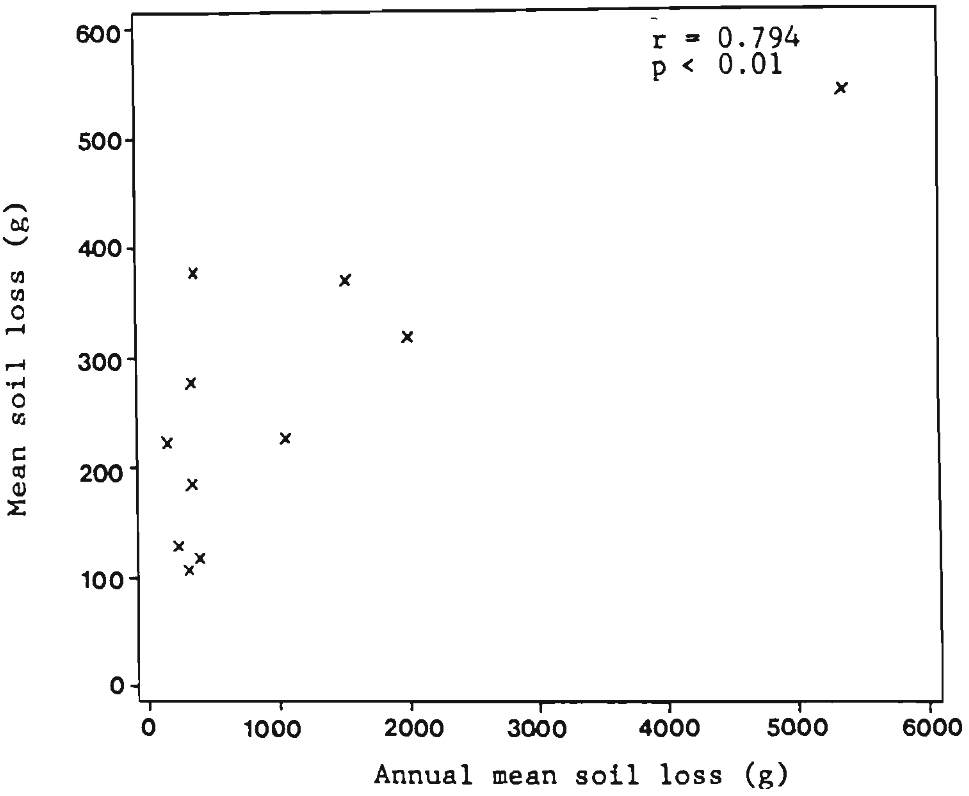

Figure 5.3 Scattergram of mean soil loss, determined by the rainfall simulator trials, against annual mean soil loss, as determined by the natural run-off plots

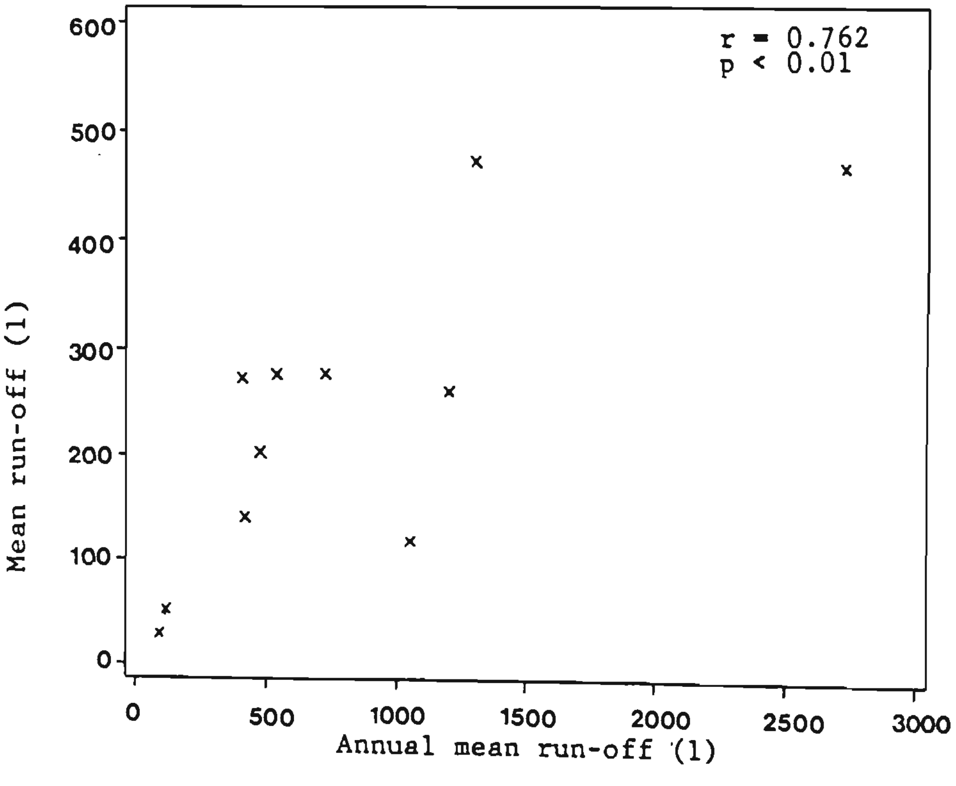

Figure 5.4 Scattergram of mean run-off, determined by the rainfall simulator trials, against annual mean run-off, as determined by the natural run-off plots

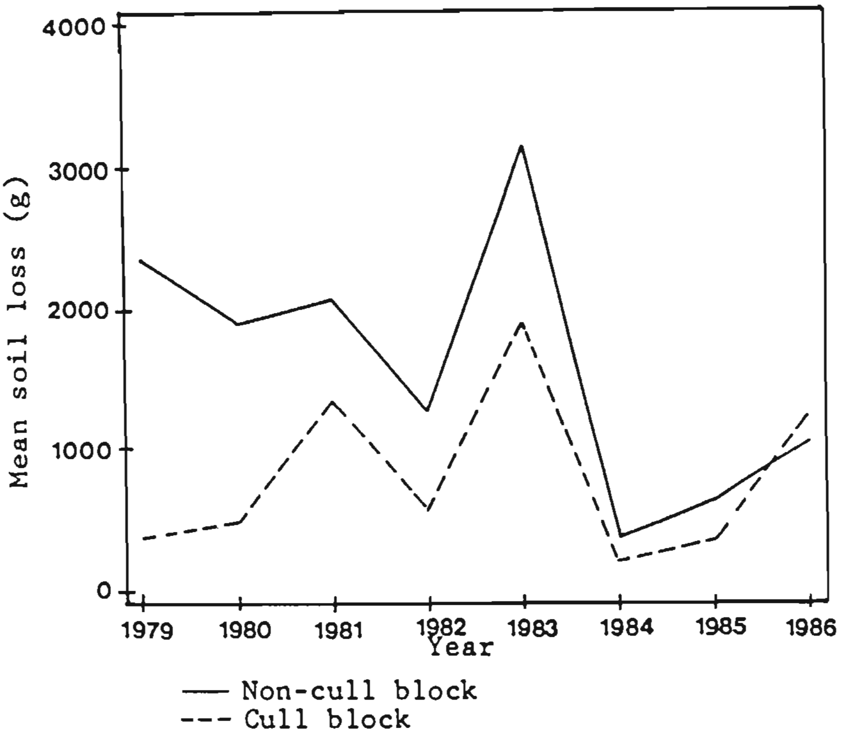

Figure 5.5 Predicted mean soil loss from Walker transect vegetation monitoring sites in the study area. Predictive equation based on rainfall simulator trial data

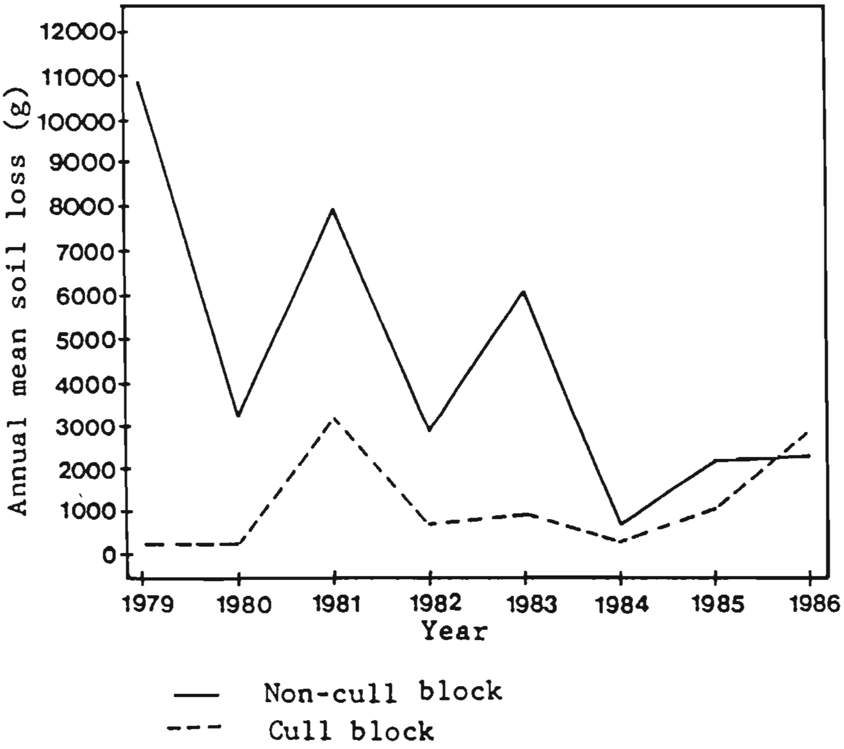

Figure 5.6 Predicted annual mean soil loss from Walker transect vegetation monitoring sites in the study area. Predictive equation based on natural run-off plot and rainfall data

Table 5.1 Physical characteristics of paired rainfall simulator and natural run-off sites

SITE	EXPERIMENTAL BLOCK		WOODY VEGETATION	SOIL CLASSIFICATION		SLOPE (%)	
NUMBER	NON-CULL	CULL	COMMUNITY	FORM	SERIES	NAT.RUN-OFF	RAIN SIMUL.
241	X		*Acacia nigrescens*	MAYO	TSHIPISE	9.5	9.6
294	X		*Acacia nilotica/A.gerrardii*	VALSRIVIER	LINDLEY	6.8	8.6
402*	X		*Acacia tortilis*	SWARTLAND	ROSEHILL	11.0	8.6
404*	X		*Acacia tortilis*	VALSRIVIER	WATERVAL	5.2	5.1
414*	X		*Acacia tortilis*	SWARTLAND	OMDRAAI	4.7	4.2
284		X	*Acacia tortilis*	SWARTLAND	SWARTLAND	10.1	10.3
403*		X	*Acacia nigrescens*	MAYO	TSHIPISE	8.3	6.6
411*		X	*Acacia nilotica/A.gerrardii*	GLENROSA	TREVANIAN	6.6	7.5

* paired sites installed during 1984/5 rainfall year

Table 5.2 Soil loss measurements from rainfall simulator and adjacent natural run-off sites. Values given are the mean and, in parentheses, the range. Mean soil loss values for rainfall simulator sites were obtained from storms 1, 2 and 3

SITE	RAINFALL	RAINFALL SIMULATOR SITE	NATURAL RUN-OFF SITE
NUMBER	YEAR	MEAN SOIL LOSS (g)	ANNUAL MEAN SOIL LOSS (g)
241	1983/4	225 (210-252)	1 047 (691-1 403)
284		318 (109-396)	1 995 (1 780-2 209)
294		540 (286-839)	5 367 (4 929-5 805)
241	1984/5	119 (112-171)	404 (306-502)
284		131 (103-196)	247 (170-323)
294		278 (189-430)	343 (322-364)
402		184 (128-358)	334 (207-461)
403		108 (101-121)	311 (301-321)
411		221 (217-234)	150 (110-190)
404		372 (192-828)	1 539 (1 023-2 055)
414		376 (242-483)	361 (279-442)

Table 5.3 Correlation matrix of mean soil loss and mean run-off, determined by the rainfall simulator trials, against mean annual soil loss and mean annual run-off, determined by the natural run-off plots

RAINFALL SIMULATOR TRIALS	CORRELATION COEFFICIENT			
	MEAN ANNUAL SOIL LOSS	LOGe MEAN ANNUAL SOIL LOSS	MEAN ANNUAL RUN-OFF	LOGe MEAN ANNUAL RUN-OFF
MEAN SOIL LOSS	0.794 **	0.746 **	-	-
LOGe MEAN SOIL LOSS	0.672 *	0.673 *	-	-
MEAN RUN-OFF	-	-	0.762 **	0.811 **
LOGe MEAN RUN-OFF	-	-	0.648 *	0.862 **

Key
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n.s.= not significant
* = significant at 5% probability level
**= significant at 1% probability level
d.f.= 9

Table 5.4 Comparison of ranked soil loss values as determined by rainfall simulator trials and adjacent natural run-off plots

SITE NUMBER	RAINFALL YEAR	RANKING FROM HIGHEST TO LOWEST SOIL LOSS		DIFFERENCE OF RANKS
		RAINFALL SIMULATOR SITE	NATURAL RUN-OFF SITE	
294	1983/4	11	11	0
284	1983/4	8	10	-2
404	1984/5	9	9	0
241	1983/4	6	8	-2
241	1984/5	2	7	-5
414	1984/5	10	6	4
294	1984/5	7	5	2
402	1984/5	4	4	0
403	1984/5	1	3	-2
284	1984/5	3	2	1
411	1984/5	5	1	4

Table 5.5 Comparison of rankings for soil loss and run-off as determined by rainfall simulator trials and from adjacent natural run-off plots

RANKING CLASS	SOIL LOSS RANKING NUMBER	SOIL LOSS RANKING (%)	RUN-OFF RANKING NUMBER	RUN-OFF RANKING (%)
EQUAL	3	27.3	4	36.4
± 1 RANK	1	9.1	2	18.2
± 2 RANKS	4	36.4	2	18.2
± 3 RANKS	0	-	1	9.1
> 3 RANKS DIFFERENCE	3	27.2	2	18.2

Table 5.6 Run-off measurements from rainfall simulator and adjacent natural run-off sites. Values given are the mean and, in parentheses, the range. Mean run-off values for rainfall simulator sites were obtained from storms 1, 2 and 3

SITE NUMBER	RAINFALL YEAR	RAINFALL SIMULATOR SITE MEAN RUN-OFF (1)	NATURAL RUN-OFF SITE ANNUAL MEAN RUN-OFF (1)
241	1983/4	202 (192-315)	473 (285-661)
284		472 (411-668)	2 742 (2 632-2 851)
294		475 (473-539)	1 305 (1 248-1 362)
241	1984/5	53 (29-77)	116 (96-135)
284		263 (252-400)	1 191 (601-1 780)
294		278 (273-403)	725 (547-902)
402		140 (125-233)	420 (339-501)
403		28 (25-48)	86 (80-92)
411		275 (206-493)	403 (330-475)
404		117 (97-205)	1 051 (935-1 166)
414		277 (218-429)	542 (358-726)

Table 5.7 Comparison of ranked run-off values as determined by rainfall simulator trials and adjacent natural run-off plots

SITE NUMBER	RAINFALL YEAR	RANKING FROM HIGHEST TO LOWEST RUN-OFF RAINFALL SIMULATOR SITE	NATURAL RUN-OFF SITE	DIFFERENCE OF RANKS
284	1983/4	10	11	-1
294	1983/4	11	10	1
284	1984/5	6	9	-3
404	1984/5	3	8	-5
294	1984/5	9	7	2
414	1984/5	8	6	2
241	1983/4	5	5	0
402	1984/5	4	4	0
411	1984/5	7	3	4
241	1984/5	2	2	0
403	1984/5	1	1	0

Table 5.8 Correlation matrix of vegetation and soil surface variables against soil loss and run-off as determined by rainfall simulator trials and natural run-off plots

INDEPENDENT	RAINFALL SIMULATOR TRIALS			NATURAL RUN- OFF PLOTS	
VARIABLES	LOGe MEAN SOIL LOSS	LOGe MEAN RUN-OFF	MEAN RUN-OFF	LOGe ANNUAL SOIL LOSS	LOGe ANNUAL RUN-OFF
HCC1	-0.8123 **	-0.3461 **	-0.4124 **	-0.5583 **	-0.3431 *
LITC	-0.5526 **	-0.5395 **	-0.5838 **	-0.5751 **	-0.5280 **
SOCA	0.7964 **	0.4765 **	0.6115 **	0.6462 **	0.5727 **
SUTE	0.8502 **	0.4385 **	0.5283 **	0.6918 **	0.4828 **
AIZ	0.0851 n.s.	0.0284 n.s.	-0.0727 n.s.	0.2864 *	0.1527 n.s.
MAGH	-0.8399 **	-0.5040 **	-0.5678 **	-0.4582 **	-0.3006 *
MEGH	-0.7627 **	-0.4884 **	-0.4917 **	-0.5087 **	-0.3828 **
ROCK	0.2920 *	-0.0373 n.s.	-0.0757 n.s.	-0.0913 n.s.	-0.4041 **
HCC2	-0.7935 **	-0.3662 **	-0.4118 **	-0.5565 **	-0.3374 *
SURC	-0.8741 **	-0.3696 **	-0.4495 **	-0.6371 **	-0.4432 **

