Bull. Fish. Res. Stn., Ceylon. Vol. 21. No. 1. pp. 39–47 June, 1970

The Adaptive Variations in Catchability of Trawls on the Wadge Bank

By

V. N. CHESTNOY*

INTRODUCTION

The author made a trip on the Ceylon Fisheries Corporation trawler m/t "Pesalai" from 18th February, to 4th March, 1970, in order to study, amongst other matters, the "Adaptive Variations in Catchability of Trawls on the Wadge Bank." This was during the period of the North-East Monsoon which offers very unfavourable conditions for commercial fishing on the Wadge Bank. It was a normal commercial fishing trip and the work of the author was done in keeping with the schedule of work of the trawler. A trip made to the Wadge Bank on the trawler m/t "Myliddy" in November, 1969, also helped in this study.

HYDRO-OPTICAL CRITERION—PENETRATION OF LIGHT THROUGH WATER

One of the conditions which affect the behaviour of fish and thereby the catchability of trawls is the "hydro-optical condition". The effectiveness of the catching ability of the trawl is determined by the "Visual Distant Reception" of the fish. The "Visual Distant Reception" involves not only the quantities of illumination of the surroundings but also the influence of transparency, depth, etc.

When light penetrates through water there is a diminution of illumination with increase of depth. This is due to scattering and absorption of light and follows the exponential law (Gershun, 1939, and Shuleikin, 1953) given by :

$$J^1 = J^1_\circ \times e^{-(K_\circ + \rho_\circ) \times h}$$

where $J^1_\circ$ = Under surface energy of light.

J^1 = Energy of light that passed through water layer of height h meters.

$K_\circ$ = Coefficient of absorption.

$\rho_\circ$ = Coefficient of scattering.

Also $K_\circ + \rho_\circ = \gamma$

where γ is termed "the exponent of vertical extinction of light."

Hence $J = J_\circ \times e^{-\gamma \times h}$

---

*F.A.O. Fishing Technologist attached to the Ceylon Fisheries Corporation, P.O. Box 258, Colombo, Ceylon.
Permanent Address : Verhnja Krasnoselskaja Street, House 17, VNIRO, Moscow 140, USSR.

TRANSPARENCY OF WATER AND CATCHABILITY OF TRAWL

A factor which affects the "Visual Distant Reception" of fish is the transparency of water, and is measured in terms of the maximum distant visibility of an object. Poole and Atkins (1929) observed that there is a dependence between the component of vertical extinction of light "δ" and depth of disappearance of a Secchi disc— "Z_o". Ivanov (1936), Gershun (1939) and Shuleikin also expressed views on this dependence. Chestnoy (1970) worked out the relationship between the maximum distance of visibility of a Secchi Disc at different depths under different relative transparencies of sea and expressed it as :

$$Z = Z_o - 0.09\ h$$

where Z_o = Depth of disappearance of the Secchi Disc while measuring from board of vessel ;

Z = Maximum Distance of visibility of Secchi Disc.

0.09 = Constant empirical coefficient.

The most important component part of the formula of the hydro-optical criterion of catchability of trawl is a change in the relative transparency of sea—Z_o.

NOMOGRAM OF CHANGES OF "Z_o" AND THE RELATIVE TRANSPARENCY OF SEA AT NOON ON THE WADGE BANK IN NOVEMBER & FEBRUARY

The trips that were made to the Wadge Bank in November, 1969, and February, 1970, permitted the author to construct the general nomogram (Fig. 1) of changes of "Z_o" during the 24-hour period

