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A preliminary report of data collected on a co-operative hydrographic investigation of the Northeast Channel, 1975¹

by

R.J. Pawlowski and R.J. Schlitz
National Marine Fisheries Service
Northeast Fisheries Center
Woods Hole, Massachusetts USA 02543

Introduction

In 1975, the hydrography of the Northeast Channel was investigated by the National Marine Fisheries Service, Northeast Fisheries Center (NEFC), the United States Coast Guard (USCG) and the participating countries of the ICNAF Larval Herring Survey. Twenty-one temperature and salinity sections, some with dissolved oxygen and nutrients, were completed from March through December. Sections were taken in all months except June and September, with data obtained at intervals of ten days to seven weeks. The project objective is to obtain oceanographic data throughout the water column in order to characterize the water masses in the Northeast Channel and detect inflow to the Gulf of Maine. Figure 1 shows the three sections chosen for this project.

In spring the USCG sampled sections I and II seven times, from March through May. The R/V ALBATROSS IV occupied sections I and II in July as a part of an NEFC hydrographic study. Section II was added to the USCG Standard Section A-5 in August, and is planned for inclusion in all future A-5 Standard Sections. During fall ICNAF Larval Herring Cruises, three special hydrographic stations (Section III) were added to the standard set of stations to obtain additional oceanographic data within the NE Channel. This section was completed four times, from October through December.

The sampling equipment varied from Nansen casts to continuous profiling systems. Temperature and salinity data were collected on all transects. Nutrient and dissolved oxygen samples were obtained during ICNAF Larval Herring and R/V ALBATROSS IV cruises.

This report describes the 1975 sampling and results, and presents future plans.

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Methods

The Northeast Channel project had four distinct parts in 1975: The USCG-NMFS High-Seas Abstinence Area Patrols (HSAA), the USCG Standard Section A-5, the NEFC Hydrographic Cruise 75-07, and the Fall ICNAF Larval Herring Cruises. Table 1 lists the cruises, vessels involved, and samples taken. Although differences in sampling methods and data processing occurred, the results appear to be compatible.

HSAA patrols involved four USCG Cutters (USCGC) with sampling planned for the beginning and end of each two-week patrol. Transects I and II were occupied seven times each from March through May, providing relatively complete temperature and salinity data. Higher priority activities caused the USCGC HAMILTON to complete only one set of sections, however. Preliminary processing was done on board, in accordance with standard USCG procedures (USCG, 1971). Additional salinity samples were taken on each cruise and processed by the USCG Oceanographic Unit, Washington, D.C., for quality control purposes. Shipboard data were transferred to the USCG Oceanographic Unit for final reduction, and forwarded to NEFC for interpretation.

On USCG Standard Section A-5, August 1975, a continuous water-column profile was obtained at each station with a Plessey 9040 STD. Profiles were collected on magnetic tape for processing by the USCG Oceanographic Unit. Nansen bottles at surface and bottom were used for temperature and salinity standards on each station. Data were reduced in the same manner as the HSAA samples.

STD profiles were also obtained on NEFC Hydrographic Cruise, R/V ALBATROSS IV (75-07), with a Plessey 9040 system. A General Oceanics 1.7-liter Niskin Rosette sampler obtained nutrient and dissolved oxygen, along with samples for quality control, from specified depths. All samples were processed on board, with the exception of nutrients, which were frozen for later analysis ashore. Dissolved oxygen was determined by standard modified Winkler titration, temperatures were obtained both from reversing thermometers and STD profiles, and salinities were determined by an inductive salinometer. Quality control and data reduction were completed at NEFC.

The ICNAF Larval Herring Cruises involved Nansen casts and continuous STD profiles with water samples obtained by a Niskin Rosette array. Samples were taken at ICNAF standard hydrographic depths. Data were processed by vessel personnel, in a manner similar to the NEFC Hydrographic Cruise. Each representative country completed final processing and verification before forwarding data to NEFC.

Temperature-salinity diagrams, temperature-dissolved oxygen diagrams, and cross-sections were plotted. The topography for sections I and II was determined from USCGC CHASE depth profiles, 28 February and 11 March 1975, and Canadian Hydrographic Office (CHO) Chart 8006. Section III was taken from CHO Chart 8006. Sections were plotted to 1° C isotherms, 0.5 ‰ isohalines, and 0.5 ml/l isopleths of dissolved oxygen. Nutrient data are not available at this time.

Results

Figures 2 and 3 show the temperature-salinity relations found in 1975. Figure 2 depicts data collected during HSA patrol, March through May, while Figure 3 shows all data collected by other vessels, July through December. Each dot represents a data point. The historical T-S curves of McLellan, et al. (1953), McLellan (1957), Mann (1969), and Colton (1968), for neighbouring areas, are shown for comparison. Except for the effects of seasonal warming, all the data points fall within the envelope of the two Mann (1969) curves which represent the range of shelf water values off Halifax. These curves include distinct areas of surface water, 31-33 ‰; mixed channel water, 33-35 ‰; and slope water, greater than 35 ‰. Waters with characteristics of the slope boundary water, 9-15° C, as defined by Worthington (1964), are found in both figures. The cooler, deep slope water (5° to 8°) was found from March through July. It was always present in section I, but only occasionally in sections II and III. The seasonal warming of surface water is also evident with the change of range from 0-9° C in Figure 2 to 5-16° C in Figure 3. The mixing of slope water with cooler, fresher shelf water is apparent in both curves. The linearity of Figure 2 shows mixing of these waters within the Channel. The necessary shelf water is readily available on both Georges and Browns Banks.

The cross-sections, Figures 4-11, show probable intermittent inflow of slope waters. On 7 May, a parcel of slope water is found along the eastern side of section I, while lacking in section II. Two weeks later, on 21 May, slope water was found on the west side of section II. And though not as warm as the 7 May parcel, this water was warmer and more saline than the slope water found at the southern section on the same date. On 31 May both sections (not included) were cooler and less saline. Observations are consistent with the slow progression of a mass of slope water through the channel. Indications of a similar pulse were observed on 28 February and 11 March. Water of 12.9° C, 35.6 ‰ was found at section II on 11 March. A possible remnant was seen in section II on 14 April. These sections are not presented in the paper. Sections sampled during the ICNAF Larval Herring Surveys showed slope water generally at depths greater than 150 meters. Mixing had possibly occurred to make this a cooler, less saline water than observed in spring and summer sections.

Cold water is evident at 25-50 meters in section II, 21 May. Comparison with known water characteristics for Browns and Georges Banks points towards a cross-channel southwesterly flow. Schlitz (1975) documented similar occurrences for 1972 and 1973. Either seasonal warming obscured this in later sections, or a breakdown occurred in cross-channel flow for summer and fall months.

