U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES

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REPORT
ON
ROUND LAKE
WAUPACA COUNTY
WISCONSIN
EPA REGION V
WORKING PAPER No. 65

WITH THE COOPERATION OF THE

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

AND THE

WISCONSIN NATIONAL GUARD

JUNE, 1975

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS*

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

* The lake discussed in this report was included in the National Eutrophication Survey as a water body of interest to the Wisconsin Department of Natural Resources. This report relates only to the data obtained from lake sampling.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Wisconsin Department of Natural Resources for professional involvement and to the Wisconsin National Guard for conducting the tributary sampling phase of the Survey.

Francis H. Schraufnagel, Acting Assistant Director, and Joseph R. Ball of the Bureau of Water Quality, and Donald R. Winter, Lake Rehabilitation Program, provided invaluable lake documentation and counsel during the Survey. Central Office and District Office personnel of the Department of Natural Resources reviewed the preliminary reports and provided critiques most useful in the preparation of this Working Paper series.

Major General James J. Lison, Jr., the Adjutant General of Wisconsin, and Project Officer CW-4 Donald D. Erickson, who directed the volunteer efforts of the Wisconsin National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

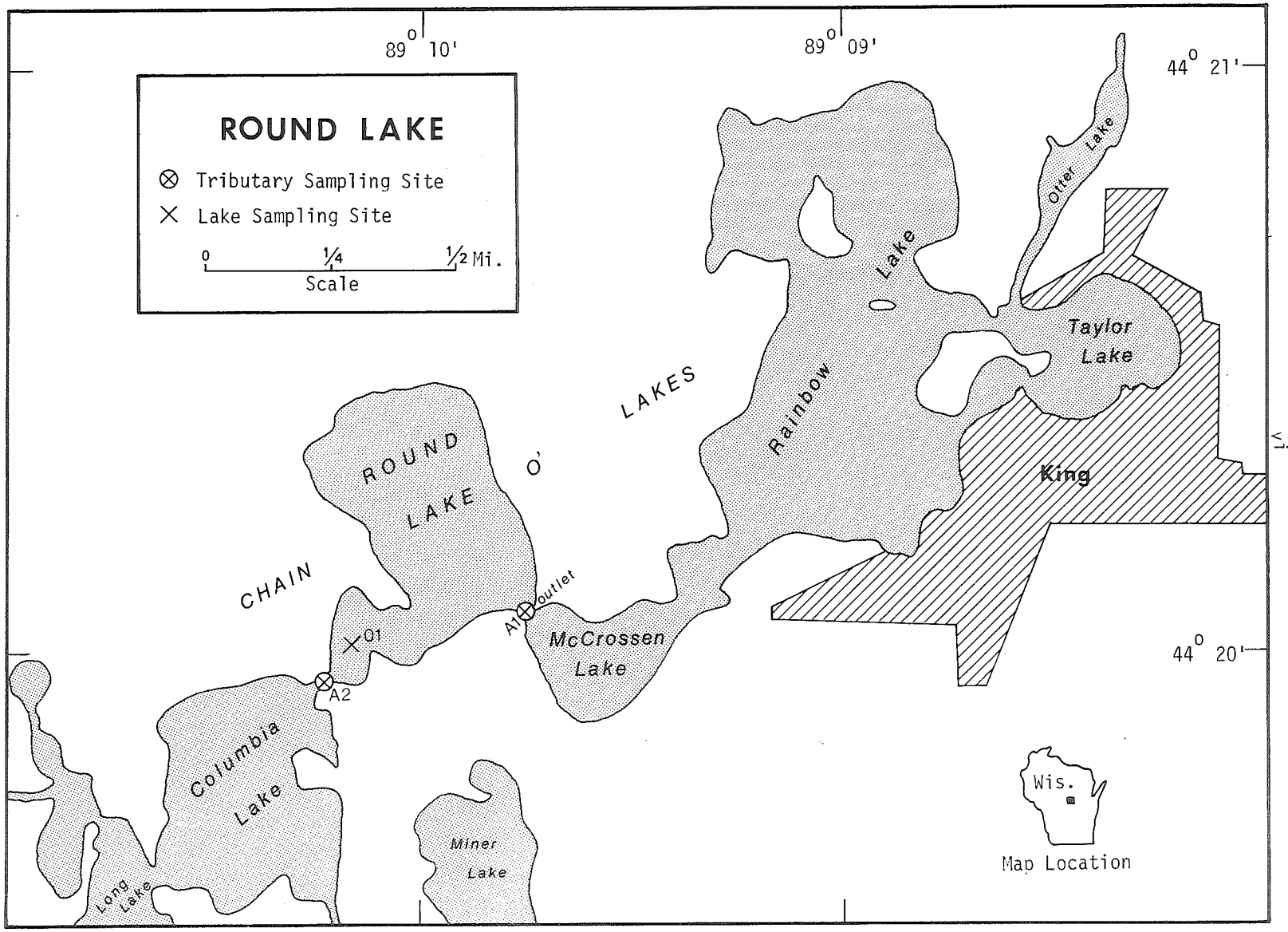
NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF WISCONSIN

