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APPROXIMATE OPTIMUM SEA TEMPERATURE BY SPECIES

by
Robert L. Dow

Historic environmental, biological, and industrial data accumulated in Maine by the Department of Sea and Shore Fisheries and the U. S. National Marine Fisheries Service or its predecessor agencies appear to be adequate to identify approximate optimum sea temperatures, as measured at Boothbay Harbor, of the most intensively fished and valuable marine species. Within the period of this study, catch, varying with species, has ranged from 50 to 90 percent or more of either the legal or the commercial supply.

Daily sea temperatures have been recorded since 1905. Total annual catch of lobster, sea scallop, and soft clam has been recorded intermittently from the 1880's and continuously since 1939. Quahog or hard shell clam production has been reported since 1931. The bait worm fishery, from its beginning in the early 1930's, was not differentiated by species until after World War II. The oyster and the hard and soft clam resources within historic times, and by interpretation of prehistoric shell accumulations, have declined and recovered periodically with climatic cycles for the last 2,000 years. The shrimp fishery evolved from exploratory fishing in 1928 and 1938.

Fishing effort, indicated by the number of specifically licensed fishermen, units of gear, fishing days and vessels, has also been recorded comparably since the 1880's. Biological data have been collected intermittently for more than 70 years, but not on a continuous basis until after World War II. These data include growth and survival rates, size distribution, maturity and abundance.

Annual average sea temperature at Boothbay Harbor has ranged from 43.4° F. (6.3° C.) in 1917 to 52.0° F. (11.1° C.) in 1953. Recorded catches by species have ranged from 5.1 million pounds (2,300 metric tons) of lobsters in 1936 to 24.4 million pounds (11,000 tons) in 1889 and 1957; from 53,000 pounds (24 tons) of scallop meats in 1899 to 2 million pounds (919 tons) in 1910; from 1.4 million pounds (700 tons) of soft clam meats in 1954 to a standing crop of 11.2 million pounds (5,100 tons) in 1970; from no hard clams in 1939, 1966, and 1967 to 590,000 pounds (258 tons) of meats in 1949; from 170,000 pounds (77 tons) of three-year-old bloodworms in 1953 to 595,000 pounds (270 tons) in 1958; from 157,000 pounds (71 tons) of three-year-old sandworms in 1949 to 814,000 pounds (369 tons) in 1960; from no oysters between 1917 and 1950 to 22,500 pounds (10 tons) of meats in 1910; and from no shrimp between 1954 and 1957 to 24.5 million pounds (11,100 tons) in 1969.

That optimum conditions for each species have recurred periodically is evident from population surveys, catch records, and temperature data. The close correlation between air and sea temperatures when both have been recorded appears to justify calculating sea temperatures from air temperatures for selected years prior to 1905. Differences in average size and age at time of capture in the scallop fishery appear to account for nearly all the difference in total catch between the record production associated with the spawn year of 1901 and that of 1927 and between 1927 and those of the early 1940's.

It has been estimated that the 1910 lobster catch would have been 24.2 million pounds (10,980 metric tons) had effort been as great as it was in 1957. Survival of commercially important hard clam year-classes

has been limited to 1937, 1947, and 1952. Increase in bacterial and other pollution has resulted in a 50 percent decline in the harvestable supply of soft shell clams in recent years. Shrimp fishing effort increased an estimated fourteenfold between the optimum temperature period of the early 1940's and that of the middle 1960's. Estimates of changes in fishing effort between the two periods are based on number of vessels, size and quality of equipment, and length of fishing season.

Although seasonal temperatures are generally more influential than annual averages, comparison of optimum temperatures among several species can only be made on a yearly basis. When species have different spawning or hatching periods strongly influenced by temperature, it is impossible to make valid comparisons seasonally. On an annual basis of evaluation, optimum temperatures by species appear to be reasonably precise (Fig. 1).

Temperature may, according to species, directly influence spawning activity, development of larvae, growth and survival of juveniles, and the availability of food and feeding time for all stages. Sometimes the influence is indirect and affects the number of predators; for example, the damage done by green crabs (C. maenas) to clam and quahog supplies.

Differences in annual sea temperatures at Boothbay Harbor have ranged 8.6° F. (4.8° C.) and all species, even oysters and shrimp at the extremes, have experienced both higher and lower than optimum temperatures. In terms of total volume and maximum value, the optimum temperature appears to be about 47 to 48° F. (8.5° C.).

Figure 1

APPROXIMATE OPTIMUM SEA TEMPERATURE BY SPECIES
BASED ON AVERAGE ANNUAL BOOTHBAY HARBOR SEA TEMPERATURES

