FISHERIES SECTION

COMMERCIAL AQUACULTURE IN VIRGINIA IN 1978

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Abstract: In 1978, all commercial aquaculture enterprises operating in the state were surveyed by telephone and in person to determine the status of the industry and to assess the biological and economic feasibility of rearing aquatic organisms for profit in Virginia.

A total of 11 commercial aquaculture firms were in business during 1978. Six establishments were producing rainbow trout (*Salmo gairdneri*) for food and stocking recreational waters, 2 were rearing warmwater sport fish fingerlings and bait fish, and 3 were culturing clams. In contrast to most southern states, no commercial producers in Virginia were growing edible-size channel catfish (*Ictalurus Punctatus*) for food.

The gross economic return from freshwater fish production in Virginia during 1978 was conservatively estimated to exceed $1,000,000 at the first level. Rainbow trout accounted for 75% of the total income. Production of warmwater fingerling sport fish was the second leading source of income, representing about 24% of the total economic returns. Income from bait minnow production contributed less than 1% to the total value.

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In Virginia, as elsewhere in the United States, public interest in developing commercial aquaculture enterprises has increased; in response, a comprehensive evaluation of present aquacultural production systems operating within each state is desirable. Encouraged by the well-publicized successes of certain trout farmers in the western U.S., catfish farmers in the lower Mississippi Valley, and producers of other aquatic species throughout the world, prospective aquaculturists question if similar opportunities may exist in Virginia. Recent public enthusiasm for aquaculture has created a strong demand for reliable information and technical assistance in rearing aquatic organisms on a commercial basis. Unfortunately, information on the economic, biological and legal aspects of operating commercial aquaculture facilities in Virginia is largely unavailable.

To date, the only study concerning commercial aquaculture in Virginia was conducted at Virginia Polytechnic and State University (Douglass and Lackey 1974). Results from this preliminary analysis on the economic and biological feasibility of rearing channel catfish indicated that it was a marginal enterprise throughout most of the state. Channel catfish can be raised commercially in the Piedmont region of Virginia using cages placed in existing ponds. Marketable-sized channel catfish could be reared in one growing season if the initial stocking size was at least 18 cm in length. Cage culture in small ponds was not recommended for south-central Virginia where summer oxygen depletion was a persistent problem. This initial economic analysis indicated commercial catfish culture was only marginally profitable. Similar information on the production of other aquatic species in Virginia does not exist.

The first step toward obtaining valid information on the types of aquaculture that are commercially feasible is an accurate evaluation of the existing aquaculture industry

operating within a state. In this respect, Arkansas is one of the few states that has closely monitored its fish farming industry. Since 1965, Arkansas has documented changes in the production and economic returns from its commercial fish farming enterprises (Bailey et al. 1974; Bailey et al. 1976; Hulsey 1965; Mayer et al. 1968; Mayer et al. 1971). As a result of these surveys, that status of the present industry and its future potential for expansion is available to all interested individuals including legislators, aquaculture and extension specialists, and fish farmers in Arkansas. The purpose of this study was to provide an accurate assessment of commercial aquaculture in Virginia by surveying representatives of all private firms currently rearing aquatic organisms.

METHODS

All commercial aquaculture firms operating within Virginia were identified through consultation with personnel of the Virginia Commission of Game and Inland Fisheries, the Virginia State Water Control board, the Virginia Institute of marine Science, and practicing aquaculturists. Commercial producers were interviewed on 2 separate occasions by telephone and when possible, in person. A standardized questionnaire form was used. We decided that an initial telephone contact with a follow-up telephone interview and a personal visit would produce more reliable responses than simply using a mail questionnaire. This method assured that relatively valid information was obtained and all known producers in the state were included in the survey. After receiving assurances that individual production values, marketing sources, and other trade secrets would be held in strict confidence, the growers appeared quite cooperative and freely answered our questions as completely as possible.

The questionnaire was designed to obtain essential baseline information on the physical, biological, economic, political and managerial aspects of commercial aquaculture as practiced in Virginia. All producers were asked to estimate the total surface acreage in production, maximum rearing capacity, present annual yield, average mortality rate, typical food conversion ratio, and average price received for each size and species produced. Additional information concerning the number of years in operation, the number of full- and part-time employees, and educational qualifications or special training required for managers was collected. Finally each manager was asked to rank (on a scale of 1 to 5, from good to poor) his relationship with various governmental regulatory agencies, his relations with other growers, and the current supply-demand for his product. Individual values for all parameters were summed and the means were used to describe averages for the state. Ancillary data on technical problems concerning water availability and quality, disease and parasites, drug use, poaching, government subsidies, tax exemptions and government regulations were recorded.

