Withering Syndrome

and the Recovery of Southern California Abalones

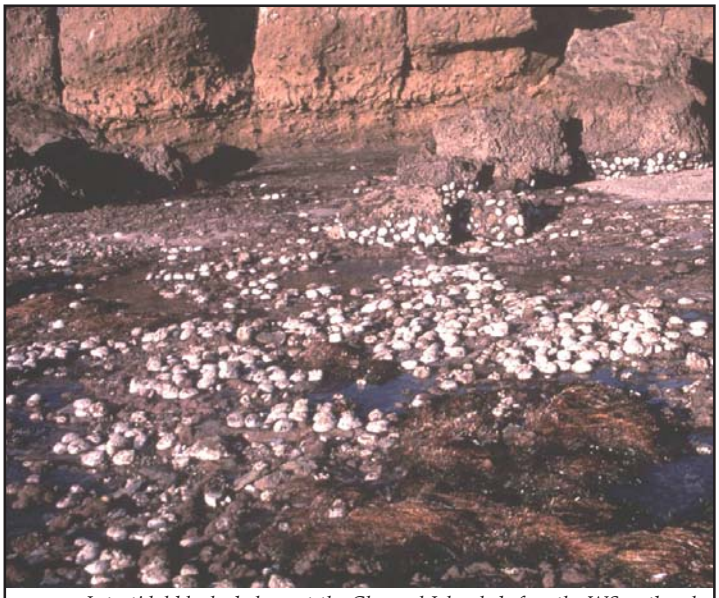
by *Jim Moore, Senior Fish Pathologist*

Transmission electron micrograph of the bacteria that causes WS. image courtesy J. Moore

If you happened to visit a southern California seafood restaurant between 1950 and 1970, chances are that you would have seen abalone on the menu. During this period, the multi-species abalone fishery was booming along the southern California coast.

The fishery grew rapidly after WWII, posting a peak harvest of 5.4 million pounds in 1957. Southern California landings held steady through the end of the 1960s, but catch numbers steadily declined throughout the 1970s, and by the mid-1980s landings were only at about 15 percent of their peak level.

In 1986 large numbers of dying black abalone and empty shells were discovered at Anacapa and Santa Rosa Islands in the Channel Islands National Park. Because the dying abalone had severely shrunken bodies inside normal-sized shells, the condition was dubbed *withering syndrome* (WS). During the 1990s, black abalone populations decreased dramatically as WS spread throughout the Channel Islands, and to the central California coast. Throughout this period, the species represented a diminishing portion of the commercial abalone fishery, comprising 43 percent of the total catch in 1986, 18 percent in 1990 and finally 0.4 percent in 1993, the last year in which black abalone landings were recorded.

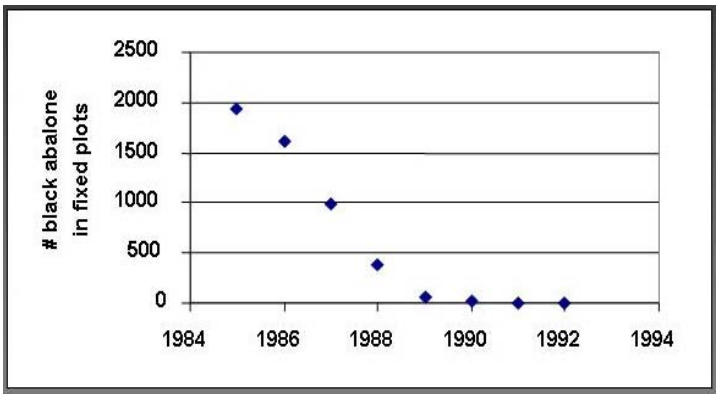


Intertidal black abalone at the Channel Islands before the WS outbreak. Image courtesy J. Moore

What Causes Withering Syndrome?

