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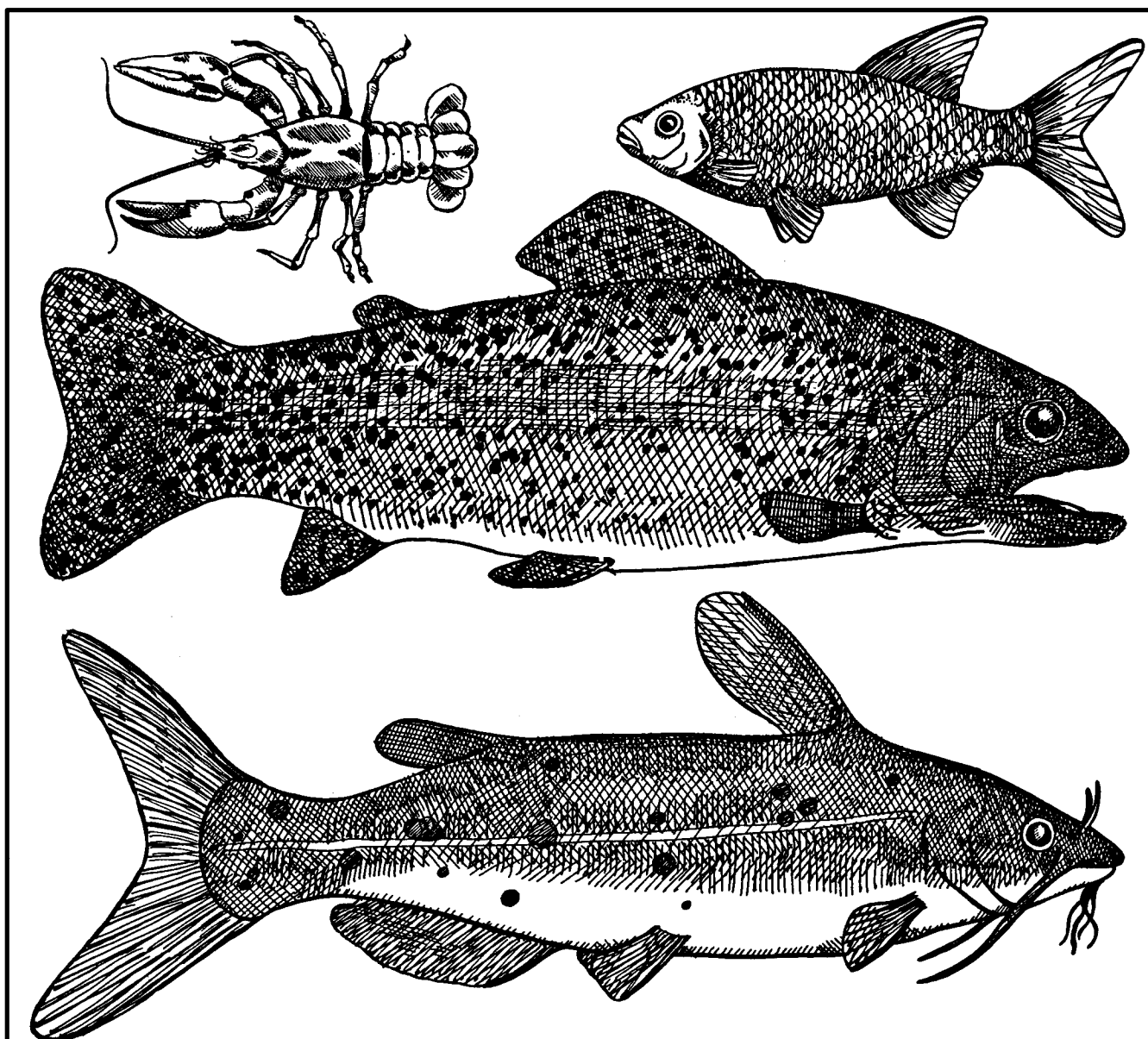


