A STUDY OF DRIFT IN THE NORTH MALACCA STRAIT FROM SALINITY DETERMINATIONS

by

V. Selvarajah

Fisheries Officer (Technical)
Fisheries Department, Federation of Malaya

ABSTRACT

The paper presents a study over twentyfive months of daily salinity changes at three points in North Malacca Strait and notes a strong correlation between salinity variations and monsoonal rain. The northwesterly current drift plays only a minor role.

INTRODUCTION

Whilst previous workers established the pattern of drift in the middle and southern parts of the Malacca Strait, the present study is on the northern entrances of the Strait and therefore is a contribution intended to complete the picture. Besides we have reason to believe that the Malayan Mackerel (*Rastrelliger* species) which is very abundant in South East Asia does not prefer a salinity of less than 30%. The influx of considerable amounts of fresh water containing nutrients from the land into the Strait of Malacca, and the heavy seasonal rainfall during the monsoon periods will necessarily have a significant effect on the salinity pattern in this area.

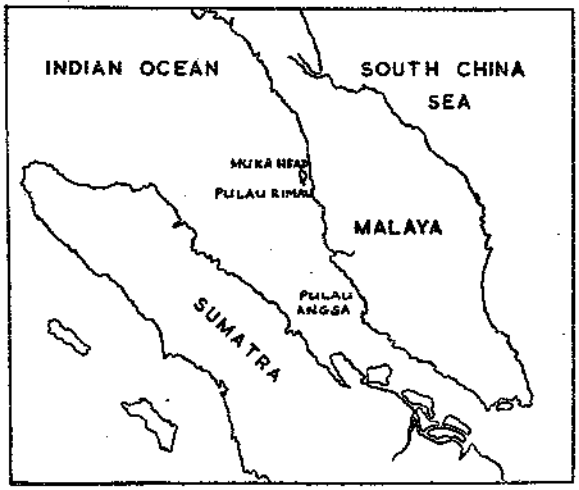
Work on the salinity pattern in the adjacent seas to Malaya has been done by various workers, in particular those of Weel (1923) who carried out a survey of the Java Sea and its entrances, Sewell (1928-29) who surveyed the Bay of Bengal and the Andaman Islands, whilst Chevey and Serene (1948) reported on the French Indo-China region.

Tham, Robinson and Tong (1952) made the study of drift in the Malacca and Singapore Straits and Soeriaatmadja completed the study of surface salinities in the Strait of Malacca in 1956.

The present study which extended from April 1958 to April 1960, was designed to complete the observations of Tham, Robinson and Tong in the Strait of Malacca and also to test the validity of the conclusions arrived at by Soeriaatmadja in 1956 in respect of the correlations between salinity and rainfall in the northern part of the the Malacca Strait.

MATERIALS AND METHODS

Samples of sea-water were collected just below sea level everyday at each of the three lighthouses in the north Malacca Strait viz. Pulau Rimau, Muka Head and Pulau Angsa (see sketch map) during the period April 1958 to April 1960. The chlorinities of the water samples were determined by Knudsen's method as described by Mathews (1923). The standard sea-water used was supplied by the Physical Oceanographic Association of Charlottenlund, Denmark, and the salinities were calculated from Knudsen's Hydrographical Tables (1901).

