The Tempura That Came From a Tank

Controlled environment agriculture grew vegetables for desert Arabs. Its latest project is shrimp on the shores of Sonora.

BY DIETRICK E. THOMSEN

"... Those fishing boats with their sails, afloat on Blue Bayou." Linda Ronstadt makes it sound very romantic, but those picturesque sailboats underline an important economic fact: In thousands of years of civilization, humanity has moved from hunting and gathering to managed agriculture in order to supply most of the items of its diet. The major exception is the animals of the sea. Seafood is still hunted.

There are, however, ongoing experiments with sea farming and sea ranching, including attempts to grow saltwater fish in fenced off areas in the way many freshwater fish are grown in ponds (European carp, for example). Experiments being done cooperatively by the University of Arizona and the University of Sonora now show promise of lifting crustacean culture from the hunting stage right past ordinary agriculture to what is called controlled environment agriculture (CEA) — growing shrimp, in this case, in an artificial environment in which their nutrition is scientifically controlled, their health is carefully watched and predators are excluded.

The experiment is being done by the Environmental Research Laboratory of the University of Arizona and is located at Puerto Peñasco on the Gulf of California in Mexico's Sonora state. The ERL is the organization that showed the Abu Dhabians how to grow cucumbers and eggplant in some of the world's most arid desert. It's done by keeping the desert at bay by building a controlled, sheltered environment that makes a lush contrast with the aridity outside. A visitor enters the ERL's headquarters, located near the Tucson airport in a typical stony, cactusy Arizona desert landscape, through a small controlled-environment jungle. The impression of humidity as one comes in from the desert is like a wet towel in the face. Growing shrimp in an environment similarly tailored for them promises yields that will far surpass those obtainable by hunting from boats that sail offshore. It will also provide a significant economic resource for developing countries, says Wayne L. Collins, the ERL's associate director.

The ERL started as a laboratory of the University's Institute of Atmospheric Physics. It consisted then mainly of physicists, and worked on solar-energy problems. It got into the Arabian scene by way of solar-powered plants for the desalination of seawater. In the course of that work, scientists noted how wasteful of the precious fresh water were the efforts to make the desert produce vegetables by traditional outdoor agriculture. The dry desert air makes the rates of evaporation and transpiration unbearably high. The solution was a controlled environment — large greenhouses in which the humidity could be controlled for optimum use of water and a more favorable atmosphere.

Having shown that vegetable food could be grown in controlled environments, the ERL scientists decided to try the same sort of technique with food animals. Aquatic animals seemed the most manageable in such a trial, and for various reasons a process of elimination led to saltwater shrimp. The location was chosen because the Gulf of California is the nearest ocean water to Tucson, and Puerto Peñasco is a shrimping port with processing plants in place. The ERL already had a large research staff there, and a history of good cooperation with the Mexicans.

The shrimp are raised in long shallow tanks called raceways. The arrangement makes them easy to see so that their growth can be monitored and their health supervised. Seawater is continually circulated in the raceways.

The shrimp project started in January 1973, but in Collins's opinion it was well into 1974 before it really got off the ground. They thought at first that they would have a "quick and dirty" job. There is a large body of literature on shrimp culture, and the ERL scientists thought they could build on that. But, says Collins, "little of it was applicable to the real world."

"From the very beginning," he says, "we weren't dealing in terms of five shrimp in a 10-gallon aquarium on a shelf behind some professor's desk. We were talking about hundreds of thousands of shrimp. We found ourselves inventing all sorts of new ways to kill shrimp. We found that the state of the art of caring for their health and happiness had not at all been thoroughly investigated."

The CEA team had to add "a whole spectrum of animal scientists" to the ERL's staff. Among those needed was a crustacea pathologist, a very rare kind of specialist. It was also found that nobody had experience with large numbers of shrimp. There were animal scientists with experience with large numbers of poultry, cattle and other classes of beast, but not shrimp.