From our original list of over 25 commercial aquaculture firms believed operating within Virginia, only 11 producers were currently producing aquatic organisms. The others were no longer in business or had been improperly described as commercial aquaculture firms. Aquaculture, as used in this paper, includes any intentional production of aquatic organisms on private property for commercial profit. Individuals that occasionally harvest wild or unmanaged fish populations were not included. Fee fishing pond operators or wholesale distributors that are not directly engaged in culturing their own product were also excluded. Moreover, we have excluded from this survey aquaculturists that specialize in the breeding of ornamental or exotic fish species. The data presented in this paper represent only those firms directly engaged in the commercial production of aquatic organisms within Virginia.

RESULTS AND DISCUSSION

Trout Culture

At present, the major food and sportfish species cultured in Virginia is the rainbow trout. During 1978, rainbow trout production totalled at least 450,000 pounds statewide. Of this total, 40% was marketed as edible-sized food fish, 38% was produced to supply catchable-sized fish for fee fishing enterprises, and 22% was sold as fingerlings for stocking private recreational waters. Virtually all commercial trout culture within the state was based on rainbow trout production in a monoculture system. Propagation of brook trout (*Salvelinus fontinalis*) and brown trout (*Salmo trutta*) was negligible, constituting less than 1% of the total annual trout production. Apparently, the predominance of rainbow trout is due to its marketability, adaptability, rapid growth, and availability of its eggs. Although some trout farmers in Virginia produce their own egg stock, many firms purchase eggs from Pacific Coast hatcheries that specialize in rainbow trout egg production.

Production of rainbow trout, a luxury food item and high quality sportfish, was the leading contributor to the total income derived from aquaculture in the state. Of all aquatic species reared, rainbow trout generated the highest retail selling price averaging $1.65 per pound. Production of rainbow trout in 1978 was conservatively estimated to have a gross value of $750,000. Current market prices appear to reflect a high consumer demand for rainbow trout. In many instances, rainbow trout sold for over $2.00 per pound. Dressed and boned trout and some purchased by fee fishing Establishments commanded premium prices. When asked to rank the demand for their product and their potential for expansion, all trout farmers rated both demand for trout and their expansion potential as high. If demand and expansion potential, as assessed by trout farmers, are reliable indicators of consumer acceptability, then rainbow trout are certainly a preferred species to culture in Virginia.

The trout farming industry in Virginia is comprised mainly of well-established, small-scale, family operated firms. Our census of the 6 commercial trout producers currently operating within the state revealed that the average commercial trout farmer had been in business for 10 years, has a labor force of 2 full-time and 2 part-time employees, and has 1.6 acre-feet of raceways with an average flow of 2100 gallons per minute (4.7 cubic feet per second). The average annual production of rainbow trout is 75,000 pounds with an estimated gross value of $125,000. Virginia's commercial trout industry is centered in the Ridge and Valley Province (Alleghanies and Blue Ridge Mountains) where an abundant supply of high quality, cold spring water (isothermal at about 13°C) provides ideal trout rearing conditions. Because trout are typically reared in raceways, production values are not comparable to the acreage figures normally reported for warm water aquaculture systems. Raceway culture depends on the volume of water flowing through the system, a function of current velocity, and not on the volume of water in an enclosure. Annual production of a well managed trout farm with high quality water is about 10,000 pounds for each cubic foot per second of flow (450 gallons per minute). Our survey suggests that commercial trout farms in Virginia are well managed, producing an average of 16,000 pounds of rainbow trout for each cubic foot per second of flow. None of the trout producers interviewed, reported any substantial problems with diseases or parasites.

Bait Fishes

Commercial production of bait fishes in Virginia is much lower than that reported for most other southern states. In 1978, bait minnow production totalled only 15,000 pounds statewide. In contrast, production of bait species in Arkansas, the nation's leading producer, totalled 8 million pounds during 1975 (Bailey et al. 1976). The major difference between bait minnow production in Arkansas and other areas of the United States is the exceptionally large size of the rearing ponds. In Arkansas, minnow ponds are often called

reservoirs and minnow reservoirs of 100 surface acres are common (Hulsey 1965). Our survey revealed that the largest minnow pond in Virginia was 3 surface acres. Despite low in-state production, Virginia provides a ready market for bait fishes produced in other states. Approximately 300,000 pounds of bait fishes purchased from commercial growers in other states, notably Arkansas, are sold in Virginia.

In 1978, a total of 38 acres was devoted to the production of bait minnows in Virginia. Ninety-five percent of this total acreage was used to rear golden shiners (*Notemigonus crysoleucas*). Other bait species produced include fathead minnows (*Pimephales promelas*), Israeli carp (*Cyprinus carpio*) and goldfish (*Carassius auratus*). Bait minnow production is centered in the Piedmont and coastal Plain provinces of Virginia. Bait fishes are reared in heavily fertilized ponds supplied with well water. Harvest may exceed 500 pounds per surface acre, but typically average about 350 pounds per surface acre. Despite a ready market, most bait fish producers surveyed were gradually shifting from bait fish production to the propagation of warmwater sportfish.

