Appendices

Appendix. 1: Table showing the soil property of cabbage fields in the highlands of Chomthong district

pH	Organic matter(%)	Phosphorous (ppm)	Potassium (ppm)	Sand(%)	Silt(%)	Clay(%)
5 ± 0.3	9.4 ± 3.8	71 ± 29	283 ± 177	53.8± 2.7	29.1± 3.3	17.1 ± 3.0
	..					

Source: Chomthong District office, 1992

Appendix.2 Table showing the water quality parameters measured in different seasons in different sampling sites.

Month	site	% saturation	D.O (mg/l)	pH	alkalinity (mq/l)	velocity (m/sec	NO_3 (mg/l	$P0_4$ mg/l)	NH_3 (mg/l)	conductivity µs/cm	depth (cm)
March	1	80	6.1	7.07	17	.32	.20	.1	.1	25	10.3
“	2	97	7.3	7.19	10	.33	.1	.1	.00	26	14.4
“	3	95	6.8	6.9	11	.42	.3	.1	.05	33	18.8
“	4	92	6.9	6.8	12	.52	.1	.11	.05	33	16.0
‘	5	95	6.4	6.8	11	.53	.8	.16	00	33	17.3
June	1	75	6.3	8.14	17	.42	1.6	.26	.57	41	20.
“	2	82	7.1	6.96	14	.44	.6	.19	.23	40	30
“	3	85	6.6	8.2	8	.60	.7	.32	.45	36	25
“	4	92	7.2	7.37	11	..68	.3	.20	.44	35	28
“	5	89	6.3	7.31	11	.66	.7	.28	.42	39	25
Nov	1	106	9.2	7.21	12	.29	.5	.09	.82	29	18
“	2	106	9.0	7.1	17	.30	.7	.16	.75	29	15
“	3	100	8.8	7.15	12	.48	.9	.8	1.01	28	19
“	4	103	8.3	7.19	15	.50	1.6	.1	.94	28	18
“	5	103	8.9	7.15	14	.56	2.6	.1	.91	28	

Appendix 3 output from factorial analysis using physico- chemical parameters of water quality in stream A

Initial Statistics:

Variable	Communality	*	Factor	Eigenvalue	Pct of Var	Cum Pct
		*				
DEPTH	1.00000	*	1	5.14002	51.4	51.4
VELOCITY	1.00000	*	2	2.45439	24.5	75.9
D.O	1.00000	*	3	1.54943	15.5	91.4
PERSAT	1.00000	*	4	.74112	7.4	98.8
PH	1.00000	*	5	.11504	1.2	100.0
NITRATE	1.00000	*	6	.00000	.0	100.0
PHOSPHAT	1.00000	*	7	.00000	.0	100.0
AMMONIA	1.00000	*	8	.00000	.0	100.0
ALKALINI	1.00000	*	9	.00000	.0	100.0
CD	1.00000	*	10	.00000	.0	100.0

PC extracted 3 factors.

Factor Matrix:

	Factor 1	Factor 2	Factor 3
PHOSPHAT	.94889	.25578	.04962
CD	.91308	.18104	.34390
VELOCITY	.89238	-.24041	.37453
NITRATE	.82504	.52417	-.17880
DEPTH	.69691	-.11597	.68215
PH	.67897	.29164	-.42880
AMMONIA	-.00038	.97537	-.10134
D.O	-.59118	.74407	.30554
PERSAT	-.62156	.62487	.44716

PC analysis for water quality parameters in stream A

Final Statistics:

Variable	Communality	*	Factor	Eigenvalue	Pct of Var	Cum Pct
		*				
DEPTH	.96446	*	1	5.14002	51.4	51.4
VELOCITY	.99442	*	2	2.45439	24.5	75.9
D.O	.99649	*	3	1.54943	15.5	91.4
PERSAT	.97675	*				
PH	.72993	*				
NITRATE	.98741	*				
PHOSPHAT	.96827	*				
AMMONIA	.96163	*				
ALKALINI	.57972	*				
CD	.98476	*				

Appendix 4 : Output from factoria; analysis using physico-chemical parameters of water quality in stream B

Initial Statistics:

Variable	Communality	*	Factor	Eigenvalue	Pct of Var	Cum Pct
		*				
ALKALINI	1.00000	*	1	6.12841	61.3	61.3
AMMONIA	1.00000	*	2	2.49684	25.0	86.3
CD	1.00000	*	3	.64549	6.5	92.7
D.O	1.00000	*	4	.44994	4.5	97.2
DEPTH	1.00000	*	5	.12916	1.3	98.5
NITRATE	1.00000	*	6	.06588	.7	99.2
PERSAT	1.00000	*	7	.05768	.6	99.7
PH	1.00000	*	8	.02660	.3	100.0
PHOSPHAT	1.00000	*	9	.00000	.0	100.0
VELOCITY	1.00000	*	10	.00000	.0	100.0

PC extracted 2 factors.

Factor Matrix:

	Factor 1	Factor 2
PERSAT	-.97077	.07779
CD	.95749	-.06234
PHOSPHAT	.90040	.39778
ALKALINI	-.87514	.08698
VELOCITY	.86838	.27325
D.O	-.76824	.51200
NITRATE	-.62648	.56176
AMMONIA	-.54849	.81141
PH	.52851	.75230
DEPTH	.61296	.66663

Final Statistics:

Variable	Communality	*	Factor	Eigenvalue	Pct of Var	Cum Pct
		*				
ALKALINI	.77343	*	1	6.12841	61.3	61.3
AMMONIA	.95922	*	2	2.49684	25.0	86.3
CD	.92068	*				
D.O	.85234	*				
DEPTH	.82011	*				
NITRATE	.70805	*				
PERSAT	.94845	*				
PH	.84528	*				
PHOSPHAT	.96894	*				
VELOCITY	.82874	*				

