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Aquacultural Economics Bibliography

John Vondruska

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

NOAA TECHNICAL REPORTS

National Marine Fisheries Service, Special Scientific Report—Fisheries

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The Special Scientific Report—Fisheries series was established in 1949. The series carries reports on scientific investigations that document long-term continuing programs of NMFS, or intensive scientific reports on studies of restricted scope. The reports may deal with applied fishery problems. The series is also used as a medium for the publication of bibliographies of a specialized scientific nature.

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649. Distribution of forage of skipjack tuna (*Euthynnus pelamis*) in the eastern tropical Pacific. By Maurice Blackburn and Michael Laurs. January 1972, iii + 16 p., 7 figs., 3 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
650. Effects of some antioxidants and EDTA on the development of rancidity in Spanish mackerel (*Scomberomorus maculatus*) during frozen storage. By Robert N. Farragut. February 1972, iv + 12 p., 6 figs., 12 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
651. The effect of premortem stress, holding temperatures, and freezing on the biochemistry and quality of skipjack tuna. By Ladell Crawford. April 1972, iii + 23 p., 3 figs., 4 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
653. The use of electricity in conjunction with a 12.5-meter (Headrope) Gulf-of-Mexico shrimp trawl in Lake Michigan. By James E. Ellis. March 1972, iv + 10 p., 11 figs., 4 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
654. An electric detector system for recovering internally tagged menhaden, genus *Brevoortia*. By R. O. Parker, Jr. February 1972, iii + 7 p., 3 figs., 1 app. table. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
655. Immobilization of fingerling salmon and trout by decompression. By Doyle F. Sutherland. March 1972, iii + 7 p., 3 figs., 2 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
656. The calico scallop, *Argopecten gibbus*. By Donald M. Allen and T. J. Costello. May 1972, iii + 19 p., 9 figs., 1 table. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
657. Making fish protein concentrates by enzymatic hydrolysis. A status report on research and some processes and products studied by NMFS. By Malcolm B. Hale. November 1972, v + 32 p., 15 figs., 17 tables, 1 app. table. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
658. List of fishes of Alaska and adjacent waters with a guide to some of their literature. By Jay C. Quast and Elizabeth L. Hall. July 1972, iv + 47 p. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
659. The Southeast Fisheries Center bionumeric code. Part I: Fishes. By Harvey R. Bullis, Jr., Richard B. Roe, and Judith C. Gatlin. July 1972, xl + 95 p., 2 figs. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
660. A freshwater fish electro-motivator (FFEM)-its characteristics and operation. By James E. Ellis and Charles C. Hoopes. November 1972, iii + 11 p., 2 figs.
661. A review of the literature on the development of skipjack tuna fisheries in the central and western Pacific Ocean. By Frank J. Hester and Tamio Otsu. January 1973, iii + 13 p., 1 fig. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
662. Seasonal distribution of tunas and billfishes in the Atlantic. By John P. Wise and Charles W. Davis. January 1973, iv + 24 p., 13 figs., 4 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
663. Fish larvae collected from the northeastern Pacific Ocean and Puget Sound during April and May 1967. By Kenneth D. Waldron. December 1972, iii + 16 p., 2 figs., 1 table, 4 app. tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
664. Tagging and tag-recovery experiments with Atlantic menhaden, *Brevoortia tyrannus*. By Richard L. Kroger and Robert L. Dryfoos. December 1972, iv + 11 p., 4 figs., 12 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
665. Larval fish survey of Humboldt Bay, California. By Maxwell B. Eldrige and Charles F. Bryan. December 1972, iii + 8 p., 8 figs., 1 table. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
666. Distribution and relative abundance of fishes in Newport River, North Carolina. By William R. Turner and George N. Johnson. September 1973, iv + 23 p., 1 fig., 13 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
667. An analysis of the commercial lobster (*Homarus americanus*) fishery along the coast of Maine, August 1966 through December 1970. By James C. Thomas. June 1973, v + 57 p., 18 figs., 11 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
668. An annotated bibliography of the cunner, *Tautoglabrus adspersus* (Wilbaum). By Fredric M. Serchuk and David W. Frame. May 1973, ii + 43 p. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
669. Subpoint prediction for direct readout meteorological satellites. By L. E. Eber. August 1973, iii + 7 p., 2 figs., 1 table. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
670. Unharvested fishes in the U.S. commercial fishery of western Lake Erie in 1969. By Harry D. Van Meter. July 1973, iii + 11 p., 6 figs., 6 tables. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
671. Coastal upwelling indices, west coast of North America, 1946-71. By Andrew Bakun. June 1973, iv + 103 p., 6 figs., 3 tables, 45 app. figs. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

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Elliot L. Richardson, Secretary

National Oceanic and Atmospheric Administration

Robert M. White, Administrator

National Marine Fisheries Service

Robert W. Schoning, Director

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Aquacultural Economics Bibliography

JOHN VONDRUSKA¹

ABSTRACT

This aquacultural economics bibliography includes recent published and some unpublished United States and foreign literature (originally in or translated into English). Based upon U.S. aquacultural activity and interests, the 262 entries are listed alphabetically within eight categories: catfish, trout, salmon, oysters and other mollusks, shrimp and other crustaceans, other animal species, seaweeds, and general. Included literature concerns production economics, methodology, demand, supply, markets and marketing, institutions, constraints, state of the art, investment analysis, data, and other subjects. Some entries are general, or primarily descriptive, or of primarily non-economic content.

INTRODUCTION

Contents

The following discussion is intended to help users find entries of interest. An author index follows the entries. Entries are alphabetized by author name in eight categories:

Catfish	1- 66 (also 176)
Trout	67- 81 (also 38, 51, 52, 176, 201)
Salmon	82- 97 (also 176)
Oysters and other mollusks	98-120 (also 85, 176, 245)
Shrimp and other crustaceans	121-144 (also 171, 176)
Other animal species	145-161
Seaweeds	162-169 (also 225)
General (not species specific)	170-262

Enterprise budgets (tables or statements of revenue, costs, and returns for a specified period of operation or for a production cycle) are available for most of the plant and animal species being cultured. These statements vary in purpose, sophistication, and completeness.