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Aquaculture Overview

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Aquaculture Overview

Aquaculture in the United States represents a relatively small segment of agricultural production, but this industry is relatively young and growing rapidly. Per capita consumption of fish and fish products in the United States has increased more than 50 percent since 1970. During this same period, world catches of wild fishes have not increased and in some cases have declined, while cost per unit catch has increased. Americans consumed over 5 billion pounds of fisheries products in 1980 and almost 9 billion pounds in 1991. Consumer awareness of the nutritional value of fish products, greater acceptance in expanded markets, and increased availability at competitive prices are expected to increase per capita consumption dramatically in the next 10 to 20 years. As United States and world seafood demand increases, aquaculture is becoming more important. The aquaculture industry is the fastest growing sector in United States agriculture, increasing over 20 percent annually in the 1980s and early 1990s.

Aquaculture is the rearing of aquatic organisms under controlled conditions. Species presently farmed in the United States include channel catfish, salmon, trout, bait and ornamental fish, crawfish, shrimp, oysters and clams. Other species such as tilapia, hybrid striped bass, red drum, alligators, white sturgeon and aquatic plants are also being farmed on a smaller scale. All have considerable commercial potential. There are other aquatic species with possible commercial potential.

HISTORY

Fish farming has been practiced for many centuries. The ancient Chinese left records indicating that they were raising common carp more than 4,000 years ago. Hieroglyphics in the tombs of the Pharaohs describe the farming of tilapia in ancient Egypt. The Romans built small ponds for raising fish. Although the practice of aquaculture has a long history, only in this century has this form of agriculture become an important supplier of fishes and other aquatic products. Until recently there was no reason for intensive development of fish farming techniques. There were abundant supplies of fishes and shellfishes from natural sources. World population growth and increasing per capita consumption of fishes and shellfishes have resulted in over-exploitation of some species.

Increasing demand has stimulated the development of aquaculture.

Early development of aquaculture in the United States was stimulated by interest in recreational fishing. In the late 1800s, federal and state hatcheries were built to propagate various gamefish species for stocking public and private waters. Commercial fish farming began in the United States in 1853 with the production of rainbow trout. Early efforts in the private sector were directed at raising fishes for recreational purposes. Large scale commercial trout production began in western United States during the early 1950s.

In the 1870s, production of Pacific salmon fingerlings was attempted for release into streams in an effort to supplement natural reproduction. However, commercial salmon production met with little success until the early 1970s.

The baitfish industry began in the early 1900s to satisfy the demand by sport fishermen. It did not expand until the late 1940s when there was increased interest in recreational fishing. Baitfish are now an important crop with production centered in the Southeast and are raised throughout the United States.

Channel catfish farming began about 1955. For the first 10 years, growth was limited to several Southeastern states. Catfish are now produced in numerous states, including Idaho, California, Kansas, Missouri and most Southern states.

Crawfish farming is another recent aquacultural enterprise. Traditionally, natural stocks of crawfish were harvested from the wild in Louisiana. Most of the catch was sold to local markets. The culture of crawfish in managed production units began in the 1950s. Louisiana and Texas are the primary crawfish producing states. Other states with some crawfish production are Arkansas, Florida, Georgia, Maryland, Mississippi and South Carolina.

The production of ornamental fishes is centered in Florida but occurs in several other states, including Maryland and Texas. Oyster and clam production is increasing in many coastal states due to recent advances in the production of domestic seed stock.

PROSPECTIVE AQUACULTURIST

Aquacultural enterprises can be described as capital, management and labor intensive. There is no sim-

ple formula whereby "fish + water = profits." Many factors must be considered before a profit-producing equation for aquaculture can be developed. The following is a general discussion and guide to help the prospective producer determine the feasibility of an aquacultural enterprise.

Species Cultured

There are a number of aquatic species that have commercial production potential. However, not all aquatic species with economic value are candidates for commercial culture. Ideally, species with the best potential have the following characteristics:

1. Techniques for producing large numbers of seed stock in a hatchery or other controlled area have been developed.
2. The species is adaptable to high density culture practices.
3. The species grows efficiently on nutrients or feed provided by the manager.
4. There is an accessible market where selling price exceeds cost of production.

