# GRAPHIC REPRESENTATION OF SALINITY IN A TIDAL ESTUARY

By

LESLIE A. STAUBER[1,2]

In any study of organisms in tidal estuarine areas, such as the oyster and its associates, the salinity of the water is of recognized importance as a factor limiting the distribution and controlling the activity (movement, feeding, spawning) of the various species.

All previous graphic methods of presenting salinity data, such as the construction of isochlors or the spotting of a single series of samples, are deficient in that they in no way indicate the variations and extremes which can occur. Since biological activity is greatly altered by such extremes a more inclusive technic of presentation is desirable.

In Figure 44 this has been done for the oyster-growing areas of the New Jersey waters of Delaware Bay. This haligraph combines a map and graph on which are plotted not only the points from which water samples were obtained and the recorded salinity of these samples, but also the position of such samples with reference to the total range of salinity as it varies with the tide or the depth. The length of the line which denotes the extent of variation with the tide has been determined for many of the stations by actually obtaining hourly samples over a complete tidal cycle (12–13 hours).

From the extremes so obtained we can construct lines on the map which show the position of penetration of any given salinity. These have been called hyperhals and hypohals. Hyperhal 10, for example, is defined as that point where the salinity just reaches 10 parts per mille during the saltiest part of the tidal cycle (usually between high water and the first hour of ebb in these areas of Delaware Bay). Hypohal 10 represents that point where the salinity falls just to 10 p. p. m. during the freshest part of the tidal cycle.

The completed haligraph can then be compared with a weather map except that changes will not occur with such rapidity. Knowing the temperature of the water and the duration of any given set of haligraphic conditions we are able to compare field with laboratory

[1] From the Oyster Research Laboratory, N. J. Agricultural Experiment Station, Bivalve, N. J.

[2] The author wishes to express his appreciation for the many valuable suggestions of Dr. Thurlow C. Nelson, whose interest made this work possible.

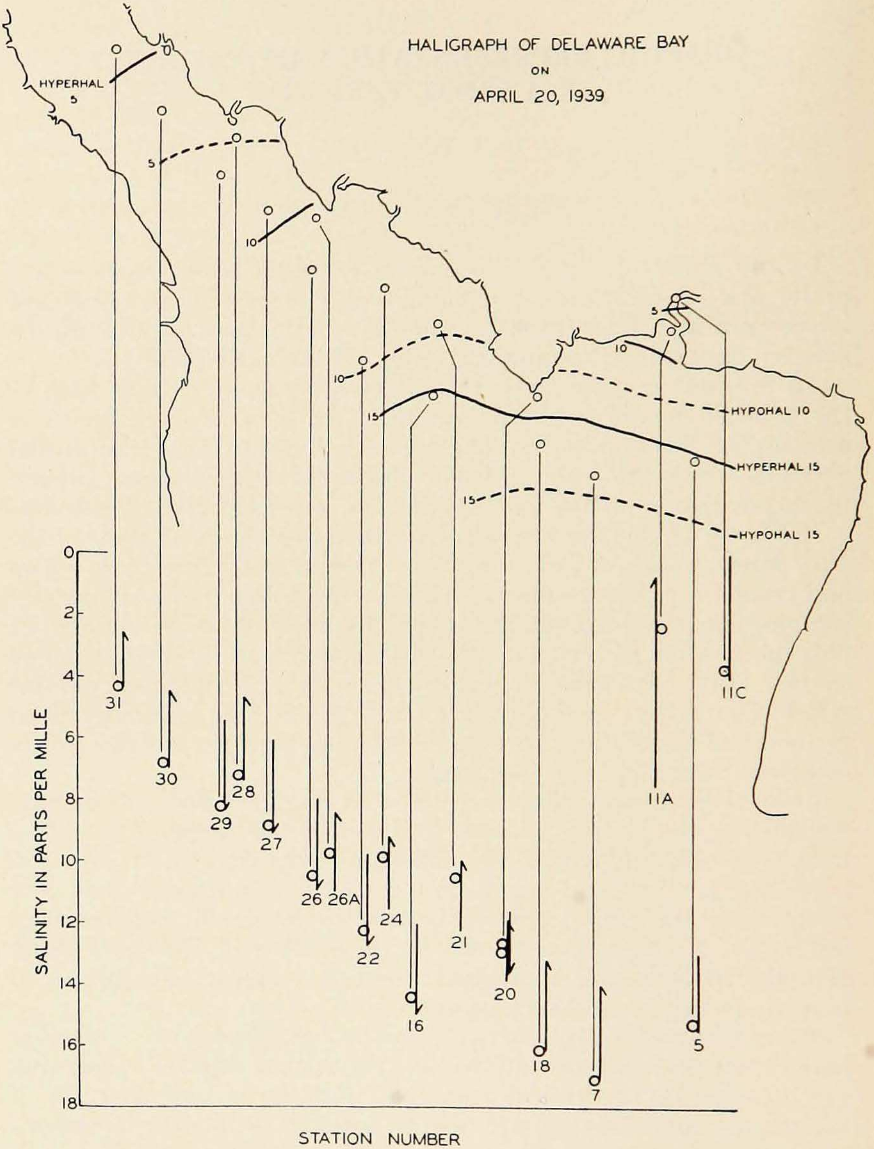


Figure 44. Haligraph of Delaware Bay on April 20, 1939. The circles in the upper or map portion represent the positions of the stations sampled. Heavy solid or dotted lines connect points of approximately equal salinity. In the graph portion a circle designates the salinity of the respective sample. The length of the heavy vertical line drawn tangential to each of these circles denotes the range of salinity occurring at this station. The arrow and the position of the circle along the vertical line indicates the approximate stage of the tide (arrow pointing up—ebb tide; down—flood tide). When the heavy vertical line is to the left, the circle indicates the salinity of water taken at the surface (see station 11A); when to the right, of water taken 1 foot from the bottom.

data on such problems as the duration and the degree of salinity necessary to maintain life.

In Figure 44 conditions were probably unfavorable to oyster life above hyperhal 10. Yet, because of the low temperatures prevailing during these adverse conditions no appreciable mortality occurred except at station 31. When similar conditions occurred in July and August of 1938, with water temperatures fluctuating around 25° C., oysters died from station 24 to station 31 in numbers which roughly varied inversely with the salinity of the water. During this same period of low salinities and high temperatures oyster drills (*Urosalpinx cinerea*) were destroyed at points above hypohal 10 except for a few small foci at stations 21, 22 and 26. At the same time oyster drill activity was inhibited at all stations where large scale trapping of this pest was in progress. All these stations had hypohals lower than 15. Traps were also out at the time indicated for Figure 44 (April 20, 1939) and although water temperatures were much lower (9° C.) it is still possible to demonstrate the greater inhibition of drills under conditions of hyperhals less than 15 than with hyperhals greater than 15.

The haligraph for September 22, 1932 clearly shows the effect of drought conditions on the salinity of Delaware Bay.[3] The position of hypohal 15 on this occasion was over 26 miles farther up the bay than on April 20, 1939 or above station 31 on Figure 44. Since extremes almost as great as these can occur within a few months (e. g. between April and August, 1939) we get a very clear picture of the variations in environment to which organisms living in these waters are exposed.

The recording of mean salinities can have but little meaning in biology. Brackish water species are kept within certain spatial limits by the effects of the extremes of salinity and of their duration, not by the means.

It is hoped that the haligraph will facilitate work on similar problems and that refinements of expression can be added in the future.

[3] Many thanks are due Mr. J. Richards Nelson for the use of these data which were gathered when he was in charge of this station.