Investment, optimizing, systems analysis, engineering design, benefit cost, and other models have been applied to aquaculture, including the following examples. Mange and Thompson applied an investment decision model to catfish farming. Pinchuk applied linear programming to optimize fish culture production in the Donetsk region, Russia. Engineering design and systems analysis models have been applied to closed system oyster culture by Costello, Marsh, and others. This bibliography includes benefit cost analyses of salmon hatchery programs by

Bollman; Richards; and Wahle, Vreeland, and Lander. Johnston and Allen, and Schuur, Allen, and Bottsford discussed applications of computerized budget, systems, and engineering design models to lobster culture. Shang has applied net present value investment models to prawns, baitfish, and eel in separate studies.

Market functions, problems, surveys, channel identification, and other marketing matters are the concern of entries in this bibliography relating to catfish, trout, pan-sized salmon, oysters, crawfish, baitfish, and other fish.

Empirical demand relationships have been estimated for products dependent on aquaculture. These products vary in their degree of similarity to like or competing products dependent on conventional capture (natural or wild stock) fisheries. Miller and Nash, and Raulerson and Trotter reported results for catfish. Agnello and Donnelley, and Charbonneau provided simultaneous equation results for oysters. Ffrench's results relate to seaweeds, and Shang's to eels. The multination analysis of all fishery products by Bell et al. included some cultured products or fish.

Regional, natural resource, and/or economic development in relation to aquaculture have been considered by many authors in overview, prognostic, and analytical reports involving different approaches and disciplines. Among the treatments and approaches most familiar to economists are those of Gates on less developed countries; Bell and Canterbury on technology transfer; Landis on technology assessment; and those relating to traditions, adoptive or innovative behavior, and the effects of social, political, and economic institutions in oyster culture.

Some of the papers concerning the legal and institutional aspects of aquaculture are included in this bibliography, for example, salmon—Manhnken, Novotny, and Joyner; oysters—Matthiessen; general (not species specific)—Cowan, Henry, Rutka, and Trimble.

Aquaculture and pollution pose a variety of problems. Odum analyzed the relationships and effects. Revenue, cost, and return figures for various systems are provided

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by Allen, Conversano, and Colwell; Bond et al.; Palmer; Smith and Huguenin; Welsh; and Yee. Kildow and Huguenin examined broader legal, social, political, and economic considerations, including consumer acceptance and marketing strategies in relation to produced goods and services. Also, see entry 173.

Many writers discussed the risks of aquaculture, and Webber's treatment is the most complete. Secretan discussed risk management as part of an insurance program for an aquacultural enterprise.

Some papers included in this bibliography relate primarily to the outlook, problems, constraints, development rationale, and biological and technical aspects of aquaculture. A few papers and reports are included because they provide data on production, acreage, consumption, and other variables. Bibliographies relating to trout (Meade), to biology of most species (in books by Bardach, Ryther, and McLarney; Iversen; Hammack's bibliography), and to economic evaluations of shellfish aquaculture (Johnston and Collingsworth) may be helpful to some users of this bibliography.

Sources

Several sources of literature were used. Requests were sent to various individuals and institutions. Recent issues of periodicals were searched, for example, *The Commercial Fish Farmer and Aquaculture News* (and predecessor periodicals), *Aquaculture*, *Marine Fisheries Abstracts* (formerly *Commercial Fisheries Abstracts*), and *Aquatic Sciences & Fisheries Abstracts* (and predecessors, cited as ASFA). In addition, certain computer-access data bases were examined. Listed in order of usefulness and fruitfulness for this bibliography they are: National Technical Information Service (NTIS), Selected Water Resource Abstracts (SWRA), *Aquaculture* (AQ, to which this bibliography's entries are now added), and the National Agricultural Library (CAIN), all of which are accessible on the NOAA Oceanic and Atmospheric Scientific System (OASIS). For foreign literature, the National Marine Fisheries Service (NMFS, formerly Bureau of Commercial Fisheries, BCF) Office of International Fisheries library files of index cards were searched to obtain possible entries. As appropriate, more specific addresses and information are given for some sources to assist the user in obtaining cited literature.

This bibliography could be revised in several ways. It is based on a nonexhaustive literature search, and the

germane literature is growing. The author would appreciate receiving reports and papers to include in a possible revised version of the bibliography and to help answer inquiries. These reports and papers, along with any comments or suggestions, may be sent to:

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Obtaining Cited Literature

It is suggested that users interested in obtaining literature cited in this bibliography work through a university, research institution, or other library familiar with or able to obtain fishery literature. Generally, neither the author nor NMFS have cited items for distribution or loan. If a citation indicates that a copy of a translation may be obtained on loan from NMFS, please write to:

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Washington, DC 20235

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Environmental Science Information Center, NOAA
U.S. Department of Commerce
Washington, DC 20235

CATFISH

001

Adrian, J. L.; McCoy, E. W.
1971.

Costs and returns of commercial catfish production in Alabama.

Auburn Univ., Agri. Exp. Sta., Bull. 421, 23 pp.

The primary objectives of the study were to evaluate inputs, costs, and returns, and to determine the optimum size for commercial catfish operations in Alabama. A purposive sample of 58 growers was obtained. Grouped data are shown for small (under 5 acres), middle sized (5 to 10 acres) and large operations (over 10 acres). Data for the following variables are itemized: investment, labor, annual costs (variable, fixed, other, and total), gross receipts, and returns (to various owned factor combinations and as a percentage of investment). The data did not permit determination of the optimum size of operation, but economies of scale with respect to acreage are shown in tables and in a regression of cost per acre on firm acreage. Concomitantly, returns increased. The analysis also considers other comparisons and aspects of the industry.

Subject descriptors:

Catfish; revenue; costs; returns; economies of scale; sample data.

002

Adrian, J. L.; McCoy, E. W.
1972.

Experience and location as factors influencing income from commercial catfish enterprises.

Auburn Univ., Agri. Exp. Sta., Bull. 437, 28 pp.