Many aquatic species have specific environmental requirements for life and optimal growth. For example, rainbow trout die at water temperatures above 70°F and grow at optimum efficiency at 55°F. Channel catfish, on the other hand, die at water temperatures above 95°F, and optimum growth efficiency is achieved at 83°F. Channel catfish stop growing at 60°F or colder.

With the success, growth and visibility of aquaculture, there are a number of species being promoted that should be considered high risk. These species may have potential but should be considered cautiously.

Another concern in selection of a species is relative economic advantage of one production location over another. For example, Southern states have an economic advantage over Northern states in raising channel catfish. Catfish can be grown in colder climates, but it may take twice as long to produce a marketable fish. Coldwater species such as rainbow trout and salmon have a relative economic advantage in colder climates. This relative advantage may be overcome if producers in marginal areas can retail their products locally or enhance product value to receive premium prices.

Production Systems

Prospective producers considering alternative production systems should be cautious. Aquaculture technology is changing, and there are a number of unproven production systems and equipment types being marketed. Many have not been adequately evaluated relative to profitability and suitability for different cultured species. For example, cage culture of channel catfish has advantages and disadvantages when compared to open water culture. Cages increase the possibility of disease problems. Caged fish require a more complete and expensive diet. Cages require more management. The advantages of cage production include ease of harvest and adaptability to many ponds where open water culture is not feasible. When considering a culture system and its design, remember initial costs are generally high, design mistakes are costly and initial start-up costs affect overall profitability.

Marketing

Although the demand for aquaculture products is increasing, there is no guarantee that a new producer will have an accessible or profitable market. Prospective producers should research market options thoroughly. Not only should the producer have a good estimate of the price he will receive, he should also understand other aspects of the particular market. Other factors to consider include: the margin between market price and individual production cost; seasonal fluctuations in price and demand; the producer's ability to consistently supply quality and quantity demanded by the market; market competition; available transportation; and local, state, and federal laws or regulations including permits, inspection requirements, etc.

Laws and Regulations

Aquaculture is regulated by local, state and federal agencies. Regulations affecting site development, water use and discharge, species permits, marketing regulations, etc., differ from state to state. Depending on species cultured and production/marketing location, permits may be required or production and/or marketing may even be prohibited. Prospective aquaculturists should contact state Cooperative Extension Service and wildlife and fisheries agencies to determine if permits or licenses are required for a proposed aquacultural project.

Federal agencies also regulate aquaculture. In coastal areas and around wetland sites, permits may

be required by the U.S. Army Corps of Engineers.

The U.S. Food and Drug Administration (FDA) regulates therapeutic chemicals used in aquaculture production. For most aquaculture species, there are few and sometimes no chemicals registered for treatment of diseases and parasites and for use in water quality management.

The U.S. Environmental Protection Agency (EPA) regulates the use of pesticides in aquaculture. Producers must be knowledgeable and comply with regulations and restrictions concerning the use of chemicals in aquatic systems. For more information, prospective aquaculturists should contact state Cooperative Extension Service, FDA and EPA.

Financing

Although the aquaculture industry is growing and there are many examples of profitable operations, obtaining financing for a new operation can be difficult. A few states offer low interest rate loans or other financial incentives to attract new aquaculture operations. Presently, there are no special federal financial programs for prospective or established aquaculture producers. The federal government does recognize most aquacultural enterprises as farming. Thus, most new or established farmers may qualify for traditional United States Department of Agriculture loans and other programs offered by the department.

Commercial or farm loan institutions can be a source of financing for aquaculture operations. Obtaining financing from these institutions can be difficult. In many areas, loan officers are unfamiliar with aquaculture enterprises and are hesitant to approve loans. To help overcome this problem, prospective producers should have a complete and detailed financial prospectus for the proposed operation based on realistic projections.

