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FISHERY - OCEANOLOGICAL EXPERIMENT IN

THE IRISH SHELF AREA - "SHELEX - 74 "

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Fishery - Oceanological Experiment  
in the Irish Shelf Area - S H E L E X - 7.4

(Theses)

In this paper the conduction of the studies in the fishery - oceanographic field situated on the continental shelf to the south-west of Ireland is reported. Experimental investigations included the observations on the currents at seven anchored buoyant stations, the fulfillment of 15 hydrological and hydrobiological surveys, the observations on the distribution of fish concentrations by means of hydroacoustic instruments, In operations in the field two ships participated simultaneously. All the measurements of temperature and salinity were made by thermosalounder. The methods of planning of oceanological fields are described. The preliminary analysis of the expedition results is given.

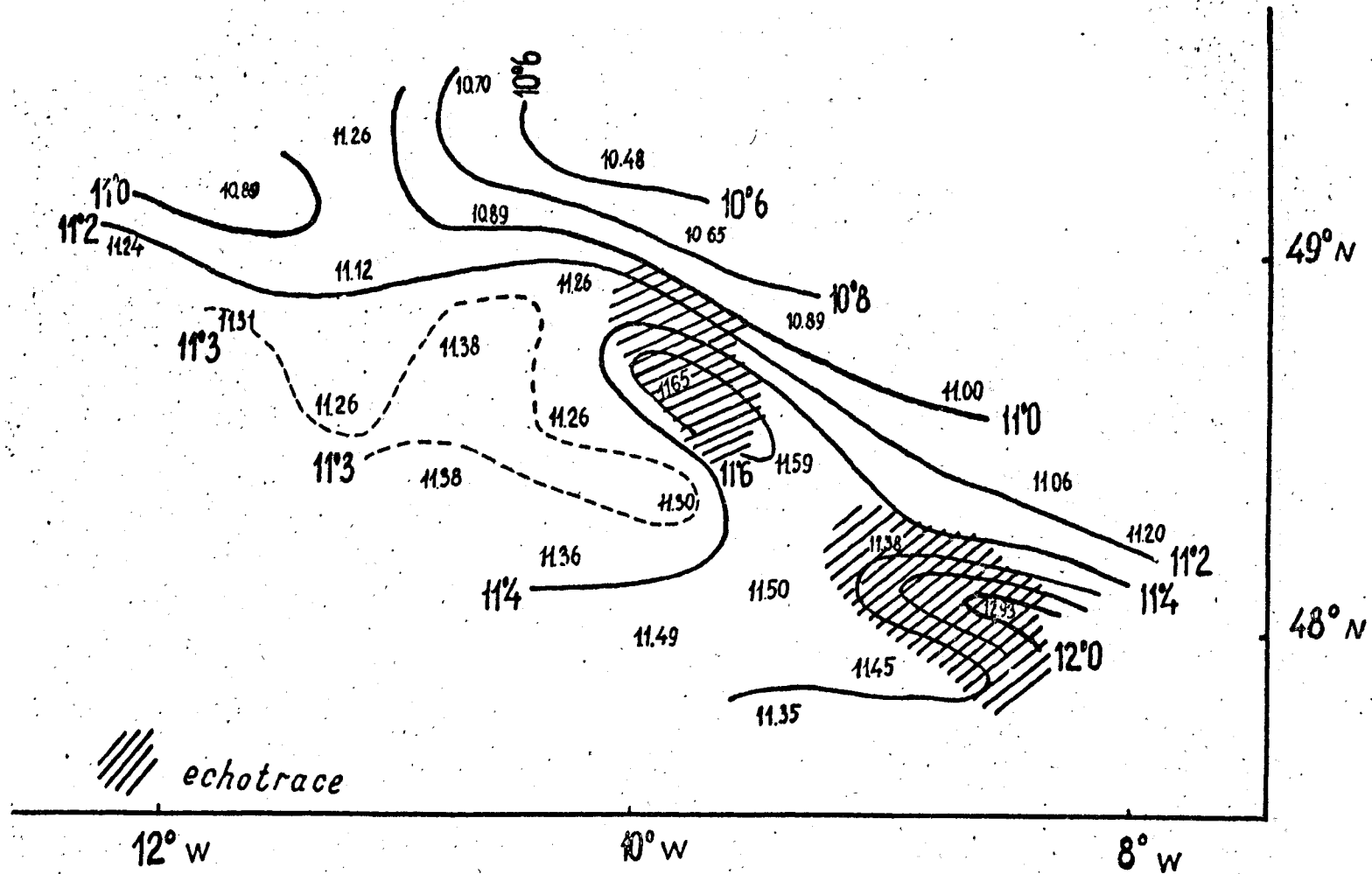


Fig.4. The temperature distribution at a 100 m horizon,  
22.06 - 26.06.74.

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In May-August 1974 on board the research ships of AtlantNIRO ZVEZDA and ALIOT a fishery - oceanological experiment was carried out in the area of Irish Shelf and adjacent continental shelf, which has become known as "Shelf Experiment 1974"- SHELEX - 74.

SHELEX - 74 is one of the stages in designing of a complex model of formation of commercial fish concentrations. The model will be based on the dependence of distribution characteristics and the behaviour of commercial objects upon the dynamic and hydrobiological structure of water.

Taking into account the inadequate knowledge of dynamic processes, we have formulated the principal tasks of experimental activities as follows:

- detailed study of variability in dynamic structure of the Irish Shelf water in time and space;
- revealing of the extent and nature of dynamic water structure influence on the behaviour and distribution of commercial concentrations;
- getting of reliable experimental data for improvement and examination of numerical model of water dynamics on the shelf, as a component of the complex model of formation of commercial fish concentrations.

To solve the above tasks, an oceanological field was established to the south-west of Ireland (fig.1). The area of the field was 70 x 130 miles, the depth

varied from 150 to 3500 m. In planning of the position and size of the field, such factors as the dynamic and fishing characteristics of the region, the bottom relief, the expected scale of investigated movements in space and time were taken into consideration. In the present paper a brief review of the operations fulfilled in the field together with a preliminary analysis of some observational results are given.