Key

n.s.= not significant
* = significant at 5% probability level
** = significant at 1% probability level
d.f.= 50

Table 5.9 Comparison of ranked correlation coefficient values for soil loss as determined by rainfall simulator trials and natural run-off plots

INDEPENDENT VARIABLE	RANKING FROM HIGHEST TO LOWEST LOGe MEAN SOIL LOSS	 LOGe ANNUAL SOIL LOSS	DIFFERENCE OF RANKS
ROCK	9	10	-1
AIZ	10	9	1
MAGH	3	8	-5
MEGH	7	7	0
HCC2	6	6	0
HCC1	4	5	-1
LITC	8	4	4
SURC	1	3	-2
SOCA	5	2	3
SUTE	2	1	1

Wilcoxon matched-pairs signed-ranks test: Smallest T score = 6.0 (n.s.)
(N = 5; two-tailed test; alpha = 0.05)

Key

n.s.= not significant

Table 5.10 Comparison of ranked correlation coefficient values for run-off as determined by rainfall simulator trials and natural run-off plots

INDEPENDENT VARIABLE	RANKING FROM HIGHEST TO LOWEST			DIFFERENCE OF RANKS	
	LOGe MEAN RUN-OFF (1)	MEAN RUN-OFF (2)	LOGe ANNUAL RUN-OFF (3)	(1) vs (3)	(2) vs (3)
AIZ	10	10	10	0	0
MAGH	2	3	9	-7	-6
HCC2	7	8	8	-1	0
HCC1	8	7	7	1	0
MEGH	3	5	6	-3	-1
ROCK	9	9	5	4	4
SURC	6	6	4	2	2
SUTE	5	4	3	2	1
LITC	1	2	2	-1	0
SOCA	4	1	1	3	0

LOGe MEAN RUN-OFF vs. LOGe ANNUAL RUN-OFF : Wilcoxon matched-pairs signed-ranks test: smallest T score = 22.0 (n.s.) (N = 9; two-tailed test; alpha = 0.05)

MEAN RUN-OFF vs. LOGe ANNUAL RUN-OFF : Wilcoxon matched-pairs signed-ranks test: smallest T score = 17.0 (n.s.) (N = 5; two-tailed test; alpha = 0.05)

Key

n.s.= not significant

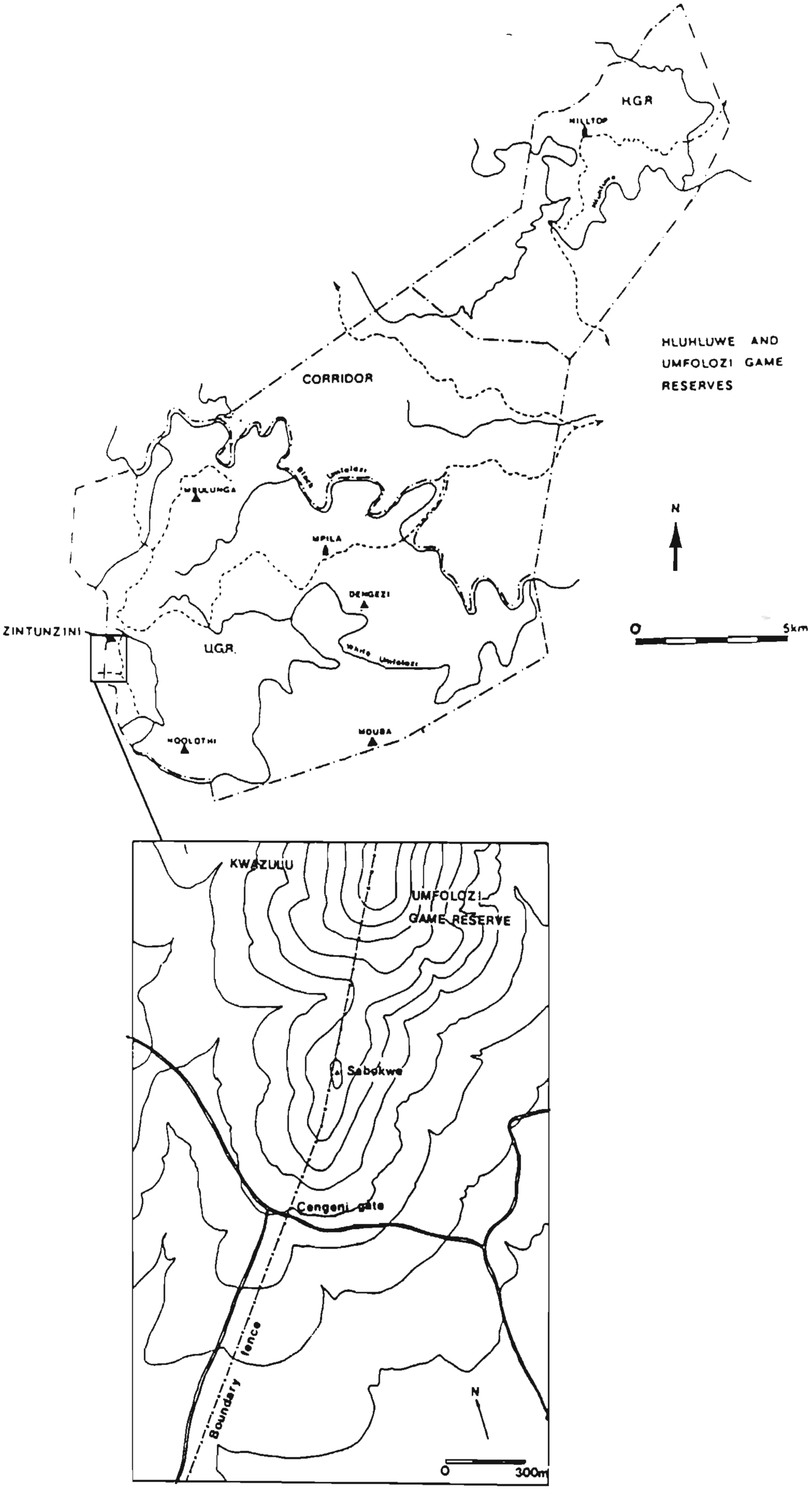

Figure 6.1 Location of the study area at Cengeni gate

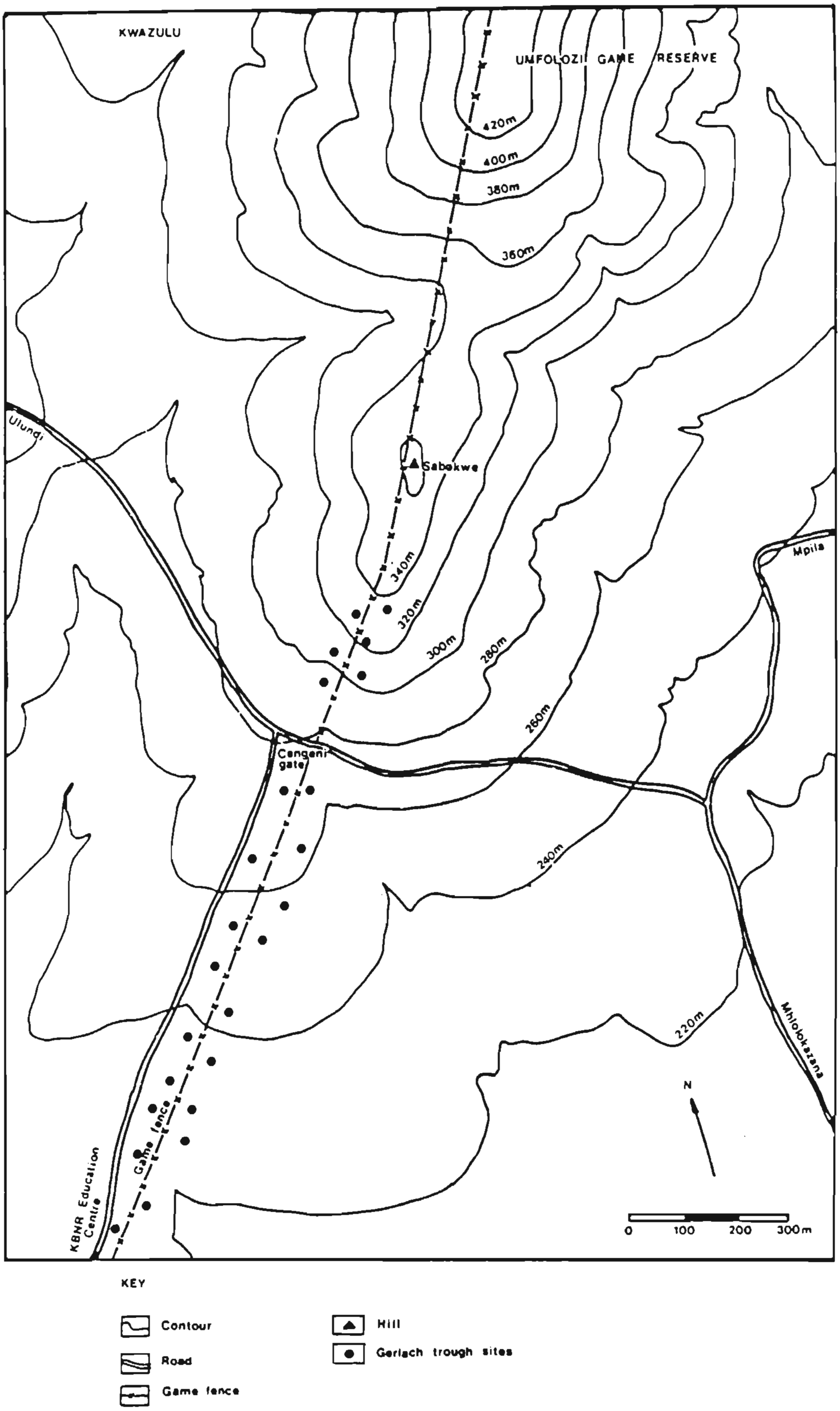

Figure 6.2 Location of Gerlach trough sites in Umfolozi Game Reserve and KwaZulu

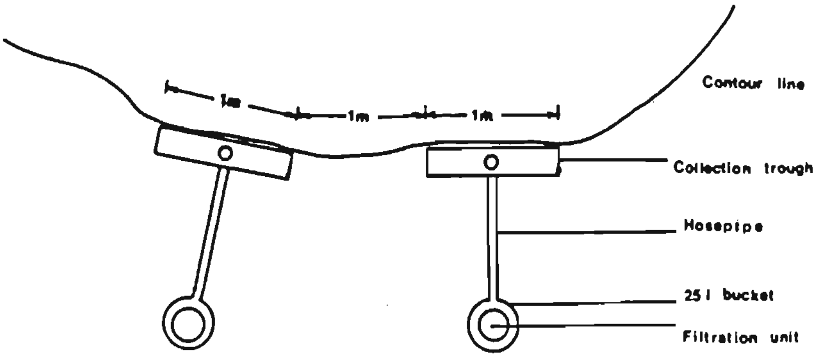

Figure 6.3 Dimensions and layout of a typical Gerlach trough site in the study area

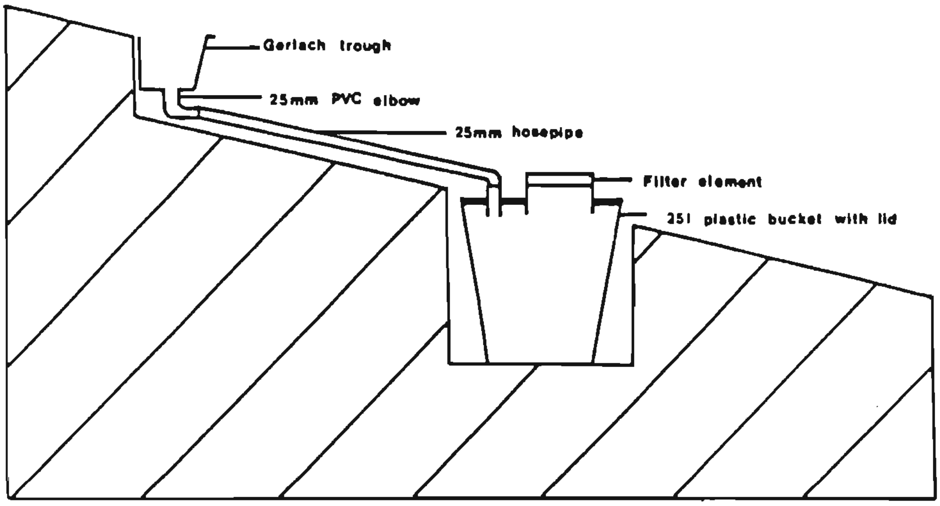

Figure 6.4 Vertical plan of Gerlach trough and sediment collecting apparatus

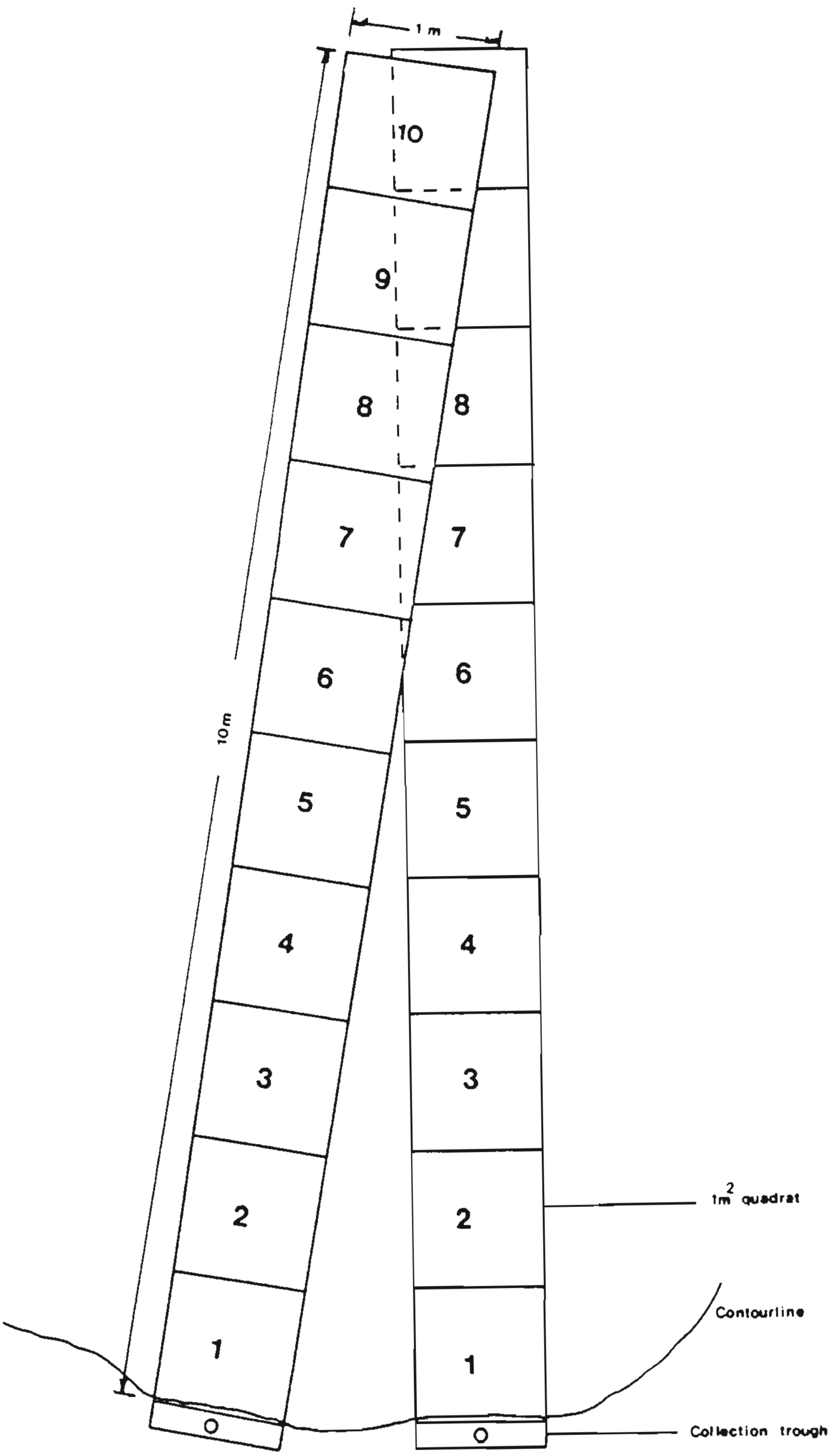

Figure 6.5 Dimensions and layout of a typical vegetation monitoring site located above the Gerlach troughs