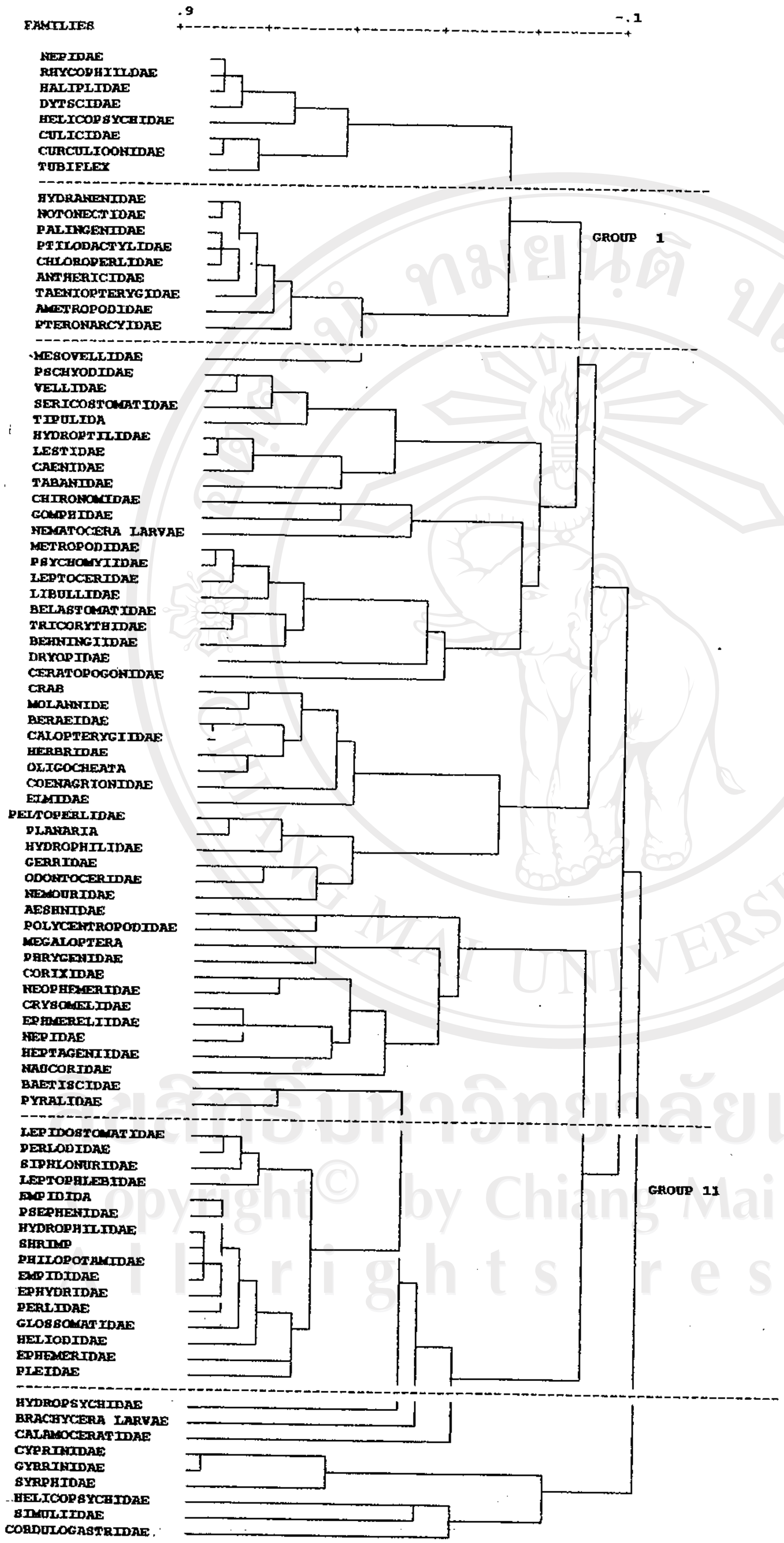
Appendix 5 Table showing the % recovery for organochlorine pesticde analysis in the two stream sediment

	% recovery	S.D
β-HCH	138	7.18
HCH	41.6	20.6
γ-HCH	157	11.5
Heptachlor	105	5.6
Hept. Epoxide	119	12.6
o,p'-DDE	165	35.9
p,p'-DDE	77.6	20.4
Dieldrin	185.5	31.8
p,p'-DDD	157.57	4.2
o,p'-DDT	96.8	2.5.6
p,p'-DDT	84.4	5.8

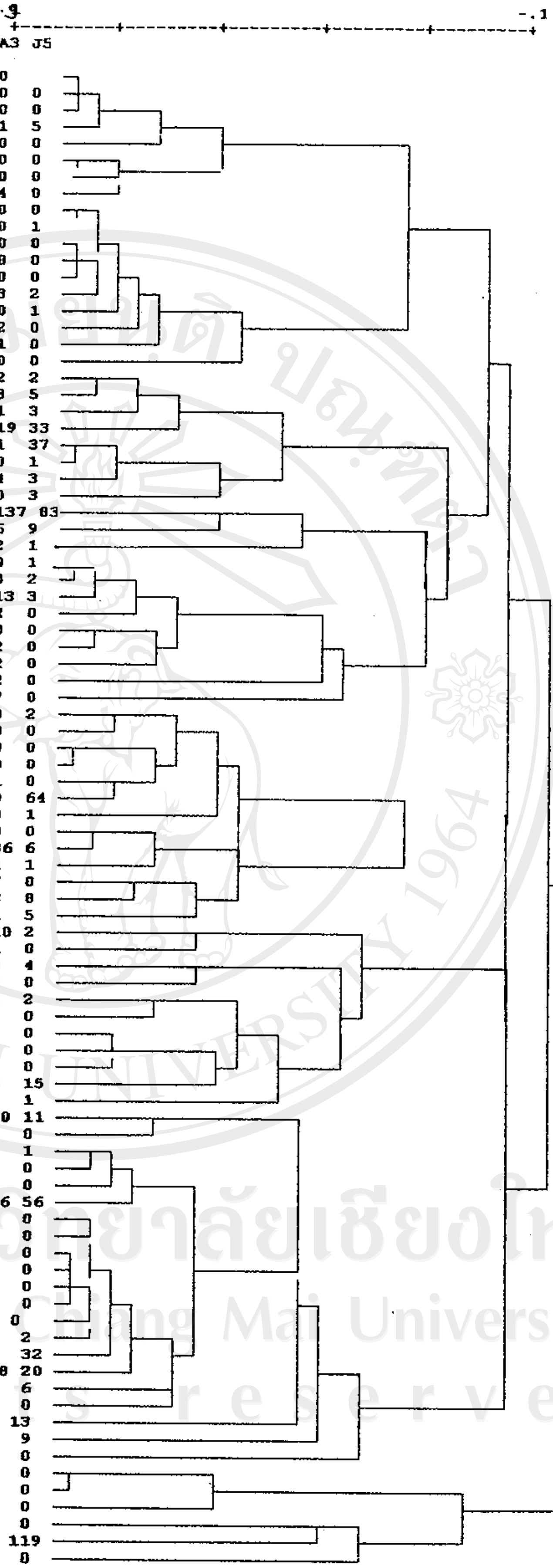
Appendix 6 Textural analysis for the stream sediment samples

sample name	%Organic matter	% sand	% silt	% clay	Texture
Stream A	0.04	88.94	8.5	2.16	sand
Stream B	1.05	85.84	1.16	8.5	sand

Appendix. 7: Cluster analysis using benthic community. The dendrogram shows the formation of two distinct groupings at high significant level



