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Salinity and Temperature Variations of the Surface Waters in the Jaffna Lagoon

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A study of the influence of the physical, chemical and biological factors on the fishery of the Jaffna Lagoon and the adjacent waters is being carried out. The present paper deals with the variations of the temperature and salinity of the surface waters in the Jaffna Lagoon.

Investigations of the distribution of salinity and temperature in the surface waters of the Bay of Bengal have been made since 1925. Sewell (1925) prepared charts for the seasonal cycle of both Temperature and Salinity of the Bay of Bengal. Jeyaraman (1954) recorded detailed information for specific locations in near-shore areas. La Fond (1958) discussed the relation of these data to water masses and circulation in these areas. Ganapathy and Murthy (1954) related them to the currents in the Bay of Bengal. Murthy and Udayavarma (1964) recorded the hydrographical features Palk Bay in March, 1963.

The data embodied in the present paper were collected for twelve months from August, 1967, in five locations in the Jaffna Lagoon and in one location in the near-shore area in the open sea, Palk Bay, off Myliddy.

The distribution of surface temperature and salinity in oceanic and lagoon waters reflect the effect of mixing, evaporation and precipitation of these water types. The study of these properties of a semi-enclosed water body often indicate, qualititively, the nature of water exchange within that body of water and also between it and the open sea. Surface salinity variations depend usually upon the difference between evaporation and precipitation and its annual variation corresponds to the annual variation in evaporation. Change in atmospheric circulation also affects, to a great extent, the average values for surface salinity. Radiant heat income and the winds prevailing in an area influence the distribution of surface temperature. The exchange of heat energy between the air and the sea surface fluctuates with the seasons.

The Jaffna Lagoon referred to here covers an area of water bounded by the Jaffna mainland on the north-eastern side, Karaithivu Island on the northern side, Kayts Island on the south-western side and Mandaithivu Island on the southern side. It is a continuation of the open sea running in between the Peninsula and the three Islands. The connection is maintained through four openings. Of these four, two—one at Punnalai and the other between Mandaithivu and Kayts—are very shallow, the depth ranging from $1\frac{1}{2}$ feet to 3 feet. The other two—one between Karaitivu Island and Kayts and the other between Jaffna and Mandaithivu—are fairly deep, the depth ranging from 6 feet to 40 feet. The tidal currents enter and flow out of the Jaffna Lagoon mainly through the deep channels. The five locations in the Jaffna Lagoon are Velichchaveedu Bay, Kallundai Bay, Punnalai Bay (South), Punnalai Bay (North) and Kayts Channel. The location in the near-shore area in the Palk Bay is off Myliddy coast (Vide Figure I).

The samples were collected during the early hours of the morning, once a fortnight, mostly on the days immediately succeeding full moon day and the new moon day. Salinities were obtained by determining chlorinity by the Silver Nitrate Titration method. Salinity values were calculated using the formula—

