U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES

AN APPROACH TO A RELATIVE

TROPHIC INDEX SYSTEM FOR

CLASSIFYING LAKES AND RESERVOIRS

WORKING PAPER NO. 24

A Preliminary Analysis of
National Eutrophication Survey Data
Collected During
the 1972 Sampling Period

PACIFIC NORTHWEST ENVIRONMENTAL RESEARCH LABORATORY

An Associate Laboratory of the

NATIONAL ENVIRONMENTAL RESEARCH CENTER - CORVALLIS, OREGON

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National Eutrophication Survey
Pacific Northwest Environmental Research Laboratory
Corvallis, Oregon
December, 1974

F O R W A R D

The Trophic State Index discussed in this report is not proposed as the final answer to determining the trophic condition of lakes and reservoirs; and there were, in fact, some reservations by the Survey staff about making this paper available for public distribution. The method described herein, however, has been useful to the Survey for categorizing each water body according to trophic condition and is therefore offered for whatever value it might have to others interested in evaluating trophic conditions of lakes and reservoirs.

INTRODUCTION

One of the major tasks confronting the staff of the National Eutrophication Survey is the assessment of the trophic condition of the water bodies studied. Many of these waters previously have been studied only superficially, if at all, and the Survey data provide the only basis for the evaluation of trophic condition.

In addition, Section 314(a) of Public Law 92-500 requires that each State classify, according to trophic condition, each of its publicly owned waters. The question, of course, is which classification system or index system to use. The Environmental Protection Agency (EPA) also wants an index or indices which can be used to evaluate changes in water quality over a period of time to determine whether conditions have improved or deteriorated.

Therefore, from the beginning of the Survey, it was apparent that there was a need for a lake classification system, based on Survey data, from which the trophic condition of the Survey lakes could be better defined and which also had some utility to the States in classifying other lakes not included in the Survey.

The intent of the approach used by the Survey is to provide a numerical trophic index which will permit a more realistic assignment of trophic condition then the relatively inflexible categorizations of oligotrophic, mesotrophic, eutrophic, or hypereutrophic. It is apparent, particularly when working with a large group of lakes, that trophic condition is a

continuum with no sharp demarcations as are suggested by the traditional classes and the trophic index utilized in this paper demonstrates that.

INDEX DEVELOPMENT

The development of an index or lake classification system is not a new consideration in the limnological community. In perusing the literature, it quickly becomes evident that "the most striking feature of limnological classifications is not the difficulty of producing some sort of arrangement, but the multiplicity of arrangements that have been proposed" (Sheldon, 1972). However, guided by a desire to devise a method that could be used by those with little or no knowledge of the more complex and sophisticated tools of statistical analyses (for some of which large-scale computer capability is a necessity), our first effort was a variation of a relatively simple ranking method used by Lueschow, et al. (1970) for 12 Wisconsin lakes. Using the unweighted mean annual values of selected physical, chemical and biological parameters-- each of which in one way or another reflect the trophic condition of a lake, Lueschow, et al. derived a composite rating which was the sum of the numerical values of position for each of the five parameters used (e.g., a value of one was given for the lake with the greatest transparency, two for the lake with the next greatest transparency, and so on), so the lake with the lowest composite value was judged the most oligotrophic, and the lake with the highest composite value was judged the most eutrophic.

The Survey data base was much larger than that of the Wisconsin study, however, and involved more than 200 lakes surveyed in 1972 for the present assessment. Before the Survey is complete, another 500 lakes will be included for a total data base of 700+ lakes in which nine usable water quality parameters were measured. This data base includes the range of trophic conditions from some of the most pristine lakes and reservoirs in the United States to some of the most eutrophic and, therefore, will provide an excellent "relative" classification system which could be used to determine the trophic condition of any lake not in the original sample of 700 lakes (~200 treated in this report).

Rather than the positional ranking used by Lueschow, et al., a percentile ranking procedure was used. In this procedure, for each of the unweighted parameters used, the percentage of the 200+ lakes exceeding Lake X in that parameter, e.g. level of chlorophyll a, was determined. The final ranking value or index number is simply the sum of the percentile ranks for each of the parameters used (the values for Secchi disc transparency and minimum dissolved oxygen are subtracted from fixed values so that all parameters contribute in a positive way to the ranking).

To test the merits of what might at least be a theoretical objection to the use of correlated parameters, such as chlorophyll a and phosphorus or chlorophyll a and Secchi disc transparency, percentile rankings were determined with various combinations of the nine most pertinent parameters

(a tabulation of seven non-weighted parameter combinations and resulting rankings by the percentile method and two non-weighted parameter combinations and resulting rankings by multivariate analysis is appended to this report). Two of the combinations, one with six parameters and the other with seven, appear to provide the best fit (with two kinds of exceptions as noted below), and both combinations include correlated parameters*.

Fortunately, a judgment of fit could be made with a degree of confidence because a number of the 1972 lakes previously had been studied by others, and the trophic condition of these lakes was generally agreed upon. Among these "bench-mark" lakes were Lake Zoar, Connecticut; Sebasticook Lake, Maine; Houghton and Higgins lakes, Michigan; Minnetonka and Shagawa lakes, Minnesota; Lake Winnipesaukee, New Hampshire; the Finger Lakes, New York; Lake Memphremagog, Vermont; and Geneva, Green, Kegonsa, and Shawano lakes in Wisconsin.

Table 1, 2, and 3 provide an example of how the percentile ranking system is used to develop an index. Nine Maine lakes, studied in 1972, provide the data base in this example.

The six parameters (Table 1) which are used in combination to arrive at an index number (Table 3), were those which seemed to provide the best

* The six-parameter ranking included the median total phosphorus, dissolved phosphorus, and inorganic nitrogen; the mean chlorophyll a; 500 minus the mean Secchi depth; and 15 minus the minimum dissolved oxygen. The algal assay control yield was added in the seven parameter ranking. Respectively, these are combinations #1 and #2 in the appended tabulation.

TABLE 1

Values of the Six Parameters Used in Developing a Trophic Index Based Only on a Data Base of Nine Maine Lakes

Lake Code	Lake Name	Median Total P (mg/l)	Median Inorg N (mg/l)	500-Mean Sec (inches)	Mean Chlorophyll a (µg/l)	15-Min DO (mg/l)	Median Diss P (mg/l)
2304	Estes Lake	0.094	0.230	459	28.3	12.8	0.057
2306	Long Lake	0.008	0.080	365	3.2	9.2	0.006
2308	Mattawamkeag Lake	0.011	0.120	438	2.0	11.6	0.007
2309	Moosehead Lake	0.005	0.180	351	1.5	7.6	0.003
2310	Rangeley Lake	0.007	0.110	352	2.4	7.8	0.005
2311	Sebago Lake	0.004	0.155	301	1.5	6.4	0.003
2312	Sebasticook Lake	0.050	0.110	456	49.5	9.0	0.024
2313	Long Lake	0.010	0.200	396	6.9	9.0	0.006
2314	Bay of Naples	0.005	0.070	374	1.8	6.6	0.003

TABLE 2

Percent of Maine Lakes Exceeding Parameter Value of Each Lake and the Trophic Index Number of Each Maine Lake Using A Data Base of Nine Lakes

Lake Code	Lake Name	Median Total P (mg/l)	Median Inorg N (mg/l)	500-Mean Sec (inches)	Mean Chlorophyll a (µg/l)	15-Min DO (mg/l)	Median Diss P (mg/l)	Index No. (Sum of Percentages)
2304	Estes Lake	0	0	0	11	0	0	11
2306	Long Lake	44	77	55	33	22	33	264
2308	Mattawamkeag Lake	22	44	22	55	11	22	176
2309	Moosehead Lake	77	22	77	88	66	66	396
2310	Rangeley Lake	55	55	66	44	55	55	330
2311	Sebago Lake	88	33	88	77	88	77	451
2312	Sebasticook Lake	11	55	11	0	33	11	121
2313	Long Lake	33	11	33	22	33	33	165
2314	Bay of Naples	66	88	44	66	77	77	418

TABLE 3

Trophic Index Number and Trophic Condition of Each Surveyed Maine Lake Using Data Base of Nine Lakes

Rank	Lake Code	Lake Name	Index No.	Trophic Condition
1	2311	Sebago Lake	451	O
2	2314	Bay of Naples	418	O
3	2309	Moosehead Lake	396	O
4	2310	Rangeley Lake	330	O
5	2306	Long Lake	264	M
6	2308	Mattawamkeag Lake	176	M
7	2313	Long Lake	165	M
8	2312	Sebasticook Lake	121	E
9	2304	Estes Lake	11	HE

O - oligotrophic
M - mesotrophic
E - eutrophic
HE - hypereutrophic

separation of trophic condition when applied to the entire group of 209 lakes.

Table 1 simply depicts the values of each parameter for the nine Maine lakes. Table 2 represents, for each parameter, the percent of lakes in the data base (9 lakes) which exceed the parameter level for the lake of interest. The last column in the table is the trophic index number which is the sum of the percentiles for each parameter.

Using the data base of only 9 lakes, the highest percentile which can be achieved for any parameter is 88 (8/9); therefore the highest possible index number is 528 (6x88). In Table 3 the nine Maine lakes are arrayed in order of their trophic index number from most oligotrophic to the most eutrophic lake and also classified according to the traditional system of oligo-, meso-, eutrophic, or hypereutrophic.

The example of the nine Maine lakes does not include either of the two kinds of exceptions to the good fit of rankings referred to on page 3. The two exceptions are (1) water bodies with very short hydraulic retention times (less than five days) and (2) water bodies characterized by extensive littoral zones, and excessive production of macrophytes. In the first case, the essentially "flow-through" hydraulic regimes result in flushing of nutrients, and nutrient concentrations may remain relatively low in spite of loading rates that frequently are very high. In the second case, the macrophytes may compete effectively with algae for the available nutrients with the result that nutrient levels frequently are

low, chlorophyll levels are low (because algal populations are low), and Secchi disc values may be relatively high (possibly a combination of fewer algae and the enhancement of sedimentation of particulate matter in the relatively quiet waters provided by the weed beds).

