Aquaculture of Bait Shrimp on the Gulf Coast

Introduction

Three native penaeid shrimp species of commercial importance live in the Southern Atlantic and Gulf coasts of the United States: *Litopenaeus setiferus* (white shrimp), *Farfantepenaeus duorarum* (pink shrimp), and *F. aztecus* (brown shrimp). These species not only support the economy of the food shrimp industry, but also play an important role in the recreational and sport fishing industry in the South Atlantic and Gulf of Mexico. Live shrimp is one of the more popular bait options for anglers on the Gulf Coast. More than 9 million anglers visit the Gulf Coast annually. Bait and tackle proprietors use live bait, specifically shrimp, to attract these anglers to their establishments where they consume additional goods and services, including gasoline, ice, tackle, food, and fishing guide services.

Live bait shrimp are captured through trawling activities in local bays and estuarine environments and then transferred to bait shops. Excessive handling and stress during netting, holding, and transport can drastically reduce the shrimp's chances of survival. Furthermore, weather, mechanical, and seasonal variables result in an unreliable supply to the wholesale market. Many times, angler demand for live shrimp exceeds available supply. Dealers who do not consistently have live shrimp will lose customers to other dealers. A number of surveys have been conducted to better understand the seasonality and, more importantly, the desire of the sports and recreational fishermen for live bait shrimp. Based on surveys in Alabama, Florida, and Texas, a significant, almost year-round demand for live bait shrimp has been identified.

The wild harvest supply could be enhanced and stabilized through the commercial culture of bait shrimp. Culture techniques for bait shrimp, which are based on established practices in the food shrimp industry, are intended to relieve this market of many uncertainties it faces. Product availability and survivability are two of the key obstacles the bait shrimp industry currently faces. Cultured shrimp are handled less than their wild counterparts, and water quality parameters are better controlled. This increases the survival rate from around 50 percent, which is typical for wild harvested shrimp, to 90 percent for cultured shrimp. Furthermore, wholesale bait suppliers will have more control over access to live shrimp than wild harvesters, so more reliable delivery schedules can be developed with the retailer. An increase in product availability and quality will allow retail outlets to establish and grow a loyal customer base.

Farm Location

Currently, retail bait outfits buy live shrimp from wholesalers around the Gulf Coast. This supply chain is well established, but is limited to relatively short hauling distances, so the wholesalers are quite often in the area of the retailer. A variety of technical and economic factors often limit hauling of live shrimp to about 6 hours. This limits, to some degree, the geographic market that the farm can easily service. A central location to the primary target markets is desirable. Because transporting the product is not a major restriction, the farm should be situated away from metropolitan areas in a location with a suitable water source and appropriate soil types if ponds will be constructed. If the farm plans to spawn its own shrimp, having access to high quality seawater is essential. Farms
purchasing seed stock will only require a good source of seawater (brackish to full strength). In either case, water quality and quantity and how the water will be pumped need to be considered. Before building a new facility, the water source and soil should be tested using a biological assay. Because water will also be discharged from the facility, regulations regarding both intake and effluents must be evaluated.

**Legalities**

Because bait shrimp are intended to be released into the wild as part of angling activity, only the three previously listed native species may be used. With this consideration, a farm must use native postlarvae (PLs), or juvenile shrimp, that are free of viruses, which have caused problems in some aquaculture settings. The availability of PLs is currently the primary limitation to the industry’s development. Hatcheries typically do not produce native PLs. However, many hatcheries are capable of production if a farm were expected to contract for PLs.

In Alabama, farms must register with the Alabama Marine Resource Division. If shrimp will be transported through Alabama or other states, the operator must comply with regulations, which will vary. The Department of Conservation and Natural Resources has the authority to declare regulations governing facilities, sale, transportation, and documentation for such activities.