Growth of catfish farming began in Alabama in 1967, but supply-demand conditions soon reduced prices. Disease and oxygen deficiency reduced yields. Experienced producers were found to receive 6 cents more per pound of catfish, their output was 100 pounds more per acre, and their net returns were about \$100 per acre. Efficient use of resources and maximum production increased net returns. Commercial production in the central part of the State allowed some cost reduction, apparently because of concentration of growers.

Subject descriptors:

Catfish; enterprise comparison.

003

Anonymous.
1974.

Catfish farm production survey, 1973.

U.S. Dep. Commer., Natl. Mar. Fish. Serv. (Room 147, Post Office and Courts Building, Little Rock, Arkansas 72201), mimeographed, 3 pp.

Results of a 1973 survey of catfish farming by the Soil

Conservation Service are reported, including information on acreage, production and disposition. Pond acreage totaled 54,633 acres, and 47.95 million pounds were harvested from 29,942 acres. Adding production from raceways, cages and tanks, 1.86 million pounds, brought the total to 49.81 million pounds valued at \$26.19 million. Disposition data from a fewer number of States indicates that 32% went to processors, 24% went to local retailers, 31% went to live haulers, and 13% went to pay lakes, of which the last two categories are thought to represent the recreational market.

Subject descriptors:
Catfish; survey data.

004

Anonymous.

1973.

Catfish farming risky, larger farms more profitable, study shows. Amer. Fish Farmer World Aquacult. News 4(3): 9.

Results of a study are summarized. (See annotation under Carroll Garner.)

Subject descriptors:

Catfish; revenue; costs; returns; economies of scale; sensitivity analysis.

005

Anonymous.

1971.

The catfish industry--1971: an economist leads a seminar discussion.

Amer. Fish Farmer World Aquacult. News 2(4): 12-14, 27.

This article is based on a seminar in which J. E. Greenfield, Regional Economist for the Southeast Region of National Marine Fisheries Service, was the principal speaker. Among the items of economic interest is a discussion of the break-even cost for Delta farmers (28 cents per pound). The 1971 net price paid, however, at the farm level was 26 cents per pound of catfish sold. Raceway culture, water temperature, imported catfish vs. domestic catfish competition, and disease treatment are discussed in a question and answer session. The market for catfish is in the food service area.

Subject descriptors:

Catfish; marketing.

006

Anonymous.

1970.

Catfish profit potential: \$179 per acre.

Fish Farming Ind. 1(1): 12.

This article is based on comments made by Mark Luper,

Greenville, Miss., catfish farmer, to the Convention of the Catfish Farmers of America. Contrary to some statements of cost, Lupher counts interest on land, construction, and equipment investments, as well as interest on working capital before computing net profit. Per acre revenue, cost, and net profit data are presented for three rates of output (1,000, 1,500, and 2,000 pounds of catfish per acre), with cost variations among them being due to differences in feed, fingerlings, and hauling expenses. Various expense items are discussed, including factors that could cause revenue, costs, and returns to depart from the amounts shown. The data are based on Lupher's operation and others with which he is familiar.

Subject descriptors:

Catfish; revenue; costs; returns.

007

Anonymous.

1973.

Cost-returns--catfish food production (40 acre operation).

U.S. Dep. Agri., Soil Conserv. Serv., unpubl. table, 2 pp. Obtain from Mayo Martin, Ext. Biologist, Bur. Sport Fish. Wildlife, Fish Farming Exp. Sta., P. O. Box 860, Stuttgart, AR 72160.

Initial investment costs, annual costs and returns, computational assumptions, and other data are given for a 40-acre operation (with four 1-acre and four 7-acre ponds). Gross returns and net returns to land and management, average net return per acre, and production costs per pound are given for three levels of output (1,500, 1,200, and 2,000 pounds per acre).

Subject descriptors:

Catfish; revenue; costs; returns.

008

Anonymous.

1976.

Catfish farming--how to make it profitable.

Commercial Fish Farmer Aquacult. News 2(3): 9-15.

This article presents comments made by four farm operators at the workshop on the economics of catfish farming at the annual convention of the Catfish Farmers of America, February 4-7, 1976, Biloxi, Miss. Various cost, technique, management and other information is provided for the four operations. One operator indicated that catfish farming is less subject to uncontrollable factors (such as weather) than such land-based crops as wheat, beans and cotton.

Subject descriptors:

Catfish; costs; returns; techniques.

009

Anonymous.

1971.

Culcat Corporation: an investment study and analysis. Bradley Univ., Peoria, Ill., Dep. Ind. Eng., Eng. Adm. Class of 1971. Obtain copies from Steve Maple, Culcat Proj. Chairman, 3334 W. Wilshire Dr., Peoria Ill., 61614 (\$10 per copy), 169 pp. This report is a class project prepared to fulfill requirements of the engineering administration graduate program, Bradley University. It includes chapters on administration, marketing, finance, plantsite location, manufacturing operations, technological and biological reference information, and bibliography, all as related to the formation of a hypothetical catfish-producing business. A differentiated product; sales promotion, cost, and forecasts; and the U.S. market situation are discussed. Five years of costs and returns (by month) and a break-even diagram are shown for the firm. Among the factors considered (with data) to demonstrate the rationale for plant location were utility, labor, tax, government assistance, transportation, and other costs; amenities; and locations of markets and supplies. The chapter on operations includes plans, operating data, item costs, and a cost-summary table for four sizes of plant, with growing, feeding, harvesting, and processing costs separated.

Subject descriptors:

Catfish; revenue; costs; returns; marketing; forecasts; technology; techniques; biology; processing.

010

Anonymous.

1969.

Proceedings, Commercial Fish Farming Conference, Jan. 27-28, 1969, Athens, Ga.

Univ. Ga., Coop. Ext. Serv. and Inst. Community Area Dev., 85 pp. Some of the papers are annotated separately. Topics include: overview, pond construction and water use, cultural practices (growth of fingerlings and food fish, disease and parasite control, growth response to feed, harvesting), processing, marketing, profit potential, and economic characteristics and potential.

