OTHER DISEASES, OTHER MOLLUSCS

Hemic Neoplasia of Bivalve Molluscs

The disease known as hemic, hematopoietic, or hemocytic neoplasia (HCN) is also referred to as hemic proliferative disease, leukocytic neoplasia, sarcomatous neoplasia, sarcomatoid proliferative disorder, disseminated sarcoma, and atypical hemocyte condition. As a neoplasia, it is considered to be a form of cancer of shellfish similar to leukemia in higher animals and man in the way it affects the host. It should be emphasized, however, that this is a cancer of shellfish, not of humans, and that consuming shellfish with this condition poses no known health threat to humans.

Some research has suggested that the disease is caused by a virus, but this is not yet confirmed or generally accepted. However, it has been shown in some cases to be highly contagious from one individual shellfish to another.

The disease occurs throughout the world in a variety of bivalve molluscs and appears to cause significant mortality in certain farmed populations of shellfish.

Geographic Range and Species Infected

The disease affects many species throughout the world. Like many other shellfish diseases, it is probably more widely distributed than is now known. The following species and locations have been identified: *Adula californica*, Pacific coast of North America; *Artica islandica* (mahogany quahog), Rhode Island Sound, Atlantic coast of North America; *Cerastoderma edule* (common cockle), Cork Harbour, Ireland; *Saccostrea commercialis* (Australian rock oyster), Australia; *Crassostrea gigas* (Japanese or Pacific oyster), Matsushima Bay, Japan; *Crassostrea rhizophorae*, Brazil; *Crassostrea virginica* (Eastern or American oyster), Atlantic coast of North America, discontinuously from the Chesapeake Bay to Long Island Sound and sites on the Gulf coast; *Macoma calcarea*, Baffin Island, Canada; *Macoma nasuta* and *M. irus*, Yaquina Bay, Oregon; *Mya arenaria* (soft shell clam), Atlantic coast of North America, discontinuously from Chesapeake Bay to England; *Mya truncata*, Baffin Island, Canada; *Mytilus edulis* (bay or blue mussel), Pacific coast of North America, discontinuously from Yaquina Bay, Oregon, to sites in British Columbia, North Wales, Denmark, Finland, and southern coast of England; *Ostrea chilensis* (Chilean oyster), Chiloé, Chile; *Ostrea lurida* (Olympia oyster), Yaquina Bay, Oregon; and *Ostrea edulis* (European flat oyster), Mali-Ston area of Yugoslavia near Dubrovnic, Ria de Noya in Galicia, Spain, and the Brittany region of France.
Mortality Rate, Environmental Factors, and Seasonality

Some cultured populations appear to be 100% infected if individual animals are monitored over several months. Mortality rates due to the disease are reported to approach 100% over an annual period in some species. In other cases, in cultured populations, annual mortality rates of 30%-50% are typical.

Specific environmental factors that induce or enhance the disease are not known. Although much research has been conducted to determine whether various types of pollution contribute to the disease, no single factor which has these effects has been identified. Hemic neoplasia appears to be highly infectious, and dense populations of farmed shellfish maintain high disease levels because of ease of transmission from one animal to another. In all species in which seasonality has been investigated, the disease is reported to be most prevalent (judging by percentage of infected individual shellfish) during fall and winter months, typically from October through March. The prevalence drops in the spring and summer, possibly because heavily infected individuals die in the winter and the disease does not start another cycle of infection until autumn.

Diagnosis

Diagnosis is based on microscopic examination of blood or histological examination of tissues by a qualified pathologist. Common signs of the disease for all affected species are not established, but the following are known to apply in some cases: failure to produce mature reproductive follicles; high levels of mortality which spread geographically; and tissues swollen from the massive proliferation of abnormal blood cells in individuals with advanced cases of the disease.

Prevention and Management

Disease-free Areas

Every effort should be made to avoid introducing infected shellfish into areas that do not have the disease. Hemic neoplasia is known to be contagious from one animal to another within a given species. It is not known, however, if it can be transmitted from one species to another. It is possible, using techniques of pathological examination, to establish reasonable assurance of the presence or absence of the disease in given populations of shellfish. Field observations indicate that some populations within a given species may be more resistant than others.

Areas Known to Have the Disease

Eradication of the disease is not feasible since the disease can persist at low levels in natural populations of shellfish. General management methods based on available knowledge consist of keeping cultured population densities as low as practical and scheduling harvests so that market-sized shellfish are harvested before the typical period of increased disease in the fall and winter. Spat from wild spawn should not be allowed to collect on the shells of older infected bivalves.

It also appears that the severity of infection in individual shellfish and the percentage of individuals that are infected may increase as the animals get older. Thus, it may be desirable to harvest all individuals at as early an age as possible and to remove older shellfish from the population.
References


Vibriosis of Larval and Juvenile Molluscs

Vibriosis is an opportunistic disease of the larval stage of many, perhaps all, bivalve molluscs. It is also known to affect juvenile stages of the red abalone, *Haliotis rufescens*. The bacteria that cause the disease, members of the *Vibrio* group, occur in all marine waters where hatchery culture of bivalves is practiced. The disease is regarded by most as a “management disease,” meaning that it can be controlled by proper hygienic procedures in the hatchery. In fact, the presence of the disease indicates that proper procedures are not being followed.

