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Surface Temperatures and Salinities: Massachusetts to Cape Sable, Nova Scotia, and New York to the Gulf Stream, 1984

by

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Monitoring of water column temperature and surface salinity has been conducted by the Northeast Fisheries Center since 1977 along a Gulf of Maine route, and since 1976 along a New York Bight route as part of its Ship of Opportunity Ocean Monitoring Program (Figures 1 and 2). Numerous results of the New York Bight water column and bottom temperatures have appeared in previous reports (Hughes and Cook, 1984). The bottom temperature reports have resulted from the generation of a standardized time-space data matrix which has been particularly valuable for climatological investigations. This concept has now been expanded to the surface temperature and salinity data. Matrix cell dimensions for these latter data have not yet been standardized, so only the 1984 data are presented at this time. The matrix consists of time vs standardized reference distance where reference distance is the radial distance in kilometers from a route specific reference position to each sampling position, and has been adjusted so that the result is a distance beginning at the United States coast and increasing seaward. All samples taken within a route polygon have reference distance calculated (Figures 1 and 2).

Massachusetts to Cape Sable, N.S.

Coldest temperatures (Figure 3) anywhere along the route were the less than 2°C values occurring within 30 km of Cape Sable during the

last half of March and early April. Also on the Cape Sable end 3°-4°C water temperature spread westward as the year progressed reaching over one-third the way across the Gulf of Maine by the first of May. This sizable parcel of cold surface water no doubt influenced the rate and extent of spring warming along eastern portions of the route. Minimum temperatures on the Massachusetts side of the Gulf of Maine were just under 3°C in mid-March lasting briefly and being confined to 45 km from the Massachusetts coast. Maximum temperatures were reached along the western 330 km of the route in early August, exceeding 20°C for the 60-160 km range of reference distance. For the eastern 110 km, peak temperatures for 1984 of 12-13°C were not reached until early to mid-September. The rapid increase from 7-13°C on the extreme eastern end of the route between late July and early August may have resulted from a localized coastal event.

Salinities (Figure 4) near the western end of the route were below 29 °/00 from late May to early June with a brief period in June of less than 27 °/00 water found 50-60 km from Massachusetts. Salinities less than 31 °/00 occurred on the western end from mid-April to late August and a tongue of this water extended eastward reaching the central Gulf of Maine by late July. The highest salinities were generally found between reference distance 70- and 330-km from late February to mid April, and over a slightly greater extent of the route after November.

New York to the Gulf Stream

Figure 5 shows the time-space variation of temperature along this route in 1984. The shelf water front location determined from vertical temperature sections, and indicated for selected cruises by the solid square varied in reference distance by more than 160 km during the year. The mean distance to the shelf break (200m isobath) along this route is 194 km. (For a more detailed discussion of the 1984 shelf water front see Armstrong, MS 1985) Minimum temperatures of less than 3°C occurred along the route for the first 20 km seaward of Ambrose Light in February (Sampling usually begins at Ambrose Light which has a reference distance of 20 km.). Water less than 10°C which extended to 275 km in January had retreated to 180 km by mid-February corresponding to the shelf water front shoreward migration. By mid-to

late March less than 10°C water had advanced offshore to 250 km, and after mid-May water of these low temperatures were not found along the route. The most rapid heating took place during the first half of June along most of the length of the route. Excluding the Gulf Stream, maximum temperatures were reached along the route in mid-August. The Gulf Stream north wall was intense and convoluted occurring beyond 350 km during the winter and spring. No warm-core Gulf Stream rings occurred on this route during 1984, but Gulf Stream north wall meanders of 90 km are seen in the winter and spring. From July to November temperatures beyond 300 km are too high to clearly identify the position of the north wall. By November a strong gradient at 330-340 km again can be seen.

