

APPENDICES

APPENDIX A

Outputs from MANOVA and LSD test

***** Analysis of Variance -- design 1*****

EFFECT .. LOCATION

Multivariate Tests of Significance (S = 3, M = 5 1/2, N = 14 1/2)

Test Name	Value	Approx. F	Hypoth. DF	Error DF	Sig. of F
Pillais	1.91795	3.89953	45.00	99.00	.000
Hotellings	23.42293	15.44178	45.00	89.00	.000
Wilks	.01028	7.57311	45.00	92.87	.000
Roys	.95412				

EFFECT .. LOCATION (Cont.)

Univariate F-tests with (3,45) D. F.

Variable	Hypoth. SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
ALKA	16096.9150	52781.1519	5365.63835	1172.91449	4.57462	.007
BOD5	280.47583	123.12351	93.49194	2.73608	34.17006	.000
COND	256750.282	329398.746	85583.4273	7319.97213	11.69177	.000
HARD	4158.83672	570121.831	1386.27891	12669.3740	.10942	.954
TEMP	247.32477	488.29932	82.44159	10.85110	7.59754	.000
VELO	.09070	1.65972	.03023	.03688	.81974	.490
ZN	11.91563	77768.1004	3.97188	1728.18001	.00230	1.000
PH	2.92413	2.64137	.97471	.05870	16.60575	.000
SATO2	36403.1434	4813.20189	12134.3811	106.96004	113.44780	.000
LFE	1.55000	3.47026	.51667	.07712	6.69976	.001
LMN	3.80852	2.70310	1.26951	.06007	21.13418	.000
LNO3	.31112	3.65451	.10371	.08121	1.27700	.294
LCU	.03059	1.00183	.01020	.02226	.45805	.713
SQPO4	2.20367	3.85687	.73456	.08571	8.57044	.000
SQNH3	9.48619	2.14846	3.16206	.04774	66.23010	.000

- - - - - O N E W A Y - - - - -

Variable FAC1_3 REGR factor score 1 for analysis 1
By Variable LOCATION

Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	3	61.9540	20.6513	92.0746	.0000
Within Groups	76	17.0460	.2243		
Total	79	79.0000			

Group	Count	Mean	Standard Deviation	Standard Error	95 Pct Conf Int for Mean		
Grp 1	32	-.6287	.3558	.0629	-.7570	TO	-.5004
Grp 2	16	.0431	.1870	.0467	-.0566	TO	.1427
Grp 3	16	-.4751	.2897	.0724	-.6295	TO	-.3207
Grp 4	16	1.6894	.8694	.2174	1.2261	TO	2.1527
Total	80	.0000	1.0000	.1118	-.2225	TO	.2225

GROUP	MINIMUM	MAXIMUM
Grp 1	-1.4530	.1577
Grp 2	-.2547	.4001
Grp 3	-.9339	-.0229
Grp 4	.4355	2.8673
TOTAL	-1.4530	2.8673

- - - - - O N E W A Y - - - - -

Variable FAC1_3 REGR factor score 1 for analysis 1
By Variable LOCATION

Multiple Range Tests: LSD test with significance level .05

The difference between two means is significant if
 $MEAN(J) - MEAN(I) \geq .3349 * RANGE * \sqrt{1/N(I) + 1/N(J)}$
 with the following value(s) for RANGE: 2.82

(*) Indicates significant differences which are shown in the lower triangle

		G G G G
		r r r r
		P P P P
		1 3 2 4
Mean	LOCATION	
-.6287	Grp 1	
-.4751	Grp 3	
.0431	Grp 2	* *
1.6894	Grp 4	* * *

APPENDIX B

Outputs from Factor Analysis

- - - - - F A C T O R A N A L Y S I S - - - - -

Analysis number 1 Listwise deletion of cases with missing values

Kaiser-Meyer-Olkin Measure of Sampling Adequacy = .80511

Bartlett Test of Sphericity = 324.70370, Significance = .00000

Extraction 1 for analysis 1, Principal Components Analysis (PC)

Initial Statistics:

Variable	Communality	*	Factor	Eigenvalue	Pct of Var	Cum Pct
ALKA	1.00000	*	1	5.01066	55.7	55.7
BOD5	1.00000	*	2	1.15956	12.9	68.6
COND	1.00000	*	3	.95876	10.7	79.2
FE	1.00000	*	4	.83720	9.3	88.5
NH3	1.00000	*	5	.45197	5.0	93.5
PH	1.00000	*	6	.22547	2.5	96.0
PO4	1.00000	*	7	.18384	2.0	98.1
SATO2	1.00000	*	8	.09634	1.1	99.2
TEMP	1.00000	*	9	.07620	.8	100.0

PC extracted 2 factors.

Factor Matrix:

	Factor 1	Factor 2
NH3	.93350	-.01028
BOD5	.90905	-.22568
SATO2	-.90462	.11311
COND	.87857	.18005
PO4	.81100	.26974
ALKA	.70697	.30642
PH	-.64592	.36333
FE	.20822	-.78835
TEMP	.32330	.37836

Factor Transformation Matrix:

	Factor 1	Factor 2
Factor 1	.91944	.39323
Factor 2	.39323	-.91944

2 PC EXACT factor scores will be saved.

Following factor scores will be added to the working file:

Name	Label
FAC1_4	REGR factor score 1 for analysis 1
FAC2_4	REGR factor score 2 for analysis 1

APPENDIX C

**Derivation of weights, Rating Curves,
Subindex scores
Surface Water Quality Standard and Classification**

Derivation of weighting factors

From the theory, sum of all weighting factor is equal to 1.0. Therefore, sum of correlation coefficient of five selected determinands was assumed to be 1.0.

Variables	Coefficiency
NH ₃ -N	0.93350
BOD ₅	0.90905
Sat. O ₂	-0.90462
Cond.	0.87857
<u>Total PO₄</u>	<u>0.81100</u>

$$\text{sum} = 4.43674$$

If summary of all coefficients , 1.13674 = 1.0

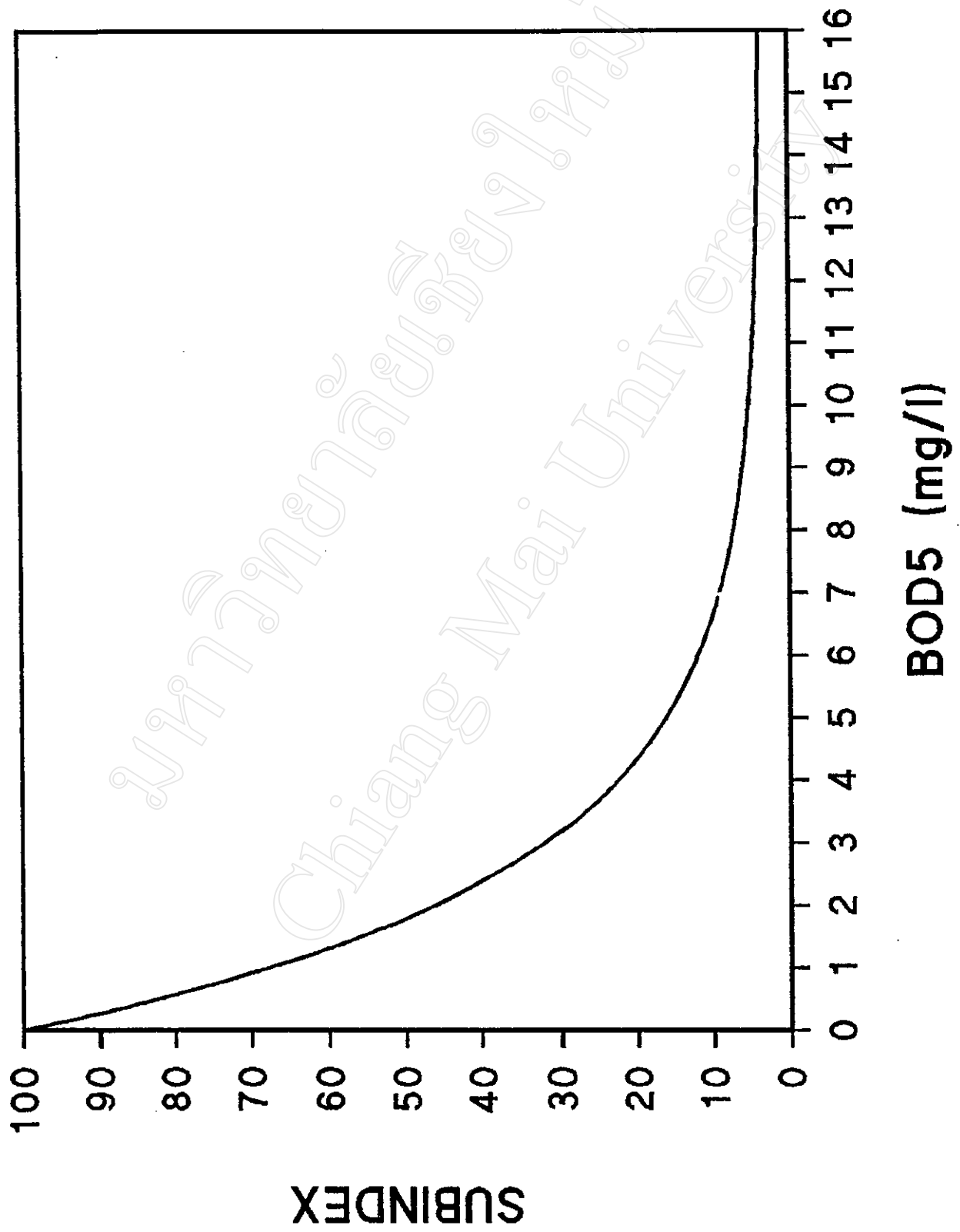
$$\text{then coefficient of NH}_3, 0.93350 = \frac{1.0 \times 0.93350}{4.43674} = 0.2104 \sim 0.21$$

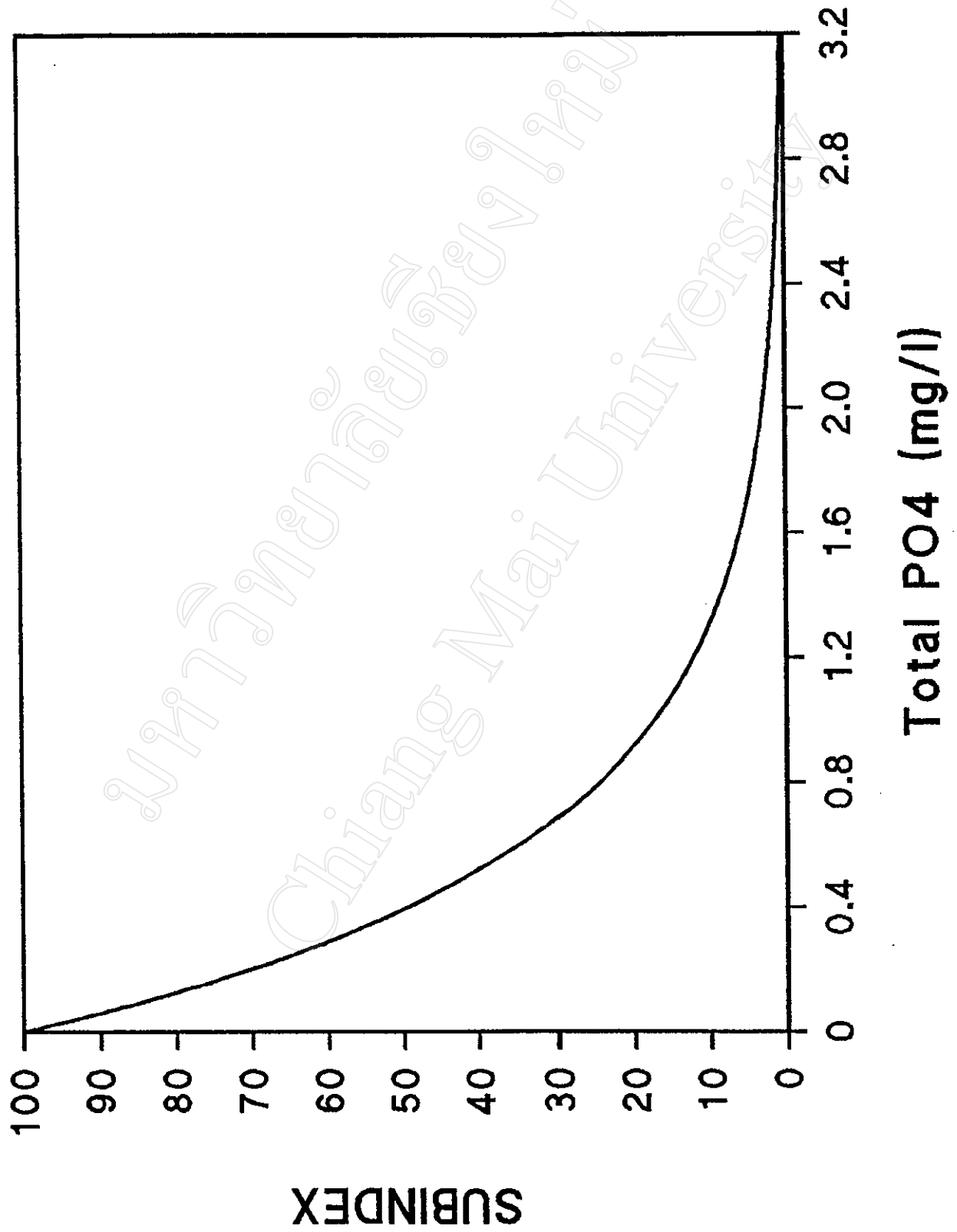
$$\text{coefficient of BOD}_5, 0.90905 = \frac{1.0 \times 0.90905}{4.43674} = 0.2048 \sim 0.20$$