The disease has been reported since the beginnings of hatchery technology development. Many members of the *Vibrio* group of bacteria have not yet been specifically identified. It is likely that one or a few specific members of the group are the most important as larval bivalve mollusc pathogens.

Geographic Range and Species Infected

Vibriosis can occur in any marine hatchery situation since the causative bacteria are ubiquitous. Probably all species are subject to the disease, although some may be more
susceptible than others. For example, the disease has been observed more often in American oysters, *Crassostrea virginica*, than in Pacific oysters, *Crassostrea gigas*. The disease in the red abalone is caused by *Vibrio alginolyticus*, one of the most common and widespread bacteria in the marine environment.

**Mortality Rate, Environmental Factors, and Seasonality**

In a well-managed hatchery there should not be any appreciable loss of larval bivalves to the disease under most circumstances. However, outbreaks can occur unexpectedly. In one well-documented case involving a production hatchery for the American oyster, a reduction of seed oyster production from 60 million (a good year) to 20 million oysters (a poor year) was attributed to vibriosis. The disease is associated with warm temperatures and typically is a problem only in the warmest months of the year.

**Diagnosis**

Vibriosis may be suspected when larvae grow slowly, batches of larval cultures fail, or larvae do not set. A confirmed diagnosis requires professional assistance and must be made by culturing the causative bacteria and examining the tissues of sick larvae. However, much can be done to detect vibrios in the hatchery and eliminate them from the system as discussed below.

**Prevention and Management**

Vibrios, like other pathogens, enter the hatchery or nursery by three principal routes: the seawater source, the brood stock, and algal food stocks. Since vibrios are ubiquitous, eradicating vibriosis is not possible and the disease is not an important consideration in the geographic transfer of larvae. However, good husbandry dictates that if animals are sick, from whatever cause, they should not be shipped, sold, or used for seed stock.

In a hatchery where vibriosis is suspected, personnel should become proficient at bacteriological sampling and culturing bacterial plates. A method for doing this is included elsewhere in the guide.

**References**


Hinge Ligament Disease of Juvenile Bivalve Molluscs

In hinge ligament disease, the hinge or ligament that binds the two valves of a bivalve mollusc together is eroded or completely destroyed by bacteria. Known as “gliding” bacteria because of their distinctive motion, this specialized group of microorganisms has not been well studied. The gliding bacteria are known to have the ability to decompose many highly organized and complex biological structures made of protein, such as the hinge ligament of bivalve molluscs. Vast numbers of these bacteria are often found within the ligaments of juvenile clams, oysters, or scallops that sicken and die in nursery areas. Once the ligament is destroyed, the mollusc is unable to open its valves for feeding and respiration. Figure 9 shows in graphic form that these bacteria can cause the normally resilient ligament to soften and even liquefy at temperatures in the 5°C-10°C range and higher. It is also possible that the destruction of the ligament allows other bacteria to infect the tissues of the animals.

![Graph showing effect of incubation temperature on ligament softening](image)

**Figure 9.** Effect of gliding bacteria on the hinge ligaments of the oyster. Four different gliding bacteria are compared with a fifth type of bacteria which is not capable of degrading the hinge ligament. The graph shows that gliding bacteria can cause softened, gelatinous, or even liquefied ligaments at temperatures down to about 10°C. The effects are less pronounced below 10°C. (Graph courtesy of C. Dungan)
This disease is the most important known disease of juvenile bivalve molluscs. It can infect any species. It has been reported from many locations where juvenile bivalves are intensively cultured. It is not known if the disease is important on oyster beds or among populations of wild oysters. The causative bacteria are probably common in all marine environments, and therefore the disease must be controlled by husbandry management techniques.

**Geographic Range and Species Infected**

Hinge ligament disease has been found in juvenile bivalves from both the east and the west coast of North America. It is likely that the disease occurs wherever bivalve molluscs are cultivated and potentially in any species. It has been found in the following species: Pacific oyster (*Crassostrea gigas*), Eastern oyster (*Crassostrea virginica*), European flat oyster (*Ostrea edulis*), hard clam (*Mercenaria mercenaria*), Manila clam (*Tapes philippinarum*), Pacific razor clam (*Siliqua patula*), and bay scallop (*Argopecten irradians*).

**Mortality Rate, Environmental Factors, and Seasonality**

In many cases, aquaculturists have reported the complete loss of large groups of clams and oysters from this disease. Usually the bivalves affected by the disease are from settlement size to 1 cm in shell height. The smaller animals are probably more susceptible.

No typical seasonal cycle of the disease has been determined. It can occur year-round, possibly because juvenile molluscs are usually grown in a controlled environment, often with heated water. Research on the disease has shown that the hinge ligaments are degraded at an increasing rate as the water temperature increases over the range from 5°C to 20°C and that the normally hard ligament, when infected with the gliding bacteria, can become jellylike at water temperatures as low as 10°C.

