A Bio-Economic Model of Recirculation Shrimp-Production Systems

Xia Vivian Zhou, Terry Hanson, Stan Spurlock, and Darren Hudson

The U.S. has the largest shrimp market in the world; it has been the single largest importer of shrimp since 1998, and shrimp has become the most popular seafood consumed by U.S. consumers (Elm 2006). During the 1990s, world shrimp mariculture was severely affected by viral diseases (Encyclopedia Aquaculture 2000). U.S. shrimp production was not immune to these viruses, and production has steadily declined since 1995 (Encyclopedia Aquaculture, 2000). The decline in world shrimp supply caused an increase in shrimp prices. However, shrimp producers have altered their management strategies—i.e., harvesting smaller shrimp before diseases can kill them—to increase supplies, and shrimp prices have declined since 2003.

In an effort to prevent shrimp disease outbreaks and increase the competitiveness of U.S. shrimp producers, U.S. shrimp-culture researchers initiated research toward developing super-intensive, biosecure, re-circulating shrimp-production systems. This research determines an optimal shrimp-harvesting strategy to maximize the net revenue for this production system.

An inventory optimization model was built to determine the optimal harvesting week, shrimp size, and number of crops per year for experimental trials conducted at the Gulf Coast Research Laboratory (Ocean Springs, MS), the Waddell Mariculture Center (Bluffton, SC), and the Oceanic Institute (Oahu, HI). Based on the data from these research institutions, both growth and feed regression functions were estimated to calculate weekly revenue and cost and then to maximize net revenue per year through the inventory model. Wholesale prices from 2002 to 2006 for wild, domestic white shrimp from the Gulf of Mexico were obtained from the Urner-Barry website through a paid subscription. Wholesale prices for Pacific white shrimp (*Litopenaeus vannemei*) were back-calculated into farm-gate prices used in the inventory model.

The optimal harvest strategy was obtained and survival-rate and selling-price sensitivity analyses were conducted to determine their effect on the system's net revenue. The optimal harvesting strategy obtained by this model was determined by shrimp growth and feed functions. Producer selling price and survival rate affect the annual net revenue, but do not affect the optimal harvesting strategy—i.e., culture period and harvest size. Shrimp producers can use the developed inventory-optimization model and results to efficiently and economically manage their operations. Researchers from the research institutions can use the results to plan future research toward reducing production costs or improving biological parameters having the greatest effect on profitability.

Xia Vivian Zhou is a graduate student, Hanson is assocaite professor, Spurlock and Hudson are professors, Department of Agricultural Economics, Mississippi State University, Mississippi State.

Senior Authorship is Shared by Zhou and Hanson.