

池田湖調査資料 (I)

The Data for the Cooperative Survey of Lake Ikeda
in August 1958 (I)

In August 1958, the limnological observations of Lake Ikeda were carried out by some members of Faculty of Fisheries, Kagoshima University. Members of the survey were as follows:

- S. Murayama : Director, Biology
- K. Kashiwada : Chemistry (Vitamin B₁₂)
- T. Huzita : Physics (Photometry)
- T. Kuroki : Technological fishery
- T. Takahashi : Physical oceanography
- D. Kakimoto : Chemistry (Vitamin B₁₂)
- K. Nozawa : Biology, Water analysis
- A. Kanazawa : Chemistry (Vitamin B₁₂)

Present paper contains the result of the observations. As shown in Fig. 1, eighteen points on the surface of the lake were selected as the stations, in which 'A-series' were on the line from south-east to-ward north-west, 'B-series' were from south-west to-ward north-east, 'C series' were along the north-western coast of the lake and 'D-series' were the bottom sediment collected.

The used echo-sounder was of the type S-301 made by FURUNO electric Ind. Co. Water analysis was followed the method fixed in the 'Kaiyo-Kansoku Shishin', a guide book of oceanographical method in Japan. While the fixing of chemical oxygen demand was examined by the oxydizing of potassium permanganate in alkaline condition. Vitamin B₁₂ was calculated by the Euglena method.

It is noticeable that the scattering layer from 0 to 12 metres and clear thermocline from 12 to 13 metres were widely spread all over the lake.

It is also noteworthy that both the dissolved oxygen and vitamin B₁₂ are most abundant at the layer of 20 metres in all stations. The main distribution of the fish schools being observed at the same depth.

鹿児島県庁企画室の企画による西南薩開発計画学術調査の一部として、1958年8月下旬に本学部の研究者による池田湖の協同調査を行なった。この調査は今後も機会を得て継続する予定であり、未だ結果の未整理の部分もあるが、今後の研究に資するためここに一部を資料として発表する。尚調査に際して地元指宿市産業課の大きな協力を得た事を感謝する。

調査は村山三郎が企画統括し、魚探による魚群及び湖底地形の調査並びに観測点の測量を黒木敏郎・中山博、採水、測温、透明度測定、採泥、プランクトン調査、及び水質分析を村山三郎・野沢治治・国崎敏広、ビタミン B₁₂ の定量及び細菌数の測定を柏田研一・柿本大竜・金沢昭夫、照度測定を藤田親男、躍層微細観測及び表面熱収支観測を高橋淳雄が行なった。

調査期間中は2日目(8月20日)に時々聚雨があつたが調査結果に大きな影響を与える程ではなく、他は大体晴天であつた。

1. 魚探記録

魚探は古野電気KK製、S-301型を用いた。使用魚探の目盛深度は吊下ワイヤ実測値と比べて約10%浅く読まれた。この差は海水用目盛を淡水用に換算した時の差よりも大である。

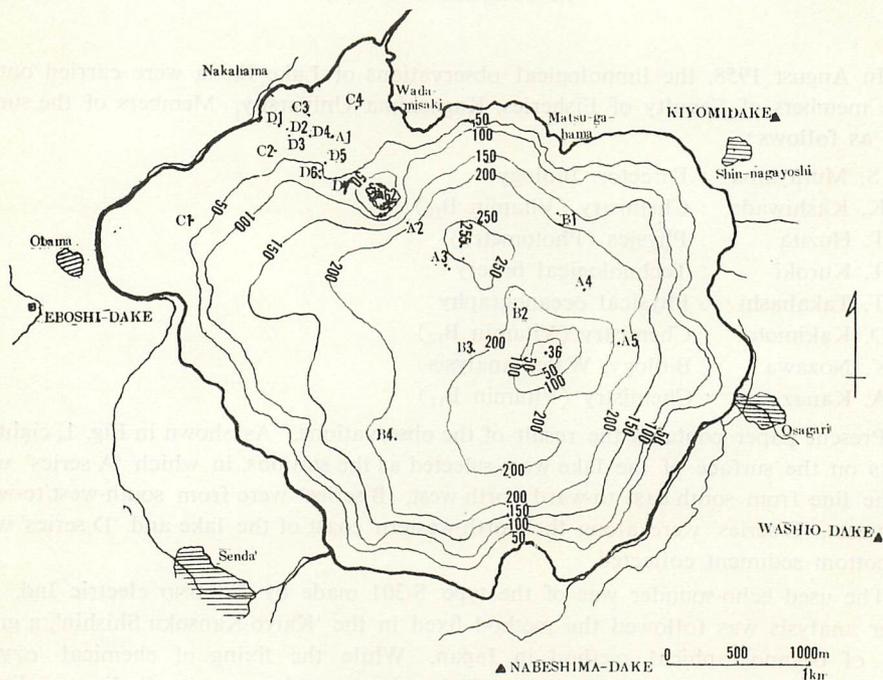


Fig. 1. Bathymetric chart of Lake Ikeda.