Subject descriptors:

Catfish; biology; techniques; facilities; processing; marketing; outlook.

011

Anonymous.

1971.

Proceedings, First Annual Kerr Foundation Fish Farming Conference, Feb. 26, 1971, Poteau, Okla.

Kerr Foundation, Poteau, Okla., 41 pp.

Presentations by speakers and panelists are compiled. Topics

include: fish pond construction, water quality and quantity, fingerling production, cage culture, culture from fingerlings to food fish, diseases and parasites, marketing, fish pond biology, and aquatic vegetation control. Briefly, items of economic interest include some comparisons of production methods, factor usage, and costs.

Subject descriptors:

Catfish; techniques; methods; biology; marketing; costs.

012

Anonymous.

1972.

Proceedings, Second Annual Kerr Foundation Fish Farming Conference, March 10, 1972, Poteau, Okla.

Kerr Foundation, Poteau, Okla., 55 pp.

Various aspects of catfish farming are discussed in five presentations, panel discussions, and question and answer sessions. Topics include basic aspects of catfish nutrition, recognition and treatment of the common catfish diseases, catfish marketing problems, cage culture of channel catfish (including costs), and economics of production in ponds. Briefly, the economic concerns were: supply and demand of various catfish species, consumer preferences, production and investment costs, depreciation, interest rates, net profit and risk in investment. An article by Collins is separately annotated in this bibliography.

Subject descriptors:

Catfish; biology; methods; marketing; costs; returns; risks; techniques.

013

Anonymous.

1971.

Producing and marketing catfish in the Tennessee Valley.

Conference Proceedings, June 30-July 1, 1971, Knoxville, Tenn., T.V.A., Bull. Y-38, 96 pp.

Several of the papers include tables and discussion on production costs using different methods (ponds, raceways and cages) of farming. Marketing is considered at several stages, as well as in terms of product form. Other topics include: financing, nutrition, disease, new and needed developments, and factors for prospective investors and managers to consider. The focus of the conference was on private catfish farming, with only incidental recognition being given to sport and commercial fishing from public waters.

Subject descriptors:

Catfish; costs; returns; marketing; financing; general description.

014

Anonymous.

1972.

Raceways versus ponds: how they compare costwise, profitwise.

Fish Farming Ind. 3(1): 12-13.

Summarized are results of a Georgia study (by E. Evan Brown and Jerry L. Chesness, University of Georgia; Samuel R. Chapman, Soil Conservation Service). Hypothetical 1970 investment costs, annual costs and returns, computational assumptions, and other information are given to compare ponds and raceways for raising catfish. The comparison is based on four 5-acre ponds and one 20-segment raceway, both operations producing 114,000 pounds per year. Three output prices (all in excess of average costs for both methods, about \$0.28/lb.) are used to show the effect on gross returns and net returns to management, holding costs constant. Feed and fingerlings are the major cost items for both methods and they are both higher for raceways, offsetting the advantage raceways have in lower initial investment cost, lower pumping costs, and lower harvesting costs.

Subject descriptors:

Catfish; revenue; costs; returns; method comparison.

015

Anonymous.

1970.

Report to the fish farmers (the status of warmwater fish farming and progress in fish farming research).

U. S. Dep. Inter., Bur. Sport Fish. Wildl., Resour. Publ. 83, 124 pp.

This report is essentially similar to Second report to fish farmers, annotated under Meyer, Fred P. and others.

Subject descriptors:

Catfish; general description.

016

Anonymous.

1972.

A statistical reporting system for the catfish farming industry, methodology and 1970 results.

Univ. Ark., Ind. Res. Ext. Cent., and Dep. Agri. Econ. Rural Sociol. (subcontractor), Econ. Dev. Adm., Tech. Assist. Proj. Rep. 99-6-09044-2, 233 pp.

The report gives information that was collected to develop and test the proposed system. This information relates to various aspects of farming, processing, marketing, and sources of supplies; for example, data on farm-pond acreage, production (for food and for fingerlings), operators, cages and raceways, market outlet (processor, retailer, and live-hauler), supply source, and disposition.

Subject descriptors:

Catfish; production data; processing; marketing; methods; markets; acreage data.

017

Anonymous.

1972.

What's ahead for catfish.

Fish Farming Ind. 3(3): 10-12.

The article presents some of the comments made by Tennessee Valley Authority (TVA) economist, Carl Madewell, to fish producers. Growth in demand for catfish is discussed, along with advantages to marketers and producers. Data on estimated production indicate an increase from 0.3 million pounds worth \$0.1 million in 1960 to 54 million pounds worth \$18.9 million in 1970. Estimated itemized cost and return information is shown for three kinds of farming operations: catfish in ponds (40-acre farm with 80,000 pounds of output annually), and catfish or trout in raceways (200,000 pounds of output annually). In a comparison of catfish pond and raceway operations, feed accounts for about 40% and 47% of the annual cost, respectively; fingerlings, 21% and 19%; and annual investment costs (amortized capital costs), 18.5% and 9%. Under the specified assumptions, cost per pound (round or whole weight basis) for both systems came to about 34 cents, and a survey of actual farm operations in the TVA area revealed costs in the 24- to 71-cent range, with more than half of the operators achieving a cost of 31 cents per pound or less.

Subject descriptors:

Catfish; production data; revenue; costs; returns; method comparison.

018

Ayers, James W.

1971.

Marketing problems demand production efficiency and sales promotion (The catfish market: problems and promise).

Amer. Fish Farmer World Aquacult. News 2(4): 10, 16-17.

Several ways of improving catfish production and market approach are discussed. The growth of catfish farming from more than 250 acres of water devoted to catfish culture in 1960 to more than 250,000 acres in 1971 is cited. The price per pound of catfish delivered to a processing plant is about 30 cents while the cost of processing the catfish is 65 cents. There are also brokerage fees, transportation costs, and markups at the retail level. Efficiency in producing, harvesting, transporting, and marketing of the finished product is stressed. Causes for most catfish processing plants operating at a loss include high expenses for operation and overhead, high cost of raw materials, excess labor costs, unnecessary mechanical breakdowns, and excess waste of raw materials (catfish).