In summary, the following points were observed:

1. Slope water was regularly present in the Northeast Channel, at depths greater than 100 meters, from March through December, and frequently inside the channel sill. Intermittent observations of warmer, more saline slope water are consistent with a presumed sporadic flow into the Gulf of Maine.
2. As expected, the surface water temperatures were highly variable with the seasons.
3. Mixing of bank, surface and slope waters occurred in the channel.
4. Areas of cold shelf water, from 25 to 50 meters depth, were observed, suggesting occasional southwesterly flow across the channel.

1976 and Future

So far, in 1976, at least one Northeast Channel section has been occupied every month. USCG Standard Section A-5 was completed in January, two ICNAF hydrographic stations were occupied by the R/V ALBATROSS IV in February, and the USCGC BIBB collected samples from sections I and II in March during HSAA patrol. Problems encountered in the BIBB's cruise caused only two sections to be occupied for March.

In April the R/V WIECZNO is expected to occupy section II and section I. The USCGC ACTIVE will make two XBT transects across sections I and II while on HSAA patrol and also collect surface salinity samples.

The remainder of 1976 calls for continued activity in the Northeast Channel. The USCGC HAMILTON is scheduled to sample sections I and II twice in May while on HSAA patrol, NEFC hydrographic cruises have scheduled work in the Channel during May, July, August and September, and USCG Standard Section A-5 is planned for August. The expected fall ICNAF Larval Herring Cruises, from September through December, should complete the year.

Several current meters will be deployed by NEFC in late August or September at the sill of the Northeast Channel. There will be three moorings, each with three AMF Vector Averaging Current Meters (VACM) including temperature sensors, across the Channel in water depth of approximately 200-230 meters. The moorings are expected to remain in place for six months and be replaced by three equivalent moorings for an additional six-month period. Mooring positions have not been determined.

Project changes for 1976 include the addition of a station to section I at 42° 04.0' N, 65° 41.5' W, and a suggestion that the ICNAF Larval Herring Stations be moved to deeper positions in the Channel.

The project is scheduled to continue in the future to monitor flow into the Gulf of Maine. The first year has proved successful in documenting water masses and possible occurrences of inflow. Future sampling of the transects in addition to direct current measurements will aid in determining the circulation in the Northeast Channel and its effects on the Gulf of Maine.

Acknowledgements

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References

- Anonymous. 1971. Manual for Oceanographic Operations, U.S. Department of Transportation, U.S. Coast Guard, 175 p.
- Colton, J. B., Jr. 1968. Recent Trends in Subsurface Temperatures in the Gulf of Maine and Contiguous Waters. J. Fish. Res. Bd. Can. 25(11): 2427-2437.
- Mann, C. R. 1969. A Summary of Variability Observed with Monitoring Sections off the East and West Coasts of Canada. Progress in Oceanography 5: 17-30.
- McLellan, H. J. 1957. On the Distinctness and Origin of the Slope Water off the Scotian Shelf and its Easterly Flow South of the Grand Banks. J. Fish. Res. Bd. Can. 14(2): 213-239.
- McLellan, H. J., L. Lauzier, and W. B. Bailey. 1953. The Slope Water off the Scotian Shelf. J. Fish. Res. Bd. Can. 10(4): 155-176.
- Schlitz, R. J. 1975. A Preliminary Summary of Hydrographic Data Collected on ICNAF Larval Herring Surveys, 1971-1973. ICNAF Res. Doc. 75(111), 29 p.
- Worthington, L. V. 1964. Anomalous Conditions in the Slope Water Area in 1959. J. Fish. Res. Bd. Can. 21(2): 327-333.

Table 1. Schedule of transects completed across Northeast Channel in 1975.

Date	Ship	Cruise	Section	Sample Type	Sal	Temp	D.O	Nut
28 February	CGC CHASE	HSAA	I & II	Nansen	X	X		
11 March	CGC CHASE	HSAA	I & II	Nansen	X	X		
14 April	CGC HAMILTON	HSAA	I & II	Nansen	X	X		
25 April	CGC SHERMAN	HSAA	I & II	Nansen	X	X		
07 May	CGC SHERMAN	HSAA	I & II	Nansen	X	X		
21 May	CGC DUANE	HSAA	I & II	Nansen	X	X		
30 May	CGC DUANE	HSAA	I & II	Nansen	X	X		
13 July	ALBATROSS IV	Hydrographic	I & II	STD-Rosette	X	X	X	X
15 August	CGC EVERGREEN	Section A5	II	STD	X	X		
08 October	BELOGORSK	ICNAF	III	Nansen	X	X	X	X
17 October	BELOGORSK	ICNAF	III	Nansen	X	X	X	X
02 November	ANTON DOHRN	ICNAF	III	Nansen	X	X	X	X
05 December	ALBATROSS IV	ICNAF	III	STD-Rosette	X	X	X	X