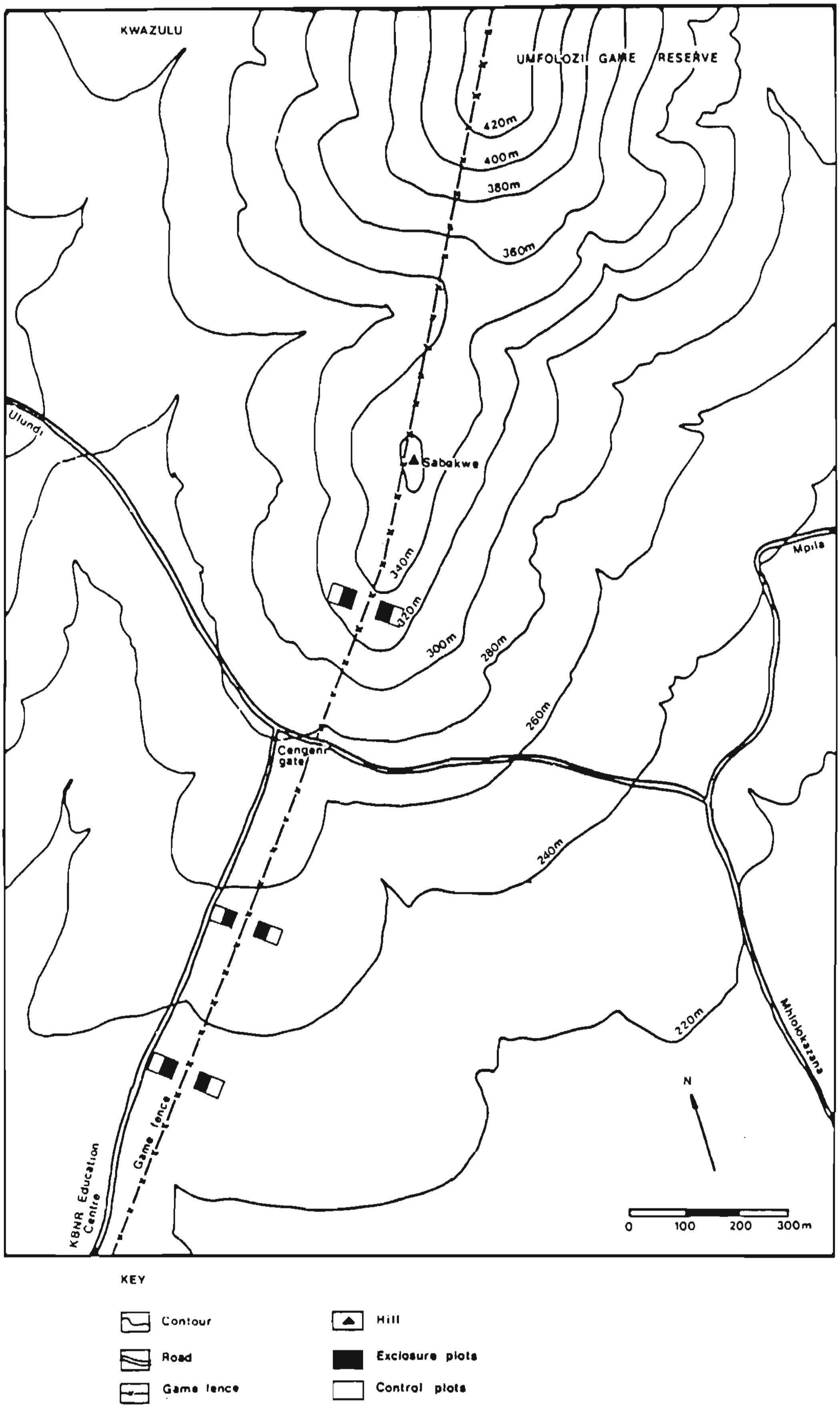

Figure 6.6 Location of exclosure and control plots in Umfolozi Game Reserve and KwaZulu

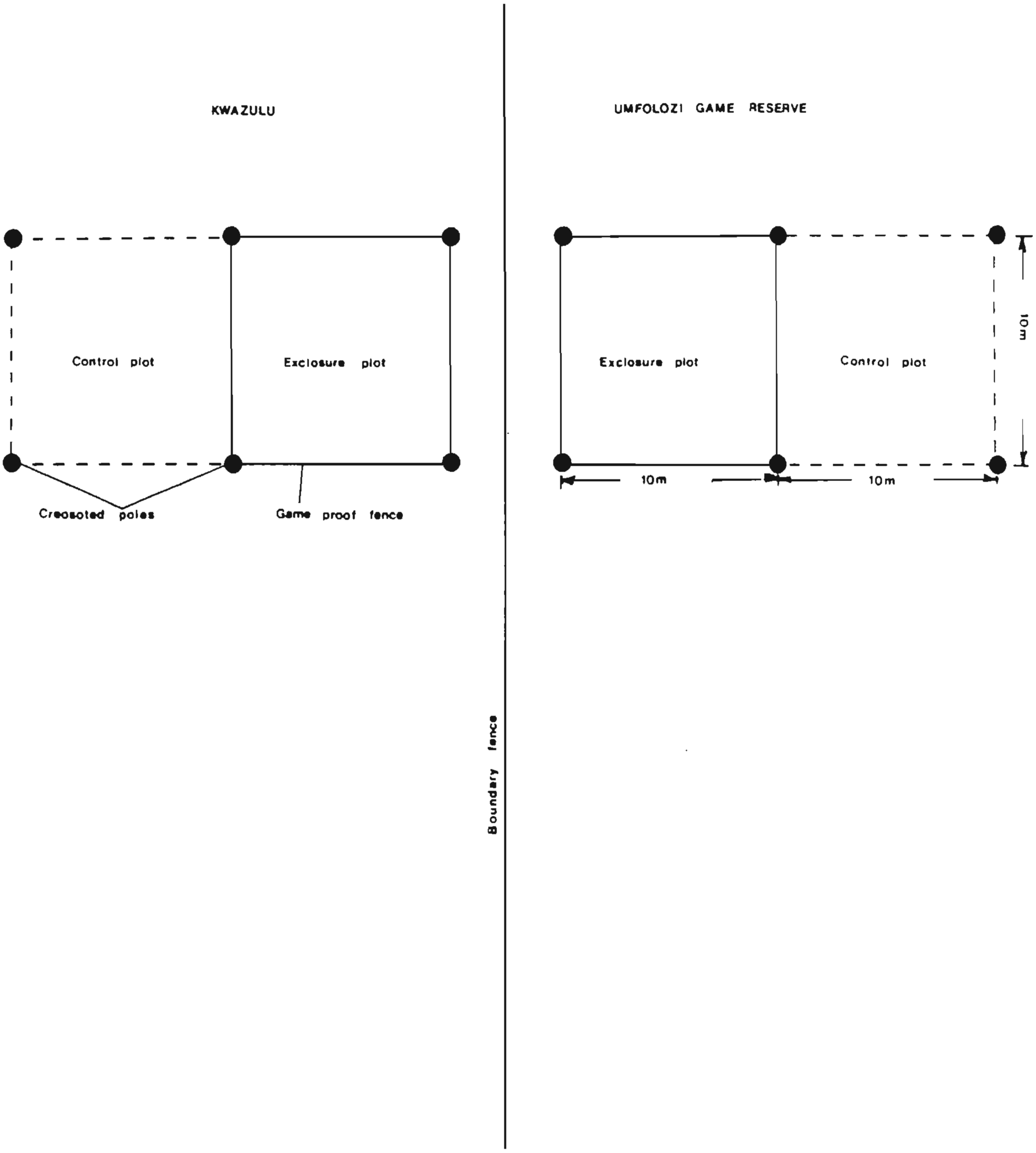

Figure 6.7 Dimensions and layout of a typical exclosure plot site in the study area

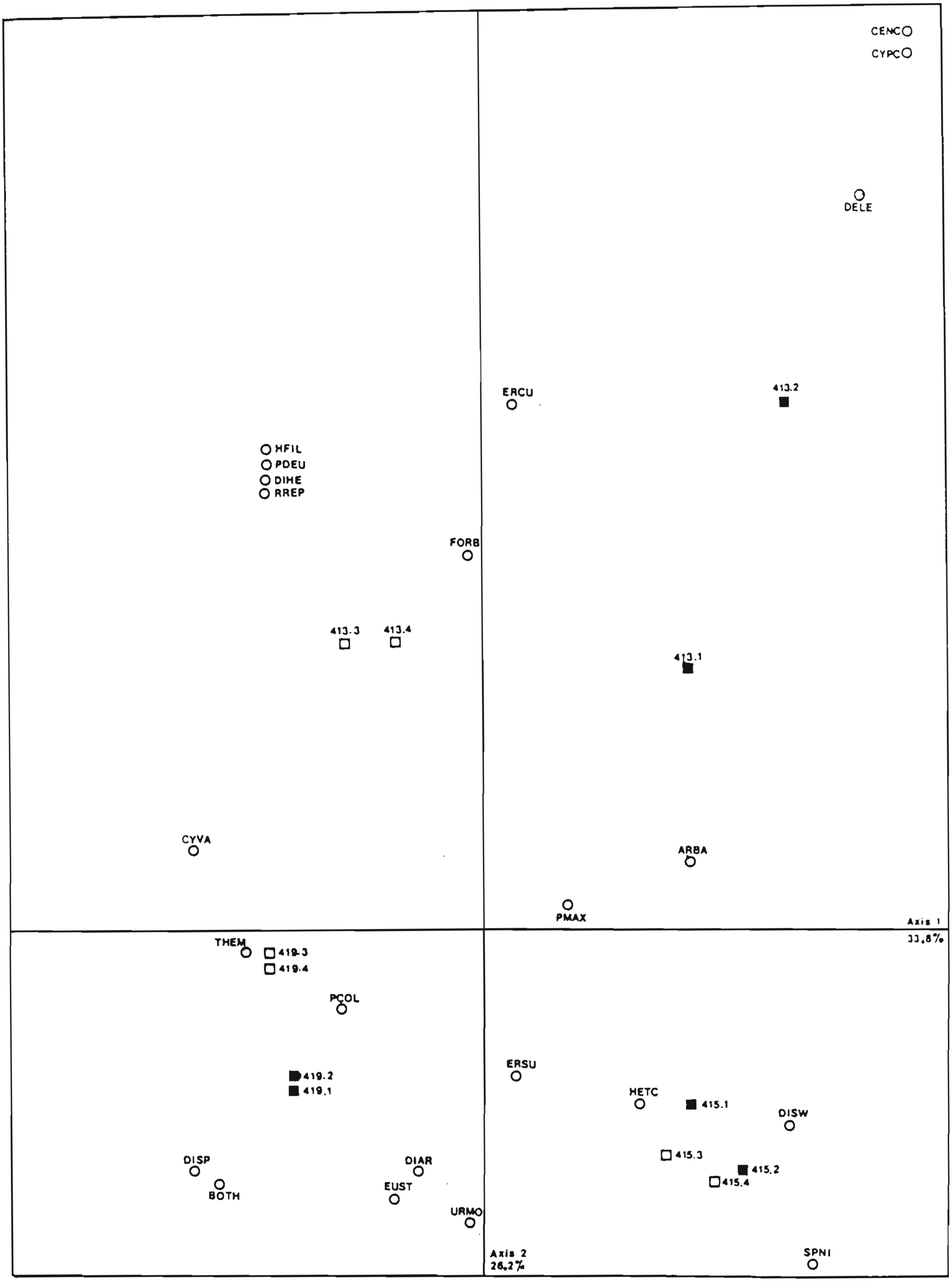

Figure 6.8 Two-dimensional display, obtained by correspondence analysis, of the 1984 herbaceous species composition data at the exclosure and control plots. Data derived using the Walker (1976) method

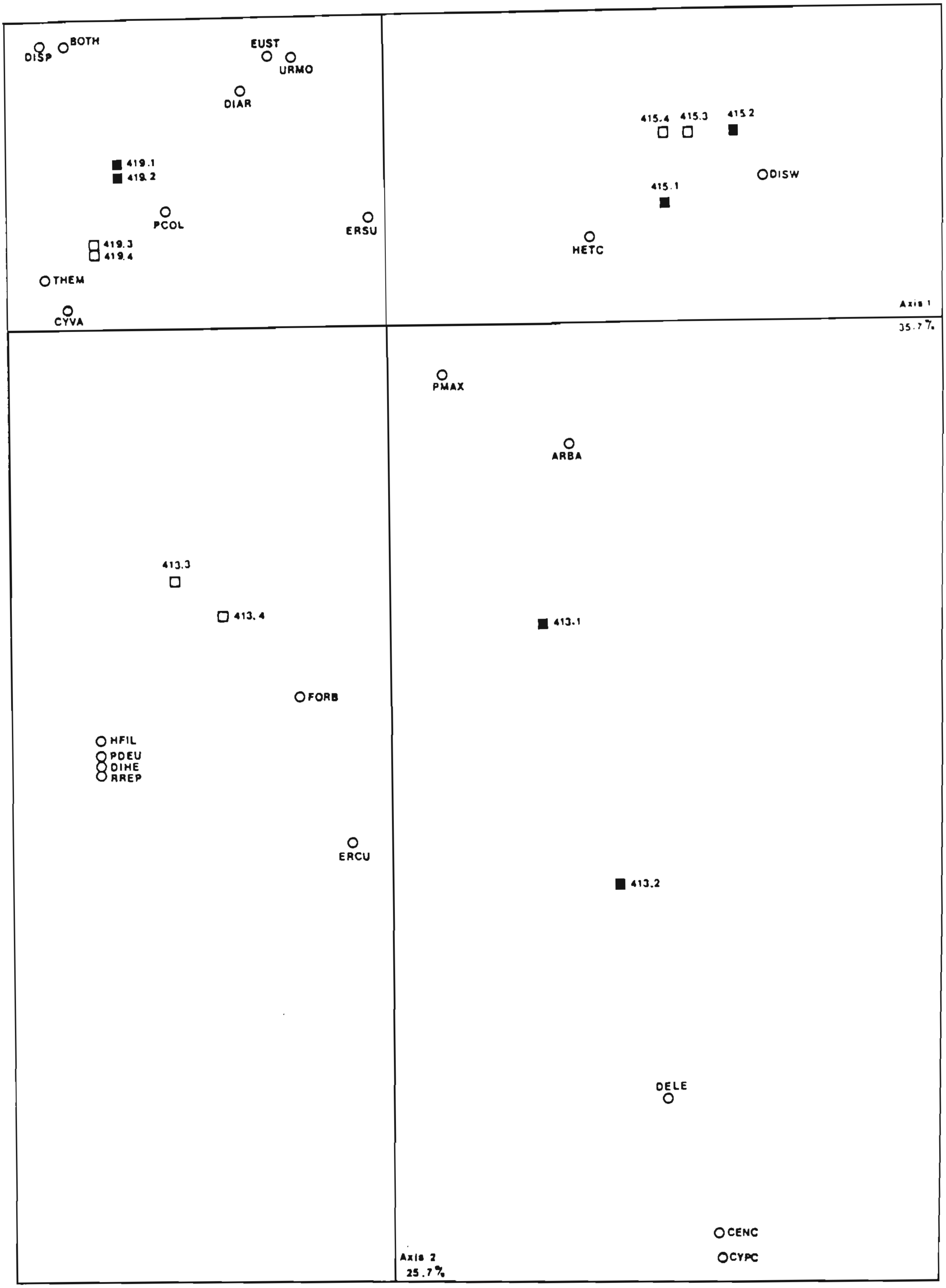

Figure 6.9 Two-dimensional display, obtained by correspondence analysis, of the 1984 herbaceous species composition data at the exclosure and control plots. Data derived using the Barnes *et al.* (1982) method

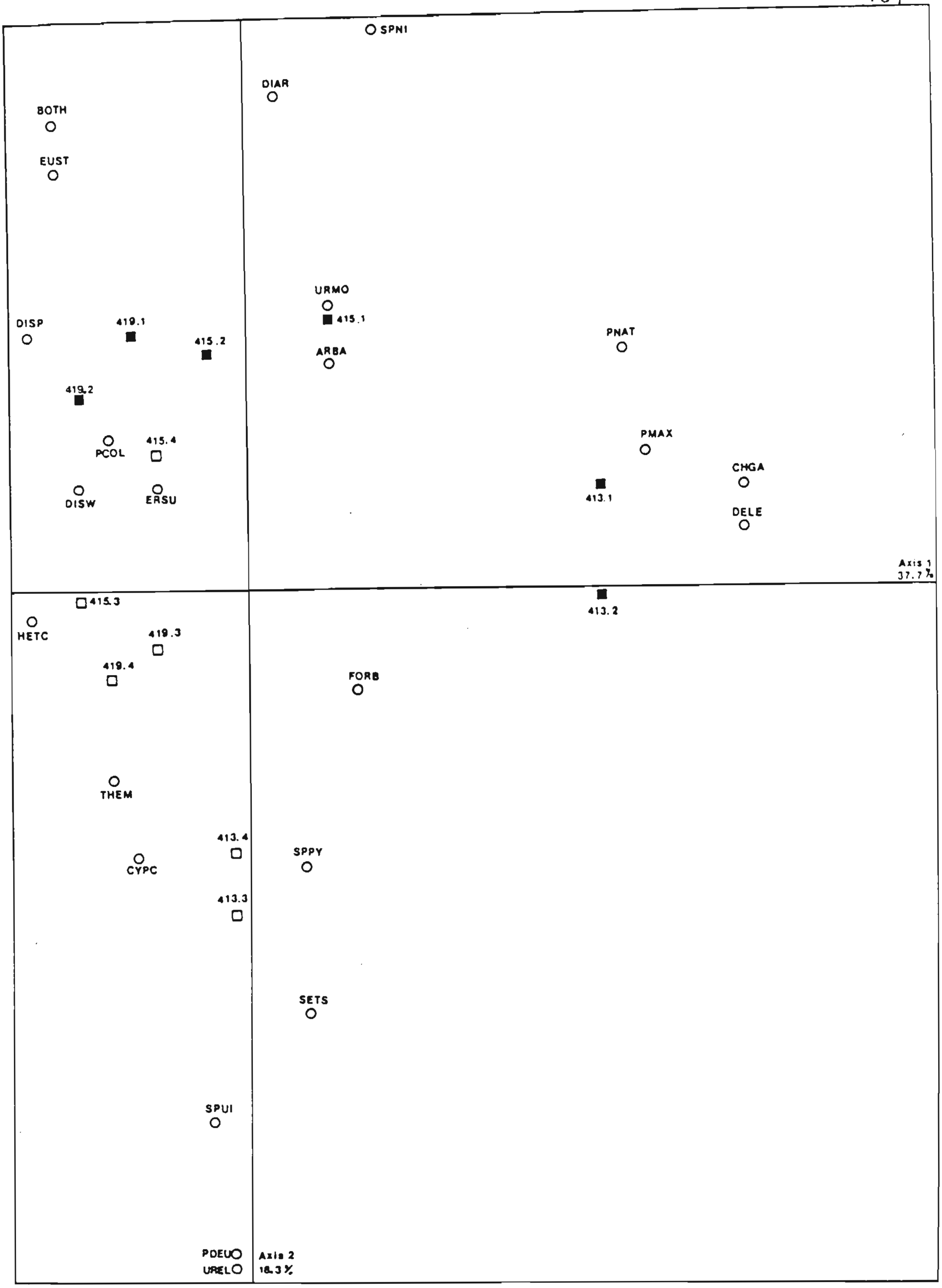

Figure 6.10 Two-dimensional display, obtained by correspondence analysis, of the 1986 herbaceous species composition data at the exclosure and control plots. Data derived using the Walker (1976) method