While the mean hydraulic retention time can be quantified and used as a parameter in ranking if it is known, the volumes of many of the 1972 Survey study waters are not known, and the retention times cannot be determined. Likewise, if macrophyte populations could be conveniently quantified, this parameter could also be used in ranking the waters.

The same procedures explained above for the nine Maine lakes were applied to all of the lakes surveyed in 1972 representing a data base of 209 water bodies of many different trophic conditions. With this data set, the highest index number which could be achieved would be 594 (99 x 6) which would represent the most oligotrophic lake and the lowest index number which could be achieved would be 0, representing the most eutrophic lake.

Table 4 lists the 209 lakes ranked in order from best to worst trophic condition according to the index numbers and also indicates the trophic state nomenclature (oligotrophic, mesotrophic, or eutrophic) which is believed to typify each water body.

In general, the conclusion can be drawn from Table 4 that those lakes with a trophic index number of 500-600 correspond to a very good trophic condition and are oligotrophic with the transitional range to mesotrophic beginning in the 500-525 range.

TABLE 4

Trophic State, Trophic Index Number, and Rank in Order of Decreasing Trophic Condition for National Eutrophication Survey Lakes Sampled in 1972

RANK	LAKE CODE	LAKE NAME	INDEX NO	TROPHIC CONDITION
1	2314	BAY OF NAPLES	573	O
2	2311	SEBAGO LAKE	566	O
3	3303	LAKE WINNIPESAUKEE	562	O
4	5571	CRYSTAL LAKE	549	O
5	2695	HIGGINS LAKE	547	O
6	2309	MOOSEHEAD LAKE	547	O
7	2310	RANGELEY LAKE	546	O
8	3634	SCHROON LAKE	541	O
9	2682	BOARDMAN HYDRO POND	524	M
10	2306	LONG LAKE	517	M
11	5572	TROUT LAKE	507	M
12	2617	LAKE CHARLEVOIX	502	O
13	3604	CANANDAIGUA LAKE	497	O-M
14	3619	LONG LAKE	496	M
15	3617	KEUKA LAKE	493	M
16	2704 *	BADGER LAKE	487	M-E
17	3629	RAQUETTE POND	486	M
18	3635	SENECA LAKE	482	M
19	3606	CARRY FALLS RESERVOIR	471	M
20	2780	WHITE BEAR LAKE	464	M
21	2313	LONG LAKE	463	M
22	5011	WATERBURY RESERVOIR	460	M
23	2694	CRYSTAL LAKE	459	M
24	2771	RABBIT LAKE	457	M
25	5002 **	CLYDE POND	455	E
26	5561	LAKE GENEVA	453	M
27	5005	HARRIMAN RESERVOIR	452	M
28	5564	ROCK LAKE	451	M

TABLE 4
(Page 2)

RANK	LAKE CODE	LAKE NAME	INDEX NO	TROPHIC CONDITION
29	2782	GREEN LAKE	451	M
30	2308	MATTAWAMKEAG LAKE	449	M
31	3632	SACANDAGA RESERVOIR	444	M
32	2696	HOUGHTON LAKE	443	M
33	2789	LAKE CARLOS	441	M
34	5008	LAKE MEMPHREMAGOG	438	E
35	5007**	LAMOILLE LAKE	433	E
36	3627	OWASCO LAKE	431	M-E
37	2782	SWAN LAKE	431	M
38	3608*	LAKE CAYUGA	426	M
39	5560*	BROWNS LAKE	425	E
40	5010**	LAKE ARROWHEAD	425	E
41	2730	FALL LAKE	425	M
42	2746	LEECH LAKE	422	M
43	5563*	LAC LA BELLE	419	E
44	2610**	BETSIE LAKE	419	E
45	5539*	SHAWANO LAKE	418	E
46	3639*	CONESUS LAKE	418	E
47	2710	BIRCH LAKE	416	E
48	5536*	PINE LAKE	412	E
49	5532*	OCONOMOWOC LAKE	403	E
50	5519	GREEN LAKE	403	M
51	3636	SWAN LAKE	403	E
52	5569*	MIDDLE LAKE	397	M-E
53	3306**	KELLY FALLS POND	393	E
54	3610	CHAUTAUQUA LAKE	391	E
55	3615	HUNTINGTON LAKE	390	E
56	2672**	ROGERS POND	387	E

TABLE 4
(Page 3)

RANK	LAKE CODE	LAKE NAME	INDEX NO	TROPHIC CONDITION
57	5001	CHAMPLAIN LAKE	385	M
58	3302**	POWDER MILL POND	383	E
59	2784	DARLING LAKE	380	E
60	3633	SARATOGA LAKE	373	E
61	5558*	OKAUCHEE LAKE	372	E
62	2761	MINNEWASKA LAKE	372	E
63	2674**	SANFORD LAKE	371	E
64	5566	ROUND LAKE	370	E
65	3602	BLACK LAKE	368	E
66	2793	TROUT LAKE	367	E
67	2649**	MANISTEE LAKE	365	E
68	2715	CASS LAKE	364	M
69	2749*	FOREST LAKE	360	E
70	2737	GULL LAKE	358	E
71	2785	LE HOMME DIEU	357	E
72	3640	LOWER ST REGIS	354	E
73	2745	LAKE OF THE WOODS	353	E
74	3625	OTTER LAKE	352	E
75	3613	GOODYEAR LAKE	351	E
76	2751	MENOMIN LAKE	346	E
77	5574	WILLOW RESERVOIR	345	E
78	2701	LAKE BEMIDJI	344	E
79	2711	BLACKDUCK LAKE	342	E
80	4402**	SLATERSVILLE RESERVOIR	340	E
81	2698	PERE MARQUETTE LAKE	336	E
82	2688	WHITE LAKE	334	E
83	2618	LAKE CHEMUNG	334	E
84	0902	HANTAN LAKE	332	E

TABLE 4
(Page 4)

RANK	LAKE CODE	LAKE NAME	INDEX NO	TROPHIC CONDITION
85	3641	ALLEGHENY RESERVOIR	330	E
86	2765	PELICAN LAKE	330	E
87	2673	ROSS RESERVOIR	330	E
88	3607	CASSADAGA LAKE	328	E
89	2700	ANDRUSIA LAKE	328	E
90	5557	PEWAUKEE LAKE	327	E
91	3305	GLENN LAKE	327	E
92	0912	SHELTON LAKE	325	E
93	5556	LAKE WISSOTA	324	E
94	5575	ELK LAKE	303	E
95	2509	ROCHDALE POND	303	E
96	2716	CLEARWATER LAKE	300	E
97	2780	SHAGAWA LAKE	297	E
98	2783	NEST LAKE	293	E
99	2312	SEBASTICOOK LAKE	293	E
100	5573	LONG LAKE	292	E
101	5550	WAPOGASSET LAKE	291	E
102	5576	YELLOW LAKE	286	E
103	2712	BLACKHOOF LAKE	279	E
104	2685	UNION LAKE	279	E
105	2621	CONSTANTINE RESERVOIR	273	E
106	2640	HOLLOWAY RESERVOIR	271	E
107	0904	EAGLEVILLE LAKE	271	E
108	5551	LAKE WAUSAU	266	E
109	3630	ROUND LAKE	266	E
110	2697	THOMPSON LAKE	266	E
111	5562	LAKE COMO	265	E
112	2787	ST CROIX LAKE	264	E

TABLE 4
(Page 5)

RANK	LAKE CODE	LAKE NAME	INDEX NO	TROPHIC CONDITION
113	5578	ST CROIX LAKE	262	E
114	2720	CRANBERRY LAKE	262	E
115	2665	PENTWATER LAKE	259	E
116	27A2	WOLF LAKE	258	E
117	0911	LILLINOAH LAKE	258	E
118	2749	WHITEWATER LAKE	257	E
119	5509	BUTTERNUT LAKE	256	E
120	5508	BUTTE DES MORTS	254	E
121	2683	THORNAPPLE LAKE	254	E
122	5535	PIGEON LAKE	247	E
123	0910	ZOAR LAKE	246	E
124	27A1	WINONA LAKE	245	E
125	2725	ELHOW LAKE	244	E
126	2699	STRAWBERRY LAKE	243	E
127	2760	LAKE MINNETONKA	241	E
128	2643	KENT LAKE	237	E
129	2659	MUSKEGON LAKE	231	E
130	2692	LONG LAKE	230	E
131	5538	POYGAN LAKE	229	E
132	2786	SUPERIOR BAY	229	E
133	2513	HUDSON IMPOUNDMENT	225	E
134	2756	MASHKENODE LAKE	223	E
135	5548	TOWN LINE LAKE	218	E
136	5546	TAINTER LAKE	216	E
137	2786	CALHOUN LAKE	216	E
138	5520	KEGONSA LAKE	214	E
139	3637	SWINGING BRIDGE RESERVOI	214	E
140	2709	BIG STONE LAKE	213	E

TABLE 4
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RANK	LAKE CODE	LAKE NAME	INDEX NO	TROPHIC CONDITION
141	2777	SAKATAH LAKE	211	E
142	5581	SUPERIOR BAY	209	E
143	2693	ST LOUIS RESERVOIR	209	E
144	2705	BARTLETT LAKE	208	E
145	5502	ALTOONA LAKE	207	E
146	5531	LAKE NAGAWICKA	205	E
147	2792	TRACE LAKE	205	E
148	2511	BILLERICA IMPOUNDMENT	204	E
149	2503	HARRIS POND	203	E
150	2404	ESTES LAKE	201	E
151	2671	RANDALL LAKE	199	E
152	2731	FANNY LAKE	196	E
153	5510	CASTLE ROCK FLOWAGE	193	E
154	26A1	CARO RESERVOIR	193	E
155	5545	SWAN LAKE	191	E
156	2748	LITTLE LAKE	191	E
157	5503	BEAVER DAM LAKE	189	E
158	5534	PETENWELL FLOWAGE	186	E
159	0901	ASPINOOK LAKE	186	E
160	27C3	COTTONWOOD LAKE	182	E
161	2609	BELLEVILLE LAKE	181	E
162	2796	TUTTLE LAKE	180	E
163	2613	BRIGHTON LAKE	180	E
164	0905	HANOVER POND	178	E
165	5522	KOSHKONONG LAKE	176	E
166	2752	MALMEDAL LAKE	176	E
167	5555	WISCONSIN LAKE	174	E
168	2719	COKATO LAKE	171	E