The dominant feature in the salinity field (Figure 6) is seen by following the 32 °/00 contour. Water less than 32 °/00 occupies over 20% of the time-space field in 1984. It includes all water within 60 km of Ambrose Light in January, progressing to 280 km offshore in August and then retreating to about 30 km offshore near the end of the year. Salinities near Ambrose Light dropped from greater than 30 °/00 to less than 27 °/00 during the last two weeks of March. This freshening stalled and then resumed in mid-May reaching minimum salinities for the year of less than 20 °/00 by the first week in June. The following month showed an equally rapid increase of salinity to a value of over 30 °/00. This low salinity pattern coincides with above normal January-May and record breaking June fresh water runoff into Long Island Sound, and above normal runoff from the Hudson-Raritan Estuary. No sharp salinity gradients through time are seen along the seaward end of the route but the 35 °/00 isohaline corresponds to the Gulf Stream meanders (Figure 5) between January and July and again in November. The shelf water front positions for selected cruises are shown as solid squares, which for the year was generally near or seaward of the shelf break (200m isobath), located at 194 km reference distance.

References

HUGHES, M. M., and S. K. COOK. 1984. Water column thermal structure across the shelf and slope southeast of Sandy Hook, New Jersey in 1981. ICES Annales Biol., 38: 14-17.

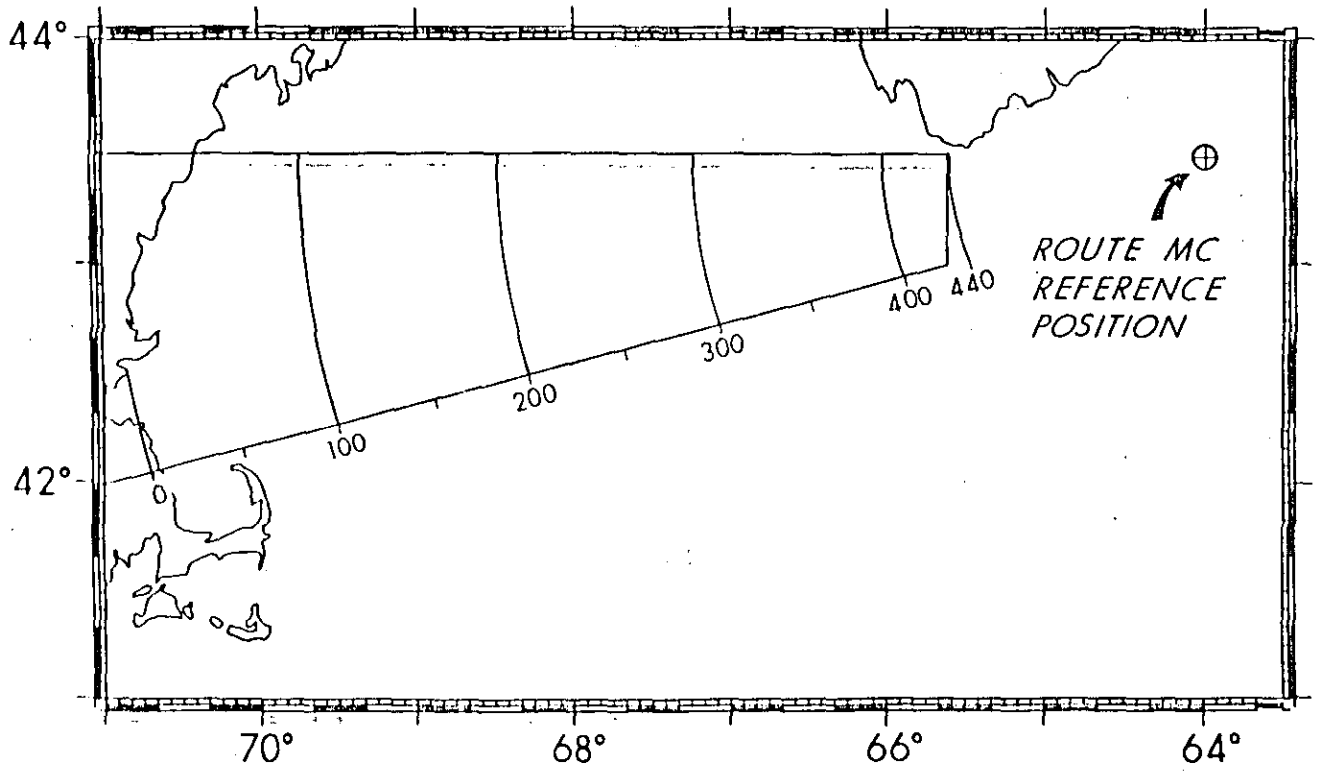

Figure 1. Massachusetts to Cape Sable, N.S., (Route MC) polygon, reference position, and reference distance scale.

