AQUACULTURE update

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Disease Risks Associated with the Transplantation of Abalone, Geoducks, Sea Urchins, and Spot Prawns in British Columbia

There are many examples of catastrophies in the shellfish culture industry that were caused by the inadvertent introduction of infectious diseases in conjunction with the transplantation of shellfish. The best known example occurred during the 1980's among flat oysters (*Ostrea edulis*) cultured in Europe. The small protozoan parasite *Bonamia ostreae* was accidentally brought into the major flat oyster seed-producing area in Brittany, France along with flat oysters imported from California. The parasite caused high mortalities (about 80%) among flat oysters and quickly spread along most of the Atlantic coast of Europe devastating a multibillion dollar flat oyster industry. Because of this parasite, it is currently almost impossible to dine on flat oysters in Europe. The European oyster culture industry now grows the less desirable Pacific oyster, *Crassostrea gigas*, which is resistant to bonamiasis. A similar scenario has occurred in many areas that undertook the culture of shrimp (*Penaeus* spp.). But, the agents of disease in these cases were usually various viruses (to date, 12 distinct viral pathogens have been encountered in cultured *Penaeus*). Because of infectious diseases, potentially lucrative shrimp culture has been abandoned in many areas.

Although numerous investigations have identified many infectious diseases of economically important species of oysters and *Penaeus* shrimp, very little is known about the diseases of other shellfish. Information that is available suggests that all species of shellfish

harbour parasitic organisms that have the potential to cause disease in the original host species or in other stocks or species of shellfish.

In British Columbia, various endemic shellfish are being considered as candidates for aquaculture. These species include the northern abalone *Haliotis kamtschatkana*, the green sea urchin *Strongylocentrotus droebachiensis*, the red sea urchin *Strongylocentrotus franciscanus*, the geoduck *Panope abrupta*, and the spot prawn *Pandalus platyceros*. If shellfish are to be cultured in the vicinity of the broodstock origin, the issue of disease introduction is non-existent. In this scenario, the only diseases that will have to be circumvented are those enzootic to the particular stock of shellfish. Most enzootic diseases are relatively benign and manageable because the shellfish stock being cultured has already developed mechanisms that allow it to coexist with the potential pathogen. However, potential pathogens introduced from areas outside their normal range through the transplantation of shellfish stocks can be devastating to native stocks that have never encountered the introduced organism. Also, potential pathogens residing in the habitat to which the shellfish are introduced could cause significant losses among the imported stocks.

Following are a few specific examples of infectious agents that cause disease problems in shellfish currently under consideration for culture in B.C. Although many of the diseases have not yet been reported in B.C. nor in species native to B.C., it is essential to be aware of them as potential risks involved with shellfish transplantations. It is also anticipated that many more infectious diseases of shellfish will be identified as the culture of non-traditional shellfish species proceeds.

<u>Agents of disease in abalone</u>:

Labyrinthuloides haliotidis is a protozoan that was encountered during an attempt to establish an abalone hatchery in Saanich Inlet and in Sooke, B.C. It was lethal for northern abalone (*H. kamtschatkana*) and red abalone (*Haliotis rufescens*) less than 5 mm in shell length and contributed to the failure of this attempt to culture abalone in B.C.

Perkinsus olseni is a protozoan that proliferates in abalone tissues and is suspected of causing mortalities in several species of wild abalone from the Gulf of St. Vincent, South Australia.

Pseudoklossia haliotis is a protozoan that resides in the kidney cells of all species of wild and cultured abalone in California. It can occur in extremely heavy infections with associated histopathology. Although *P. haliotis* has been reported from *H. kamtschatkana* in California, this parasite has not been observed from the same species of abalone in B.C.

Vibrio fluvialis is a bacterium that caused a serious pustule disease and high mortalities (50-60%) among all stages of abalone (*Haliotis discus hannai*) being cultured by several companies in China in 1993.

A species of sabellid polychaete (thought to have been accidentally introduced into California -- possibly from South Africa) is currently causing havoc at many abalone culture facilities in California. This polychaete infests the leading edge of the shell causing shell deformities and interferes with abalone growth. The infestation has resulted in a serious problem for abalone producers.

Foot withering syndrome, a lethal disease (for which the agent is unknown) that causes weakness, lethargy, and foot muscle atrophy in abalone, is associated with mass mortalities of black abalone (*Haliotis cracherodii*) in California and Mexico. This disease progressively spread throughout the California Channel Islands causing population decimation of black abalone on six of the eight Channel Islands by 1992 and closure of the black abalone fishery in 1993. A similar syndrome has been reported in a few specimens of other abalone species (*Haliotis rufescens* and *Haliotis corrugata*) in California.

<u>Agents of disease in sea urchins</u>:

Paramoeba invadens is a protozoan that causes muscle necrosis and high mortalities in *S. droebachiensis* along the coast of Nova Scotia. From 1980 to 1983 losses were estimated to be 245,000 tons of sea urchins which had a marked effect on ecosystem structure.