A and B series: Stations of across-the-lake.

C series: Stations of along-the-coast.

D series: Stations of sediment collected.

湖底の地形は図に示した通りで前回の調査(黒木敏郎・中馬三千雄・本紀要3巻1号)に加うべき知見はなかつた。

今回の調査の著しい特徴は、殆んど湖面全域にわたつて表層より12m層にわたつて Scattering layer が認められたことである。この Scattering layer は12mから13mにある非常に顕著な躍層上で行なわれている水の混濁の物理的な影響が主な原因であると思われる。魚群は20mから30mの層に多く、又湖内にある2つの火山の頂点附近に群れている点も注目される。(黒木敏郎)

2. 水質

測定項目はpH、アルカリ度、溶存酸素、珪酸塩、磷酸塩、亜硝酸塩、アムモニウム塩、過マンガン酸カリ消費量、等で、アルカリ度は Methyl orange alkalinity、過マンガン酸カリ消費量は富山法によつた。他は海洋観測法指針記載の方法に従つた。

可成りの貧栄養湖であり明らかな化学成層は認められないが、全観測点において溶存酸素量が躍層の下の20m層で最高値を示していることが、非常に発達した躍層とともに認められる。

透明度は最大 14.7 m であり、これは従来の報告にある 26.7 m (宮地伝三郎: 1929 年 5 月) と可成り異なるが今回のものは夏期の躍層が浅部に発達した時期のものであるから、これだけでは透明度が小になつたとは云えない。(野沢治治)

3. ビタミン B₁₂

ビタミン B₁₂ は東洋濾紙 No. 3 で濾過した試水について Euglena 法によつて定量した。その量は 0 から 5 mg/l の範囲にあり、各観測点とも深度 20 m に最高濃度を示し、その垂直分布は溶存酸素のそれと殆んど一致している。(柏田・柿本・金沢)

4. 細菌数

Station A₄ 及び A₅ の試水を用い平板培養による細菌検査の常法に従つて 30°C, 24 時間培養後におけるコロニー数を肉眼で数え算出した。(柏田・柿本・金沢)

5. 躍層微細観測

ビード型サーミスターを利用している ET 3 型電気水温計 (東邦電探 K K 製) を使用して、深さ 29 m 迄の層で 1 m 毎の深さの水温を 28 点で観測した。温度の目盛は観測の前後に実験室で行なつた検定によつて補正した。観測層の深さはキャップタイヤコード上に附した目盛によつて決定したので、コードが鉛直に降下しない場合における補正不可能の誤差が入り得る。これを小さい範囲に止めるため、デテクターの下端に空中重量 4.5 kg の錘りを附した。幸い多くの場合に観測中の風は極めて弱く風による舟の漂流は微小であり、又注目すべき程の湖流もなかつたので、少くも表面附近のコードのなす形状は目視によれば鉛直と認め得る程度であつた。故に観測層の深さの数値に対する補正は行なつていない。観測結果は未整理であるが、最初の観測点 (Station B 1 附近) の観測結果は表 2 に示す通りで、深さ 12 m に極めて顕著な躍層が見られる。この特徴は湖全域に亘つて居り、湖底までの深さが 30 m 以内の浅い所でも同様である。躍層のかかる鋭さは過去の観測値を集めた報告 (高橋淳雄, 本紀要 6 卷 47~76, 1958) からは見過し勝ちな事実である。(高橋淳雄)

6. 照度

照度測定は東芝製照度計 5 号を用い、目盛の読み及びフィルターに対する補正を行なつた。晴天に於いて午前 9 時半約 6,000 lux. 正午約 40,000 lux. 午後 4 時半約 4,000 lux であつたが、この間の透明度は 14 m から 14.7 m であつた。(藤田親男)

以上の外、底質、プランクトン、表面熱収支等については未整理であるので後日報告する。

Table 1. The chemical contents of Lake Ikeda and remarks on echo-sounder record.