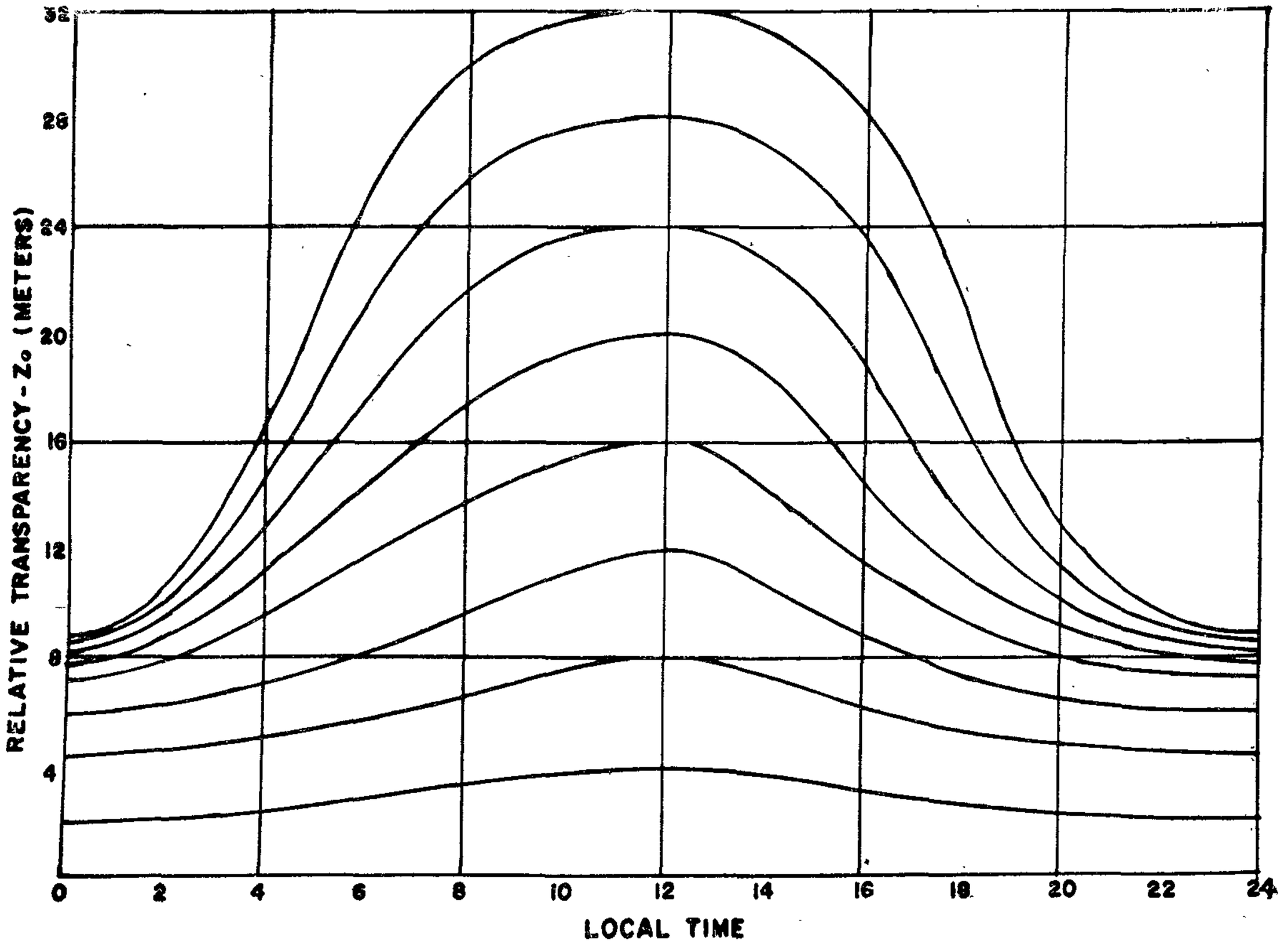


Fig. 1.—Nomogram of 24 Hour changes of " z_o " on the Wadge Bank.

in the water with the different "Exponent of Vertical Extinction." This nomogram made it possible to prepare the maps for the relative transparency of the sea at noon time in November and February (Fig. 2).