TABLE 4
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RANK	LAKE CODE	LAKE NAME	INDEX NO	TROPHIC CONDITION
169	5554	LAKE WINNEBAGO	170	E
170	2776	ST LOUIS BAY	168	E
171	3611	CROSS LAKE	167	E
172	5513	LAKE DELAVAN	165	E
173	2753	MUD LAKE AT MAPLE LAKE	162	E
174	2507	WOODS POND	162	E
175	2750	MADISON LAKE	161	E
176	2504	MAYNARD IMPOUNDMENT	160	E
177	2706	BEAR LAKE	159	E
178	5565	BIG EAU PLEINE RESERVOIR	158	E
179	2629	FORD LAKE	155	E
180	2606	BARTON LAKE	150	E
181	2744	LAKE PEPIN	146	E
182	5582	LAKE PEPIN	144	E
183	5515	EAU CLAIRE LAKE	141	E
184	2746	SPRING LAKE	139	E
185	2603	ALLEGAN LAKE	138	E
186	2508	MATTFIELD IMPOUNDMENT	137	E
187	2788	LOST LAKE	134	E
188	2640	JORDAN LAKE	133	E
189	5570	GRAND LAKE	132	E
190	2748	BUDD LAKE	130	E
191	3616	IRONDEQUOIT BAY	128	E
192	2745	ZUMBRO LAKE	126	E
193	5580	ST LOUIS BAY	125	E
194	2648	LAKE MACATAWA	123	E
195	2781	WAGONGA LAKE	122	E
196	2713	BUFFALO LAKE	118	HE

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(Page 8)

RANK	LAKE CODE	LAKE NAME	INDEX NO	TROPHIC CONDITION
197	2691	MONA LAKE	118	HE
198	2782	SILVER LAKE	114	HE
199	0903	COMMUNITY LAKE	112	HE
200	2702	ALBERT LEA LAKE	102	HE
201	2702	MUD LAKE	100	HE
202	2714	CARRIGAN LAKE	99	HE
203	2502	HAGER POND	94	HE
204	2785	ST CLAIR LAKE	93	HE
205	4403	TURNER RESERVOIR	92	HE
206	2631	FREMONT LAKE	92	HE
207	5559	TICHIGAN LAKE	80	HE
208	27A3	WOODCOCK LAKE	60	HE
209	2787	WALLMARK LAKE	41	HE

O - Oligotrophic
M - Mesotrophic
E - Eutrophic
HE - Hypereutrophic

* - Weeds
** - Short Hydraulic Retention Time

Lakes with a trophic index of 420-499 are those which would ordinarily be classed mesotrophic and below 420 the lakes become progressively more eutrophic. The 300-419 range of the index represents lakes which are eutrophic and have occasional nuisance algal problems but still may support excellent fisheries. Below 300, nuisance conditions may be expected more frequently; however, even some of these lakes may be expected to support good fish populations.

The reader should understand that the index number ranges mentioned above, which correspond to the various trophic states, are only valid when used with the data base of 209 lakes and reservoirs considered in this report. If a different data base were used, for example, one containing a higher percentage of high quality lakes, the resulting index number might be interpreted quite differently, e.g. oligotrophic rather than eutrophic.

As discussed earlier, all lakes and reservoirs sampled in 1972 were included in this index regardless of morphometry or detention time. Therefore, lakes with relatively low trophic index numbers may have the apparent potential for developing nuisance conditions but may not do so because of extremely short flow-through times.

It is of interest to evaluate the proposed index in terms of lakes and reservoirs with known nuisance levels of algae. Such an evaluation was made with water bodies listed in "Problem Lakes of the United States"

which was compiled by Ketelle and Uttormark (1971) of the University of Wisconsin Water Resources Center. In Table 5, lakes which were cited in the aforementioned publication and were also included in the Survey are listed by State and the Trophic Index Number for each lake is also given.

The data in Table 5 substantiate that for overall lake quality, the trophic index does differentiate the high quality lakes from those which have the potential of developing nuisance conditions. If a specific lake were beginning to exhibit signs of eutrophication along shoreline areas or in bays, the index would not show the localized degradation unless the lake was specifically sampled in the worst areas. This characteristic would, however, be a weakness in any simple trophic index system.

While the major Survey effort in ranking of lakes has been with the percentile method outlined above, the more sophisticated methods of statistical analysis have also been examined. Thus far, Survey data have been subjected to the multivariate analysis recently recommended by Harkins (1974), and Don A. Pierce, Associate Professor of Statistics at Oregon State University, has employed a discriminate function analysis. Also, Dale H. P. Boland, a doctoral candidate at Oregon State University, who is investigating the feasibility of estimating the trophic status of inland lakes through the use of the Earth Resources Technology Satellite (ERTS-1) multispectral scanner and is using the ground-truth data of 100 of the 1972 Survey lakes (see Working Paper

TABLE 5

Trophic Index Numbers for Lake and Reservoirs Cited in "Problem Lakes of the United States" and Included in the National Eutrophication Survey

State	Lake Name	Trophic Index Number
Connecticut	Bantam	332
	Lillinoah	258
	Zoar	246
Maine	Estes	201
	Sebasticook	293
Massachusetts	Hager Pond	94
Michigan	Barton	150
	Brighton	180
	Betsie	419
	Chemung	334
	Ford	155
	Fremont	92
	Jordan	133
	Kent	237
	Macatawa	123
	Manistee	365
	Mona	118
	Muskegon	231
	Randall	199
	White	334
Minnesota	Big Stone	213
	Budd	130
	Madison	161
	Minnetonka	241
	Shagawa	297
	Sakatah	211
New York	Cayuga	426*
	Conesus	418
	Saratoga	373
	Schroon	541*
	Seneca	482*
Wisconsin	Butternut	256
	Butte Des Morts	254
	Delavan	165
	Koshkonong	176
	Kegonsa	214
	Nagawicka	205
	Pewaukee	327
	Poygon	229
	Shawano	418**
	Tichigan	80
	Winnebago	170
Vermont	Champlain	385
	Memphremagog	439†

* Generally high quality lakes showing positive signs of deterioration.
** A naturally eutrophic lake with an aquatic macrophyte problem.
† An oligotrophic lake which has deteriorated in the south end due to phosphorus inputs from U.S. point sources.

No. 10), has subjected the data to principal component analysis and cluster analysis. None of the complex analyses noted above provide a better ranking of the lakes than the percentile method (some are not as good), and all have the same failing as the percentile method with respect to retention times and macrophytes.

TROPHIC INDEX USE

Using the data base of 209 lakes as presented or a larger base as the data are produced by the Survey, it would be relatively easy to determine the relative trophic condition of an unknown lake (Lake X) by determining its trophic index number. Changes in the trophic condition of Lake X could also be followed in the same manner by determining its trophic index number each year and charting the improvements, deterioration, or status quo, whichever the case might be.

The data required to compute the trophic index would have to be for the same parameters used in the index system presented above; i.e., (1) total phosphorus, (2) dissolved phosphorus, (3) inorganic nitrogen, (4) Secchi depth, (5) minimum dissolved oxygen (in the hypolimnion if stratification occurs), and (6) chlorophyll a. Each of the values used should be means or medians for the entire lake or at least values which are believed to be representative of the entire water body or that portion which the investigator is interested in classifying.

After the data for the appropriate parameters had been gathered, the percentile table (Table 6) would be used to determine for each parameter the percent of lakes exceeding the value for the lake of interest. The

TABLE 6

Parameter Value Percentiles for Establishing Trophic Index Numbers for Unclassified Lakes; Based on 209 Lakes Sampled by the National Eutrophication Survey in 1972

MEDIAN TOTAL P (mg/l)	PERCENT HIGHER	MEDIAN INORG N (mg/l)	PERCENT HIGHER	500-MEAN SECCHI (inches)	PERCENT HIGHER	MEAN CHLOR-OPHYLL a (µg/l)	PERCENT HIGHER	15-MINIMUM DO (mg/l)	PERCENT HIGHER	MEDIAN DIS-SOLVED P (mg/l)	PERCENT HIGHER
0.004	99	0.060	99	184.000	99	1.043	99	4.800	99	0.003	99
0.004	99	0.060	99	268.500	99	1.267	99	5.300	99	0.003	99
0.005	98	0.070	97	272.555	98	1.462	98	6.200	98	0.003	98
0.005	98	0.070	97	283.667	98	1.487	98	6.300	98	0.003	98
0.006	97	0.070	97	300.933	97	1.500	97	6.400	97	0.004	95
0.006	97	0.070	97	323.250	97	1.767	97	6.600	95	0.004	95
0.006	96	0.080	95	338.000	96	1.767	96	6.600	95	0.004	95
0.007	95	0.080	95	342.875	96	1.850	96	6.600	95	0.004	95
0.007	95	0.080	95	351.048	95	1.989	95	6.600	95	0.004	95
0.007	95	0.090	93	351.250	95	2.067	95	7.000	94	0.005	92
0.008	93	0.090	93	351.714	94	2.075	94	7.000	94	0.005	92
0.008	93	0.090	93	353.000	94	2.083	94	7.000	94	0.005	92
0.008	93	0.090	93	354.000	93	2.233	93	7.200	93	0.005	92
0.008	93	0.090	93	358.667	93	2.283	93	7.200	93	0.005	92
0.009	90	0.100	91	359.333	92	2.433	92	7.400	90	0.005	92
0.009	90	0.100	91	360.778	92	2.683	92	7.400	90	0.005	92
0.009	90	0.100	91	362.000	91	2.986	91	7.400	90	0.005	91
0.009	90	0.100	91	363.500	91	3.008	91	7.400	90	0.006	88
0.009	90	0.110	89	364.111	90	3.067	90	7.400	90	0.006	88
0.009	90	0.110	89	365.333	90	3.067	90	7.440	90	0.006	88
0.010	88	0.110	89	366.333	89	3.189	89	7.500	89	0.006	88
0.010	88	0.120	88	373.875	89	3.236	89	7.500	89	0.006	88
0.010	88	0.120	88	374.000	88	3.467	88	7.600	88	0.006	88
0.010	88	0.120	88	374.500	88	3.533	88	7.600	88	0.006	88
0.011	88	0.125	88	380.000	88	3.540	88	7.600	88	0.006	88
0.011	87	0.130	86	383.833	87	3.783	87	7.700	87	0.007	85
0.011	87	0.130	86	385.333	87	3.810	87	7.700	87	0.007	85
0.012	86	0.130	86	385.364	86	4.333	86	7.800	84	0.007	85

