

# Temperature and Oxygen Determinations in Some Irish Lakes

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Information about temperature and dissolved oxygen profiles in Irish lakes has hitherto been lacking. During the period 1966 to 1969 data on temperature and dissolved oxygen content at various depths were determined for a number of Irish lakes. The results are summarised in this paper.

Determinations were made by means of an electrical oxygen probe and thermistor. During 1966, 1967 and the early part of 1968 investigations were limited to depths of 50 feet (15 m) by the length of cable available. During the latter part of 1968 and during 1969 depths down to 200 feet (61 m) could be studied.

The lakes investigated in most detail were Lough Sheelin (Counties Cavan-Westmeath), Lough Ennell (Co. Westmeath), Lough Mask (Co. Mayo), Coosan Lough (Co. Westmeath) and Drumkeary Lough (Co. Cavan). Their location is shown in Fig. 1 and their dimensions, bicarbonate alkalinity, electrical conductivity and pH are indicated in Table 1. Other lakes for which some data were obtained included Loughs Owel (Co. Westmeath), Corrib (Co. Galway), Ballynafid (Co. Westmeath), Castle (Co. Cavan) and Gouganebarra (Co. Cork).

Loughs Sheelin, Ennell and Mask are large, limestone trout lakes. They are highly productive, rich in food, and hold big, fast-growing fish. Lough Sheelin is shallow; Lough Ennell has some extensive shallows and a deep central basin; Lough Mask has very extensive shallows and numerous islands, but there is a deep gully running down the lake near the west shore. (The greatest depth recorded for an Irish lake—59 m—is in this depression in Lough Mask). Whereas Sheelin and Ennell lie entirely on the limestone, Lough Mask lies near the western edge of the limestone plain and is bounded on the west by acid rocks and high ground. Coosan Lough is a ramification of Lough Ree, which is a big limestone lake; Coosan itself is a sheltered coarse fish lake of high productivity. Drumkeary is a small coarse fish lake located in a region of Silurian and Ordovician formations. It is much less alkaline than the other lakes and the fish are rather small and slow-growing.

Data for these five lakes are given graphically in Figs. 2 to 6.

The mean monthly air temperature in the Irish midlands varies from 4°C (January) to 15°C (August). It is only during exceptionally severe winters that the large trout lakes become frozen. Even then, ice is often limited to the marginal shallows and seldom persists for more than a few weeks at most. Thermal stratification in winter is therefore usually not well marked. Lake temperatures rise rather slowly during early spring and more rapidly during late spring and early summer. In late May or early June, when there is often a spell of warm, calm, anticyclonic weather, a warm surface layer of water develops. However, during the spells of more broken, windy weather which occur between anticyclones, circulation is established to depths of 20 to 35 metres, according to the size and contours of the lake. By August a well-marked thermocline therefore exists only in the deepest parts of lakes such as Mask or Ennell, while thermal stratification scarcely exists in shallow, open lakes such as Lough Sheelin.

Open-water surface temperatures reach higher values during summer anticyclones in Coosan Lough than in the large trout lakes, but by August temperature in Coosan Lough is usually uniform from surface to bottom. In Drumkeary Lough a thermocline or a temperature gradient exists off and on during the summer.

In Lough Ennell there is a marked drop in the dissolved oxygen content of the hypolimnion in August and September, values falling to less than half a part per million below the thermocline. In Lough Mask there is a reduction in the dissolved oxygen content of the hypolimnion in August and September, but it is much less pronounced than in Lough Ennell; the minimum value does not fall below 5 p.p.m. In Drumkeary Lough there is also a summer reduction in the dissolved content of the deeper water layers.

By October the temperature in most Irish lakes is the same from surface to bottom and the lower layers are well oxygenated again if there has been oxygen depletion during summer.

The Irish climate is insular and temperate. Irish weather, in winter and summer alike, is variable. Most Irish lakes are shallow in proportion to their surface area and tend to be broad and exposed to the wind. It is not surprising, therefore, that temperature and oxygen profiles in Irish lakes do not, in general, conform to the classic patterns described for North American and Continental waters by Whipple (1899), Rüttner (1952) and

Hutchinson (1957). The dissolved oxygen concentration in the deeper layers of an Irish lake may depend as much on the exposure of the lake to wind action as on the productivity of the lake.