$$S\ {}^{\circ}/_{00} = (Cl\ {}^{\circ}/_{00} \times 1{\cdot}805) + 0{\cdot}03$$

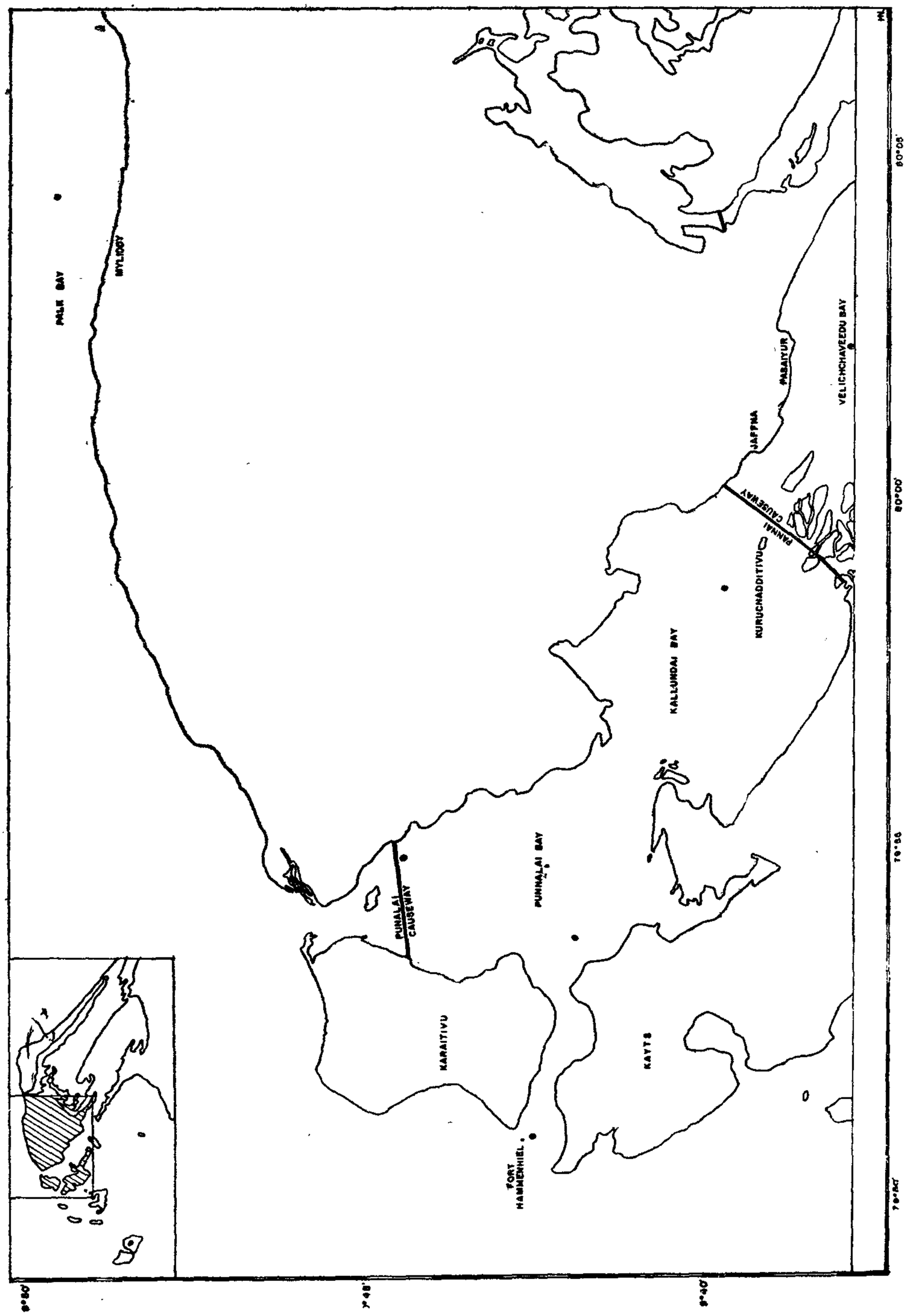

Figure 1. Map showing locations in the Jaffna Lagoon and the Palk Bay.

Temperature readings of the air and sea surface were made with the aid of a Centigrade thermometer calibrated to read 0·1°. Rainfall figures for Jaffna, Kayts and Palaly-Myliddy areas from August, 1967, to July, 1968, were supplied by the Meteorological Department.

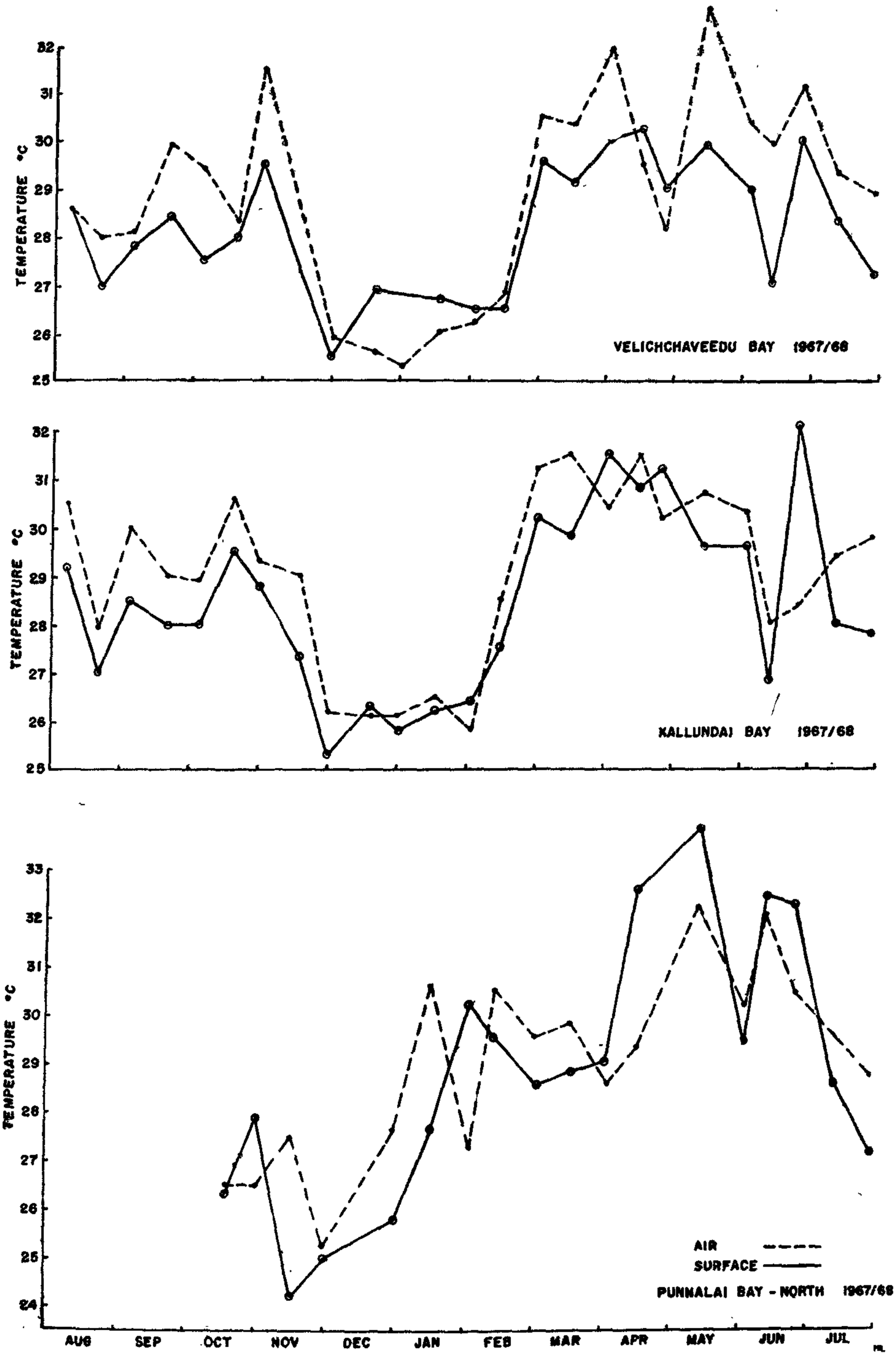

Figure 2. Seasonal variation of the air and sea surface temperature.