TABLE 6
(Page 2)

MEDIAN TOTAL P (mg/l)	PERCENT HIGHER	MEDIAN INORG N (mg/l)	PERCENT HIGHER	500-MEAN SECCHI (inches)	PERCENT HIGHER	MEAN CHLOROPHYLL a (µg/l)	PERCENT HIGHER	15-MINIMUM DO (mg/l)	PERCENT HIGHER	MEDIAN DISSOLVED P (mg/l)	PERCENT HIGHER
0.013	84	0.135	85	388.250	86	4.567	86	7.800	84	0.007	85
0.013	84	0.135	85	388.364	85	4.633	85	7.800	84	0.007	85
0.013	84	0.135	85	389.000	85	4.667	85	7.800	84	0.007	84
0.013	84	0.140	82	389.555	84	4.733	84	7.800	84	0.007	84
0.014	84	0.140	82	390.167	84	4.811	84	7.800	84	0.008	80
0.014	83	0.140	82	393.333	83	4.850	83	7.880	83	0.008	80
0.015	81	0.140	82	393.600	83	4.867	83	7.900	82	0.008	80
0.015	81	0.140	82	396.125	82	5.000	82	7.900	82	0.008	80
0.015	81	0.140	82	398.667	82	5.000	82	7.900	82	0.008	80
0.015	81	0.140	81	399.333	81	5.017	81	8.000	80	0.008	80
0.015	81	0.145	79	400.833	81	5.133	81	8.000	80	0.008	80
0.016	80	0.145	79	403.833	80	5.178	80	8.000	80	0.008	80
0.016	80	0.145	79	404.333	80	5.240	80	8.020	79	0.009	77
0.017	79	0.145	79	405.833	79	5.583	79	8.020	79	0.009	77
0.017	79	0.145	79	407.889	79	5.650	79	8.100	79	0.009	77
0.018	77	0.150	78	408.463	78	5.767	78	8.200	77	0.009	77
0.018	77	0.150	78	408.667	78	6.067	78	8.200	77	0.009	77
0.018	77	0.150	77	408.778	77	6.180	77	8.200	77	0.009	77
0.019	77	0.150	77	408.889	77	6.187	77	8.200	77	0.009	77
0.019	77	0.150	77	411.167	77	6.200	77	8.200	77	0.009	77
0.020	75	0.155	76	413.000	76	6.242	76	8.300	76	0.009	76
0.020	75	0.155	76	413.454	76	6.317	76	8.400	74	0.010	73
0.020	75	0.160	75	415.167	75	6.400	75	8.400	74	0.010	73
0.020	75	0.160	74	415.333	75	6.400	75	8.400	74	0.010	73
0.021	73	0.160	74	416.000	74	6.700	74	8.400	74	0.010	73
0.021	73	0.170	73	417.778	74	6.911	74	8.420	74	0.010	73
0.021	73	0.170	73	418.400	73	7.011	73	8.600	72	0.010	73
0.022	72	0.170	73	419.500	73	7.033	73	8.600	72	0.010	73

TABLE 6
(Page 3)

MEDIAN TOTAL P (mg/l)	PERCENT HIGHER	MEDIAN INORG N (mg/l)	PERCENT HIGHER	500-MEAN SECCHI (inches)	PERCENT HIGHER	MEAN CHLOROPHYLL a (µg/l)	PERCENT HIGHER	15-MINIMUM DO (mg/l)	PERCENT HIGHER	MEDIAN DISSOLVED P (mg/l)	PERCENT HIGHER
0.022	72	0.175	72	419.667	72	7.044	72	8.600	72	0.011	70
0.022	72	0.175	72	419.800	72	7.050	72	8.660	72	0.011	70
0.024	71	0.175	71	420.500	71	7.133	71	8.700	71	0.011	70
0.024	71	0.175	71	420.667	71	7.186	71	8.760	71	0.011	70
0.025	70	0.180	70	420.833	70	7.233	70	8.800	70	0.011	70
0.025	69	0.180	70	421.444	70	7.450	70	8.900	69	0.011	70
0.025	69	0.185	69	422.000	69	7.500	69	8.900	69	0.012	68
0.026	68	0.190	67	422.667	69	7.500	69	8.900	69	0.012	68
0.026	68	0.190	67	423.500	68	7.622	68	9.000	65	0.012	68
0.026	68	0.190	67	424.000	68	7.933	68	9.000	65	0.013	66
0.026	67	0.190	67	424.500	67	8.100	67	9.000	65	0.013	66
0.026	67	0.195	67	424.800	67	8.133	67	9.000	65	0.013	66
0.027	66	0.200	66	425.000	66	8.133	66	9.000	65	0.013	66
0.027	66	0.200	66	425.667	66	8.183	66	9.000	65	0.013	66
0.028	64	0.200	66	425.889	66	8.350	66	9.000	65	0.014	63
0.028	64	0.200	65	426.000	65	8.483	65	9.000	65	0.014	63
0.028	64	0.205	65	426.333	65	8.533	65	9.020	65	0.014	63
0.028	64	0.210	63	426.833	64	8.689	64	9.200	62	0.014	63
0.028	63	0.210	63	427.667	63	9.167	64	9.200	62	0.014	63
0.028	63	0.210	63	427.667	63	9.211	63	9.200	62	0.014	63
0.029	63	0.210	63	428.400	63	9.217	63	9.200	62	0.015	61
0.030	62	0.220	62	429.000	62	9.467	62	9.200	62	0.015	61
0.031	62	0.220	62	430.333	62	9.483	62	9.200	62	0.015	61
0.032	60	0.230	61	430.667	61	9.511	61	9.240	61	0.015	61
0.032	60	0.230	61	430.750	61	9.633	61	9.240	61	0.016	60
0.032	60	0.230	60	430.800	60	9.700	60	9.400	60	0.016	60
0.033	60	0.230	60	432.167	60	9.783	60	9.500	60	0.016	60
0.034	59	0.240	59	432.333	59	9.800	59	9.520	59	0.017	58

TABLE 6
(Page 4)

MEDIAN TOTAL P (mg/l)	PERCENT HIGHER	MEDIAN INORG N (mg/l)	PERCENT HIGHER	500-MEAN SECCHI (inches)	PERCENT HIGHER	MEAN CHLOR-OPHYLL a (µg/l)	PERCENT HIGHER	15-MINIMUM DO (mg/l)	PERCENT HIGHER	MEDIAN DIS-SOLVED P (mg/l)	PERCENT HIGHER
0.034	59	0.240	59	432.333	59	9.867	59	9.600	58	0.017	58
0.035	58	0.240	57	432.667	58	10.067	58	9.600	58	0.017	58
0.035	58	0.240	57	432.750	58	10.244	57	9.600	58	0.018	57
0.036	57	0.240	57	432.889	57	10.244	57	9.760	57	0.018	57
0.038	57	0.240	57	434.500	57	10.250	57	9.800	57	0.018	57
0.039	56	0.250	56	434.667	56	10.383	56	10.000	55	0.018	56
0.039	56	0.255	56	435.500	55	10.517	56	10.000	55	0.019	56
0.040	55	0.260	55	435.500	55	10.667	55	10.000	55	0.019	55
0.041	55	0.260	55	436.444	55	10.678	55	10.100	55	0.019	55
0.042	55	0.260	55	437.000	54	10.800	55	10.320	55	0.020	54
0.043	53	0.270	53	437.000	54	11.061	54	10.360	54	0.020	54
0.043	53	0.270	53	437.667	54	11.117	54	10.400	52	0.020	53
0.043	53	0.270	53	437.833	53	11.133	53	10.400	52	0.020	53
0.043	53	0.270	53	438.000	52	11.133	53	10.400	52	0.020	53
0.043	51	0.270	52	438.000	52	11.317	52	10.400	52	0.021	52
0.043	51	0.280	51	438.300	52	11.400	52	10.400	52	0.022	51
0.043	51	0.280	51	439.375	51	11.433	51	10.460	51	0.022	51
0.043	51	0.287	51	441.000	51	11.500	51	10.500	51	0.022	50
0.044	50	0.290	50	441.333	50	11.833	49	10.600	50	0.022	50
0.044	50	0.290	50	441.500	50	11.833	49	10.600	50	0.023	49
0.045	49	0.300	49	441.667	49	11.833	49	10.700	49	0.023	49
0.047	48	0.300	48	442.833	49	11.878	49	10.800	47	0.023	49
0.047	48	0.300	48	445.444	48	11.967	48	10.800	47	0.024	48
0.048	48	0.305	48	445.833	48	11.967	48	10.800	47	0.024	48
0.048	47	0.305	47	446.000	47	12.033	47	10.800	47	0.025	47
0.049	47	0.305	47	446.500	47	12.233	47	10.800	47	0.025	47
0.049	46	0.310	46	446.667	46	12.444	46	10.880	46	0.026	46
0.050	45	0.310	46	446.667	46	12.467	46	10.960	46	0.026	46

TABLE 6
(Page 5)