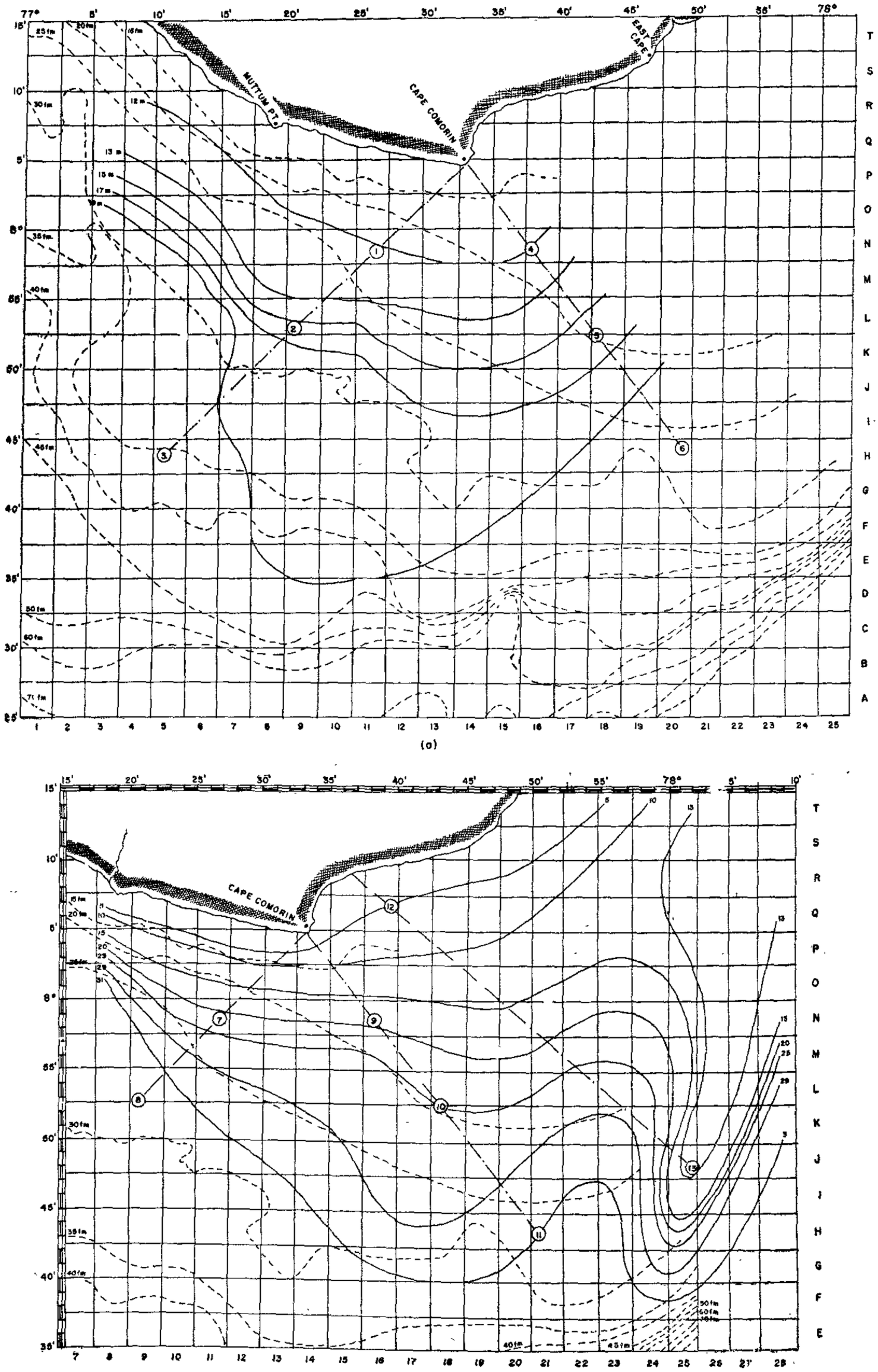


Fig. 2.—Relative Transparaency of sea at Mid-day on the Wadge Bank. (*a*) November 1969. (*b*) February 1970.

It is seen from Fig. 2 that with the development of the North-East Monsoon the optical exponent of water masses also changes. Water becomes more transparent. The catches of the trawlers drop. Only in the zone of a narrow coastal strip where the transparency remains practically the same, did the catches remain the same. In this area catches of 300 kg. per trawling hour are usual and such a catch rate is considered good for the North-East Monsoon.

OPTIMUM AREAS AND BEST TIME OF THE DAY FOR TRAWLING ON THE WADGE BANK IN NOVEMBER & FEBRUARY

The forecasting of the optimum areas and time of commercial trawl fishing, when the catchability of the trawl has the maximum value, acquires special significance for the practice of fishery. The preliminary knowledge of the areas and the time of commercial trawl fishing creates the favourable pre-requisites for working out the optimum tactics of commercial trawl fishing.

The computations stated in the previous paragraph can be made from the data gathered during the trips to the Wadge Bank in November and February. The initial exponent of these computations is a graph of adaptive changes in the catchability of trawls. The quantity of the amplitude of adaptive variations in the catchability of trawls is first determined on the basis of data on the different speeds of trawling. (Chestnoy, 1969).

The data on 24-hour variations of catches and relative transparency of sea makes it possible to determine the positions of maxima and minima of catchability of trawls in relation to the scale of hydro-optical criterion of catchability. (Chestnoy, 1969). On the basis of this data nomograms have been prepared (Fig. 3). The curves of adaptation to irritation and rest correspond to every type of 24-hour course of light irritation. These curves were determined with the help of the formula of hydro-optical criterion of catchability and maps for the midday relative transparency and appropriate curve of Fig. 1. Its own adaptive curve will correspond to every concrete point of trawling. On the basis of these curves corresponding to the data of Fig. (1) and formula of hydro-optical criterion of catchability one can construct the curve of 24-hour variations in catchability of trawls at each point of commercial trawl fishing.

