International Council for the Exploration of the Sea

C.M. 1968/H: 17
Pelagic Fish (Northern) Committee

Hydrographic factors and the vertical migration of the herring in the Norwegian Channel

by

Ulrich Falk

Institut für Hochseefischerei und Fischverarbeitung, Rostock

In the Norwegian Channel and Skagerrak adult wintering autumn-spawning herring shoals predominantly accomplish a diurnal vertical migration. The upper limit of the nightly herring traces is situated at different levels between 0 and 100 m varying from place to place and from day to day. On hydrographic surveys with the research vessels "Karl Liebknecht", "Eisbär" and "Prof. Albrecht Penck" [1) several serial stations have been made on herring traces. This paper intends to contribute some observations to the limited ascent of herring shoals.

Fig. 1/1 - 18 is showing temperature, salinity , density diagrams of 18 stations in March and April 1962, 1966 and 1967 predominantly from the Egersund area. The upper limit of the herring traces is situated in all cases in or below the steepest gradients of the discontinuity layer separating the less saline, cold

---

1) For the use of the data of "Prof. Albrecht Penck" I am very obliged to the colleagues of the Oceanic Research Institute Warnemuende. For processing of all salinity and density data I am most grateful to Mr. H. Franck of the same institute.

Baltic water from the intermediate water mass of the Skagerrak. In the top layers of the herring traces the values of the above mentioned parameters range from 4.[illegible] to [illegible] °C, 34.0 to 35.0 S °/oo, sigma-t 26.9 to 27.5. In the upper layers avoided by herring traces the hydrographic data extend at a depth of 1 m from 3,[illegible] to 5,4 °C, 31.9 to 33.9 S °/oo, sigma-t 26.2 to 27.4 and in their lowest part from 3.6 to 6.5 °C, 33.2 to 34.8 S °/oo and sigma-t 26.2 to 27.4. The observations justify the statement, that autumn-spawning adult herring is avoiding the Baltic water mass (STEELE 1960, RUDNEV 1964, VASILJEV 1964). According to some more sporadic measurements this statement may be applied to the autumn season also (October till December) e. g. Fig. 2/1 - 4,9.

Hitherto it is not possible to determine the factor limiting the ascent of the herring. Steele's food-temperature-hypothesis is not practicable to autumn conditions. Most authors consider the thermocline to be the limiting factor (BLAXTER and HOLLIDAY). But the underlying observations mostly refer to summer conditions. In March April maximum gradients of the stations per 10 m run to 0.4 - 2.5 °C, 0.4 - 1.4 S °/oo, 0.1 - 1.0 sigma-t, So the temperature gradient is much smaller. Also there is nothing known about the influence of salinity and density.

During the months of temperature decrease in the surface layer there are some observations of limited vertical migration without remarkable temperature, salinity or density gradients (Fig. 2/5 - 8, 10 - 15). It should be pointed to Fig. 2/11, 13, 5 and Fig. 2/12, 14, 6 showing 2 stations which have been measured three times for 5 nights. The series of stations in Fig. 2/5 - 9 is characterised by a sharp edge between the 10 sm distant stations Fig. 2/9 and 2/7, 8. In the upper layer from 0 to more than 50 m a horizontal difference has been found of about 2.5 °/oo salinity and about 2.0 units density, pointing to handsome current differences. This might be an argument for the assumption that currents could have influenced the distribution of the herring at stations Fig. 2/5 - 8 and could be of general importance to the problem.

References

BLAXTER, J.H.S. and HOLLIDAY, F.G.T.: The behaviour and physiology of herring and other clupeids. Adv. Mar. Biol. 1, 1963

RUDNEV, K.M.: O promyslovych prognosach v Norvežskom zelobe. Trudy Atlant NIRO 13, 1964

STEELE, J.H.: The environment of a herring fishery. ICES, Herring Committee No 36, 1960

VASILJEV, G.D.: Vertikalnaja ustojcivost vodnych mass i raspredelenije sel'di. Trudy Atlant NIRO 13, 1964