Subject descriptors:

Catfish; marketing.

019

Bartonek, Frank A.

1972.

Catfish farming.

Amer. Fish Farmer World Aquacult. News 3(8): 4-7. (Reprinted from Farmland News.)

Information on the development of catfish farming, farming methods, and some individual operations is provided on the basis of the reporter's visits and interviews. Business risks include poor management (said to be responsible for as high as 80% of the catfish business failures), lack of technical know how, absentee rather than on-farm owner (manager), location, operation on too large a scale when a pond is being tried and experience is being gained, and other risks associated with an industry in the early stages of development. Discussed briefly are historical developments, feeds, yield variations (1,000 pounds of fish per acre of pond for new growers and 2,000 pounds per acre for experienced growers), feed conversion ratios, research by various individuals and institutions, laws, and other matters.

Subject descriptors:

Catfish; risks; history.

020

Billy, Thomas J.

1973.

Pond-grown catfish in the United States: present situation and future opportunities.

Paper presented to the FAO Technical Conference on Fishery Products, Dec. 4-11, 1973, Tokyo. FAO, FII: FP/73/E-33, 13 pp. Industry development, activity from farm to consumer, organization, products, markets, and problems are described briefly. Among the factors accounting for development of a pond-grown catfish industry are stability of wild catfish output, the established product market, adaptability of catfish to culture, timely Federal Government R&D, the abundance of low-cost freshwater in the U.S. south-central region, and available surplus agricultural land for pond sites. Key farm management problem areas are ponds, fingerlings, production limits (growing season, feeds, etc.), diseases, parasites, and harvesting. A schema or flow chart shows processing and marketing steps. The industry faces several problems in the future.

Subject descriptors:

Catfish; processing; marketing; technology; general description; industry development.

021

Billy, Thomas J.

1969.

Processing pond-raised catfish.

Proceedings, Fish Farming Conference, Jan. 27-28, 1969, Athens, Ga. Univ. Ga., Coop. Ext. Serv., Inst. Community Area Dev., pp. 42-48.

This paper indicates the general considerations involved in moving farm-reared catfish from the pond to and through a processing plant for distribution to market. Each step along the way is discussed in general terms. Particular emphasis is placed on the special considerations and interrelations between the various operations, and on proper design, layout, and equipping of a processing plant. The lowering of costs of production, processing, and marketing is one of the major limiting factors to the continued orderly development of the processing sector of the industry.

Subject descriptors:

Catfish; technology; processing; general description.

022

Brown, E. Evan; Holemo, Fred J.; Hudson, Horace.
1973.

What the Georgia fee fishing survey reveals.

Fish Farming Ind. 4(3): 10, 12 and 13.

Initial results of a 1972 survey of 23 Georgia catfish fee fishing operators are reported, along with the discussion of certain factors necessary to the success of such business. Among these factors are pond site selection, pond and structure design, water quality and quantity, fish culture, species selection, feeding, fertilization, and control of predators and disease. Itemized sample budget data are given for revenue, costs and returns, including survey average and range data for certain items of expense. On the average, fishout pond operators were open for business 200 days per year. Income came from fees only, not from sales of sundries and tackle, which proved unprofitable. After deducting variable and fixed expenses, including interest on investment, the net returns to family labor and management averaged \$2,003 per acre.

Subject descriptors:

Catfish; recreation; fee fishing; survey data; revenue; costs; returns.

023

Brown, E. Evan; LaPlante, M. G.; Covey, L. H.
1969.

A synopsis of catfish farming.

Univ. Ga., Coll. Agri. Exp. Sta., Res. Bull. 69, 50 pp.

Contents: spawning and hatching, chemical control of diseases and parasites, pond construction and water quality control, feeding, harvesting, marketing, expected costs and returns of channel catfish farming, summary and observations, and literature cited. Market outlets for commercial growers include: live fish (for pay-lake operators), now the presently highest priced and dominant market; local markets, upon which small operators depend; and volume food-fish markets. Gross and net returns per acre for various fish and agronomic field crops are cited (1966, Arkansas data). Itemized investment and annual costs, and annual

returns are shown and discussed. The effects of two feed conversion ratios (1.87:1 and 2.0:1) and two sets of assumptions are indicated, along with the effects of different product prices (range: 25 cents to 65 cents/lb.) on net returns. Organized catfish markets are lacking, investment costs are substantial, risks are many, industry expansion seems likely, if improved cultural practices are adopted, and research by several government agencies has helped to overcome problems.

Subject descriptors:

Catfish; general description; revenue; costs; returns; outlook; markets.

024

Buettner, Howard J.

1972.

Fish farming in twelve south central states (species, acreage and number of farmers).

Natl. Mar. Fish. Serv., Current Fish. Stat. No. 6038, 20 pp.

Results of a 1969 survey of fish farmers in 12 states are reported. Of 1241 respondents engaged in fish farming on 75,413 acres, 804 were growing adult catfish (on 30,330 acres), 429 were growing fingerling catfish (on 6,782 acres) and 292 were growing minnows (on 26,866 acres). Some 23 aquatic fauna were reported as being grown.

Subject descriptors:

Survey data.

025

Collins, Charles M.

1972.

Cage culture of channel catfish (1971 experiment).

Paper presented to the Fourth Annual Convention of the Catfish Farmers of America, February 3-5, 1972, Dallas, Tex. Kerr Foundation, Inc., 23 pp.

An experiment was conducted to assess the commercial feasibility of cage culture of channel catfish, and the report contains itemized data and discussion on production, biological and environmental factors, costs, and returns. Study objectives related to determination of fingerling size to reach food fish size in one growing season, stocking rate, suitability of two types of foods, and economic potential. Certain functional relations are reported, namely: profit increased with the size and rate of fingerlings stocked; total cost per pound of output decreased as stocking rate increased, as did average weight gain, although total weight gain decreased. Some comparisons and problems with commercial operations are discussed.