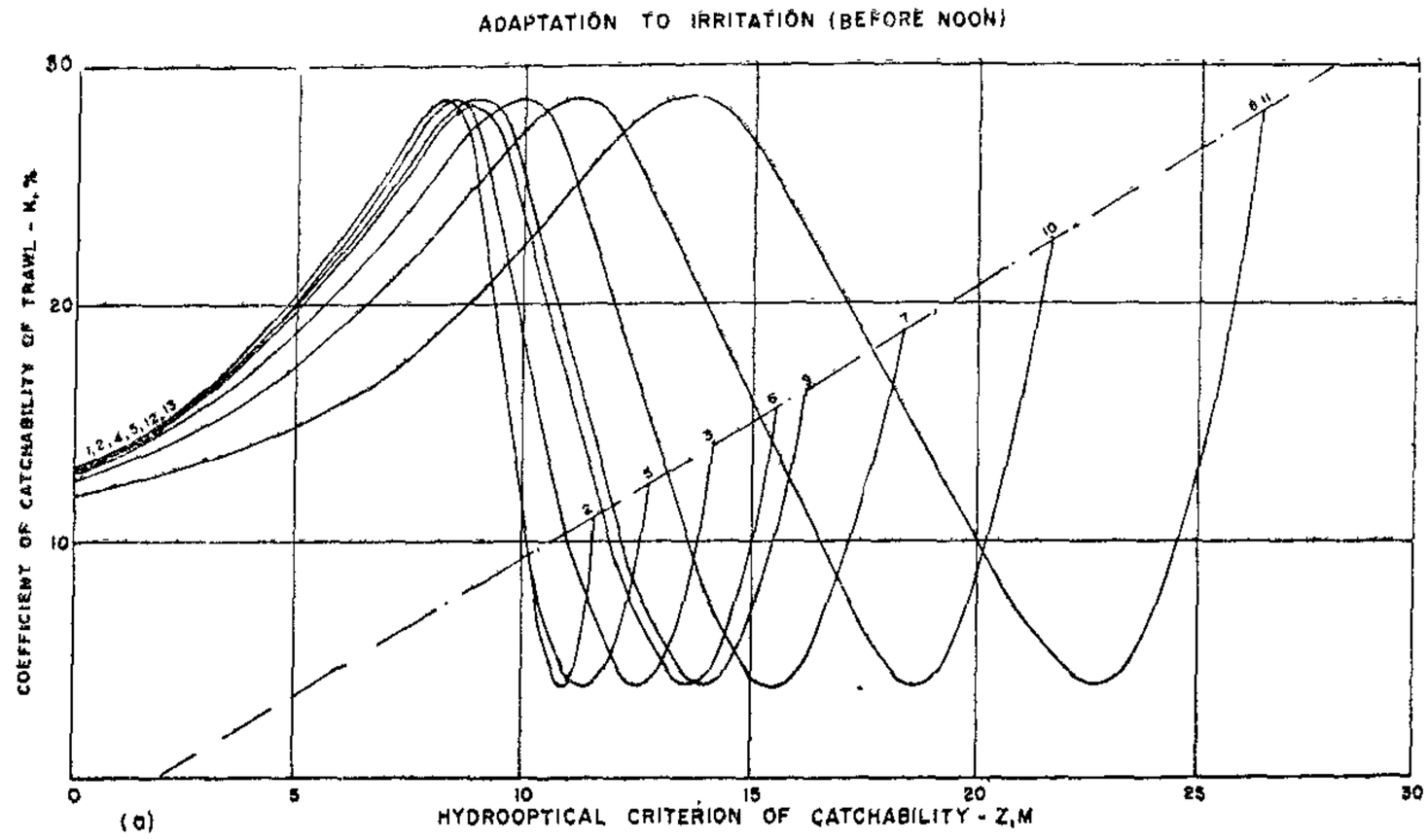
A series of curves of 24 hour variations in the catchability of trawls was constructed, (Fig. 4) a curve each for the circled points marked 1 to 13 in Figs. 2 and 3. Three types of variations in catchability can be identified for these curves.

"*Type A*" (maximum—at midday hours; minimum—at midnight) are observed in the coastal areas.

"*Type B*" In moving off the shore, the first signs of minimum of catchability of trawls start to appear during the midday hours and catchability gradually reduces.

"*Type C*" In the central areas of the Bank in waters of high transparency the 24 hours variations in catchability with 3 maxima are predominant.

The comparison of the time of appearance of maxima in the different areas shows that this time is different. On the basis of the data on the 24 hours changes in the time of maximum catchability of trawls, the maps for 24 hour shift of maximum catchability of trawls on the Wadge Bank in November and February have been prepared. (Fig. 5) The figure indicates that the movement of the wave of maximum catchability of trawls before the midday period is directed towards the shore. The speed of movement of the wave in the central part of the Bank is about 10 m.p.h. Close to shore the speed reduces up to 2 m.p.h.