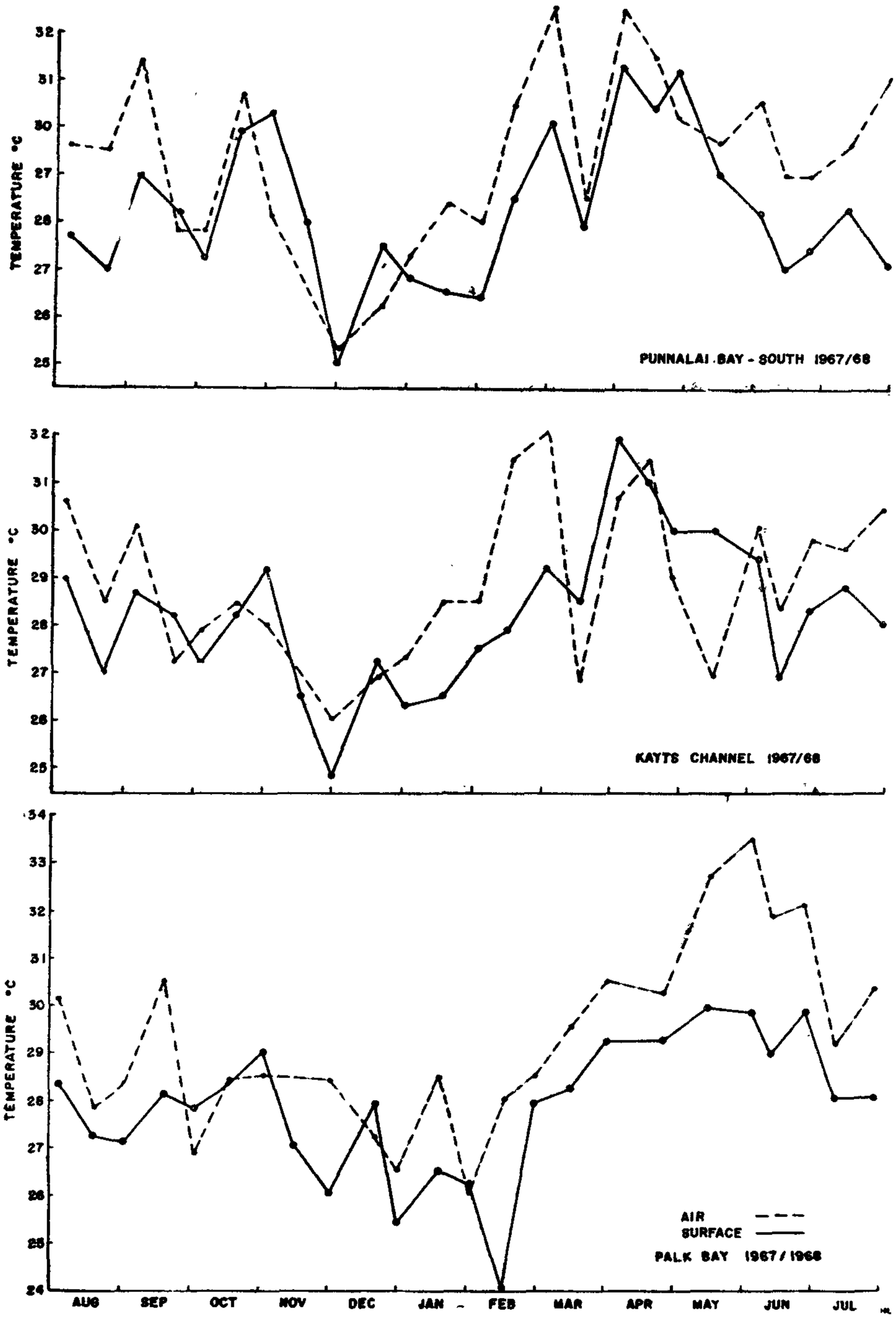

Figure 3. Seasonal variation of the air and sea surface temperature.

The surface temperature in the Lagoon varied from 24·2°C. to 33·8°C. whereas the variation in the open sea was from 24·0°C. to 29·9°C. The greatest variation in the lagoon was at Punnalai Bay North (24·2°C. to 33·8°C.). At the other stations, viz., Velichchaveedu Bay (25·5°C to 30·2°C.), Kalundai Bay (25·3°C. to 32·1°C.), Punnalai Bay South (25·0°C.to 31·3°C.) and Kayts Channel (24·8°C. to 31·9°C.), the variations were not so large. The surface temperatures in the Lagoon were at the highest during the month of April and were at their lowest during the month of December. In the Lagoon the air temperatures were higher than the sea surface temperatures throughout the year, except during the months of December and April. In the sea off Myliddy the surface temperatures were higher than the air temperatures only during the period from October to December.

The salinity values for the Jaffna Lagoon varied from a maximum of 45·49°/oo during July-August to a minimum of 10·38°/oo during December. The largest variation was observed at Punnalai Bay North. The salinity value for the open sea fluctuated between 28·39°/oo and 36·06°/oo. Salinity values for the different parts of the lagoon were as follows :—

Station	*Minimum*	*Maximum*
Vellichchiaveedu Bay	20·68°/oo ..	39·38°/oo
Kalundai Bay	10·38°/oo ..	42·28°/oo
Punnalai Bay North	11·5°/oo ..	45·49°/oo
Punnalai Bay South	13·54°/oo ..	43·60°/oo
Kayts Channel	13·04°/oo ..	38·6°/oo
Palk Bay off Myliddy	28·39°/oo ..	36·06°/oo

The salinity values were high during June, July and August and were low during December, January and April.

The lagoon waters were largely influenced by the two Monsoons—the North-East Monsoon and the South-West Monsoon. The North-East Monsoon set in during mid-October and was characterised by heavy rainfall. The rainfall values were high during November and December, resulting in the heavy inflow of fresh water into the lagoon. There was little or no rainfall during the period from January to March. Rainfall values increased during April and thus there was influx of fresh water into the lagoon.