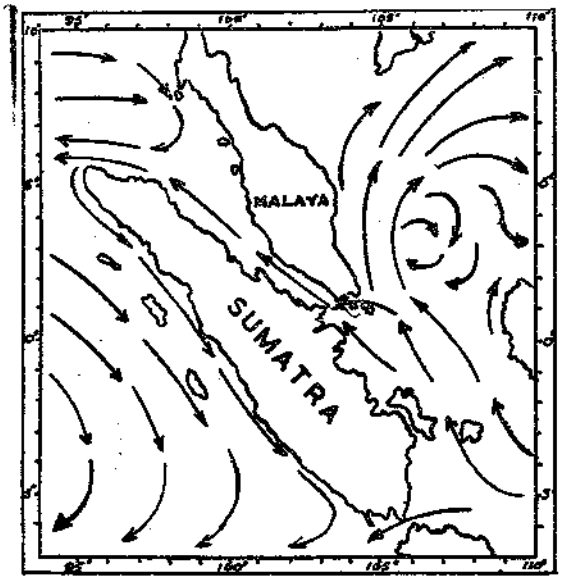


MAP SHOWING THREE SAMPLING STATIONS

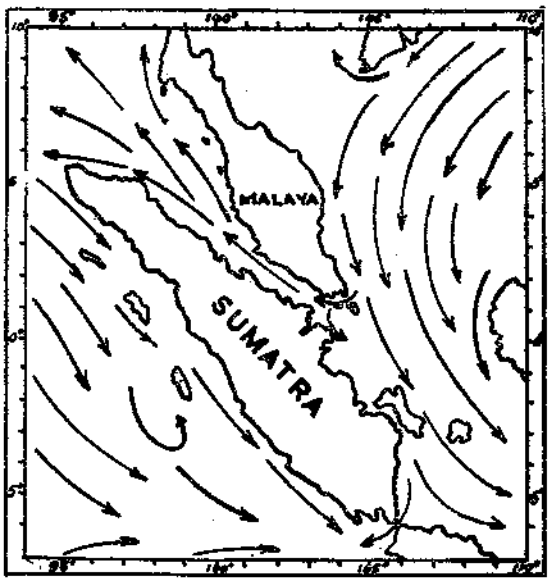
Summary of currents and rainfall in the Malacca Strait

According to the Malacca Strait Pilot (1946) continuous north-west going currents prevail in the central part of the strait throughout the year, except in June and August, when the currents are weak and sometimes reverse in the southern part. (Figs 1 and 2 extracted from the Malacca Strait Pilot (1946).

The northern part is influenced by the currents. During the north-east monsoon (November-April) currents of high salinity from the China Sea pass through the Singapore Straits into the Malacca Strait, while during the south-west monsoon (May to October) currents of low salinity from the Java Sea filter through the islands south of Singapore together with low saline water from the southern Malacca Strait. (Tham, Robinson and Tong 1952, page 2).



JULY



DECEMBER

GENERAL CURRENT CIRCULATION

FIG. 1 FIG. 2

Tidal flow is not appreciable beyond a distance of about 8 miles off the northern coast of Sumatra and about 40 miles off the north-east coast. Currents exceeding the rate of one knot, setting in various directions, may be experienced throughout the year in the Malacca Strait. Accoding to Weel's observations (1923) there is a great difference in salinity between the bottom layers and surface layers in the northern section of the strait of Malacca throughout the year, except for a few weeks during or about August, where the salinity of the surface layers is about the same as that of the bottom layer.

It is also noted that during the full south-west monsoon period of June-July, a current flows along the eastern part of the Andaman Sea along the west coast of the Malay Peninsula southward but turns to the west before entering the Strait of Malacca. This current meets the west going current emerging from the Malacca Strait between the lats. 6°N., penetrating the Indian Ocean. During the north-east monsoon period of October-April, a south-going current prevails in the South China Sea bringing in water of over 32% from the South China Sea and rounds the Malay peninsula before entering the Strait of Malacca. This is evidenced by the increase in salinity of the low saline water in the southern part of the Strait. A similar observation was made by Tham in 1952. The low saline water in the southern part moves slowly northward and mixes with the higher salinities in the northern part and the invesion of high saline water from the South China Sea into the Strait of Malacca is illustrated first by an increase in salinity in the southern part after October (Tham 1952, Soeriaatmadja 1956) to its maximum in March, and then a second higher salinity in the southern part than in the middle part during December—March.

In spite of the heavy rainfall during the north-east monsoon, the salinity is maintained in the southern part during this period. This necessarily means that the salinity in the southern

part of the Strait of Malacca is not affected by the heavy north-east monsoon.

The picture in the northern part of the Strait is different, as is shown by the graphs of salinity and rainfall. (Fig. 3).

The monthly averages of salinity readings at the three lighthouses have been tabulated for the period between April 1958 and April 1960. (See Appendix A).