Time	Depth (m)	Water temp. (°C)	pH	Alkalinity (10 ⁻³ N)	Dissolved O ₂ (mg O ₂ /L)	Silicate (μg atom/L)	Phosphate (μg atom/L)	Nitrite (μg atom/L)	Ammonium (μg atom/L)	Chemical O ₂ demand (O ₂ cc/L)	Vitamin B ₁₂ (mγ/L)	Number of bacteria per mL
Station A 1 (Aug.-20)												
6.02 p.m.	0	28.9	7.5	5.28	5.19	130	0.01	0.25	11.8	3.49	1.0	
6.09	10	27.0	7.5	5.32	5.34	134	0.45	0.10	0.2	0.95	1.0	
6.15	20	13.6	7.3	5.79	7.14	146	0.27	0.08	4.0	0.69	3.2	
6.22	30	11.8	6.8	5.39	3.93	135	0.01	0.18	6.0	0.55	1.6	
Station A 2 (Aug.-21)												
9.00 a.m.	0	28.7	7.4	4.94	5.04	120	0.01	0.05	5.0		1.9	
9.04	10	28.6	7.4	4.82	4.95	120	0.25	0.08	5.1	1.14	2.2	
9.10	20	14.0	7.8	4.69	7.35	127	tr.	0.16	tr.	0.08	3.9	
9.17	30	11.9	6.8	4.47	4.63	151	tr.	0.11	tr.	1.64	2.6	
9.25	50	11.1	6.8	5.77	4.19	122	0.06	0.09	3.1	0.71	0.6	
9.33	100	10.8	7.5	5.39	4.94	120	0.06	0.06	5.1	1.14	2.6	
Station A 3 (Aug.-19)												
4.00 p.m.	0	28.9	7.5	5.86	4.71	144	0.11	0.15	4.5	1.69	1.3	
	10	27.8	7.6	5.15	5.51	136	0.02	0.18	4.0	1.06	1.3	
	12	26.2	7.9									
	14	18.9	8.0	5.11	7.97							
	20	16.2	7.7	5.41	7.83	119	0.04	0.18	4.9	2.14	5.0	
	30	12.1	6.9	5.62	5.17	158		0.34	12.8	2.35	2.6	
	50	11.3	6.9	5.32	5.27	134	0.01	0.20	8.8	0.79	1.6	
	100	10.8	6.8	5.39	6.73	136	0.09	0.19	6.2	1.71		
6.00	150	10.7	6.8	5.58	5.24	134	0.04	0.27	tr.	1.00	3.9	
Station A 4 (Aug.-20)												
4.15 p.m.	10	28.9	7.5	5.19	5.10	161	0.03	0.19	11.4	1.67	0.3	10,900
4.25	20	16.1	7.6	5.34	7.37	135	0.02	0.15	7.6	1.37	2.2	0
4.40	30	11.7	6.8	4.96	4.69	155	0.23	0.10	4.9	1.06	1.9	130
4.48	50	11.1	6.9	5.32	5.16	146	0.02	0.17	3.7	0.56	0.6	1,115
4.52	100	10.8	6.9	5.41	5.29	157	0.15	0.10	tr.	0.45	2.2	710
5.10	150	10.7	6.9	5.46	5.20	134	0.02	0.18	tr.	1.03	1.9	0
Station A 5 (Aug.-20)												
	0	28.8	7.6	5.17	5.24	130	8.64	0.10	7.1	0.95	0.3	520
	5	28.8			4.88						0.3	13,400
	10	29.0	7.6	5.21	4.68	133	0.17	0.10	3.8	0.81	1.9	20,000
	15	18.9									4.4	0
	20	14.4	7.6	5.34	6.42	135	0.18	0.10	8.9	0.82	3.2	0
	30	12.1	7.0	5.17	4.65	133	0.03	0.10	8.9	0.77	3.2	1,050
	50	11.1	6.9	5.17	4.67	134	0.22	0.09	7.8	0.79	0.3	1,500
	100	10.7	6.8	5.28	4.05	136	0.25	0.10	4.0	0.37	3.2	31,000
	150		6.9	5.13	4.67	146	0.01	0.23	4.7	0.56	3.1	29,400
Station B 1 (Aug.-21)												
1.56 p.m.	0	29.3	7.6	5.37	5.09	136	0.01	0.15	2.0	1.08	0	
2.11	10	28.7	7.6	5.34	4.97	135	0.01	0.10	2.8	0.63	0.6	
2.20	20	13.7	7.5	5.32	6.43						5.4	
2.28	30	11.7	6.8	5.37	4.43						2.2	
2.35	50	11.7	6.9	5.52	4.76						1.6	
2.44	100	10.8	6.8	5.69	4.89						1.9	
2.59	150	10.7	6.8	5.49	5.07						3.5	
Station B 2 (Aug.-21)												
0.55 p.m.	0	29.1	7.5	5.34	5.08	124	0.07	0.11	5.1		0	
1.00	10	28.8	7.4	5.34	4.89	147	0.06	0.05	5.2	0.95	0.6	
1.06	20	14.0	7.7	5.39	6.67	149	0.27	0.18	tr.	1.29	4.4	
1.14	30	11.8	6.8	5.45	4.70	130	0.20	0.08	0.9		1.9	
1.19	50	11.0	6.8	5.58	4.71	120	0.01	0.13	2.2		1.9	
1.29	100	10.8	6.8	5.62	4.89	134	0.32	0.10	2.0	1.19	2.6	
1.43	150	10.7	6.8	5.37	4.84	123	0.02	0.12	2.2		2.2	