Surface salinity in the lagoon shows wide fluctuations. The range of fluctuations is narrow in the Palk Bay but is very wide in the lagoon. The seasonal variation in the surface salinity values closely approximates to the seasonal variation in the rainfall values for the year. Heavy rainfall experienced during the November and December months resulted in a large influx of rainwater from the land into the sea which brought about a considerable reduction in the surface salinity values. Even the slight rainfall experienced during late April lowered the salinity values in the lagoon and in the sea only to a smaller extent. Continuous absence of rainfall during May, June and July resulted in the rapid increase of the surface salinity values.

Lower salinity values in November and December in the Palk Bay may be attributed to the strong northerly current in the Bay of Bengal bringing large amounts of fresh water from those rivers emptying into the Bay of Bengal (Ganapathi and Murthy, 1954). Similar lowering of salinity in surface waters of the Bay of Bengal during these months has been recorded by Sewell (1928–1929) and Jayaraman (1951). The salinity value for the month of March for Palk Bay off Myliddy agrees with that recorded for Palk Bay in March, 1963 (Murthy andU dayawarma, 1964). The high salinity values during May in Palk Bay may also be due to the southerly current bringing high salinity waters from the south.

Insufficient exchange of water within the lagoon and, between the lagoon and the sea causes wide range in the fluctuations of the salinity values. The exchange of water between the sea and the lagoon is maintained mainly through two channels, the Kayts Channel and the Channel off Velichchiaveedu Bay. The Kayts Channel as it enters meets very shallow regions in the Punnalai Bay which obstruct effective tidal currents. Exchange of water between Kayts Channel and Punnalai

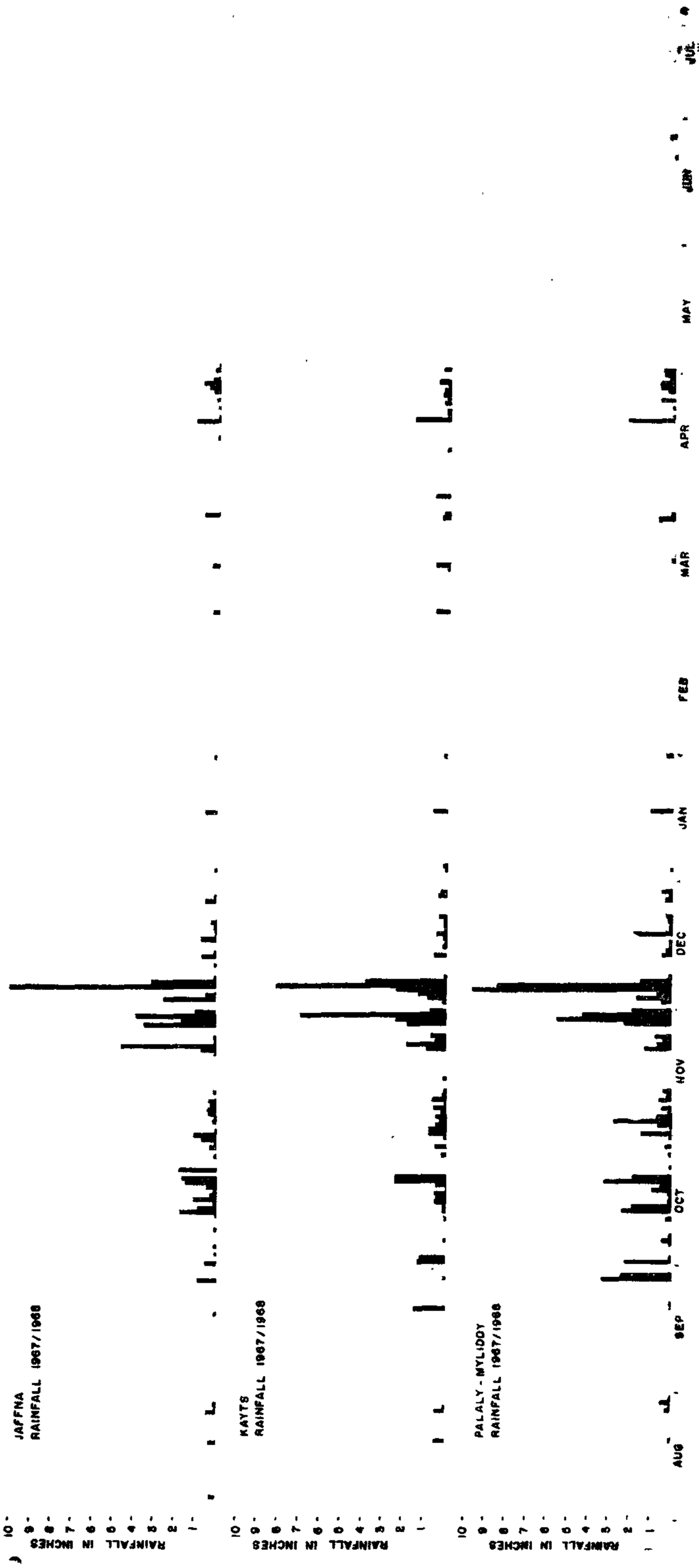

Figure 4. Daily rainfall data.