Resc



	A	A2	J1	J2	N2	N1	N3	N4	N5	J3	J4	A4	A5	A3	J5
EPIDAE			0		0	0	0	0	0	0	1	0	0	0	
HYACOPHILIDAE	0	0	0	0	0	0	0	0	0	6	0	0	1	0	0
ALIPLIDE	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
YTSCIDAE	0	0	0	0	0	0	14	0	0	1	9	1	8	1	5
ELICOPSCYCHIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ULICIDAE	0	0	0	0	0	0	0	1	0	8	0	1	0	0	0
URCULIONIDAE	0	0	0	0	0	0	1	0	0	0	0	4	6	0	0
UBIFLEX	0	0	0	0	0	0	0	5	0	12	0	15	16	4	0
YDRAENIDAE	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0
OTONECTECTIDA	0	0	0	0	0	0	9	0	0	0	0	7	2	0	1
ALINGENIDAE	0	0	0	0	0	0	0	0	0	4	0	1	0	0	0
TILODACTYLIDAE	0	0	0	0	0	0	0	0	3	0	0	1	0	0	0
HLOROPERLIDAE	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
NTHERICIDAE	0	0	0	0	0	0	20	0	4	0	46	16	9	3	2
AENIOPTERYGIDAE	0	0	0	0	0	0	0	0	0	4	0	2	0	0	1
METROPODIDAE	0	0	0	0	0	0	0	0	1	1	0	1	0	2	0
TERONARCYIDAE	0	0	0	0	0	0	0	0	0	0	0	2	1	1	0
ESOVELIDAE	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
SCHYCODIDAE	0	0	0	1	0	0	0	0	0	0	0	0	1	2	2
ELIIDAE	0	0	0	0	0	0	0	0	0	0	1	1	2	3	5
ERICOSTOMATIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3
IPULIDAE	6	10	5	7	3	5	1	11	12	4	21	10	14	19	33
YDROPTILIDAE	1	14	0	1	2	0	2	0	7	2	6	39	6	1	37
ESTIDAE	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
AENIDAE	0	0	0	0	0	0	6	0	0	2	0	11	1	4	3
ABANIDAE	1	3	1	0	0	0	0	0	0	1	0	3	2	0	3
HIRONOMIDAE	114	102	39	71	52	21	13	19	27	49	63	33	35	137	83
OMPHIDAE	2	13	5	5	2	0	0	2	20	0	0	3	4	6	9
EMATOCERIDAE	4	5	2	1	0	0	0	2	8	2	1	2	2	2	1
ETROPODIDAE	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
SYCHOMYIIDAE	0	13	0	0	3	0	0	0	0	0	0	0	1	0	2
EPTOCERIDAE	0	0	1	0	0	0	0	0	2	0	4	0	3	13	3
EBELLUIDAE	0	0	0	0	0	0	0	12	0	0	0	1	0	2	0
ELASTOMATIDAE	0	0	0	0	0	0	0	0	0	0	5	0	1	0	0
RICORYTTHIDAE	0	0	0	0	0	0	0	0	12	0	0	0	1	2	0
EHNINGIIDAE	0	0	0	0	0	0	0	0	1	0	0	1	0	2	0
RYOPIDAE	0	1	0	0	0	2	1	0	0	9	0	0	0	2	0
ERATOPOGONIDAE	0	9	4	0	0	0	0	0	0	0	0	0	0	7	0
RAB	0	0	0	0	0	0	0	1	0	0	2	1	0	0	2
OLANNIDE	1	0	0	0	0	0	0	0	0	0	2	1	0	0	0
IRAEIDAE	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
ALOPTERYGIDAE	0	0	0	0	0	0	0	7	0	0	8	0	0	0	0
ERBRIDAE	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0
LIGOCHEATA	0	0	6	9	0	0	1	0	0	6	22	0	9	0	64
OENAGRIONIDAE	0	0	0	0	0	0	0	3	0	0	2	0	1	0	1
MIDAE	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0
ANARIA	0	0	0	0	0	4	7	2	18	87	76	13	5	36	6
DROPHILIDAE	3	12	0	1	2	2	0	1	0	14	21	3	3	4	1
RRIDAE	0	0	0	0	0	2	1	1	1	13	2	7	2	7	0
ONTOCERIDAE	0	0	0	0	0	0	3	2	0	17	5	5	2	3	8
MOURIDAE	0	0	0	0	0	0	0	0	0	0	1	0	0	1	5
SHNIDAE	3	2	4	0	5	13	5	14	5	11	3	2	4	10	2
LYCENTROPODIDA	0	0	1	0	0	2	0	2	0	0	1	0	1	1	0
GALOPTERA	2	0	0	4	1	1	0	6	0	0	0	0	2	0	4
RYGAENIDAE	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0
RIXID	0	0	0	0	0	0	1	0	0	1	0	7	7	1	2
OPHEMERIDAE	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
YSOMELIDAE	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
EMERELLIDAE	0	0	0	0	0	0	8	20	7	1	1	5	2	5	0
PIDAE	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
PTAGENIIDAE	2	5	3	9	21	31	24	45	19	3	2	26	24	6	15
UCORIDAE	0	0	0	0	0	0	1	2	0	0	0	0	2	1	1
ETISCIDAE	5	11	0	0	25	49	19	27	40	9	10	22	5	10	11
RALIDAE	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0
PIDOSTOMATIDAE	0	0	0	0	0	0	2	52	0	0	1	0	0	0	1
RLODIDAE	0	0	0	0	0	0	0	0	0	1	0	6	1	1	0
PHLONURIDAE	2	0	1	0	0	3	4	16	23	0	0	1	8	2	0
PTOPHLEBIIDAE	3	2	0	1	5	4	29	95	14	14	50	24	27	16	56
PIDIDA	0	0	0	0	0	0	0	0	17	1	1	0	6	0	0
EPHENIIDAE	0	0	0	0	0	0	0	0	4	1	0	1	1	0	0
DROPHLILIDAE	0	0	0	0	0	0	0	0	0	0	0	3	0	3	0
RIMP	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
ILOPOTAMIDAE	0	0	0	0	0	0	3	7	85	0	2	0	2	2	0
PIDIDA	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
HYDRIDAE0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0
OSSOMATIDAE	0	0	0	0	0	1	12	2	40	4	2	6	7	5	2
RLIDAE	0	2	0	4	0	0	9	15	27	5	8	0	0	0	32
LODIDAE	2	20	5	0	2	0	11	34	93	12	38	33	36	28	20
HEMERRLLIDAE	0	0	0	0	0	0	3	0	8	4	0	2	3	4	6
SIDAE	0	0	0	3	0	0	0	0	5	3	2	2	3	0	0
DROPSYCHIDAE	13	46	14	12	47	43	25	20	60	68	48	4	5	3	13
ACHYCERA	1	0	2	6	3	5	0	2	11	11	3	4	0	4	9
LAMOCERATIDAE	0	2	0	0	0	0	0	0	1	3	0	1	0	1	0
PRINIDAE	5	0	1	0	0	1	0	0	0	0	0	0	0	0	0
RRINIDAE	0	0	1	0	8	1	0	0	0	0	0	0	0	0	0
RPHIDAE	0	6	1	0	0	0	0	0	0	0	0	0	0	0	0
LICOPSYCHIDAE	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
RULIIDAE	2	2	6	65	198	81	25	69	94	79	0	24	2	0	119
RDULOGASTRIDAE	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0

Appendix.8 : Table showing the calculated values for diversity, evenness and richness of the benthic community in different seasons and sites.

Month	site	H	N_0	N_1	N_2	E_5
March	1	1.68	18	5.18	2.65	.38
March	2	1.99	19	7.37	4.45	.34
March	3	2.8	46	16	9	.52
March	4	3.22	48	25	18	.71
March	5	3.31	54	27	18	.67
June	1	1.36	21	10	6	.54
June	2	1.18	23	8.9	5.3	.54
June	3	2.69	40	14	9	.62
June	4	2.76	41	15	11	.72
June	5	2.72	37	15	10	.66
Nov.	1	1.23	20	9.32	7.0	.32
Nov.	2	1.86	18	6.44	3.7	.5
Nov.	3	2.88	30	17	14	.7
Nov.	4	2.78	36	16	11	.69
Nov.	5	2.91	35	18	13	.73

H= Shannom Weiner diversity Index

N1= abundant families

N2= very abundant families

E= Hill's eveness Index

Appendix. 9: Output of factorial analysisis using benthic community . The output shows the eigenvalues, percent of variance, and cumulative percent of variance for each of the factor extracted.