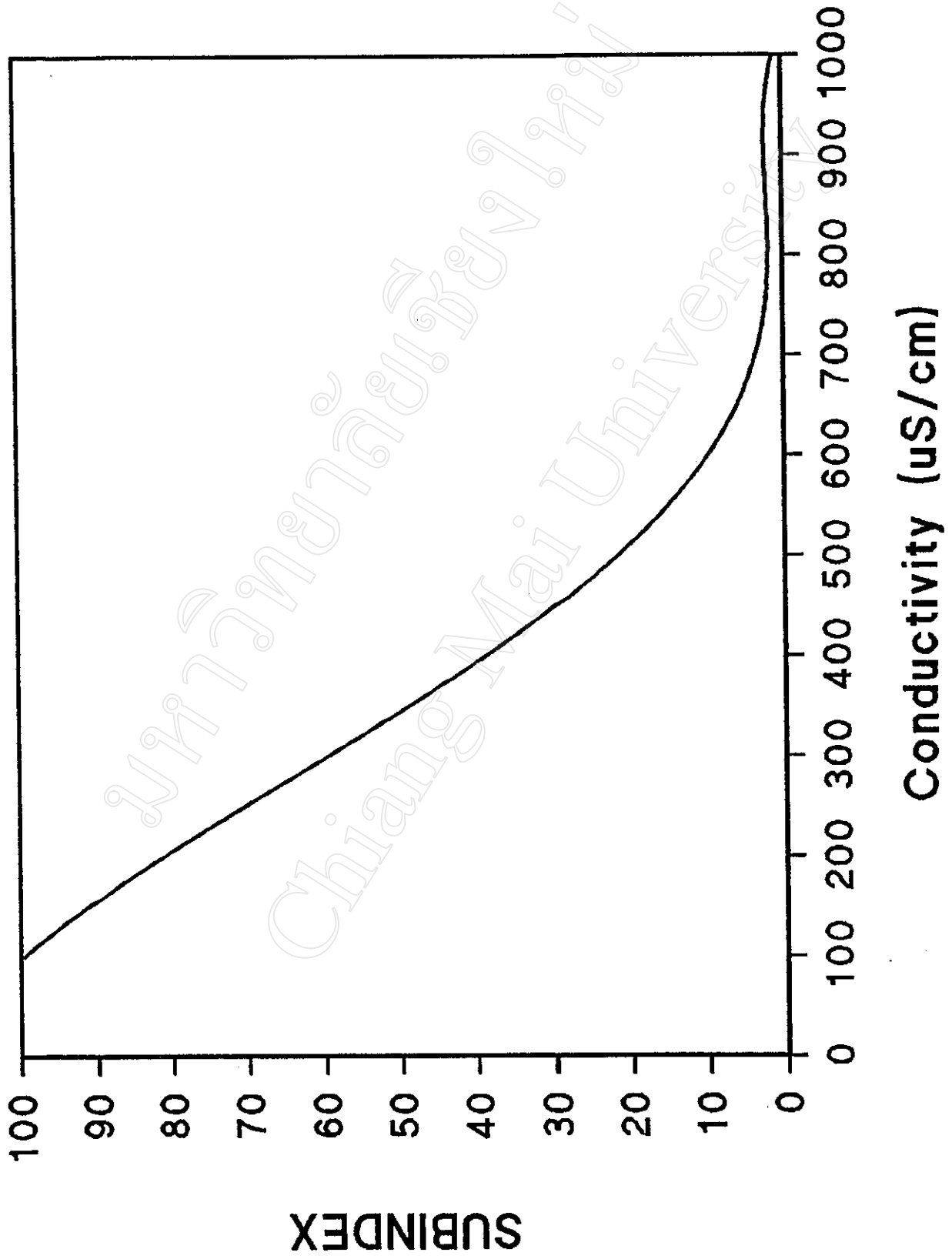
$$\text{coefficient of Sat. O}_2, 0.90462 = \frac{1.0 \times 0.90462}{4.43674} = 0.2038 \sim 0.20$$

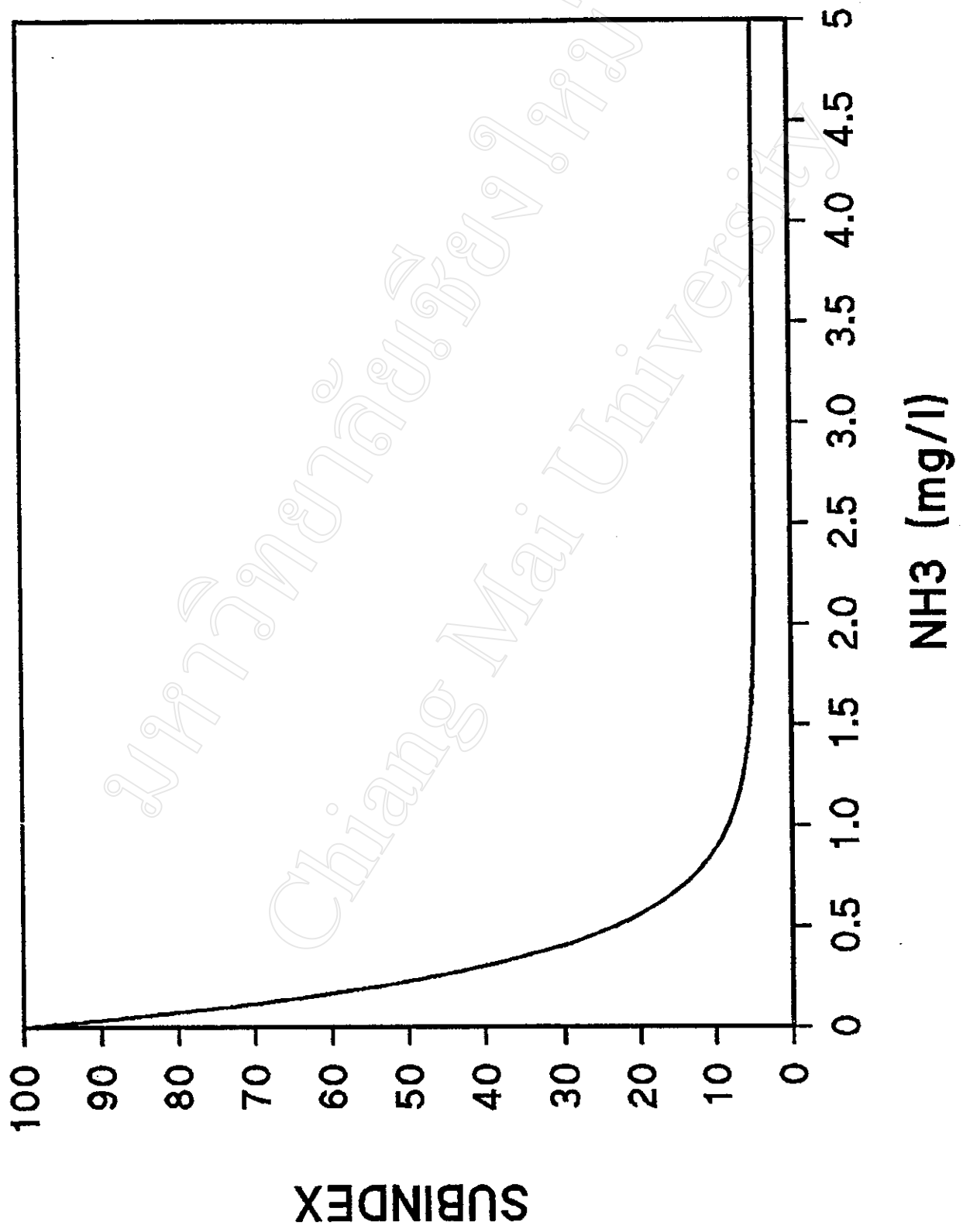
$$\text{coefficient of Cond. , 0.87857} = \frac{1.0 \times 0.87857}{4.43674} = 0.198 \sim 0.20$$

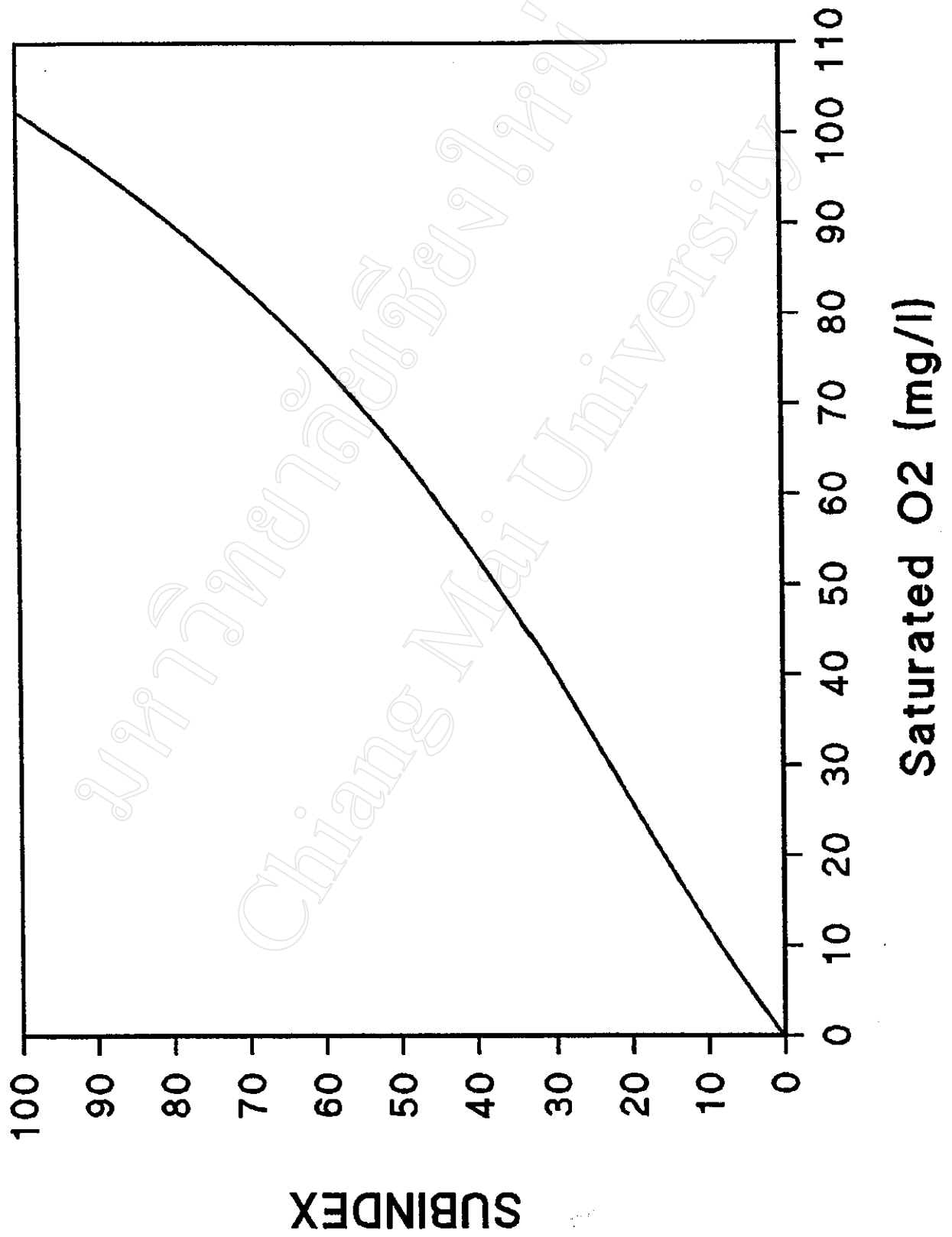
$$\text{coefficient of total PO}_4, 0.811 = \frac{1.0 \times 0.811}{4.43674} = 0.1827 \sim 0.19$$