Technical and Educational Services

If you are a new or prospective aquaculturist, not only will you need information concerning production management techniques, you may also need information concerning processing, marketing, economics, financial assistance, disease diagnostic services, water quality analyses, aquatic weed control, local and state laws and regulations, site selection and development, etc. In some areas, locating this information can be difficult. The following are possible sources of information or assistance.

1. The county Cooperative Extension Service office, usually listed under "County Government" in the telephone directory, can provide assistance. County Extension agents are employees of land-grant universities. The county agent may assist you directly or

draw upon the experience and training of a university expert or refer you to some other state or federal agency who can provide you with the information or service you need.

2. In the coastal and Great Lakes states, land grant universities also have Sea Grant programs. In many of these states, marine advisory service specialists can provide needed information.

3. State game and fish agencies may also be a source of information on laws and regulations, production technology and diseases.

4. The United States Department of Agriculture Soil Conservation Service can assist in site selection and facility development. This agency is usually listed in the telephone directory under "federal or United States Government."

5. The United States Department of Agriculture's five Regional Aquaculture Centers can also refer you to state specialists or other resources specific to your needs. The Aquaculture Centers are:

Center for Tropical and
Subtropical Aquaculture
The Oceanic Institute
Makapu'u Point
Waimanalo, HI 96795

Northeast Regional
Aquaculture Center
Univ. of Massachusetts
Dartmouth
Research 201
North Dartmouth, MA
02747

North Central Regional
Aquaculture Center Room 13
Nat. Res. Bldg. Michigan
State University East
Lansing, MI 48824-1222
Western Regional Aquaculture
Consortium School of
Fisheries WH-10 University of
Washington Seattle, WA
98195

Southern Regional
Aquaculture Center
Delta Branch Exp. Stn.
P.O. Box 197
Stoneville, MS 38776

6. The United States Department of Agriculture National Agriculture Library is the national Aquaculture Information Center. It provides informational services on aquaculture topics both practical and technical. The address is:

U.S. Department of Agriculture
Aquaculture Information Center
Room 304, National Agricultural Library
10301 Baltimore Boulevard
Beltsville, MD 20705

THE FUTURE

The future for aquaculture development in the United States looks good. Foreign and domestic demand for seafood and aquacultural products should continue to increase.

Aquaculture is in the pioneering phase of development. As other countries develop aquaculture industries, many United States aquaculture commodities will compete with foreign products for both domestic and export markets. Regulatory and economic constraints will also impact future aquaculture growth in the United States. Compared to traditional livestock production, aquaculture is decades behind in research and development. In the 1980s there was growth in state and federal research, educational and service programs to aid development. There is an important need for even more support from federal and state governments and universities in the areas of research, development and marketing.

It appears that global catches of wild fishes have stabilized, and per capita consumption of fish and shellfish products will likely continue growing. Other factors will probably contribute to an expansion of the aquaculture industry. Growing public concern about possible environmental contamination of some wild fish species may increase demand for aquaculture products produced in controlled environments. Increasing public demand for recreational fishing will also contribute to the growth of aquaculture markets. Aquaculture can be used to help protect or enhance certain fish species in the wild that are overexploited due to recreational or commercial fishing. All these factors suggest that opportunities for growth of the aquaculture industry will likely continue.

INFORMATION SOURCES

This publication provides general guidelines for the prospective aquaculturist. Detailed aquaculture information is available from a variety of sources. The following is a partial listing of assistance resources for informational purposes only. The United States Department of Agriculture does not endorse or recommend any business or private agency listed.

AQUACULTURE MAGAZINES

Aquaculture Magazine. General trade magazine for United States aquaculture. Bimonthly. PO Box 2329, Asheville, NC 28802.

Aquaculture Today. For owners and operators of fish farms. 31 Helmcken St., Vancouver, B.C. V6Z 1H1 Canada.

The Aquaculture News. Covers the farm raised catfish industry plus some information on general aquaculture. Monthly. PO Box 416, Jonesville, LA 71343.