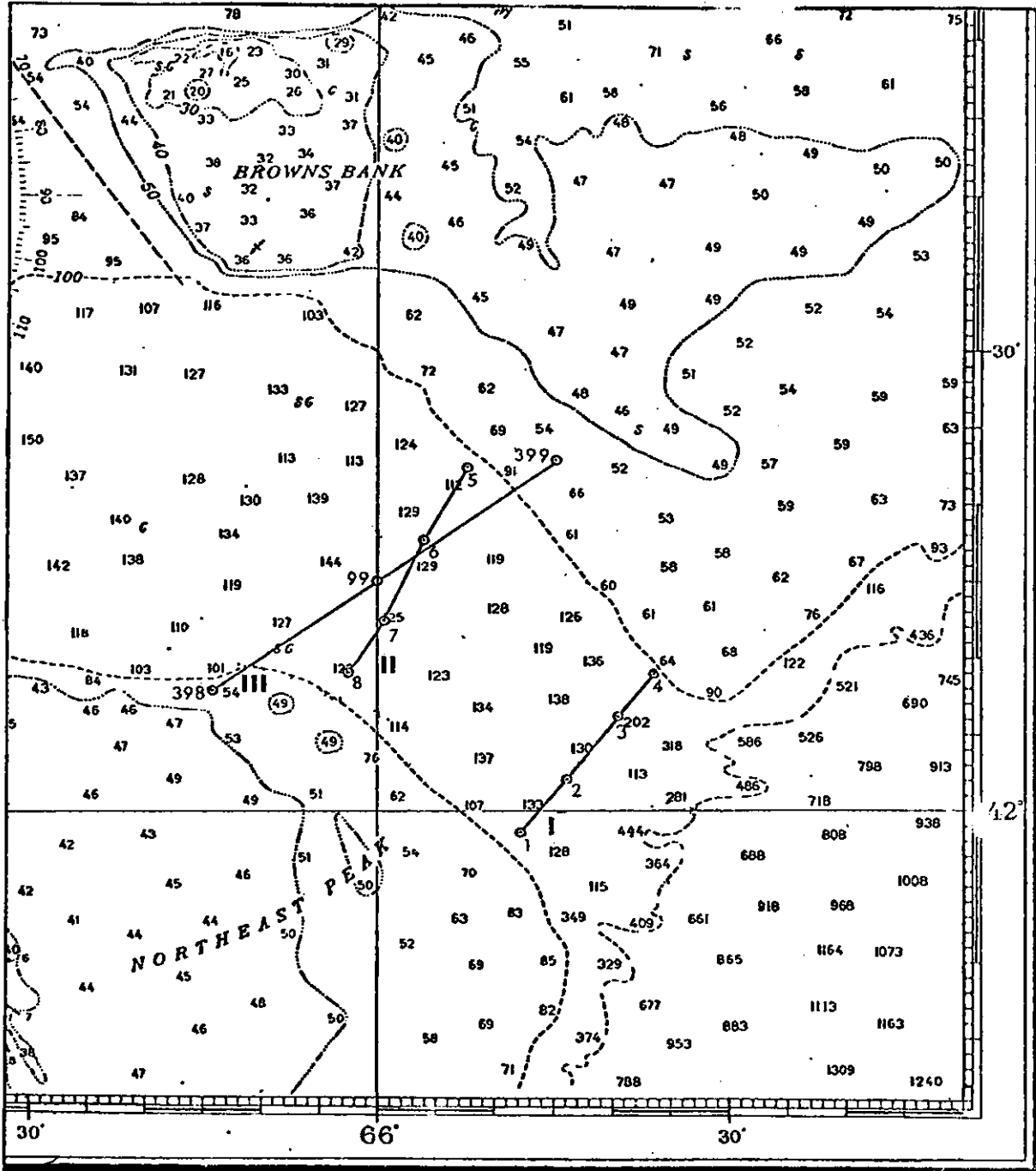


Figure 1. Sections (with stations) occupied in the Northeast Channel in 1975.

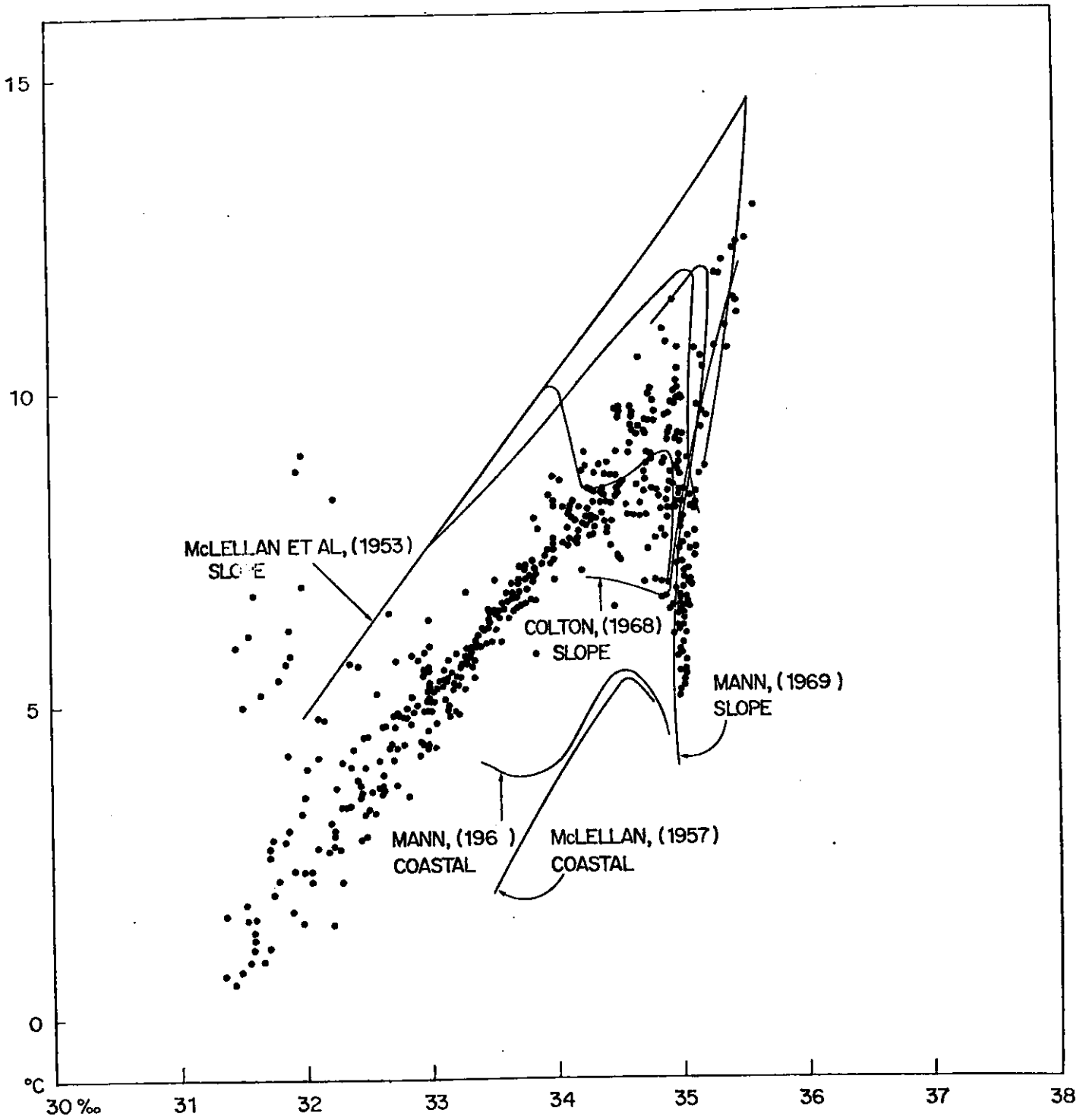


Figure 2. T-S diagram for the Northeast Channel from data collected on USCG HSAA Patrols, March through May 1975.