Subindex scores

[illegible]

SatO ₂	0	1	2	3	4	5	6	7	8	9
0	1	1	2	2.5	3	4	5	6	7	7.5
10	8	9	10	10.5	11.5	12	12.5	13	14	15
20	16	17	17.5	18	18.5	19	20	21	21.5	22.5
30	23	24	24.5	25	25.5	26	26.5	27	27.5	29
40	30	30.5	31	32	33	34	34.5	35	35.5	36
50	37	38	39	40	41	42	43	43.5	44	44.5
60	45	46	47	48	49	50	51	52	53	54
70	55	56	57	58	59	60	62	63.5	65	66
80	67	68	69	70	72	73.5	74.5	76	77.5	79
90	80	82	83	85	86.5	88	90	92	94	95
100	96	97.5	99	100	100	100	100	100	100	100

[illegible]

NH ₃	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0	99.5	98.0	93.0	91.0	87.5	85.0	82.5	80.0	77.5	75.5
0.1	73.5	70.5	68.0	66.0	64.0	62.0	60.0	58.0	56.0	54.0
0.2	52.5	51.0	49.5	48.0	46.5	45.0	43.9	42.8	41.7	40.6
0.3	39.5	38.4	37.3	36.2	35.1	34.0	33.15	32.3	31.45	30.6
0.4	29.75	28.9	28.05	27.2	26.35	25.5	24.9	24.3	23.7	23.1
0.5	22.5	22.0	21.5	21.0	20.5	20.0	19.6	19.2	18.8	18.4
0.6	18.0	17.5	17.0	16.5	16.0	15.5	15.1	14.7	14.3	13.9
0.7	13.5	13.3	13.1	12.9	12.7	12.5	12.3	12.1	11.9	11.7
0.8	11.5	11.4	11.3	11.2	11.1	11.0	10.9	10.8	10.7	10.6
0.9	10.5	10.4	10.3	10.2	10.1	10.0	9.9	9.8	9.7	9.6
	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1	9.5	8.5	7.5	6.5	5.5	5.0	4.5	4.3	4.1	4.0
2	3.9	3.8	3.7	3.6	3.5	3.5	3.5	3.5	3.5	3.5
3	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5

PO ₄	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0	99.0	97.5	96.0	94.5	93.0	91.5	90.0	88.5	87.0	85.5
0.1	94.0	82.5	81.2	79.8	78.4	77.0	75.6	74.2	72.8	71.4
0.2	70.0	68.9	67.8	66.7	65.6	64.5	63.4	62.3	61.2	60.1
0.3	59.0	58.0	57.0	56.0	55.0	54.0	53.0	52.0	51.0	50.0
0.4	49.0	48.3	47.6	46.9	46.2	45.5	44.8	44.1	43.4	42.7
0.5	42.0	41.3	40.6	39.9	39.2	38.5	37.8	37.1	36.4	35.7
0.6	35.0	34.4	33.8	33.2	32.6	32.0	31.4	30.8	30.2	29.6
0.7	29.0	28.5	28.0	27.5	27.0	26.5	26.0	25.5	25.0	24.5
0.8	24.0	23.6	23.2	22.8	22.4	22.0	21.6	21.2	20.8	20.4
0.9	20.0	19.7	19.3	18.9	18.6	18.3	17.9	17.6	17.2	16.9
1.0	16.5	16.3	16.0	15.8	15.5	15.3	15.0	14.8	14.5	14.3
1.1	14.0	13.8	13.6	13.4	13.2	13.0	12.8	12.6	12.4	12.2
1.2	12.0	11.8	11.6	11.4	11.2	11.0	10.8	10.6	10.4	10.2
1.3	10.0	9.9	9.8	9.7	9.6	9.5	9.4	9.3	9.2	9.1
1.4	9.0	8.9	8.8	8.7	8.6	8.5	8.4	8.3	8.2	8.1
1.5	8.0	7.9	7.8	7.7	7.6	7.5	7.4	7.3	7.2	7.1
1.6	7.0	6.9	6.8	6.7	6.6	6.5	6.4	6.3	6.2	6.1
1.7	6.0	5.9	5.8	5.7	5.6	5.5	5.4	5.3	5.2	5.1
1.8	5.0	4.9	4.8	4.7	4.6	4.5	4.4	4.3	4.2	4.1
1.9	4.0	3.9	3.8	3.7	3.6	3.5	3.4	3.3	3.2	3.1
2.0	3.0	2.95	2.9	2.85	2.8	2.75	2.7	2.65	2.6	2.55
2.1	2.50	2.48	2.45	2.43	2.40	2.38	2.35	2.33	2.30	2.28
2.2	2.25	2.23	2.20	2.18	2.15	2.13	2.10	2.08	2.05	2.03
2.3	2.00	1.98	1.95	1.93	1.90	1.88	1.85	1.83	1.80	1.78
2.4	1.75	1.73	1.70	1.68	1.65	1.63	1.60	1.58	1.55	1.53
2.5	1.50	1.48	1.45	1.43	1.40	1.38	1.35	1.33	1.30	1.28
2.6	1.25	1.23	1.20	1.18	1.15	1.13	1.10	1.08	1.05	1.03

GW Weighted subindex scores (q_i^{wi})

[illegible]

SatO ₂	0	1	2	3	4	5	6	7	8	9
0	1.000	1.000	1.148	1.201	1.246	1.319	1.379	1.431	1.476	1.496
10	1.516	1.552	1.585	1.600	1.629	1.644	1.657	1.670	1.695	1.719
20	1.741	1.762	1.773	1.783	1.792	1.802	1.821	1.838	1.847	1.864
30	1.872	1.888	1.895	1.904	1.911	1.919	1.926	1.933	1.940	1.961
40	1.974	1.981	1.987	2.00	2.012	2.024	2.030	2.036	2.042	2.048
50	2.059	2.069	2.081	2.091	2.101	2.111	2.122	2.127	2.132	2.136
60	2.141	2.151	2.160	2.169	2.178	2.187	2.195	2.204	2.212	2.221
70	2.229	2.237	2.245	2.253	2.260	2.268	2.283	2.294	2.305	2.312
80	2.318	2.325	2.332	2.339	2.352	2.362	2.368	2.378	2.387	2.396
90	2.402	2.414	2.420	2.432	2.440	2.448	2.454	2.470	2.481	2.486
100	2.491	2.499	2.507	2.512	2.512	2.512	2.512	2.512	2.512	2.512

[illegible]

NH ₃	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0	2.628	2.619	2.590	2.579	2.558	2.542	2.526	2.510	2.493	2.480
0.1	2.466	2.444	2.426	2.410	2.395	2.379	2.363	2.346	2.329	2.311
0.2	2.297	2.283	2.269	2.254	2.240	2.224	2.213	2.201	2.189	2.177
0.3	2.164	2.151	2.138	2.125	2.111	2.097	2.086	2.075	2.063	2.051
0.4	2.039	2.027	2.014	2.001	1.988	1.974	1.964	1.954	1.944	1.934
0.5	1.923	1.914	1.905	1.895	1.886	1.876	1.868	1.860	1.852	1.843
0.6	1.835	1.824	1.813	1.802	1.790	1.778	1.768	1.758	1.748	1.788
0.7	1.727	1.722	1.716	1.711	1.705	1.670	1.694	1.689	1.682	1.672
0.8	1.670	1.667	1.664	1.661	1.658	1.654	1.651	1.648	1.644	1.642
0.9	1.638	1.635	1.632	1.629	1.625	1.622	1.618	1.615	1.611	1.608
	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1	1.604	1.567	1.527	1.481	1.430	1.402	1.371	1.358	1.345	1.338
2	1.331	1.324	1.316	1.308	1.301	1.301	1.301	1.301	1.301	1.301
3	1.301	1.301	1.301	1.301	1.301	1.301	1.301	1.301	1.301	1.301

PO ₄	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0	2.394	2.387	2.380	2.375	2.365	2.359	2.351	2.434	2.256	2.328
0.1	2.320	2.313	2.306	2.298	2.290	2.282	2.275	2.666	2.258	2.250
0.2	2.241	2.349	2.228	2.221	2.214	2.207	2.213	2.193	2.185	2.178
0.3	2.170	2.163	2.156	2.148	2.141	2.139	2.126	2.119	2.111	2.103
0.4	2.095	2.089	2.083	2.077	2.071	2.065	2.059	2.053	2.047	2.041
0.5	2.034	2.028	2.021	2.015	2.008	2.001	1.994	1.987	1.980	1.972
0.6	1.965	1.959	1.952	1.945	1.939	1.932	1.925	1.918	1.911	1.903
0.7	1.896	1.890	1.883	1.877	1.871	1.864	1.857	1.850	1.843	1.836
0.8	1.829	1.823	1.817	1.811	1.805	1.799	1.793	1.786	1.780	1.733
0.9	1.767	1.761	1.755	1.749	1.743	1.736	1.729	1.724	1.717	1.710
1.0	1.703	1.698	1.693	1.688	1.683	1.678	1.673	1.668	1.717	1.710
1.1	1.651	1.647	1.642	1.637	1.633	1.628	1.623	1.618	1.613	1.608
1.2	1.603	1.598	1.593	1.588	1.583	1.577	1.572	1.566	1.560	1.555
1.3	1.549	1.546	1.543	1.540	1.537	1.534	1.531	1.528	1.524	1.521
1.4	1.518	1.515	1.512	1.508	1.505	1.502	1.498	1.495	1.492	1.489
1.5	1.485	1.481	1.477	1.474	1.470	1.466	1.463	1.459	1.455	1.451
1.6	1.447	1.443	1.439	1.435	1.432	1.427	1.423	1.419	1.414	1.410
1.7	1.406	1.401	1.397	1.392	1.387	1.383	1.378	1.373	1.368	1.363
1.8	1.358	1.352	1.347	1.342	1.336	1.331	1.325	1.319	1.313	1.307
1.9	1.301	1.295	1.289	1.282	1.276	1.269	1.262	1.255	1.247	1.239
2.0	1.232	1.228	1.224	1.220	1.216	1.212	1.208	1.203	1.199	1.195
2.1	1.190	1.188	1.186	1.183	1.181	1.179	1.176	1.174	1.171	1.169
2.2	1.166	1.164	1.162	1.159	1.156	1.154	1.151	1.149	1.146	1.143
2.3	1.141	1.138	1.135	1.133	1.129	1.127	1.124	1.121	1.118	1.115
2.4	1.112	1.109	1.106	1.103	1.099	1.097	1.093	1.090	1.087	1.083
2.5	1.080	1.077	1.073	1.069	1.066	1.062	1.059	1.055	1.051	1.047
2.6	1.043	1.039	1.035	1.031	1.027	1.023	1.018	1.014	1.009	1.005

SW weighted subindex scores ($q_i w_i$)[illegible][illegible][illegible]

NH ₃	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0	20.89	20.58	19.53	19.11	18.38	17.85	17.33	16.8	16.28	15.86
0.1	15.44	14.81	14.28	13.86	13.44	13.02	12.60	12.18	11.76	11.34
0.2	11.03	10.71	10.40	10.08	9.77	9.45	9.22	8.99	8.76	8.53
0.3	8.29	8.07	7.83	7.60	7.37	7.14	6.96	6.78	6.60	6.43
0.4	6.25	6.07	5.89	5.71	5.53	5.36	5.23	5.10	4.98	4.85
0.5	4.73	4.62	4.52	4.41	4.31	4.20	4.12	4.03	3.95	3.86
0.6	3.78	3.68	3.57	3.47	3.36	3.26	3.17	3.09	3.00	2.92
0.7	2.84	2.79	2.75	2.71	2.67	2.63	2.58	2.54	2.50	2.46
0.8	2.42	2.39	2.37	2.36	2.33	2.31	2.29	2.27	2.25	2.23
0.9	2.21	2.18	2.16	2.14	2.12	2.10	2.08	2.06	2.04	2.02
	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1	1.99	1.79	1.58	1.37	1.16	1.05	0.95	0.90	0.86	0.84
2	0.82	0.80	0.78	0.74	0.74	0.74	0.74	0.74	0.74	0.74
3	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74