In otherwise well oxygenated lakes the dissolved oxygen within 15 to 30 cm of the bottom mud often falls to low or even zero values, especially in depths of 10 m and over. In shallow water this does not usually occur. Where there is weed on the bottom there may, indeed, be an increase in dissolved oxygen concentration immediately above the weeds. For example, in Ballynafid Lake (limestone, 25—30 acres, maximum depth 6 m) on September 25, 1966, the dissolved oxygen readings included the following:—

Depth (m)	Open Lake	Over bottom	
	Oxygen (ppm.)	Type of bottom	Oxygen (ppm.)
Surface	7.1	—	—
2	7.0	Chara	8.54
4.5	4.9	—	—
5	—	Mud	2.2

#### REFERENCES

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- WHIPPLE, G. C., 1899 (1954). *Microscopy of drinking water*. New York: John Wiley and Sons Inc. (4th edition, Rev. G. M. Fair and M. C. Whipple).

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Table 1. Dimensions, bicarbonate alkalinity, electrical conductivity and pH of principal lakes investigated.

Lake O.S. $\frac{1}{2}$ inch map reference	Area (Hectares)	Axis	Maximum Length (Kilometres)	Maximum Width (Kilometres)	Maximum Depth (metres)	Bicarbonate Alkalinity (mEq/l)	Conductivity (Reciprocal megohms per cm <sup>o</sup> at 20°C)	pH
Mask M 10 66	8293	NNE—SSW	16.0	7.2	59.0	1.85	218	8.3
Ennell N 40 47	1396	NE—SW	7.4	3.5	27.5	4.6	425	8.2
Sheelin N 44 84	1883	NE—SW	7.2	4.0	14.0	2.65-3.2	267.5-317.5	8.5
Coosan N 5 44	80	N—S	1.3	1.0	13.0	3.6	374	—
Drumkeary H 66 00	14	NE—SW	0.9	0.3	8.5	0.5	88	6.9

