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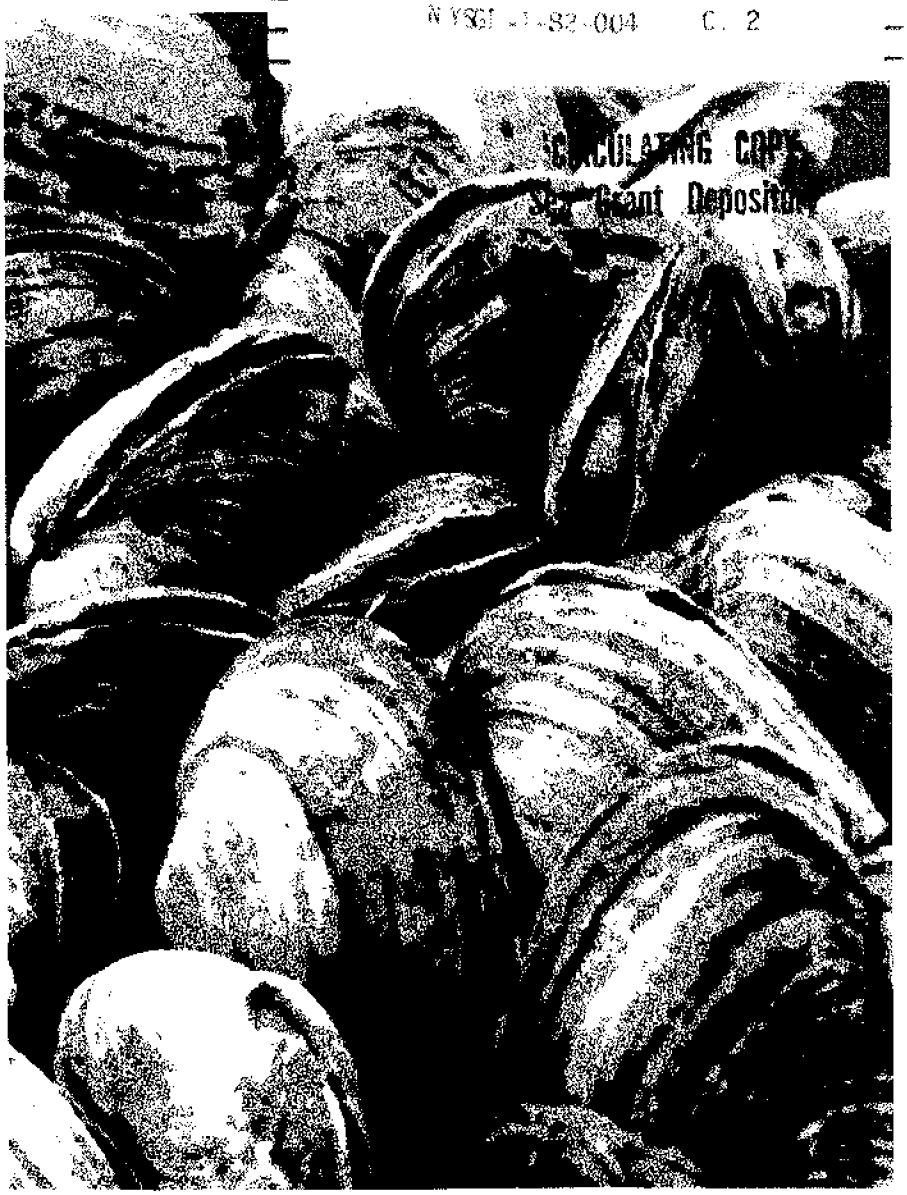

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SHELLFISH PATHOLOGY

Case Histories from Cornell

New York Sea Grant Institute
Albany, New York

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SHELLFISH PATHOLOGY:

Case Histories from Cornell

Preface

The aquaculture industry is growing, and shellfish are gaining importance as a food source. Yet shellfish diseases continue to decimate stocks and hamper production.

This booklet highlights some of the recent Sea Grant-supported work in shellfish pathology by Ralph Elston, Louis Leibovitz, Theodore Meyers, and others in Cornell University's Department of Avian and Aquatic Animal Medicine. Their innovative research has contributed much to our basic knowledge of structure and function in these organisms; to our understanding of the sources and mechanisms of common diseases; and to the development of techniques for prevention and control.