**Diagnosis**

There is no known way to make a certain diagnosis of hinge ligament disease without the microscopic examination of the ligament. However, in any large mortality of juvenile molluscs this disease should be suspect and samples submitted for a pathological evaluation.

**Prevention and Management**

Eradication of hinge ligament disease is not possible because the causative organism is common in marine environments. Thus, the disease must be prevented and limited by husbandry management techniques (see “Preventing and Managing Disease in the Hatchery”).

The approaches tried have been geared toward the regular disinfection of the surface of juvenile molluscs. The most effective disinfectant has been sodium hypochlorite, otherwise known as common household bleach. Such a treatment can be applied only when the juveniles are in containers in a controlled environment, and the treatment is more practical for single bivalves than for oysters attached to cultch.

The concentration, frequency, and length of treatment may have to be adjusted to
meet individual circumstances. A suggested starting point for the treatment is a three-minute dip in 25 parts per million sodium hypochlorite daily for five days. This concentration is made by diluting household bleach, usually labeled 5.25% sodium hypochlorite, with seawater by a factor of 2,100. This should be performed routinely if serious problems have been experienced from the disease. The continuing need for treatment will have to be determined for each operation.

Three antibiotics, penicillin, novobiocin, and tetracycline, are known to inhibit growth of some of the strains of causative bacteria. Penicillin is effective at restricting the growth of most, if not all, strains of the ligament-degrading bacteria, while novobiocin restricts growth of the least number of strains tested to date. Antibiotics are not recommended for routine use and should be applied only in a serious disease situation, with the dosage estimated in consultation with a pathologist.

References


Ameboflagellate Disease of Larval Geoduck Clams

This disease of the larval geoduck clam (Panope abrupta) is caused by a parasitic protozoan known as an ameboflagellate and probably belonging to a group known as Isonema. It was recently discovered in hatchery-reared larval clams.
Geographic Range and Species Infected
The disease has been detected only in the one location where geoduck larvae are cultivated in Washington. Only geoduck larvae are known to be infected by this flagellate.

Mortality Rate, Environmental Factors, and Seasonality
Exact mortality rates of larvae due to the disease have not been determined, but hatchery personnel report losses to be “substantial.” The mortalities have occurred throughout the time in which the larvae are cultured, from February through May.

Diagnosis
A preliminary diagnosis can be made microscopically by examining wet mounts of sick larvae for the characteristic protozoan (see Figure 10). The diagnosis should be confirmed by having a shellfish pathologist microscopically examine tissues for the presence of the parasites in the mantle and body cavity of the larvae.

Figure 10. Geoduck larva infected with the parasite Isonema. The parasites are located between the valves (arrows) and can be identified with a low-power microscope.
Prevention and Management

No specific methods are known for the management of the disease. It is not known to infect juvenile or adult geoduck clams and does not infect oyster larvae grown in the same vicinity as the larval geoducks.

Reference

Diseases of Abalone

The abalone group of molluscs, long cultured in Japan, are being increasingly farmed in North America. Several diseases have been reported, but relatively little is known about the diseases or health management of the abalone.

Vibriosis has been reported in the red abalone, *Haliotis rufescens*, as it has been in many intensively cultured molluscs. This disease is considered to be cosmopolitan, that is, caused by a common marine bacterium, and the effects of the disease can be controlled by good husbandry practices.

One of the most common bacteria in the marine environment, *Vibrio alginolyticus*, invades damaged epithelium or skin of the cultured abalone, then grows through the circulatory system of the animals, causing a fatal disease. Abalone stressed by high temperatures and supersaturated oxygen conditions are particularly subject to the disease. Nothing specific is reported for the management of this disease, but controlling temperature and oxygen levels as well as minimizing the number of vibrios in the system should reduce losses.

In Australia, a parasite known as *Perkinsus olseni*, similar to the one causing dermo (perkinsiosis) in oysters, is reported in the black-lipped abalone, *Haliotis ruber*. The disease is found in wild harvested abalone. It causes soft, cream-colored or yellow-to-brown pustules in the adductor muscle, in mantle tissue, and on body surfaces. Animals with these lesions are considered unacceptable for processing. Infection appears to depend, at least in part, upon temperature; abalone at 15°C had the lesions filled with dead parasites, while abalone at 20°C had active lesions containing live parasites.

Another parasite, *Labyrinthuloides halidotidis*, is reported to cause mortalities in hatchery-reared red and pinto abalone (*Haliotis rufescens* and *H. kamtschatkana*) in British Columbia. The parasite is considered to be a protozoan (single-celled animal). It was lethal to abalone under six months of age in an intensive culture facility. Parasites are found in the head and foot tissues of infected abalone. The parasites are reported to grow best at a temperature of 10°C (but not above 28°C) and a salinity of 30 parts per thousand in experimental studies.
Mortalities of cultured seed abalone of the three important species in Japan, *Nordotis discus*, *N. gigantea*, and *N. sieboldii*, have been attributed to bacterial pathogens. Mortalities were reported to be reduced by treatment with dihydro-streptomycin sulphate at 100 parts per million in the 32 days following development of the veliger larvae.

References