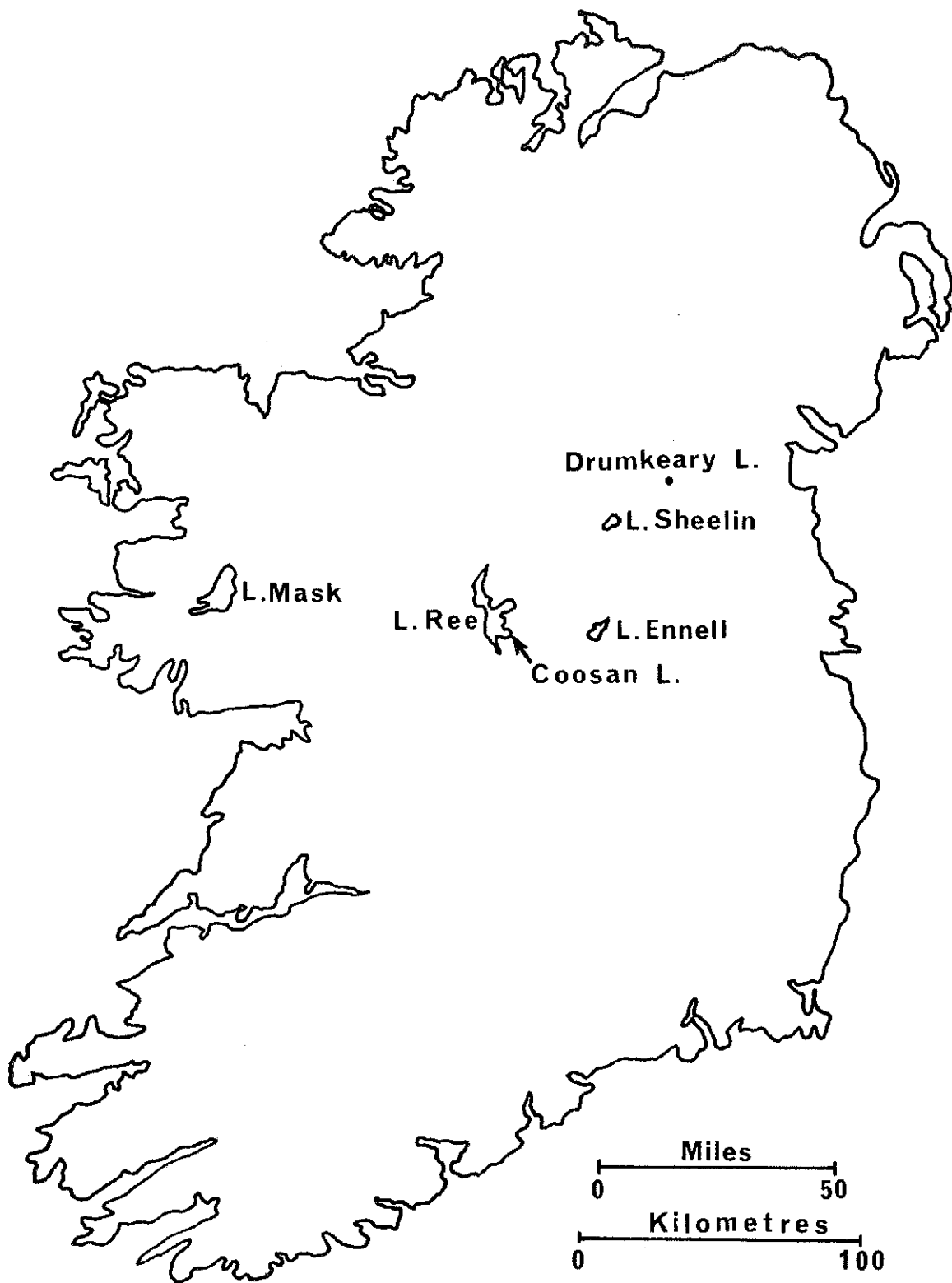


Fig. 1. Location of principal lakes in which temperature and oxygen data were obtained.

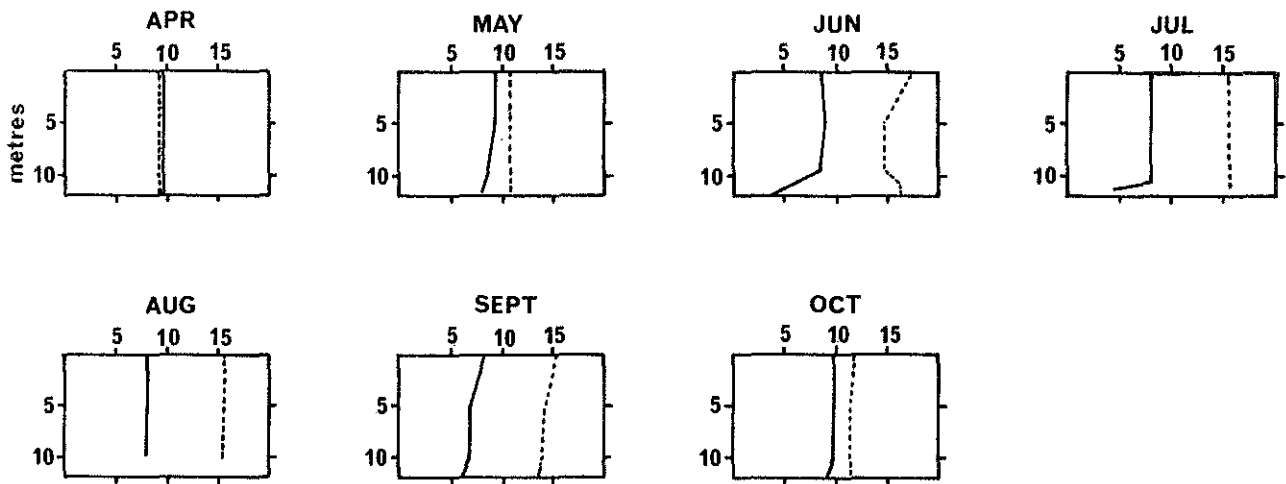


Fig. 2. Lough Sheelin temperature and oxygen profiles. Broken line = temperature ( $^{\circ}\text{C}$ ). Continuous line = dissolved oxygen (parts per million). Determinations made on the following dates: April 29, 1969; May 25, 1967; June 13, 1967; July 7, 1967; August 14, 1967; September 15, 1967; October 22, 1968.