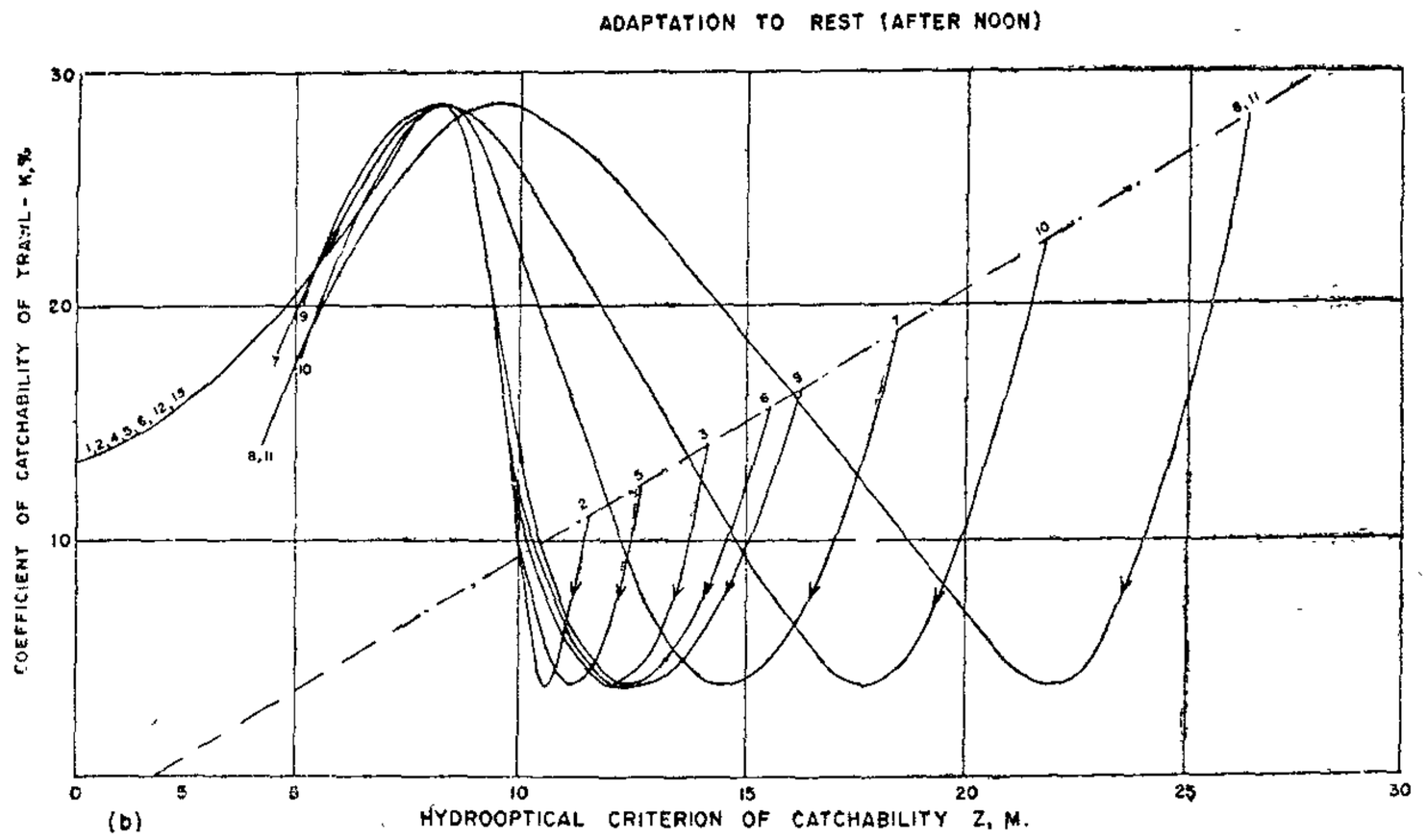


Fig. 3.—Nomograms of Adaptive variations in Catchability of Trawls on the Wadge Bank
(a) Adaptation to Irritation (b) Adaptation to Rest.

Using Fig. 5 one can plan the tactics of commercial trawling so as to move together with the wave of maximum catchability of trawls.

Trawling in November in the central areas of the Bank was extremely unprofitable. The speed of shift of the waves exceeds the speeds of trawling by a considerable amount. The trawling in the coastal areas is much more profitable. One can plan the directions of trawling so as to let the trawl be under the conditions of maximum catchability during the considerable time of the 24 hour period.

In February the conditions for commercial trawl fishing are slightly complicated. (Fig. 6).

In the central areas of the Bank the speed of movement of the wave sometimes reaches 77 m.p.h. In the coastal areas the speed reduces upto 0.6 p.m.h. It creates special favourable conditions for the commercial trawl catching in the coastal area. Yet, to come very close to the coastal strip is also not profitable due to a reduction in the catchability of trawls during the midday hours. (See Curve 12, Fig. 4)

The South-East area of the Bank is especially interesting from the point of view of commercial trawl fishiery.

Moving towards the South-Eastern direction along the South Eastern sea coast of India, the coastal current is divided into 2 branches. One branch moves along the sea coast and forms two circulations in the area of Cape Comorin. (Chetsnoy 1969) The second branch of the current moves along the continental slope.