MEDIAN TOTAL P (mg/l)	PERCENT HIGHER	MEDIAN INORG N (mg/l)	PERCENT HIGHER	500-MEAN SECCHI (inches)	PERCENT HIGHER	MEAN CHLOR-OPHYLL a (µg/l)	PERCENT HIGHER	15-MINIMUM DO (mg/l)	PERCENT HIGHER	MEDIAN DIS-SOLVED P (mg/l)	PERCENT HIGHER
0.050	45	0.320	45	447.000	45	12.467	45	11.000	44	0.026	45
0.050	45	0.320	45	447.600	45	12.600	45	11.000	44	0.026	45
0.052	44	0.330	44	448.667	44	12.750	44	11.000	44	0.027	44
0.054	44	0.335	44	448.667	44	12.950	44	11.300	44	0.027	44
0.055	44	0.335	44	448.667	44	12.967	44	11.300	44	0.028	43
0.057	43	0.340	43	450.444	43	13.050	43	11.380	43	0.028	43
0.057	43	0.340	43	450.667	43	13.267	43	11.400	42	0.028	42
0.057	42	0.350	42	451.333	42	13.333	42	11.400	42	0.028	42
0.058	42	0.355	41	451.667	42	13.383	42	11.420	42	0.029	41
0.059	41	0.355	41	452.857	41	13.483	41	11.520	41	0.029	41
0.059	41	0.355	41	453.000	41	13.667	41	11.600	40	0.029	41
0.060	40	0.360	40	453.667	40	13.683	40	11.600	40	0.030	40
0.061	40	0.360	40	454.000	40	13.789	40	11.900	40	0.030	40
0.062	39	0.380	38	455.000	39	13.791	39	12.000	39	0.031	39
0.063	39	0.380	38	455.000	39	13.844	39	12.000	39	0.031	39
0.064	39	0.380	38	455.500	38	14.000	38	12.200	38	0.032	38
0.065	37	0.385	38	456.000	36	14.089	38	12.200	38	0.032	38
0.065	37	0.395	37	456.000	36	14.150	37	12.300	37	0.033	37
0.068	37	0.395	37	456.000	36	14.380	37	12.600	36	0.033	37
0.070	36	0.395	36	456.000	36	14.550	36	12.600	36	0.036	36
0.071	36	0.410	35	456.167	35	14.650	36	12.800	35	0.036	36
0.073	35	0.410	35	456.167	35	14.733	35	12.800	35	0.036	35
0.074	35	0.410	34	456.167	35	14.878	34	12.800	35	0.036	35
0.075	34	0.410	34	456.333	34	14.878	34	12.900	34	0.037	34
0.076	33	0.410	34	456.333	34	15.483	34	13.000	32	0.038	34
0.076	33	0.420	33	456.833	33	15.667	33	13.000	32	0.039	33
0.076	33	0.440	32	457.333	33	15.800	33	13.000	32	0.040	33
0.078	33	0.440	32	457.333	33	16.083	33	13.000	32	0.040	33

TABLE 6
(Page 6)

MEDIAN TOTAL P (mg/l)	PERCENT HIGHER	MEDIAN INORG N (mg/l)	PERCENT HIGHER	500-MEAN SECCHI (inches)	PERCENT HIGHER	MEAN CHLOR-OPHYLL a (µg/l)	PERCENT HIGHER	15-MINIMUM DO (mg/l)	PERCENT HIGHER	MEDIAN DIS-SOLVED P (mg/l)	PERCENT HIGHER
0.079	32	0.440	32	458.000	32	16.475	32	13.000	32	0.042	32
0.087	32	0.460	32	458.000	32	16.579	32	13.040	32	0.042	31
0.089	31	0.475	31	458.667	31	16.600	31	13.200	31	0.042	31
0.092	31	0.480	29	458.750	31	17.167	31	13.220	31	0.044	31
0.092	30	0.480	29	458.889	30	17.600	30	13.300	30	0.048	30
0.094	30	0.480	29	459.333	29	18.267	30	13.400	29	0.048	29
0.094	29	0.480	29	459.333	29	18.667	29	13.400	29	0.048	29
0.107	29	0.480	28	459.555	29	18.867	29	13.600	27	0.049	29
0.108	28	0.480	28	460.000	28	19.259	28	13.600	27	0.051	28
0.111	27	0.485	28	460.667	28	19.400	28	13.600	27	0.053	28
0.111	27	0.490	27	461.333	27	19.467	27	13.600	27	0.055	27
0.115	27	0.500	26	461.667	27	20.311	27	14.000	26	0.057	27
0.116	26	0.500	26	462.667	26	20.517	26	14.000	26	0.059	26
0.122	26	0.510	26	463.333	26	21.433	26	14.020	26	0.060	26
0.124	25	0.510	25	464.000	25	21.783	25	14.100	25	0.061	25
0.125	25	0.520	25	465.167	25	21.800	25	14.160	25	0.063	25
0.133	24	0.530	24	465.250	24	22.917	24	14.200	24	0.068	24
0.135	24	0.535	24	465.333	23	25.300	24	14.200	24	0.074	24
0.136	23	0.550	23	465.333	23	25.383	23	14.400	22	0.078	23
0.141	22	0.560	23	466.167	23	25.456	23	14.400	22	0.081	23
0.141	22	0.570	22	466.625	22	25.600	22	14.400	22	0.111	22
0.159	22	0.570	22	467.000	22	27.217	22	14.400	22	0.117	22
0.159	22	0.580	22	468.000	20	27.783	22	14.400	22	0.126	22
0.171	21	0.580	21	468.000	20	27.800	21	14.440	21	0.126	21
0.176	21	0.590	21	468.000	20	28.262	21	14.500	21	0.128	21
0.181	20	0.605	20	468.000	20	28.322	20	14.600	15	0.134	20
0.185	19	0.640	20	468.222	20	28.333	20	14.600	15	0.138	20
0.185	19	0.645	19	468.800	19	28.500	19	14.600	15	0.140	19

TABLE 6
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MEDIAN TOTAL P (mg/l)	PERCENT HIGHER	MEDIAN INORG N (mg/l)	PERCENT HIGHER	500-MEAN SECCHI (inches)	PERCENT HIGHER	MEAN CHLOROPHYLL a (µg/l)	PERCENT HIGHER	15-MINIMUM DO (mg/l)	PERCENT HIGHER	MEDIAN DISSOLVED P (mg/l)	PERCENT HIGHER
0.190	19	0.660	18	469.000	19	28.667	19	14.600	15	0.140	19
0.192	18	0.660	18	469.200	18	30.167	18	14.600	15	0.141	18
0.209	18	0.670	18	469.889	18	30.800	18	14.600	15	0.145	18
0.210	17	0.680	17	470.000	17	30.878	17	14.600	15	0.150	17
0.216	17	0.700	17	470.200	17	31.180	17	14.600	15	0.153	17
0.231	16	0.710	16	470.222	16	31.367	16	14.600	15	0.156	16
0.237	16	0.740	16	471.333	16	33.944	16	14.600	15	0.160	16
0.240	15	0.780	15	472.000	15	35.467	15	14.600	15	0.161	15
0.240	15	0.795	15	472.111	15	35.820	15	14.700	13	0.168	15
0.269	14	0.815	14	473.000	14	36.100	14	14.700	13	0.171	14
0.274	14	0.815	14	474.000	13	36.400	14	14.700	13	0.189	14
0.286	13	0.820	13	474.000	13	38.083	13	14.700	13	0.207	13
0.295	13	0.840	13	476.750	13	39.317	13	14.700	13	0.215	13
0.298	12	0.850	12	477.167	12	41.000	12	14.740	12	0.216	12
0.300	12	0.890	12	477.333	12	43.933	12	14.740	12	0.218	12
0.330	11	0.920	11	477.600	11	44.233	11	14.760	11	0.220	11
0.346	11	0.940	11	477.600	11	44.683	11	14.800	5	0.221	11
0.361	11	0.985	11	477.609	11	45.148	11	14.800	5	0.235	11
0.363	10	1.020	10	477.667	10	48.300	10	14.800	5	0.236	10
0.369	10	1.075	10	479.167	10	49.455	10	14.800	5	0.251	10
0.378	9	1.080	9	479.667	9	49.467	9	14.800	5	0.282	9
0.385	9	1.080	9	480.000	8	50.567	9	14.800	5	0.310	9
0.401	8	1.090	8	480.000	8	51.367	8	14.800	5	0.319	8
0.408	8	1.090	8	480.400	8	58.550	8	14.800	5	0.321	6
0.417	7	1.110	7	481.250	7	58.767	7	14.800	5	0.330	7
0.476	7	1.160	7	482.428	7	61.233	7	14.800	5	0.344	7
0.476	6	1.280	6	482.667	6	65.320	6	14.800	5	0.353	6
0.489	6	1.310	6	483.333	6	69.037	6	14.800	5	0.356	6

TABLE 6
(Page 8)

MEDIAN TOTAL P (mg/l)	PERCENT HIGHER	MEDIAN INORG N (mg/l)	PERCENT HIGHER	500-MEAN SECCHI (inches)	PERCENT HIGHER	MEAN CHLOR-OPHYLL a (µg/l)	PERCENT HIGHER	15-MINIMUM DO (mg/l)	PERCENT HIGHER	MEDIAN DIS-SOLVED P (mg/l)	PERCENT HIGHER
0.535	5	1.310	5	485.333	5	69.467	5	14.800	5	0.360	5
0.600	5	1.410	4	485.333	5	75.433	5	14.800	5	0.383	5
0.620	4	1.410	4	485.500	4	84.333	4	14.850	4	0.416	4
0.919	4	1.430	4	486.333	4	86.400	4	14.900	2	0.482	4
0.930	3	1.460	3	486.500	3	87.350	3	14.900	2	0.635	3
0.958	3	1.535	3	487.667	3	94.467	3	14.900	2	0.670	3
1.000	2	1.575	2	488.444	2	126.100	2	14.900	2	0.685	2
1.000	2	1.600	2	489.000	1	132.267	2	14.900	2	0.710	2
1.215	1	1.960	1	489.000	1	135.525	1	14.940	1	0.765	1
1.380	1	2.150	1	490.000	1	143.533	1	14.940	1	0.785	1
1.525	0	2.515	0	491.000	0	198.467	0	14.960	0	1.260	0
2.000	0	2.640	0	491.500	0	248.933	0	14.960	0	1.350	0
3.660	0	7.355	0	492.667	0	381.200	0	14.980	0	3.580	0

sum of the percentiles for the six parameters would be the Trophic Index Number for the lake of interest.