LAKE NAME	COUNTY
Altoona	Eau Claire
Beaver Dam	Barron
Beaver Dam	Dodge
Big Eau Pleine	Marathon
Browns	Racine
Butte des Morts	Winnebago
Butternut	Price, Ashland
Castle Rock Flowage	Juneau
Como	Walworth
Crystal	Vilas
Delavan	Walworth
Eau Claire	Eau Claire
Geneva	Walworth
Grand	Green Lake
Green	Green Lake
Kegonsa	Dane
Koshkonong	Jefferson, Rock, Dane
Lac La Belle	Waukesha
Middle	Walworth
Nagawicka	Waukesha
Oconomowoc	Waukesha
Okauchee	Waukesha
Petenwell Flowage	Juneau
Pewaukee	Waukesha
Pigeon	Waupaca
Pine	Waukesha
Poygan	Winnebago, Waushara
Rock	Jefferson
Rome Pond	Jefferson, Waukesha
Round	Waupaca
Shawano	Shawano
Sinnissippi	Dodge

LAKE NAME	COUNTY
Swan	Columbia
Tainter	Dunn
Tichigan	Racine
Townline	Oneida
Trout	Vilas
Wapogassett	Polk
Wausau	Marathon
Willow	Oneida
Winnebago	Winnebago, Fond Du Lac, Calumet
Wisconsin	Columbia
Wissota	Chippewa
Yellow	Burnett


ROUND LAKE
Tributary Sampling Site
Lake Sampling Site
0 1/4 1/2 Mi.
Scale
89° 10'
89° 09'
44° 21'
44° 20'
Otter Lake
Taylor Lake
Rainbow Lake
King
ROUND LAKE CHAIN O' LAKES
A1 Outlet
01
A2
McCrossen Lake
Columbia Lake
Miner Lake
Long Lake
Wis.
Map Location

ROUND LAKE

STORET NO. 5566

I. INTRODUCTION

Round Lake was included in the National Eutrophication Survey as a water body of interest to the Wisconsin Department of Natural Resources. The inlet and outlet of the lake were sampled (Appendix B), but no wastewater treatment plants impact the lake. Therefore, this report relates only to the lake sampling data.

Round Lake is one of the 22 Waupaca County Chain-O-Lakes which range in area from three to 116 acres (Anonymous, 1972).

II. CONCLUSIONS

A. Trophic Condition:

Survey data and a report by others (Lueschow, et al., 1970) indicate Round Lake is meso-eutrophic. Of the 46 Wisconsin lakes sampled, seven had less mean total phosphorus, six had less mean dissolved phosphorus, 43 had less mean inorganic nitrogen, four had less mean chlorophyll a, and four had greater mean Secchi disc transparency.

Dissolved oxygen was nearly depleted at the 45-foot depth in June and was depleted at the 53-foot depth in August, 1972.

B. Rate-Limiting Nutrient:

The algal assay results indicate Round Lake was phosphorus limited at the time the sample was taken (11/08/72). The lake data indicate phosphorus limitation at the other sampling times as well.

III. LAKE CHARACTERISTICS

A. Lake Morphometry*:

1. Surface area: 80 acres.
2. Mean depth: 30.4 feet.
3. Maximum depth: 67 feet.
4. Volume: 2,426 acre-feet.

B. Precipitation**:

1. Year of sampling: 37.1 inches.
2. Mean annual: 30.4 inches.

---

* Schraufnagel, 1975.
** See Working Paper No. 1, "Survey Methods, 1972".

