# Early Studies of Lake Superior Nutrients, **Productivity and Currents 1956-1961**

Lake Superior investigations 1950s . In 1956 the Minnesota Department of Health asked the School of Public Health of the University of Minnesota to conduct a limnological study of Lake Superior. • The original planning of the project was conducted in conference with individuals now widely recognized as early leaders in the fields Limnology, Oceanography and Environmental Health. These included:

- Dr. Athelstan Spilhaus, founder of Sea Grant,
- Dr. Gaylord W. Anderson, the first dean of the UMN School of Public Health, and
- Dr. Alfred C. Redfield, of Woods Hole Oceanographic Institute and the discoverer of the Redfield ratio (which describes the ratio between nutrients in plankton and ocean water).
- Dr. Redfield acted as a consultant to the project and provided a detailed memorandum regarding the development of a limnological institution for the continuous long-term study of Lake Superior.
- Dr. Theron O. Odlaug, founding member of the University of MN Department of Biology also prepared a bibliography and abstracts of Great Lakes literature extending as far back as 1829.

#### Water Movement and Temperatures of Western Lake Superior - 1957

- Released 5,000 more bottle drifters over several months (27% returned)
- Acquired additional equipment including 7 bathythermographs (used to collect more than 300 temperature profiles along cross-lake transects)... • Integrated bottle drifter data and temperature profiles
- for Dynamic Height calculations for surface currents..





Completed Drift Bottles as Used for Lake Superior Studie CHOOL OF PUBLIC HEALT OPEN THIS BOTTLE 1112 MAYO MEMORIAL UNIVERSITY OF MINNESOT

MINNEAPOLIS 14, MINNESOTA

FINDER OF THIS BOTTLE

PLEASE FILL IN THE INFORMATIO INDICATED AND SEND BY MAI This battle is one of several hundred released in Lake serior to study lake currents. The exact place and date release has been recorded and is on file, ou can make the record for this bottle complete I nishing the information requested on the enclose stal card. We will tell you where the bottle was drop d overboard if you will return the card with the best rmation you can provide Your information will be combined with that sent other finders of bottles. This is part of a study of t ift of floating objects being conducted by the Unive

OUR COOPERATION IN GIVING ACCURATE INFORMATION WILL Nº 100







igure 16. Bathythermograph record in the deeper water off Lakewood Water Station indicates a well defined thermocline on September 10, 1956



Bathythermograph (photo: Jay Austin)

#### Tom Hollenhorst, Sharon Moen, Robert Sterner, and Nancy Langston U.S. E.P.A. Mid-Continent Ecology Division, MN Sea Grant, UMD Large Lakes Observatory, Michigan Technological University



#### **An Investigation of Nutrients in** Western Lake Superior - 1960

- Sampled 11 tributaries for nutrients and WQ
- Sampled along transects from Duluth to Grand Marais • Also sampled for turbidity,
- chlorophyll, bacteria and radioactivity.





## Lake Superior Studies - (est. 1956)

• Released 1,000 bottle drifters (32% returned) • Collected hundreds of bathythermograph profiles in July, August and Sept. along transects from Duluth to Grand

• Remodeled former fisheries building into Lake Superior Research Station.



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2	Poplar River
3	Baptism River
4	St. Louis River
5	Amnicon River
6	Brule River
7.	Bad River
8	Montreal River
9	Black River
0	Presque Isle River
1	Ontonagon River
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FIGURE 3 TRIBUTARY STREAMS UNDER INVESTIGATION IN 1958

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					Table X	I					
				Nutrient	Input to La	ake Super	ior				
			In M	etric Tons	for August	and Sept	ember ]	1958			
	Mo.	Pigeon	Poplar	Baptism	St. Louis	Brule	Bad	Montreal	Black	Presque Isle	Ontonagon
	8	0.7	0.5	2	43	1	10	8	2	3	6
	9	7.8	2	4	88	0.6	8	9	2	1	9
rogen	8	1	0.5	7	123	2	20	13	8	9	16
	9	20	2	13	206	6	40	35	15	7	39
	8	22	7	62	686	115	199	102	48	92	270
	9	113	24	116	2,111	143	507	315	98	84	429
	8	0.2	0.4	0.4	3	0.6	1	0.7	0.2	0.6	1
.5	9	0.9	0.4	0.4	15	1	0.2	0.4	1	3	0.5
	8	9.0	2	12	485	16	47	40	13	17	60
	9	95	16.	23	2,861	76	305	173	64	39	167