An example for establishing the Trophic Index Number for Lake X is shown below:

Parameter	Value for Lake X	Percentile (From Table 6)
Total P (mg/l)	0.022	72
Dissolved P (mg/l)	0.010	73
Inorganic N (mg/l)	0.330	44
15-Minimum D.O. (mg/l)	14.8	5
500-Secchi disc (inches)	420	72
Chlorophyll a (μg/l)	6.5	75
Total		341 = Trophic Index Number

From Table 4, it would be concluded that the Trophic Index Number of Lake X (341) would place it well into the eutrophic category with a definite potential for developing nuisance bloom conditions.

It should be noted that Table 6 does not provide percentiles for every parameter level or concentration within the range of lakes included in the data base. This presents no problem because the data base is large enough that selecting the percentile from the next highest or lowest listed concentration does not significantly influence the Trophic Index Number.

There are pristine lakes whose parameter values will be less than the lowest shown in Table 6. In those cases, the proposed Trophic Index would not be sensitive enough to show significant changes anyway and it is suggested that an index number of 600 be arbitrarily assigned. This would indicate extremely high quality, in general, but would not negate the possibility of localized problems in some portion of the lake.

There may also be cases where parameter values will be greater than the maximum values listed in Table 6 for total phosphorus, dissolved phosphorus, inorganic nitrogen, and chlorophyll a. If that occurs for a specific paramter, a percentile of 0 could be used. Lack of sensitivity of the proposed Trophic Index at the lower end of the scale presents no serious problem either since large reductions in nutrient levels would be needed to show a marked improvement in trophic condition.

The application of Survey data to the loading concepts proposed by Vollenweider (in press) was discussed in NES Working Paper No. 23, and phosphorus loading data and the trophic states of 42 phosphorus-limited Survey lakes were plotted on Vollenweider's graph of "permissible" and "dangerous" loading rates. It was concluded that generally there was agreement between the Vollenweider model and the Survey data.

In Figure 1, the same loading data and trophic states are plotted on Vollenweider's graph; and the numerical Trophic Index Numbers from Table 4 as determined by the non-weighted six-parameter percentile method, have been added for comparison. In this case, there appears to be agreement between the trophic ranks and the Vollenweider model, with certain exceptions. At least some of the exceptions are believed to be due to the fact that the existing trophic condition is the result of previous loading rates and not necessarily the existing loading rates. For example, the lake with the trophic rank of 357 plotted at the extreme left and between the "permissible" and "dangerous" lines is one to which

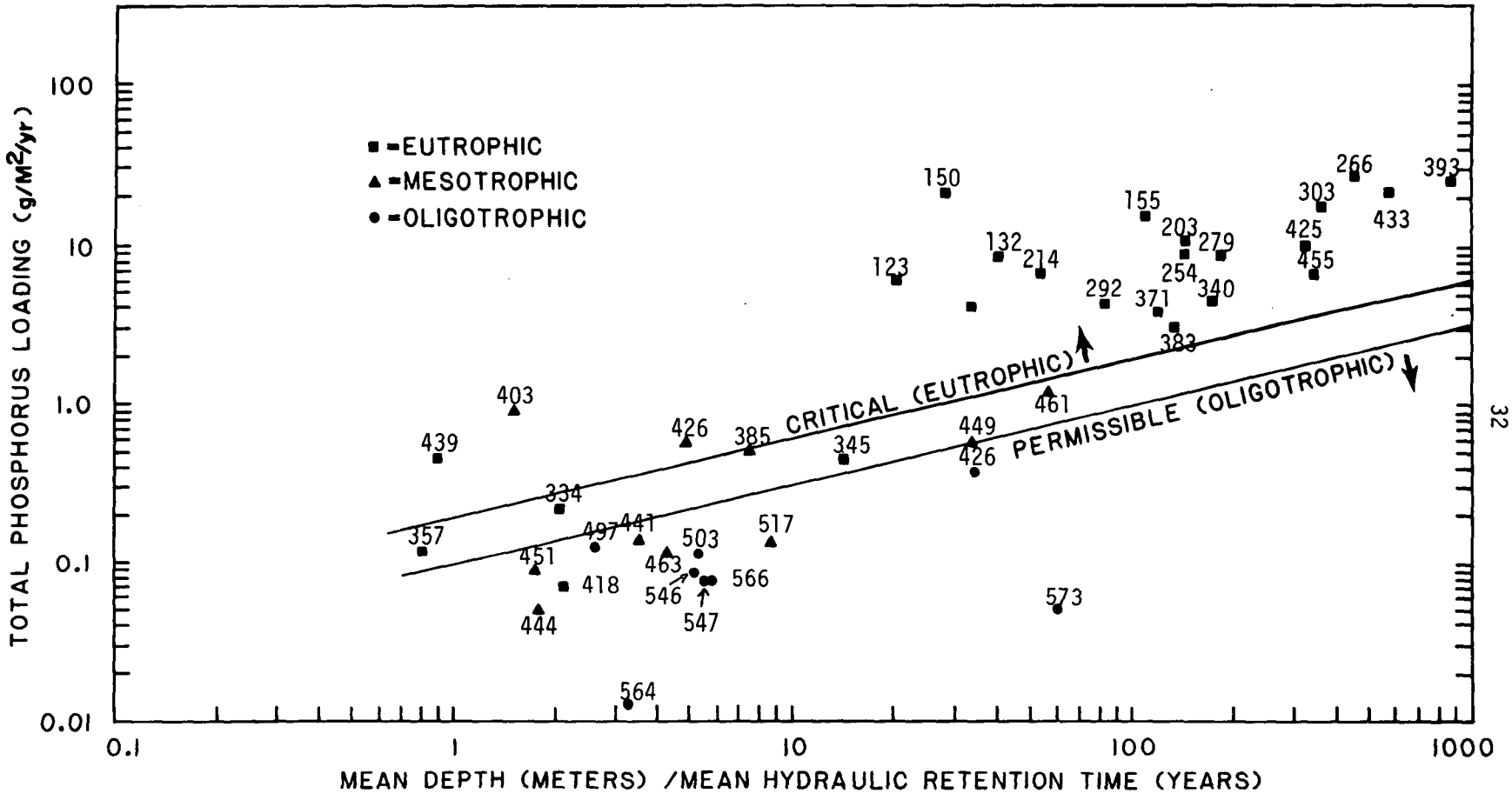

FIGURE 1 THE RELATIONSHIP OF TOTAL PHOSPHORUS LOADING AND LAKE MORPHOMETRY TO TROPHIC CONDITION OF PHOSPHORUS LIMITED LAKES

the loading rate recently has been reduced; however, this lake has a mean hydraulic retention time of eight years, and it will be some time before the trophic condition responds to the reduced loading rate (the model predicts an eventual mesotrophic condition).

SUMMARY AND CONCLUSIONS

A tentative Trophic State Index was developed in this report using data collected by the National Eutrophication Survey from lakes and reservoirs in the northeast and north-central United States.

In general, the following can be concluded:

1. A Trophic State Index ranging from 0 to 594 and incorporating the parameters of total phosphorus, dissolved phosphorus, inorganic nitrogen, Secchi disc, minimum dissolved oxygen and chlorophyll a was developed which arrayed the 209 lakes and reservoirs in a logical sequence according to their trophic conditions.

2. Using the index cited above, lakes and reservoirs with a Trophic Index Number of 500-594 were oligotrophic while those with an index number of 420-499 were mesotrophic. Below an index number of 420, the lakes became progressively more eutrophic with the lower index numbers corresponding to a higher potential for developing nuisance algal conditions.

3. The Trophic Index Numbers cited in conclusions 1 and 2 are only meaningful when used in conjunction with the data set of 209 lakes and reservoirs presented in this report.

4. Of the 44 lakes and reservoirs included in the National Eutrophication Survey and also cited in "Problem Lakes of the United States" (1971), 40 had a Trophic Index Number (TIN) of less than 420 and 30 had a TIN of less than 299.

5. Lakes or reservoirs in which the trophic problem is primarily aquatic macrophytes, generally do not fit the proposed Trophic Index System; however, this is generally true of all similar index systems.

6. For phosphorus limited lakes, the proposed Trophic Index Numbers corresponded well to Vollenweider's (1973) phosphorus loading-lake morphometry-trophic state relationships which were presented in Working Paper No. 23.

7. The proposed Trophic Index system provides a relative method by which a previously unclassified lake could be classified after the appropriate parameters had been measured. The Trophic Index could also be used to evaluate year to year changes in trophic conditions of a specific lake.

8. The Trophic Index System, as presented, was developed from lakes in northeast and north-central states. Its applicability to lakes and reservoirs in other geographical areas is still questionable.

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APPENDIX

In the following tabulation, methods and parameter combinations are:

Percentile Method-

#1 = Median total phosphorus, dissolved phosphorus, and inorganic nitrogen; mean chlorophyll a; 500 minus the mean Secchi disc depth; and 15 minus the minimum dissolved oxygen.

#2 = All parameters used in #1 plus algal assay control yield.

#3 = Median total phosphorus, inorganic nitrogen, conductivity, and total alkalinity; mean chlorophyll a; 500 minus the mean Secchi disc depth; and the algal assay control yield.

#4 = All parameters used in #3 except the median total alkalinity.

#5 = All parameters used in #3 except the median total alkalinity and the algal assay control yield.

#6 = Median total phosphorus and inorganic nitrogen; mean chlorophyll a; 500 minus the mean Secchi disc depth; and the algal assay control yield.

#7 = Median total phosphorus and inorganic nitrogen; mean chlorophyll a; and 500 minus the mean Secchi disc depth.

Multivariate Analysis (Harkins, 1974)-

H-1 = Mean total phosphorus, dissolved phosphorus, inorganic nitrogen, chlorophyll a, and conductivity; 500 minus the mean Secchi disc depth; 15 minus the minimum dissolved oxygen; and the algal assay control yield.