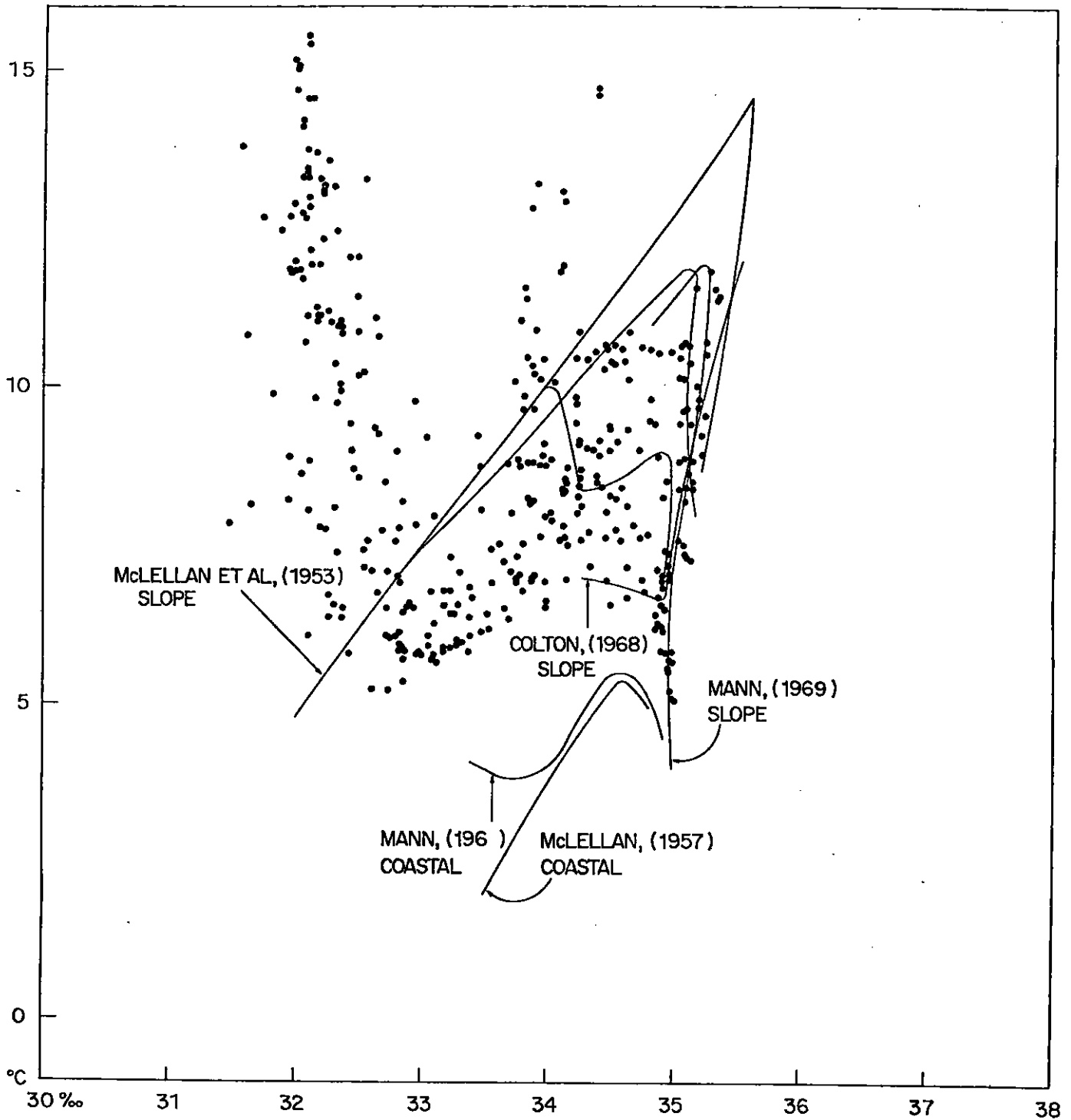


Figure 3. T-S diagram for the Northeast Channel from data collected on all cruises, July through December 1975.

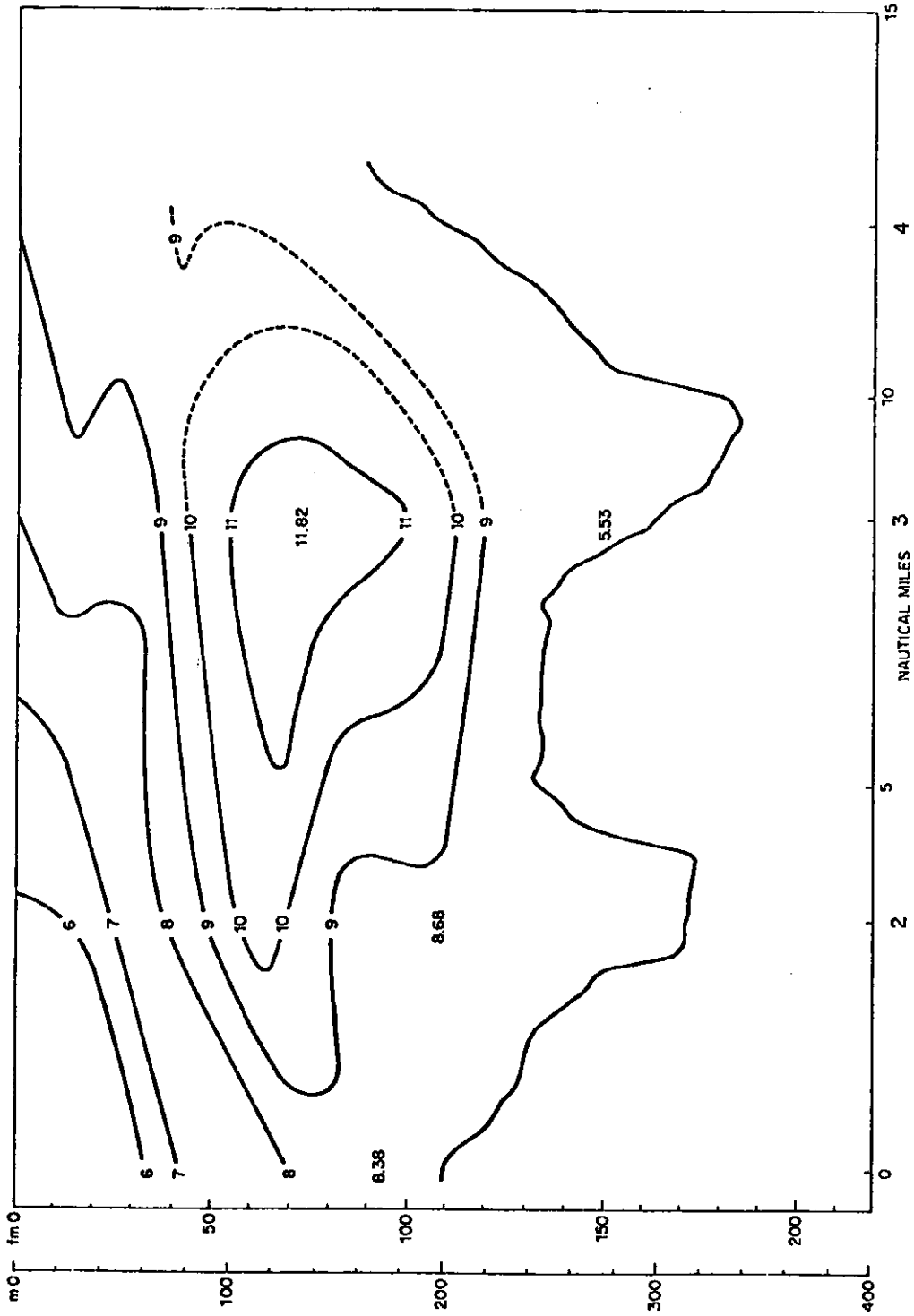


Figure 4. Temperature profile from data collected along section I by the USCGC SHERMAN, 7 May 1975.