				Mean Mo	onthly Di	scharge	Rates of	2					
Tributary Streams Sampled in 1958													
Stream	Mean	1	2	3	4	5	6	7	8	9	10	11	
Pigeon	9 yr mean 1958 mean	142 91	133 89	139 93	1120 422	1858 222	844 130	412 78	316 65	281 327	339 111	268 165	18
Poplar	6 yr mean 1958 mean	35 37	32 27	35 28	224 97	323 55	178 64	88 40	48 17	49 56	49 56	59 78	1
Baptism	9 yr mean 1958 mean	29 21	24 16	29 22	559 191	598 95	260 152	122 126	87 114	125 214	147 53	99 116	1
St. Louis	8 yr mean 1958 mean	421 278	419 410	696 641	8947 2243	5150 1105	3466 3648	3606 5338	2505 1207	2387 3900	1530 935	1291 1410	68
Brule	9 yr mean 1958 me <b>a</b> n	138 142	140 138	148 140	300 193	268 140	230 151	225 266	167 151	169 210	157 141	165 171	1
Bad	9 yr mean 1958 mean	182 181	166 163	401 310	2453 1324	1459 268	948 176	808 1225	438 378	350 834	333 131	468 354	32
Montreal	9 yr mean 1958 mean	197 193	182 161	244 190	1052 824	639 176	355 164	355 299	254 219	258 590	202 100	237 211	2
Black	4 yr mean 1958 mean	75 68 .	61 74	91 120	1078 951	282 110	118 73	142 286	154 124	149 220	197 59	200 199	1:
Presque Isle	9 yr mean 1958 mean	163 678	165 776	243 938	1261 3576	676 966	467 1025	429 1513	200 200	154 154	242 531	314 1114	22
Ontonagon	9 yr mean 1958 mean	800 699	817 792	1185 1032	4640 3443	2352 931	1791 990	1475 1551	1103 554	973 761	1048 551	1115 1143	92

(discharge rates are in cubic feet per secon

#### Memorandum on the Limnology of Minnesota by Alfred C. Redfield

• Alfred C. Redfield, senior oceanographer of the Woods Hole Oceanographic Institute, acted as a consultant and adviser for the length of the project and provided a detailed memo regarding the development of an institute at the University.

• Primary objectives included: - An investigation of the standing crop of plankton. - An attempt to evaluate primary production. -Measurements pertaining to the chlorophyll content and photosynthetic activity of the phytoplankton community.

Secondary objectives included investigations of phenomena of concern:



The staff of a first class institute of limnology should contain leaders with support for effective work in the following departments:

- 1. Hydrography which deals with the physical movement of water and which include the general circulation, the action of waves as erosive agents, etc.
- Climatology and Meteorology which deal with the principal agencies responsible for supplying the natural water initially and modifying from time to time its behavior.
- . Chemistry which provides the techniques of examining the qualities of water and tracing the sources of the components on which these qualities depend.
- 4. Geology which deals with the sedimentary deposits, their origin and

5. Biology - which is concerned equally with the production and control of fish and other life, both desirable and undesirable, and including particularly the microbiology involved in contamination by sewage.

UMN Received a Louis and Maud Hill grant of \$207,721 to fund a limnological institute.

### **Studies on the Productivity and** Plankton of Lake Superior 1961

• Fish net slime (diatom algae communities) • Green Water near Silver Bay (possibly associated with taconite waste).

> The university's 1103 electronic computer was used for calculating dynamic heights from the bathythermograph data

1955 ERA 1103 Computer Master Console "Engineering Research Associate later marketed by Remington R UNIVAC 1103 Scientific Compute



Michigan Tech