**Ponds**

The use of ponds is the most common and typically the most cost-effective way to culture aquatic animals. Pond design is critical to a successful aquaculture operation regardless of species. The Southern Regional Aquaculture Center’s Web site contains information on general pond construction. Two suggested publications are No. 100, “Site Selection of Levee-type Fish Production Ponds,” and No. 101, “Construction of Levee Ponds for Commercial Catfish Production.” The U.S. Department of Agriculture CRC, Agriculture Handbook 590, “Pond—Planning, Design, Construction” is also recommended.

To harvest live shrimp, all of the water must readily drain out of the system. One of the best methods is to use a fish pump and dewatering device to harvest the shrimp. The pump can either be placed on the effluent end of a drain pipe or in a catch basin within the pond. To deliver a quality product to the retail firm, the shrimp must be harvested quickly with minimal stress. Access to the catch basin should be available for hauling trucks, harvesting units, and any equipment needed to place and remove pumps. Additionally, a quality water source should be readily available to both the hauling trucks and the catch basin to maintain acceptable water quality parameters. All ponds should have electrical access to run aerators used to maintain dissolved oxygen levels above 3 parts per million. Aeration requirements will be dependent on stocking density, but, for most operations, 3 horsepower of aeration per acre of permanently installed aeration will be required. In addition to the permanent aeration, emergency aeration should also be available.

**Intensive Tanks Systems**

An alternative to the traditional method of culturing shrimp in ponds is to use intensive tank systems to rear the shrimp. Such systems require far less land and water, but are more expensive to build and operate. Furthermore, successfully operating these systems requires a higher degree of training, because a technical failure is more likely to be catastrophic to the crop. However, given the high cost of coastal land and the relatively high market value of bait shrimp, this technology may be appropriate for the production of bait shrimp. Examples of typical intensive systems are provided in a review reported in the "Journal of Applied Aquaculture" [12(1):1-30]. Although these systems are often complex, they have many advantages that make them an attractive alternative to traditional culture technologies.

**Shrimp**

To maintain a quality product and preserve the marketability of bait shrimp, water quality must be maintained. Several parameters should be monitored, including salinity, dissolved oxygen (DO), temperature, ammonia, nitrite, and pH. DO levels should be maintained above 3 parts per million, but should typically be maintained near saturation. To accomplish this, suitable aeration should be available in each pond, and stocking rates and feeding inputs should be based on pond size and aeration capacity. As shrimp age, their ability to tolerate lower salinities increases. Initially, larvae and PLs must be maintained at high salinities for proper growth and development. However, a 15-day-old PL will typically be able to cope with reduced salinities, so the salinity can
be gradually reduced to 4 parts per thousand. This is important because it expands the area in which shrimp can be cultured.

As farm locations move inland, property values decline. Hatchery stocks of PLs available for sale or to grow out farms, range in age from 6 to 15 days. It is important for an operation to maintain these younger PLs at higher salinities until they are at least a PL 15. Shrimp will grow best at temperatures of 28 to 30 degrees C and will tolerate much lower temperatures. The primary growing season is from early spring to late fall when temperatures are adequate for good growth. Salinity should be maintained from 4 to 32 parts per thousand and ammonia and nitrite at less than 0.5 parts per million.

**Stocking**

Stocking rates depend on the degree of culture intensity within a particular farm. Bait shrimp operations may stock grow-out ponds at 50 to 100 shrimp per square meter. The key to stocking density is to have enough animals at harvest to satisfy demand. Stocking too few animals may leave a farm unable to fulfill all commitments. Stocking too many may exceed a farm's ability to maintain water quality or harvest the production system. Factors to consider when determining stocking densities include pond size, expected mortality, and a farm's ability to monitor and react to changes in water quality. The higher the density stocked, the greater the risk for water quality problems and the loss of a crop. New farms should consider a lower initial stocking density while they gain experience and grow their markets.

**Management**

The growing season varies by location. Typically, it ranges from 5 to 7 months, but can be extended with the addition of a nursery phase. Degrees of management for bait shrimp ponds change with culture intensity. In most cases, daily water quality and feeding will be required. Periodic sampling of animals allows the farmer to evaluate growth rates and relative health of the crop and to adjust feeding. Feeding is generally based on estimated biomass. It is necessary to update this estimate to ensure appropriate feeding rates. Excessive feeding will lead to the deterioration of water quality and reduced production. Additionally, excessive feeding will add costs to the overall budget.