Parasitic nematodes, *Echinocephalus pseudo-uncinatus*, from various species of sea urchins in southern California and Baja California, Mexico, and *Echinomer-mella matsi* from *S. droebachiensis* in Norway, were reported in up to 80% and 65%, respectively, of the sea urchins in some locations and castrated infected hosts. The latter species caused sea urchin mortalities, providing one of the few known examples of a macroparasite epizootic among shellfish.

Bald-sea-urchin disease, thought to be caused by various species of bacteria in many species of sea urchins, was associated with mass mortalities of *S. franciscanus* in California and *Paracentrotus lividus* on the Mediterranean coast of France, and thought to be at least partially responsible for population declines of *Psammechinus microtuberculatus* off Port-Cros, France (Mediterranean Sea).

Spotted gonad disease (for which the agent is unknown), reported from *Strongylo-centrotus intermedius* along the coast of Hokkaido, Japan, caused partial degradation of germinal tissue, probably damaged the reproductive capacity of the gonadal tissues, and resulted in reduced

market value for affected gonads due to their anomalous colour.

Black-sea-urchin plague (for which the agent is unknown) occurred in *Diadema antillarium* in the Caribbean Sea and caused high mortalities (about 98%) within 10 days of detecting the first signs of the disease in a new locality. Unlike bald-sea-urchin disease, which appeared to be confined in distribution, black-sea-urchin plague spread throughout the Caribbean Sea from Venezuela to Bermuda (about 3.5 X 10^6 km^2), reducing population densities to 1-7% of former levels.

Agents of disease in geoducks:

"Isonema-like protozoan" is an amoeboflagellate that caused high mortalities among geoduck larvae at one geoduck hatchery in Washington State. Fortunately, this parasite did not infect juvenile or adult geoduck nor oyster larvae growing in the same vicinity as infected larval geoducks.

Neck scar disease (unknown cause) occurs in various populations of wild geoduck throughout B.C. with few to a high percentage of the geoduck from each area being affected. Inadequate investigations have been conducted to determine if the disease is infectious and whether or not the cause is the same throughout the Province. In shellfish, many different agents of disease can cause similar looking conditions. Thus, caution is required when trying to determine the cause of disease in shellfish.

Agents of disease in spot prawns:

Stained prawn disease is caused by a *Rickettsia*-like organism that infects fixed macrophages resulting in pepper like stippling on the digestive gland and dark discolouration of the body below the cuticle, especially along the ventral surfaces of the cephalothorax and along the edges of the abdominal segments. To date, this disease has been found in prawns from one location in the Strait of Georgia and from various locations in Howe Sound. In an area with the highest prevalence (15% of the prawns infected) an above average level of mortality in wild prawn stocks was detected.

Hematodinium-like disease in prawns is caused by a protozoan which overwhelms its host, rendering it lethargic with an unusual orange-pinkish colour in life and milky-like body fluids. At Myrtle Point in Malaspina Strait, B.C., where 2% of the prawns had overwhelming infections, 25% of the prawns had light infections detectable by histological examination and the hosts were castrated. This parasite has not been encountered in prawns south of Malaspina Strait; it is known to occur infrequently in prawns from the northern end of the Strait of Georgia, and has been reported in a few prawns and in a related species (*Pandalus borealis*) from Alaska.

Sylon sp., a Rhizocephalan parasite (related to barnacles), produces an ovoid pink to cream coloured sac (externa, up to 1.5 cm in length) that projects externally on the ventral surface of the abdomen. Parasitized prawns are often castrated and usually die after the parasite completes its life cycle on the host. The few surviving prawns are marked by obvious brown scars in tissues formerly inhabited by the parasite. Although this parasite generally occurs in relatively few shrimp (<5%) of various species throughout the northern hemisphere, as many as 47% of the spot prawns from some localities in northern B.C. were infected. *Sylon* sp. has never been observed in spot prawns from the southern part of the Province.

Black gill disease, evident in prawns as dark discolouration in the gill regions of the carapace, has been associated with several causes: mechanical impaction of

the gill cavity with sediment, an invasive fungal infection that is usually associated with various fouling organisms and probably indicative of poor habitat, and an infectious agent of unknown identity. This complex of diseases has occurred in prawns from several localities in B.C., as well as in prawns held in the laboratory for experimental purposes.

Despite the aforementioned concerns, there are techniques available to reduce the risks of inadvertently introducing disease problems when transplanting shellfish. An essential and required first step when planning to transplant shellfish either within the Province or importing them into the Province, is to obtain approval from the Federal/Provincial Fish Transplant Committee. Members of the committee have access to information describing mechanisms that will help to circumvent the introduction of disease agents. The current chair of the committee is Mr. Gary Caine, Ministry of Agriculture, Fisheries and Food, 2500 Cliffe Avenue, Courtenay, B.C. V9N 5M6.

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