Subject descriptors:

Catfish; cage culture; method evaluation; revenue; costs; returns; experiment.

026

Davis, James T.; Hughes, Janice S.

1970.

Channel catfish farming in Louisiana.

Baton Rouge, La. Wild Life Fish. Comm., Wildl. Educ. Bull. 98, 48 pp.

This bulletin is intended as a practical guide to supply the basic facts and principles necessary to start a commercial catfish farm. Contents include location selection, pond construction and techniques (fingerlings, spawning and hatching, pond fertilizers, feeds and feeding, harvesting, holding, hauling and marketing). Costs of various items are mentioned, and one section includes an estimate of capital costs, and annual expenses and annual income on a per acre basis.

Subject descriptors:

Catfish; general description.

027

Donahue, John R.

n.d., circa 1967.

The United States catfish market.

U.S. Dep. Inter., Bur. Commer. Fish., processed, 11 pp.

Natural catfish production and marketing problems are discussed, and the prospects for an expanded farm-cultured catfish market are suggested, if problems of erratic supplies, rising retail prices, and inconsistent quality could be overcome. Several species of fish (freshwater, saltwater, and brackish water) of varying quality have been marketed as "catfish," with freshwater channel catfish generally being highest in quality and price. Markets have been mainly in producing areas, yet there is variation in product form, price, preferences, and price flexibility.

Subject descriptors:

Catfish; markets; marketing.

028

Ford, Erwin C.

1969.

Potential of pond farm production.

Proceedings, Commercial Fish Farming Conference, Jan. 27-28, 1969, Athens, Ga., Univ. Ga., Coop. Ext. Serv. and Inst. Community Area Dev., pp. 77-78.

Factors to consider in evaluating the potential for catfish businesses and industry expansion are (1) the industry is new, with profits for entrepreneurial risk and with business failure expected for the same reasons as in other industries (inexperience and incompetence); (2) farm growth cannot be isolated from other functions, if consumption is to be increased; (3) quality of cultured fish must be maintained as a means of product identification (and separation from natural-stock catfish, which sells at lower prices); and (4) supplies must be adequate to satisfy

market demand through time and during the year.

Subject descriptors:

Catfish; problems; outlook.

029

Foster, Thomas H.; Waldrop, John E.

1972.

Cost-size relationships in the production of pond-raised catfish for food.

Miss. State Univ., Agri. Forestry Exp. Sta., Bull. 792, 69 pp.

Itemized costs and returns are provided for six farm situations, based on six sizes of ponds (5, 10, 20, 40, 80, and 160 acres) on 160 acres of land, and based on specified methodology, assumptions, and detailed supporting data. Input-output coefficients were synthesized on the basis of information from several sources, and factor prices were applied to estimate costs. Investment, cost, and return data are summarized in tables and one figure (which shows per-pound average total, operating and ownership costs as a function of pond size). Sensitivity analysis results indicate separately the effects of changes in fingerling and food costs on average cost of output, and of changes in output price on various measures of net income. Farm situation III (20-acre ponds) had the lowest average cost of output and highest net return, but no substantial net return differences occurred among farm situations III, IV, and V. The appendix provides detailed tables and discussion on input usage, labor time requirements, equipment and capital costs, pond design, and other variables.

Subject descriptors:

Catfish; revenue; costs; returns; economies of scale; sensitivity analysis.

030

Garner, Carroll R.; Halbrook, W. A.

1972.

Catfish production in Southeastern Arkansas: estimated investment requirements, costs and returns, for two sizes of farms.

Univ. Ark., Agri. Exp. Sta., Div. Agri., Rep. Ser. 203, 27 pp.

Estimates were made of investment costs, and annual costs and returns for a 40-acre farm with a 33-acre pond and a 160-acre farm with four 33-acre ponds. The data used were based on farm surveys, specified assumptions, and other information. Using itemized budgets, the costs and returns are compared for the two sizes of farms and economies of scale are shown. The effects of five price levels and six production levels are shown, demonstrating some aspects of risk.

Subject descriptors:

Catfish; revenue; costs; returns; economies of scale; sensitivity analysis.

031

Gray, D. LeRoy.

1970.

How to make a success in the fee fishing business.

Fish Farming Ind. 1(1): 28-31.

Growing demand for recreational fishing and prices in excess of those offered by processors are among the reasons a fish farmer may feel an initial interest in fee fishing operations. However, there are several factors necessary to a successful, profitable fee fishing business. Among these are location, customer amenities, aesthetic appearance, fishing quality, promotion (advertising, contests, prizes), complementary goods and services, species mix, pond shape, pond size, stocking rates, and ability of the operator to handle certain problems. The operator must be able to meet customer demands. Liability insurance is a must. Labor may be a problem. Fish culture itself poses several problems. For reasons of fishing quality several species are suggested for consideration, with the selection depending on the local situation.

Subject descriptors:

Catfish; fee fishing; recreation; general description.

032

Greenfield, J. E.

1970.

Catfish marketing, 1970.

Catfish Farmer 2(3): 37-44.

Market functions, development, and problems are discussed. Marketing is the major barrier to continued, orderly growth of the catfish industry. Results of two surveys are reported briefly, one involving about 780 restaurants in the Midwest and South with respect to catfish, and the second involving some 1500 housewives who kept daily records of food purchases. Preliminary data for the second survey indicate income, racial, and regional characteristics for catfish consumers in 1969. In contrast, the restaurant survey indicated no significant seasonal, age, or racial patterns to catfish consumption in conventional, family-style restaurants. Restaurant managers' experience with catfish are among the other survey results discussed. Survey results and other information are related to market development and opportunities. Catfish supply factors are also discussed, for example, the declining importance of wild production, imports as a source of competition, the effects of possible changes in technology (such as the use of raceways or cages in place of ponds, or the use of powerplant thermal effluent), and large-market requirements of uniform high-quality, specification-complying product flows.

Subject descriptors:

Catfish; marketing; demand; consumption.

033

Greenfield, J. E.

1970.

Economic and business dimensions of the catfish farming industry (revised).