A NEW DISEASE OF LARVAL PACIFIC OYSTERS (CRASSOSTREA GIGAS)

Louis Leibovitz, Ralph Elston, V.P. Lipovsky, J. Donaldson

The Pacific oyster (Crassostrea gigas) is an important industry on the west coast. From 1975 to 1977, shellfish growers in Ocean Park, Washington tried to learn more about a mysterious disease that had been decimating larval stocks. Based on their observations and on a detailed study in June 1977, Leibovitz et al. report here some breakthroughs in understanding this disease.

Bodies resembling zoospores on the cilia of the larval velum appeared to be the first sign of the disease. As these bodies increased in number, the velum and the mantle eroded, leading finally in the terminal stages to severe erosion, spherical bodies in the stomach, and dilated darkened intestines.

Based on histologic and electron microscopic study of these phenomena, the authors suggest that aquatic fungi similar to Dermocystidium organisms may cause the disease. Importing infective agents with foreign seed stock could be the original and continuing source of infection, although reports of the same infection in wild stocks of Pacific oysters indicate that the disease is endemic.

Article reprinted from Proceedings, 9th Annual Meeting of the World Mariculture Society, Atlanta, January 1978.

VIRUSLIKE PARTICLES ASSOCIATED WITH LESIONS IN LARVAL PACIFIC OYSTERS (CRASSOSTREA GIGAS)

Ralph Elston

Continuing the work begun by Leibovitz et al. in 1977 (see preceding abstract), Elston performed electron microscope analysis of their sample of diseased Pacific oyster (Crassostrea gigas) larvae and found relatively large, hexagonal, viruslike particles in the velar lesions that had not been detected previously.

The largeness of these particles, Elston points out, is not unprecedented in the tissues of mollusks and other aquatic animals. One study reported similar large, viruslike particles in Portuguese oysters (Crassostrea angulata); other studies have associated them with certain fish diseases. Since viruslike particles in general have also been found in lesions of bivalve mollusks, some role in the Crassostrea gigas disease appears likely.

Elston speculates that "a virus may be acting secondarily to or in concert with other pathogens" implicated in the study by Leibovitz et al. Further work is now needed on the role of viruses in mollusk diseases--work that "might have practical importance in helping to limit hatchery mortalities of larval bivalves."

Article reprinted from Journal of Invertebrate Psychology, vol. 33, 1979.

PATHOGENESIS OF EXPERIMENTAL VIBRIOSIS IN LARVAL AMERICAN OYSTERS (CRASSOSTREA VIRGINICA)

Ralph Elston and Louis Leibovitz

Oysters are an important food source not only on the west coast, but in North America in general as well as other parts of the world. Because of decreases in the natural productivity of oyster beds as well as increases in demand, oyster larvae are now cultured intensively in hatcheries. However, disease outbreaks, or epizootics, in these hatcheries have been a persistent problem.

The most frequent culprit in these epizootics may well be the bacteria genus Vibrio. To understand better how this disease can be diagnosed and, ultimately, prevented, Elston and Leibovitz investigated in detail the effects of Vibrio on experimentally infected larval American oysters (Crassostrea virginica).

The authors were able to identify three basic patterns of the disease, which they designated pathogenesis types 1, 2, and 3. The first type affects all larval stages; types 2 and 3 affect the early and late veliger stages, respectively. Using photos and tabular material, Elston and Leibovitz give a detailed characterization of these types.

"The results of these studies clearly suggest hatchery management tools which can aid in the control and prevention of disease." The authors conclude by discussing some of these diagnostic and preventive tools.

Article reprinted from Canadian Journal of Fisheries and Aquatic Sciences, 1980.

FUNCTIONAL ANATOMY, HISTOLOGY AND ULTRASTRUCTURE OF THE SOFT TISSUES OF THE LARVAL AMERICAN OYSTER (CRASSOSTREA VIRGINICA)

Ralph Elston

Adult bivalve molluscs have been studied extensively, but much less work has been done on the larvae of these species. Recently, however, there has been a renewed interest in larval oysters. "The general purpose of this paper," says Ralph Elston, "is to further add to our basic knowledge of these early stages by studying the functional anatomy, histology and ultrastructure of the soft tissues of the larval American oyster, Crassostrea virginica (Gmelin)."

Elston stresses the importance of the visceral cavity, which had not been fully appreciated in previous studies. He also points out that "the velum has been incorrectly described as attached to the body by a broad stalk; rather it is attached to the mantle with retractor muscles and the peripheral velar membrane." He further discusses digestive and other functions that distinguish the larval C. virginica from the adult.

Article reprinted from Proceedings of the National Shellfisheries Association, 1980.

