1957

Sanitary Criteria for Shellfish by Species and by Area

Robert L. Dow

SANITARY CRITERIA FOR SHELLFISH BY SPECIES AND BY AREA

Robert L. Dow

Department of Sea and Shore Fisheries
Augusta, Maine

Abstract

Recommendations to establish shellfish sanitary criteria by species and areas were approved by the National Shellfish Sanitation Conference in 1954 on the basis of laboratory and field observations and experiments reported by the writer.

To implement these recommendations (1) further studies were conducted in Maine to evaluate the relative importance of hydrographic, geological and biological factors having actual or potential influence on the sanitary qualities of shellfish growing areas and (2) cooperative experiments among the several northeastern states (Maine, Massachusetts, Rhode Island, Connecticut and New York) have been carried on to establish standards for (a) blue mussel (Mytilus edulis) and (b) (still in progress) soft clam (Mya arenaria) shell stock.

Introduction

Traditionally the problem of sanitary control of shellfish-growing areas has been the responsibility of chemists, bacteriologists and sanitarians. With the development of biological knowledge of the several shellfish species and greater understanding of factors influencing the growing area, it has become apparent that problems of hydrography, of geology and of biology must also be given consideration in the establishment of criteria for adequate sanitary control of shellfish-growing areas.

To establish sanitary standards for shellfish-growing areas without taking into account biological differences among the several shellfish species, or to conduct sanitary surveys without benefit of hydrographical and geological study, is to assume that all shellfish species behave alike physiologically and that all growing areas have the same hydrographical and geological conditions. These assumptions, applied indiscriminately, could be disastrous to the industry as well as to public health.

Laboratory and field observations and experiments of the Department of Sea and Shore Fisheries indicating the need for a

review of shellfish sanitary criteria were reported by the writer to the National Shellfish Sanitation Conference in 1954. As a result of this report, the Conference amended its resolution on shellfish sanitation to include two recommendations:

(1) Establishment of sanitary requirements by shellfish species, and
(2) Establishment of sanitary requirements on an area basis.

Clarence Sterling and Leo Fox of Massachusetts, Leslie Sherman of Connecticut, Harold Udell of New York, and the writer arranged for a northwestern area (New England and New York) meeting to work out a cooperative research program to implement these proposals.

In addition to the cooperative program, the Department of Sea and Shore Fisheries undertook an investigation of problems peculiar to representative shellfish growing areas of Maine.

Factors Influencing the Growing Area

Results of these and previous studies indicate that factors associated with growing areas and having actual or potential influence upon sanitary requirements fall into three major categories: hydrographical, geological, and biological. It was further suggested that the relative importance of each varies seasonally by area and by species.

I. Hydrographic factors

A. One of several coves which make up Quahog Bay, Harpswell, Maine, serves to illustrate the complex influence of inshore hydrography. This serpentine cove is shallow at its head but slopes to about sixty feet in depth at its constricted mouth.

1. A survey was made to enumerate sources of pollution and to estimate the pollution load and its probable distribution. Results suggested that the cove might be a borderline area as far as satisfactory sanitary conditions were concerned.

2. Scores of bacterial water samples, ranging from zero to 3.6 MPN, compared favorably with those from the most isolated growing areas.

3. A hydrographic survey of the cove indicated that: (a) water currents moved independently of wind direction, with large homogeneous water masses shifting with the direction of the tide; (b) buoyant material at or near the surface drifted with the direction of the wind; (c) the volume of fresh sea water moved into the cove with each eight-to-twelve foot tide could account for low bacterial scores; and (d) inferences derived from the shoreline survey that the overlying waters might be excessively contaminated were not supported by hydrographic studies. (a)

B. Similar studies have been made in other areas. Results suggest evaluating parts of a sanitary survey in the order: hydrographic studies, bacteriological analysis of water quality, and other components.

C. Additional experiments during the last several years indicate that complexity of inshore hydrography is seriously underestimated.

1. In one study area it was repeatedly observed that a water mass moved through another water mass of similar temperature and salinity. Water pressure created by the tide in combination with geological features appeared to be the causative factor. Direction of movement was related to conformation of the bottom.

2. In a second study area, current velocity during the tidal cycle varied from nearly zero to more than six miles per hour.