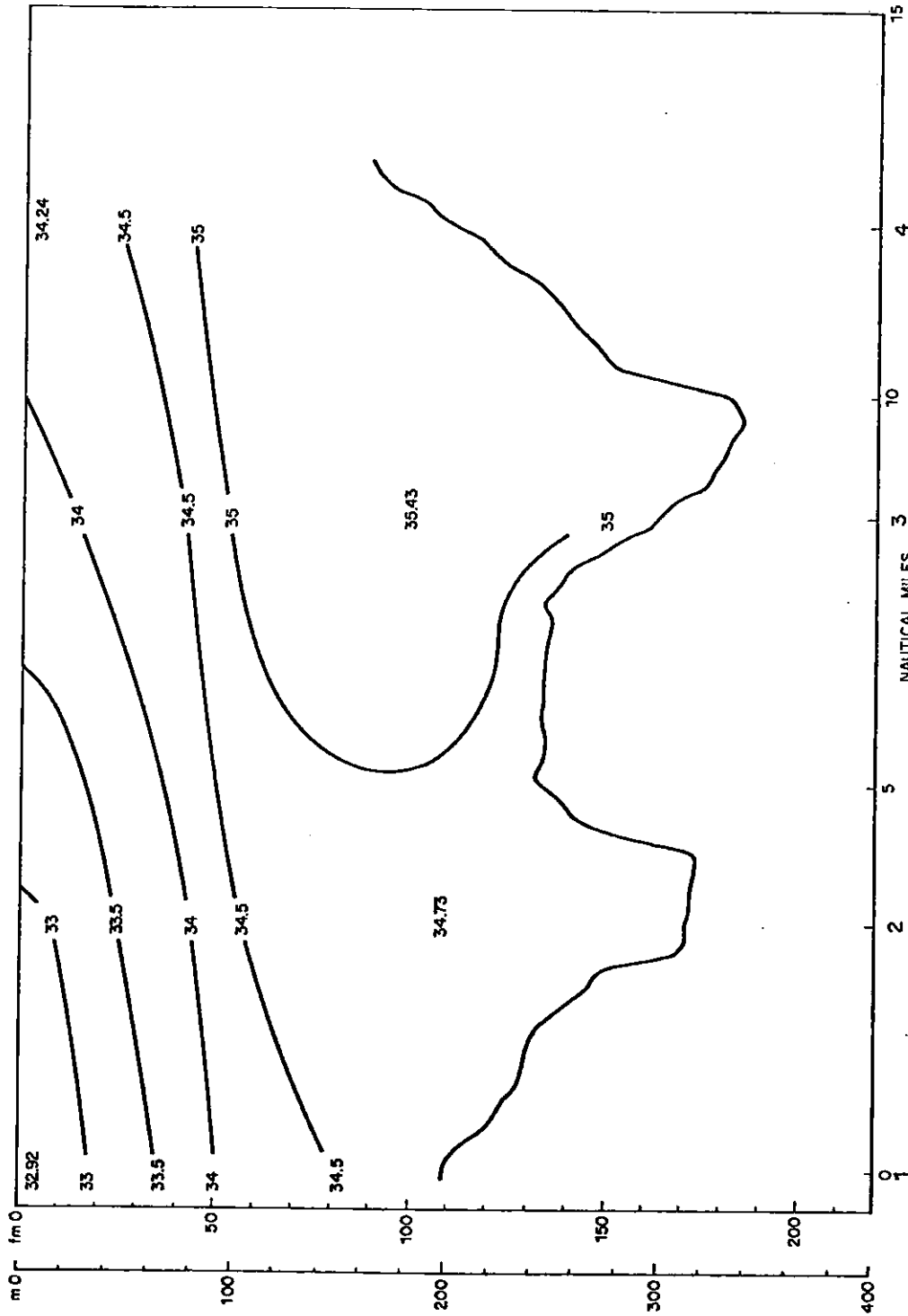


Figure 5. Salinity profile from data collected along section I by the USCGC SHERMAN, 7 May 1975.

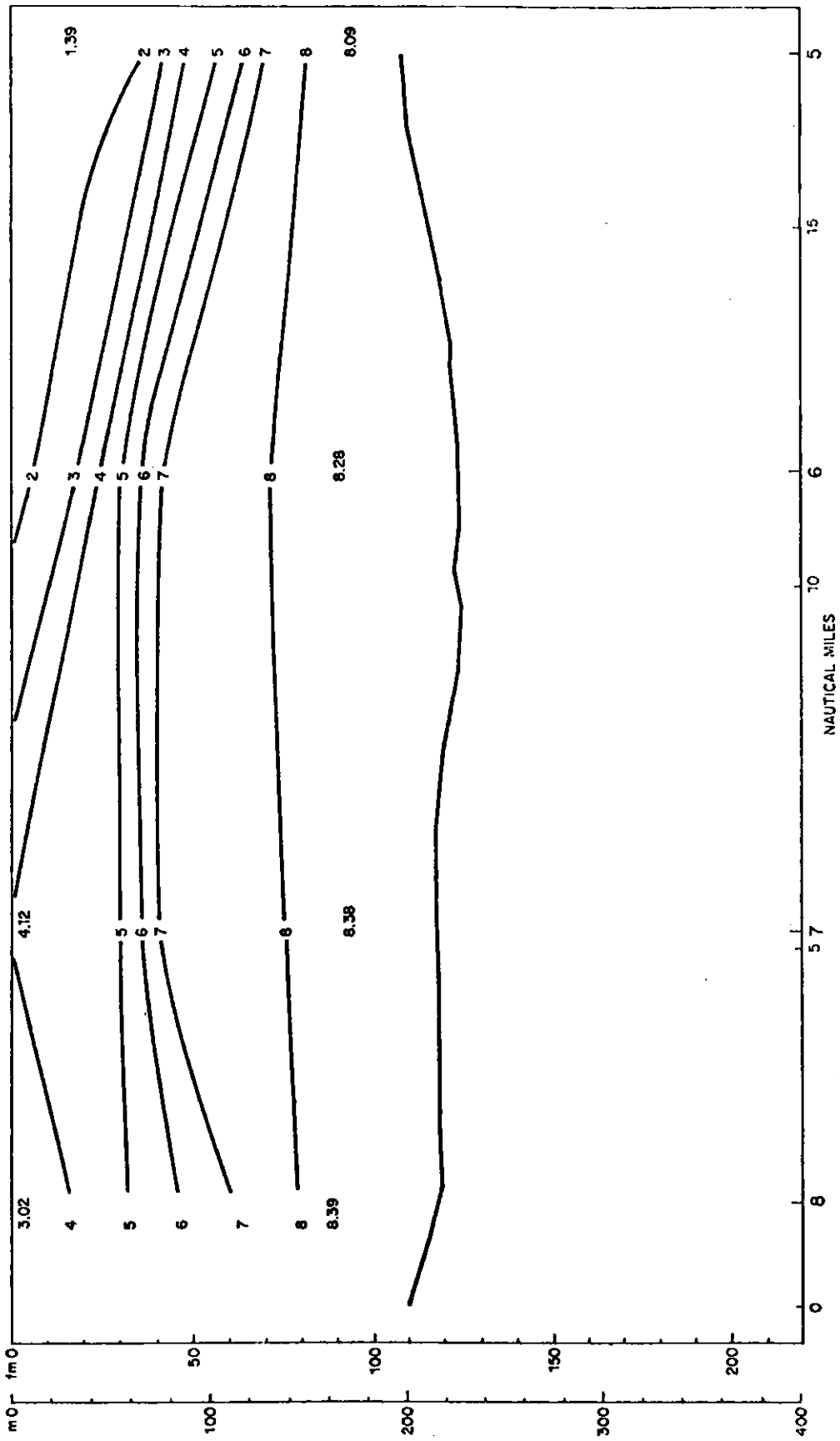


Figure 6. Temperature profile from data collected along section II by the USCGC SHERMAN, 7 May 1975.