#### 1. Observations on currents

A total of seven buoyant stations were made for current measurements in the field (fig.1.). The observations according to this scheme were carried out from May 20 to July 20.

It was suggested that the determination of statistical structure of a current field would make it possible to restore it for the field as a whole, basing on the measurements in separate points.

To specify the statistical structure at small distances and to check the precision of restoring, the measurement grid in the centre of the field was thickened by means of rearrangement of BS - 1, BS - 4, BS - 5 on the second stage (with the duration of 14 days).

Finally, at the third stage of 4 days duration the four buoyant stations were set linearly in normal to a continental slope

This experiment was aimed at determination of the pattern of dynamic process immediately within the continental slope zone.

The observational data indicated that the velocity of summed currents in the field averaged 30-40 cm/sec. The currents were of pronounced tidal character with semi-diurnal period. The velocity of residual currents was not high and did not generally exceed 5-6 cm/sec, occasionally increasing to 15-20 m/sec.

In general the picture obtained is similar enough to the results of studies in the Atlantic field in 1970 (Brekhovskikh, I.M. et. al., 1971), a single principal difference being a considerably larger scale of dynamic disturbance in space and time in the open ocean as compared with the shelf area. It can be suggested (this suggestion will be supported in further processing of the data) that the intrusion of synoptic eddies of 30-50 miles in diameter occurred in the field. If so, the phenomena of water rise and water cycle over the shelf in the local scale, exerting a considerable influence on the fishery are none other than a display of the vertical nature of the ocean currents. Then the elaboration of the methods for calculation of generation and behaviour of individual eddies can be adopted as a foundation

for designing of a complex model of formation of commercial concentrations

## 2. Geostrophic experiment

The object of geostrophic experiment was to elucidate a question of possible application of the dynamic method in the shelf zone, and in case of successful outcome, to specify the currents field, obtained as a result of instrumental observations in a limited number of points, by means of revealing of an agreement between this currents field and the geostrophic currents.