H-2 = Median total phosphorus, dissolved phosphorus, and inorganic nitrogen; mean chlorophyll a; 500 minus the mean Secchi disc depth; and 15 minus the minimum dissolved oxygen (note that these are the same parameters used in percentile method, combination #1).

LAKES RANKED BY INDEX NOS. PAGE 1

RANKS

RANK	LAKE CODE		LAKE NAME #1	INDEX NO	#2	#3	#4	#5	#6	#7	H-1	H-2
1	2314	O	BAY OF NAPLES	573	2	3	3	3	4	4	2	1
2	2311	O	SEBAGO LAKE	566	1	4	4	5	5	6	1	5
3	3303	O	LAKE WINNIPESAUKEE	564	3	1	1	2	2	3	3	2
4	5571	O	CRYSTAL LAKE	549	5	2	2	1	3	2	6	6
5	2309	O	MOOSEHEAD LAKE	547	8	8	10	7	11	10	7	8
6	2310	O	RANGELEY LAKE	546	7	6	6	4	7	7	5	4
7	2695	O	HIGGINS LAKE	542	4	12	8	10	1	1	25	9
8	3634	O	SCHROON LAKE	541	6	5	5	9	6	9	4	7
9	2642	M	BOARDMAN HYDRO POND	525	9	30	23	26	14	16	15	11
10	2305	M	LONG LAKE	517	10	7	7	6	9	8	8	10
11	5572	M	TROUT LAKE	507	14	9	9	8	8	5	13	15
12	2517	O	LAKE CHARLEVOIX	503	11	25	16	20	10	12	16	14
13	3604	O-M	CANANDAIGUA LAKE	497	12	32	29	34	23	32	28	23
14	3619	M	LONG LAKE	496	13	10	11	11	16	17	9	12
15	3617	M	KEUKA LAKE	493	16	47	51	31	32	31	19	16
16	2704	*M-E	RAINER LAKE	487	17	56	39	49	21	23	34	13
17	3629	M	RAQUETTE POND	486	18	16	18	18	31	34	12	18
18	3635	M	SENECA LAKE	482	15	59	65	75	30	37	56	24
19	3605	M	CARRY FALLS RESERVOIR	471	19	17	21	19	34	35	11	21
20	2780	M	WHITE BEAR LAKE	464	23	23	20	17	13	13	51	57
21	2313	M	LONG LAKE	463	20	18	17	21	26	33	10	17
22	5011	M	WATERBURY RESERVOIR	461	21	14	14	16	20	27	17	27
23	2694	M	CRYSTAL LAKE	459	22	26	22	24	12	15	30	29
24	2771	M	RABBIT LAKE	457	31	40	37	33	38	30	72	69
25	5002	**E	CLYDE POND	455	25	33	35	43	51	56	14	20
26	5561	M	LAKE GENEVA	453	27	44	25	27	15	14	47	36
27	5005	M	HARRIMAN RESERVOIR	452	24	11	12	13	17	21	20	35
28	5564	M	ROCK LAKE	451	28	72	47	57	37	39	32	19

* WEEDS
** SHORT DETENTION

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE		LAKE NAME	#1 INDEX NO	#2	#3	#4	#5	#6	#7	H-1	H-2
29	2782	M	GREEN LAKE	451	32	49	33	30	35	18	61	25
30	2306	M	MATTAWAMKEAG LAKE	449	30	15	15	14	24	22	24	34
31	3632	M	SACANDAGA RESERVOIR	444	26	13	13	15	19	26	23	39
32	2696	M	HOUGHTON LAKE	444	29	34	34	39	39	45	18	22
33	2789	M	LAKE CARLOS	441	35	58	32	32	25	19	39	33
34	5008	(E)	LAKE MEMPHREMAGOG	439	41	54	68	50	71	69	33	30
35	5007**	E	LAMOILLE LAKE	433	40	39	50	42	61	61	26	32
36	3637	M-E	OWASCO LAKE	431	34	68	70	77	63	76	49	59
37	2744	M	SWAN LAKE	431	44	19	19	12	18	11	42	45
38	3602	*M	LAKE CAYUGA	426	33	71	73	85	42	58	60	54
39	5560*	E	BROWNS LAKE	425	39	73	67	68	43	42	43	26
40	5010**	E	LAKE ARROWHEAD	425	36	31	41	51	57	65	21	31
41	2730	M	FALL LAKE	425	42	20	27	25	52	46	22	28
42	2746	M	LEECH LAKE	422	38	36	26	28	28	25	36	43
43	5563	*E	LAC LA BELLE	420	37	79	65	70	40	48	46	38
44	2610**	E	HETSIE LAKE	419	52	93	86	78	81	73	54	44
45	5534	*E	SHAWANO LAKE	418	43	42	43	45	49	49	29	37
46	3634	*E	CONESUS LAKE	418	45	41	36	35	33	28	48	42
47	2710	E	BIRCH LAKE	416	47	28	24	22	29	20	40	47
48	5536	*E	PINE LAKE	412	49	62	49	47	44	40	35	40
49	5532	*E	OCONOMOWOC LAKE	403	46	69	40	50	22	24	80	64
50	5514	M	GREEN LAKE	403	50	67	44	41	35	29	62	53
51	3636	E	SWAN LAKE	403	57	38	61	40	78	66	37	41
52	5569	*M-E	MIDDLE LAKE	397	48	81	53	64	36	41	91	93
53	3306	**E	KELLY FALLS POND	393	51	22	30	29	48	50	27	46
54	3610	E	CHAUTAUQUA LAKE	391	67	57	69	52	76	62	52	49
55	3515	E	HUNTINGTON LAKE	390	58	21	28	23	45	36	59	58
56	2672	**E	ROGERS POND	387	65	90	79	72	69	59	57	48

* WEEDS

** SHORT DETENTION

LAKES RANKED BY INDEX NOS. PAGE 3

RANK	LAKE CODE		LAKE NAME	#1 INDEX NO	#2	#3	#4	#5	#6	#7	H-1	H-2
57	5001	M	CHAMPLAIN LAKE	385	56	45	55	37	58	53	38	52
58	3302	** E	POWDER MILL POND	383	53	27	38	48	62	75	31	50
59	2784	E	DARLING LAKE	380	54	91	71	73	56	54	79	82
60	3633	E	SARATOGA LAKE	373	79	64	74	53	72	51	67	60
61	5559	* E	OKAUCHEE LAKE	372	74	113	92	87	77	70	75	62
62	2761	E	MINNEHASKA LAKE	372	59	110	84	94	59	63	77	53
63	2674	** E	SANFORD LAKE	371	60	107	96	109	82	85	69	63
64	5566	E	ROUND LAKE	370	55	66	57	66	47	52	93	97
65	3402	E	BLACK LAKE	368	64	50	66	65	75	79	41	56
66	2793	E	TROUT LAKE	367	68	51	52	46	41	38	63	74
67	2649	** E	MANISTEE LAKE	365	66	102	91	103	68	71	88	61
68	2715	M	CASS LAKE	364	62	61	46	54	46	49	66	75
69	2737	E	GULL LAKE	358	77	60	63	55	66	57	76	86
70	2785	E	LE HOME DIEU	357	61	76	60	69	54	60	74	85
71	3640	E	LOWER ST. REGIS	355	70	29	42	44	65	72	53	71
72	2745	E	LAKE OF THE WOODS	353	76	74	81	83	90	93	55	68
73	3625	E	OTTER LAKE	352	73	105	101	112	98	109	78	73
74	3613	E	GOODYEAR LAKE	352	71	53	58	67	60	67	50	65
75	2789	* E	FOREST LAKE	350	69	52	48	60	50	55	68	81
76	2751	E	MENOMIN LAKE	347	83	78	75	62	64	47	82	77
77	5574	E	WILLOW RESERVOIR	345	63	35	45	63	67	83	44	70
78	2701	E	LAKE HEMIDJI	344	78	70	54	56	53	44	71	76
79	2711	E	BLACKDUCK LAKE	342	81	94	89	92	89	90	58	66
80	4402	** E	SLATERSVILLE RESERVOIR	340	72	37	64	74	80	89	45	67
81	2495	E	PERE MARQUETTE LAKE	336	91	125	119	114	104	96	90	72
82	2488	E	WHITE LAKE	334	89	108	98	93	83	77	87	79
83	2414	E	LAKE CHEMUNG	334	85	92	85	81	70	64	100	89
84	0902	E	HANTA LAKE	332	92	83	90	86	102	99	116	117

* WEEDS
** SHORT DETENTION

LAKES RANKED BY INDEX NOS..

RANK	LAKE CODE	LAKE NAME	#1	INDEX NO	#2	#3	#4	#5	#6	#7	H-1	H-2
85	3641	E ALLEGHENY RESERVOIR		330	94	98	110	96	113	103	83	80
86	2765	PELICAN LAKE		330	82	43	59	59	73	78	—	78
87	2673	ROSS RESERVOIR		330	80	128	111	125	88	101	96	83
88	3607	CASSADAGA LAKE		328	93	80	80	71	85	80	86	96
89	2709	ANDROSIA LAKE		328	84	84	77	80	79	81	81	84
90	5557	PEWAUKEE LAKE		327	86	103	88	90	76	74	111	95
91	3305	GLENN LAKE		327	75	24	31	36	55	68	70	90
92	0912	SHELTON LAKE		326	90	96	100	104	101	100	73	88
93	5559	LAKE WISSOTA		324	88	65	78	76	92	88	65	87
94	5575	ELK LAKE		303	95	63	82	79	96	98	92	91
95	2509	ROCHDALE POND		303	99	85	105	99	107	106	103	92
96	2715	CLEARWATER LAKE		300	96	106	95	97	86	84	101	100
97	2740	SHAGAWA LAKE		297	100	55	76	61	87	82	107	103
98	2743	NEST LAKE		293	101	123	106	106	95	86	106	101
99	2312	SEBASTICOOK LAKE		293	106	99	113	107	119	116	98	104
100	5573	LONG LAKE		292	87	48	72	84	84	102	64	98
101	5550	WAPOGASSET LAKE		291	105	97	99	91	103	95	94	94
102	5576	YELLOW LAKE		286	102	88	93	89	97	94	89	99
103	2713	BLACKHOOF LAKE		279	108	95	97	88	100	87	121	110
104	2685	UNION LAKE		279	103	152	130	152	122	131	120	102
105	2621	CONSTANTINE RESERVOIR		273	114	167	156	161	141	143	128	115
106	2640	HOLLOWAY RESERVOIR		271	115	158	144	144	124	122	127	106
107	0904	EAGLEVILLE LAKE		271	112	86	107	101	117	117	99	111
108	5521	LAKE WAUSAU		266	104	82	94	105	105	118	95	118
109	3630	ROUND LAKE		266	123	138	143	135	148	135	143	150
110	2697	THOMPSON LAKE		266	109	126	115	115	94	92	109	107
111	5562	LAKE COMO		265	97	144	140	168	132	167	119	128
112	2747	ST CROIX LAKE		264	111	100	109	108	114	119	85	109