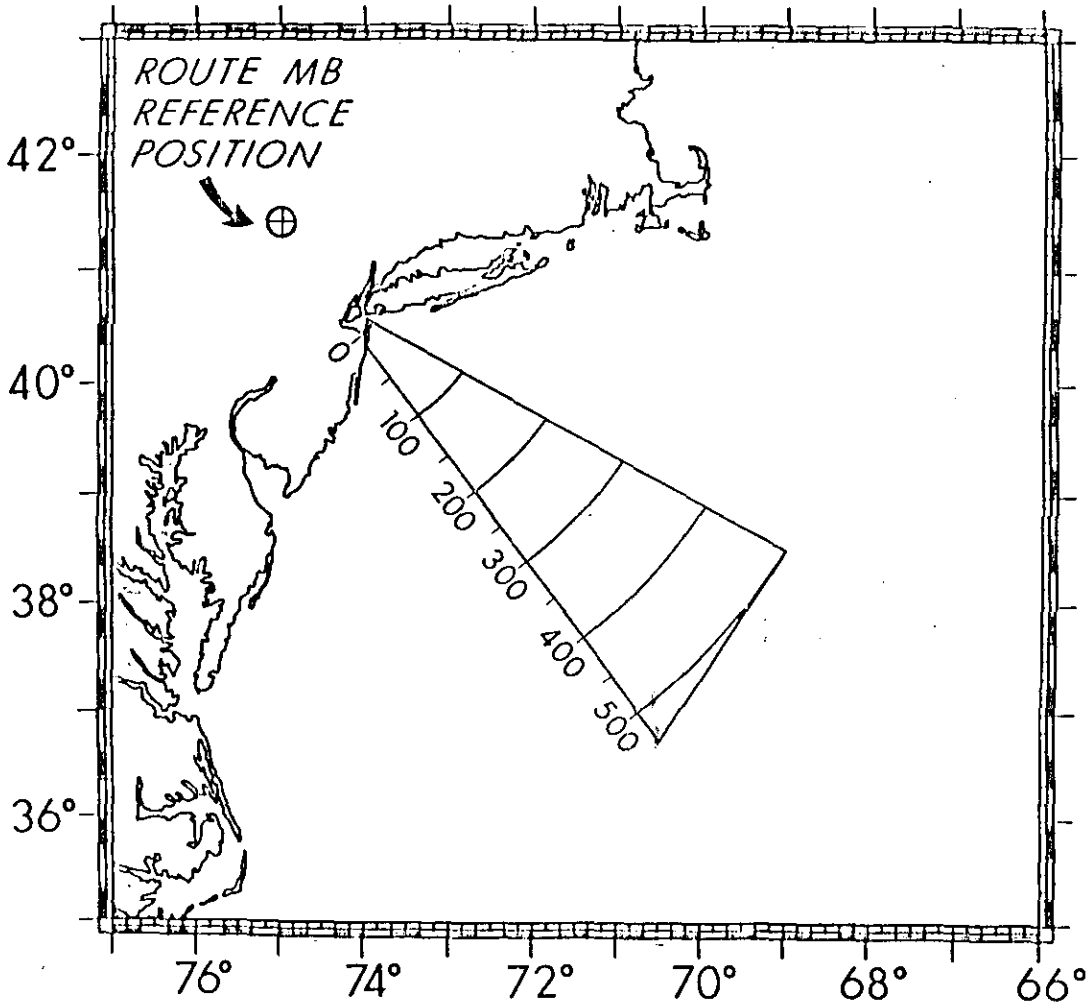

Figure 2. New York to the Gulf Stream (Route MB) polygon, reference position, and reference distance scale.