Initial Statistics:

Variable	Communality	*	Factor	Eigenvalue	Pct of Var	Cum Pct
ANTHERIC	1.00000	*	1	16.52820	18.4	18.4
ASHNIDAE	1.00000	*	2	14.78208	16.4	34.8
AMETROPO	1.00000	*	3	10.30588	11.5	46.2
BAETIDAE	1.00000	*	4	9.86586	11.0	57.2
BEHNINGI	1.00000	*	5	7.76988	8.6	65.8
BRACHYCE	1.00000	*	6	7.30419	8.1	74.0
CHIRONOM	1.00000	*	7	6.52656	7.3	81.2
CALOPTER	1.00000	*	8	4.74297	5.3	86.5
CERATOPO	1:00000	*	9	3.67610	4.1	90.6
CORIXXID	1.00000	*	10	2.88756	3.2	93.8
CURCULIO	1.00000	*	11	2.59819	2.9	96.7
CAENIDAE	1.00000	*	12	1.53100	1.7	98.4
CRYSOMEL	1.00000	*	13	.93666	1.0	99.4
DYSTICID	1.00000	*	14	.54487	.6	100.0
DRYOPIDA	1.00000	*	15	.00000	.0	100.0
EPHMEREL	1.00000	*	16	.00000	.0	100.0
EPHEMERI	1.00000	*	17	.00000	.0	100.0
EMPIDIDA	1.00000	*	18	.00000	.0	100.0
EUPHRYDI	1.00000	*	19	.00000	.0	100.0
ELMIDAE	1.00000	*	20	.00000	.0	100.0
GOMPHIDA	1.00000	*	21	.00000	.0	100.0
GERRIDAE	1.00000	*	22	.00000	.0	100.0
GLOSSOMA	1.00000	*	23	.00000	.0	100.0
GYRRINID	1.00000	*	24	.00000	.0	100.0
HYDRANID	1.00000	*	25	.00000	.0	100.0
HYDROPSC	1.00000	*	26	.00000	.0	100.0
HYDROPTI	1.00000	*	27	.00000	.0	100.0
HYDROPHI	1.00000	*	28	.00000	.0	100.0
HELIODAE	1.00000	*	29	.00000	.0	100.0
LEPTOPHL	1.00000	*	30	.00000	.0	100.0
LESTIDAE	1.00000	*	31	.00000	.0	100.0
LEPTOCER	1.00000	*	32	.00000	.0	100.0
LIBULLID	1.00000	*	33	.00000	.0	100.0
MEGALOPT	1.00000	*	34	.00000	.0	100.0
ODONTOCE	1.00000	*	35	.00000	.0	100.0
NEPIDAE	1.00000	*	36	.00000	.0	100.0
NEMATOCE	1.00000	*	37	.00000	.0	100.0
NOTONECT	1.00000	*	38	.00000	.0	100.0
NAUCORID	1.00000	*	39	.00000	.0	100.0
PLANARIA	1.00000	*	40	.00000	.0	100.0
PTERONAR	1.00000	*	41	.00000	.0	100.0
PHILOPOT	1.00000	*	42	.00000	.0	100.0
POLYCENT	1.00000	*	43	.00000	.0	100.0
PLEIDAE	1.00000	*	44	.00000	.0	100.0
PESPHENI	1.00000	*	45	.00000	.0	100.0
PSYCODID	1.00000	*	46	.00000	.0	100.0
PERLIDAE	1.00000	*	47	.00000	.0	100.0
SIPHLONU	1.00000	*	48	.00000	.0	100.0
SIMULIDA	1.00000	*	49	.00000	.0	100.0
TABANIDA	1.00000	*	50	.00000	.0	100.0
TUBIFLEX	1.00000	*	51	.00000	.0	100.0
TRICORYT	1.00000	*	52	.00000	.0	100.0
TIPULIDA	1.00000	*	53	.00000	.0	100.0
VELLIDAE	1.00000	*	54	.00000	.0	100.0
OLIGOCHE	1.00000	*	55	.00000	.0	100.0
HEPTAGEN	1.00000	*	56	.00000	.0	100.0
BRAEIDAE	1.00000	*	57	.00000	.0	100.0
HELICOPS	1.00000	*	58	.00000	.0	100.0
HALIPLID	1.00000	*	59	.00000	.0	100.0
MOLANNID	1.00000	*	60	.00000	.0	100.0
LEPIDOST	1.00000	*	61	.00000	.0	100.0
NEMOURID	1.00000	*	62	.00000	.0	100.0
PERLODID	1.00000	*	63	.00000	.0	100.0
PTILODAC	1.00000	*	64	.00000	.0	100.0
SERICOST	1.00000	*	65	.00000	.0	100.0
RHYCOPHI	1.00000	*	66	.00000	.0	100.0
HEBRIDAE	1.00000	*	67	.00000	.0	100.0
HELCOPSY	1.00000	*	68	.00000	.0	100.0
MESOVELL	1.00000	*	69	.00000	.0	100.0
SYRPHIDA	1.00000	*	70	.00000	.0	100.0
CALAMOCE	1.00000	*	71	.00000	.0	100.0
CHLOROPE	1.00000	*	72	.00000	.0	100.0
COENOGRI	1.00000	*	73	.00000	.0	100.0
AMPIDIDA	1.00000	*	74	.00000	.0	100.0
BELASTOM	1.00000	*	75	.00000	.0	100.0
CORDULOG	1.00000	*	76	.00000	.0	100.0
HYDROPHL	1.00000	*	77	.00000	.0	100.0

VARIMAX rotation 1 for extraction 1 in analysis 1 - Kaiser Normalization.

VARIMAX converged in 15 iterations.

Rotated Factor Matrix:

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
AMPIDIDA	.99273	-.06462	.01587	-.04138	-.02172
PHILOPOT	.98941	-.07654	-.08510	-.02722	-.06046
PRAWN	.98610	-.06192	-.09781	-.04254	-.07773
HYDROPHL	.98281	-.07005	-.10600	-.00056	-.08517
EMPIDIDA	.95961	-.07124	.23838	-.05402	-.03574
PERLIDAE	.95227	.02483	-.00206	.02122	-.11470
PESPHENI	.94543	.11247	.06961	-.08646	-.12900
EUPHRYDI	.94025	-.09745	-.11892	-.06457	-.11112
GLOSSOMA	.90572	-.13307	-.15105	-.10851	.13697
HELIODAE	.89992	.14548	.13453	.13159	.23327
SIPHLONU	.84417	-.10215	.12353	-.03618	-.10888
LEPTOPHL	.80912	-.04830	-.03958	-.06310	.20640
EPHEMERI	.78178	.07626	.16182	.30383	-.21042
PLEIDAE	.76427	.23259	.35061	-.11052	.17098
PERLODID	.71125	.26045	-.08865	-.04037	-.08190
LEPIDOST	.70095	-.10346	-.12867	-.09822	-.05075
PYRALIDA	.64265	-.09674	-.11139	-.08660	-.10962
BRACHYCE	.60638	.10803	-.15145	.04334	-.00294
HYDROPSC	.53313	-.29925	-.27333	-.33751	.12486
PLINGENI	-.01897	.99523	-.07175	-.00784	-.03147
CHLOROPE	-.01897	.99523	-.07175	-.00784	-.03147
PTILODAC	-.01897	.99523	-.07175	-.00784	-.03147
ANTHERIC	.00627	.96685	.05005	-.01070	.16159
NOTONECT	-.02381	.96014	.19168	-.02161	.11101
HYDRANID	-.00702	.91598	.39223	-.00248	-.03503
TONTIOPT	-.02112	.89935	-.09324	-.00619	.42245
AMETROPO	-.04790	.89280	-.07492	-.08296	-.09155
PTERONAR	-.02681	.83334	.33582	.42591	-.06747
CULICIDA	.00273	.72909	.67757	.00180	-.03272
MESOVELL	-.09487	.67899	-.09227	-.06114	-.07567
NAIDIDAE	.02269	-.00164	.99513	.01029	-.01313
RHYCOPHI	.02269	-.00164	.99513	.01029	-.01313
HALIPLID	.02269	-.00164	.99513	.01029	-.01313
DYSTICID	-.01532	.07501	.92245	.34268	-.07664
HELCOPSY	-.07338	-.06069	.82074	-.05138	-.09530
CURCULIO	-.00083	.56483	.81640	-.01932	-.04907
TUBIFLEX	-.03912	.60813	.62163	.08748	-.11427
METROPOD	-.04640	-.07290	-.07955	.98459	-.07907
LEPTOCER	.04785	-.10641	.04397	.96595	.12586
PSYCHOMI	-.08062	-.11064	-.04356	.94345	-.10667
BELASTOM	-.03229	-.06791	.38504	.91167	-.07887
LIBULLID	-.05147	.39122	-.10633	.90332	-.08732
BEHNINGI	-.04057	.33886	.29506	.82572	.32523
TRICORYT	-.01739	-.05470	.67185	.73004	-.06765
DRYOPIDA	-.21840	-.18616	-.16274	.55284	-.19704
CALOPTER	-.00792	-.03776	-.05894	.00223	.98018
BRAEIDAE	-.00792	-.03776	-.05894	.00223	.98018
MOLANNID	-.04712	.34916	-.11286	-.05416	.86228
OLIGOCHE	-.11182	-.14730	-.05119	-.12785	.84399
HEBRIDAE	-.08848	-.11264	-.10999	-.07688	.84136
COENOGRI	-.01936	.50429	.17234	-.02308	.80912
ELMIDAE	-.15914	-.05149	.08569	.40161	.71511
CRAB	-.07412	.20965	-.13774	-.11522	.71503
HYDROPHI	-.15148	-.03142	-.03910	-.02558	.71451
NEPIDAE	-.02964	-.08752	-.06374	-.08315	.00438
EPHMEREL	.25271	.07505	-.06008	.11383	-.05492
CRYSOMEL	-.06558	-.12459	-.08484	-.09954	-.05115
NEOPHEME	-.03567	.66608	-.09942	-.06677	-.01988
HEPTAGEN	.11997	.21211	.17037	-.15658	-.20863
CORIXXID	-.04875	.51072	.49821	-.01057	-.04444
NAUCORID	-.07536	-.16108	.57553	.23203	-.05656
ASHNIDAE	-.01294	-.22239	-.06822	.23257	-.16969
MEGALOPT	-.21227	-.23590	.07255	-.29626	-