List of stations

Fig.	Position	Depth (m)	Date
1/1	58°40'N 03°30'E	105	11./12. 3. 1962
1/2	58°40'N 04°30'E	300	11./12. 3. 1962
1/3	58°00'N 05°17'E	165	2./ 3. 4. 1966
1/4	58°03'N 05°23'E	260	2./ 3. 4. 1966
1/5	58°07'N 04°44'E	165	30./31. 3. 1966
1/6	58°09'N 04°47'E	210	30./31. 3. 1966
1/7	58°02'N 04°59'E	135	30./31. 3. 1966
1/8	58°03'N 05°04'E	180	30./31. 3. 1966
1/9	57°38'N 08°50'E	100	8./ 9. 3. 1967
1/10	57°45'N 08°55'E	180	8./ 9. 3. 1967
1/11	58°11'N 04°50'E	280	23./24. 3. 1967
1/12	57°59'N 05°22'E	170	28./29. 3. 1967
1/13	58°04'N 05°11'E	222	29./30. 3. 1967
1/14	58°13'N 05°06'E	300	29./30. 3. 1967
1/15	57°58'N 05°21'E	165	30./31. 3. 1967
1/16	58°30'N 03°57'E	180	10./11. 4. 1967
1/17	58°14'N 04°30'E	225	11./12. 4. 1967
1/18	58°04'N 05°03'E	170	23./24. 4. 1967
2/1	57°24'N 07°16'E	110	14./15. 12. 1967
2/2	57°28'N 07°16'E	145	14./15. 12. 1967
2/3	57°29'N 07°16'E	190	14./15. 12. 1967
2/4	57°30'N 07°14'E	206	14./15. 12. 1967
2/5	58°04'N 05°04'E	190	11./12. 12. 1965
2/6	58°07'N 05°07'E	255	11./12. 12. 1965
2/7	58°12'N 05°11'E	310	11./12. 12. 1965
2/8	58°04'N 05°25'E	265	11./12. 12. 1965
2/9	58°12'N 05°31'E	320	11./12. 12. 1965
2/10	58°01'N 05°02'E	138	6./ 7. 12. 1965
2/11	58°04'N 05°05'E	185	6./ 7. 12. 1965
2/12	58°07'N 05°07'E	260	6./ 7. 12. 1965
2/13	58°04'N 05°04'E	185	7./ 8. 12. 1965
2/14	58°07'N 05°06'E	265	7./ 8. 12. 1965