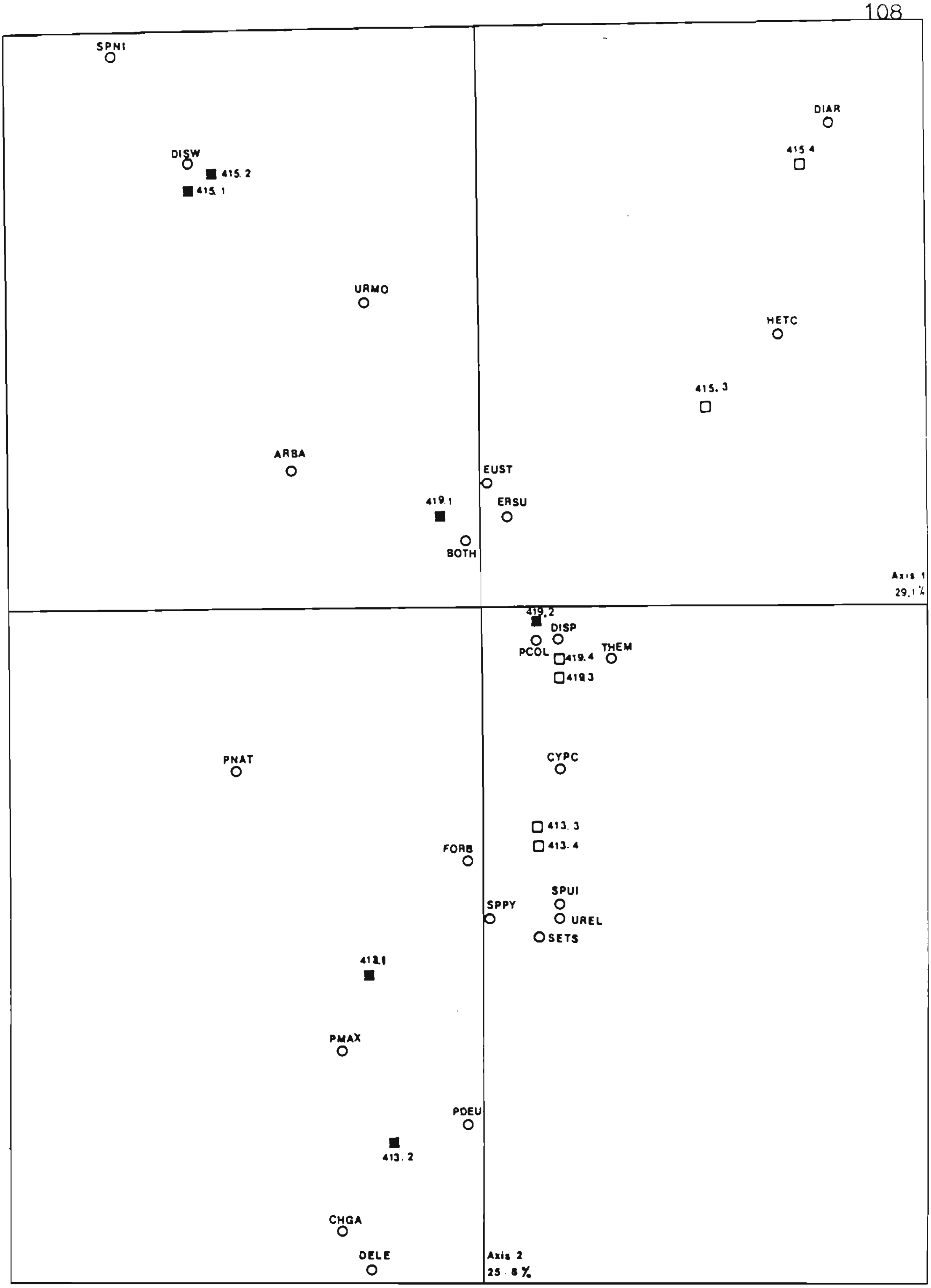

Figure 6.11 Two-dimensional display, obtained by correspondence analysis, of the 1986 herbaceous species composition data at the exclosure and control plots. Data derived using the Barnes *et al.* (1982) method

Table 6.1 Physical characteristics of Gerlach trough sites. Values for slope are given as mean and standard error and, in parentheses, range

SITE	LOCATION		TOPOGRAPHICAL POSITION			SLOPE
NUMBER	UGR	KWZ	UPPER	MID	LOWER	(%)
1	X		X			22.0 ± 2.94 (17.0 - 32.0)
2	X		X			
3	X		X			
4	X			X		9.2 ± 0.61 (6.5 - 12.8)
5	X			X		
6	X			X		
7	X			X		
8	X			X		
9	X				X	7.0 ± 0.31 (6.2 - 8.4)
10	X				X	
11	X				X	
12	X				X	
13		X	X			17.7 ± 2.18 (12.9 - 25.6)
14		X	X			
15		X	X			
16		X		X		7.7 ± 0.21 (6.9 - 8.8)
17		X		X		
18		X		X		
19		X		X		
20		X		X		
21		X			X	7.7 ± 0.57 (5.1 - 9.5)
22		X			X	
23		X			X	
24		X			X	

Table 6.2 Annual soil loss (g) measured from Gerlach trough sites in KwaZulu and Umfolozi Game Reserve during the 1984/5 rainfall year. Values given are mean and standard error and, in parentheses, range

POSITION	ANNUAL SOIL LOSS (g)	
ON SLOPE	UMFOLOZI GAME RESERVE	KWAZULU
UPPER	49.9 ± 6.4 (32.6 - 75.9) n = 6	141.5 ± 76.4 (19.3 - 463.6) n = 6
MID	66.9 ± 12.4 (18.5 - 128.9) n = 10	91.0 ± 15.2 (26.6 - 174.6) n = 10
LOWER	55.5 ± 9.0 (34.3 - 106.3) n = 8	156.3 ± 20.5 (57.4 - 234.7) n = 8
ENTIRE SLOPE	58.9 ± 6.1 (18.5 - 128.9) n = 24	125.4 ± 20.9 (19.3 - 463.6) n = 24

Table 6.3 Annual soil loss (g) measured from Gerlach trough sites in KwaZulu and Umfolozi Game Reserve during the 1985/6 rainfall year. Values given are mean and standard error and, in parentheses, range

POSITION	ANNUAL SOIL LOSS (g)	
ON SLOPE	UMFOLOZI GAME RESERVE	KWAZULU
UPPER	2 735.1 ± 720.8 (332.5 - 5 689.3) n = 6	4 296.1 ± 2 982.6 (412.5 - 19 091.0) n = 6
MID	143.2 ± 29.8 (51.3 - 338.9) n = 10	698.8 ± 166.4 (117.5 - 1 807.8) n = 10
LOWER	757.9 ± 166.4 (330.6 - 1 651.0) n = 8	3 155.0 ± 726.5 (784.1 - 5 984.3) n = 8
ENTIRE SLOPE	996.1 ± 279.4 (51.3 - 5 689.3) n = 24	2 416.9 ± 800.8 (117.5 - 19 091.0) n = 24

Table 6.4 Results of single classification ANOVA and two-level nested ANOVA on the combined 1984/5 and 1985/6 annual soil loss data set

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE	F VALUE	SIGNIFICANCE
AMONG GROUPS (UGR vs KWZ)	1	1.30696 E7	1.30696 E7	2.21	n.s.
WITHIN GROUPS	22	1.29915 E8	5.90521 E6		
TOTAL	23	1.42984 E8			
AMONG GROUPS (UPPER vs MID vs LOWER)	2	3.92200 E7	1.96100 E7	3.97	0.05>p>0.01
WITHIN GROUPS	21	1.03764 E8	4.94116 E6		
TOTAL	23	1.42984 E8			
AMONG GROUPS (UGR vs KWZ)	1	1.30696 E7	1.30696 E7	1.14	n.s.
AMONG SUBGROUPS (UPPER vs MID vs LOWER)	4	4.44367 E7	1.11092 E7	2.34	n.s.
WITHIN GROUPS	18	8.54780 E7	4.74878 E6		
TOTAL	23	1.42984 E8			

Table 6.5 A-horizon depth (cm) measured at 48 randomly located sites in KwaZulu and Umfolozi Game Reserve. Values given are mean and standard error and, in parentheses, range

POSITION	A-HORIZON DEPTH (cm)	
ON SLOPE	UMFOLOZI GAME RESERVE	KWAZULU
UPPER	9.5 ± 0.9 (3 - 20) n = 24	7.6 ± 0.6 (4 - 14) n = 24
MID	16.0 ± 2.7 (6 - 70) n = 40	10.4 ± 0.5 (3 - 18) n = 40
LOWER	26.0 ± 2.7 (12 - 62) n = 32	22.0 ± 0.9 (12 - 30) n = 32
ENTIRE SLOPE	17.7 ± 1.6 (3 - 70) n = 96	13.6 ± 0.7 (3 - 30) n = 96

Table 6.6 Results of single classification ANOVA and two-level nested ANOVA on the A-horizon depth data set

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE	F VALUE	SIGNIFICANCE
AMONG GROUPS (KWZ vs UGR)	1	103.6	103.6	0.98	n.s.
WITHIN GROUPS	22	2 320.6	105.5		
TOTAL	23	2 424.2			
AMONG GROUPS (UPPER vs MID vs LOWER)	2	926.9	463.5	6.50	p<0.01
WITHIN GROUPS	21	1 497.3	71.3		
TOTAL	23	2 424.2			
AMONG GROUPS (KWZ vs UGR)	1	103.6	103.6	0.42	n.s.
AMONG SUBGROUPS (UPPER vs MID vs LOWER)	4	940.4	235.1	3.07	n.s.
WITHIN GROUPS	18	1 380.2	76.7		
TOTAL	23	2 424.2			

Table 6.7 Correlation matrix of mean annual soil loss (g) and log$_e$ mean annual soil loss (g) against vegetation variables, soil surface variables and slope

DEPENDENT VARIABLES	COEFICIENT OF CORRELATION (r)												
	HCC1	LITC	SOCA	SUTE	ROCK	FORB	AIZ	MAGH	MEGH	HCC2	SURC	WOCC	%SLO
MEAN ANNUAL SOIL LOSS	-0.513 ‡‡	-0.400 ‡‡	0.214 n.s.	0.416 ‡‡	0.488 ‡‡	0.269 n.s.	-0.083 n.s.	-0.423 ‡‡	-0.345 ‡	-0.522 ‡‡	-0.559 ‡‡	-0.019 n.s.	0.165 n.s.
LOGe MEAN ANNUAL SOIL LOSS	-0.804 ‡‡	-0.747 ‡‡	0.568 ‡‡	0.757 ‡‡	0.413 ‡‡	0.274 n.s.	0.087 n.s.	-0.735 ‡‡	-0.678 ‡‡	-0.807 ‡‡	-0.834 ‡‡	-0.048 n.s.	0.338 n.s.

Key
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n.s.= not significant
‡ = significant at 5% probability level
‡‡ = significant at 1% probability level
degrees of freedom = 46

Table 6.8 Percentage contribution of each exclosure plot to total annual accumulated herbage for the period November 1984 to March 1987

POSITION ON SLOPE	PERCENTAGE CONTRIBUTION TO TOTAL ANNUAL ACCUMULATED HERBAGE							
	NOVEMBER 1984		MARCH 1985		MARCH 1986		MARCH 1987	
	KWZ	UGR	KWZ	UGR	KWZ	UGR	KWZ	UGR
UPPER	4.4	18.7	9.4	15.1	6.0	9.8	7.3	11.3
MID	12.9	13.9	12.0	18.0	13.9	17.6	16.2	22.9
LOWER	26.7	23.5	20.2	25.2	27.9	24.7	21.0	21.2
TOTAL	44.0	56.0	41.7	58.3	47.9	52.1	44.4	55.5

Table 6.9 Percentage contribution of each control plot to total annual accumulated herbage for the period November 1984 to March 1987

POSITION ON SLOPE	PERCENTAGE CONTRIBUTION TO TOTAL ANNUAL ACCUMULATED HERBAGE							
	NOVEMBER 1984		MARCH 1985		MARCH 1986		MARCH 1987	
	KWZ	UGR	KWZ	UGR	KWZ	UGR	KWZ	UGR
UPPER	4.6	16.1	10.2	11.4	8.9	17.0	3.8	16.4
MID	24.0	15.8	21.7	11.4	9.9	15.9	14.3	26.0
LOWER	18.9	20.6	18.4	26.8	18.8	29.5	8.0	31.4
TOTAL	47.5	52.5	50.4	49.6	37.6	62.4	26.1	73.9

Table 6.10 Results of single classification ANOVA and two-level nested ANOVA on the 1985-87 exclosure plot and the 1985-87 control plot herbage accumulation data sets

DATA SET	SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE	F VALUE	SIGNIFICANCE
EXCLOSURE PLOT	AMONG GROUPS (KWZ vs UGR)	1	56.5	56.5	1.36	n.s.
	WITHIN GROUPS	16	662.7	41.4		
	TOTAL	17	719.2			
	AMONG GROUPS (UPPER vs MID vs LOWER)	2	550.9	275.5	24.55	p<0.01
	WITHIN GROUPS	15	168.3	11.2		
	TOTAL	17	719.2			
	AMONG GROUPS (KWZ vs UGR)	1	56.5	56.5	0.40	n.s.
	AMONG SUBGROUPS (UPPER vs MID vs LOWER)	4	570.3	142.6	18.51	p<0.01
	WITHIN GROUPS	12	92.4	7.7		
	TOTAL	17	719.2			
CONTROL PLOT	AMONG GROUPS (KWZ vs UGR)	1	286.4	286.4	5.96	0.05>p>0.01
	WITHIN GROUPS	16	768.5	48.0		
	TOTAL	17	1 054.9			
	AMONG GROUPS (UPPER vs MID vs LOWER)	2	354.4	177.2	3.79	0.05>p>0.01
	WITHIN GROUPS	15	700.5	46.7		
	TOTAL	17	1 054.9			
	AMONG GROUPS (KWZ vs UGR)	1	286.4	286.4	2.50	n.s.
	AMONG SUBGROUPS (UPPER vs MID vs LOWER)	4	458.1	114.5	4.43	0.05>p>0.01
	WITHIN GROUPS	12	310.4	25.9		
	TOTAL	17	1 054.9			

Table 6.11 Data matrix used in correspondence analysis of the 1986 herbaceous species composition data. Data derived using the Walker (1976) method*