PO ₄	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0	18.81	18.53	18.24	17.96	17.67	17.39	17.1	16.82	16.53	16.25
0.1	15.96	15.69	15.43	15.16	14.89	14.63	14.36	14.10	13.83	13.57
0.2	13.30	13.09	12.88	12.67	12.46	12.26	12.05	11.84	11.63	11.42
0.3	11.21	11.02	10.83	10.64	10.45	10.26	10.07	9.88	9.69	9.50
0.4	9.31	9.18	9.04	8.91	8.78	8.65	8.51	8.38	8.25	8.11
0.5	7.98	7.85	7.71	7.58	7.45	7.32	7.18	7.05	6.92	6.78
0.6	6.65	6.54	6.42	6.31	6.19	6.08	5.97	5.85	5.74	5.62
0.7	5.51	5.42	5.32	5.23	5.13	5.04	4.94	4.85	4.75	4.66
0.8	4.56	4.48	4.41	4.33	4.26	4.18	4.10	4.03	3.95	3.88
0.9	3.80	3.73	3.67	3.60	3.53	3.47	3.40	3.33	3.27	3.20
1.0	3.14	3.09	3.04	2.99	2.95	2.89	2.85	2.80	2.76	2.71
1.1	2.66	2.62	2.58	2.55	2.51	2.47	2.43	2.39	2.36	2.32
1.2	2.28	2.24	2.20	2.17	2.13	2.09	2.05	2.01	1.98	1.94
1.3	1.90	1.88	1.86	1.84	1.82	1.81	1.79	1.77	1.75	1.73
1.4	1.71	1.69	1.67	1.65	1.63	1.62	1.60	1.58	1.56	1.54
1.5	1.52	1.50	1.48	1.46	1.44	1.43	1.41	1.39	1.37	1.35
1.6	1.33	1.31	1.29	1.27	1.25	1.24	1.22	1.20	1.18	1.16
1.7	1.14	1.12	1.10	1.08	1.06	1.05	1.03	1.01	0.99	0.97
1.8	0.95	0.93	0.91	0.89	0.88	0.86	0.84	0.82	0.80	0.78
1.9	0.76	0.74	0.72	0.70	0.68	0.67	0.65	0.63	0.61	0.59
2.0	0.57	0.56	0.55	0.54	0.53	0.52	0.51	0.50	0.49	0.48
2.1	0.475	0.47	0.465	0.461	0.460	0.451	0.450	0.442	0.440	0.430
2.2	0.427	0.423	0.418	0.413	0.410	0.400	0.399	0.394	0.389	0.385
2.3	0.380	0.375	0.370	0.366	0.361	0.356	0.352	0.347	0.342	0.337
2.4	0.330	0.328	0.323	0.318	0.314	0.309	0.304	0.299	0.295	0.289
2.5	0.285	0.280	0.276	0.270	0.266	0.261	0.257	0.252	0.247	0.240
2.6	0.237	0.232	0.228	0.223	0.219	0.214	0.209	0.204	0.199	0.195

Table 2 : Surface Water Quality Classification and Standards.

Parameters	Units	Statistic	Standard values for class				
			1	2	3	4	5
1.Temperature	°C	-	n*	n*	n*	n*	-
2.pH	-	-	n	5.9	5.9	5.9	-
3.Dissolved oxygen	mg/l	P20	n	6	4	2	-
4.BOD ₅	mg/l	P80	n	1.5	2.0	4.0	-
5.Coliform bacteria			n				
- total coliform	MPN /100 ml	P80		5,000	20,000	-	-
- Faecal coliform	:	P80		1,000	4,000	-	-
6.NO ₃ -N	mg/l	Max.	n	:	5.0	:	-
7.MH ₃ -N	mg/l	allowance	n	:	0.5	:	-
8.Phenols	mg/l	:	n	:	0.005	:	-
9.Cu	mg/l	:	n	:	0.1	:	-
10.Ni	mg/l	:	n	:	1.0	:	-
11.Mn	mg/l	:	n	:	1.0	:	-
12.Zn	mg/l	:	n	:	0.005*0.05*	:	-
13.CD	mg/l	:	n	:	*	:	-
14.Cr (Hexavalent)	mg/l	:	n	:	0.05	:	-
15.Pb	mg/l	:	n	:	0.05	:	-
16.Hg (total)	mg/l	:	n	:	0.002	:	-
17.As	mg/l	:	n	:	0.01	:	-
18.CN					0.005		
19.Radioactivity	Becquerel/l	:	n	:		:	-
- Gross α	Becquerel/l	:	n	:	0.1	:	-
- Gross β	mg/l	:	n	:	1.0	:	-
20.Pesticides (total)	µg/l	:	n	:	0.05	:	-
- DDT	µg/l	:	n	:	1.0	:	-
- α BHC	µg/l	:	n	:	0.02	:	-
- Dieldrin	µg/l	:	n	:	0.1	:	-
- Aldrin				:	0.1	:	-
- Heptachlor&	µg/l	:	n				
Heptachlor epoxide	µg/	:	n		0.2		-
- Endrin					none		

Note : P = Precentile value

n = Naturally

n* = Naturally but changing not more than 3°C

* = when water hardness not more than 100 mg/l as CaCO₃**= when water hardness more than 100 mg/l as CaCO₃

Water Classification

Classification	Condition and Beneficial usage
Class 1	Extra clean fresh surface water resources using for 1. conservation, not necessary pass through water treatment processes, require only ordinary process for pathogenic destruction 2. ecosystem conservation which basic living organisms can spread breeding naturally
Class 2	Very clean fresh water resources using for 1. consumption which require the ordinary water treatment process before uses 2. aquatic organism conservation for living and assisting for fishery 3. fishery 4. recreation
Class 3	Medium clean fresh water resources using for 1. consumption but have to pass through an ordinary treatment process before uses 2. agriculture
Class 4	Fairly clean fresh water resources using for 1. consumption but require special water treatment process before uses 2. industry 3. other activities
Class 5	The resources which are not classified in class 1-4 and using for 1. navigation

Source : Motification of The Ministry of Science, Technology and Environment

APPENDIX D

Outputs from MVSP

 ***** M V S P *****

 Ver. 2.1b

Date of analysis - August 23, 1995
 Time of analysis - 9:09:41pm

Input file name - A:\DATA\BIOO.MVS
 Output file name - A:\DATA\BIOO.OUT

CORRESPONDENCE ANALYSIS
 =====

*L 75 20 dis rawdata of Guruge
 File of 72 rows x 19 columns

Scores will be detrended
 Rare species will be downweighted

AXIS	EIGENVALUE	PERCENT OF TOTAL	CUMULATIVE PERCENT
----	-----	-----	-----
1	0.565	23.29	23.29
2	0.239	9.86	33.15
3	0.115	4.74	37.89
4	0.049	2.00	39.89

SAMPLE SCORES

	PLOT	AXIS 1	AXIS 2	AXIS 3	AXIS 4
dryst1	A	276	163	185	57
dryst2	B	260	176	121	50
dryst3	C	300	180	81	0
dryst4	D	208	249	62	72
drypr1	E	268	155	0	30
drypr2	F	112	131	48	84
dryic1	G	162	116	86	96
dryic2	H	189	21	63	99
drysc1	I	33	210	72	57
wetst1	J	290	183	113	136
wetst2	K	362	208	106	125
wetst3	L	324	195	128	137
wetst4	M	241	259	155	126
wetpr1	N	111	90	106	81
wetpr2	O	61	112	59	88
wetic1	P	157	50	59	78
wetic2	Q	208	0	108	38
wetsc1	R	0	150	72	74
wetsc2	S	177	297	130	107

SPECIES SCORES

120

	PLOT	AXIS 1	AXIS 2	AXIS 3	AXIS 4
baetidae	A	407	215	85	169
caenidae	B	383	237	-91	-54
hepragen	C	378	303	8	-157
neophem	D	279	130	141	160
leptophleb	E	301	314	-144	-48
ephemerid	F	239	359	-8	-13
hydroptili	G	317	-46	209	-135
hydropsych	H	323	33	211	-47
brachycen	I	273	128	198	-103
helicop	J	261	209	170	37
rhyacophi	K	248	130	106	-80
limnephil	L	297	367	254	-45
odontocer	M	126	66	225	175
lepidostom	N	248	130	106	-80
glossosom	O	292	116	-190	-55
philopotam	P	254	92	172	-45
peltoperli	Q	248	130	106	-80
perlidae	R	363	94	-189	-125
elmidae	S	279	118	15	-70
staphylini	T	271	166	-1	-195
hydrophili	U	323	153	-109	-90
helodidae	V	271	166	-1	-195
halipidae	W	271	166	-1	-195
hydraenid	X	359	152	301	-235
psephenid	Y	313	133	-169	-53
chironomid	Z	210	305	155	131
simuliidae	a	325	209	236	173
athericid	b	194	165	13	3
ephydriidae	c	271	373	-27	-104
tipulidae	d	369	285	152	167
tabanidae	e	373	148	350	-228
empididae	f	273	351	-2	-59
nematocera	g	312	333	218	509
psychodida	h	378	199	162	-39
certopogon	i	141	254	116	51
belostomat	j	409	148	363	423
corixidae	k	213	345	-5	94
naucoridae	l	352	121	552	86
veliidae	m	213	345	-5	94
gomphidae	n	266	73	1	117

corduleges	o	312	328	219	513
libellulid	p	186	1212	49	157
aeshnidae	q	351	185	224	336
pyralidae	r	427	315	97	254
atyidae	s	297	381	43	-14
grapsidae	t	248	130	106	-80
poduridae	u	185	483	80	21
isotomaida	v	213	345	-5	94
lumbricida	w	-26	191	47	35
tubificida	x	48	216	-3	58
naididae	y	80	190	42	-36
ampularida	z	21	184	142	11
corbiculid	!	133	64	89	94
thairidae	"	178	16	17	121
viviparida	#	22	147	109	106
buccinidae	\$	255	-94	-84	208
uninoid	%	168	-17	36	161
planorbid	&	217	567	38	25
lymnaeidae	'	-46	130	104	128
bithynidae	(	229	-187	196	0
ostracoda	)	213	345	-5	94
tricorythi	*	262	181	222	458
phryganeid	+	228	212	154	153
limnichid	,	262	181	222	458
dryopidae	-	344	170	205	430
blepharicr	.	286	163	176	315
stratiomid	/	262	181	222	458
gerridae	:	286	163	176	315
macromidae	;	141	115	156	170
paratheiph	<	406	221	204	315
ancyclidae	=	-25	120	112	127
melanoidae	>	180	25	115	-34