CALOPTER	-.00792	-.03776	-.05894	.00223	.98018
BRAEIDAE	-.00792	-.03776	-.05894	.00223	.98018
MOLANNID	-.04712	.34916	-.11286	-.05416	.86228
OLIGOCHE	-.11182	-.14730	-.05119	-.12785	.84399
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COENOGRI	-.01936	.50429	.17234	-.02308	.80912
ELMIDAE	-.15914	-.05149	.08569	.40161	.71511
CRAB	-.07412	.20965	-.13774	-.11522	.71503
HYDROPHI	-.15148	-.03142	-.03910	-.02558	.71451
NEPIDAE	-.02964	-.08752	-.06374	-.08315	.00438
EPHMEREL	.25271	.07505	-.06008	.11383	-.05492
CRYSOMEL	-.06558	-.12459	-.08484	-.09954	-.05115
NEOPHEME	-.03567	.66608	-.09942	-.06677	-.01988
HEPTAGEN	.11997	.21211	.17037	-.15658	-.20863
CORIXXID	-.04875	.51072	.49821	-.01057	-.04444
NAUCORID	-.07536	-.16108	.57553	.23203	-.05656
ASHNIDAE	-.01294	-.22239	-.06822	.23257	-.16969
MEGALOPT	-.21227	-.23590	.07255	-.29626	-.13754
SERICOST	-.08629	-.13699	-.09343	.20078	.02638
CAENIDAE	-.10197	.27555	-.08790	-.01989	-.00139
VELLIDAE	-.08556	.02639	.22283	.41405	.16700
LESTIDAE	-.06787	.64446	-.10390	-.09465	.01621
TIPULIDA	.09407	-.04240	.09253	.27409	.47109
PSYCODID	-.07747	-.13606	.24842	.61974	-.02288
HYDROPTI	.04571	.66524	-.02913	-.10689	.09490
GERRIDAE	-.02315	.03492	.05117	.33323	-.04657
ODONTOCE	.35095	.15354	-.01734	-.02848	.06752
NEMOURID	-.15131	-.11970	-.08209	-.02100	-.03048
PLANARIA	.07449	-.00023	-.07278	.17483	.52742
PELTOPER	-.05429	-.06584	-.05732	-.11904	.61958
PHRYGEID	-.07023	-.10236	-.06084	-.18169	-.09646
CYPRINID	-.15436	-.10252	-.06763	-.11307	-.13569
GYRRINID	-.15436	-.10252	-.06763	-.11307	-.13569
SYRPHIDA	-.10003	-.06980	-.03817	-.07862	-.11326
POLYCENT	-.15087	-.17208	-.14318	.20530	.22696
NEMATOCE	.20991	.05900	-.13948	.01633	-.13429
GOMPHIDA	-.19435	-.09996	-.01409	.08946	-.20490
CHIRONOM	-.15051	-.20620	-.20172	.52383	.05186
TABANIDA	-.18687	.45547	.24469	-.22635	-.10676
CALAMOCE	.42219	-.17887	-.20531	.45510	-.24217
CERATOPO	-.23516	.08611	.37731	.35099	.12943
CORDULOG	-.12799	-.10423	.21328	-.06783	.18973
HELICOPS	-.15199	-.13955	-.10418	-.13834	-.11753
SIMULIDA	.03246	-.29188	-.27106	-.31130	-.21293
BAETIDAE	.45471	.10960	-.21341	-.07835	-.09701

Appendix. 10 a : Multivariate ouput for water quality parameters (alkalinity, ammnia, nitrate, pH, phosphate velocity and % saturation)

Multivariate tests of Significance (s = 4, M = 1, N = 1)

-Test Name	values	DF.	Error DF	Sig. F
Pillais	2.18	28.00	28.00	.316
Hotellings	9.84	28.00	10.00	.629
Wilks	.018	28.00	10.00	.395

Univarate F- teses with (4, 10) D.F.

Varaible	Hypoth. SS	Error SS	Hypoth. MS	Error Ms	Sig. F
Alkalinity	41.7	64.6	10.4	6.4	.246
Ammonia	.06	1.84	.015	.18	.985
Nitrate	1.43	5.09	.256	.509	.608
% saturation	195.1	1108.6	48.7	110.4	.77
pH	.44	1.96	.11	.19	.693
Phospahorous	.15	.30	.03	.03	.692

Appendix 10b : Multivaraite output for substrate composition

-Test Name	values	DF.	Error DF	Sig. F
Pillais	.98	3	11	.000
Hotellings	94.8	3	11	.000
Wilks	.01	3.	11	.00

Effect: Stream

Univarate F- teses with (4, 10) D.F.

Varaible	Hypoth. SS	Error SS	Hypoth. MS	Error Ms	Sig. F
SAND	2116	250	2116	1100	.00
STONE	10346	576	1036	44.33	.00
GRAVEL	1646	426	1646	233	.00

Appendix 10C: Multivariate output for seasonal varaition of physico- chemical parameters of water quality between the two streams

EFFECT -- SEASONS

Multivariate tests of Significance (s = 1 M = 1/2, N =4, 1/2)

Test Name	values	DF.	Error DF	Sig. F
Pillais	1.88	16.1	14	.000
Hotellings	47.66	17.02	14	.000
Wilks	.002	16.9	14	.000

Univarate F- teses with (4, 10) D.F.