Figures 4 and 5 show the corresponding rise and fall between the three stations, Muka Head, Pulau Rimau and Pulau Angsa. The correlation coefficients between the monthly averages for (1) Muka Head and Pulau Rimau and (2) Pulau Rimau and Pulau Angsa have been calculated and are given in the following table together with the corresponding values of 't' and 'P' (n=24).

Correlation between	r.	t.	P
Muka Head and Pulau Rimau	0.7202	4.87	less than 0.001
Pulau Rimau and Pulau Angsa	0.3993	0.24	0.10 to 0.05

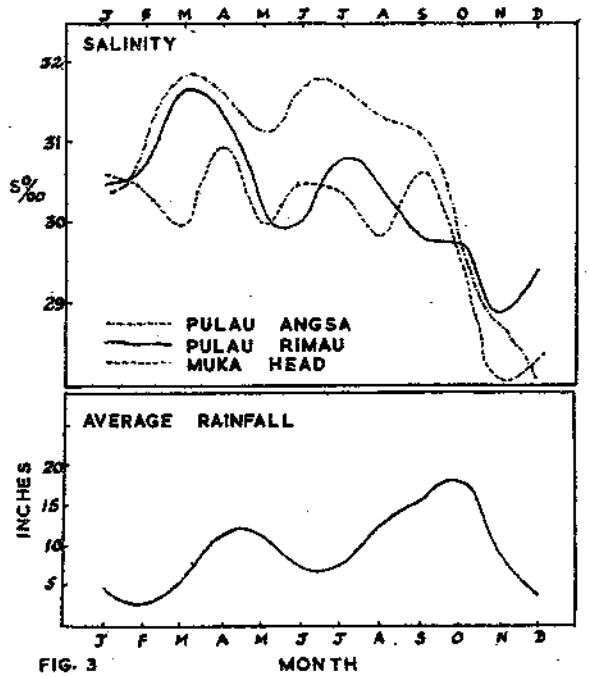


FIG. 3

Rainfall. (Average of 5 years) extracted from Malacca Strait Pilot 1946

Monthly Variation of the surface salinities in the northern part of the Strait of Malacca (monthly averages for the period January–December 1959)