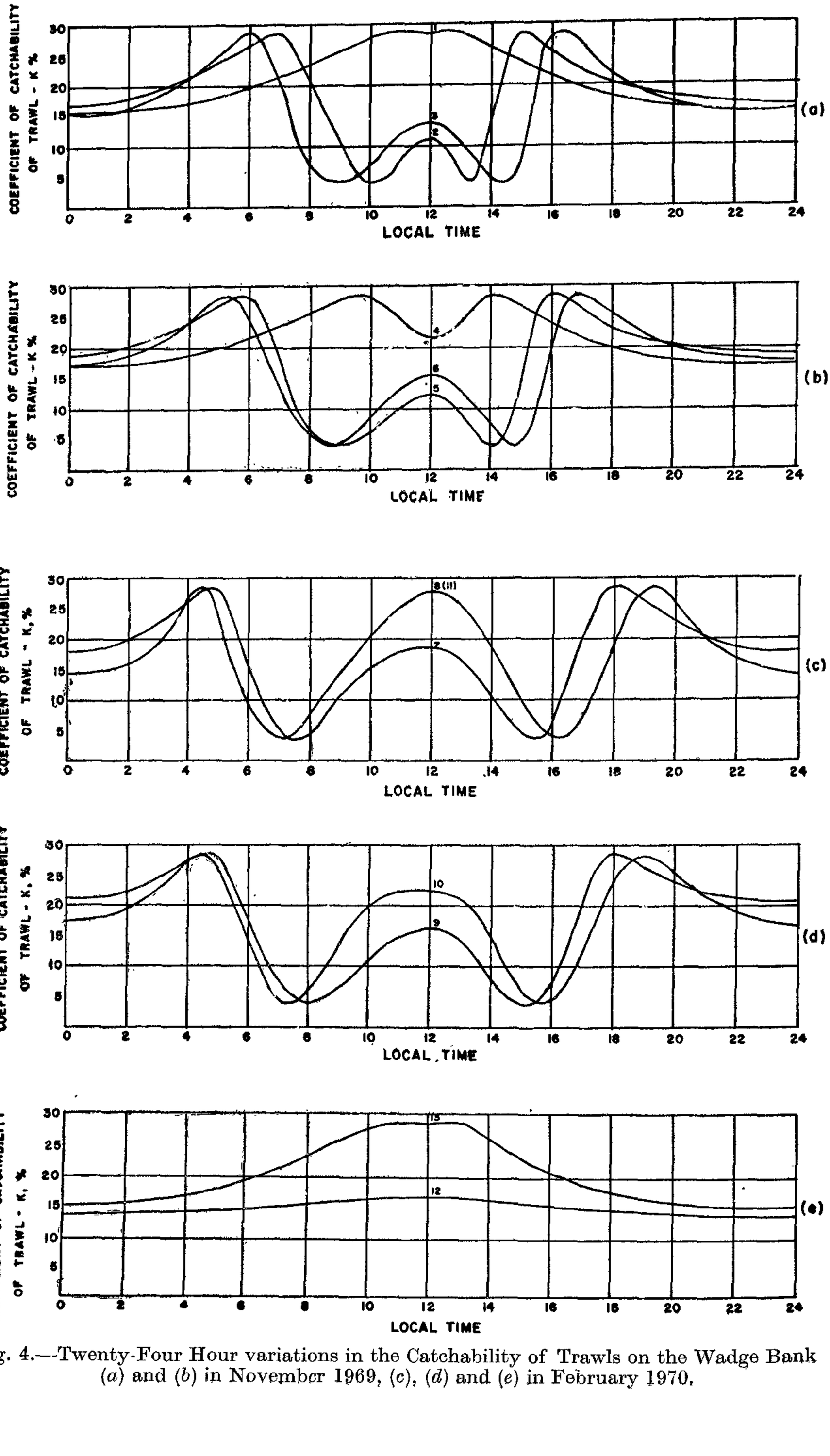


Fig. 4.—Twenty-Four Hour variations in the Catchability of Trawls on the Wadge Bank (*a*) and (*b*) in November 1969, (*c*), (*d*) and (*e*) in February 1970.