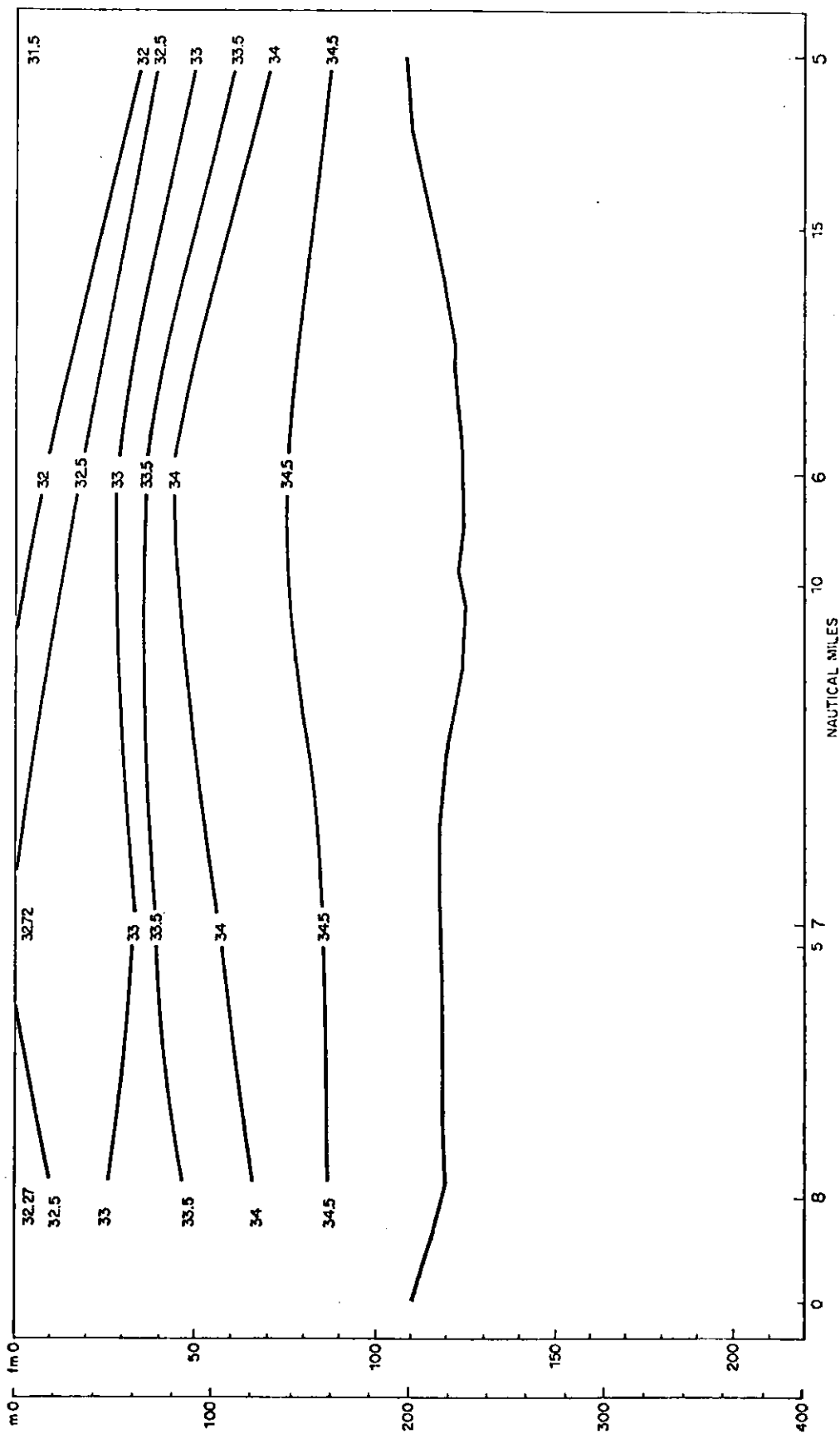


Figure 7. Salinity profile from data collected along section II by the USCGC SHERMAN, 7 May 1975.