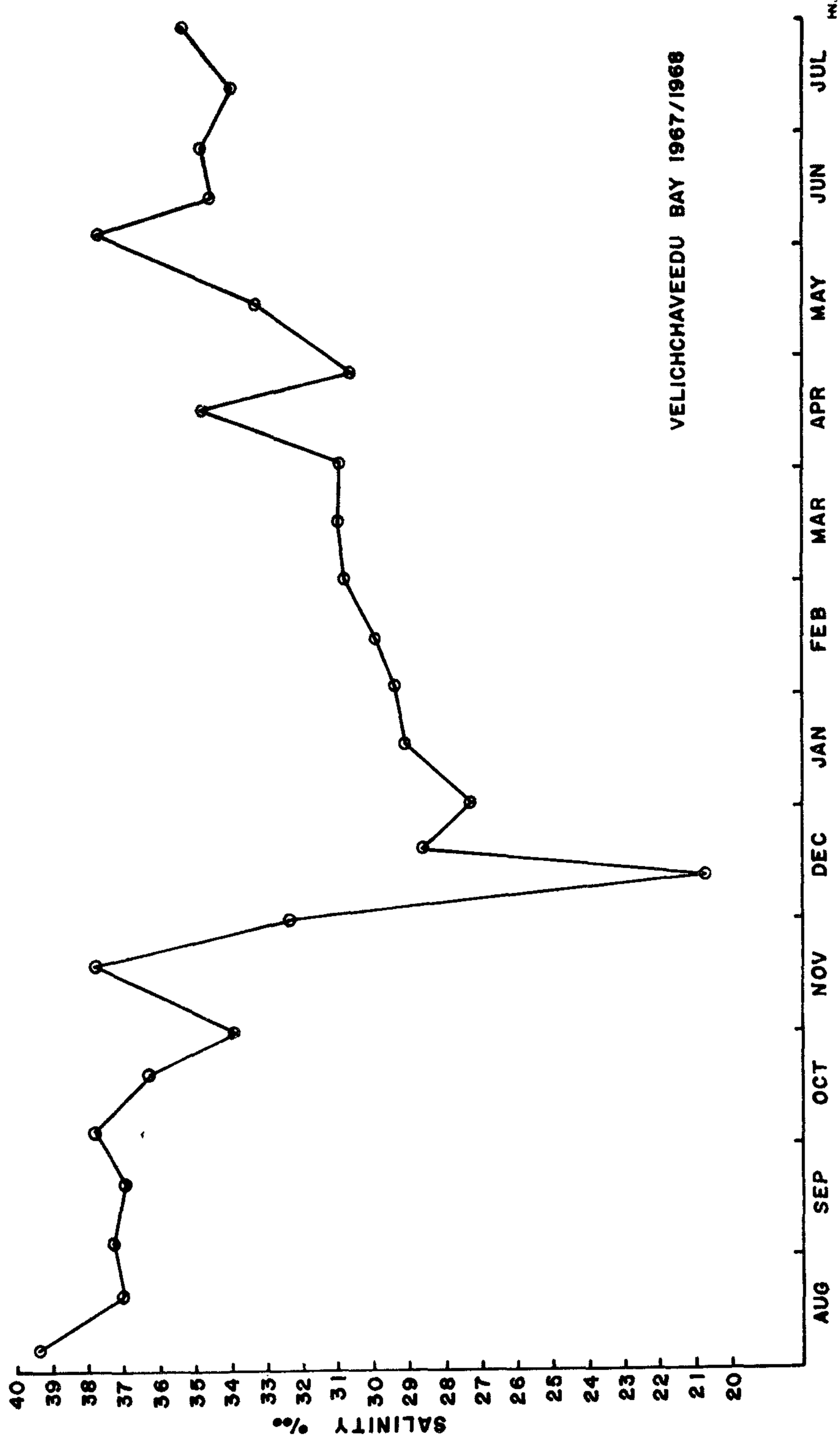

Figure 5. Seasonal variation of the sea surface salinity.