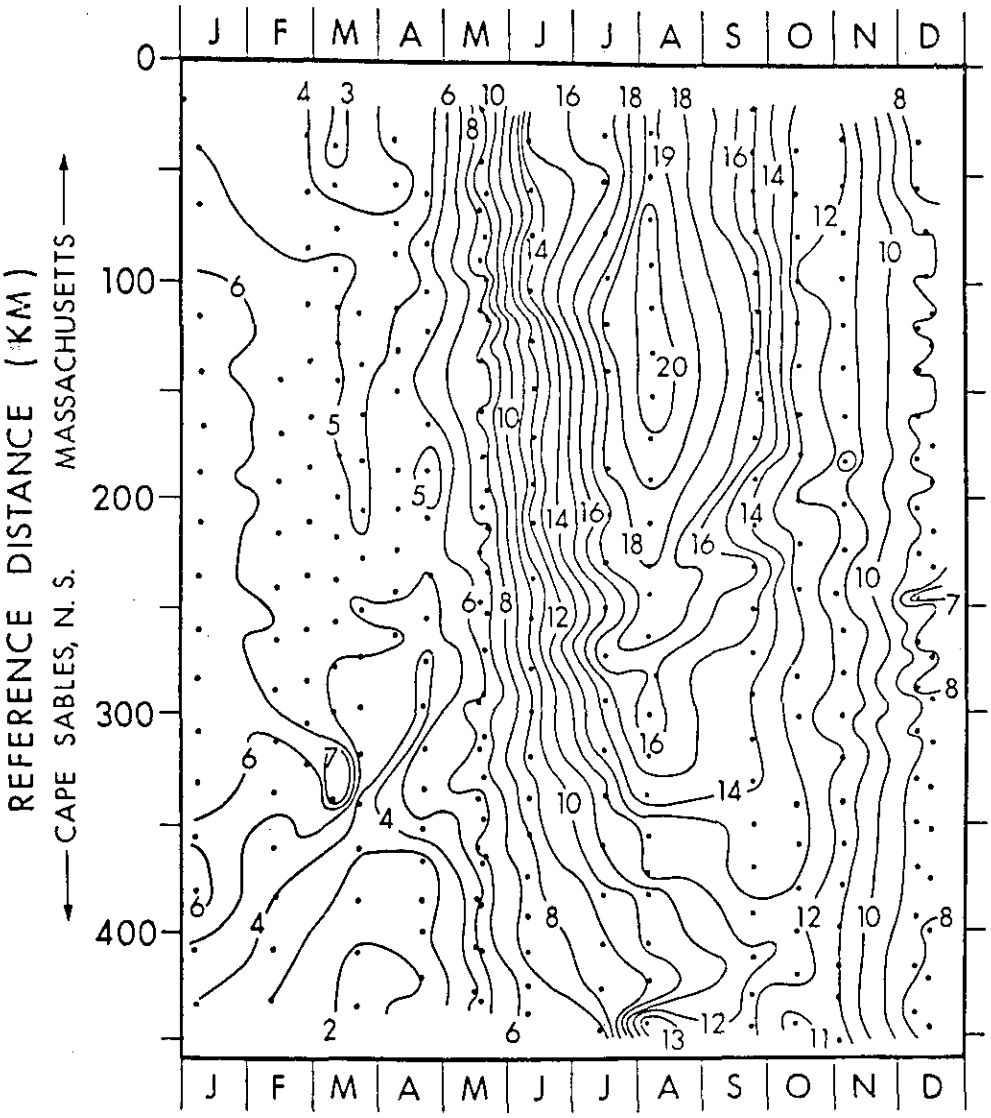

Figure 3. Time-distance field of surface temperature (degrees centigrade) for a transect between Massachusetts and Cape Sable, N.S., during 1984. Sample locations are shown by small solid dots. Reference distance is equivalent to the radial distance to each sample from Boston harbor.