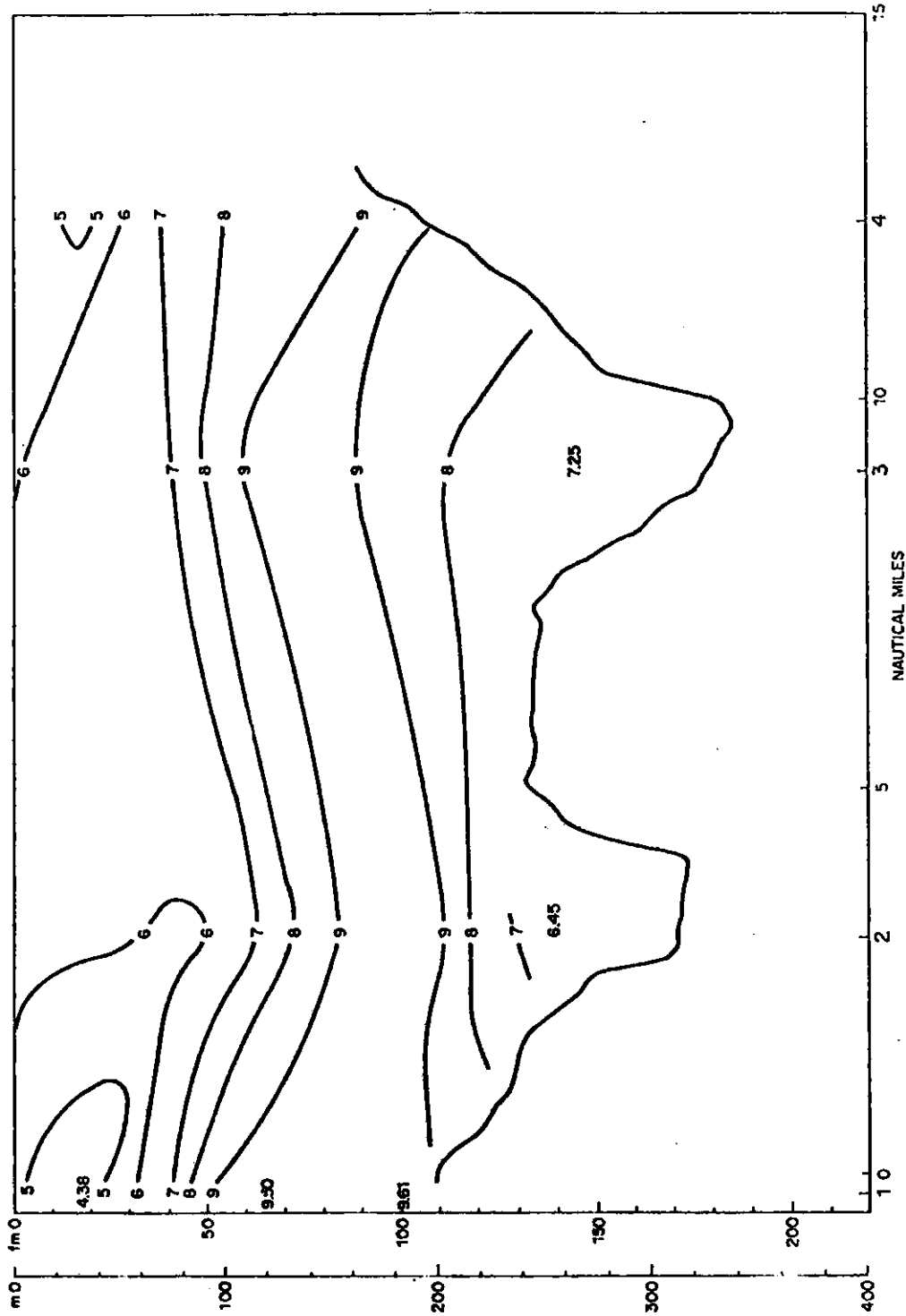


Figure 8. Temperature profile from data collected along section I by the USCGC DUANE, 21 May 1975.

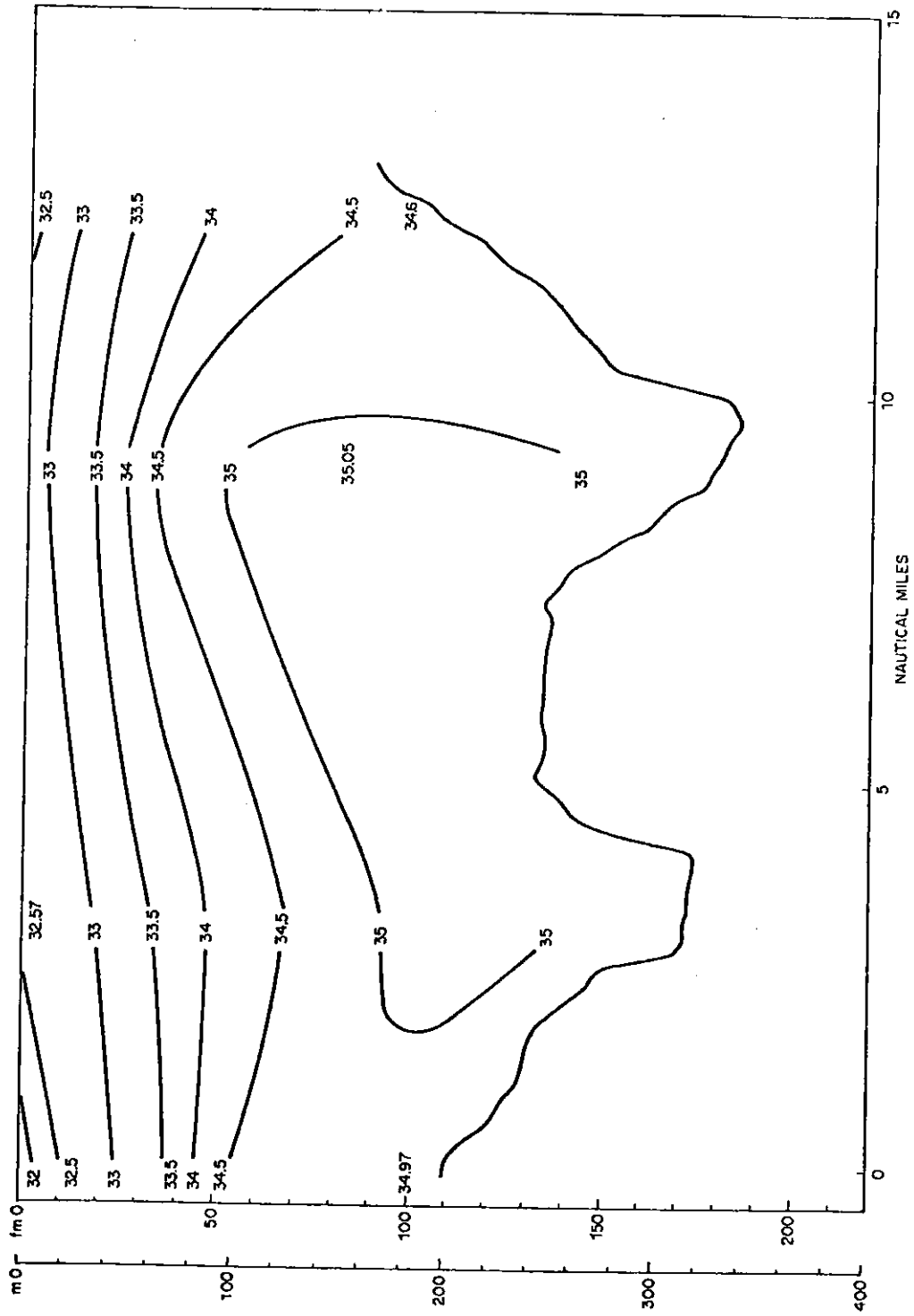


Figure 9. Salinity profile from data collected along section I by the USCGC DUANE, 21 May 1975.