U. S. Bur. Commer. Fish., Ann Arbor, Mich., 38 pp.

Major headings include industry structure, production, processing, and marketing; the first two are emphasized. Discussed are production (farm) capital structure; operating performance (for three growing periods, 2 operations, average management); return on investment (ROI), sensitivity for the two operations for three "levels" of land value, growing period length, fingerling cost, harvesting cost and stocking rate; the effect of superior management; and the sensitivities of profit per acre and ROI to 11 output prices (24-44 cents per pound). Processing costs, industry value added, marketing, processing output and overall sales, and other aspects of the industry are discussed.

Subject descriptors:

Catfish; revenue; costs; returns; sensitivity analysis; processing; marketing; survey data.

034

Greenfield, J. E.

1970.

How much profit in pond culture?

Fish Farming Ind. 1(1): 32-35 and 44.

This article is based on Greenfield's report, Economic and business dimensions of the catfish farming industry, which is annotated separately.

Subject descriptors:

Catfish; revenue; costs; returns.

035

Greenfield, J. E.

1970.

1970 profile of the catfish market.

Fish Farming Ind. 1(2): 18, 19, and 25.

Marketing is a major problem facing the catfish industry for several reasons. Catfish is produced largely by crop farmers with little experience in specialized product markets and they don't understand marketing functions. Other reasons include demand and market character, difficulty in establishing brand preferences, and lack of preference for catfish as a species in regions of the country where per capita consumption of fish is highest. Results of two 1969 surveys financed by the Bureau of Commercial Fisheries are also reported briefly. One survey concerned 780 restaurant managers in the South and Midwest to determine their experience with catfish. The second survey concerned 1,500 housewives who kept daily diaries of food purchases; it showed per capita consumption of fish products by

income group, region and race, and data for catfish.

Subject descriptors:

Catfish; markets; marketing; survey data.

036

Greenfield, J. E.

1969.

Some economic characteristics of pond-raised catfish enterprises (revised).

U.S. Dep. Commer., Natl. Mar. Fish. Serv., Econ. Mark. Res. Div., unpubl. manusc., 19 pp.

Using information for the Mississippi Delta production region (Arkansas, Louisiana, and Mississippi), the author discusses capital costs, and how profits, costs and return on investment are sensitive to changes in the length of growing period, fingerling costs, harvesting costs, stocking rates, management level, prices, and selected combinations of these factors.

Subject descriptors:

Catfish; revenue; costs; returns; sensitivity analysis; processing; marketing.

037

Greenfield, J. E.

1969.

Some economic characteristics of pond-raised catfish enterprises. Proceedings, Conference on Commercial Fish Farming, Jan. 28-29, 1969, Athens, Ga., Univ. Ga., Coop. Ext. Serv. and Inst. Community Area Dev., pp 67-76.

Using information for the Mississippi Delta production region (Arkansas, Louisiana and Mississippi), the author discusses capital costs, and how profits, costs and return on investment are sensitive to changes in length of growing period, fingerling costs, harvesting costs, stocking rates, management level, prices, and selected combinations of these factors.

Subject descriptors:

Catfish; revenue; costs; returns; sensitivity analysis; processing; marketing.

038

Grizzell, Roy A., Jr.

1972.

All you want to know about the fee fishing business "but were afraid to ask".

Fish Farming Ind. 3(3): 14-17.

Information is provided on U.S. catfish and trout fee fishing enterprises. Initial investment costs, and annual revenue, costs, and returns are itemized in a table for an 80-acre channel catfish fee fishing operation, with average net return to land and management of about \$125 per acre. Growth in demand is

foreseen, but returns depend upon management ability. Several factors contributing to successful management are discussed. Among these are location, customer amenities (parking, picnic tables, restrooms, freedom from snakes and insects, etc.), fishing quality, advertising, geographic separation from fish farming activities that may be on the property, complementary goods and services (bait, snack, tackle, boat, and fish-cleaning facilities), charges (five are discussed), pond size, pond numbers, and proper fish culture techniques. Capital investment is in the range of several hundred thousand dollars for sophisticated operations.

Subject descriptors:

Catfish; trout; fee fishing; recreation; revenue; costs; returns.

039

Grizzel, Roy A., Jr.

1971.

SCS survey shows caged catfish culture not pie in the sky.

Fish Farming Ind. 2(3): 17-18.

The results of a 1970 Soil Conservation Service (SCS) survey of Arkansas operators of catfish cage-culture enterprises are reported, with data on the numbers of successes and failures, and a brief discussion of problems encountered in the initial commercial trials of this method. Of 586 cages, 55 were failures, 75 averaged 47% survival from fingerling to food fish size (i.e., 47% success), 39 had survival in the 80% to 100% range, and survival data on two large growers are not reported. The surveyed operators are optimistic about the future.

Subject descriptors:

Catfish; survey data; cage culture.

040

Grizzell, Roy A.; Sullivan, Edward G.; Dillon, Olan W.

1969.

Catfish farming, an agricultural enterprise.

U.S. Dep. Agri., Soil Conserv. Serv., Farm. Bull. 2244, 22 pp.

The report is a practical guide to successful catfish farming. The section on economics considers factors that affect the cost of capital and other inputs, market or product form choices, management decisions, and net returns. Other topics relate to water, pond structures, species selection, hatcheries, fingerlings, stocking procedures, feeding, winter care, troubles, treatments, and harvesting. Cost and input-use data are presented.

Subject descriptors:

Catfish; general description; costs.

041

Heffernan, Bernard E.

1974.

Five ways to cut costs on a catfish farm.

Fish Farming Ind. 5(1): 16-19.

Five of many cost-reducing changes in methods and equipment on the Edgar Farmer and Sons operation, Dumas, Ark., are discussed on the basis of an interview with Kelly Farmer, manager of the fish division. With the increase in feed prices, 800 instead of 2,000 1/2-pound catfish were stocked per acre of pond in 1973, along with 10 instead of 5 pounds of fathead minnows, and commercial feed was applied at the rate of 12 instead of 30 to 35 pounds per acre per day. Dust, which is undesirable for feeding, is recovered from feed at the rate of 1% to 3%. A refrigeration unit added to live-haul truck trailers reduced the requirements for ice from as much as 9,000 pounds to 500 pounds per trailer load (as much as 15,000 pounds of fish) on long trips. Lime is being added to ponds to reduce organic decay. Live-haul and seine harvesting equipment has been designed or improved, reducing labor requirements.