SPECIES	PLOT NUMBER											
	413.1	413.2	413.3	413.4	415.1	415.2	415.3	415.4	419.1	419.2	419.3	419.4
CODE	PERCENTAGE CONTRIBUTION TO HERBACEOUS SPECIES BIOMASS											
FORB	30.6	49.3	44.1	44.0	9.5	8.3	3.6	5.2	19.4	15.0	26.0	12.4
PNAT	1.6	4.1	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PCOL	3.1	1.1	0.0	3.6	2.1	2.5	3.8	5.1	4.0	26.8	21.2	6.5
PMAX	16.9	7.2	1.1	0.0	2.1	0.0	0.0	0.0	.4	.4	.9	1.1
DISW	10.6	0.0	0.0	0.0	66.2	70.2	0.0	1.1	20.1	3.5	0.0	0.0
ARBA	1.8	0.0	1.5	.9	2.4	4.3	0.0	0.0	.4	0.0	0.0	0.0
DELE	4.6	10.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHGA	23.4	24.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SPPY	1.1	2.8	8.6	3.3	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0
URMO	.4	0.0	0.0	0.0	5.5	2.5	0.0	2.1	0.0	0.0	3.9	.4
ERSU	5.9	.4	1.1	5.5	6.7	8.5	7.7	9.6	13.6	1.7	8.8	24.6
SETS	0.0	1.1	.4	6.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
THEM	0.0	0.0	35.8	35.0	0.0	0.0	19.0	5.1	9.8	23.6	26.9	43.9
CYPC	0.0	0.0	7.2	1.1	0.0	0.0	.9	0.0	0.0	.4	12.0	6.3
PDEU	0.0	0.0	.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UREL	0.0	0.0	.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EUST	0.0	0.0	0.0	0.0	1.1	2.5	1.9	1.7	27.2	19.4	.4	2.4
SPNI	0.0	0.0	0.0	0.0	.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DIAR	0.0	0.0	0.0	0.0	0.0	1.1	61.6	70.2	0.0	1.5	0.0	0.0
HETC	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0
BOTH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	1.1	0.0	0.0
DISP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.6	0.0	2.5
SPUI	0.0	0.0	0.0	.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HFIL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

* For explanation of codes see Table 6.12

Table 6.12 Explanation of codes used in tables, figures and text

SPECIES CODE	SPECIES NAME
ARBA	Aristida barbicollis
BOTH	Bothriochloa insculpta
CENC	Cenchrus ciliaris
CHGA	Chloris gayana
CYPC	Cymbopogon plurinodis
CYVA	Cymbopogon validus
DIAR	Digitaria argyrograpta
DISP	Digitaria species
DISW	Digitaria swazilandensis
DIHE	Diheteropogon amplectens
DELE	Diplachne eleusine
ERCU	Eragrostis curvula
ERSU	Eragrostis superba
EUST	Eustachys paspaloides
FORB	Forb species
HETC	Heteropogon contortus
HFIL	Hyparrhenia filipendula
PCOL	Panicum coloratum
PDEU	Panicum deustum
PMAX	Panicum maximum
PNAT	Panicum natalense
RREP	Rhynchelytrum repens
SETS	Setaria sphacelata
SPUI	Species unidentified
SPNI	Sporobolus nitens
SPPY	Sporobolus pyramidalis
THEM	Themeda triandra
UREL	Urelytrum squarrosum
URMO	Urochloa mosambicensis

PLOT NUMBER	PLOT POSITION AND TREATMENT
413.1	KwaZulu, upper slope, control
413.2	KwaZulu, upper slope, exclosure
413.3	UGR, upper slope, exclosure
413.4	UGR, upper slope, control
415.1	KwaZulu, mid-slope, control
415.2	KwaZulu, mid-slope, exclosure
415.3	UGR, mid-slope, exclosure
415.4	UGR, mid-slope, control
419.1	KwaZulu, lower slope, control
419.2	KwaZulu, lower slope, exclosure
419.3	UGR, lower slope, exclosure
419.4	UGR, lower slope, control

Table 6.13 Total herbaceous species richness in the exclosure and control plots in KwaZulu and Umfolozi Game Reserve

POSITION ON SLOPE	SIZE OF QUADRAT	TOTAL NUMBER OF SPECIES			
		KWAZULU		UMFOLOZI	
		EXCLOSURE	CONTROL	EXCLOSURE	CONTROL
UPPER	20x20cm	6	9	9	8
	20x40cm	7	9	10	10
	40x40cm	9	9	11	11
	MEAN	7.3	9.0	10.0	9.7
MID	20x20cm	10	9	12	11
	20x40cm	10	9	12	11
	40x40cm	10	10	12	11
	MEAN	10.0	9.3	12.0	11.0
LOWER	20x20cm	14	12	10	12
	20x40cm	14	13	10	13
	40x40cm	14	14	10	13
	MEAN	14.0	13.0	10.0	12.7

Table 6.14 Results of single classification, two-level and three-level nested ANOVA on the herbaceous species richness data as determined by the nested quadrat technique

SOURCE OF VARIATION	D.F.	SUM OF SQUARES	MEAN SQUARE	F VALUE	SIGNIFICANCE
AMONG GROUPS (UGR vs KWZ)	1	1.8	1.8	0.45	n.s.
WITHIN GROUPS	34	134.2	3.9		
TOTAL	35	136.0			
AMONG GROUPS (UPPER vs MID vs LOWER)	2	70.2	35.1	17.59	$p<0.01$
WITHIN GROUPS	33	65.8	2.0		
TOTAL	35	136.0			
AMONG GROUPS (UGR vs KWZ)	1	1.8	1.8	0.07	n.s.
AMONG SUBGROUPS (UPPER vs MID vs LOWER)	4	100.9	25.2	22.70	$p<0.01$
WITHIN GROUPS	30	33.3	1.1		
TOTAL	35	136.0			
AMONG GROUPS (UGR vs KWZ)	1	1.8	1.8	4.00	n.s.
AMONG SUBGROUPS (CONTROL vs EXCLOSURE)	2	0.9	0.4	0.03	n.s.
AMONG SUBSUBGROUPS (UPPER vs MID vs LOWER)	8	118.7	14.8	24.27	$p<0.01$
WITHIN GROUPS	24	14.7	0.6		
TOTAL	35	136.0			

Table 6.15 Herbaceous species occurring within each control plot. Species have been ranked from highest to lowest percentage frequency of occurrence, based on 40 x 40 cm nested quadrat data

POSITION ON SLOPE	SPECIES OCCURRING WITHIN EACH PLOT RANKED FROM HIGHEST TO LOWEST		INDEX OF SIMILARITY (Si)
	KWAZULU	UMFOLOZI GAME RESERVE	
UPPER	Forb	Forb	0.60
	Digitaria swazilandensis	Themeda triandra	
	Aristida barbicollis	Eragrostis superba	
	Diplachne eleusine	Eragrostis curvula	
	Eragrostis superba	Aristida barbicollis	
	Panicum coloratum	Cymbopogon plurinodis	
	Eragrostis curvula	Panicum maximum	
	Panicum maximum	Eustachys paspaloides	
	Panicum natalense	Rhynchelytrum repens	
		Panicum coloratum	
		Hyparrhenia filipendula	
MID	Digitaria swazilandensis	Digitaria argyrograpta	0.86
	Digitaria argyrograpta	Eragrostis superba	
	Forb	Forb	
	Panicum coloratum	Eustachys paspaloides	
	Eragrostis superba	Panicum coloratum	
	Panicum maximum	Themeda triandra	
	Eustachys paspaloides	Heteropogon contortus	
	Urochloa mosambicensis	Aristida barbicollis	
	Themeda triandra	Digitaria swazilandensis	
	Aristida barbicollis	Urochloa mosambicensis	
		Digitaria species	
LOWER	Forb	Forb	0.92
	Eragrostis superba	Panicum coloratum	
	Digitaria swazilandensis	Eragrostis superba	
	Eustachys paspaloides	Eustachys paspaloides	
	Panicum coloratum	Themeda triandra	
	Themeda triandra	Cymbopogon plurinodis	
	Aristida barbicollis	Aristida barbicollis	
	Urochloa mosambicensis	Urochloa mosambicensis	
	Cymbopogon plurinodis	Digitaria species	
	Digitaria species	Panicum maximum	
	Panicum maximum	Sporobolus smutsii	
	Digitaria argyrograpta	Digitaria swazilandensis	
	Sporobolus nitens	Urochloa panicoides	
	Sporobolus pectinatus		

Table 6.16 Herbaceous species occurring within each exclosure plot. Species have been ranked from highest to lowest percentage frequency of occurrence, based on 40 x 40 cm nested quadrat data

POSITION ON SLOPE	SPECIES OCCURRING WITHIN EACH PLOT RANKED FROM HIGHEST TO LOWEST		INDEX OF SIMILARITY (Si)
	KWAZULU	UMFOLOZI GAME RESERVE	
UPPER	Forb	Forb	0.40
	Digitaria swazilandensis	Eragrostis curvula	
	Diplachne eleusine	Themeda triandra	
	Panicum maximum	Eragrostis superba	
	Eragrostis curvula	Panicum maximum	
	Eragrostis superba	Aristida barbicollis	
	Aristida barbicollis	Cymbopogon plurinodis	
	Panicum coloratum	Rhynchelytrum repens	
	Rhynchelytrum repens	Species unidentified	
		Panicum deustum	
		Urochloa mosambicensis	
MID	Digitaria swazilandensis	Digitaria argyrograpta	0.82
	Digitaria argyrograpta	Forb	
	Forb	Eragrostis superba	
	Aristida barbicollis	Eustachys paspaloides	
	Themeda triandra	Panicum coloratum	
	Eragrostis superba	Aristida barbicollis	
	Urochloa mosambicensis	Heteropogon contortus	
	Eustachys paspaloides	Digitaria species	
	Panicum coloratum	Digitaria swazilandensis	
	Sporobolus nitens	Panicum maximum	
		Themeda triandra	
		Urochloa mosambicensis	
LOWER	Panicum coloratum	Forb	0.83
	Forb	Eragrostis superba	
	Eragrostis superba	Panicum coloratum	
	Urochloa mosambicensis	Themeda triandra	
	Eustachys paspaloides	Eustachys paspaloides	
	Digitaria swazilandensis	Cymbopogon plurinodis	
	Digitaria species	Aristida barbicollis	
	Themeda triandra	Panicum maximum	
	Cymbopogon plurinodis	Urochloa mosambicensis	
	Aristida barbicollis	Digitaria argyrograpta	
	Sporobolus nitens		
	Panicum maximum		
	Digitaria argyrograpta		
	Sporobolus pectinatus		

Table 6.17 Mean percentage contribution to herbaceous biomass of herbaceous species in November 1984 as determined by the Walker (1976) method on the exclosure and control plots

POSITION ON SLOPE	HERBACEOUS SPECIES	MEAN PERCENTAGE CONTRIBUTION TO BIOMASS		INDEX OF SIMILARITY (Si)
		KWZ	UGR	
UPPER	Forb	27.5	53.4	0.58
	Digitaria swazilandensis	27.4	0.0	
	Diplachne eleusine	21.0	.2	
	Panicum maximum	6.2	0.0	
	Eragrostis curvula	4.0	5.7	
	Panicum coloratum	3.9	.2	
	Cenchrus ciliaris	3.6	0.0	
	Aristida barbicollis	3.3	1.8	
	Eragrostis superba	2.2	4.2	
	Cymbopogon plurinodis	.6	0.0	
	Themeda triandra	.5	25.6	
	Cymbopogon validus	0.0	6.2	
	Hyparrhenia filipendula	0.0	.9	
	Diheteropogon amplectens	0.0	.6	
	Panicum deustum	0.0	.6	
	Heteropogon contortus	0.0	.4	
	Rhynchelytrum repens	0.0	.2	
MID	Digitaria swazilandensis	66.7	65.5	0.73
	Panicum maximum	8.5	0.0	
	Forb	7.1	2.2	
	Eragrostis superba	6.6	12.1	
	Aristida barbicollis	3.6	.8	
	Urochloa mosambicensis	2.0	1.9	
	Panicum coloratum	1.6	3.4	
	Bothriochloa insculpta	1.5	0.0	
	Urochloa mosambicensis	1.2	.9	
	Digitaria argyrograpta	.8	1.2	
	Sporobolus nitens	.4	0.0	
	Themeda triandra	0.0	10.6	
	Heteropogon contortus	0.0	1.1	
	Cymbopogon validus	0.0	.2	
LOWER	Themeda triandra	32.0	46.2	0.82
	Bothriochloa insculpta	27.4	.2	
	Panicum coloratum	7.7	14.6	
	Forb	7.3	7.2	
	Panicum maximum	7.1	2.9	
	Eragrostis superba	5.2	8.2	
	Urochloa mosambicensis	4.1	.9	
	Eustachys paspaloides	2.7	1.4	
	Digitaria swazilandensis	2.5	0.0	
	Digitaria species	2.3	0.0	
	Digitaria argyrograpta	1.3	1.8	
	Aristida barbicollis	.4	0.0	
	Cymbopogon validus	0.0	16.7	

Table 6.18 Mean percentage contribution to herbaceous biomass of herbaceous species in November 1984 as determined by the Barnes et al. (1982) method on the exclosure and control plots

POSITION ON SLOPE	HERBACEOUS SPECIES	MEAN PERCENTAGE CONTRIBUTION TO BIOMASS		INDEX OF SIMILARITY (Si)
		KWZ	UGR	
UPPER	Forb	28.4	54.8	0.58
	Digitaria swazilandensis	27.4	0.0	
	Diplachne eleusine	20.8	.2	
	Panicum maximum	6.0	0.0	
	Eragrostis curvula	3.9	5.0	
	Panicum coloratum	3.8	.2	
	Cenchrus ciliaris	3.5	0.0	
	Aristida barbicollis	2.9	1.8	
	Eragrostis superba	2.1	4.0	
	Cymbopogon plurinodis	.6	0.0	
	Themeda triandra	.5	25.2	
	Hyparrhenia filipendula	0.0	.9	
	Cymbopogon validus	0.0	6.2	
	Panicum deustum	0.0	.6	
	Diheteropogon amplectens	0.0	.2	
	Rhynchelytrum repens	0.0	.6	
	Heteropogon contortus	0.0	.4	
MID	Digitaria swazilandensis	75.3	73.4	0.76
	Panicum maximum	7.6	0.0	
	Forb	5.2	1.8	
	Aristida barbicollis	3.0	.8	
	Bothriochloa insculpta	1.5	0.0	
	Urochloa mosambicensis	1.4	1.9	
	Eragrostis superba	1.2	11.1	
	Panicum coloratum	.9	3.4	
	Eustachys paspaloides	.8	1.1	
	Digitaria argyrograpta	.6	.7	
	Themeda triandra	0.0	3.0	
	Cymbopogon validus	0.0	1.9	
	Heteropogon contortus	0.0	.9	
LOWER	Themeda triandra	31.5	48.4	0.82
	Bothriochloa insculpta	28.4	.2	
	Panicum coloratum	8.5	14.6	
	Forb	7.5	6.0	
	Panicum maximum	7.2	1.9	
	Eragrostis superba	4.8	7.8	
	Urochloa mosambicensis	4.1	1.9	
	Eustachys paspaloides	2.9	.9	
	Digitaria species	2.2	0.0	
	Digitaria argyrograpta	1.2	1.8	
	Digitaria swazilandensis	1.1	0.0	
	Aristida barbicollis	.6	0.0	
	Cymbopogon validus	0.0	16.4	

Table 6.19 Mean percentage contribution to herbaceous biomass of herbaceous species in January 1986 as determined by the Walker (1976) method on the exclosure and control plots

POSITION ON SLOPE	HERBACEOUS SPECIES	MEAN PERCENTAGE CONTRIBUTION TO BIOMASS		INDEX OF SIMILARITY (Si)
		KWZ	UGR	
UPPER	Forb	40.0	44.0	0.58
	Chloris gayana	23.7	0.0	
	Panicum maximum	12.0	.6	
	Diplachne eleusine	7.3	0.0	
	Digitaria swazilandensis	5.3	0.0	
	Eragrostis superba	3.2	3.3	
	Panicum natalense	2.8	0.0	
	Panicum coloratum	2.1	1.8	
	Sporobolus pyramidalis	1.9	5.9	
	Aristida barbicollis	.9	1.2	
	Setaria sphacelata	.6	3.2	
	Urochloa mosambicensis	.2	0.0	
	Themeda triandra	0.0	35.4	
	Cymbopogon plurinodis	0.0	4.2	
	Panicum deustum	0.0	.2	
	Urelytrum squarrosum	0.0	.2	
	Species unidentified	0.0	.2	
MID	Digitaria swazilandensis	68.2	.6	0.67
	Forb	8.9	4.4	
	Eragrostis superba	7.6	8.7	
	Urochloa mosambicensis	4.0	1.1	
	Aristida barbicollis	3.3	0.0	
	Panicum coloratum	2.3	4.4	
	Panicum natalense	1.8	0.0	
	Eustachys paspaloides	1.8	1.8	
	Panicum maximum	1.1	0.0	
	Digitaria argyrograpta	.6	65.9	
	Sporobolus nitens	.5	0.0	
	Themeda triandra	0.0	12.1	
	Heteropogon contortus	0.0	.8	
	Cymbopogon plurinodis	0.0	.5	
LOWER	Eustachys paspaloides	23.3	1.4	0.73
	Forb	17.2	19.2	
	Themeda triandra	16.7	35.4	
	Panicum coloratum	15.4	13.8	
	Digitaria swazilandensis	11.8	0.0	
	Eragrostis superba	7.6	16.7	
	Digitaria species	3.3	1.2	
	Sporobolus pyramidalis	1.8	0.0	
	Bothriochloa insculpta	1.3	0.0	
	Digitaria argyrograpta	.8	0.0	
	Panicum maximum	.4	1.0	
	Aristida barbicollis	.2	0.0	
	Cymbopogon plurinodis	.2	9.2	
	Urochloa mosambicensis	0.0	2.1	