Remarks on the echo-sounder record

Continuous observation of scattering layer (S.L.) through the depth (0-12 m).
No fish school was to be observed anywhere near this station.

No fish school, near this station.
Several schools, almost all of them were with the thickness (1 m), were observed near the bottom of the depth (20-30 m), lying to the section between station A 1 and station A 2.

In this sounding, the location of the S.L. was fixed to be at the depth (0-12 m), though it was found out at depth (30-40 m) is the spring, 1958.

Fish schools were found at the layer above the top of the under-water crater-wall near this station; their swimming upper limit, 22-24 m; lower limit, 32 m were to be observed.

In our returning to Nakahama, scattered fish groups were found in the layer 12-30 m; the varying ranges of the length of those groups were within 10-20 m and those of the height were within 2-5 m.

No school, in the shallow.

Something suspending, in the writer's view, a special water mass or a light deposit mass, was recorded at the bottom 184-187 m depth. Its height was about 4 m, and its shape was ascertained, for a moment, in the process of sounding the depth with the use of bottom sampler.

In this day, too, S.L. lay in the layer 0-12 m.

Fish schools were observed at the different depths above the top of another under-water crater-wall: 40-44, 34-38, 20-30 m depth layer near the bottom. Fish schools apart from the bottom; in the middle layer 22-24 m.

On the way to this station, a fish school (height 3 m, length 10 m) was found in the layer 35 m near the bottom.

S.L.: 0-12 m.

Few schools were found near the lock gate. It seemed that the kinds of fish schools in the layer 10-20 m were different from the ones in the layer 25-31 m.

Fish school near the bottom was dispersed by the approach (about 3 m) of under-water-camera.

S.L.: 0-12 m.

No fish school was found near the bottom.