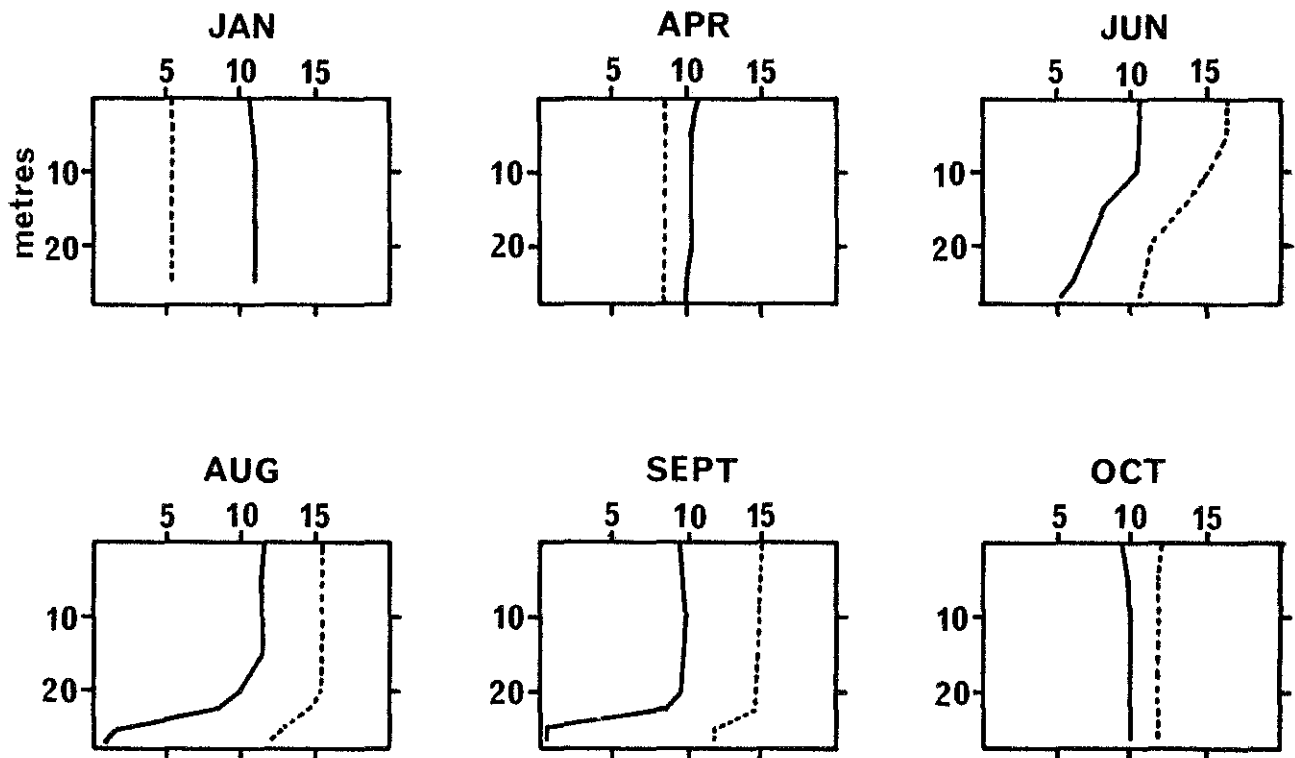


Fig. 3. Lough Ennell temperature and oxygen profiles. Broken line = temperature ( $^{\circ}\text{C}$ ). Continuous line = dissolved oxygen (parts per million). Determinations made on the following dates: January 6, 1969; April 29, 1969; June 18, 1969; August 28, 1968; September 19, 1968; October 22, 1968.