FUNCTIONAL MORPHOLOGY OF THE COELOMOCYTES OF THE LARVAL OYSTERS CRASSOSTREA VIRGINICA AND CRASSOSTREA GIGAS

Ralph Elston

Researchers have spent much time studying the cells in the body cavities of adult marine mollusks. But they have generally neglected similar work in larval forms. To remedy this, Elston studied the juvenile stage of two species of oysters.

He examined the live animals and their tissues, and probed their ultrastructure with an electron microscope. In the body cavity of each larval form were two main types of cells. One was a phagocyte, a blood cell that destroys foreign bacteria and other microorganisms. This appears to be a cell observed in the adult animals. The other type was an SER (smooth endoplasmic reticulum) cell that seems to play a role in metabolism and is apparently not found in adult bivalves.

These cells appear to develop from mantle tissue. When no longer useful, they are discarded by being forced out through the velum or other associated membranes of the larva.

These findings highlight the larval bivalve's structural and functional distinctness from the adult, which may reflect an adaptation to a larval mode of existence.

Article reprinted from Journal of the Marine Biological Association, U.K, vol. 60, 1980.

THE OYSTER INDUSTRY OF THE LONG ISLAND SOUND AND LONG ISLAND SOUND REGION

Ralph Elston and David Relyea

Nineteen eleven was a good year for oyster production in Long Island Sound: a record 50 million pounds was harvested. Since then production has declined--all the way to 2 million pounds in 1975.

What's to blame? Predation, pollution, and disease have all undoubtedly played a part; but the upshot is that the demand for oysters now exceeds the supply. That, however, is one reason Elston and Relyea believe the industry can revitalize.

In this overview of the Sound and its oyster industry, the authors look at some of the ways production has been depressed. They discuss the role of such predators as starfish, oyster drills, boring sponges, and blue mussel; the problem of disease outbreaks in both oyster beds and hatcheries; the threat of toxic chemicals--mostly petroleum products and pesticides; and such political issues as the availability of oyster beds and the need for better certification procedures for seed suppliers and consumers.

Elston and Relyea believe these problems are surmountable. Through a concerted effort that must include better disease control, more rational regulation, and greater respect for oysters' natural habitat, the industry can thrive once again.

Available from the New York Sea Grant Institute as a First Impression Report.

DIAGNOSIS OF VIBRIOSIS IN A COMMERCIAL OYSTER HATCHERY EPIZOOTIC: DIAGNOSTIC TOOLS AND MANAGEMENT FEATURES

Ralph Elston, Louis Leibovitz, David Relyea, Joseph Zatila

This report is the first detailed account of an epizootic of vibriosis in a commercial oyster hatchery and the first to use the fluorescent antibody test as a diagnostic tool in such a context. The authors also used interference microscopy, the dye exclusion test, and histological techniques to gain insight into how the disease affects its victim, the larval American oyster.

Pathological lipid deposition, which disrupts normal metabolic processes in the larvae, emerged as a consistent sign of the disease. The authors found the trypan-blue dye exclusion test a rapid and simple method for detecting some of the early pathological changes. And they found the antibody test highly effective in diagnosing the etiologic agent--in this case, the Vibrio spp. bacterium.

The Vibrio spp. had serious effects indeed: for 1979, the year the disease occurred, the hatchery's production dropped to one-third that of the previous year. Elston and colleagues' innovative research offers promise for better understanding and controlling this disease. Their account is supplemented by some unusual photographs.

Article reprinted from Aquaculture, vol. 24, 1981.

CONCHIOLIN INFECTION AND SURFACE COATING VIBRIO: SHELL FRAGILITY, GROWTH DEPRESSION AND MORTALITIES IN CULTURED OYSTERS AND CLAMS, CRASSOSTREA VIRGINICA, OSTREA EDULIS AND MERCENARIA MERCENARIA

Ralph Elston, Elisa L. Elliot, R.R. Colwell

Shellfish diseases continue to plague the hatcheries industry. Vibriosis, for example, strikes oysters at the larval stage and leads to production losses. But diseases that affect juvenile-stage shellfish can be even more of a problem because they are hard to monitor and the losses they cause hard to enumerate.

Elston et al. report here on their work with two diseases of juvenile-stage shellfish. One infected American and European oysters in Maine waters, the other hard clams in Massachusetts waters; both involved similar microbes, and both occurred in summer 1980 when seawater temperatures were rising in the two coastal zones.

Unlike most other studies of bacterial infections which have focused only on clinical and histological aspects, this article describes the bacteriological and ultrastructural aspects as well. The authors also discuss their innovative application of antibody techniques. They conclude with some suggestions for monitoring and management strategies that can help hatcheries cope with the shellfish-disease problem in the future.