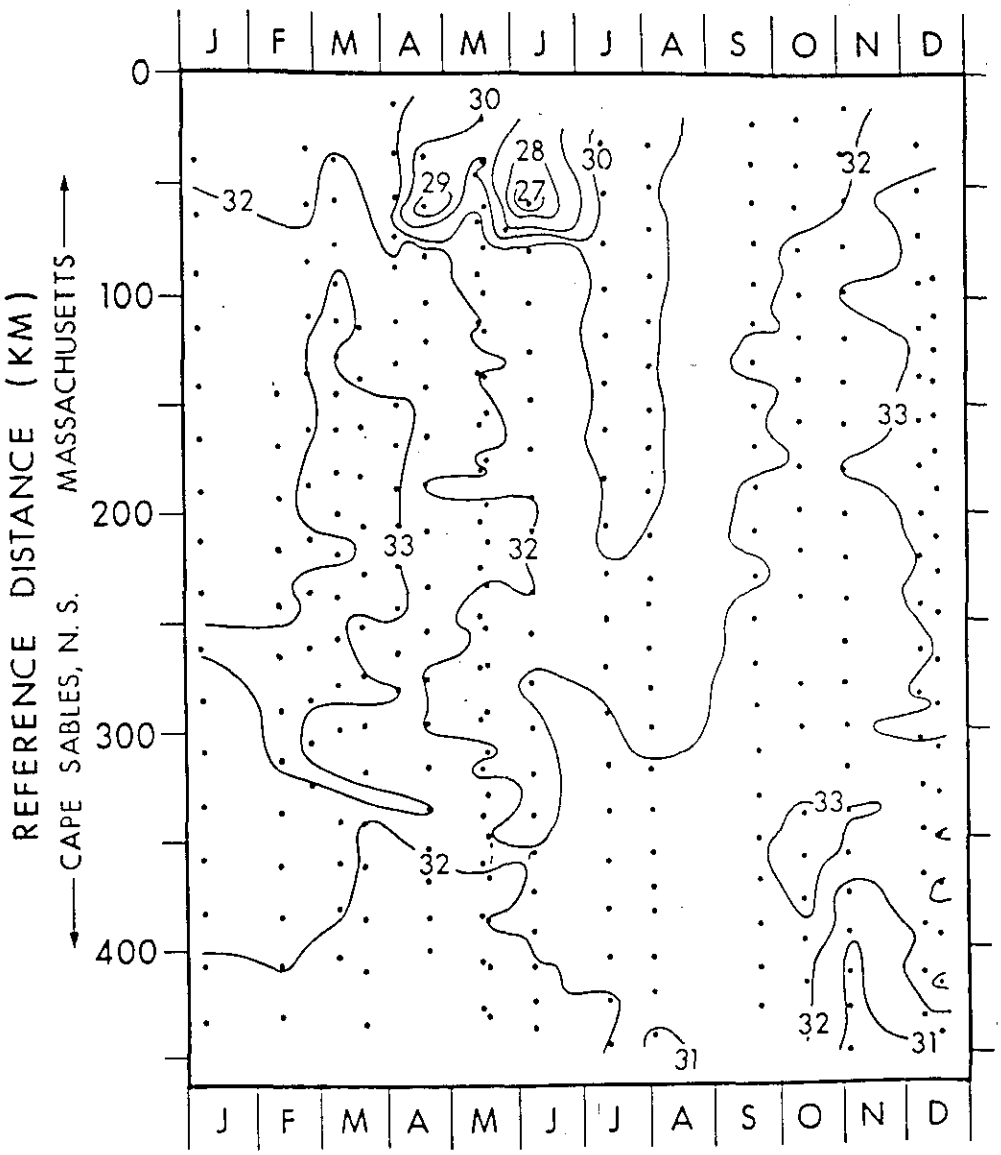

Figure 4. Time-distance field of surface salinity (parts per thousand) for a transect between Massachusetts and Cape Sable, N.S., during 1984. Sample locations are shown by small solid dots. Reference distance is equivalent to the radial distance to each sample from Boston harbor.