The pattern of spread throughout the Channel Islands and to the mainland coast suggests that WS is caused by an infectious agent. Microscopic examination

"WS" continued on page 5



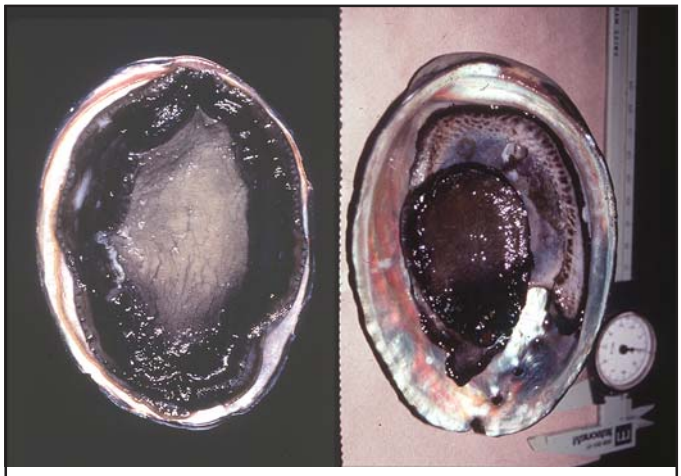
Density of black abalone in 3 fixed plots at Santa Barbara and Anacapa Islands during the initial outbreak of WS. Densities remain near zero today. Data courtesy of the Channel Islands National Park

"WS" continued from page 4

of withered abalone reveals that cells lining the gut are infected by a unique bacterium. DNA sequencing helped identify the bacterium as a new member of a large and diverse group that lives only *within* animal cells, and often causes disease. This group includes the bacteria that causes Rocky Mountain Spotted Fever, Q Fever, typhus, and a wide variety of other diseases in mammals, fish and marine invertebrates.

The infection appears to begin when abalone ingest the bacteria along with their food (kelp). The bacteria enter cells lining the gut and divide repeatedly, forming large masses. The infected abalone gut cells then burst into the digestive tract, allowing individual bacteria to infect nearby cells, or pass out of the animal to be ingested by other abalone. Abalone with severe infections stop eating, and their bodies shrink. Laboratory studies have shown that the five most-valued California abalone species - black, red, green, pink and white - are all susceptible to the bacteria that causes WS.

However, not every infected abalone will die from the disease, as each species reacts differently to infection. For most species, living in cooler water keeps the abalone from getting sick. Field and laboratory studies have shown that warm water temperatures, such as those accompanying El Niño events, can exacerbate WS in red and black abalone.



A healthy black abalone (left) and one in an advanced stage of withering syndrome (right). *Image courtesy J. Moore*

Withering Syndrome and the *Abalone Recovery and Management Plan*

The Department's Abalone Recovery and Management Plan (ARMP), which is scheduled for adoption by the Fish and Game Commission in early 2005, details a recovery plan for abalone populations off southern California. The small number of abalone remaining at locations where they were once abundant suggests that recovery will be a long-term effort that may require relocating solitary abalone into groups and the out-planting of cultured stocks. The ARMP acknowledges that WS presents a particular challenge for black abalone, and could have a significant impact on the recovery of other species.

Assessment of ARMP recovery efforts will include surveys of abalone population density and size distribution. During surveys, individual abalone will be assessed for body shrinkage, the hallmark sign of WS. Over time, this information will aid management efforts by establishing geographic, temporal and thermal trends in WS for each species. While we cannot directly control El Niño events and long-term climatic shifts, we can tailor recovery methods to incorporate the possibility of their occurrence.

Although black abalone are exceedingly rare throughout most of southern California, a few healthy-appearing survivors do remain. These animals may be genetically resistant to the WS bacterium. The ARMP calls for investigation of these animals, which may be used for broodstock to produce WS-resistant abalone for out-planting in the wild. If successful, the same technique could be used for other abalone species.

For more information about the Abalone Recovery and Management Plan, contact Mr. Ian Taniguchi, ARMP Coordinator, at (562) 342-7182 or visit the ARMP Web site at **www.dfg.ca.gov/mrd/armp/index.html.**

Have a question? Need help identifying a fish? Send your e-mail questions to: *AskMarine@dfg.ca.gov*

threadfin bass, *Pronotogrammus multifasciatus*

photo by E. Roberts

Don't Forget!!

Beginning in January, you can call our Automated Telephone Information System for the most up-to-date fishing regulations!

(831) 649-2801