Varaible	Hypoth. SS	Error SS	Hypoth. MS	Error Ms	Sig. F
Alkalinity	10	95	15.4	7.9	.526
Ammonia	1.79	.10	.89	.001	.000
Nitrate	2.3	4.22	1.15	.35	.608
% saturation	195.1	1108.6	48.7	110.4	.073
pH	1.08	1.32	.54	.11	.028
Phospahorous	.06	.39	.03	.03	.420
-Velocity	.08	.02	.04	.00	.000

Appendix 10.d : Multivariate analysis output for community structure

EFFECT -- Community

Multivariate tests of Significance (s = 1 M = 1/2, N =4, 1/2)

Test Name	values	DF.	Error DF	Sig. F
Pillais	.89	32.5	3.0	.000
Hotellings	8.87	32.0	3.0	.004
Wilks	.10	32.0	3.0	.001

Univarate F- teses with (4, 10) D.F.

Varaible	Hypoth. SS	Error SS	Hypoth. MS	Error Ms	Sig. F
Diversity	3.69	1.18	3.69	.09	.000
Evenness	.09	.10	.09	.00	.004
Richness	1173	762	1173	58.61	.001

Appendix. 11: Correlation coefficient Matrix for physico-chemica, biological and % substrate cover for stream A

Stream A	depth	velocit	DO	% sat	pH	nitrate	Phosp	Ammo	alkalin	Condu	Divers	evenss	Richn	Sand	stone	graval	fac 1
Depth	1	.89**	-.28	-.19	0.06	.37	.68	.17	.07	.84**	.55	=.01	.84*	.08	-.22	.23	.96**
velocity		1	-.59	-.55	.38	.54	.79	-.26	.17	.91**	.55	-.10	.83*	.09	-.53	.23	.85**
D.O			1	.97**	-.39	-.16	-.35	.69	-.29	-.30	-.59	.65	-.18	1	.49	-.55	-.12
% Satr				1	-.41	-.26	-.38	.53	-.45	-.319	-.41	.63	-.16	.911	.51	-.4	-.079
pH					1	.89*	.68	.27	.29	.52	.04	.12	.18	.39	-.97	-.52	.13
nitrate						1	.91*	.52	.53	.78	-.02	.18	.41	.59	-.91	-.64	.5
Phosphate							1	.21	.52	.90**	.35	-.07	.55	.85*	-.81	-.37	.72
Ammonia								1	.26	.16	-.72	.57	-	.44*8	-.22	-.95	.07
alkalinity									1	.28	-.03	-.57	-.15	.29	-.41	-.31	.08
Conductivi										1	.269	.15	.84*	.94**	-.65	-.18	.90**
Diversity											1	-.54	.17	.00**	-.133	.67	.32
Eveness												1	.38	.33	-.02	.5	.12
richness													1	.8	-.29	.09	.09**
sand														1	-.54	-.41	.88
stone															1	.44	-.28
graval																1	.011
Fac 1.																	1

** .01 confidence level
* .o5 confidence level

Appendix. 12 Matrix showing the correlation coefficient among biological indices, physico-chemical parameteras and % substrate coverage for stream B

	Depth	velocit	D.O	% sat	pH	Nitrate	Phosp	Ammo	Alkali	CD	Divers	evenes	Richne	Sand	Stone	Graval	Fac 1
Depth		.73*	-.13	-.50	.74*	-.12	.76**	.21	-.35	.59	-.76	-.06	.311	-.74*	.59	-.29	-.875
velocity			-.60	-.77**	.52	-.24	.91**	-.27	-.61	.87**	-.39	-.18	.14	-.49	.61	-.42	-.528
D.O			1	.725*	.02	.62	-.53	.86**	.64*	-.76**	-.20	.54	.79**	-.22	-.34	.55	.613
% sat				1	1.00	.69	-.83*	.59	.89**	-.91**	.22	.40	-.22	-.007	-.50	.6	.898 *
pH					1	.04	.76**	.31	-.54	.37	-.63	-.08	-.34	-.64	.63	-.36	.957
nitrate						1	-.27	.73	.62	-.62	-.07	.32	.55	-.52	-.17	.53	-.625
Phosphoro							1	-.16	.75	.83**	-.49	-.238	.007	-.50	.73*	-.55	-.458
ammonia								1	-.54	.83**	.42	.56	-.9**	-.63	.03	.35	-.900*
alkalinity									1	-.56	.15	.42	.31	-.07	-.57	.73	-.076
CD										1	-.36	-.445	.315	-.10	.42	-.49	-.303
Diversity											1	.216	.64	.56	-.14	-.17	-423
Eveness												1	-.47	-.28	.21	-.07	.337
Richness													1	.53*	-.09	-.30	-.632
Sand														1	-.54	.03	.596
stone															1	-.85**	-.140
graval																1	.142
fac 1																	1

** 0.01 confidence level

* .05 confidence level

Appendix 13 Regression putput for physico- chemical parameter of water quality, biological parameter and substrate composition in stream A

Listwise Deletion of Missing Data

Equation Number 1 Dependent Variable.. RICHNESS richness

Block Number 1. Method: Stepwise Criteria PIN .0500 POUT .1000
ALKALINI AMMONIA CD D.O DEPTH FAC1_1 GRAVEL NITRATE
PERSAT PH PHOSPHAT SAND STONE VELOCITY

Variable(s) Entered on Step Number
1.. FAC1_1 REGR factor score 1 for analysis 1

Multiple R	.90902
R Square	.82632
Adjusted R Square	.78290
Standard Error	.90429

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	1	15.56236	15.56236
Residual	4	3.27098	.81774

F = 19.03084 Signif F = .0120

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
FAC1_1	1.764220	.404412	.909021	4.362	.0120
(Constant)	19.833333	.369176		53.723	.0000

------------- Variables not in the Equation -------------

Variable	Beta In	Partial	Min Toler	T	Sig T
ALKALINI	-.230507	-.551210	.993156	-1.144	.3355
AMMONIA	-.074665	-.178689	.994747	-.315	.7737
CD	.138487	.139777	.176930	.245	.8226
D.O	-.083346	-.198656	.986702	-.351	.7487
DEPTH	-.389879	-.255566	.074627	-.458	.6782
GRAVEL	.083424	.200165	.999862	.354	.7469
NITRATE	-.062843	-.130525	.749250	-.228	.8343
PERSAT	-.084613	-.202390	.993695	-.358	.7441
PH	.059743	.141997	.981144	.248	.8198
PHOSPHAT	-.204724	-.341601	.483558	-.630	.5737
SAND	-4.071E-05	-.000045	.212827	.000	.9999
STONE	-.038497	-.088543	.918742	-.154	.8874
VELOCITY	.224376	.276909	.264526	.499	.6520

Appendix 14 Regression output for factor 1 dependent parameter in stream A

Equation Number 1 Dependent Variable.. FAC1_1 REGR factor score 1 for a

Variable(s) Entered on Step Number
2.. PH

Multiple R	.98880
R Square	.97772
Adjusted R Square	.96286
Standard Error	.19271

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	2	4.88859	2.44429
Residual	3	.11141	.03714

F = 65.81764 Signif F = .0033

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
CD	.160854	.014157	1.147441	11.362	.0015
PH	-1.067632	.233976	-.460813	-4.563	.0197
(Constant)	2.642012	1.519408		1.739	.1804

------------- Variables not in the Equation -------------

Variable	Beta In	Partial	Min Toler	T	Sig T
ALKALINI	-.119559	-.755772	.704902	-1.632	.2442
AMMONIA	.013723	.088339	.690789	.125	.9117
D.O	.085059	.528726	.690121	.881	.4713
PERSAT	.119757	.725076	.662275	1.489	.2749
PHOSPHAT	-.061487	-.138326	.112774	-.198	.8617
VELOCITY	-.057363	-.154737	.138294	-.221	.8453