Table 6.20 Mean percentage contribution to herbaceous biomass of herbaceous species in January 1986 as determined by the Barnes <u>et</u> <u>al</u>. (1982) method on the exclosure and control plots

POSITION ON SLOPE	HERBACEOUS SPECIES	MEAN PERCENTAGE CONTRIBUTION TO BIOMASS		INDEX OF SIMILARITY (Si)
		KWZ	UGR	
	Forb	40.2	44.5	
	Chloris gayana	22.9	0.0	
	Panicum maximum	12.6	.5	
	Diplachne eleusine	7.6	0.0	
	Digitaria swazilandensis	5.0	0.0	
	Eragrostis superba	3.0	2.4	
	Panicum natalense	2.5	0.0	
	Panicum coloratum	2.2	1.8	
	Sporobolus pyramidalis	1.9	6.4	
UPPER	Aristida barbicollis	.8	1.2	0.62
	Setaria sphacelata	.5	3.4	
	Urochloa mosambicensis	.5	0.0	
	Cymbopogon plurinodis	.2	4.3	
	Themeda triandra	0.0	34.5	
	Urelytrum squarrosum	0.0	.5	
	Panicum deustum	0.0	.2	
	Species unidentified	0.0	.2	
	Hyparrhenia filipendula	0.0	.2	
	Digitaria swazilandensis	73.5	.5	
	Forb	6.6	4.0	
	Eragrostis superba	6.5	7.8	
	Urochloa mosambicensis	3.6	.9	
	Aristida barbicollis	2.4	0.0	
	Panicum coloratum	2.3	3.2	
	Panicum natalense	1.8	0.0	
MID	Eustachys paspaloides	1.4	1.5	0.67
	Panicum maximum	1.1	0.0	
	Digitaria argyrograpta	.6	53.6	
	Sporobolus nitens	.2	0.0	
	Themeda triandra	0.0	27.7	
	Heteropogon contortus	0.0	.5	
	Cymbopogon plurinodis	0.0	.2	
	Eustachys paspaloides	21.4	1.3	
	Forb	18.5	17.9	
	Themeda triandra	16.0	35.4	
	Panicum coloratum	15.6	13.9	
	Digitaria swazilandensis	12.3	0.0	
	Eragrostis superba	7.8	18.0	
LOWER	Digitaria species	3.6	1.4	0.73
	Sporobolus pyramidalis	1.8	0.0	
	Bothriochloa insculpta	1.4	0.0	
	Digitaria argyrograpta	.8	0.0	
	Panicum maximum	.5	.9	
	Cymbopogon plurinodis	.2	8.9	
	Aristida barbicollis	.2	0.0	
	Urochloa mosambicensis	0.0	2.1	

Table 6.21 Results of the correspondence analysis of the November 1984 herbaceous species composition data at the control and exclosure plots. Data derived using the Walker (1976) method

VARIABLES	QLT	PRINCIPAL AXIS 1			PRINCIPAL AXIS 2		
		K=1	COR	CTR	K=2	COR	CTR
THEM	820	-802	818	218	-42	2	1
PCOL	226	-515	197	25	-199	29	5
DISW	974	972	775	451	-491	199	149
DELE	706	1200	221	90	1776	485	254
PMAX	40	230	37	4	71	3	0
ERCU	651	46	0	0	1278	651	60
ERSU	487	86	25	1	-366	462	20
ARBA	290	633	266	12	194	24	1
FORB	713	-68	4	1	901	709	323
CENC	502	1376	145	20	2158	357	64
CYPC	502	1376	145	3	2158	357	10
HFIL	183	-764	54	2	1180	129	5
CYVA	406	-1015	389	70	216	17	4
PDEU	183	-764	54	1	1180	129	3
DIHE	183	-764	54	1	1180	129	3
RREP	183	-764	54	0	1180	129	1
HETC	87	462	49	1	-402	38	1
DIAR	205	-258	33	1	-585	172	7
SPNI	365	1056	227	1	-824	138	1
URMO	432	-119	12	0	-707	420	17
BOTH	297	-898	201	69	-621	96	43
EUST	346	-340	77	2	-633	269	9
DISP	135	-997	101	7	-582	34	3
413.1	675	619	326	60	640	349	83
413.2	730	930	251	135	1284	479	333
413.3	531	-516	186	50	702	345	119
413.4	486	-327	84	19	716	402	120
415.1	614	636	438	81	-403	176	42
415.2	873	791	569	109	-577	304	75
415.3	708	548	346	53	-559	362	71
415.4	832	659	443	79	-616	389	89
419.1	440	-691	340	90	-376	100	34
419.2	358	-673	283	92	-346	75	31
419.3	515	-775	512	118	-66	3	1
419.4	529	-770	523	114	-87	6	2

Table 6.22 Results of the correspondence analysis of the November 1984 herbaceous species composition data at the control and exclosure plots. Data derived using the Barnes <u>et al</u>. (1982) method

VARIABLES	QLT	PRINCIPAL AXIS 1			PRINCIPAL AXIS 2		
		K=1	COR	CTR	K=2	COR	CTR
THEM	850	-910	830	236	143	20	8
PCOL	280	-550	211	25	315	69	11
DISW	985	1080	885	543	363	100	85
DELE	673	806	100	36	-1926	573	284
PMAX	31	177	21	2	-121	10	1
ERCU	630	-99	3	0	-1291	627	54
ERSU	161	-31	2	0	280	159	9
ARBA	269	533	206	7	-294	63	3
FORB	733	-212	35	12	-947	698	339
CENC	473	916	64	8	-2304	409	68
CYPC	473	916	64	1	-2304	409	11
HFIL	158	-802	60	2	-1029	98	4
CYVA	318	-834	317	45	53	1	0
PDEU	158	-802	60	1	-1029	98	2
DIHE	158	-802	60	0	-1029	98	1
RREP	158	-802	60	1	-1029	98	2
HETC	107	565	92	1	228	15	0
DIAR	212	-390	62	2	606	150	6
URMO	399	-244	46	1	676	353	16
BOTH	318	-866	187	59	726	131	58
EUST	249	-276	34	1	697	215	10
DISP	145	-948	92	5	725	53	4
413.1	675	460	182	30	-755	493	111
413.2	705	656	126	60	-1401	579	380
413.3	496	-575	227	55	-626	269	90
413.4	505	-436	137	31	-715	368	115
415.1	685	755	581	101	320	104	25
415.2	874	967	696	139	489	178	49
415.3	829	829	608	108	500	221	55
415.4	831	745	579	90	492	252	54
419.1	479	-732	352	90	440	127	45
419.2	382	-679	269	83	441	113	49
419.3	528	-800	488	112	230	40	13
419.4	544	-767	498	101	234	46	13

Table 6.23 Results of the correspondence analysis of the January 1986 herbaceous species composition data at the control and exclosure plots. Data derived using the Walker (1976) method

VARIABLES	QLT	PRINCIPAL AXIS 1			PRINCIPAL AXIS 2		
		K=1	COR	CTR	K=2	COR	CTR
FORB	703	333	451	62	-248	252	71
PNAT	417	1339	345	35	615	72	15
PCOL	446	-507	285	43	382	161	50
PMAX	773	1481	734	138	342	39	15
ARBA	90	242	13	1	587	77	17
DELE	795	1890	791	109	140	4	1
CHGA	914	1890	899	353	250	15	13
SPPY	316	211	23	2	-737	293	45
URMO	200	318	32	4	727	168	42
ERSU	254	-355	158	25	278	96	31
SETS	278	147	4	0	-1207	274	48
THEM	900	-503	458	105	-494	442	209
CYPC	417	-451	118	12	-717	299	62
PDEU	331	-65	0	0	-1715	331	5
UREL	331	-65	0	0	-1715	331	5
EUST	580	-694	170	57	1076	410	281
SPNI	83	467	8	0	1399	75	8
HETC	40	-847	40	2	-90	0	0
BOTH	453	-740	124	3	1206	329	16
SPUI	228	-152	2	0	-1383	226	3
DISP	262	-840	167	13	635	95	16
DISW	52	-679	46	136	263	6	42
DIAR*	219	77	0	2	1283	219	1212
413.1	880	1313	845	344	271	35	30
413.2	878	1313	878	375	-24	0	0
413.3	685	-45	2	0	-830	683	298
413.4	568	-105	13	2	-669	555	202
415.1	184	324	34	8	678	150	73
415.2	239	-209	24	4	627	215	65
415.3	288	-602	287	39	-43	1	0
415.4	354	-402	198	11	358	156	19
419.1	382	-442	124	35	638	258	150
419.2	547	-612	323	90	510	224	128
419.3	261	-358	226	32	-142	35	10
419.4	449	-510	375	59	-226	74	24

* Supplementary point

Table 6.24 Results of the correspondence analysis of the January 1986 herbaceous species composition data at the control and exclosure plots. Data derived using the Barnes et al. (1982) method

VARIABLES	QLT	PRINCIPAL AXIS 1			PRINCIPAL AXIS 2		
		K=1	COR	CTR	K=2	COR	CTR
FORB	772	-84	12	2	-661	760	165
PNAT	360	-1078	314	12	-614	46	2
PCOL	34	213	34	4	-28	0	0
PMAX	402	-650	103	17	-1106	299	54
DISW	984	-1402	624	454	1066	360	296
ARBA	517	-910	471	10	286	46	1
DELE	476	-602	54	7	-1674	422	61
CHGA	528	-645	77	24	-1560	451	159
SPPY	238	7	0	0	-756	238	16
URMO	455	-561	171	6	724	284	11
ERSU	77	122	22	2	193	55	5
SETS	80	244	6	1	-807	74	7
THEM	395	559	374	90	-134	21	6
CYPC	117	371	56	5	-386	61	6
PDEU	322	-127	3	0	-1295	319	2
UREL	58	286	7	0	-759	51	1
EUST	17	-64	1	0	236	16	4
SPNI	412	-1737	260	2	1330	152	1
DIAR	709	1599	473	356	1130	236	200
HETC	201	1329	167	2	600	34	0
BOTH	3	-90	1	0	115	2	0
DISP	19	312	18	1	-91	1	0
SPUI	56	292	7	0	-745	49	0
HFIL	56	292	7	0	-745	49	0
413.1	880	-589	141	45	-936	356	128
413.2	878	-422	56	23	-1346	569	260
413.3	685	223	38	7	-558	242	48
413.4	568	227	35	7	-547	209	45
415.1	184	-1355	612	239	977	318	140
415.2	239	-1234	560	212	1034	392	168
415.3	288	1037	642	153	441	115	31
415.4	354	1419	436	267	1048	238	164
419.1	382	-286	58	1	180	22	5
419.2	547	199	25	6	-33	0	0
419.3	261	267	69	11	-198	39	7
419.4	449	369	128	19	-144	19	3

Table 6.25 Comparison of the Walker (1976) and Barnes *et al*. (1982) methods used to collect herbaceous species composition data in KwaZulu and Umfolozi Game Reserve. Critical values of T are based on the 5% level of significance using a two-tailed test

WILCOXON MATCHED-PAIRS	KWAZULU		UMFOLOZI GAME RESERVE	
SIGNED-RANKS TEST	1984	1986	1984	1986
N	14	14	11	11
CRITICAL T VALUE	21	21	11	11
CALCULATED T VALUE	59.0	99.5	75.0	51.5
LEVEL OF SIGNIFICANCE	n.s.	n.s.	n.s.	n.s.

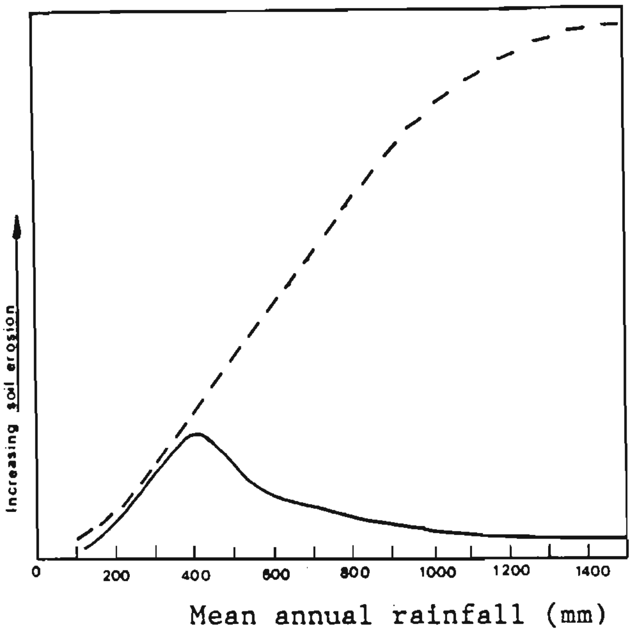

Figure 7.1 Relationship between soil erosion and mean annual rainfall for areas of natural vegetation cover (solid line) and bare ground (dashed line). Modified after Branson *et al.*, 1981

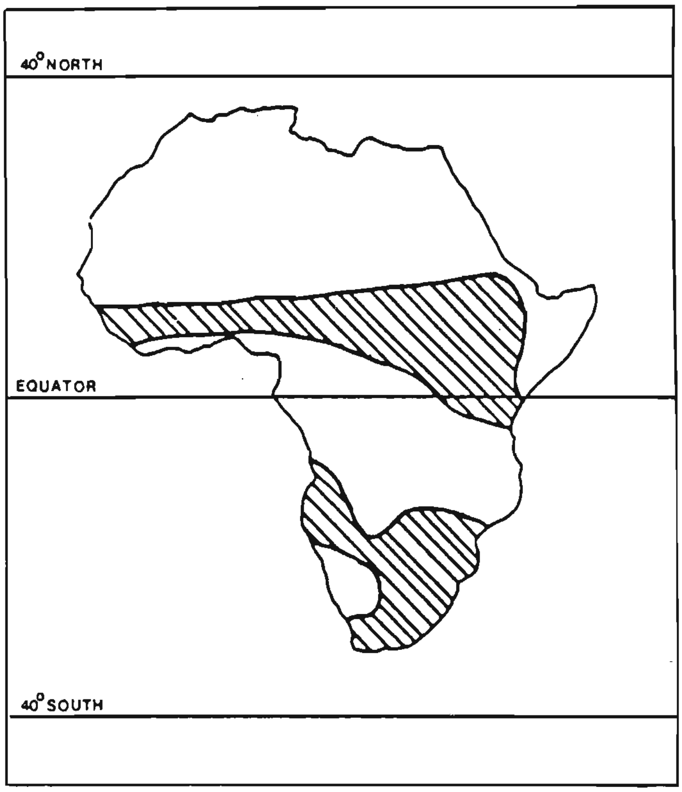

Figure 7.2 Map of Africa showing areas particularly susceptible to rainfall erosion (hatched area). Modified after Hudson, 1981

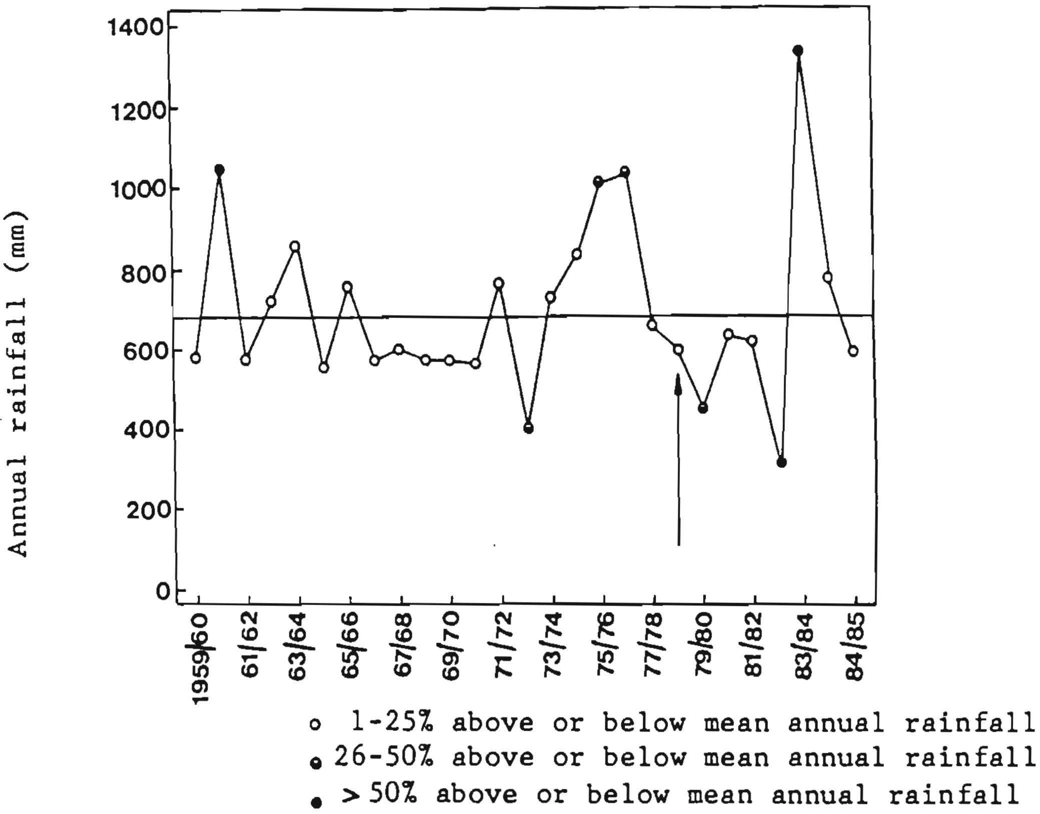

Figure 7.3 Annual rainfall (mm) measured at Mpila for the period 1959/60 to 1985/86. Arrow indicates the beginning of the non-cull/cull experiment