IV. LAKE WATER QUALITY SUMMARY

Round Lake was sampled three times during the open-water season of 1972 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from a number of depths at a single station on the lake (see map, page vi). During each visit, a single depth-integrated (15 feet to surface) sample was collected for phytoplankton identification and enumeration, and a similar sample was collected for chlorophyll a analysis. During the last visit, a single five-gallon depth-integrated sample was taken for algal assays. The maximum depth sampled was 56 feet.

The results obtained are presented in full in Appendix A, and the data for the fall sampling period, when the lake essentially was well-mixed, are summarized below. Note, however, the Secchi disc summary is based on all values.

For differences in the various parameters at the other sampling times, refer to Appendix A.

A. Physical and chemical characteristics:

Parameter	Minimum	Mean	Median	Maximum
		FALL VALUES		
Temperature (Cent.)	7.5	7.5	7.5	7.5
Dissolved oxygen (mg/l)	9.0	9.3	9.4	9.6
Conductivity (μmhos)	320	323	322	330
pH (units)	7.9	7.9	7.9	8.0
Alkalinity (mg/l)	130	146	149	149
Total P (mg/l)	0.009	0.010	0.010	0.012
Dissolved P (mg/l)	0.005	0.006	0.006	0.007
NO_2 + NO_3 (mg/l)	0.610	0.615	0.615	0.620
Ammonia (mg/l)	0.240	0.260	0.260	0.270
		ALL VALUES		
Secchi disc (inches)	130	134	135	136

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Number per ml
06/23/72	1. Fragilaria	673
	2. Cyclotella	152
	3. Chroococcus	141
	4. Oocystis	83
	5. Dinobryon	54
	Other genera	177
	Total	1,280
08/22/72	1. Cyclotella	2,717
	2. Microcystis	1,739
	3. Chroococcus	1,196
	4. Dinobryon	652
	5. Rhabdoderma	507
	Other genera	617
	Total	7,428
11/08/72	1. Microcystis	438
	2. Dinobryon	195
	3. Fragilaria	32
	4. Flagellates	22
	Other genera	152
	Total	839

2. Chlorophyll a -
(Because of instrumentation problems during the 1972 sampling, the following values may be in error by plus or minus 20 percent.)

Sampling Date	Station Number	Chlorophyll a (µg/l)
06/23/72	01	2.5
08/22/72	01	3.4
11/08/72	01	4.7

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.005	0.780	0.2
0.006 P	0.011	0.780	0.5
0.012 P	0.017	0.780	3.0
0.024 P	0.029	0.780	9.6
0.060 P	0.065	0.780	19.8
0.060 P + 10.0 N	0.065	10.780	26.5
10.0 N	0.005	10.780	0.2

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Round Lake was relatively low at the time of sample collection (11/08/72). Also, the increased yields with increased levels of orthophosphorus show the lake was phosphorus limited at that time (note the lack of yield response when only nitrogen was added).

The lake data indicate phosphorus limitation at the other sampling times as well; i.e., the mean N/P ratios were 40/1 and greater, and phosphorus limitation would be expected.

V. LITERATURE REVIEWED

Anonymous, 1972. Wisconsin lakes. Publ. 218-72, WI Dept. Nat. Resources, Madison.

Fassbender, Ronald L., and John J. Weber, 1971. Surface water resources of Waupaca County. WI Dept. Nat. Resources, Madison.

Lueschow, Lloyd A., James M. Helm, Donald R. Winter, and Gary W. Karl; 1970. Trophic nature of selected Wisconsin lakes. Trans. Wisc. Acad. Sci., Arts & Ltrs., vol. 58, pp. 237-264.

Schraufnagel, Francis H., 1975. Personal communication (lake morphometry). WI Dept. Nat. Resources, Madison.