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	#1 INDEX NO	#2	#3	#4	#5	#6	#7	H-1	H-2
~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~110~~	~~101~~	~~108~~	~~110~~	~~115~~	~~120~~	~~84~~	
114	2720	E CRANBERRY LAKE	262	98	75	83	95	91	107	97	113
115	2665	PENTWATER LAKE	259	116	127	120	119	110	110	123	120
116	2742	WOLF LAKE	258	107	112	104	111	99	105	105	112
117	0911	LITTLEINDIAN LAKE	258	122	109	112	100	109	97	113	125
118	2749	WHITEWATER LAKE	257	113	77	87	82	93	91	104	116
119	5504	BUTTERNUT LAKE	256	118	87	103	98	112	112	102	114
120	5534	BUTTE DES MORTS	254	120	143	133	142	139	145	112	126
121	2583	THORNAPPLE LAKE	254	119	156	138	148	121	126	146	135
122	5535	PIGEON LAKE	247	126	134	124	118	118	108	133	123
123	0910	ZOAR LAKE	246	124	119	121	116	125	124	108	119
124	2725	ELHOW LAKE	245	136	137	141	127	142	128	154	149
125	2741	WINONA LAKE	245	131	162	164	162	164	161	140	136
126	2694	STRAWBERRY LAKE	243	133	147	131	128	123	111	164	139
127	2763	LAKE MINNETONKA	241	117	120	116	122	106	113	130	122
128	2643	KENT LAKE	237	127	159	152	154	130	133	170	142
129	2692	LONG LAKE	231	137	148	134	130	126	115	168	148
130	2569	MISSISSIPPI LAKE	231	128	122	118	113	108	104	118	121
131	5534	MORGAN LAKE	229	132	145	148	151	149	149	125	129
132	2795	SUPERIOR BAY	229	129	117	114	117	120	130	110	133
133	2513	HUDSON IMPOUNDMENT	225	152	131	142	126	150	132	153	163
134	2758	MASHKENODE LAKE	223	125	116	117	124	116	125	126	127
135	5544	TOWN LINE LAKE	218	130	89	102	102	111	114	117	145
136	5545	TAINTER LAKE	216	149	132	132	129	147	138	129	134
137	2785	CALHOUN LAKE	216	139	140	139	139	127	123	147	144
138	5520	KEGONSA LAKE	214	135	153	146	150	137	139	138	137
139	3637	SWINGING BRIDGE RESERVOI	214	143	115	127	121	144	141	131	132
140	2709	BIG STONE LAKE	213	140	170	166	169	143	146	152	130

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME #1	INDEX NO	#2	#3	#4	#5	#6	#7	H-1	H-2
141	2777 E	SAKATAH LAKE	211	150	154	147	141	136	129	145	147
~~142~~	~~2641~~	~~[illegible]~~	~~[illegible]~~	~~139~~	~~147~~	~~122~~	~~103~~	~~131~~	~~148~~	~~114~~	
143	2693	ST LOUIS RESERVOIR	209	155	186	179	170	157	147	178	162
144	2705	BARTLETT LAKE	208	144	155	159	165	176	182	196	154
145	5502	ALTOONA LAKE	207	142	124	129	132	152	152	122	140
146	5531	LAKE NAGAWICKA	205	158	166	154	146	135	127	165	157
147	2792	TRACE LAKE	205	147	171	168	172	166	174	149	160
148	2511	BILLERICA IMPOUNDMENT	204	151	139	135	134	146	142	134	143
149	2903	HARRIS POND	203	141	111	123	123	134	136	135	151
150	2304	ESTES LAKE	201	153	114	126	120	140	137	132	141
151	2671	RANDALL LAKE	199	161	180	181	174	167	159	159	155
152	2731	FANNY LAKE	196	148	188	177	187	161	175	166	183
153	5510	CASTLE ROCK FLOWAGE	193	134	118	125	138	133	153	115	146
154	2681	CARO RESERVOIR	193	138	182	170	189	153	171	150	156
155	5545	SWAY LAKE	192	163	151	136	131	128	121	148	158
156	2748	LITTLE LAKE	191	162	190	183	178	162	156	182	177
157	5503	BEAVER DAM LAKE	189	159	181	174	173	173	172	163	181
158	5534	PETENWELL FLOWAGE	186	145	121	128	137	138	151	124	152
159	0901	ASPINOOK LAKE	186	164	139	155	153	179	176	141	159
160	2703	COTTONWOOD LAKE	182	157	191	199	206	192	197	175	176
161	2509	BELLEVILLE LAKE	181	169	196	194	193	191	187	176	166
162	2796	TUTTLE LAKE	180	166	183	187	186	175	173	174	174
163	2513	BRIGHTON LAKE	180	146	178	169	190	155	185	155	175
164	0905	HANOVER POND	178	172	163	182	171	197	191	171	179
165	5522	KOSHKONONG LAKE	176	171	200	192	184	182	169	180	171
166	2752	MALMEDAL LAKE	176	160	187	186	192	171	186	151	165
167	5555	WISCONSIN LAKE	174	167	135	145	143	156	155	139	161
168	2719	COKATO LAKE	171	175	176	160	155	145	134	181	182

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE		LAKE NAME	#1 INDEX NO	#2	#3	#4	#5	#6	#7	H-1	H-2
169	5554	E	LAKE WINNEBAGO	170	170	161	163	160	172	166	161	167
170	2776	E	ST LOUIS BAY	168	178	136	149	136	160	150	167	196
171	3411		CROSS LAKE	167	156	149	153	164	129	140	156	153
172	5513		LAKE DELAVAN	165	177	164	165	158	154	144	187	172
173	2753		MUD LAKE AT MAPLE LAKE	162	168	199	191	196	184	192	189	197
174	2507		WOODS POND	162	182	160	171	159	183	168	162	180
175	2750		MADISON LAKE	161	165	146	150	157	151	163	137	164
176	2504		MAYNARD IMPOUNDMENT	160	183	142	157	147	177	158	172	178
177	2706		BEAR LAKE	159	154	165	173	194	169	195	160	187
178	5565		BIG EAU PLEINE RESERVOIR	158	176	133	151	145	174	170	144	168
179	2429		FORD LAKE	155	180	185	180	175	163	162	173	170
180	2606		BARION LAKE	150	179	168	161	167	159	157	169	173
~~181~~	~~5593~~		~~LAKE BEAN~~	~~147~~	~~173~~	~~173~~	~~141~~	~~181~~	~~168~~	~~181~~	~~157~~	
182	2744		LAKE PEPIN	144	174	174	142	182	170	183	158	184
183	5515		EAU CLAIRE LAKE	141	181	130	137	140	158	165	142	169
184	2746		SPRING LAKE	139	188	203	203	199	200	199	191	191
185	2603		ALLEGAN LAKE	138	185	201	195	195	188	188	184	185
186	250		MATTHIELM IMPOUNDMENT	137	192	141	158	149	181	164	190	199
187	2788		LOST LAKE	134	187	157	167	163	186	179	183	189
188	2640		JORDAN LAKE	133	189	172	172	166	165	154	185	188
189	5570		GRAND LAKE	132	186	205	198	200	195	196	192	194
190	2748		BUCK LAKE	130	184	175	178	180	178	180	186	196
191	3416		IRONDEQUOIT BAY	128	195	208	208	207	204	202	206	211
192	2735		ZUMBRO LAKE	126	196	197	189	176	180	160	196	193
~~193~~	~~[illegible]~~		~~[illegible]~~	~~[illegible]~~	~~198~~	~~159~~	~~162~~	~~156~~	~~199~~	~~178~~	~~177~~	
194	2648		LAKE MACATAWA	123	198	192	197	197	196	193	188	190
195	2781		WAGONGA LAKE	122	190	209	207	208	201	204	199	204
196	2713	HE-	BUFFALO LAKE	118	191	184	184	179	187	189	179	192

LAKES RANKED BY INDEX NOS. PAGE 8

RANK	LAKE CODE	LAKE NAME #1	INDEX NO	#2	#3	#4	#5	#6	#7	H-1	H-2
197	2591	HE MONA LAKE	118	197	177	190	183	189	177	197	200
198	2782	SILVER LAKE	114	198	204	201	201	199	201	193	202
199	0903	COMMUNITY LAKE	112	201	179	196	191	205	203	195	201
200	2702	ALBERT LEA LAKE	102	203	210	210	210	208	208	208	208
201	2702	MUD LAKE	100	202	194	202	198	206	206	205	212
202	2714	CARRIGAN LAKE	99	199	202	200	203	194	194	200	206
203	2503	HAGER POND	94	206	198	209	209	209	209	204	210
204	2785	ST CLAIR LAKE	93	200	189	185	185	185	190	198	198
205	4403	[illegible] RESERVOIR	92	204	164	188	177	202	200	194	205
206	2531	FREMONT LAKE	92	205	193	193	188	193	184	201	203
207	5559	TICHIGAN LAKE	80	207	206	204	204	198	198	207	207
208	2703	WOODCOCK LAKE	60	208	207	205	205	203	205	202	209
209	2757	HALLMARK LAKE	41	209	195	206	202	207	207	203	213

O - oligotrophic
M - mesotrophic
E - eutrophic
HE - hypereutrophic