3. Even in areas where land mass constrictions or other obstacles to laminar flow induced turbulence, stratification regularly occurred with respect to salinity, temperature and bacteriological water quality.

II. Geological factors

A. Studies of periodic changes in surface hydrography and in geological modification of intertidal growing areas were carried on jointly by the Maine Geological Survey and the Department of Sea and Shore Fisheries from 1948 through 1954. Although conclusions are not final, results of these investigations show that geological factors with their influence on hydrography must be considered if a valid appraisal of pollution conditions is to be made.

1. Photographic (both still and motion) records of minor geological changes were made by the writer while working with Dr. Joseph M. Trefethen, State Geologist and Dr. Wilmot H. Bradley of the United States Geological Survey. Redistribution of marine sediments and other debris by surface tension, sub-surface vortices, tidal run-off, and ice floes was observed and photographed.

2. Major changes were observed to take place under extraordinary meteorological conditions. Flats in some growing areas were drastically altered in elevation, conformation and compaction.

3. More permanent geological features, including sub-surface bedrock, were found to retard distribution.

4. Observations suggest that geological factors including surface texture, particle size, compaction, permeability and gradient influence the distribution or redistribution of pollutants.

III. Biological factors

A. There are several species characteristics which have bearing upon sanitary criteria.

1. Examination by the Department of Sea and Shore Fisheries of shell liquors of clams (Mya arenaria) from commercial areas of Maine indicates that clams did not siphon or feed when salt concentrations of the water dropped below twenty-four parts per thousand. Some clams have been found to survive in water that, on occasion, dropped below one part per thousand. That clams siphon overlying waters of much lower salinity than twenty parts per thousand in other geographical areas has been verbally reported to the writer by marine biologists working in Massachusetts and in Maryland.

2. When the range of salinities is wide, clams siphon only during the higher concentrations of that range.

3. Grossly-polluted clams repeatedly cleansed themselves at temperatures as low as 41°F., approximately nine degrees lower than the temperature reported in the "Manual of Recommended Practice for Sanitary Control of the Shellfish Industry".

4. In shellfish growing areas of Maine where both clams and quahogs (Mercenaria mercenaria) occur in commercial concentrations, quahogs invariably will be found in those portions of the area where the overlying waters are of higher salinity. Since, under normal conditions, contaminated waters are those of lower salinity, species that tolerate lower salinity are more likely to be exposed to contamination than are those that require more saline water. Quahogs are less subject to contamination than clams in the same growing area.

5. Shell form can contribute to contamination. The quahog, with ability to close its valves completely, is less exposed to contamination from brief periods of polluted fresh water than the clam which can neither completely retract its siphon nor close its valves. Although the clam may not feed during these periods, the external parts of the siphon and the mantle may become contaminated.

6. Differences in viability among shellfish species is an important health consideration. Experience in holding shellfish alive under varying conditions indicates that clams will live more than twice as long as blue mussels, but only from one-half to one-fifth as long as quahogs. It is apparent that because of biological differences the same sanitary requirements should not apply to these three shellfish species.

Standards for Blue Mussel (*Mytilus edulis*)

Blue mussel shell stock has for years been a quality problem for producers, distributors and wholesalers as well as for consumers. Although the magnitude of production is not comparable to that of the oyster, clam, and quahog fisheries, the lack of essential information on quality control is considered by research personnel of the northeastern states to be a major deterrent to market development and production increase. The group selected the blue mussel for its initial research effort because of industrial considerations.

Minutes of the meeting held in Lawrence, Massachusetts, on April 18, 1956 contain the results of experiments carried on cooperatively by research personnel of New York, Connecticut, Rhode Island, Massachusetts and Maine. Recommendations on sanitary requirements covering harvesting, cleansing, shipping, refrigeration, seasonal harvesting and shipping problems, and bacterial limitations for mussel shell stock in interstate commerce were prepared from these findings. After further study by the regulatory and advisory agencies of the several states, these recommendations were adopted as sanitary criteria.

Clam (*Mya arenaria*) Shell Stock

Currently the same group of researchers is cooperating on a program to establish sanitary requirements for clam shell stock. Experiments were outlined by the writer and Phillip L. Goggins, bacteriologist of the Department of Sea and Shore Fisheries.