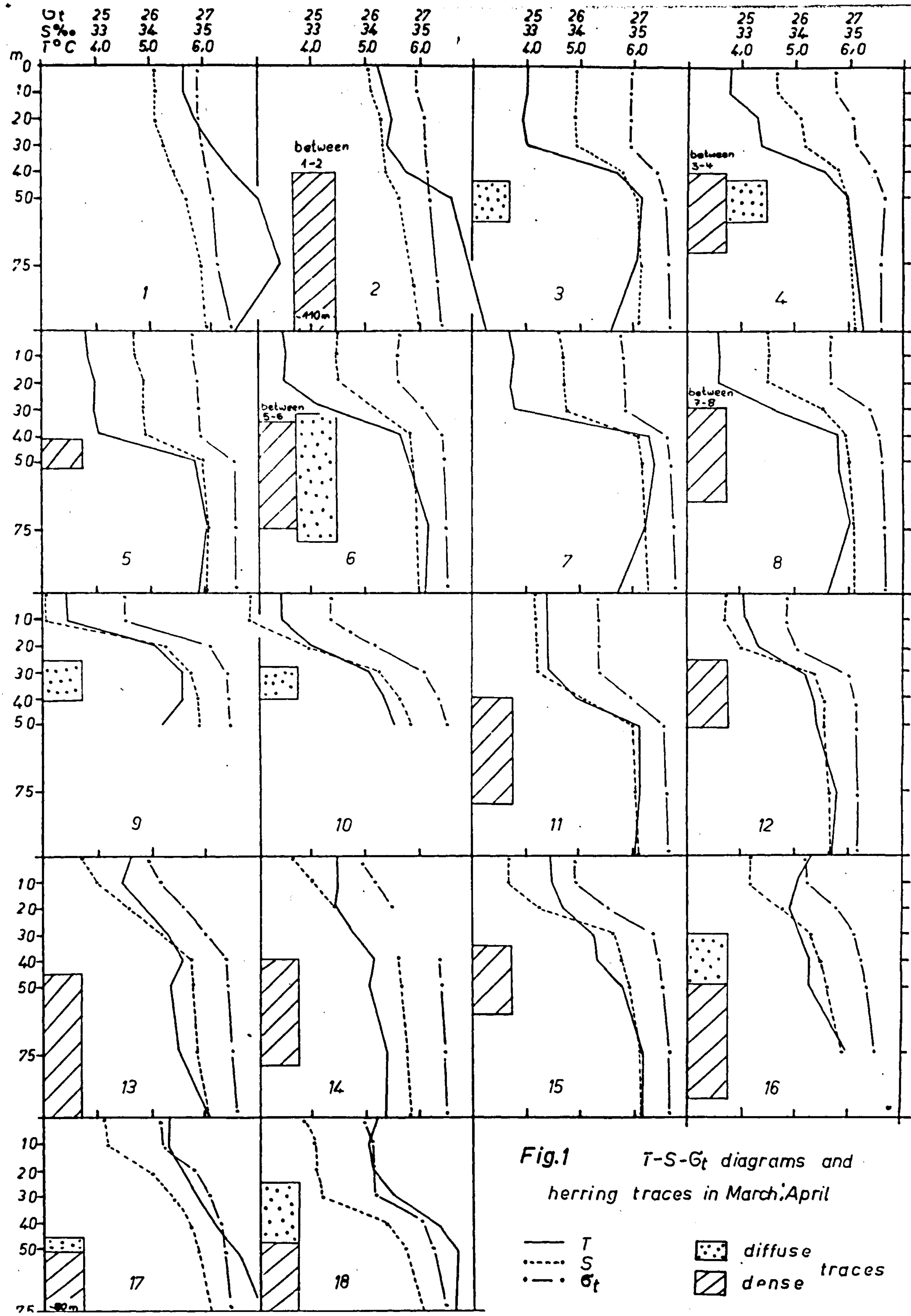

Fig.1 T-S-σ_t diagrams and herring traces in March/April

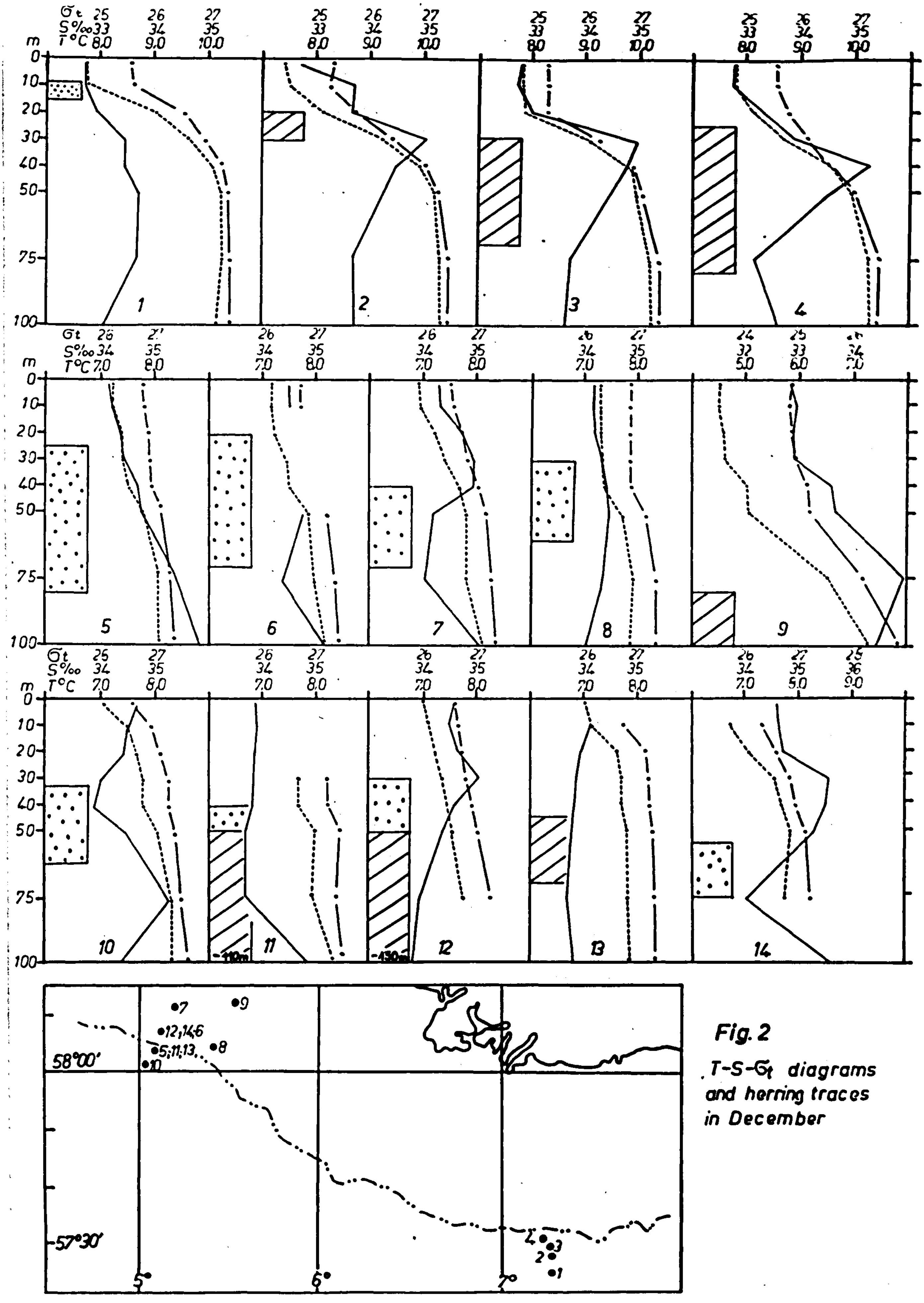

Fig. 2

T-S-σ_t diagrams and herring traces in December