Warmwater Sport Fishes

Virginia, with over 350 inland lakes and more than 50,000 farm ponds, provides a major market for the sale of fingerling sport fishes. Demand for fingerling sport fish species, particularly largemouth bass (*Micropterus salmoides*), bluegill sunfish (*Lepomis macrochirus*), and channel catfish, to stock freshwater ponds and lakes exceeds in-state production.

In 1978, production in Virginia was estimated to have totaled 600,000 fingerlings. Of this total, 75% consisted of bluegill sunfish, 17% were largemouth bass and 8% were channel catfish. The average production of fingerling sport fish in the state was estimated at 40,000 individuals per acre (poundage values were not available). This value was similar to others reported for fingerling production in the southern United States.

The production of sport fish fingerlings contributed a major portion of the total income derived from warmwater fin fish culture in Virginia. In 1978, the gross return from sport fish fingerling production was valued at $250,000. Although estimated yields in pounds per acre for fingerling sport fishes were comparable to those for bait minnow production, the economic return from fingerling sport fishes was higher. These fingerlings were marketed on a per individual basis, rather than being sold by weight as with bait fish. Motivated by the current market demand for fingerlings and their potential economic value, most bait farmers in Virginia were shifting their limited acreage to sport fish fingerling production and relying on large bait minnow establishments in other states to supply minnows to meet the angler demand in Virginia.

Fee Fishing

Despite an abundance of public fishing waters in Virginia, the high demand for recreational fishing also supports a large number of fee fishing enterprises throughout the state. In 1978, at least 50 commercial fish-out enterprises were providing "easy fishing" in Virginia. Although this survey did not include fee fishing operations, general information was provided by several producers who also operated fish-out ponds.

Most successful fee fishing enterprises are intensively managed systems. Small ponds or controlled streams are heavily stocked with catchable-sized fish, primarily trout, that have been reared in raceways. Patrons pay a basic fee for the priviledge of fishing and also a set price per pound of fish harvested. Apparently, the public is willing to pay high prices, if they are assured of catching fish. Total income from fish-out operations is frequently supplemented by the sale of fish bait, food, ice, camping facilities and gear rental. Although gross returns are high, income exceeding $20,000 per acre at certain ponds, operational expenses are correspondingly high, particularly if the free fishing operator must purchase stock from a commercial hatchery at the current market price. In contrast

to intensive fee fishing enterprises, some fish-out pond operators simply stocked controlled waters with fingerling sport fish and allowed them to grow to catchable size on naturally available food items. Fertilizer and some artificial food may be introduced, but no major effort was made to maximize sport fish production. In these extensive-type fee fishing enterprises, anglers normally paid only an "access fee". In such ponds, fish production, angler harvest and economic returns were low.

Shellfish Culture

Chesapeake Bay supports a major shellfish industry in Virginia. Commercial fishermen harvested 16.6, 2.6, and 3.6 million pounds of clam, oyster, and scallop meats, respectively in 1977 (NOAA Virginia Landing Reports).

Clams are one of the largest seafood commodities in Virginia. The industry harvests several species of clams: *Spisula solidissimus*, surf clam; *Mercenaria mercenaria*, quahog; and *Artica islandica*, mahogany clam. Surf clams represented the majority (95%) of the 1977 harvest, at 15.8 million pounds. Excessive harvests have caused a decline in surf clam harvest since 1974. These declines have resulted in a surf clam Fisheries Management Plan aimed at reducing current landings by 40%. Reducing the harvest should affect significant increases in exvessel and wholesale prices and stimulate expansion of the quahog fishery. Interest in commercial clam culture is expected to increase.

Three companies are actively involved in establishing clam culture operations. One company hopes to harvest 2 million clams in 1980 whereas the other companies are still in the early stages of development and will not harvest clams until 1981-1982. Necessary training for clam culture was obtained through the Virginia Institute of Marine Sciences (VIMS). VIMS conducts an annual workshop for commercial clam producers at their Wachapreaque, Virginia laboratory.

A pilot oyster hatchery has been operated by VIMS since 1970. Current efforts include larval oyster nutrition and short courses in hatchery and oyster culture techniques. There are no private commercial oyster culture operations in Virginia.

Eel Culture

The largest U.S. eel exporter (1.5 - 2 million pounds/year) is located in eastern Virginia. Adult eels are obtained from commercial fishermen in Virginia, surrounding states, and as far away as Louisiana. At present, eel culture in Virginia is restricted to short term holding and weekly hand feeding of the adult eels until exported to Japan. Rearing adult eels from elvers is impossible in Virginia because collection of elvers is prohibited by law. The law is strongly supported by the exporter and commercial fishermen to protect economic investments. Consequently, growth of eel culture seems improbable at this time.

Processors

The processing-marketing network necessary for establishing viable commercial aquaculture operations exists in Virginia's large seafood industry. There are currently 121 seafood facilities in Virginia that process shellfish (56), crabs (53), fin fish (10) and fish meal (2).

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