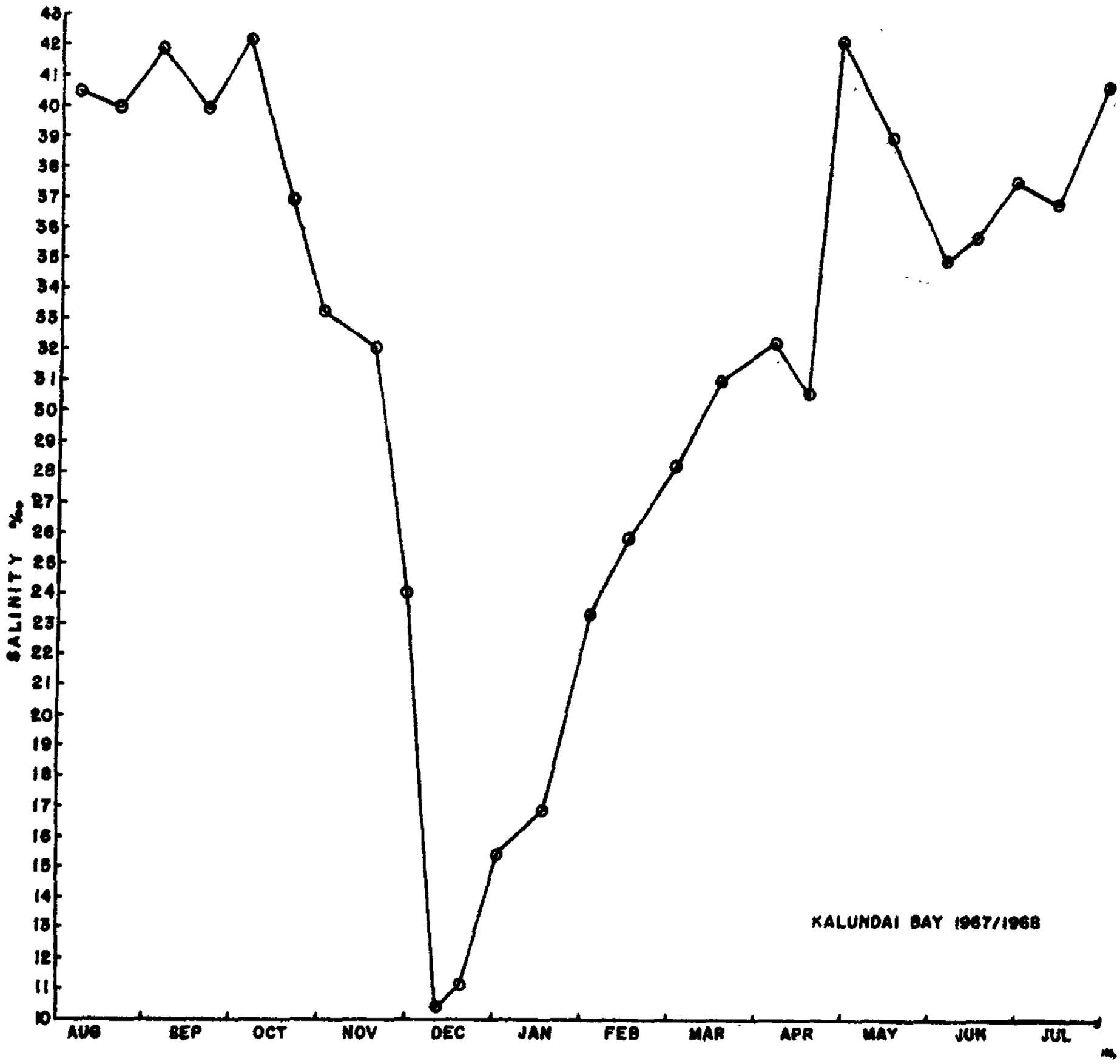

Figure 6. Seasonal variation of the sea surface salinity.

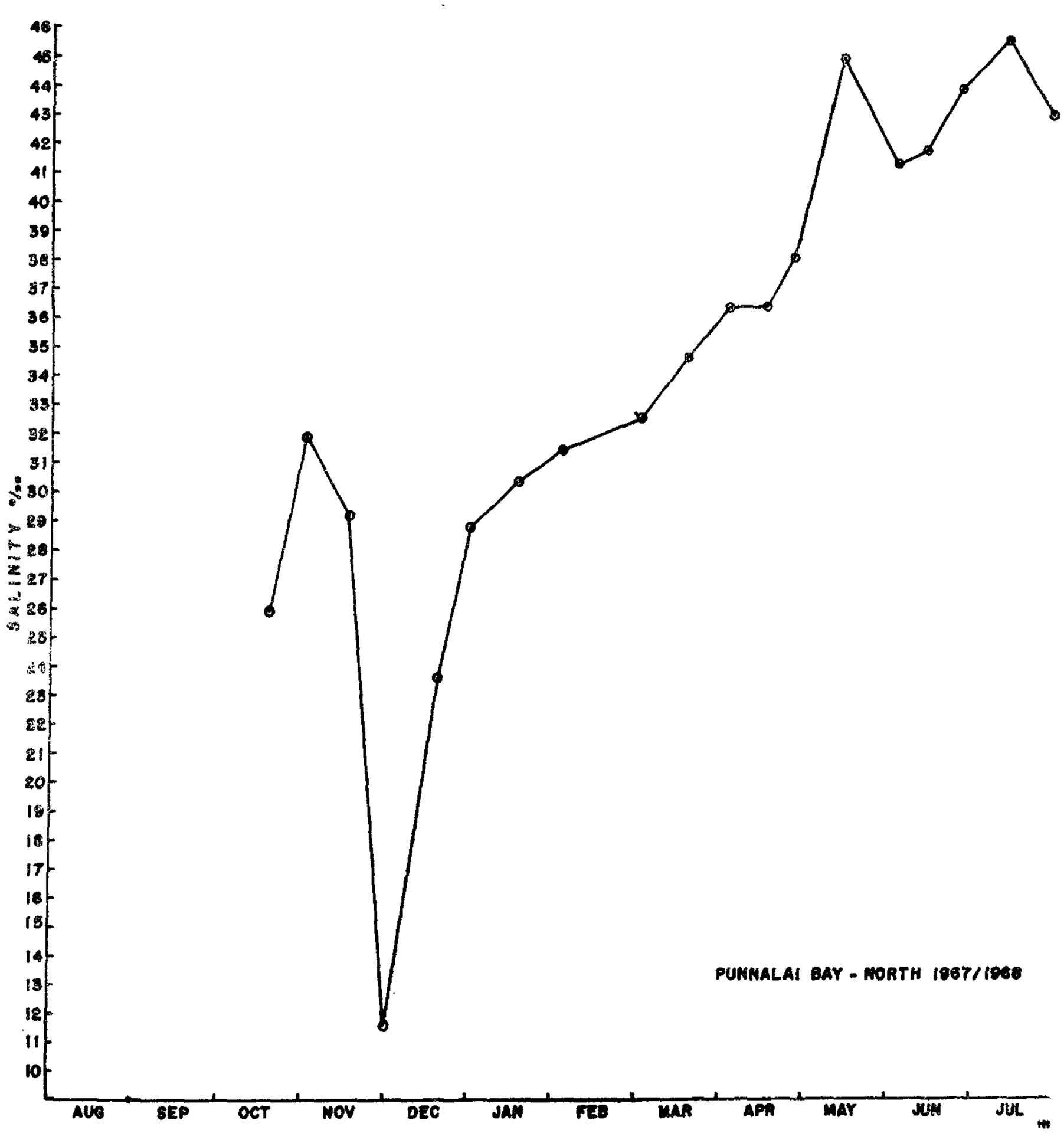

Figure 7. Seasonal variation in the sea surface salinity.