Time	Depth (m)	Water temp. (°C)	pH	Alkalinity (10 ⁻³ N)	Dissolved O ₂ (mg O ₂ /L)	Silicate (μg atom/L)	Phosphate (μg atom/L)	Nitrite (μg atom/L)	Ammonium (μg atom/L)	Chemical O ₂ demand (O ₂ cc/L)	Vitamin B ₁₂ (mγ/L)	Number of bacteria per mL
Station B 3 (Aug.-21)												
0.01 p.m.	0	29.1	7.4	5.34	4.05	139	0.06	0.10	6.0	0.10	0.6	
0.08	10	28.7	7.4	5.67	4.78	120	0.04		4.4		0.9	
0.14	20	13.9	7.8	5.15	6.71	130	0.03		4.5		4.4	
0.20	30	11.9	6.8	5.34	4.54	123	0.03		2.5		2.2	
0.25	50	11.1	6.9	5.37	4.68	158	0.27	0.09		0.71	3.2	
0.35	100	10.8	6.9	5.75	5.10						1.9	
0.43	150	9.7	6.9	5.58	5.11						1.3	
Station B 4 (Aug.-21)												
10.09 a.m.	0	28.9	7.4	5.34	4.92	128	0.52	0.03	5.2		0	
10.14	10	28.7	7.4	5.58	5.21	132	0.07	0.02	10.9		1.9	
10.17	20	14.3	7.8	5.34	6.79	129	0.07	0.09	12.5	0.19	4.4	
10.31	30	11.7	6.7	5.82	4.35	130	0.34	0.01	0.6	0.87	0.6	
10.40	50	11.0	6.8	5.19	4.94	110	0.07	0.01	7.4	1.35	1.9	
10.57	100	10.7	6.9	5.93	5.09						2.6	
11.07	150	10.7	6.9	5.60	4.65						2.2	
Station C 1 (Aug.-21)												
4.14 p.m.	0	29.0	7.5	5.21	4.92	132	0.01	0.13	4.5	0.06	1.9	
4.19	10	28.4	7.5	5.30	5.22	149	0.02	0.10	9.9	1.67	0	
4.25	20	14.1	7.2	5.34	6.12	138	0.48	0.08	1.2	0.72	4.8	
4.32	30	11.6	6.8	5.27	4.46	142	2.35	0.18	11.4	1.43	3.5	
Station C 2 (Aug.-21)												
5.00 p.m.	0	28.8	7.4	5.17	5.26	135	0.28	0.18	2.0	1.10	1.9	
5.05	10	28.6	7.6	5.69	5.09	133	0.58	0.15	4.4	0.63	0.6	
5.11	20	14.4	7.7	5.75	7.33	150	0.39	0.10	1.4	0.81	4.8	
5.17	30	11.8	6.8	5.32	4.32	135	0.16	0.10	0.1	0.68	1.9	
Station C 3 (Aug.-22)												
8.50 a.m.	0	29.0	7.6	5.19	5.37	132	0.06	0.23	tr.	1.96	2.6	
9.12	10	28.6	7.6	5.06	5.29	136	0.18	0.10	0.3	0.87	1.6	
9.15	20	14.1	7.4	5.15	7.27	152	0.50	0.34	2.0	1.66	3.9	
9.22	30	12.0	7.0	5.19	5.07	153	4.97	0.18	2.8	1.87	2.9	
Station C 4 (Aug.-22)												
9.41 a.m.	0	28.9	7.4	5.24	5.19	149	0.45	0.08	2.0	1.82	0.6	
9.45	10	28.7	7.2	4.81	5.18	121	0.03	0.23	0	1.87	1.0	
9.50	20	13.8	7.3	5.37	6.87	158	0.08	0.15	5.2	1.51	4.4	

Table 2. Water temperature at every metres between 0-29 metres near the station B 1.

Depth (m)	Water-temperature (°C)	Depth (m)	Water-temperature (°C)
0	29.11	15	20.54
1	29.11	16	18.36
2	29.05	17	16.80
3	29.03	18	15.59
4	29.00	19	14.82
5	28.82	20	14.46
6	28.65	21	14.03
7	28.60	22	13.51
8	28.60	23	13.30
9	28.58	24	12.95
10	28.55	25	12.68
11	28.52	26	12.40
12	28.51	27	12.20
13	24.68	28	12.06
14	22.27	29	11.90

4 p.m. 21 st, Aug., 1958.

Remarks on the echo-sounder record

S.L.: 0-12 m, was disturbed somewhat by the movement of wire attached to the water bottle.

Something, not fish school, was found near the bottom; its height 7-8 m.
S.L. was very clear at the end of the work of observation on this station.

S.L.: 0-12 m. No fish, near the bottom.

Searching for fish school was done; on the bank off Osagari (10.50 a.m.) was found out a mass (weed, water mass or fish school), at the lake bottom 47-48 m depth.

Near the lock gate (11.30 a.m.), many fish schools (height 5-6 m) were found over the bottom (10-30 m depth).

In the flat bottom (32-33 m depth) the top of a hill was found at the 22 m depth under the lake surface.

Fish schools (length 14-22 m) were found near the top of the hill. Something (a mass of weed or fish), was found height 2 m, on the bottom.

Thin schools (height 1.5-2 m) were found at the lower layer (4 m from the bottom, about 28 m depth).

Rich schools (height 5 m), near the bottom. These schools were found near the bottom depth 25 m or less that; and were not found near the bottom, depth 30 m or more.

Only one fish school (height 3 m) was found near the bottom. The top of this school was at the layer 27 m depth, and went down to the 29 m depth at the sudden approach (to 26 m depth) of our under-water-camera. It took for the school 1.5 minute to return to the normal state. This school dispersed at the falling of a dredger. It took 2 minutes to return to normal after the dredger's leave.

On the way to this station, many schools (height 3-5 m) were found over the bottom (16 m depth). The heights of these fish schools near the bottom were about 2-3 m, the water depth being ascertained to be 25 m.