Appendix 15 Regression output for physico-chemical parameters, biological indices and substrate coverage in stream B

Listwise Deletion of Missing Data

Equation Number 1 Dependent Variable.. RICHNESS richness

Block Number 1. Method: Enter D.O ,

Variable(s) Entered on Step Number

1.. D.O dissolveoxygen

Multiple R	.79994
R Square	.63991
Adjusted R Square	.58847
Standard Error	4.76595

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	1	282.55556	282.55556
Residual	7	159.00000	22.71429

F = 12.43955 Signif F = .0096

------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
D.O	-5.000000	1.417645	-.799943	-3.527	.0096
(Constant)	77.000000	10.392199		7.409	.0001

Appendix 16 Regression output for physico-chemical, biological indices and substrate coverage, combining datas from both the streams

* * * * M U L T I P L E R E G R E S S I O N * * * *

Equation Number 1 Dependent Variable.. RICHNESS richness

------------- Variables not in the Equation -------------

Variable	Beta In	Partial	Min Toler	T	Sig T
ALKALINI	-.070236	-.108717	.651969	-.379	.7114
AMMONIA	-.340057	-.650339	.995243	-2.966	.0118
CD	.127777	.243840	.990955	.871	.4009
D.O	-.261790	-.496120	.977284	-1.979	.0712
DEPTH	-.169100	-.324102	.999604	-1.187	.2583
EVENESS	-.132190	-.194159	.587041	-.686	.5060
FAC1_1	.049582	.093432	.966244	.325	.7507
GRAVEL	.137719	.163021	.381282	.572	.5776
NITRATE	-.125140	-.237399	.979308	-.847	.4138
PERSAT	-.063412	-.121542	.999702	-.424	.6789
PH	-.208804	-.400278	.999999	-1.513	.1561
PHOSPHAT	-.071354	-.133807	.956929	-.468	.6484
SAND	-.323206	-.124667	.040485	-.435	.6711
VELOCITY	.014563	.025892	.860182	.090	.9300

* *

Variable(s) Entered on Step Number
2.. AMMONIA ammonia

Multiple R	.91814
R Square	.84297
Adjusted R Square	.81680
Standard Error	5.16616

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	2	1719.32969	859.66485
Residual	12	320.27031	26.68919

F = 32.21022 Signif F = .0000

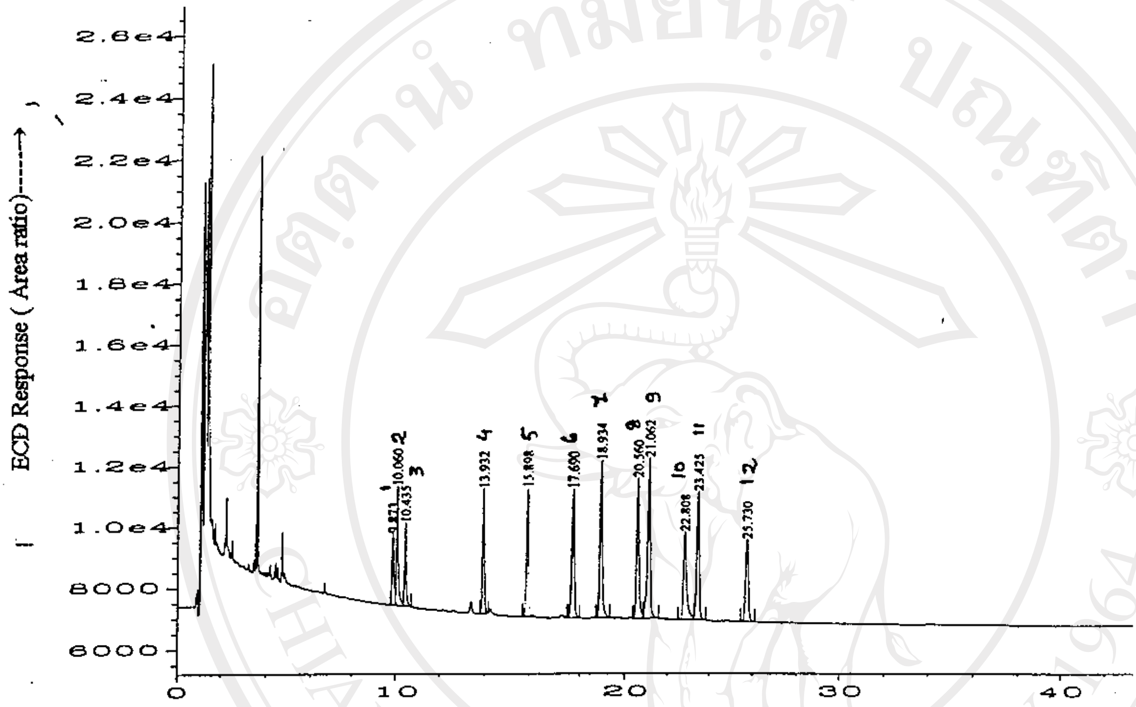
------------------ Variables in the Equation ------------------

Variable	B	SE B	Beta	T	Sig T
AMMONIA	-11.503352	3.878857	-.340057	-2.966	.0118
STONE	.378795	.049548	.876615	7.645	.0000
(Constant)	21.819966	2.901795		7.519	.0000

Appendix 17 Table showing the list of families accounted in each of the stream in different sampling sites of the two streams in differnt seasons

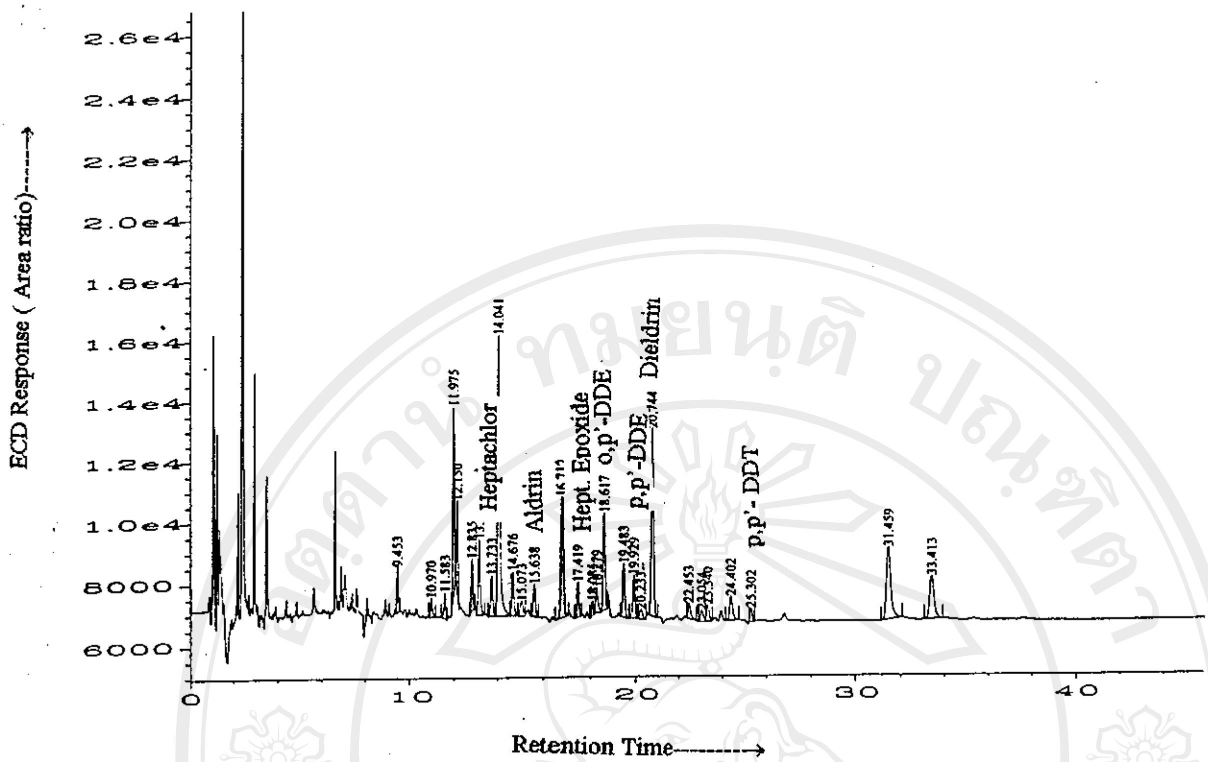
		stream A	streamB
order	families		
1. Plecoptera			X
	Perlodidae		X
	Perlidae	X	X
	Pteronarcydae		X
	Taeniopterygidae		X
	Chloroperlidae		X
	Peltoperlidae		X
	Nemouridae		X
2.Ephemeroptera			
	Baetidae	X	X
	Leptophlebiidae	X	X
	Ametropodidae		X
	Ephemerellidae		X
	Heptagiinidae	X	X
	Caenidae		X
	Behningiidae		X
	Metretopodidae		X
	Siphlonuridae	X	X
	Tricorythidae		X
	Hydrophlebidae		X
	Ephemeridae	X	X
	Neoephemeridae		X
3. Coleoptera			
	Helodidae	X	X
	Elmidae	X	X
	Htdrophilidae	X	X
	Gyrinidae		
	Chrysomelidae		
	Dryopidae		
	Dystiscidae		
	Ptilodactylidae		
	Hydraenidae		
	Psephenidae		
	Curculionidae		
4.Odonata			
	Ashnidae	X	X
	Gomphidae	X	X
	Calopterygidae		X
	Coenogrionidae		X
	Codulegastridae		X
	Libelludae		X
5. Hemiptera			X
	Naucoridae	X	X
	Veliidae		X
	Corixidae		X
	Gerridae		X

