Nuclear Inclusion X

I. Causative Agent and Disease

Nuclear inclusion X (NIX) is a unique rickettsia-like organism infecting the nuclei of non-ciliated branchial epithelium in razor clam populations from Washington and Oregon. This pathogen has caused massive mortality in Washington razor clams and has possibly caused declines in clam populations in Oregon as well. The organism completes its replication cycle by rupturing infected gill epithelium causing respiratory failure and secondary infection by other opportunistic bacteria.

II. Host Species

This organism is exclusive to razor clams in Oregon, Washington and lower British Columbia, Canada. One sample of razor clams from Alaska, among two others that were negative, was found to be positive for NIX. However, the positive clams were held for about 2 months in infected state waters of Washington before they were examined. Consequently, it is very unlikely that NIX occurs in Alaska as it has not been found in other samples above Vancouver Island, BC. Nonetheless, the pathogen is included here for future reference.

III. Clinical Signs

Infected clams present with extensive swelling of branchial epithelium and enlarged nuclei within intact cells or the nuclei are floating free nearby lysed cells when examined in wet mounts. Secondary infection by other opportunistic bacteria is common. Histological examination shows massively enlarged cell nuclei enclosing the basophilic rickettsial organism within the non-ciliated respiratory epithelium of the gills.

IV. Transmission

The mode of transmission is not known but is likely horizontal via ambient seawater contaminated by nuclei from ruptured host cells each containing the parasite. The cycle of the disease appears to begin by infection occurring in late fall or early winter. The parasite is detected in the spring and early summer followed by enlargement and rupture of branchial host cells by fall and winter. This cell damage leads to secondary bacterial infection and death of the clams. There may also be other life stages that are infectious that have not been described and alternate reservoir hosts or vectors.

V. Diagnosis

Diagnosis is made by wet mounts and histological examination demonstrating enlarged branchial cell nuclei with typical intranuclear inclusions containing the parasite (average 21 X 13 μm in diameter). Transmission electron microscopy confirms the morphology of the parasite as rickettsia-like which is unique regarding its exclusive intranuclear occurrence during all observed life stages and its size that is larger than any known bacterium.

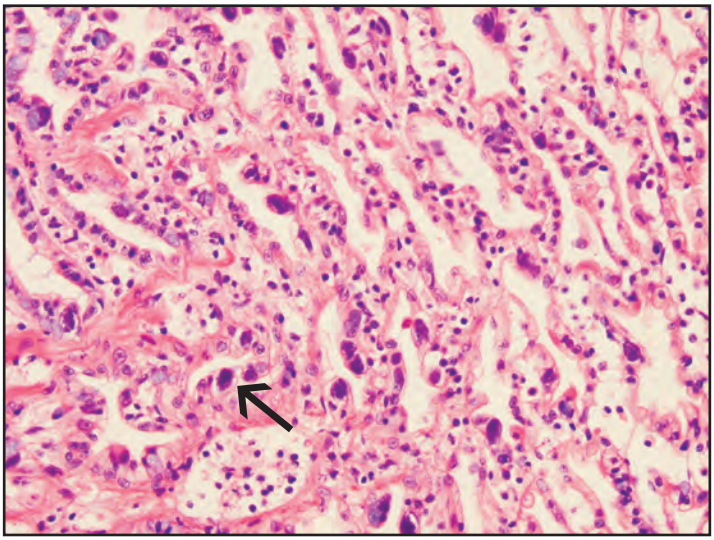
VI. Prognosis for Host

The organism has been found where populations of razor clams in Washington have undergone extreme declines of as much as 95% during 1983-1984 and 1985-1986. This may have been peak proliferative periods in the parasite life cycle, possibly influenced by unknown marine environmental conditions. Although some populations of razor clams appear to survive low intensity infec-

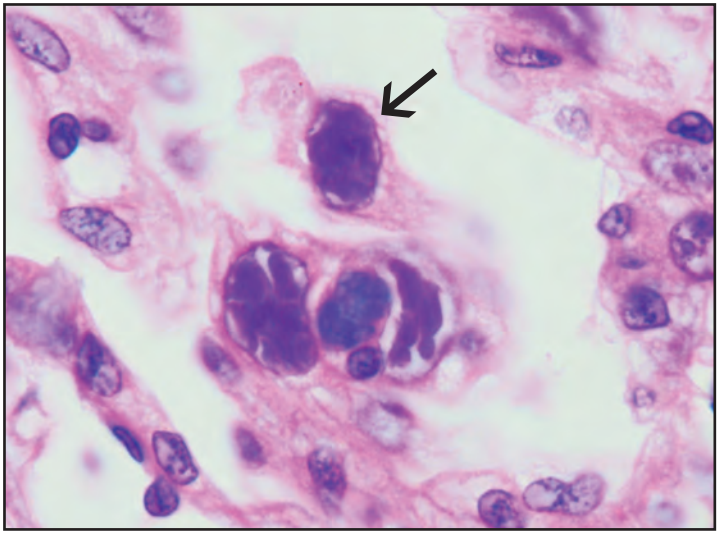
tions, the parasite has a proven potential to cause very significant population declines for reasons that are not well understood.

VII. Human Health Significance

There are no known zoonotic human health concerns regarding NIX infections in razor clams.



Histological section of NIX-infected gill epithelium (arrow) of razor clam



Histological section of inclusion bodies within enlarged nuclei (arrow) of NIX infected cells