In the process of preparing to the expedition a method for optimal planning of oceanographic surveys was developed (Dubrovina B.I., Chernishkov P.P., 1975). The essence of this method is as follows. It is known (Moiseev G.A., Timchenko I.E., 1971) that the 60° rhombic grid is the most effective one for restoring of oceanological fields according to measurements in separate points. The knowledge of spacial statistical structure of oceanological fields allows to calculate the step of measuring grid ( a distance between stations) which can meet a required precision. However, the precision calculated in this way is fictitious, since a temporal error of restoring appearing due to asynchronous fulfilment of hydrological stations and prolonged time period of the survey is not taken into account here. (Sukhovey, V.F., 1967; Dubrovina, B.I., 1972). From general consideration it is evident



that the size of spatial error is increased with an increase in grid step. On the contrary, with an increase in the distance between the stations, the duration of the survey is decreased (at a fixed area), thus leading to a decreased temporal error.

The case of equality between these two errors seems to be the optimal version. Therefore, the problem of planning of oceanographical survey comes to a possible agreement between temporal and spatial error of restoring.

The realization of the method described was stipulated by a suggestion, that the temperature fluctuations were the major contribution in the density variability, and that statistical structure of temperature fields did not change considerably with the depth. According to the material of a half-year series of facsimile charts, smoothed by five-day periods of surface water temperature, the temporal and spatial errors in restoring of temperature field at different grid spaces, but at fixed speed of the ship and fixed area were calculated and the optimal grid of oceanographic stations designed. The optimal distance between the stations is 22 miles provided the survey is carried out by two ships simultaneously; theoretical error of restoring being  $0.24^\circ$  and the survey duration - 48 hours.

Real duration of the survey appeared to be somewhat greater, as compared with the calculated one and approximated 72 hours. A total of 10 surveys over the whole field was made at the intervals exceeding no more than 48 hours. Besides, at the second stage of the activities brief surveys were made covering the central part of the field. In this case the distance between the stations was 10-12 miles and the duration of a station averaged 40 hours.

A geostrophic experiment was carried out by means of thermosalounders ISTOK - 3 (Modern apparatus ... 1970) and KASHALOT which provided the measurements of temperature, electrical conductivity (salinity) and depth

### 3. Observations on internal waves

The observations on internal waves were envisaged in the expeditional program mainly in order to exclude the vertical fluctuations in the density field in calculation of geostrophical currents. For this aim a total of 16 daily stations at sounding intervals of an hour were occupied. At separate stations the observations were made each 5-10 min. Preliminary analysis of the data obtained indicated a wide distribution of internal waves of tidal origin in the area of investigation, both with a half-diurnal period, and of 10-20 min period to several hours; the amplitude of these waves could reach 50-70 m. It should be emphasized that internal waves give rise not only to vertical migration of

water layers, but also cause considerable reorganization of the thermocline (fig. 3). At that, the thickness of the above quasiuniform layer, for example, fluctuates during the tidal cycle from 10 m to 60-70 m which, evidently, greatly affects the conditions of transmission of energy from the atmosphere to the ocean and may be an additional reason of occurrence of half-diurnal periodicity of the ocean currents.

As it is seen from fig. 4, the measurements taken in the same point at some hours interval may give not only different temperature values for different horizons, but also considerably different average temperatures within the whole active layer. Thus, the data obtained during the expedition make the elaboration of the sampling method for hydrological information which reflects the actual ocean state one of the principal problems.