Analysis finished at - 9:18:20pm

 ***** M V S P *****

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Ver. 2.1b

Date of analysis - August 27, 1995

Time of analysis - 6:32:58pm

Input file name - A:\DATA\PAT1.MVS

Output file name - A:\DATA\PAT1.OUT

SIMILARITY AND DISTANCE COEFFICIENTS

=====

*L raw data of Manasa

File of 17 rows x 20 columns will be transposed before analysis

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENT

	cond	velo	pH	alka	hard	LDO	LBOD5
cond	1	0.553	-0.196	0.813	0.424	-0.731	0.477
velo	0.553	1	-0.190	0.358	0.122	-0.308	-0.106
pH	-0.196	-0.190	1	0.156	0.422	0.625	-0.326
alka	0.813	0.358	0.156	1	0.773	-0.453	0.348
hard	0.424	0.122	0.422	0.773	1	-0.023	0.202
LDO	-0.731	-0.308	0.625	-0.453	-0.023	1	-0.671
LBOD5	0.477	-0.106	-0.326	0.348	0.202	-0.671	1
LNO3	0.158	0.587	-0.345	-0.140	-0.400	-0.137	-0.217
LNH3	0.517	0.046	-0.525	0.322	0.021	-0.674	0.710
Fe	0.135	0.027	-0.205	-0.114	-0.145	-0.164	0.359
LCu	0.002	-0.200	-0.463	-0.151	-0.162	-0.146	0.159
Zn	0.108	-0.350	0.487	0.518	0.747	0.113	0.157
Mn	0.746	0.361	-0.428	0.470	-0.021	-0.763	0.623
axis1	-0.399	-0.137	0.361	-0.231	-0.031	0.559	-0.786
axis2	-0.038	-0.284	-0.338	-0.188	-0.253	0.017	-0.217
axis3	-0.207	0.034	-0.044	-0.214	-0.280	0.314	-0.437
axis4	-0.428	-0.128	-0.176	-0.508	-0.475	0.290	-0.310
	LNO3	LNH3	Fe	LCu	Zn	Mn	axis1
cond	0.158	0.517	0.135	0.002	0.108	0.746	-0.399
velo	0.587	0.046	0.027	-0.200	-0.350	0.361	-0.137
pH	-0.345	-0.525	-0.205	-0.463	0.487	-0.428	0.361
alka	-0.140	0.322	-0.114	-0.151	0.518	0.470	-0.231
hard	-0.400	0.021	-0.145	-0.162	0.747	-0.021	-0.031
LDO	-0.137	-0.674	-0.164	-0.146	0.113	-0.763	0.559
LBOD5	-0.217	0.710	0.359	0.159	0.157	0.623	-0.786
LNO3	1	-0.005	0.060	-0.176	-0.849	0.103	-0.024
LNH3	-0.005	1	0.118	0.273	-0.013	0.665	-0.589
Fe	0.060	0.118	1	0.545	-0.129	0.442	-0.242
LCu	-0.176	0.273	0.545	1	-0	0.304	0.184
Zn	-0.849	-0.013	-0.129	-0	1	-0.058	0.078
Mn	0.103	0.665	0.442	0.304	-0.058	1	-0.507
axis1	-0.024	-0.589	-0.242	0.184	0.078	-0.507	1
axis2	0.120	0.158	-0.016	0.375	-0.105	-0.015	0.369
axis3	0.322	-0.218	-0.278	0.077	-0.247	-0.196	0.482
axis4	0.445	-0.092	-0.299	-0.024	-0.568	-0.363	0.282

	axis2	axis3	axis4 123
cond	-0.038	-0.207	-0.428
velo	-0.284	0.034	-0.128
pH	-0.338	-0.044	-0.176
alka	-0.188	-0.214	-0.508
hard	-0.253	-0.280	-0.475
LDO	0.017	0.314	0.290
LBOD5	-0.217	-0.437	-0.310
LNO3	0.120	0.322	0.445
LNH3	0.158	-0.218	-0.092
Fe	-0.016	-0.278	-0.299
LCu	0.375	0.077	-0.024
Zn	-0.105	-0.247	-0.568
Mn	-0.015	-0.196	-0.363
axis1	0.369	0.482	0.282
axis2	1	0.438	0.390
axis3	0.438	1	0.465
axis4	0.390	0.465	1

Analysis finished at - 6:32:59pm

APPENDIX E

Outputs from PCORD

TWINSPAN output.fil
Macroinvertebrate data

Source of data : Guruge 1997

NUMBER OF SAMPLES 19

NUMBER OF SPECIES 72

LENGTH OF RAW DATA ARRAY 675

SPECIES NAMES

1	baetid	2	caenid	3	heptag	4	neoeph	5	leptop
6	epheme	7	hydrot	8	hydros	9	brachy	10	helico
11	rhyaco	12	limnep	13	odonto	14	lepido	15	glosso
16	philop	17	peltop	18	perlid	19	elmida	20	staphy
21	hydrop	22	helodi	23	halipi	24	hydrae	25	psephe
26	chiron	27	simuli	28	atheri	29	ephydr	30	tipuli
31	tabani	32	empidi	33	nemato	34	psycho	35	cerato
36	belost	37	corixi	38	naucor	39	veliid	40	gomphi
41	cordul	42	libell	43	aeshni	44	pyrali	45	atyida
46	grapsi	47	poduri	48	isotom	49	lumbri	50	tubifi
51	naidid	52	ampula	53	corbic	54	thairi	55	vivipa
56	buccin	57	uninoi	58	planor	59	lymnae	60	bithyn
61	ostrac	62	tricor	63	phryga	64	limnic	65	dryopi
66	blepha	67	strati	68	gerrid	69	macrom	70	parath
71	ancycl	72	melano						

SAMPLE NAMES

1	dryst1	2	dryst2	3	dryst3	4	dryst4	5	drypr1
6	drypr2	7	dryic1	8	dryic2	9	drysc1	10	wetst1
11	wetst2	12	wetst3	13	wetst4	14	wetpr1	15	wetpr2
16	wetic1	17	wetic2	18	wetsc1	19	wetsc2		

NOW ENTER INPUT PARAMETERS

Enter number (not exceeding 9) of pseudospecies cut levels
OR type -1 for default cut levels, which are 0 2 5 10 20.
Answer = -1

CUT LEVELS

.00

Default options:

Minimum group size for division = 5
Maximum number of indicators per division = 7
Maximum number of species in final table = 100
Maximum level of divisions = 6

Length of data array after defining pseudospecies 347

Total number of species and pseudospecies 72

Number of species, excluding pseudospecies and ones with no occurrences

DIVISION 1 (N= 19) I.E. ¹²⁶GROUP *

Eigenvalue .364 at iteration 2

INDICATORS and their signs

tipuli 1(-) baetid 1(-) caenid 1(-) heptag 1(-)

Maximum indicator score for negative group -2

Minimum indicator score for positive group -1

ITEMS IN NEGATIVE GROUP 2 (N= 9) I.E. GROUP *0

dryst1 dryst2 dryst3 dryst4 wetst1 wetst2 wetst3 wetst4
weticl

ITEMS IN POSITIVE GROUP 3 (N= 10) I.E. GROUP *1

drypr1 drypr2 dryic1 dryic2 drysc1 wetpr1 wetpr2 wetic2
wetsc1 wetsc2

BORDERLINE POSITIVES (N= 2)

drypr1 wetsc2

NEGATIVE PREFERENTIALS

baetid 1(9, 2)	caenid 1(7, 0)	heptag 1(7, 0)	neoph 1(7, 3)
epheme 1(3, 0)	hydrot 1(7, 2)	hydros 1(8, 4)	helico 1(2, 0)
limnep 1(3, 0)	perlid 1(2, 1)	hydrop 1(5, 2)	hydrae 1(2, 0)
simuli 1(7, 0)	atheri 1(3, 1)	ephydr 1(3, 0)	tipuli 1(8, 0)
tabani 1(3, 0)	empidi 1(3, 0)	nemato 1(3, 0)	psycho 1(4, 0)
cerato 1(6, 2)	belost 1(5, 0)	corixi 1(2, 0)	naucor 1(6, 0)
veliid 1(2, 0)	cordul 1(2, 0)	aeshni 1(3, 0)	pyrali 1(3, 0)
atyida 1(4, 0)	dryopi 1(2, 0)	parath 1(4, 0)	

POSITIVE PREFERENTIALS

tubifi 1(2, 5)	corbic 1(2, 8)	uninoi 1(0, 2)	ancycl 1(0, 3)
-----------------	-----------------	-----------------	-----------------

NON-PREFERENTIALS

leptop 1(3, 2)	brachy 1(3, 2)	odonto 1(2, 2)	glosso 1(3, 2)
philop 1(3, 3)	elmida 1(8, 7)	psephe 1(2, 2)	chiron 1(9, 9)
gomphi 1(6, 4)	lumbri 1(7, 8)	ampula 1(2, 3)	thairi 1(4, 8)
vivipa 1(2, 3)	buccin 1(2, 3)	lymnae 1(3, 5)	bithyn 1(2, 4)

----- E N D O F L E V E L 1 -----

DIVISION 2 (N= 9) I.E. ¹²⁷GROUP *0

Eigenvalue .296 at iteration 2

INDICATORS and their signs

heptag 1(+)

Maximum indicator score for negative group 0

Minimum indicator score for positive group 1

ITEMS IN NEGATIVE GROUP 4 (N= 2) I.E. GROUP *00

dryst4 weticl

ITEMS IN POSITIVE GROUP 5 (N= 7) I.E. GROUP *01

dryst1 dryst2 dryst3 wetst1 wetst2 wetst3 wetst4

NEGATIVE PREFERENTIALS

atheri 1(2, 1)	ephydr 1(2, 1)	empidi 1(2, 1)	nemato 1(2, 1)
corixi 1(2, 0)	veliud 1(2, 0)	cordul 1(1, 1)	poduri 1(1, 0)
isotom 1(1, 0)	tubifi 1(1, 1)	ampula 1(1, 1)	corbic 1(1, 1)
thairi 1(2, 2)	planor 1(1, 0)	ostrac 1(1, 0)	melano 1(1, 0)

POSITIVE PREFERENTIALS

heptag 1(0, 7)	brachy 1(0, 3)	helico 1(0, 2)	odonto 1(0, 2)
glosso 1(0, 3)	philop 1(0, 3)	perlid 1(0, 2)	hydrae 1(0, 2)
psephe 1(0, 2)	simuli 1(0, 7)	aeshni 1(0, 3)	vivipa 1(0, 2)
buccin 1(0, 2)	bithyn 1(0, 2)	dryopi 1(0, 2)	parath 1(0, 4)

NON-PREFERENTIALS

baetid 1(2, 7)	caenid 1(1, 6)	neoeph 1(1, 6)	leptop 1(1, 2)
epheme 1(1, 2)	hydrot 1(1, 6)	hydros 1(2, 6)	limnep 1(1, 2)
elmida 1(2, 6)	hydrop 1(1, 4)	chiron 1(2, 7)	tipuli 1(2, 6)
tabani 1(1, 2)	psycho 1(1, 3)	cerato 1(2, 4)	belost 1(1, 4)
naucor 1(1, 5)	gomphi 1(2, 4)	pyrali 1(1, 2)	atyida 1(1, 3)
lumbri 1(1, 6)	lymnae 1(1, 2)		

DIVISION 3 (N= 10) I.E. ¹²⁸GROUP *1

Eigenvalue .443 at iteration 2

INDICATORS and their signs

elmida 1(-)

Maximum indicator score for negative group -1

Minimum indicator score for positive group 0

ITEMS IN NEGATIVE GROUP 6 (N= 7) I.E. GROUP *10

drypr1 drypr2 dryic1 dryic2 wetpr1 wetpr2 wetic2

ITEMS IN POSITIVE GROUP 7 (N= 3) I.E. GROUP *11

dryscl wetscl wetsc2

NEGATIVE PREFERENTIALS

baetid 1(2, 0)	neoeph 1(3, 0)	leptop 1(2, 0)	hydrot 1(2, 0)
hydros 1(4, 0)	brachy 1(2, 0)	odonto 1(2, 0)	glosso 1(2, 0)
philop 1(3, 0)	elmida 1(7, 0)	hydrop 1(2, 0)	psephe 1(2, 0)
gomphi 1(4, 0)	corbic 1(7, 1)	thairi 1(7, 1)	buccin 1(3, 0)
uninoi 1(2, 0)	bithyn 1(4, 0)		

POSITIVE PREFERENTIALS

cerato 1(1, 1)	poduri 1(0, 1)	naidid 1(0, 1)	ampula 1(1, 2)
vivipa 1(1, 2)	planor 1(0, 1)		

NON-PREFERENTIALS

chiron 1(6, 3)	lumbri 1(5, 3)	tubifi 1(3, 2)	lymnae 1(3, 2)
ancycl 1(2, 1)			

----- E N D O F L E V E L 2 -----

DIVISION 4 (N= 2) I.E. ¹²⁹GROUP *00
Group too small for further division.