**Nursery Phase Option**

Recent research has indicated the benefits of adding a nursery phase to a bait shrimp operation go beyond simply extending the growing season. By incorporating a nursery phase, a producer can stock larger shrimp for grow out, which increases survival rates while reducing the time required to reach a predetermined market size. In addition to a hardier shrimp, adding a nursery phase in an overall production scheme will better use land resources, which, along the Gulf Coast, can be a significant cost consideration in the business plan.

The drawbacks to the nursery system revolve around the additional costs. The cost of tanks, labor, utilities, and filtration must be considered when evaluating the effectiveness of adding a nursery phase to a grow-out operation. A good plan for nursery harvest and transfer to grow out is necessary for an effective nursery operation. Instead of absorbing the costs of a nursery system, a grow-out operation may be better suited to stock at space maximization rates rather than growth rates. Individual commercial operations should consider all the costs and benefits of the nursery phase in the business model before production.

**Production**

Several species of shrimp have been cultured for food and research. The non-indigenous shrimp *Litopenaeus vannamei* is one of the most commonly cultured species of shrimp in the region. Food-size *L. vannamei*, grown to a final size of 12 to 25 grams, can produce yields of 4,000 to 6,000 pounds per acre when stocked at densities between 25 to 45 shrimp per square meter. For the native shrimp species *Litopenaeus setiferus*, research has shown that 12- to 15-gram shrimp produced at yields of 1,555; 5,259; and 7,995 kilograms per hectare are possible when stocked at 12, 40, and 60 shrimp per square meter, respectively (*Journal of the World Aquaculture Society* 24:295–303). In Alabama, bait shrimp are typically marketed at a 5- to 10-gram size. Because this is considerably smaller than food-size shrimp, the growing season is reduced, possibly allowing for multiple crops during the warmer summer months. A management plan should consider site-specific
conditions and provide adequate aeration to support the final biomass of shrimp, adjust feed inputs that will maximize growth but do not exceed 100 kilograms per hectare (80 lbs/acre), include routine crop sampling to adjust feeding rates, and use harvesting technologies that minimize stress on the shrimp.

The suggestion of on-site water exchange is still debated. Though the water quality can be improved, in particular related to ammonia, through water exchanges, a pond will lose important algae and bacteria in the process. Storing exchanged water for reuse may be a good idea. It will allow for water to remain onsite, reducing the risk of importing disease agents with new water. It will also help a farm reduce its overall discharge, which may be of concern with the Environmental Protection Agency's new and developing effluent regulations for aquaculture.

**Harvest**

Bait shrimp harvest is a critical time. A farm must minimize handling stress to keep the shrimp alive. Bait retailers will be loyal to farms that deliver a healthy, live product. Harvesting in the early morning or late evening when temperatures are cooler will help to reduce stress. Harvesting falls into two categories: partial harvest and complete harvest. A seine or trap is used in partial harvest. Seining involves considerable handling stress; it can disturb the sediment, which reduces water quality. However, large numbers of shrimp can be captured in a short time. Trapping reduces the impact on water quality and minimizes handling stress; however, smaller numbers of shrimp can be captured per unit effort. Complete harvesting may be the best choice. If ponds are designed well, the farmer can reduce handling stress and capture large numbers of shrimp. An Alabama Cooperative Extension System aquaculture specialist can provide additional information about harvest options.

**Marketing**

Marketing bait shrimp is an important process the farmer often overlooks. Knowing the market and having buyers lined up should be done well before the first PL is stocked. Because these animals must be delivered alive and healthy, harvest time is not the time to market the product. Most retail bait shops will pay a little more for quality and reliability. Some 2001 estimates indicated that a farm would have to receive $50 per thousand live shrimp to be profitable. Market price, order size, and delivery times should be agreed upon before harvest to protect both the wholesale and retail firms.