#### Hydrobiological operations

Hydrobiological operations were made during all the hydrological stations occupied in the field (if weather conditions permitted). The catch within 200-0 m was carried out by Judaynet (gauze No 38, 1444 meshes/cm<sup>2</sup>).

A total of 280 samples was collected by both ships.

#### Scouting operations

Scouting operations were carried out by means of hydroacoustic apparatus during the passages from one hydrological station to another. After fulfilment of each survey the summary plane-tables with the results of scouting operations were compiled; which were immediately compared with temperature fields (fig. 5.). Preliminary analysis

of these materials showed that during the fulfilment of short term stations the fields of hydrological characteristics may serve a guide reliable enough in scouting operations and forecasting of fishing conditions.

#### CONCLUSIONS

The organization of a long-term fishery - oceanological field resulted in the detailed experimental study of oceanological process along the border between the open ocean and the shelf. New data concerning the structure of hydrophysical fields in time and space, as well as their influence upon the formation of commercial concentrations were collected. High variability of hydrological characteristics in the shelf zone, revealed during the expedition, makes the elaboration of the sampling method for hydrological information which may be useful for fishery forecast one of the principal problems.

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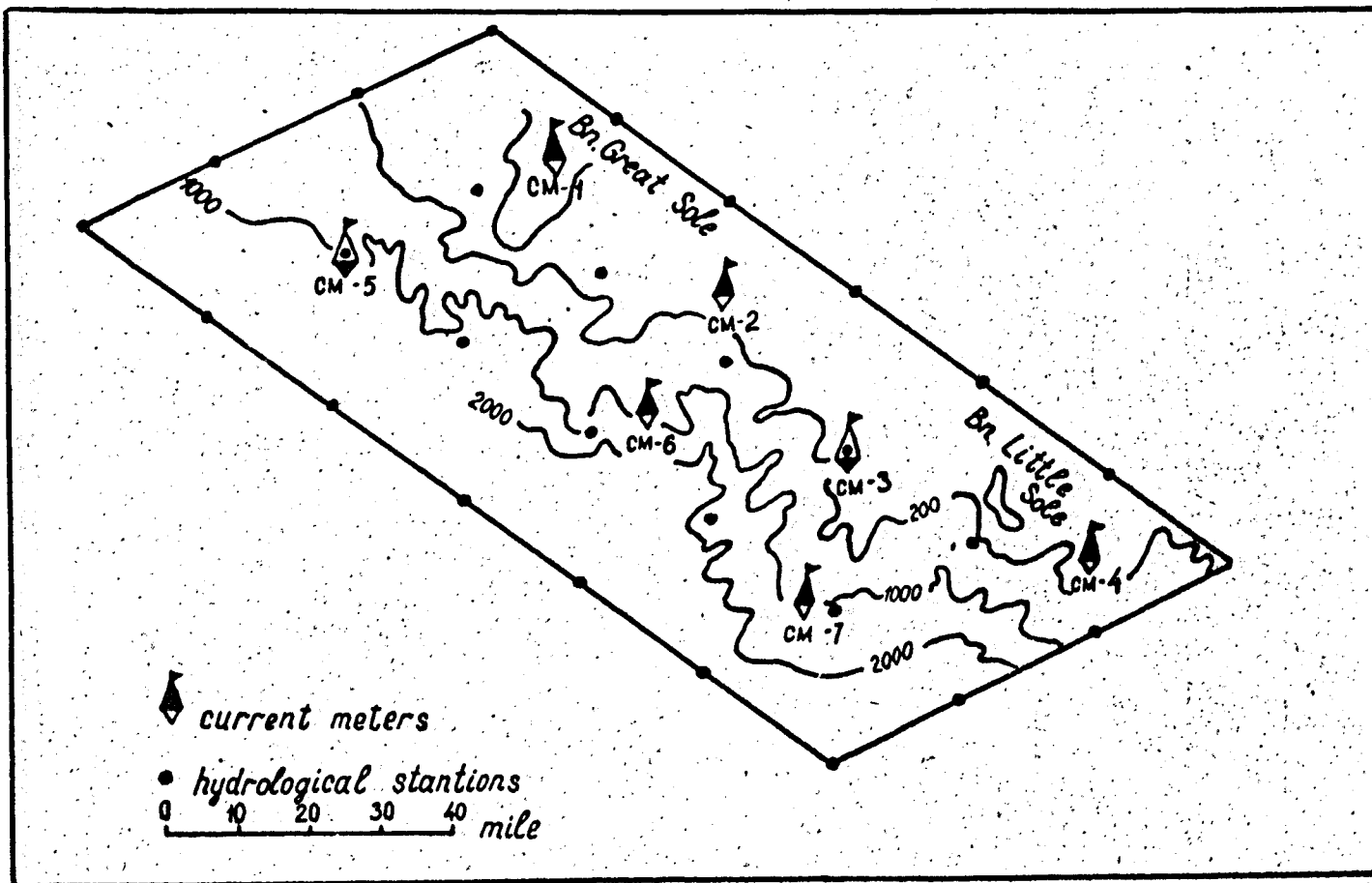


