FORUM

Present and Future Issues in Aquaculture

Our nation's inland waters and coasts provide a wide variety of seafood with diverse health benefits. Fish are high in protein and low in fat, and they have an excellent balance of nutritious fatty acids. As per capita consumption of seafood rises in the United States and throughout the world, ARS scientists across the country are exploring research and development solutions to some of aquaculture's biggest challenges: developing domesticated lines of aquatic animals for farmed production, improving aquatic-animal health and growth efficiency, conserving water resources, and developing novel diets and feed ingredients.

ARS has made significant contributions to the field of aquaculture genetics. Domestication and improvement of hybrid striped bass and yellow perch are in the early stages, while breeding programs for catfish, rainbow trout, Atlantic salmon, and oysters are well under way. Scientists at the Catfish Genetics Research Unit in Stoneville, Mississippi, and at the National Center for Cool and Cold Water Aquaculture in Leetown, West Virginia, are engaged in genomic research and genetic-improvement efforts for channel catfish and rainbow trout. Their work has begun to pay dividends as the genes involved in complex traits such as disease resistance, fillet yield, and response to stress are becoming better understood. In catfish and rainbow trout, selective breeding programs are under way to improve resistance to major bacterial pathogens.

ARS is actively pursuing several strategies for controlling aquatic-animal health, including vaccine development, selective breeding for disease resistance, and therapeutics. Scientists at the Aquatic Animal Health Research Unit, in Auburn, Alabama, have developed and licensed vaccines for enteric septicemia of catfish and columnaris, major pathogens of catfish culture. Other vaccines for warm-water fish diseases are currently in development there, too.

Studies conducted at the Harry K. Dupree Stuttgart National Aquaculture Research Center in Arkansas are leading toward federal approval of copper sulfate to treat fish diseases. Development of novel disease-control strategies, such as bacteriophage therapy, is progressing in Leetown. Because disease is the main cause of fish mortality in aquaculture facilities, these prevention tools could save aquaculture industries millions of dollars.

An equally important aspect of ARS aquaculture research involves conservation of a precious and limited resource: water. Water-recirculation technologies are being developed by collaborators at the Conservation Fund's Freshwater Institute, in Shepherdstown, West Virginia, to maximize water quality in culture tanks by removing and concentrating waste. ARS scientists at the Harbor Branch facility in Fort Pierce, Florida, are exploring methods for growing marine fish in low-salinity water. The water is being treated for waste removal and recirculated through the culture tanks. With water-treatment costs increasing, high-intensity reuse systems like this are proving economically viable for high-value species.

Improving the efficiency with which animals convert feed into flesh is another integral aspect of ARS research. Feed expenses represent a large portion of animal production costs. Improving the efficiency of nutrient retention—the rate at which consumed nutrients are incorporated into the edible portion of the animal—is an important economic consideration.

Increasing nutrient retention decreases undesirable release of nutrients into the environment. Nutrient use and growth efficiency are important components of research in our hybrid striped bass, rainbow trout, and catfish programs. Our scientists have identified rainbow trout with higher growth and protein-retention efficiency and are investigating the physiological mechanisms of nutrient digestion and metabolism in catfish and rainbow trout.

An associated challenge is the source of nutrients for fish feeds. As aquaculture production increases worldwide, the harvest of fishmeal and fish-oil species has remained steady, increasing the need for additional sources of protein and lipid content. ARS and University of Idaho scientists at the Hagerman Fish Culture Experiment Station in Idaho are developing diet formulations using sustainable plant-derived proteins with amino acid profiles that will support animal growth.

Of particular interest is the use of coproducts from ethanol and biodiesel production. Auburn scientists have observed excellent growth responses in catfish and tilapia after incorporating an ethanol production coproduct, dried distillers grains with solubles, into their feed. This is one of many ARS research projects focusing on diet development using non-fishmeal proteins and oils.

Farmed finfish aren't the only focus of ARS aquaculture research. Our work on oyster culture is steadily gaining momentum. An excellent example of this innovative research can be found in the story beginning on page 4, which describes how ARS researchers in Oregon are helping oyster producers respond to nonedible shrimp pests.

The United Nations Food and Agriculture Organization estimates that more than 40 percent of the seafood consumed worldwide is coming from aquaculture and that production must double to meet the expected demand by 2030. Momentum for marine-based systems is also growing. With strong interdisciplinary linkages and important contributions from a broad array of cooperating producer groups, agencies, universities, and other organizations, ARS's national program in aquaculture provides a strong foundation for building up the domestic capacity for aquaculture production.

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