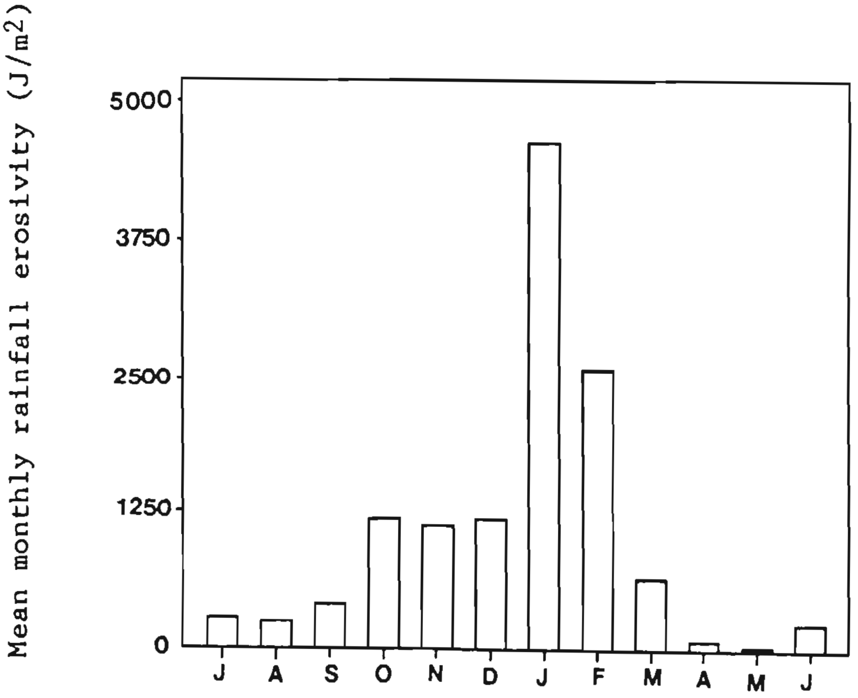

Figure 7.4 Mean monthly values of rainfall erosivity in western Umfolozi Game Reserve. Mean values calculated from the 1983/4, 1984/5 and 1985/6 rainfall years

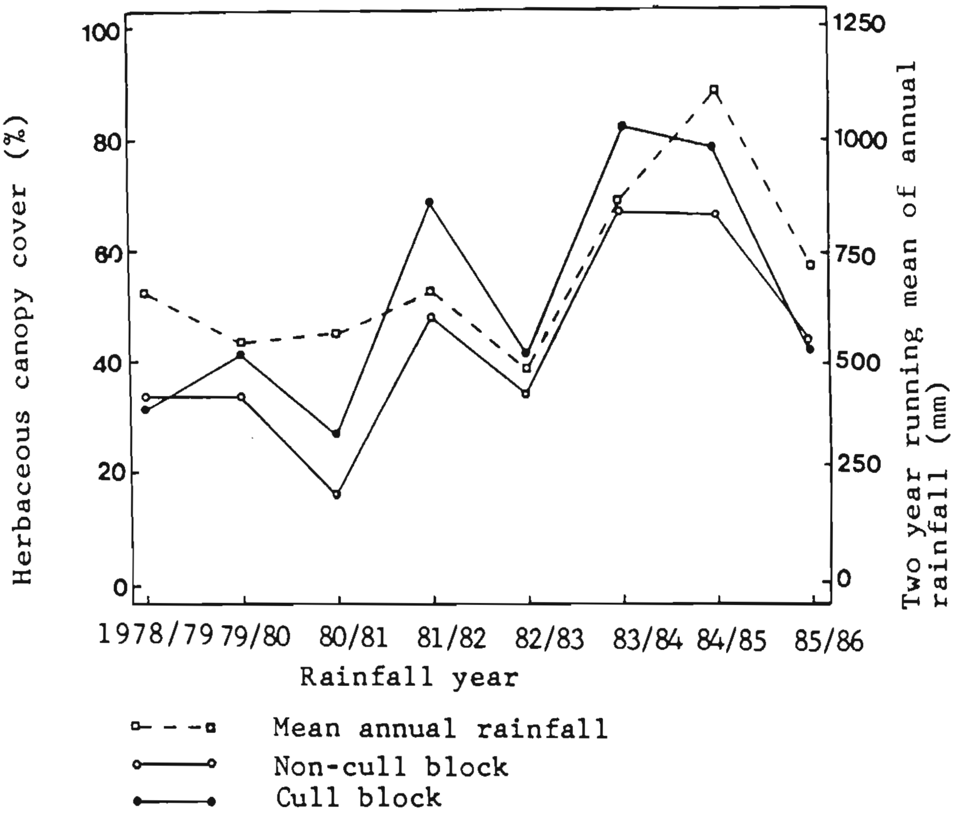

Figure 7.5 Relationship between mean annual rainfall and percentage herbaceous canopy cover in the cull and non-cull blocks

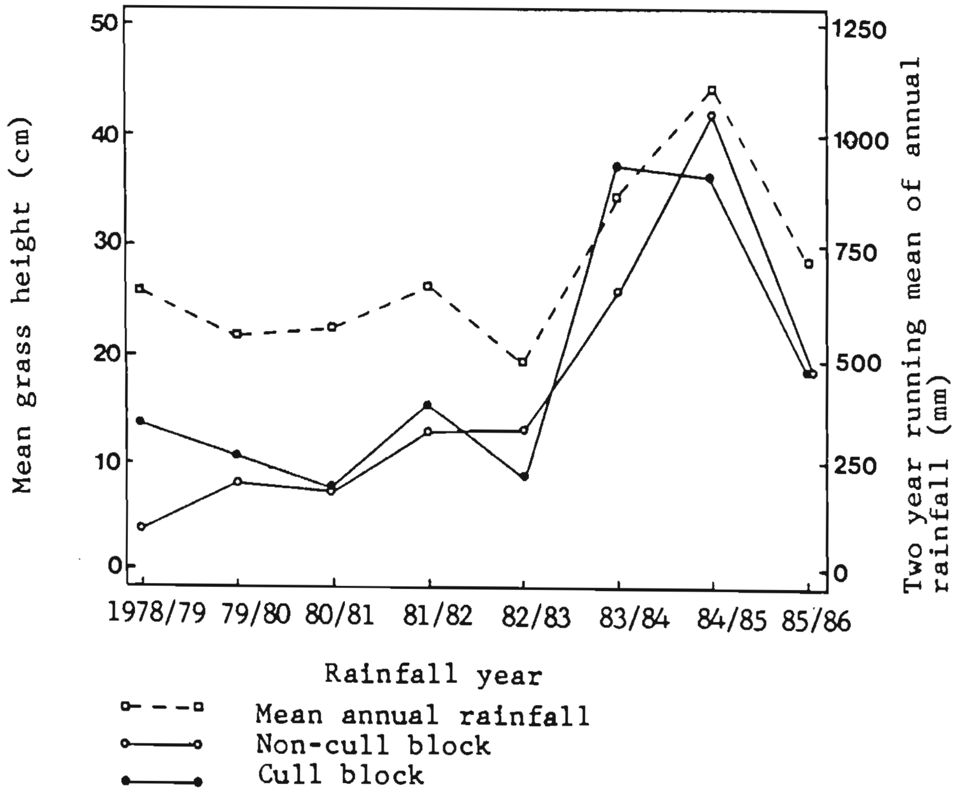

Figure 7.6 Relationship between mean annual rainfall and mean grass height in the cull and non-cull blocks

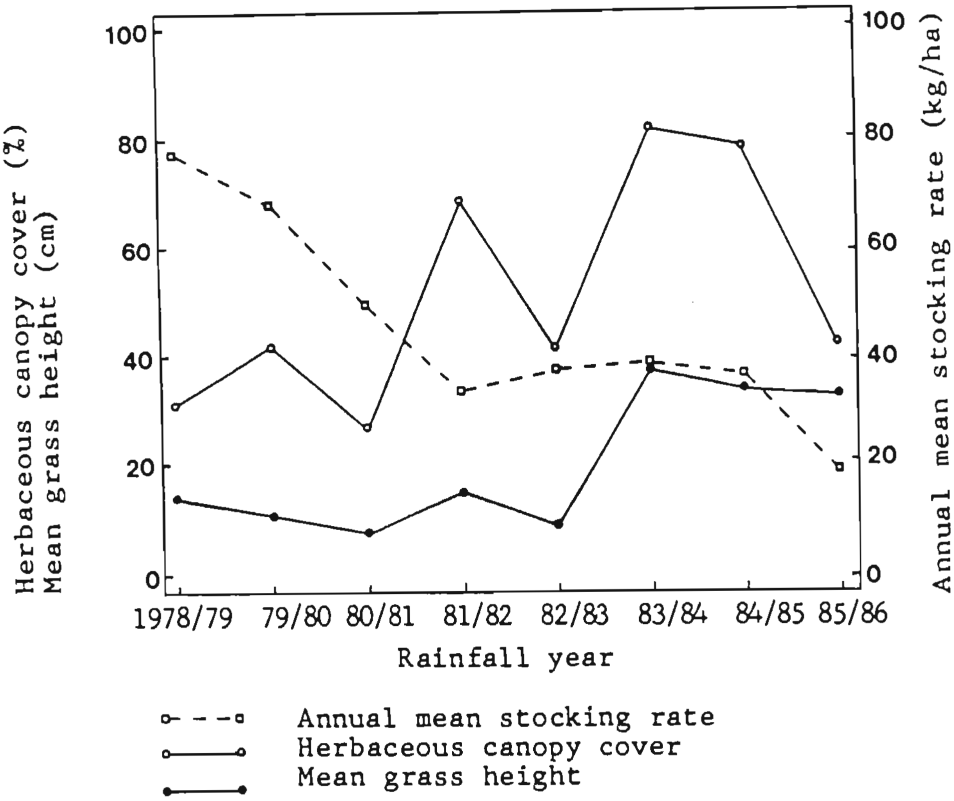

Figure 7.7 Relationship between annual mean stocking rate, herbaceous canopy cover and mean grass height in the cull block

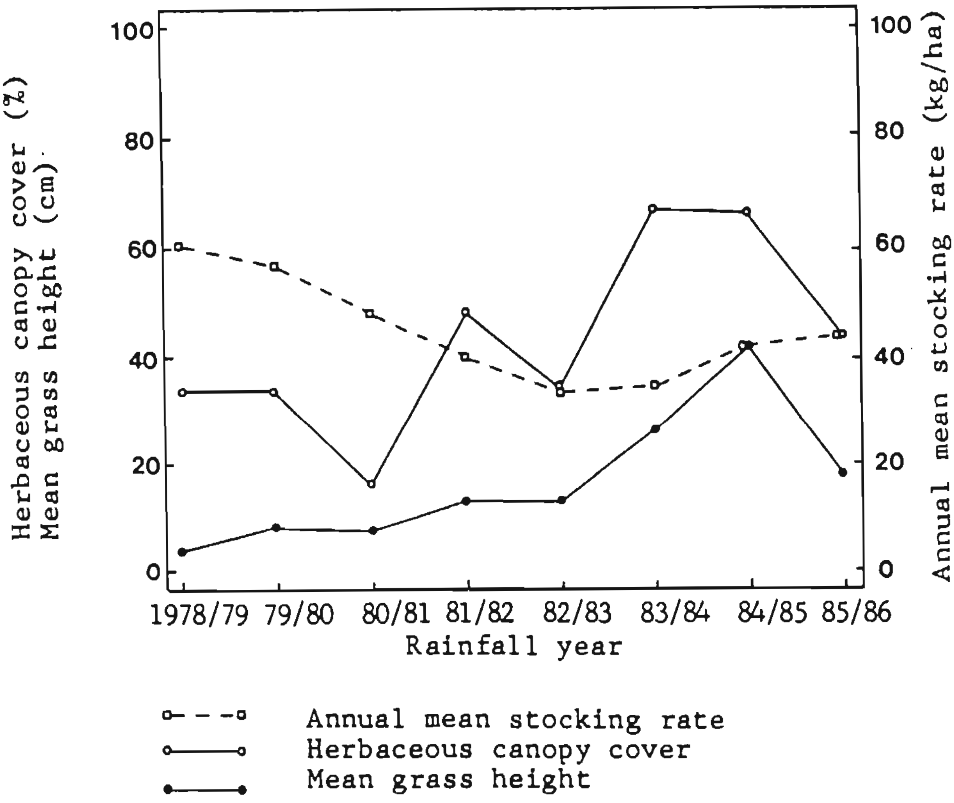

Figure 7.8 Relationship between annual mean stocking rate, herbaceous canopy cover and mean grass height in the non-cull block

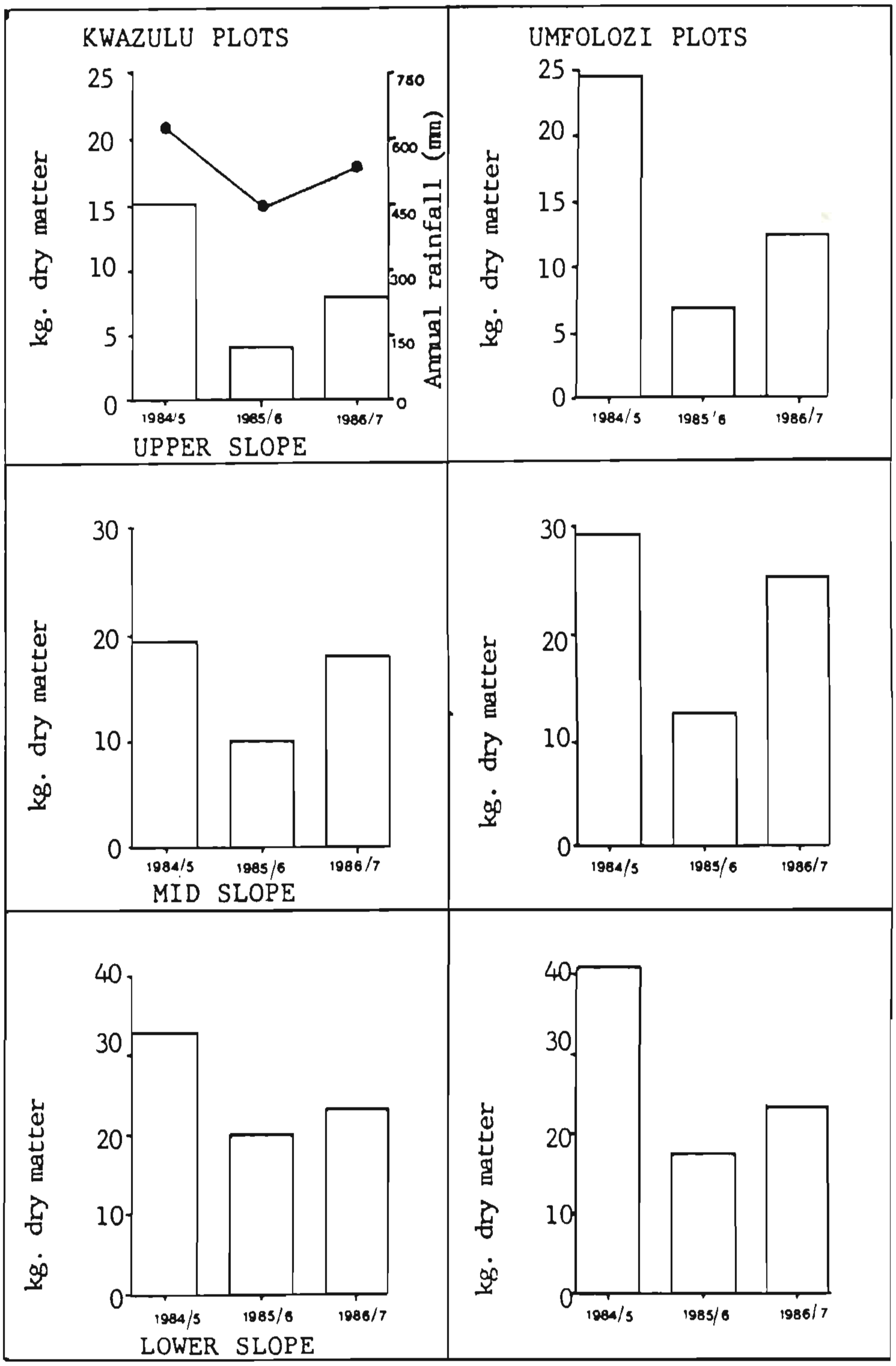

Figure 7.9 Herbage accumulation in exclosure plots in KwaZulu and Umfolozi Game Reserve during the 1984/5, 1985/6 and 1986/7 rainfall years. Annual rainfall is shown in the KwaZulu upper slope histogram

Table 7.1 Summary of results on the influence of livestock grazing on sediment yield in the United States of America and South Africa

LOCATION	EXPERIMENTAL TECHNIQUE	GRAZING TREATMENT	SEDIMENT YIELD RATIO	REFERENCES
COLORADO	PLOTS	UNGRAZED vs HEAVILY GRAZED	1 : 2.4	Durnford, 1954
COLORADO	GAUGED CATCHMENTS	UNGRAZED vs VERY HEAVILY GRAZED	1 : 1.3 - 2.0	Lusby *et al*., 1971
TEXAS	INFILTROMETER	UNGRAZED vs CONTINUOUSLY GRAZED	1 : 1.3	McGinty *et al*., 1978
TEXAS	INFILTROMETER	UNGRAZED vs HEAVILY GRAZED	1 : 6.8 - 28.8	Wood & Blackburn, 1981
COLORADO	PLOTS	UNGRAZED vs HEAVILY GRAZED	1 : 2.3	Currie, 1975
TRANSVAAL	PLOTS	UNGRAZED vs MODERATELY GRAZED	1 : 1.5 - 4.0	Haylett, 1960

Table 7.2 Summary of soil loss results from western Umfolozi Game Reserve obtained from rainfall simulator trials and natural run-off plots

EXPERIMENTAL TECHNIQUE	MONITORING PERIOD (YEARS)	ANNUAL MEAN SOIL LOSS (t/ha)		MEAN ANNUAL SOIL LOSS (t/ha)		SOIL LOSS RATIO
		CULL	NON-CULL	CULL	NON-CULL	
RAINFALL SIMULATOR	4	0.26	0.88	-	-	1 : 3.4
NATURAL RUN-OFF PLOTS	3	-	-	0.24	0.74	1 : 3.1

Table 7.3 Correlation matrix of rainfall and stocking rate against vegetation variables. Vegetation data derived from Walker transects

DEPENDENT VARIABLES	COEFFICIENT OF CORRELATION			
	CULL BLOCK		NON-CULL BLOCK	
	ANNUAL RAINFALL (mm)	STOCKING RATE (kg/ha)	ANNUAL RAINFALL (mm)	STOCKING RATE (kg/ha)
HERBACEOUS CANOPY COVER	0.775 *	-0.573 n.s.	0.832 *	-0.466 n.s.
MEAN GRASS HEIGHT	0.925 **	-0.414 n.s.	0.904 **	-0.510 n.s.