DIVISION 5 (N= 7) I.E. GROUP *01

Eigenvalue .324 at iteration 2

INDICATORS and their signs

brachy 1(-)

Maximum indicator score for negative group -1

Minimum indicator score for positive group 0

ITEMS IN NEGATIVE GROUP 10 (N= 3) I.E. GROUP *010

dryst1 dryst2 dryst3

ITEMS IN POSITIVE GROUP 11 (N= 4) I.E. GROUP *011

wetst1 wetst2 wetst3 wetst4

BORDERLINE POSITIVES (N= 1)

wetst2

NEGATIVE PREFERENTIALS

leptop 1(2, 0)	brachy 1(3, 0)	rhyaco 1(1, 0)	limnep 1(2, 0)
lepido 1(1, 0)	philop 1(3, 0)	peltop 1(1, 0)	perlid 1(2, 0)
staphy 1(1, 0)	helodi 1(1, 0)	halipi 1(1, 0)	hydrae 1(2, 0)
ephydr 1(1, 0)	tabani 1(2, 0)	empidi 1(1, 0)	naucor 1(3, 2)
grapsi 1(1, 0)	naidid 1(1, 0)	ampula 1(1, 0)	

POSITIVE PREFERENTIALS

atheri 1(0, 1)	nemato 1(0, 1)	cordul 1(0, 1)	pyrali 1(0, 2)
tubifi 1(0, 1)	corbic 1(0, 1)	thairi 1(0, 2)	buccin 1(0, 2)
lymnae 1(0, 2)	tricor 1(0, 1)	phryga 1(0, 1)	limnic 1(0, 1)
dryopi 1(0, 2)	blepha 1(0, 1)	strati 1(0, 1)	gerrid 1(0, 1)
macrom 1(0, 1)	parath 1(0, 4)		

NON-PREFERENTIALS

baetid 1(3, 4)	caenid 1(2, 4)	heptag 1(3, 4)	neoeph 1(3, 3)
epheme 1(1, 1)	hydrot 1(3, 3)	hydros 1(3, 3)	helico 1(1, 1)
odonto 1(1, 1)	glosso 1(1, 2)	elmida 1(3, 3)	hydrop 1(2, 2)
psephe 1(1, 1)	chiron 1(3, 4)	simuli 1(3, 4)	tipuli 1(2, 4)
psycho 1(1, 2)	cerato 1(2, 2)	belost 1(2, 2)	gomphi 1(2, 2)
aeshni 1(1, 2)	atyida 1(1, 2)	lumbri 1(2, 4)	vivipa 1(1, 1)
bithyn 1(1, 1)			

DIVISION 6 (N= 7) I.E. ¹³⁰GROUP *10
 Eigenvalue .370 at iteration 3
 INDICATORS and their signs
 odonto 1(+)
 Maximum indicator score for negative group 0
 Minimum indicator score for positive group 1

ITEMS IN NEGATIVE GROUP 12 (N= 5) I.E. GROUP *100

drypr1 drypr2 dryic1 dryic2 wetic2

ITEMS IN POSITIVE GROUP 13 (N= 2) I.E. GROUP *101

wetpr1 wetpr2

NEGATIVE PREFERENTIALS

baetid 1(2, 0)	neoeph 1(3, 0)	leptop 1(2, 0)	hydrot 1(2, 0)
hydros 1(4, 0)	brachy 1(2, 0)	glosso 1(2, 0)	perlid 1(1, 0)
hydrop 1(2, 0)	psephe 1(2, 0)	cerato 1(1, 0)	gomphi 1(4, 0)
libell 1(1, 0)	ampula 1(1, 0)	vivipa 1(1, 0)	uninoi 1(2, 0)
melano 1(1, 0)			

POSITIVE PREFERENTIALS

odonto 1(0, 2)	atheri 1(0, 1)	lymnae 1(1, 2)	macrom 1(0, 1)
ancycl 1(0, 2)			

NON-PREFERENTIALS

philop 1(2, 1)	elmida 1(5, 2)	chiron 1(4, 2)	lumbri 1(4, 1)
tubifi 1(2, 1)	corbic 1(5, 2)	thairi 1(5, 2)	buccin 1(2, 1)
bithyn 1(3, 1)			

 DIVISION 7 (N= 3) I.E. GROUP *11
 Group too small for further division.

----- E N D O F L E V E L 3 -----

 DIVISION 10 (N= 3) I.E. GROUP *010
 Group too small for further division.

 DIVISION 11 (N= 4) I.E. GROUP *011
 Group too small for further division.

DIVISION 12 (N= 5) I.E. ¹³¹GROUP *100
 Eigenvalue .420 at iteration 1
 INDICATORS and their signs
 baetid 1(+)
 Maximum indicator score for negative group 0
 Minimum indicator score for positive group 1

ITEMS IN NEGATIVE GROUP 24 (N= 3) I.E. GROUP *1000
 dryic1 dryic2 wetic2

ITEMS IN POSITIVE GROUP 25 (N= 2) I.E. GROUP *1001
 drypr1 drypr2

NEGATIVE PREFERENTIALS

hydrot 1(2, 0) brachy 1(2, 0) libell 1(1, 0) vivipa 1(1, 0)
 bithyn 1(3, 0) melano 1(1, 0)

POSITIVE PREFERENTIALS

baetid 1(0, 2) leptop 1(0, 2) glosso 1(0, 2) philop 1(0, 2)
 perlid 1(0, 1) hydrop 1(0, 2) cerato 1(0, 1) tubifi 1(0, 2)
 ampula 1(0, 1) lymnae 1(0, 1)

NON-PREFERENTIALS

neoph 1(2, 1) hydros 1(2, 2) elmida 1(3, 2) psephe 1(1, 1)
 chiron 1(2, 2) gomphi 1(2, 2) lumbri 1(2, 2) corbic 1(3, 2)
 thairi 1(3, 2) buccin 1(1, 1) uninol 1(1, 1)

 DIVISION 13 (N= 2) I.E. GROUP *101
 Group too small for further division.

----- E N D O F L E V E L 4 -----

 DIVISION 24 (N= 3) I.E. GROUP *1000
 Group too small for further division.

 DIVISION 25 (N= 2) I.E. GROUP *1001
 Group too small for further division.

THIS IS THE END OF THE DIVISIONS REQUESTED

DIVISION 1 (N= 72) I.E. GROUP *
Eigenvalue .822 at iteration 1

ITEMS IN NEGATIVE GROUP 2 (N= 46) I.E. GROUP *0

baetid	caenid	heptag	neoeph	epheme	hydrot	hydros	helico
rhyaco	limnep	lepido	peltop	perlid	staphy	hydrop	helodi
halipi	hydrae	simuli	atheri	ephydr	tipuli	tabani	empidi
nemato	psycho	cerato	belost	corixi	naucor	veliid	cordul
aeshni	pyrali	atyida	grapsi	isotom	ostrac	tricor	phryga
limnic	dryopi	blepha	strati	gerriid	parath		

ITEMS IN POSITIVE GROUP 3 (N= 26) I.E. GROUP *1

leptop	brachy	odonto	glosso	philop	elmida	psephe	chiron
gomphi	libell	poduri	lumbri	tubifi	naidid	ampula	corbic
thairi	vivipa	buccin	uninoi	planor	lymnae	bithyn	macrom
ancycl	melano						

----- E N D O F L E V E L 1 -----

DIVISION 2 (N= 46) I.E. GROUP *0
Eigenvalue .429 at iteration 1

ITEMS IN NEGATIVE GROUP 4 (N= 39) I.E. GROUP *00

baetid	caenid	heptag	epheme	helico	rhyaco	limnep	lepido
peltop	staphy	helodi	halipi	hydrae	simuli	ephydr	tipuli
tabani	empidi	nemato	psycho	belost	corixi	naucor	veliid
cordul	aeshni	pyrali	atyida	grapsi	isotom	ostrac	tricor
phryga	limnic	dryopi	blepha	strati	gerriid	parath	

ITEMS IN POSITIVE GROUP 5 (N= 7) I.E. GROUP *01

neoeph	hydrot	hydros	perlid	hydrop	atheri	cerato	
--------	--------	--------	--------	--------	--------	--------	--

DIVISION 3 (N= 26) I.E. GROUP *1
Eigenvalue .240 at iteration 2

ITEMS IN NEGATIVE GROUP 6 (N= 8) I.E. GROUP *10

leptop	brachy	glosso	philop	elmida	psephe	gomphi	naidid
--------	--------	--------	--------	--------	--------	--------	--------

ITEMS IN POSITIVE GROUP 7 (N= 18) I.E. GROUP *11

odonto	chiron	libell	poduri	lumbri	tubifi	ampula	corbic
thairi	vivipa	buccin	uninoi	planor	lymnae	bithyn	macrom
ancycl	melano						

----- E N D O F L E V E L 2 -----

DIVISION 4 (N= 39) I.E. GROUP *00
Eigenvalue .153 at iteration 2

ITEMS IN NEGATIVE GROUP 8 (N= 26) I.E. GROUP *000

caenid	heptag	helico	rhyaco	lepidi	peltop	staphy	helodi
halipi	hydrae	simuli	tipuli	psycho	belost	naucor	aeshni
atyida	grapsi	tricolor	phryga	limnic	dryopi	blepha	strati
gerriid	parath						

ITEMS IN POSITIVE GROUP 9 (N= 13) I.E. GROUP *001

baetid	epheme	limnep	ephydr	tabani	empidi	nemato	corixi
veliif	cordul	pyrali	isotom	ostrac			

DIVISION 5 (N= 7) I.E. GROUP *01
Eigenvalue .144 at iteration 1

ITEMS IN NEGATIVE GROUP 10 (N= 3) I.E. GROUP *010

hydrot	atheri	cerato
--------	--------	--------

ITEMS IN POSITIVE GROUP 11 (N= 4) I.E. GROUP *011

neoph	hydros	perlid	hydrop
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DIVISION 6 (N= 8) I.E. GROUP *10
Eigenvalue .318 at iteration 2

ITEMS IN NEGATIVE GROUP 12 (N= 5) I.E. GROUP *100

leptop	brachy	glosso	elmida	gomphi
--------	--------	--------	--------	--------

ITEMS IN POSITIVE GROUP 13 (N= 3) I.E. GROUP *101

philop	psephe	naidid
--------	--------	--------

DIVISION 7 (N= 18) I.E. GROUP *11
Eigenvalue .269 at iteration 1

ITEMS IN NEGATIVE GROUP 14 (N= 12) I.E. GROUP *110

odonto	chiron	poduri	lumbri	tubifi	ampula	thairi
planor	lymnae	macrom	melano			

ITEMS IN POSITIVE GROUP 15 (N= 6) I.E. GROUP *111

libell	corbic	buccin	uninoi	bithyn	ancycl
--------	--------	--------	--------	--------	--------

----- E N D O F L E V E L 3 -----

DIVISION 8 (N= 26) I.E. GROUP *000
Eigenvalue .082 at iteration 1

ITEMS IN NEGATIVE GROUP 16 (N= 20) I.E. GROUP *0000

heptag	helico	rhyaco	lepido	peltop	staphy	helodi	halipi
hydrae	simuli	aeshni	grapsi	tricolor	phryga	limnic	dryopi
blepha	strati	gerriid	parath				

ITEMS IN POSITIVE GROUP 17 (N= 6) I.E. GROUP *0001

caenid	tipuli	psycho	belost	naucor	atyida
--------	--------	--------	--------	--------	--------

DIVISION 9 (N= 13) I.E. GROUP *001
Eigenvalue .188 at iteration 1

ITEMS IN NEGATIVE GROUP 18 (N= 12) I.E. GROUP *0010

epheme	limnep	ephydr	tabani	empidi	nemato	corixi	veliid
cordul	pyrali	isotom	ostrac				

ITEMS IN POSITIVE GROUP 19 (N= 1) I.E. GROUP *0011

baetid

DIVISION 10 (N= 3) I.E. GROUP *010
Group too small for further division.

DIVISION 11 (N= 4) I.E. GROUP *011
Group too small for further division.

DIVISION 12 (N= 5) I.E. GROUP *100
Eigenvalue .384 at iteration 1

ITEMS IN NEGATIVE GROUP 24 (N= 4) I.E. GROUP *1000

leptop	brachy	glosso	gomphi
--------	--------	--------	--------

ITEMS IN POSITIVE GROUP 25 (N= 1) I.E. GROUP *1001

elmida

DIVISION 13 (N= 3) I.E. GROUP *101
Group too small for further division.