VI. APPENDICES

APPENDIX A

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 74/09/30

556601
44 20 00.0 089 00 00.0
ROUND LAKE
55 WISCONSIN

11EPALES 2111202
6 0050 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/23	13	25 0000	20.0	11.0	136	300	8.30	139	0.500	0.050	0.042	0.041
	13	25 0015	19.0	10.8		360	7.30	170	1.200	0.310	0.053	0.042
	13	25 0045	6.0	0.6		360	7.30	173	1.100	0.290	0.015	0.005
72/08/22	14	14 0000			135	275	8.30	132	0.380	0.080	0.007	0.004
	14	14 0004	23.6	8.6		280	8.35	129	0.380	0.070	0.006	0.003
	14	14 0015	20.2	10.5		275	8.40	133	0.440	0.110	0.005	0.004
	14	14 0025	10.8	14.9		315	8.30	158	1.450	0.130	0.010	0.005
	14	14 0035	7.5	13.4		320	8.30	165	1.450	0.070	0.019	0.006
	14	14 0047	5.6	0.2		348	7.40	175	0.750	0.680	0.023	0.006
	14	14 0050	5.4	0.4		338	7.35	175	0.450	0.870	0.023	0.006
	14	14 0053	5.1	0.0		360	7.30	178	0.130	1.400	0.033	0.008
	14	14 0056	4.9	0.0		340	7.30	182	0.100	2.570	0.019	0.006
72/11/08	08	30 0000			130	320	7.90	149	0.620	0.270	0.010	0.005
	08	30 0004	7.5	9.6		320	7.90	149	0.610	0.260	0.010	0.006
	08	30 0015	7.5	9.4		320	7.90	130	0.610	0.260	0.010	0.006
	08	30 0025	7.5	9.0		325	7.90	148	0.610	0.250	0.010	0.006
	08	30 0035	7.5	9.3		325	8.00	149	0.620	0.270	0.012	0.007
	08	30 0046	7.5	9.4		330	8.00	149	0.620	0.240	0.009	0.006

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/06/23	13	25 0000	2.5J
72/08/22	14	14 0000	3.4J
72/11/08	08	30 0000	4.7J

J VALUE KNOWN TO BE IN ERROR

APPENDIX B

TRIBUTARY DATA

STORET RETRIEVAL DATE 74/10/02

```
 555661                 LS555661
44 20 00.0 089 10 00.0
ROUND LAKE OUTLET
55        15 WAUPACA
O/ROUND LAKE
END OF RD OFF CO HWY Q 4 MISW WAUPACA
11EPALES                      2111204
4                          0000 FEET  DEPTH
```

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/23	12 35		0.249	0.675	0.094	0.005K	0.012
72/10/14	09 45		0.299	0.550	0.056	0.005K	0.010
72/11/11	09 00		0.310	0.820	0.120	0.005K	0.016
72/12/09	09 05		0.315	1.050	0.138	0.005K	0.016
73/01/06	09 30		0.370	0.960	0.260	0.005K	0.010
73/03/17	09 35		0.126	0.220	0.189	0.009	0.040
73/04/02	19 10		0.860	0.600	0.105	0.006	0.010
73/04/19	19 30		0.510	0.640	0.150	0.005K	0.020
73/05/20	14 10		0.730	0.520	0.018	0.005K	0.010
73/05/31	16 10		0.770	0.800	0.036	0.005K	0.015
73/06/16	10 35		0.580	0.440	0.032	0.007	0.015
73/07/16	11 35		0.380	0.500	0.033	0.005K	0.010
73/09/31	10 30		0.250	0.520	0.120	0.008	0.020

K- VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 74/10/02

5566B1 LS5566B1
44 20 00.0 089 10 30.0
ROUND LAKE INLET
55 15 WAUPACA
I/ROUND LAKE
CO HWY Q BRDG 1.5 MI NSW OFKING
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/09/23	12 01		0.345	0.700	0.102	0.005K	0.008
72/10/14	09 30		0.420	0.750	0.076	0.005K	0.010
72/11/11	08 45		0.570	0.600	0.147	0.005K	0.010
72/12/09	09 00		0.630	3.000	0.100	0.005K	0.020
73/01/06	09 05		0.700	1.320	0.210	0.012	0.140
73/02/10	09 15		0.730	0.720	0.220	0.009	
73/04/02	19 00		0.680	0.610	0.120	0.005K	0.080
73/04/19	19 30		0.990	1.180	0.110	0.005K	0.020
73/05/20	14 00		0.750	0.560	0.026	0.005K	0.015
73/05/31	14 10		0.750	1.700	0.075	0.005K	0.015
73/06/16	10 30		0.620	0.560	0.034	0.005K	0.017
73/07/16	11 30		0.440	0.440	0.029	0.005K	0.010
73/09/31	10 25		0.357	1.380	0.072	0.005K	0.022

K VALUE KNOWN TO BE LESS
THAN INDICATED