Farm Pond Harvest. General aquaculture in recreational ponds. Quarterly. PO Box 736, Mo, IL 60954.

Feed Management. Feed industry information. Monthly. 122 S. Wesley Ave., Mt. Morris, IL 61054-1497.

Fish Farming International. Monthly. Audit House, 260 Field End Road, Middlesex, HA4 9LT, England.

Mollusk Farming USA. Bimonthly. Aquaculture Digest, 9434 Kearny Mesa Road, San Diego, CA 92126.

Naga, the ICLARM. Quarterly. International Center for Living Aquatic Resources, MC, PO Box 1501, Makati, Metro Manila, Philippines.

Practical Aquaculture & Lake Management. Fish and shellfish farming and pond management tips. Bimonthly. PO Box 1294, Garner, NC 27529-1294.

Salmonid. Focus on trout and salmon farming. U. S. Trout Farmers Assn., 506 Ferry St., Little Rock, AR 72202.

Seafood Business Magazine. Seafood industry. Bimonthly. PO Box 905, Rockland, ME 04841.

Seafood International. General seafood. Monthly. AGB Heighway Ltd., Cloister Court, 22-26 Farringdon Lane, London EC1R 3AU, England.

Seafood Leader. Seafood industry marketing information. Five times per year. Waterfront Press Co., 1115 N.W. 46th St., Seattle, WA 98107.

The Catfish Journal. Publishes catfish industry information. PO Box 34, Jackson, MS 39202.

Water Farming Journal. Emphasis on U. S. Aquaculture. Monthly. 3400 Neyrey Dr., Metairie, LA 70002.

World Aquaculture. Aquaculture information of world interest. Quarterly. World Aquaculture Society, 16 East Fraternity Lane, Louisiana State University, Baton Rouge, LA 70803.

World Shrimp Farming. Bimonthly. Report on shrimp and prawn farming. Aquaculture Digest, 9434 Kearny Mesa Road, San Diego, CA 92126.

INFORMATIONAL SYSTEMS

Aquatic Sciences and Fisheries Information System (ASFIS). An international bibliographic service covering the world's literature on aquatic sciences and fisheries, including aquaculture. FAO, Rome. Contact: Aquaculture Development and Coordination Programme (ADCP), FAO, Via delle Terme di Caracalla, 00100 Rome, Italy.

Aquaculture Information System, AQUIS. AQUIS is connected to FAO's Aquatic Sciences and Fisheries Information System (ASFIS). Both conventional (bibliographic) and unconventional information are accessible.

Selective Fisheries Information Service. Smaller system containing tropical finfish information. ICLARM MC, PO Box 1501, Makati, Metro Manila, Philippines.

ABSTRACTING AIDS

Fisheries Review. Covers broad fisheries field but includes aquaculture. U. S. Fish and Wildlife Service. For current subscription price contact: Superintendent of Documents, U. S. Government Printing Office, Washington, D.C. 20402.

ASIA Aquaculture Abstracts. Published five times per year. Compilation of aquaculture-raised references. Developed from ASFIS (see above). Cambridge Scientific Abstracts, 7200 Wisconsin Ave., Bethesda, MD 20814. Sea Grant Abstracts. Publications from the nation's Sea Grant Program. Quarterly. Free. PO Box 125, Woods Hole, MA 02543.

STATISTICAL REFERENCES

Aquaculture Situation and Outlook. Provides United States aquaculture statistics and explores

industry trends. United States Department of Agriculture, ERS-NASS, 341 Victory Drive, Herndon, Virginia 22070.

Current Fisheries Statistics, Fisheries of the United States. Published by the National Marine Fisheries Service. Gives statistics for previous year. U.S. Government Printing Office, Washington, D.C. 20402.

Catfish and Trout Crop Reports. Both are USDA publications. Agricultural Statistics Service Publications, 341 Victory Drive, Herndon, Virginia 22070.