DIVISION 14 (N= 12) I.E. GROUP *110
Eigenvalue .210 at iteration 2

ITEMS IN NEGATIVE GROUP 28 (N= 7) I.E. GROUP *1100

chiron poduri lumbri ampula vivipa planor lymnae

ITEMS IN POSITIVE GROUP 29 (N= 5) I.E. GROUP *1101

odonto tubifi thairi macrom melano

DIVISION 15 (N= 6) I.E. GROUP *111
Eigenvalue .163 at iteration 1

ITEMS IN NEGATIVE GROUP 30 (N= 2) I.E. GROUP *1110

buccin bithyn

ITEMS IN POSITIVE GROUP 31 (N= 4) I.E. GROUP *1111

libell corbic uninol ancycl

----- E N D O F L E V E L 4 -----

DIVISION 16 (N= 20) I.E. GROUP *0000
Eigenvalue .068 at iteration 1

ITEMS IN NEGATIVE GROUP 32 (N= 8) I.E. GROUP *00000

rhyaco lepido peltop staphy helodi halipi hydrae grapsi

ITEMS IN POSITIVE GROUP 33 (N= 12) I.E. GROUP *00001

heptag helico simuli aeshni tricolor phryga limnic dryopi
blepha strati gerrid parath

DIVISION 17 (N= 6) I.E. GROUP *0001
Eigenvalue .049 at iteration 2

ITEMS IN NEGATIVE GROUP 34 (N= 4) I.E. GROUP *00010

caenid tipuli psycho atyida

ITEMS IN POSITIVE GROUP 35 (N= 2) I.E. GROUP *00011

belost naucor

DIVISION 18 (N= 12) I.E. GROUP *0010
Eigenvalue .117 at iteration 1

ITEMS IN NEGATIVE GROUP 36 (N= 3) I.E. GROUP *00100

epheme limnep tabani

ITEMS IN POSITIVE GROUP 37 (N= 9) I.E. GROUP *00101

ephydr empidi nemato corixi veliid cordul pyrali isotom
ostrac

DIVISION 19 (N= 1) I.E. GROUP *0011
Group too small for further division.

DIVISION 24 (N= 4) I.E. GROUP *1000
Group too small for further division.

DIVISION 25 (N= 1) I.E. GROUP *1001
Group too small for further division.

DIVISION 28 (N= 7) I.E. GROUP *1100
Eigenvalue .195 at iteration 1

ITEMS IN NEGATIVE GROUP 56 (N= 4) I.E. GROUP *11000

poduri ampula vivipa planor

ITEMS IN POSITIVE GROUP 57 (N= 3) I.E. GROUP *11001

chiron lumbri lymnae

DIVISION 29 (N= 5) I.E. GROUP *1101
Eigenvalue .279 at iteration 1

ITEMS IN NEGATIVE GROUP 58 (N= 3) I.E. GROUP *11010

tubifi thairi melano

ITEMS IN POSITIVE GROUP 59 (N= 2) I.E. GROUP *11011

odonto macrom

DIVISION 30 (N= 2) I.E. GROUP *1110
Group too small for further division.

DIVISION 31 (N= 4) I.E. GROUP *1111
Group too small for further division.

----- E N D O F L E V E L 5 -----

DIVISION 32 (N= 8) I.E. GROUP *00000

 DIVISION 33 (N= 12) I.E. GROUP *00001
 Eigenvalue .051 at iteration 1

ITEMS IN NEGATIVE GROUP 66 (N= 4) I.E. GROUP *000010

heptag helico simuli aeshni

ITEMS IN POSITIVE GROUP 67 (N= 8) I.E. GROUP *000011

tricolor phryga limnic dryopi blepha strati gerrid parath

 DIVISION 34 (N= 4) I.E. GROUP *00010
 Group too small for further division.

 DIVISION 35 (N= 2) I.E. GROUP *00011
 Group too small for further division.

 DIVISION 36 (N= 3) I.E. GROUP *00100
 Group too small for further division.

 DIVISION 37 (N= 9) I.E. GROUP *00101
 Eigenvalue .135 at iteration 1

ITEMS IN NEGATIVE GROUP 74 (N= 7) I.E. GROUP *001010

ephydr empidi nemato corixi veliid isotom ostrac

ITEMS IN POSITIVE GROUP 75 (N= 2) I.E. GROUP *001011

cordul pyrali

 DIVISION 56 (N= 4) I.E. GROUP *11000
 Group too small for further division.

 DIVISION 57 (N= 3) I.E. GROUP *11001
 Group too small for further division.

 DIVISION 58 (N= 3) I.E. GROUP *11010
 Group too small for further division.

 DIVISION 59 (N= 2) I.E. GROUP *11011
 Group too small for further division.

----- E N D O F L E V E L 6 -----

ORDER OF SPECIES INCLUDING RARER ONES

11	rhyaco	14	lepdo	17	peltop	20	staphy	22	helodi
23	halipi	24	hydrae	46	grapsi	3	heptag	10	helico
27	simuli	43	aeshni	62	tracor	63	phryga	64	limnic
65	dryopi	66	blepha	67	strati	68	gerrid	70	parath
2	caenid	30	tipuli	34	psycho	45	atyida	36	belost
38	naucor	6	epheme	12	limnep	31	tabani	29	ephydr
32	empidi	33	nemato	37	corixi	39	veliid	48	isotom
61	ostrac	41	cordul	44	pyrali	1	baetid	7	hydrot
28	atheri	35	cerato	4	neoeph	8	hydros	18	perlid
21	hydrop	5	leptop	9	brachy	15	glosso	40	gomphi
19	elmida	16	philop	25	psephe	51	naidid	47	poduri
52	ampula	55	vivipa	58	planor	26	chiron	49	lumbri
59	lymnae	50	tubifi	54	thairi	72	melano	13	odonto
69	macrom	56	buccin	60	bithyn	42	libell	53	corbic
57	uninoi	71	ancycl						

ORDER OF SAMPLES

4	dryst4	16	weticl	1	dryst1	2	dryst2	3	dryst3
10	wetst1	11	wetst2	12	wetst3	13	wetst4	7	dryicl
8	dryic2	17	wetic2	5	drypr1	6	drypr2	14	wetpr1
15	wetpr2	9	drysc1	18	wetscl	19	wetsc2		

139
1 111 1 11 11
4612301237875645989

11	rhyaco	---1-----	00000
14	lepid	---1-----	00000
17	peltop	---1-----	00000
20	staphy	---1-----	00000
22	helodi	---1-----	00000
23	halipi	---1-----	00000
24	hydrae	--1-1-----	00000
46	grapsi	---1-----	00000
3	heptag	--1111111--	000010
10	helico	---1---1---	000010
27	simuli	--1111111--	000010
43	aeshni	---1-1---1---	000010
62	tricolor	---1-----	000011
63	phryga	---1-----	000011
64	limnic	---1-----	000011
65	dryopi	---1-1-----	000011
66	blepha	---1-----	000011
67	strati	---1-----	000011
68	gerrid	---1-----	000011
70	parath	---1111--	000011
2	caenid	1--111111--	00010
30	tipuli	11-111111--	00010
34	psycho	-1-1--1-1---	00010
45	atyida	1--1-1-1---	00010
36	belost	-111-1-1---	00011
38	naucor	-11111-1---	00011
6	epheme	1--1--1---	00100
12	limnep	1-11-----	00100
31	tabani	-11-1-----	00100
29	ephydr	11--1-----	001010
32	empidi	11-1-----	001010
33	nemato	11---1-----	001010
37	corixi	11-----	001010
39	veliud	11-----	001010
48	isotom	1-----	001010
61	ostrac	1-----	001010
41	cordul	1---1-----	001011
44	pyrali	1-----11---	001011
1	baetid	111111111---11---	0011
7	hydrot	-1111111--11---	010
28	atheri	11---1-----1---	010
35	cerato	11-111--1---1--1---	010
4	neoeph	1-111111-11-1---	011
8	hydros	111111-11-1111---	011
18	perlid	---11-----1---	011
21	hydrop	1--111-1---11---	011
5	leptop	1--11-----11---	1000
9	brachy	--111---11-----	1000
15	glosso	---1-1-1---11---	1000
40	gomphi	1111-1--1-1111---	1000
19	elmida	111111-111111111--	1001
16	philop	--111-----111---	101
25	psephe	---11--1-1---	101
51	naidid	---1-----1---	101
47	poduri	1-----1	11000
52	ampula	-11-----1-11-	11000
55	vivipa	---1---11-----11-	11000
58	planor	1-----1	11000
26	chiron	11111111111-1111111	11001
49	lumbri	1--11111111-11-1111	11001
59	lymnae	-1---1--1---11111-	11001
50	tubifi	1---1-----11-111-	11010
54	thairi	11---1--11111111-1-	11010
72	melano	-1-----1-----	11010
13	odonto	--1--1-----11---	11011
69	macrom	---1-----1---	11011
56	buccin	---1--1-1-1--1---	1110
60	bithyn	--1--1---111--1---	1110
42	libell	-----1-----	1111
53	corbic	-1---1---1111111-1-	1111
57	unioi	-----1--1-----	1111
71	ancycl	-----11-1-	1111

0000000001111111111
0011111110000000111
00011110000011
00011

APPENDIX F

Outputs from MDA

- - - - - D I S C R I M I N A N T A N A L Y S I S - - - - -

On groups defined by LEVEL1

20 (Unweighted) cases were processed.
 1 of these were excluded from the analysis.
 1 had at least one missing discriminating variable.
 19 (Unweighted) cases will be used in the analysis.

Number of cases by group

LEVEL1	Number of cases		Label
	Unweighted	Weighted	
1	9	9.0	
2	10	10.0	
Total	19	19.0	

Group means

LEVEL1	ALKA	COND	LBOD5	LDO
1	73.22222	169.26667	-.66295	.85122
2	91.20000	247.33000	.26248	.71462
Total	82.68421	210.35263	-.17589	.77932

LEVEL1	LMN	LNH3	PH	FE
1	-.85319	-1.53607	7.83333	.74778
2	-.78094	-.84162	7.76000	1.06500
Total	-.81516	-1.17057	7.79474	.91474

Group standard deviations

LEVEL1	ALKA	COND	LBOD5	LDO
1	47.64656	93.21973	.44502	.04626
2	23.10147	81.86789	.50916	.23340
Total	36.88993	93.89896	.66559	.18193

LEVEL1	LMN	LNH3	PH	FE
1	.24344	.65147	.40927	.47100
2	.35523	.97500	.42999	.57822
Total	.30134	.88930	.41025	.54060

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Wilks' Lambda (U-statistic) and univariate F-ratio
with 1 and 17 degrees of freedom

Variable	Wilks' Lambda	F	Significance
ALKA	.93750	1.1333	.3020
COND	.81812	3.7794	.0686
LBOD5	.49127	17.6041	.0006
LDO	.85166	2.9611	.1034
LMN	.98487	.2611	.6159
LNH3	.83953	3.2494	.0892
PH	.99159	.1442	.7089
FE	.90939	1.6939	.2104

- - - - - D I S C R I M I N A N T A N A L Y S I S - - - - -

On groups defined by LEVEL1

Analysis number 1

Direct method: all variables passing the tolerance test are entered.

Minimum tolerance level..... .00100

Canonical Discriminant Functions

Maximum number of functions..... 1
 Minimum cumulative percent of variance... 100.00
 Maximum significance of Wilks' Lambda.... 1.0000

Prior probability for each group is .50000

Canonical Discriminant Functions

	Fcn	Eigenvalue	Pct of Variance	Cum Pct	Canonical Corr	After Fcn	Wilks' Lambda	Chi-square	df	Sig
1*	2.0488	100.00	100.00	.8198	:	0 .327996	14.492	8	.0698	

* Marks the 1 canonical discriminant functions remaining in the analysis.

Standardized canonical discriminant function coefficients

Func 1

ALKA	-.24919
COND	1.23627
LBOD5	.82727
LDO	.26953
LMN	-1.22331
LNH3	-.02654
PH	-.36781
FE	.99090

Structure matrix:

Pooled within-groups correlations between discriminating variables
 and canonical discriminant functions
 (Variables ordered by size of correlation within function)

Func 1

LBOD5	.71094
COND	.32941
LNH3	.30544
LDO	-.29157
FE	.22053
ALKA	.18038
LMN	.08658
PH	-.06433

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Canonical discriminant functions evaluated at group means (group centroids)

Group	Func 1
1	-1.42718
2	1.28446

Classification results -

Actual Group		No. of Cases	Predicted Group Membership	
			1	2
-----		-----	-----	-----
Group	1	9	8 88.9%	1 11.1%
Group	2	11	2 18.2%	9 81.8%

Percent of "grouped" cases correctly classified: 85.00%

Classification processing summary

20 (Unweighted) cases were processed.
 0 cases were excluded for missing or out-of-range group codes.
 20 (Unweighted) cases were used for printed output.