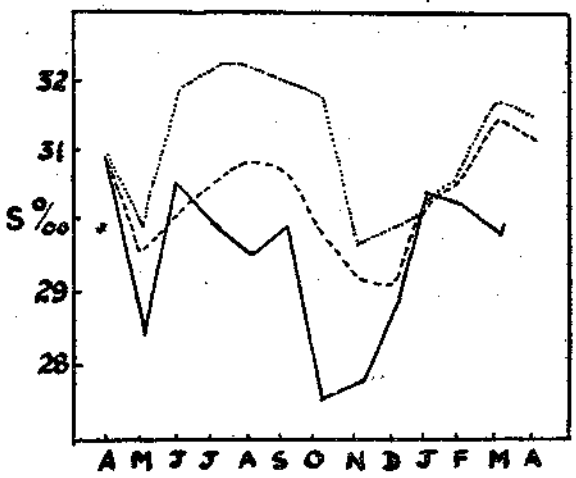


Fig. 4 —— Muka Head
---- Pulau Rimamu
.... Pulau Angsa

Monthly Average Salinities 1958-1959

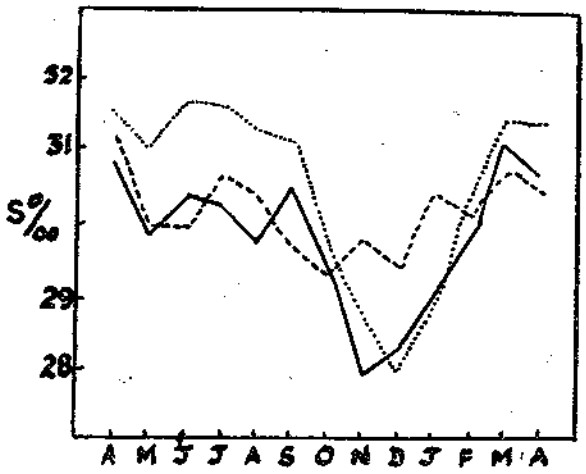


Fig. 5 —— Muka Head
---- Pulau Rimau
.... Pulau Angsa

Monthly Average Salinities 1959-1960

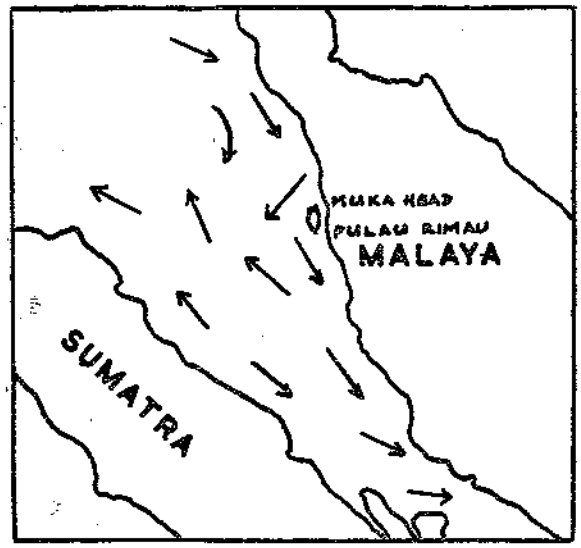


FIG. 6

Direction of Surface Current August
(According to the U.S. Navy Hydr. Office)

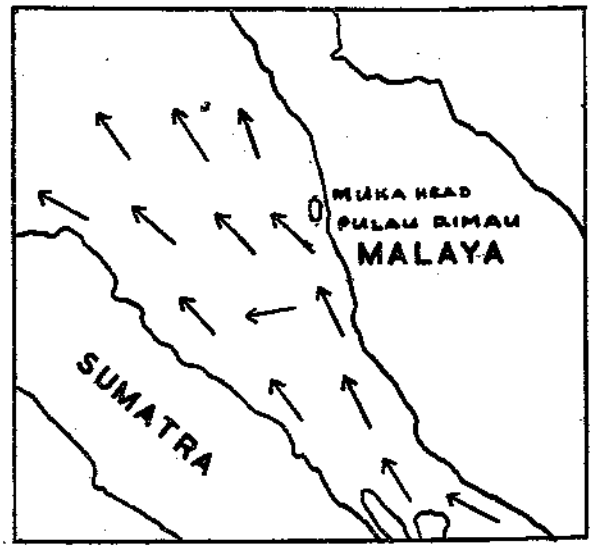


FIG. 7

Direction of Surface Currents September
(According to the U.S. Navy Hydr. Office)

An interesting observation is seen when we compare the salinity data of the northern part of the Strait of Malacca with the data of rainfall in the coastal area of the Malacca Strait. (Fig. 3). There is no doubt that the salinity pattern consists of the two maxima, one in July-August and the other during March-April and two minima, one during May and the other during November—December.

The salinity minima undoubtedly coincides with the heavy north-east monsoon rainfall in November—December and the onset of the south-west monsoon in May.

The decrease in salinity in May is due to the slight increase in rainfall after February (Fig. 3) as well as the transfer of low saline water from the middle and southern parts of the Strait by the nort-west-going current during March-April. The sudden increase in salinity after May to a maximum in August is due to the decrease in rainfall after May. The onset of the heavy north-east monsoon after August with its peak in November—December likewise lowers the salinity during these two months. These observations on the corresponding rise and fall of surface salinities show a strong correlation to the marked rainfall periods of the monsoon in the northern part of the Straits of Malacca.

Tham (1952) and R. Soeriaatmadja (1956) made similar observations in this respect on the above, and my findings over the period April 1958 to April 1960 strongly support the conclusions they reached.

Direction of Drift in the North Malacca Strait

While the general pattern of salinity variation consists of two maxima and two minima throughout the Strait of Malacca, the salinity variation off Muka Head shows a third minimum in August and maximum in September. This could be explained by the fact that during the full south-west monsoon period of June—July, a current flows along the eastern part of the Andaman Sea along the west coast of the Malay peninsula southward, bringing in water of low salinity due to land drainage along the Kedah coast and turning off to the west above Muka Head and joins the north-west going current of a

slightly higher salinity from the southern part of the Strait (see Figs. 6 and 7). This also happens to be a rainy period for the Kedah coast.