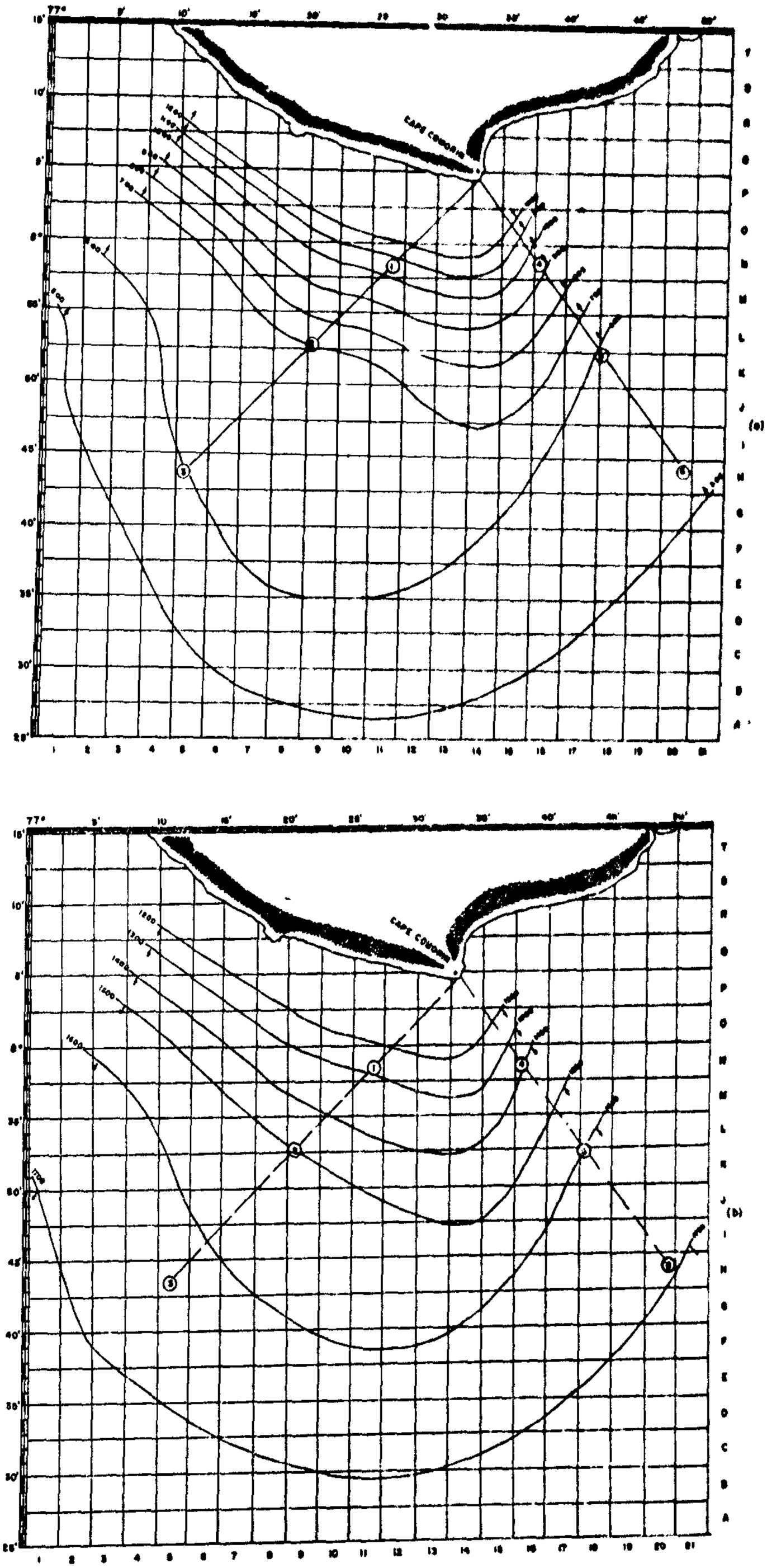


Fig. 5.—Maps for the Movement of Wave of Maximum Catchability of Trawls (*a*) before, and (*b*) after the Mid-day of Twenty-four Hour Period in November 1969.