----- DISCRIMINANT ANALYSIS -----

On groups defined by LEVEL2

20 (Unweighted) cases were processed.
 1 of these were excluded from the analysis.
 0 had missing or out-of-range group codes.
 1 had at least one missing discriminating variable.
 19 (Unweighted) cases will be used in the analysis.

Number of cases by group

LEVEL2	Number of cases		Label
	Unweighted	Weighted	
1	2	2.0	
2	7	7.0	
3	7	7.0	
4	3	3.0	
Total	19	19.0	

Group means

LEVEL2	ALKA	COND	LBOD5	LDO
1	50.00000	141.50000	-.13380	.79581
2	79.85714	177.20000	-.81414	.86705
3	88.28571	216.80000	.03970	.82528
4	98.00000	318.56667	.78229	.45641
Total	82.68421	210.35263	-.17589	.77932

LEVEL2	LMN	LNH3	PH	FE
1	-.97930	-1.69897	7.75000	.68000
2	-.81715	-1.48952	7.85714	.76714
3	-.94848	-1.31855	7.94286	.93000
4	-.39002	.27121	7.33333	1.38000
Total	-.81516	-1.17057	7.79474	.91474

Group standard deviations

LEVEL2	ALKA	COND	LBOD5	LDO
1	7.07107	46.95189	.12452	.07842
2	52.79655	104.34903	.37612	.02265
3	16.88653	32.88485	.43207	.05879
4	38.03945	126.65727	.16587	.30316
Total	36.88993	93.89896	.66559	.18193

LEVEL2	LMN	LNH3	PH	FE
1	.45499	.42572	.35355	.28284
2	.19415	.72409	.44668	.52961
3	.26570	.71546	.25728	.60847
4	.16910	.29746	.49329	.42568
Total	.30134	.88930	.41025	.54060

Wilks' Lambda (U-statistic) and univariate F-ratio
with 3 and 15 degrees of freedom

Variable	Wilks' Lambda	F	Significance
ALKA	.87280	.7287	.5507
COND	.66859	2.4784	.1010
LBOD5	.25576	14.5498	.0001
LDO	.35880	8.9352	.0012
LMN	.55915	3.9421	.0294
LNH3	.46190	5.8248	.0076
PH	.72816	1.8666	.1786
FE	.82630	1.0511	.3989

----- DISCRIMINANT ANALYSIS -----

On groups defined by LEVEL2

Analysis number 1

Direct method: all variables passing the tolerance test are entered.

Minimum tolerance level..... .00100

Canonical Discriminant Functions

Maximum number of functions..... 3

Minimum cumulative percent of variance... 100.00

Maximum significance of Wilks' Lambda.... 1.0000

Prior probability for each group is .25000

Canonical Discriminant Functions

Fcn	Eigenvalue	Pct of Variance	Cum Pct	Canonical Corr	After Fcn	Wilks' Lambda	Chi-square	df	Sig
1*	9.0365	85.75	85.75	.9489	0	.034992	40.232	24	.0202
2*	1.2185	11.56	97.31	.7411	1	.351194	12.557	14	.5617
3*	.2835	2.69	100.00	.4700	2	.779107	2.995	6	.8094

* Marks the 3 canonical discriminant functions remaining in the analysis.

Standardized canonical discriminant function coefficients

	Func 1	Func 2	Func 3
ALKA	-1.62067	.31185	.88681
COND	2.17381	.07289	.14091
LBOD5	.78328	.67436	-.31905
LDO	-.31439	.35584	.33434
LMN	-.34940	-.91466	-.67964
LNH3	.00855	-.53515	.64507
PH	-.33023	-.22032	-.10763
FE	.68245	.45176	.95591

Structure matrix:

Pooled within-groups correlations between discriminating variables
and canonical discriminant functions
(Variables ordered by size of correlation within function)

	Func 1	Func 2	Func 3
LBOD5	.55119*	.36658	-.05421
LDO	-.41630*	.41321	.21364
LMN	.20207	-.58196*	.15444
LNH3	.32581	-.38095*	.31918
PH	-.15869	.31710*	.28636
ALKA	.06593	-.04581	.60535*
COND	.21256	-.12451	.49162*
FE	.14301	-.08231	.24590*

* denotes largest absolute correlation between each variable and any discriminant function.

Canonical discriminant functions evaluated at group means (group centroids)

Group	Func 1	Func 2	Func 3
1	-.36406	.66048	-1.34049
2	-2.56448	-.85241	.09110
3	.34169	1.12445	.29298
4	5.42921	-1.07508	-.00254

Classification results -

Actual Group		No. of Cases	Predicted Group Membership			
			1	2	3	4
Group	1	2	2 100.0%	0 .0%	0 .0%	0 .0%
Group	2	7	0 .0%	7 100.0%	0 .0%	0 .0%
Group	3	7	1 14.3%	0 .0%	6 85.7%	0 .0%
Group	4	4	0 .0%	0 .0%	0 .0%	4 100.0%

Percent of "grouped" cases correctly classified: 95.00%

Classification processing summary

20 (Unweighted) cases were processed.
 0 cases were excluded for missing or out-of-range group codes.
 20 (Unweighted) cases were used for printed output.

- - - - - D I S C R I M I N A N T A N A L Y S I S - - - - -

On groups defined by LEVEL3

20 (Unweighted) cases were processed.
 1 of these were excluded from the analysis.
 0 had missing or out-of-range group codes.
 1 had at least one missing discriminating variable.
 19 (Unweighted) cases will be used in the analysis.

Number of cases by group

LEVEL3	Number of cases		Label
	Unweighted	Weighted	
1	2	2.0	
2	3	3.0	
3	4	4.0	
4	5	5.0	
5	2	2.0	
6	3	3.0	
Total	19	19.0	

Group means

LEVEL3	ALKA	COND	LBOD5	LDO
1	50.00000	141.50000	-.13380	.79581
2	115.00000	225.46667	-.56632	.85288
3	53.50000	141.00000	-1.00000	.87768
4	84.60000	213.12000	.05134	.82760
5	97.50000	226.00000	.01059	.81949
6	98.00000	318.56667	.78229	.45641
Total	82.68421	210.35263	-.17589	.77932

LEVEL3	LMN	LNH3	PH	FE
1	-.97930	-1.69897	7.75000	.68000
2	-.70125	-1.26896	8.03333	.68000
3	-.90408	-1.65495	7.72500	.83250
4	-1.05597	-1.33845	8.02000	.85200
5	-.67976	-1.26880	7.75000	1.12500
6	-.39002	.27121	7.33333	1.38000
Total	-.81516	-1.17057	7.79474	.91474]

Group standard deviations

LEVEL3	ALKA	COND	LBOD5	LDO
1	7.07107	46.95189	.12452	.07842
2	60.82763	130.12399	.51303	.02340
3	30.77337	80.07713	.00000	.01761
4	19.19114	39.37476	.51986	.07168
5	.00000	7.07107	.19167	.00931
6	38.03945	126.65727	.16587	.30316
Total	36.88993	93.89896	.66559	.18193

LEVEL3	LMN	LNH3	PH	FE
1	.45499	.42572	.35355	.28284
2	.21245	.85490	.58595	.59195
3	.14762	.69011	.34034	.56044
4	.23342	.70623	.24900	.67136
5	.05867	1.03407	.21213	.55861
6	.16910	.29746	.49329	.42568
Total	.30134	.88930	.41025	.54060

Wilks' Lambda (U-statistic) and univariate F-ratio
with 5 and 13 degrees of freedom

Variable	Wilks' Lambda	F	Significance
ALKA	.59840	1.7449	.1938
COND	.59003	1.8065	.1807
LBOD5	.21503	9.4915	.0005
LDO	.35688	4.6855	.0115
LMN	.39231	4.0275	.0199
LNH3	.44347	3.2628	.0398
PH	.63999	1.4626	.2675
FE	.79848	.6562	.6626

----- DISCRIMINANT ANALYSIS -----

Groups defined by LEVEL3

Analysis number 1

Direct method: all variables passing the tolerance test are entered.

Minimum tolerance level..... .00100

Canonical Discriminant Functions

Maximum number of functions..... 5

Minimum cumulative percent of variance... 100.00

Maximum significance of Wilks' Lambda.... 1.0000

Prior probability for each group is .16667

Canonical Discriminant Functions

Fcn	Eigenvalue	Pct of Variance	Cum Pct	Canonical Corr	After Fcn	Wilks' Lambda	Chi-square	df	Sig
				:	0	.003643	61.765	40	.0151
1*	10.4579	59.37	59.37	.9554	1	.041738	34.940	28	.1716
2*	5.1776	29.39	88.76	.9155	2	.257841	14.910	18	.6682
3*	1.4718	8.36	97.12	.7716	3	.637334	4.955	10	.8942
4*	.3056	1.73	98.85	.4838	4	.832105	2.022	4	.7318
5*	.2018	1.15	100.00	.4098					

* Marks the 5 canonical discriminant functions remaining in the analysis.

Standardized canonical discriminant function coefficients

	Func 1	Func 2	Func 3	Func 4	Func 5
ALKA	-3.11991	2.71600	1.01489	.23921	.17940
COND	3.95112	-2.76766	-.85871	.12883	.89959
LBOD5	.39124	.72940	.64239	-.58751	.10409
LDO	-.13328	-.44986	-.03702	-.31295	1.16211
LMN	-1.23932	1.55385	-.64027	-.69716	-.22627
LNH3	.15633	-.20163	-.35393	.95908	-.14714
PH	-.52352	.35035	.35158	.65137	-1.31208
FE	1.42028	-1.10169	.31246	.89994	.60407

Structure matrix:

Pooled within-groups correlations between discriminating variables
and canonical discriminant functions
(Variables ordered by size of correlation within function)

	Func 1	Func 2	Func 3	Func 4	Func 5
LBOD5	.47848*	.42213	.46373	-.23035	-.06858
LMN	.11762	.41368	-.58251*	-.01382	.30559
PH	-.15530	-.05256	.42153*	.32293	-.11327
ALKA	-.01789	.32214	.15091	.53045*	.23309
COND	.14309	.28381	.01070	.44316*	.13129
LNH3	.24556	.30414	-.24556	.42354*	-.09505
FE	.12179	.08269	-.12173	.05459	.44043*
LDO	-.33552	-.29051	.32158	-.01714	.41967*

* denotes largest absolute correlation between each variable and any discriminant function.

Canonical discriminant functions evaluated at group means (group centroids)

Group	Func 1	Func 2	Func 3	Func 4	Func 5
1	.13107	-.95294	.35027	-1.10485	-.56122
2	-4.36387	2.57494	-.07837	.24258	-.26607
3	-1.23080	-2.48588	-1.27287	.14398	.10888
4	.98925	-.95898	1.36792	.33759	-.00786
5	-.68069	1.44898	.34208	-.57346	.92170
6	4.72260	2.00718	-.96590	.12167	-.10633

Classification results -

Actual Group		No. of Cases	Predicted Group Membership			
			1	2	3	4
Group	1	2	1 50.0%	0 .0%	0 .0%	1 50.0%
Group	2	3	0 .0%	3 100.0%	0 .0%	0 .0%
Group	3	4	0 .0%	0 .0%	4 100.0%	0 .0%
Group	4	5	1 20.0%	0 .0%	0 .0%	4 80.0%
Group	5	2	0 .0%	0 .0%	0 .0%	0 .0%
Group	6	4	0 .0%	0 .0%	0 .0%	0 .0%

Actual Group		No. of Cases	Predicted Group Membership	
			5	6
Group	1	2	0 .0%	0 .0%
Group	2	3	0 .0%	0 .0%
Group	3	4	0 .0%	0 .0%
Group	4	5	0 .0%	0 .0%
Group	5	2	2 100.0%	0 .0%
Group	6	4	0 .0%	4 100.0%

Percent of "grouped" cases correctly classified: 90.00%

Classification processing summary

20 (Unweighted) cases were processed.

0 cases were excluded for missing or out-of-range group codes.

20 (Unweighted) cases were used for printed output.

CURRICULUM VITAE

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Educational Background

1. B.Sc. (Biology) : Khon Kaen University, Khon Kaen, Thailand.
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Work Experience

Worked as Quality Document Controller in Essilor Manufacturing,
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Papers presented

A survey of water quality in Chiang Mai area by means of chemical index.,
The 2nd international conference on environmental and industrial toxicology :
research and its application, December 9-13, 1996. Chulaborn Research Institute,
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