Article reprinted from Journal of Fish Diseases, vol. 5, 1982.

SOME ENDEMIC DISEASES OF CULTURED AMERICAN OYSTERS (CRASSOSTREA VIRGINICA) AND HARD CLAMS (MERCENARIA MERCENARIA) FROM LONG ISLAND, NEW YORK

Theodore R. Meyers

The commercial rearing of oysters and clams off the shores of Long Island has become important to seafood lovers as well as to the economy of New York State. To guard against a possible threat to this industry, Meyers conducted a tissue survey of these cultured American oysters and hard clams to identify their diseases.

After collecting specimens each month for almost two years and examining the tissues in an electron microscope, he concluded that Long Island shellfish appear to be in good health. The oysters were relatively free of important diseases. But two organisms found in the oysters, an actinomycete and Haplosporidium plasmodial forms, merited concern over their potential for causing disease.

None of the organisms present in the hard clams were significant disease causers. They were, however, responsible for a rate of infection in Long Island clams that was twice as high as in clams from other areas.

Article reprinted from Aquaculture, vol. 22, 1981.

A SHELL DEFORMING DISEASE OF HARD CLAMS

Louis Leibovitz, Theodore R. Meyers, M. Frey

Leibovitz, Meyers, and Frey found the answer to a question that had been worrying the shellfish industries of Long Island's Great South Bay: What was killing off large numbers of hatchery-raised clams right after these popular, edible bivalves had been planted in the muddy bottom of the bay?

The culprit, it turned out, was a disease that showed itself by deforming the clam shells in a distinctly different way from deformities caused by mechanical injury, predator damage, and other means.

The authors discovered the disease while studying samples collected during an 18-month survey. They found that the disease, which also affects wild clams, occurred most often in newly planted young clams that were stunted in size and deformed in shape. The typical shell deformity was a symmetrical elevation of the dorsal parts of the valves. This deformity was larger and less symmetrical in individuals that survived into adulthood.

Microscopic studies of affected juveniles also revealed abnormal changes in their soft tissues. These changes became gross lesions of the mantle and siphon in surviving adults.

Article reprinted from Proceedings of the 1st International Colloquium on Invertebrate Pathology, 9th Annual Meeting, Queens Unversity, New York, 1976.

A POLYPOID MYOMA OF THE FOOT OF A SURF CLAM

Louis Leibovitz, J.C. Harshbarger, P. Chanley

Tumorlike growths occur often on the feet of freshwater mussels and clams. Five northwestern species have been reported to have such growths. Here, Leibovitz et al. report finding a multiple-stalked tumor on the foot of a surf clam harvested from the Atlantic Ocean off Long Island.

There had been only one previous report of a surf clam with a tumor of the foot. Unlike that tumor, which was composed of disoriented nerve fibers, this one consisted of muscle tissue. This formed six firm lobes ranging from 1 to 2.5 centimeters wide and 1 to 3 centimeters high. The tumor was incompletely covered with a surface tissue thinner than that overlaying the normal part of the foot.

Tumorlike growths on the feet of the bivalves can be inflammatory or noninflammatory. Most noninflammatory lesions appear to be produced by well-differentiated cells multiplying in a disorganized way. Further studies are needed to determine what starts these growths and whether any of them truly represent a new growth of abnormal tissue.

Article reprinted from Proceedings of the 1st International Colloquium on Invertebrate Pathology, 9th Annual Meeting, Queens University, New York, 1976.

PATHOGENESIS OF RED ABALONE

Ralph Elston and George S. Lockwood

The red abalone, a commercial mollusk, can now be cultured in an intensive system. But high mortality rates in young animals still depress production. Elston and Lockwood studied dying red abalone taken from culture tanks over nine days.

The authors subjected 48 animals to supersaturated oxygen conditions and about 2,000 to an elevated temperature in order to assess how these stresses affect the abalone. They also examined all animals grossly, microscopically, and histologically; took foot muscle tissue as well as surface and water column samples for bacteriological evaluation; and tested isolates for antibody production.

A "highly opportunistic bacterium" of the genus Vibrio appears to be the culprit for this disease. In addition, "it seems likely that physico-chemical or other stresses...are required for the disease to occur." Elston and Lockwood suggest that "managing the condition may depend both on reducing numbers of opportunistic bacteria and on eliminating occasional stresses which occur during the culture process."

Available from the New York Sea Grant Institute as a First Impression Report.

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