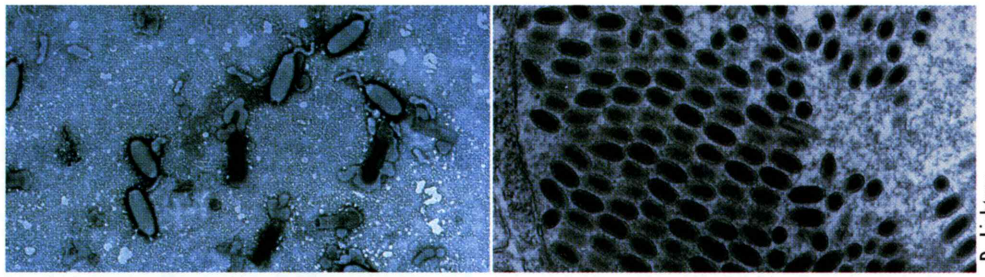
Aquaculture Pathology Program Focuses on Shrimp

Practical assistance for the worldwide shrimp industry



D. Lightner

Purified white spot virus from shrimp blood (left) and from shrimp tissue (right).

Far from the ocean, in the heart of the Sonoran Desert, Donald Lightner and his staff in the Aquaculture Pathology Program diagnose and research shrimp diseases. The ideal geographic location of the UA, isolated from coastal waters, reduces to near zero the risk of accidental introduction of shrimp pathogens into the aquatic environment.

"Our main goal is to describe diseases of farm-raised shrimp and to develop diagnostic methods for these diseases using traditional and modern molecular techniques," says Lightner, who is one of the world's foremost authorities on shrimp pathology. "After we recognize what the problem is and put a name on it, and develop an accurate diagnostic method, we do research on prevention and control methods as well." These include methods for developing specific pathogen-free (SPF) or specific pathogen-resistant stocks (SPR).

The aquaculture pathology program includes both an on-campus laboratory and a primary quarantine facility located at the West Campus Agricultural Center in Tucson, which acquires wild or farmed shrimp and assesses the disease status of these potentially SPF and SPR stocks. High standards of care and handling throughout the duration of the testing period, which can take many months, are necessary to assure the specific pathogen-free state of the animals.

The UA provides expert assistance to governments and to the shrimp farming industry with a variety of diagnostic techniques, including microbiological and histological identification of the disease process, electron microscopic examination of newly recognized shrimp pathogens, as well as other standard diagnostic methods. The UA has also pioneered the use of molecular (DNA-based) technology in the study of shrimp diseases.

In particular, researchers have prepared gene probes to several serious viral pathogens and have devised techniques for their use in diagnosis. The transfer of this technology to the private sector has led to the development of gene probe kits that can be used in diagnostic laboratories and in the field (at shrimp farms and hatcheries). Such gene probe kits provide to the shrimp farming industry much more rapid and sensitive tools for detecting pathogens than were available with traditional methods like histology and live animal bioassays.

Shrimp production worldwide has increased steadily since the 1980s, and now nearly a third of the world supply comes from farms. Most of the product is imported by the U.S., Japan and Western Europe. Shrimp diseases have also become more widespread in the industry, resulting in annual losses since 1992 averaging nearly one billion dollars.

"Bacterial and viral diseases are the most common, with viral diseases causing the most economic damage," Lightner says. "None of these viral diseases are a threat to humans and the bacterial diseases are only a threat if improperly processed shrimp are consumed raw."

The UA became involved in shrimp aquaculture during the early 1970s through experimental programs conducted in Mexico in connection with desalinization projects. The UA is the closest U.S. university to the Gulf of California in Mexico. Near Puerto Penasco, Mexico, UA faculty and staff assisted in the development of super-intensive shrimp farming methods to increase production under controlled environmental conditions, including raising SPF shrimp in seawater-filled "raceways" placed within plastic-covered greenhouses. With this technology, the UA produced market-sized shrimp at a commercial prototype farm in Hawaii at higher stocking densities than have been achieved since, anywhere else in the world.

In 1987, the UA was invited to join a USDA-funded consortium with five other institutions to assist in developing the domestic shrimp culture industry and to reduce the U.S. trade deficit that is now over two billion dollars annually in imported shrimp. As part of the Gulf Coast Marine Shrimp Farming Consortium, the aquaculture pathology program at the UA is working to provide a healthy (SPF and SPR) seed stock supply for the industry, to assist in disease control, and to address the environmental aspects and regulations of shrimp aquaculture for continued growth of the U.S. industry.

"Because there is no treatment for the viral diseases," Lightner says, "most of our work centers on detection and avoidance, or on the development of SPF and SPR stocks. Because of FDA regulations, the treatments available for treating bacterial diseases of shrimp are very limited. So, we work with farmers to change farm practices, and when permitted by FDA, to test certain types of chemotherapuents (for efficacy, food safety, and environmental effect) in controlling bacterial disease. We also help select the breeding stocks and test them for their health (SPF and SPR) status."

For the past ten years, the aquaculture faculty and staff have conducted a shrimp pathology short course during the summer session. Since the first offering of this course, 501 students from the U.S. and 45 other countries have attended, from industry, academia, and government-related agencies. This course includes training in the most up-to-date methods for the diagnosis of shrimp diseases. In addition to the short course, the aquaculture pathology laboratory offers shrimp disease services to industry through workshops, a diagnostic laboratory and post-graduate research programs.

In May, 1994, Lightner's laboratory was designated one of two reference laboratories in the world for crustacean pathogens by the Office of International Epizootics headquartered in Paris, France.

Many individuals at the UA are involved in these aquaculture pathology programs. In particular, Lightner's laboratory includes professional staff as well as graduate students who all actively participate in the diagnostic, educational and research aspects of the program.

— Susan McGinley, Wanda McCormack, Bonnie T. Poulos