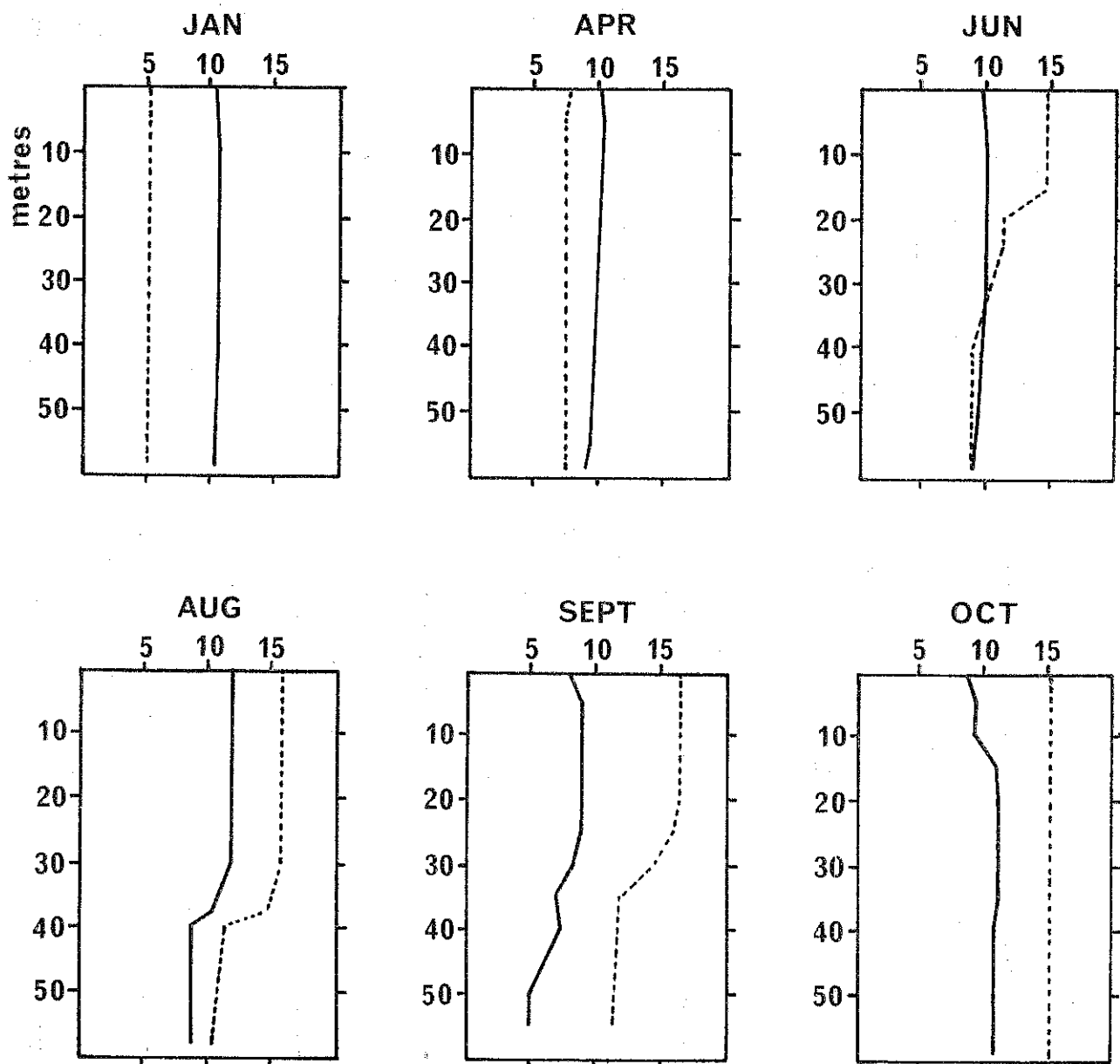


Fig. 4. Lough Mask temperature and oxygen profiles. Broken line = temperature ( $^{\circ}\text{C}$ ). Continuous line = dissolved oxygen (parts per million). Determinations made on the following dates: January 8, 1969; April 30, 1969; June 19, 1969; August 29, 1968; September 14, 1968; October 21, 1968.