Fig.1. A scheme of positions of hydrological and buoyant stations in the field.

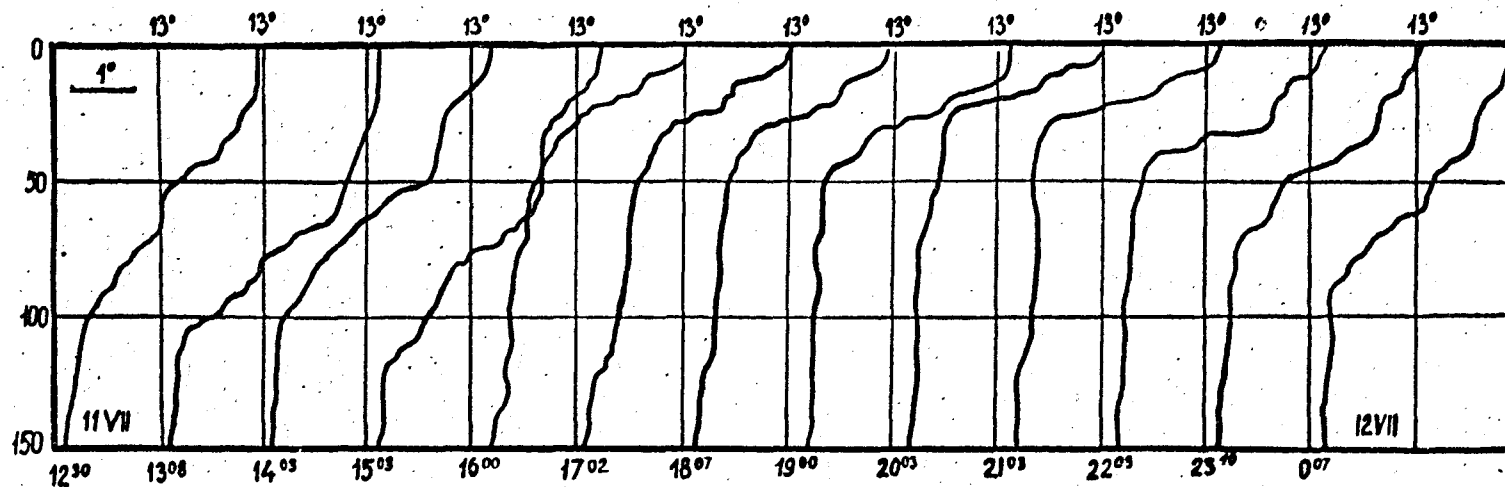


Fig.2. Temporal variability of the thermocline structure  
 12.07.1974; =48°11, = 08°35'.