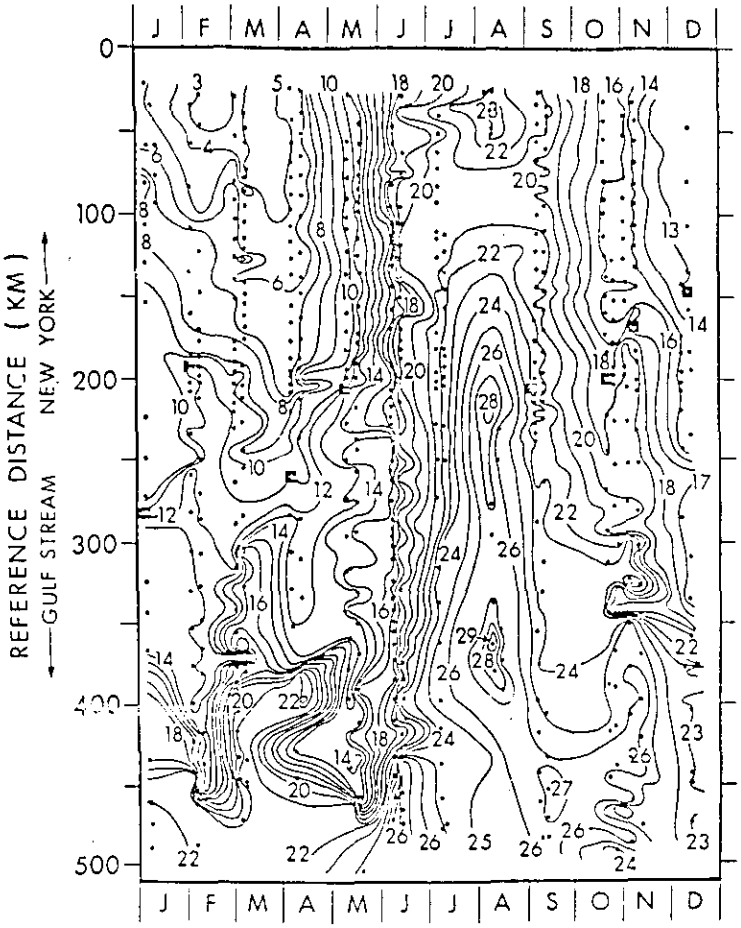

Figure 5. Time-distance field of surface temperature (degrees Centigrade) for a transect southeast of New York City during 1934. Sample locations are shown by small solid dots. Reference distance is the radial distance to each sample from New York harbor. Selected shelf water front locations are shown by solid squares.

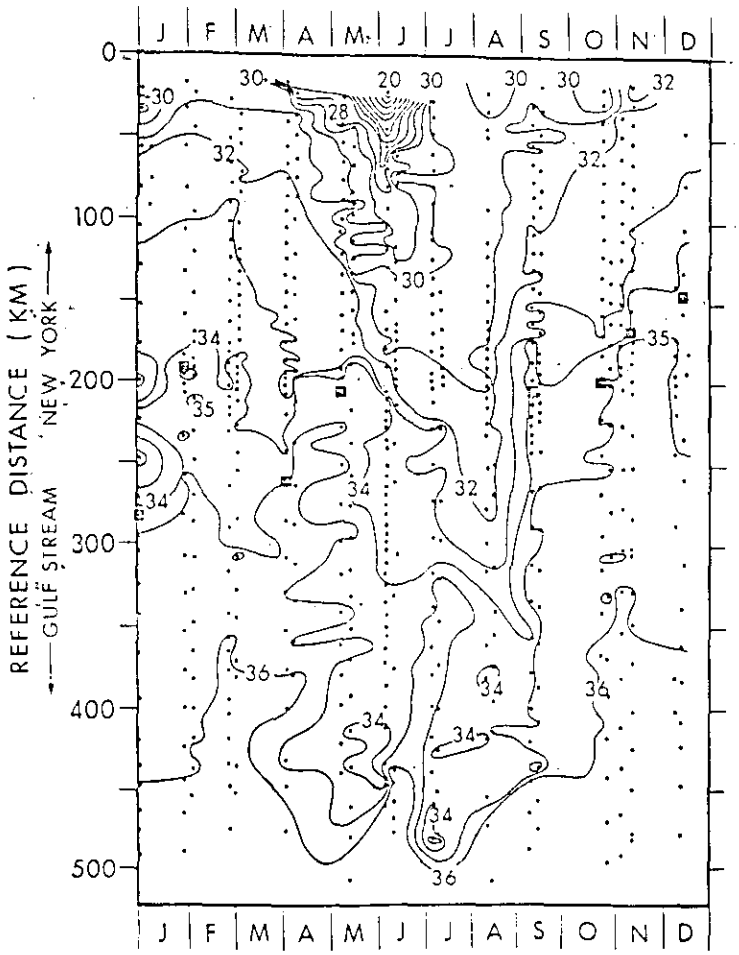

Figure 6. Time-distance field of surface salinity (parts per thousand for a transect southeast of New York City during 1984. Sample locations are shown by small solid dots. Reference distance is the radial distance to each sample from New York harbor. Selected shelf water front locations are shown by solid squares.