The purpose of the program is to enhance quality of product in order that general economy of the industry may be improved. The primary objective is to evaluate quality of clams from growing areas to receiving markets and handling and shipping in various containers at different temperatures. The secondary objective is to relate these evaluations to biological and conservation problems of the species.

1. Pre-shipment experiments carried on at Boothbay Harbor by the Department of Sea and Shore Fisheries include:

a. Harvesting -

(1) From approved areas only, unless otherwise specified.

b. Handling -

(1) A series of duplicated experiments carried out under the following conditons:

(a) washed versus unwashed.

(b) refrigerated versus unrefrigerated.

(c) broken versus unbroken.

(d) stimulated shipping conditions versus undisturbed storage (room temperature, incubator temperature, and refrigeration at 40°F.)

2. Receiving experiments carried on by agencies of states concerned include:

a. Packaging (three-month trial with each method)

(1) unprotected box and basket (no insulating or padding material).

(2) protected box and basket.

(1) various degrees of protection using various materials.

(3) clams from approved versus moderately polluted y polluted areas. Variations of receiving experiments will depend upon results at Boothbay Harbor.

Summary

For administration and enforcement convenience, it would be desirable to establish specific sanitary criteria for all species of shellfish from all growing areas. Biological differences within the same species from different growing areas and hydrographical and geological differences for all species from different growing areas preclude the application of a single index of quality.

Recognizing these problems, researchers from New York and New England are presently engaged in a cooperative program to develop applicable standards of quality for the shellfish industry.

Literature Cited

Donohue, John J. March 1949. Shore studies: Stover's Cove, South Harpswell, Maine. Rpt. of the state geologist, Augusta, Me. 1947-1948, pp. 103-109.

Dow, Robert L. and Dana E. Wallace. Jan. 1950. The Maine clam (Mya arenaria). Bull., Dept. of Sea & Shore Fish., Augusta, Me.

Dow, Robert L. and Dana E. Wallace. March 1951. Soft shell clam growth rates in Maine. Bull., Dept. of Sea & Shore Fish., Augusta, Me.

Dow, Robert L. 1954. Preliminary experiments in the use of ground controlled aerial photography in interdial hydrographic surveys. Proc. Natl. Shellfish. Assoc. 45: 199-208.

Ganaros, Anthony E. Sept. 1954. On the ecology of Mya arenaria L. and Venus mercenaria L. in Maquoit Bay and Falls Cove, Maine. Unpub. Ms. Rutgers Univ., New Brunswick, N. J.

Goggins, Phillip L. and John W. Hurst, Jr. 1949-1957. Bacteriological surveys; files, Dept. of Sea & Shore Fish., Augusta, Me.

Gustafson, Alton H. 1954. Growth studies in the quahog Venus mercenaria. Proc. Natl. Shellfish. Assoc. 45: 140-150.

Moulton, James M. and Gareth W. Coffin. Feb. 1954. The distribution of Venus larvae in Orr's Cove plankton over the tide cycle and during the summer and early fall of 1953. Res. Bull. No. 17, Dept. of Sea & Shore Fish., Augusta, Me.

Scattergood, Leslie W. and Clyde C. Taylor. Jan. 1950. The mussel resources of the North Atlantic region. Fish. Leaf. 364, U.S.F. & W.L.S., Dept. of the Int., Washington 25, D. C.

Shellfish committee representing northeastern shellfish producing states, Minutes of. April 18, 1956. Lawrence Experiment Station, Lawrence, Mass.

Trefethen, Joseph M., John J. Donohue, Philip Stackpole, and William Fairley. May 1951. Shore studies, Rpt. of the State Geologist, Augusta, Me. 1949-1950. pp. 107-158.

U. S. Public Health Service, Sanit. Eng. Div., Fed. Sec. Agency, Washington 25, D. C. 1946. Manual of recommended practice for sanitary control of the shellfish industry.

Zink, Robert M. Dec. 1953. Certain aspects of the ecology of Venus and Mya at Bunganuc and at Morgan Bay, Maine. Rpt. of the State Geologist, Augusta, Me. 1951-1952. pp. 71-115.