FAO Yearbook of Fisheries Statistics. Gives world statistics on catches and landings. Aquaculture is included. Publication runs about 18 months after end of year reported. This and other FAO publications are available from: Aquaculture Development and Coordination Programme (ADCP), FAO, Via delle Terme di Caracalla, 00100 Rome, Italy.

LIBRARIES

Aquaculture Information Center. Room 111, National Agricultural Library, Beltsville, MD 20705. This is the national library that services aquaculture.

MEETINGS AND TRADE

Regional, national and international meetings are excellent opportunities for exchanging aquaculture information. Much information is obtained outside of formal meetings. It is wise to have a good idea of who will be attending.

Trade shows offer the chance to discuss new technological advances with vendors and provide an important opportunity to gain a broad variety of technical information. Meetings and trade shows are advertised in aquaculture printed media months in advance.

JOURNALS AND BOOKS

Aquaculture-related scientific/technical journals have proliferated in recent years. The typical reader might be better served by making an occasional visit to a major library to review these journals. Books have become abundant also. Many are quite expen-

sive and should be examined before purchase. Titles often misrepresent content. Book reviews found in journals, magazines and newsletters are helpful.

EXTENSION LITERATURE

Extension publications and other educational materials are available in many county Extension agent offices.

AGENCY REPORTS

Certain state agencies and institutes produce reports that include information which is important to aquaculture. A limited number of copies are produced, but one can usually find a particular issue in major libraries. When focused on local topics, the reports are normally available for examination at county offices. Reports of national agencies are usually deposited in the governmental section of larger libraries or are available from the National Agricultural Library.

NATIONAL AQUACULTURE ASSOCIATIONS

American Alligator Farmers Association, 5145 Harvey Tew Rd., Plant City, FL 33565.

American Fish Farmers Federation, PO Box 161, Lonoke, AR 72086.

American Fisheries Society. 5410 Grosvenor Lane, Suite 110, Bethesda, MD 20814. Scientific organization of fisheries and aquatic science professionals. Has 15 sections including a fish culture section.

American Tilapia Association. Midwest Aquaculture Learning Center, 1375 Baxter Ave. NW, Amana, IA 52203.

Aquaculture Association of Canada. Box 1987, St. Andrews, NB E0G 2X0, CANADA. Purpose: Aquaculture promotion and information exchange in Canada. Quarterly newsletter.

Associated Koi Clubs of America, Inc. 340 Mariposa Drive, Camarillo, CA 93010. Annual Seminar.

Canadian Aquaculture Producers Council, PO Box 1058, Shediac, N.B. E0A 3G0. CANADA

Catfish Farmers of America. 1100 Hwy. 82 East, Ste. 202, Indianola, MS 38751. Monthly Catfish Journal, monthly newsletter.

European Aquaculture Society. Coupure Rechts 168, B-9000, Gent, BELGIUM.

International Association of Astacology. PO Box 44650, Univ. of Southwestern Louisiana, Lafayette, LA 70504-4650. Purpose: To promote scientific study and cultivation of crawfish.

National Aquaculture Association, PO Drawer 1569, Shepherdstown, WV 25443.

National Aquaculture Council, 1525 Wilson Boulevard, Suite 500, Arlington, VA 22209.

National Fish and Seafood Promotional Council, 1825 Connecticut Ave. NW, Suite 620, Washington, DC 20235.

National Fisheries Institute, 1525 Wilson Blvd., Suite 500, Arlington, VA 22209.

National Shellfisheries Association, Natural Science Division, Long Island University, Southampton, NY 11968.

Striped Bass Growers Association. PO Box 5452, Raleigh, NC 27650-5452. Promotes advancement of the commercial cultivation of striped bass and its hybrids.

United States Trout Farmers Association. PO Box 220, Harper's Ferry, WV 25425. Promotes trout industry in the United States. Annual meeting, quarterly magazine, monthly newsletter.

World Aquaculture Society. 143 J.M. Parker Coliseum, L.S.U., Baton Rouge, LA 70803.



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of The University of Georgia's
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C. Wayne Jordan, Director