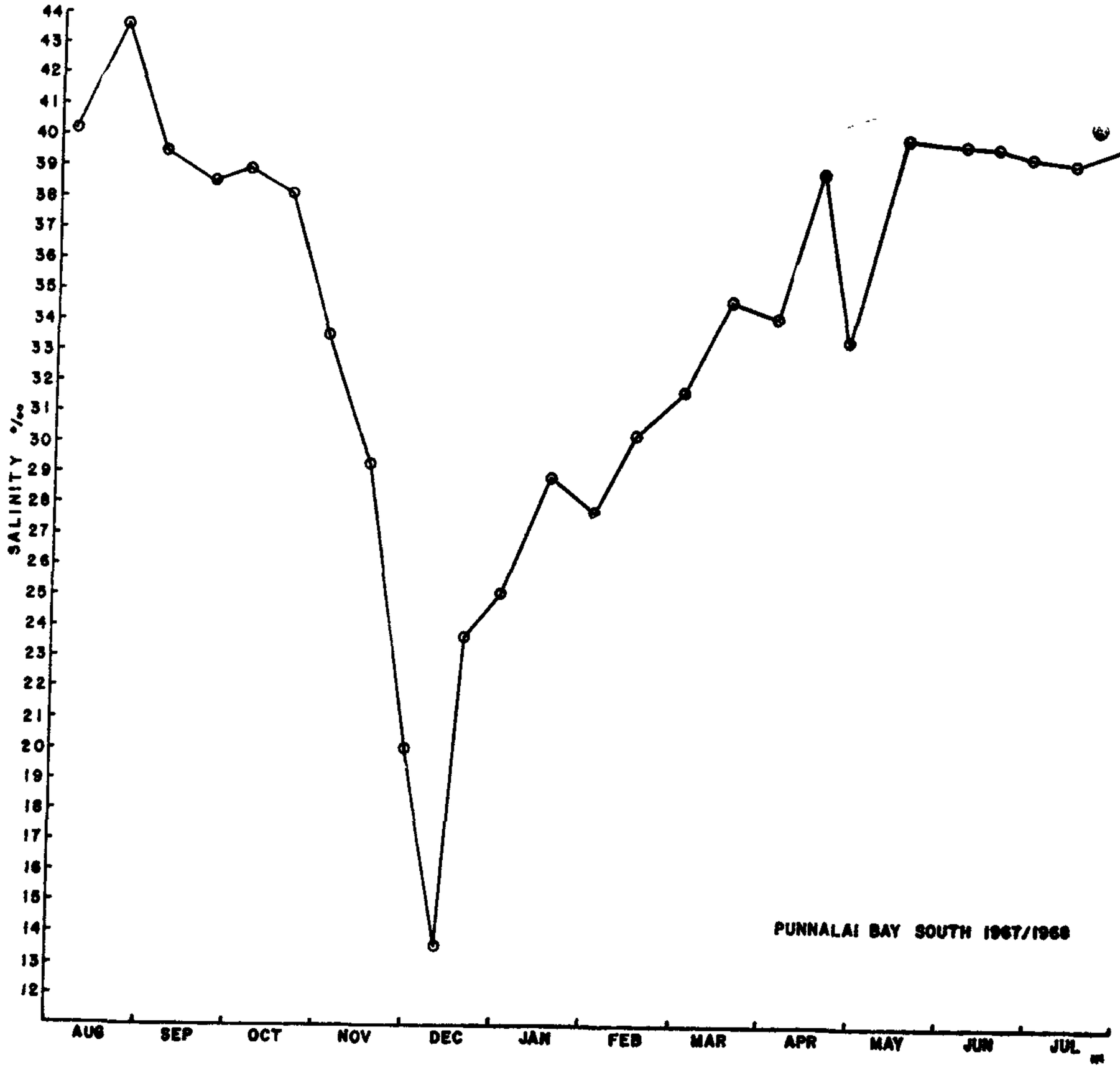

Figure 8. Seasonal variation of the sea surface salinity.