By September this current eases off and is replaced by the north-west going current of higher salinity throughout the northern entrances of the Malacca Strait.

The drop in salinity at Muka Head in October shows that the north-east monsoon has begun and indicates a corresponding drop at all three stations along the west coast of Malaya.

The above observations reveal the fact that salinity variations in the north Malacca Strait have a strong correlation with the seasonal changes of the north-east and south-west monsoon periods while the drift in this area is towards a north-west direction almost throughout the year.

SUMMARY

1. A study of the daily changes in salinity at three points in the north Malacca Strait viz. Muka Head, Pulau Rimau and Pulau Angsa have been carried out for twenty five months.

2. A strong correlation is noted between salinity variations and seasonal rainfall due to the north-east and south-east monsoons.

3. The drift of currents in the north Malacca Strait is in the north-west direction throughout the year and plays a minor role in the salinity variations in the northern area than in the southern part of the Malacca Strait.

Acknowledgement

The author wishes to express his indebtedness to the Harbour Master, Penang, and the Lighthouse Keepers at the three stations for collection of the sea-water samples, and to Mr. Soong Min Kong, Director of Fisheries, Federation of Malaya, for his constant encouragement throughout the investigation.

REFERENCES

ROBINSON, R.A., H. TONG and THAM AH KOW (1952).

"A Study of Drift in the Malacca and Singapore Straits from Salinity Determinations". *University of Malaya Contribution No. 31.* Hydrographic Department, Admiralty, 1946. Malacca Strait Pilot 1946.

SOERIAATMADJA, RD. E. (1956)

"Surface salinities in the Straits of Malacca". *Oceanographic Station List 1956.*

SOERIAATMADJA, RD. E. (1956)

"Seasonal Fluctuations in the Surface Salinity off the North Coast of Java". *Marine Research in Indonesia No. 1*

SOERIAATMADJA, RD. E. (1957).

"The Coastal Current south of Java". *Marine Reseorch in Indonesia, No. 3, 1957.*

THAM AH KOW (1950)

"The Food and Feeding Relationships of the Fishes of Singapore Straits". *Colonial Office Fishery publication* Vol. 1 No. 1, H.M. Stationery Office, London.

THAM AH KOW (1953)

"A Preliminary Study of the Physical, Chemical and Biological Characteristics of Singapore Straits". *Fishery Publication,* Vol. 1 No. 4 1953, H.M. Stationery Office, London.

KNUDSEN, M. (1901)

Hydrographical Tables. Williams and Norgate, London.

GOULDEN, C.H. (1952)

Methods of Statistical Analysis. Second edition. John Wiley and Sons Inc., New York.

APPENDIX 'A'

MONTHS		LIGHTHOUSE		
		Muka Head	Pulau Rimau	Pulau Angsa
1958	April	30.84	30.84	31.03
	May	28.47	29.72	30.06
	June	30.68	30.25	31.89
	July	30.10	30.61	32.29
	August	29.68	30.99	32.23
	September	30.14	30.82	32.06
	October	27.56	30.00	31.88
	November	27.85	29.34	29.83
	December	28.95	29.24	30.00
1959	January	30.54	30.39	30.34
	February	30.35	30.72	30.93
	March	29.93	31.59	31.81
	April	30.95	31.30	31.59
	May	29.96	30.07	31.08
	June	30.43	30.01	31.67
	July	30.33	30.75	31.68
	August	29.81	30.44	31.30
	September	30.65	29.82	31.11
	October	29.56	29.74	29.80
	November	28.03	28.33	28.75
	December	28.31	29.43	28.00
1960	January	29.03	30.48	28.82
	February	29.83	30.15	30.40
	March	31.16	30.78	31.50
	April	30.73	30.50	31.50

Monthly Averages of Daily Salinity Readings