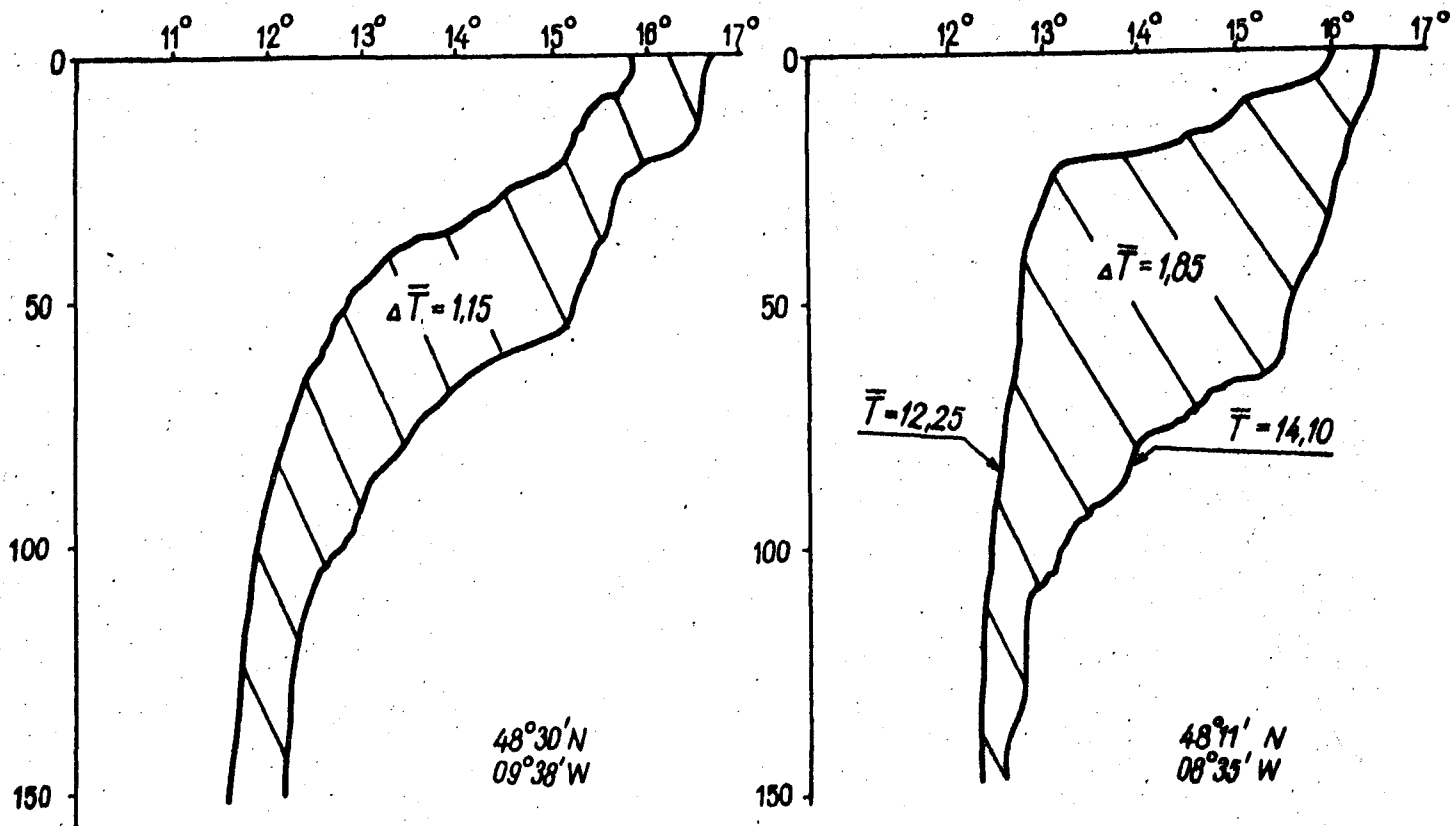


Fig.3. The extreme profiles of water temperature per 12 hours at daily stations.