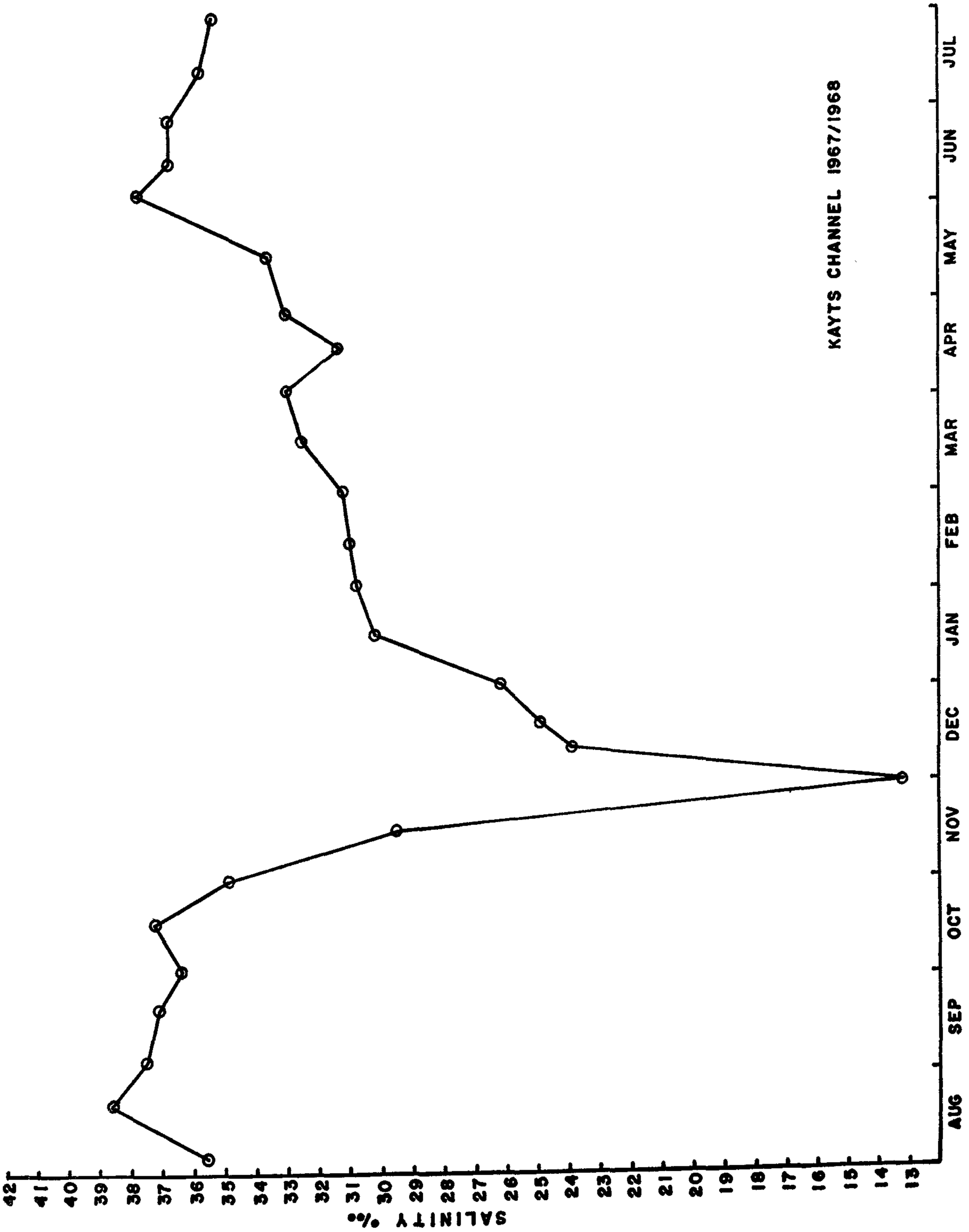

Figure 9. Seasonal variation of the sea surface salinity.

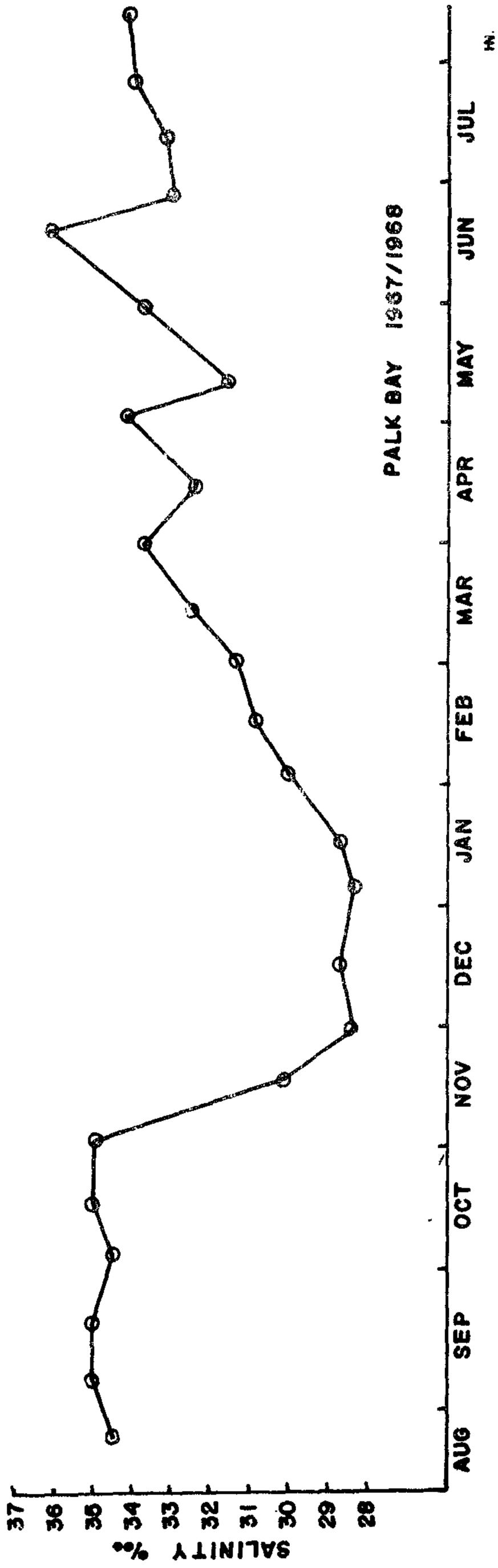

Figure 10. Seasonal variation of the sea surface salinity.

Bay is evident as the trend in the seasonal variations of surface salinity in both areas follows a closely similar pattern. But the exchange is not enough to bring the salinity values to the same level in both areas throughout the year (vide Figures 7, 8 and 9). Salinity values of Punnalai Bay as compared to those of the Kayts Channel remain higher during the period from May to September and lower during the period from October to December. Range of fluctuation of surface salinity values of the Kallundai Bay is similar to that of the Punnalai Bay. Kallundai Bay is connected to the open sea mainly through the Velichchaveedu Bay. The salinity at Kallundai Bay follows the same pattern of variation as that of the Velichchaveedu Bay but the range of fluctuation in the Kallundai Bay is wide whereas it is relatively narrow in the Velichchaveedu Bay. The Pannai Causeway connecting the Jaffna mainland and Kayts Island and built in between the two Bays may restrict the free flow of water between the two Bays as the main channel connecting the two Bays is partially blocked. Sudden lowering of salinity in the surface brought about by the run-off due to heavy showers during the first week of December was made up in January at the Punnalai Bay and only in March at Kallunadai Bay (vide Figures 6, 7 and 8).

Summary

Salinity and temperature in the sea surface of the Jaffna lagoon were observed from August, 1967, to July, 1968. Peak surface temperatures were recorded during April and the lowest temperature recorded was in December. The seasonal variations of surface temperature closely followed a similar pattern in all locations of the lagoon. Salinity values in the lagoon surface were very high during the period from May to August and were relatively low during the period from October to December. Monsoon, rainfall, exchange of water between the lagoon and the sea and within the lagoon, and the currents in the Palk Bay might have been the factors which influenced the salinity structure of the surface waters of the lagoon during this period.

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