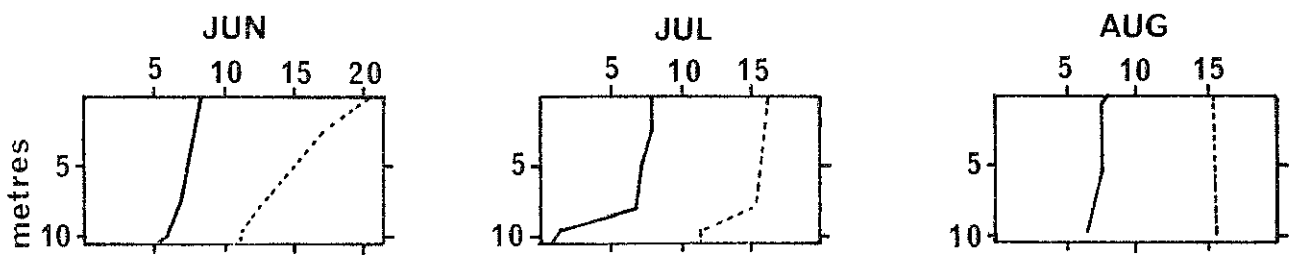


Fig. 5. Coosan Lough temperature and oxygen profiles. Broken line = temperature ( $^{\circ}\text{C}$ ). Continuous line = dissolved oxygen (parts per million). Determinations made on the following dates: June 14, 1967; July 7, 1967; August 15, 1967.

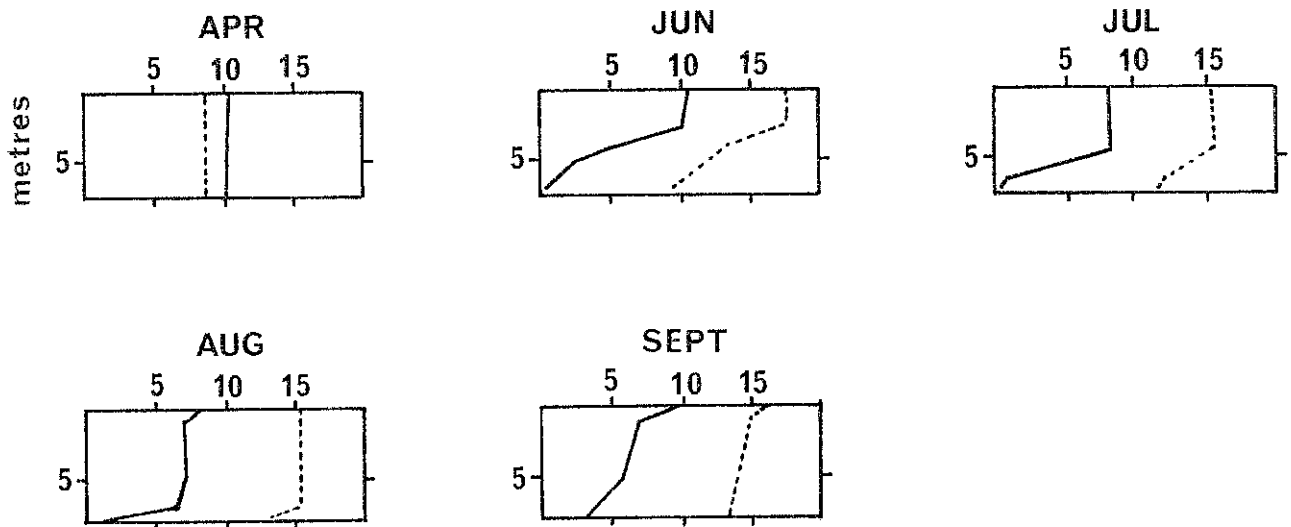


Fig. 6. Drumkeary Lough temperature and oxygen profiles. Broken line = temperature ( $^{\circ}\text{C}$ ). Continuous line = dissolved oxygen (parts per million). Determinations made on the following dates: April 17, 1969; June 17, 1969; July 3, 1967; August 15, 1967; September 20, 1966.