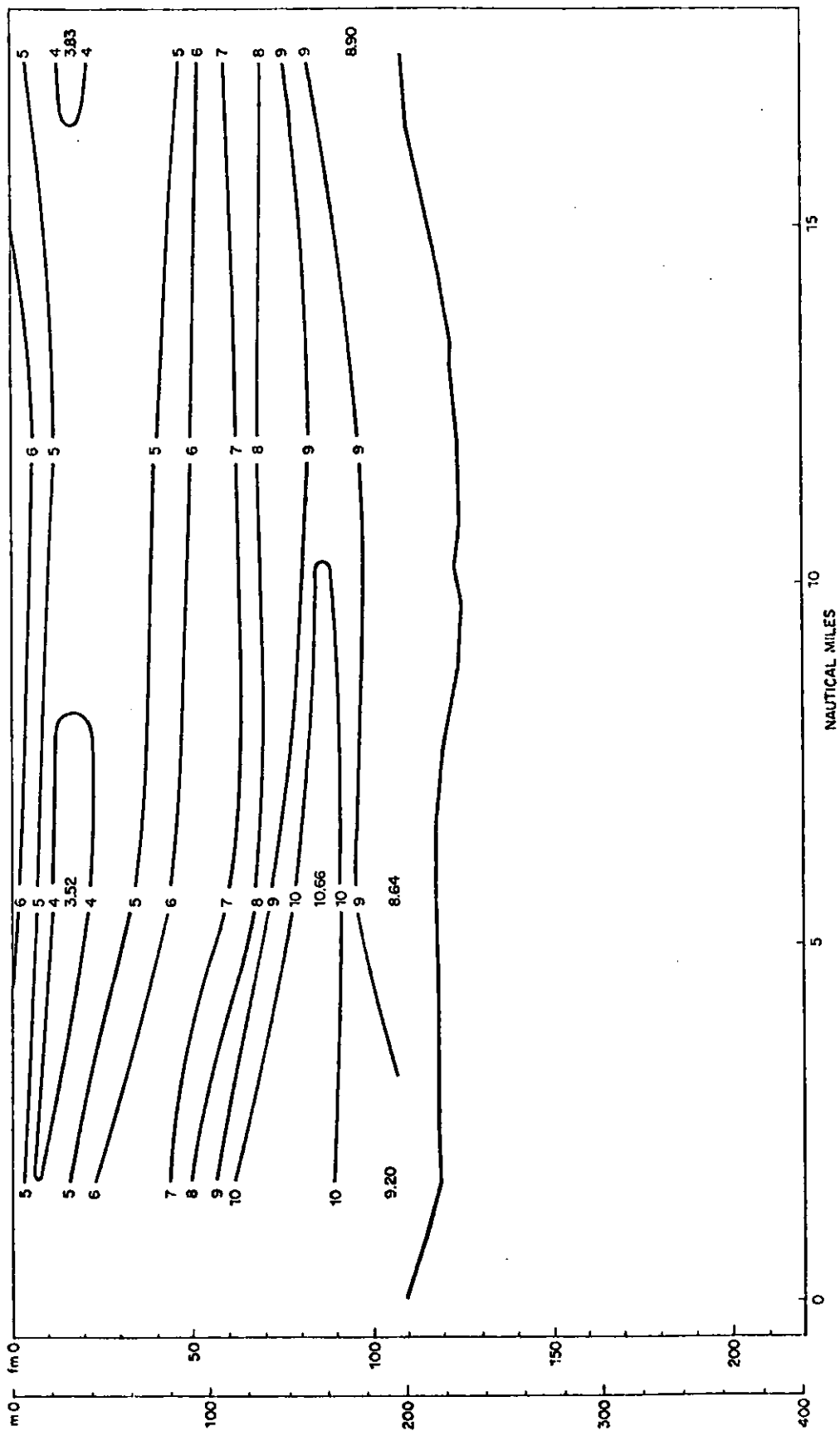


Figure 10. Temperature profile from data collected along section II by the USCGC DUANE 21 May 1975.

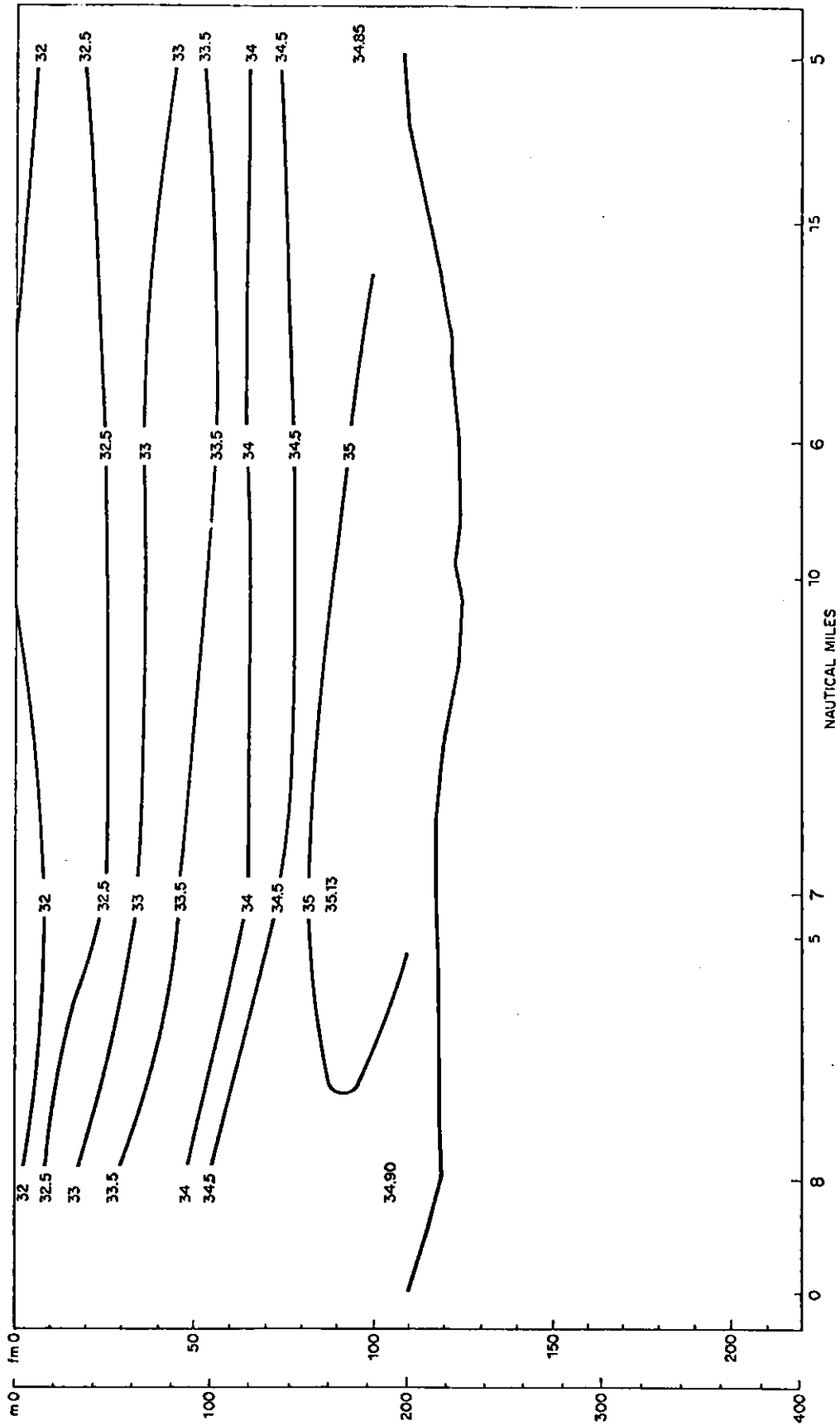


Figure 11. Salinity profile from data collected along section II by the USCGC DUANE, 21 May 1975.