Key

n.s.= not significant
* = significant at 5% probability level
** = significant at 1% probability level
degrees of freedom = 6

Table 7.4 Correlation matrix of vegetation variables, rainfall and stocking rate against mean soil loss (kg/ha). Soil loss data derived from rainfall simulator trials

DEPENDENT VARIABLES	COEFFICIENT OF CORRELATION			
	HERBACEOUS CANOPY COVER (%)	MEAN GRASS HEIGHT (cm)	ANNUAL RAINFALL (mm)	STOCKING RATE (kg/ha)
MEAN SOIL LOSS	-0.829 *	-0.573 n.s.	-0.672 n.s.	-0.386 n.s.
LOGe MEAN SOIL LOSS	-0.975 **	-0.802 *	-0.808 *	-0.226 n.s.

Key

n.s.= not significant
* = significant at 5% probability level
** = significant at 1% probability level
degrees of freedom = 6

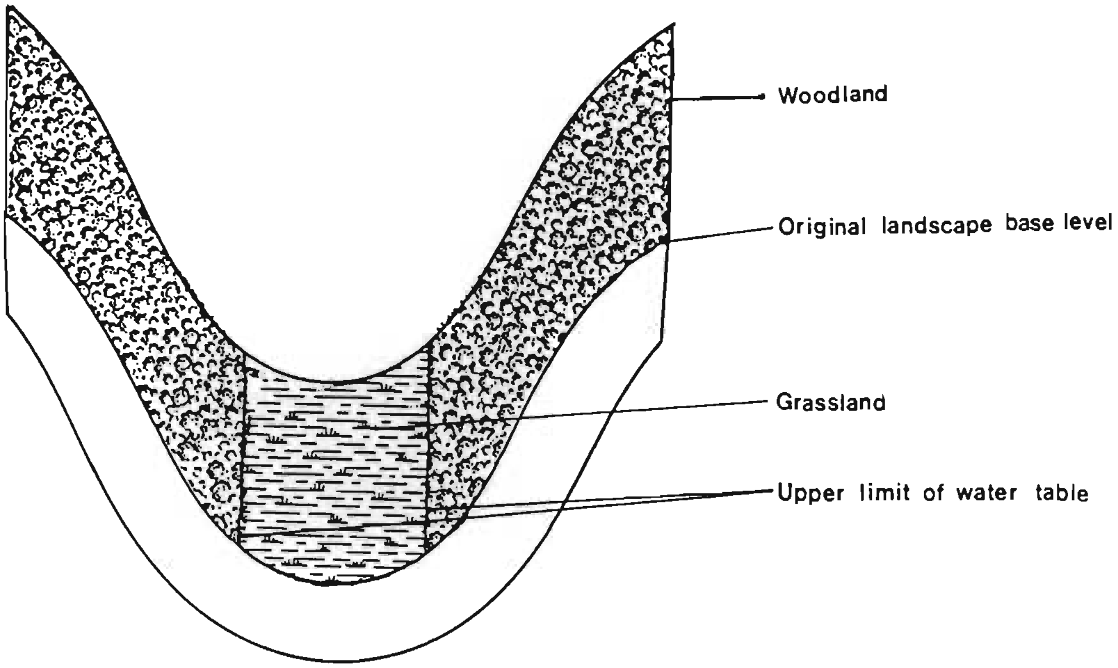

Figure 8.1 Cross-section through a landscape showing position and extent of depression mesic grassland maintained as a result of seasonal waterlogging of the soil

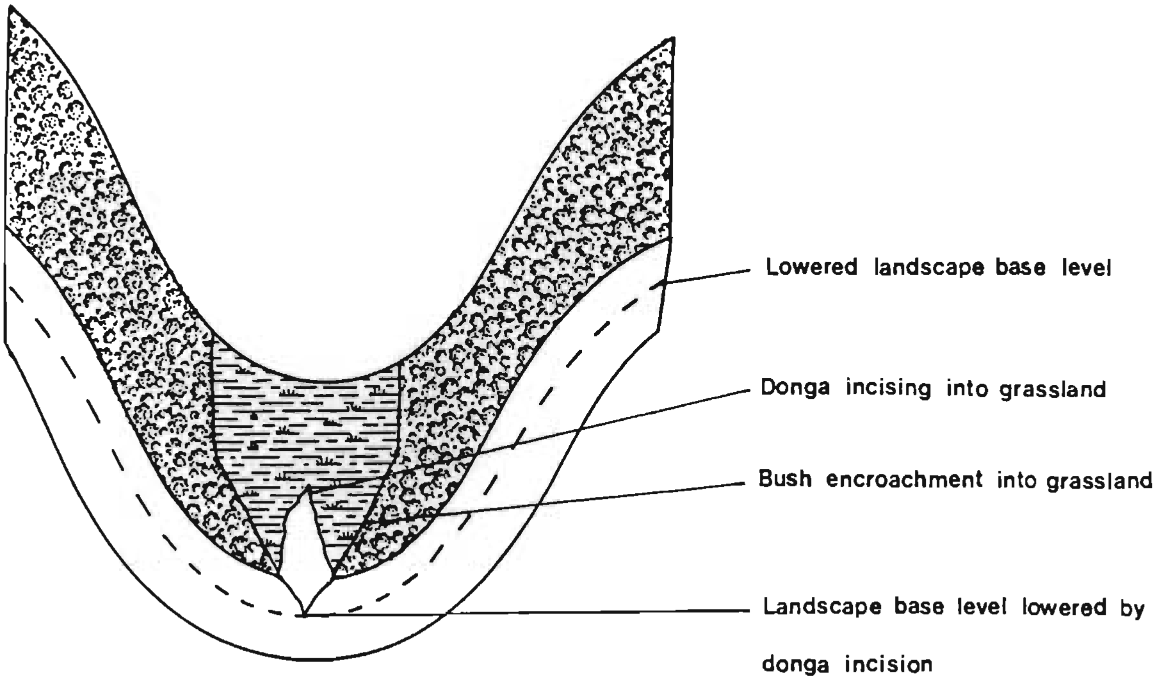

Figure 8.2 Cross-section through a landscape, showing the effect of lowering the landscape base level on the extent of depression mesic grassland

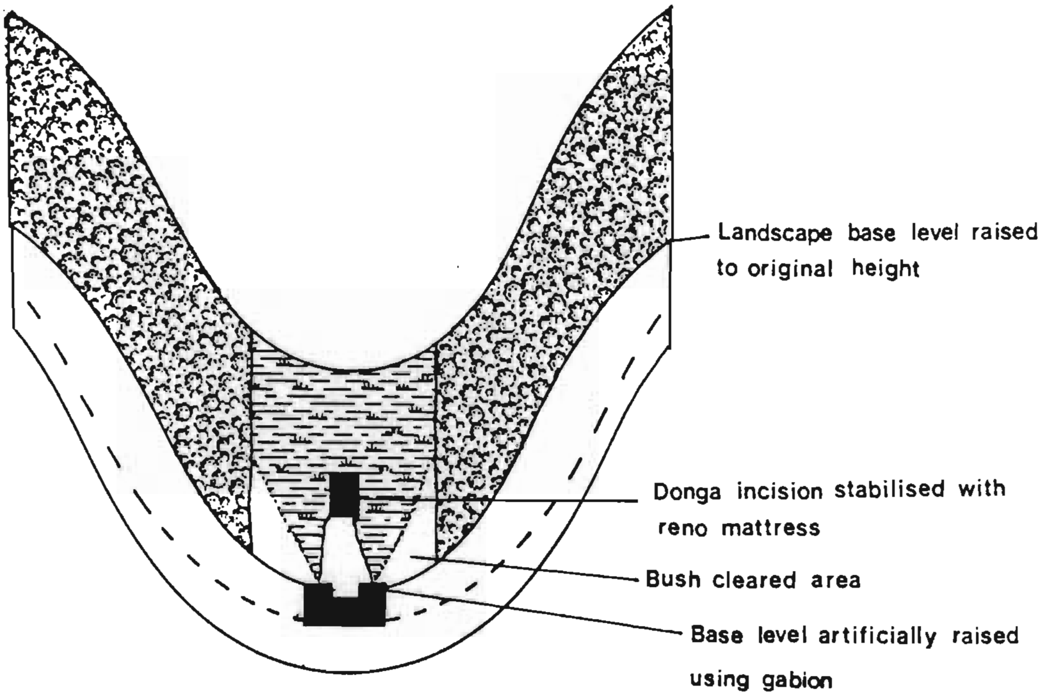

Figure 8.3 Cross-section through a landscape showing the effect of artificially raising the base level and stabilising donga incision on depression mesic grassland

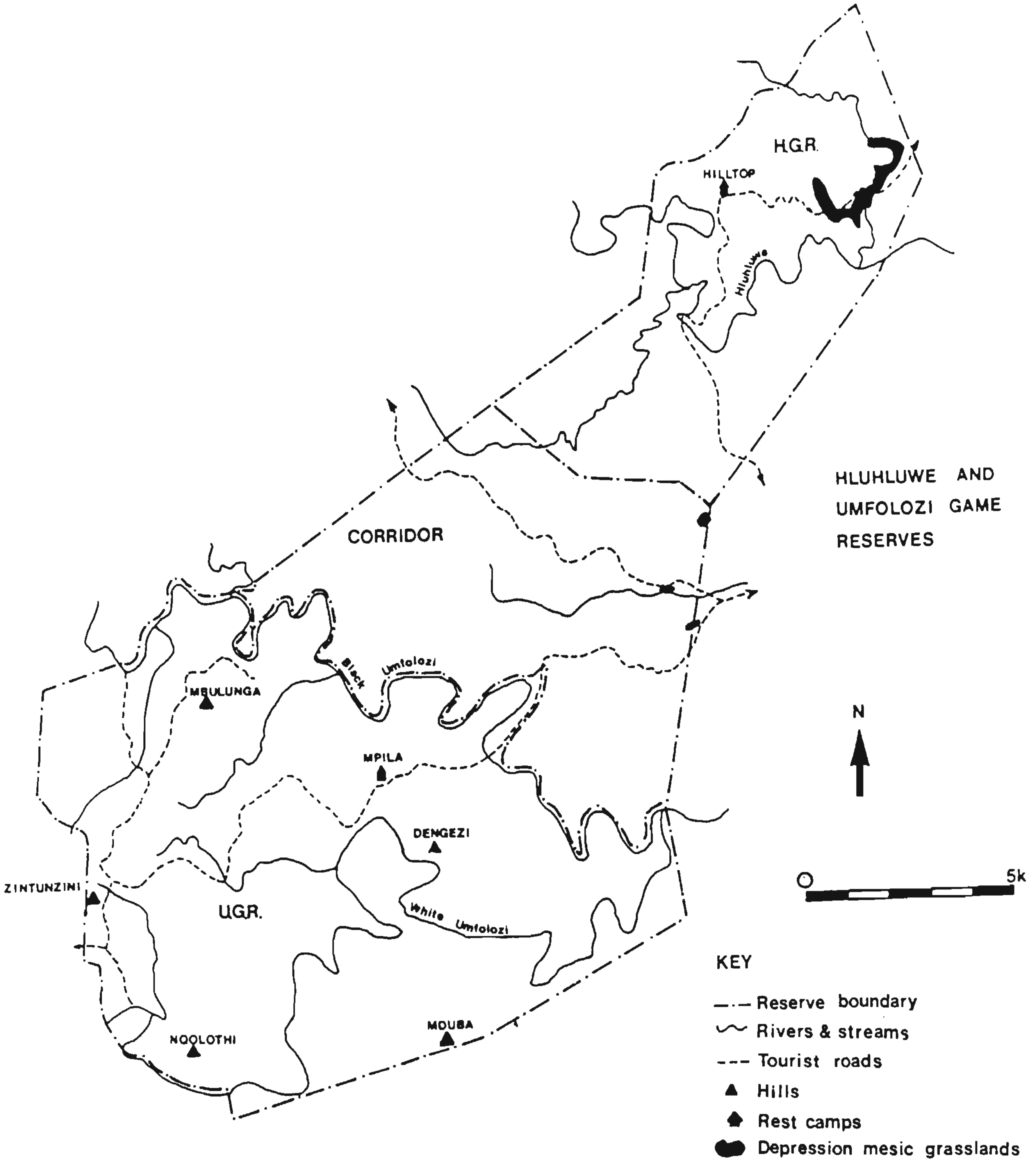

Figure 8.4 Location of hydrologically maintained depression mesic grasslands in the Hluhluwe and Umfolozi Game Reserves. Modified after Macdonald, 1982

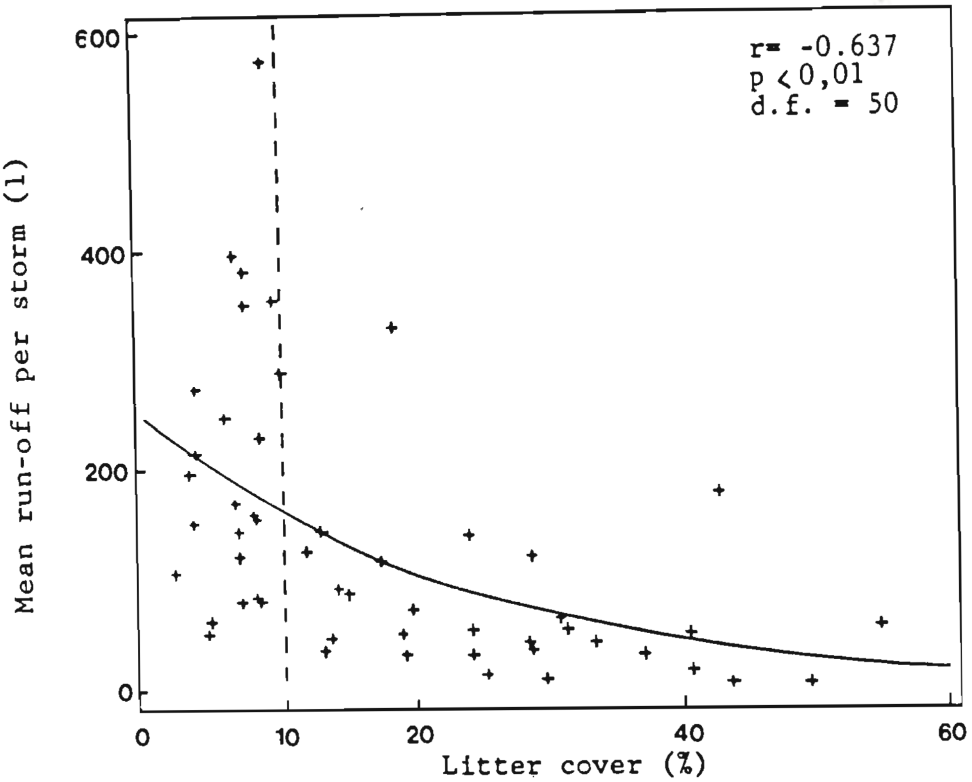

Figure 8.5 Relationship between mean run-off per storm and litter cover. Data obtained from natural run-off plots