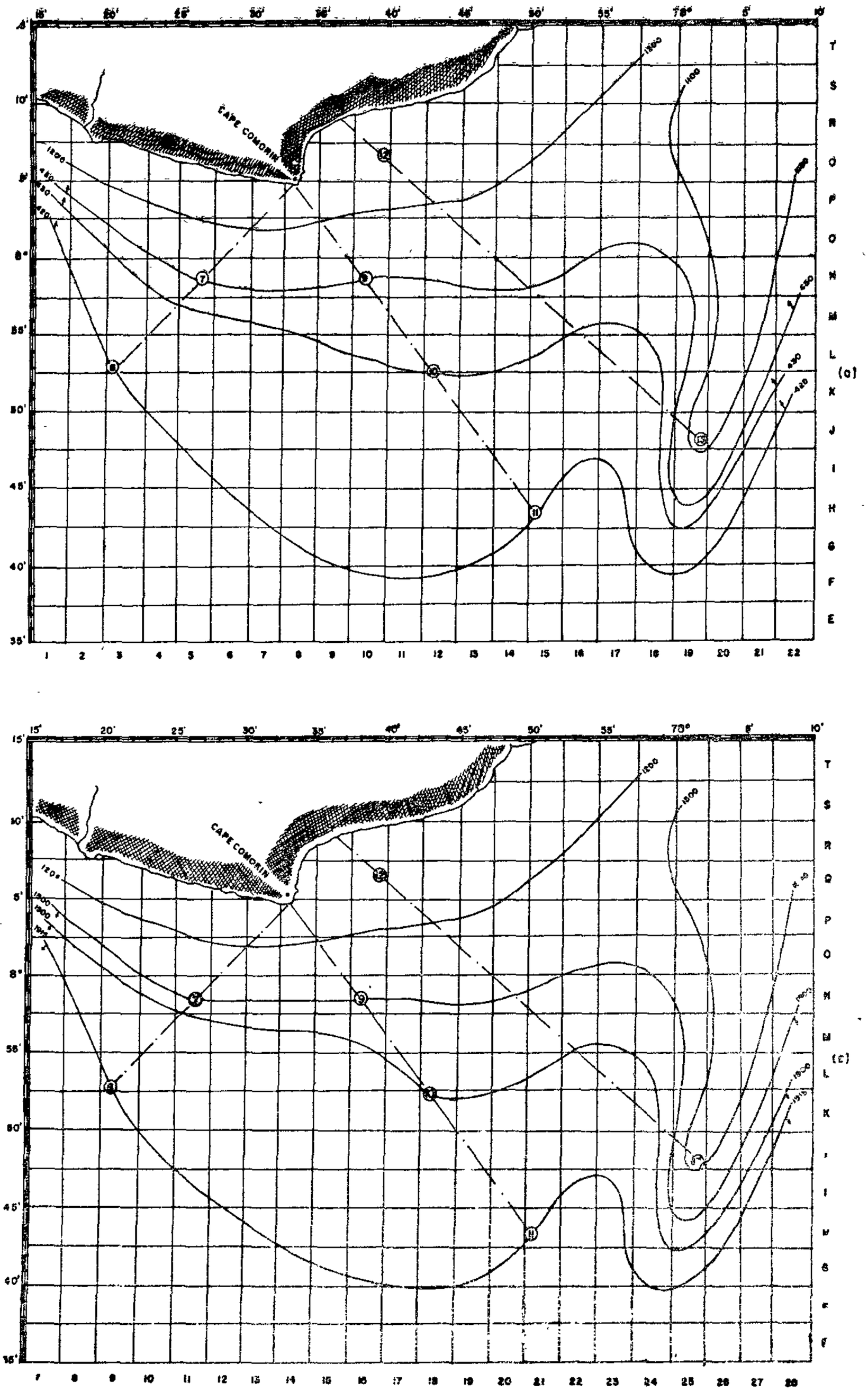


Fig. 6.—Maps for the Movement of Wave of maximum Catchability of Trawls (*a*) before, and (*b*) after a Mid-day of Twnety-four Hour period in February 1970.

The waters of both branches are of coastal origin. They are of low transparency and contain a large quantity of suspended substances of organic origin.

The branch of the current moving along the continental slope has a big influence on the efficiency of commercial trawl fishing in this area. From the point of view of 24 hour dynamics of catchability of trawls the conditions here are the same as those in the coastal areas.

In the square J 25, the maximum of catchability to trawls was observed during the midday hours. (Curve 13, Fig.4). At the same time the neighbouring squares with water of high oceanological transparency have the 24 hour rhythm of catchability with the 3 maxima in the morning, at midday and in the evening. Moving in a course N.E. and S.W. and crossing the square J 25, the trawler stays most of the time in the zone of high catchability of trawl. It can be explained by the fact that in this area the trawlers have had relatively stable commercial catches from time to time.

The comparison of the maps for transparency in November and February shows that it is not always possible to observe the branch of the current that moves along the continental slope. In November its traces were only observed. Probably this branch of the current has a pulsating character that also affects the progress of commercial trawl fishing in this area.

CONCLUSION

The experience gained from the two trips in November 1969, and February 1970 shows that the hydrological conditions heavily affect the dynamics of catchability of trawls.

In the central area of the Bank, the 24 hour catchability of trawls changes almost eight times. In the coastal areas and the area of square J 25, the catchability chages 1.5–2.0 times.

Such big Variations in the catchability of trawls mainly affect the progress of commercial trawl catching. Knowlege of both the hydrological conditions and the laws governing their changes will always determine the results of commercial trawl fishing.

From what has been stated above, it follows that the solution of the task of improvement of the catchability of trawls with the help of the method of their constructive modifications, which are based on naked empricism for the time being, is a very long process.

The process of variation in the catchability of trawls is not dependent on the will of man. The tasks of the fishermen and investigators is to study this process better. Knowledge of the hours of variations in the catchability of trawls permits one to work out the dynamic tactics that determine the success of commercial trawl fishery.

REFERENCES

CHESTNOY, 1969—"*Report on Experimental Trip on m/t "Myliddy" between 27th October—1st November, 1969*". Unpublished. Report on file in the Trawler Research Section of the Ceylon Fisheries Corporation

CHESTNOY, 1970*a*—"*Special Report : Speeds of Trawling*" Unpublished Report on File in the Trawler Research Section of the Ceylon Fisheries Corporation.

CHESTNOY, 1970*b*—"*Dynamics of Catchability of Trawls*". Unpublished Report on File in the Trawler Research Section of the Ceylon Fisheries Corporation.

GERSHUN, A. A., 1939—The success of Hydro-Optics. *Morskoi Sbornik, 22, Voenmiorzdat, Leningrad.*

IVANOV, R. N., 1936—On the Theory of the Secchi Disc. *J. of Geophysics. Vol. 6, Nos. 2 and 3.*

POOLE, H. H. and ATKINS, W. R. G. 1929—Photo-Electric Measurements of Submarine Illumination throughout the Year. *J. Mar. Biol. Ass. U. K. 16, 297—324.*

M. S. Received 30.6.1970.

5—J 15364 (7/70)