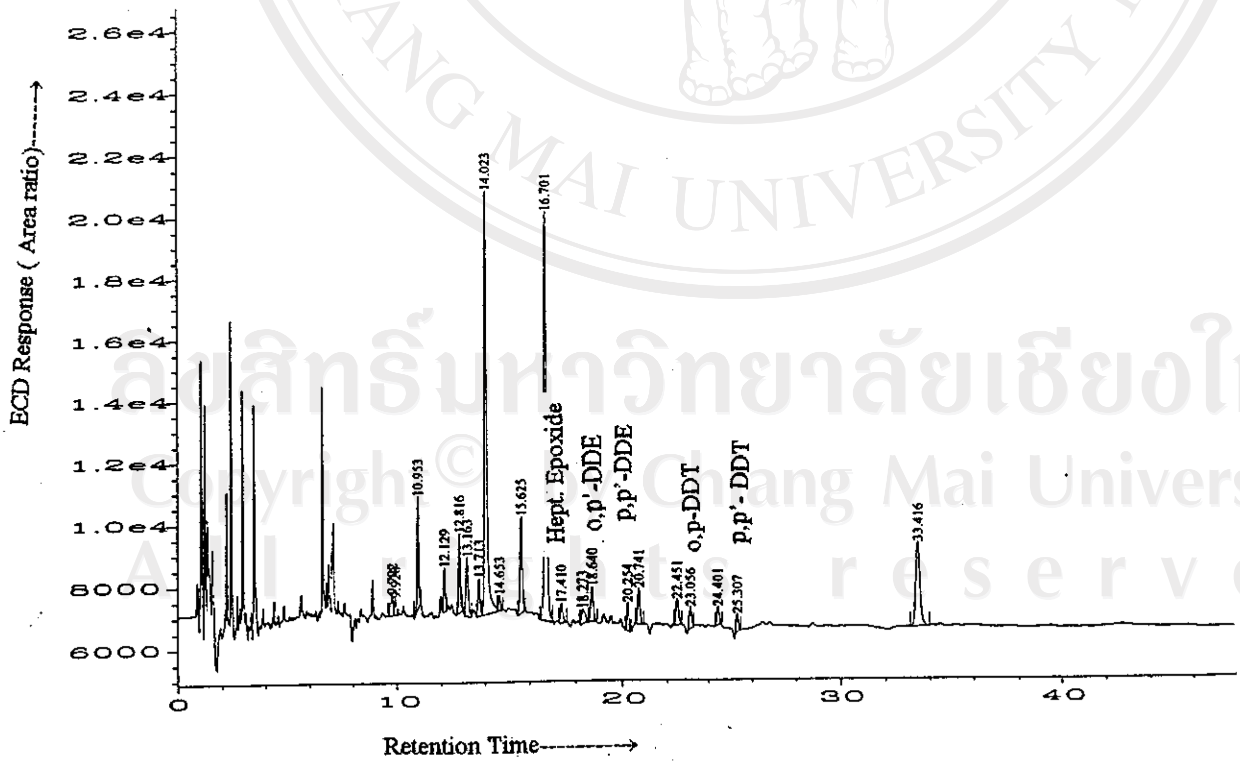
	Notonectidae	X	X
	Pleidae		X
	Herbridae	X	X
	Mesovellidae		X
	Belastomatidae		X
6. Tricoptera			
	Hydropsychidae	X	X
	Glossosomatidae	X	X
	Odontoceridae		X
	Leptoceridae	X	X
	Lepidostomatidae		X
	Polycentropodidae	X	X
	Philopotamidae		X
	Odontoceridae		X
	Brachycentridae	X	X
	Psychomyiidae		X
	Sericostomatidae		X
	Beraeidae		X
	Phrygaenidae		X
	heliocpsychidae		X
	Rhyacophilidae		X
	Lestidae		X
	Calamoceratidae		X
	Molannidae		X
	Hydroptilidae	X	X
7. Diptera			
	Brachoera larva	X	X
	Chironomidae	X	X
	Nematocera larva	X	X
	Tipulidae	X	X
	Tabanidae	X	X
	Ceratopogonidae	X	X
	Empididae	X	X
	Anthericidae	X	X
	Tubiflex	X	X
	Pschycomiidae		X
	Pschyodidae		X
	Euphydridae	X	X
	Simulidae	X	X
	Mucidae	X	
	Syrphidae	X	
Others			
	Planaria	X	X
	megaloptera	X	X
	Planaria		X
	Oligocheates	X	X
	Crabs		X
	Pyralidae		X
	Ampididae		X
	Prawn		X



Appendix 18 Representative chromatograms of OCP standard

1.β- HCB	7.o,p'-DDE
2. HCB	8.p,p'-DDE
3. γ-HCH	9.Dieldrin
4. Heptachlor	10. p,p-DDD
5. Heptachlor epoxide	11. o,p'-DDT
6. Aldrin (Surrogate)	12. p,p'-DDT





Appendix 19 Representative chromatogram of sediment from stream A (above) and strem B (below)

Curriculum Vitae

Name : Miss Rojee Joshi

Date of Birth : 6 th January, 1969

Nationality : Nepali

Educational Background

1. High School- Govt. High School, Rangpo, East Sikkim, India.
2. Senior Secondary- P.N. G. S. S. School, Gangtok, East Sikkim, India.
3. B.Sc- M.M. A. M.Campus, Biratnagar, Nepal.
4. M. Sc.(Contd.)- Tribhuvan University, Kathmandu, Nepal.