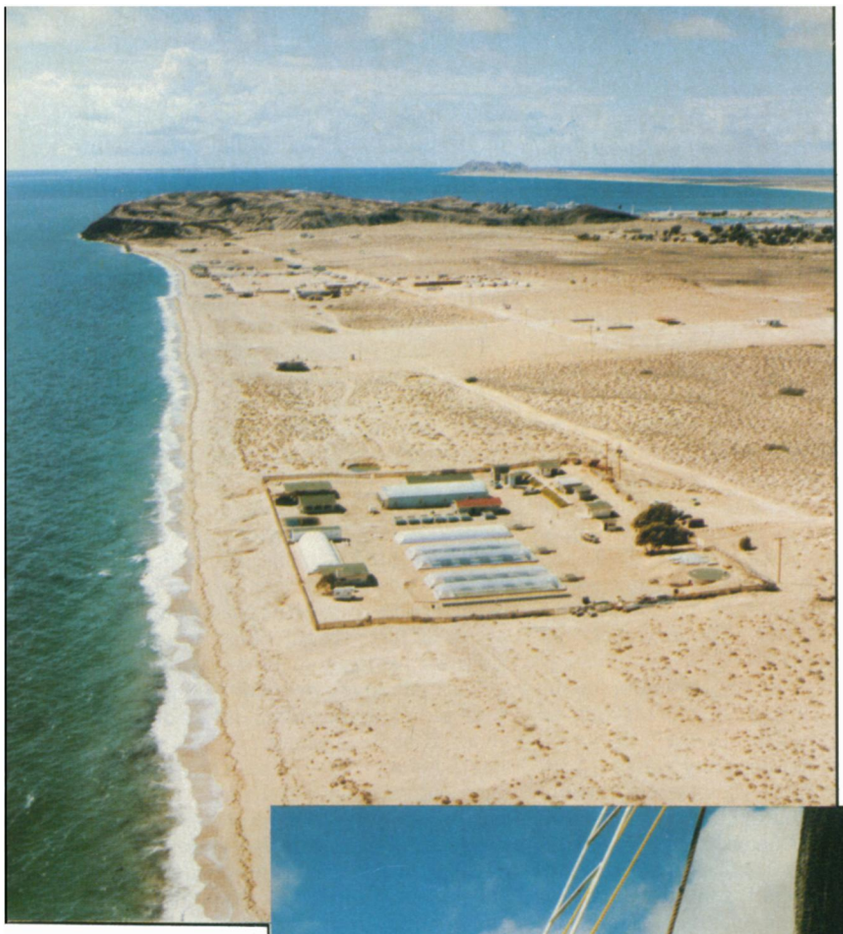
The research group had to determine the best diet for the shrimp by trial and error. "Nobody knew what the nutritional requirements really were," Collins says. Then came diseases, or to use the term that applies to hundreds of thousands of shrimp, epizootics. The causes and treatments had to be empirically determined. One malady is called the "black death" because it caused black spots to appear on the bodies of the shrimp. Another, the "gas bubble disease," was caused by excess aeration of the water.

Gradually, the difficulties were overcome, and by now Collins is very happy with the success of the experiment. It has "turned out so far to be not only the most exciting thing the laboratory group has ever worked on," he says, "it has more economic potential for desert regions of the world — coastal desert regions, obviously — than anything we've ever done." He envisions an optimum production of 2,000 to 3,000 pounds of whole animal per acre of water surface per year. Sixty-two percent of the animal's weight is edible tail meat. The experimental production rate last October was 4 kilograms of animal per square meter. Three months before that it had been 3 kilograms per square meter. "We're doing 4, and we'll do better," Collins says. "How much better, I've given up guessing. I don't think we have started to push the type of system we're working with."

The work at Puerto Peñasco has used three species of shrimp native to the waters there. Other experiments with other species of shrimp are planned for other locations. Meanwhile, the first commercial

application will be in Mexico. Designs are being drawn up for prototype plants in two locations there. The commercial controlled environment operation will fill in around the local two-to-three-month shrimp catching season, using the existing plants and labor during periods when they would otherwise be idle.

The harvested shrimp can be frozen and sent to market anywhere in the world. Vegetable production by CEA is for those who can afford it, like the Abu Dhabians. The vegetables have to be harvested when ready and sent immediately to market. Since the capital costs of CEA are high, a good price has to be obtained. The capital costs of shrimp production are similarly high, but shrimp are an animal with high economic value. "It's a Tiffany food," says Collins. It gets such a high price in fact that the only large markets for it are in the United States and Japan. In frozen form the shrimp can be kept for two years, so getting it to market is not a problem. Developing countries can produce the shrimp and sell them to rich countries. □



Shrimp are being experimentally grown on shore in these buildings at Puerto Peñasco (above).

Shrimp boats from Puerto Peñasco go out into the Gulf of California to hunt for edible crustaceans. Soon the boats may be supplemented by installations that grow the animals in controlled environments.

Photos: Mickey Prim/Ray Manley Studios