Subject descriptors:

Catfish; technology; techniques.

042

Jones, Walter G.

1969.

Market alternatives and opportunities for farm catfish.

Paper presented to the Fish Farming Conference., Oct. 1969, Texas A&M Univ., College Station, Tex. U.S. Bur. Commer. Fish., Ann Arbor, processed, 6 pp.

While the long-run prospects for catfish market development are viewed optimistically, growth requires planning and market research, and there are some short-run problems. The general market outlook is discussed, along with an indication of sources of competition for farm-raised catfish (wild U.S. and imported catfish, especially growth in the latter, and perhaps imported farm-raised catfish in the future). Price, quality, product form, and other differences exist; marketing research can help further identify avenues of development. Producer (farmer or grower) market alternatives include local, live-haul, processing plant, wholesaler and distributor, and fingerling and broodstock markets. Processor market alternatives include specialty restaurants, supermarket chains, food caterers, and foreign markets. Each of these alternatives is discussed as to current and future importance.

Subject descriptors:

Catfish; markets; marketing.

043

Jones, Walter G.

1969.

Market prospects for farm catfish production.

Proceedings, Conference on Commercial Fish Farming, Jan. 27-28, 1969, Athens, Ga. Univ. Ga., Coop. Ext. Serv. and Inst. Community Area Dev., pp. 49-61.

In assessing future prospects, quality, production, market, and demand factors are discussed with emphasis on the latter. U.S. per capita and total fish consumption, and import growth are cited as factors affecting the demand for farm-raised catfish. Using estimated or actual data for 1955-68, wild and farm-raised production, imports and total U.S. catfish supplies are projected for 1969-75 at two levels. The data are shown in tables and graphs, along with prices for wild catfish from several States or producing areas. The projections were made informally (without a formal mathematical model) on the basis of the author's 10-year association with the industry. He indicated that rapid growth in imports, wild-cultured fish price differentials, lack of market development (promotion), and other factors could affect potential sales expansion in the Midwest and other areas outside the main producing region.

Subject descriptors:

Catfish; production data; import data; consumption data; forecasts; marketing; markets; outlook.

044

Kinnear, H. M.

1972.

Catfish spawning--trough culture makes a big difference.

Amer. Fish Farmer World Aquacult. News 3(6): 6-7.

The shift from the use of natural to controlled environment catfish spawning at the Leon Hill Catfish Hatchery, near Lonoke, Ark., is described briefly on the basis of an interview. Hill estimates that with natural spawning in outdoor ponds about 15% of the eggs become fingerlings, and that there is about 50% survival under controlled conditions. Careful supervision, water temperature control (80 degrees F., plus or minus less than 1 degree), water quality control, proper feeds, feeding, and other aspects of procedure are discussed. The business is said to be profitable, but subject to risk.

Subject descriptors:

Catfish; technology; hatcheries; techniques.

045

Kirby, Martin.

1972.

Catfish vs. poverty?

Amer. Fish Farmer World Aquacult. News 4(1): 8-9.

A plan devised by Earl Evans, an Arkansas catfish farmer, aimed at fighting poverty in Arkansas and Mississippi is outlined. It

would require \$2.6 million for implementation in 10 Arkansas counties and \$2.6 million in 15 Mississippi counties, most of which would come from the Office of Economic Opportunity and the Economic Development Administration. Participants in these programs would receive technical, managerial, and biological aid in the establishment of catfish farms. The projection of new catfish farmers was estimated at 150 with about 6,000 more acres of catfish farms in each of the two States.

Subject descriptors:

Catfish; economic development role.

046

Lee, Jasper S.

1971.

Catfish farming, a reference unit.

Miss. State Univ., Curriculum Coord. Unit Vocat. Tech. Educ., 103 pp.

While this "publication is designed primarily for use by secondary teachers of agricultural occupations," it is a useful, descriptive, nontechnical handbook in which chapter 1 (job 1) provides an economic view and prospectus of the catfish farming business and industry. Besides this, topics include pond and other water facility construction, fingerling production, growing food, feeding, water management, disease and parasite control, other controls (predators, trash fish, and other pests), harvesting and hauling, marketing, processing, and bibliography. Also presented are revenues, costs and returns for selected scales of operation (different pond acreages and output levels); equipment costs, equipment lives and minimum-maximum compatible acreage levels; investment (initial) costs; projected total and per capita consumption (to year 2020); marketing alternatives; and other factors that affect business and industry performance.

Subject descriptors:

Catfish; general description; revenue; costs, returns; consumption data; forecasts; markets.

047

Lee, Jasper S.

1973.

Commercial catfish farming.

Interstate Printers and Publishers, Danville, Ill., 263 pp.

The material in this book covers a broad range of factors which influence the catfish industry. The first three chapters include the history of catfish farming and how to establish a catfish farm. The biology of catfish, the construction of water facilities, and securing and managing water are described in three chapters. There are chapters on nutrition of catfish, production and selection of breedfish and fingerlings, increasing growth, harvesting, and marketing. Other chapters cover controlling diseases, parasites, predators, and other pests. There is a chapter on recreational fee-lake operation. The final

chapter describes the methods and forms of catfish processing. In one appendix a chart relates length to weight per thousand fish, number of fish per pound, and weight of each fish. Another appendix gives catfish recipes.

Subject descriptors:

Catfish; technology; methods; marketing; general description.

048

McCoy, E. W.; Ruzic, J. E.

1973.

Alabama's recreational catfish ponds.

Auburn Univ., Agri. Exp. Sta., Bull. 451, 21 pp.

The objectives of the study were to determine the supply of Alabama recreational catfish water, related demand factors, problems encountered in production and marketing, and fishout operation characteristics. A complete inventory of these operations was made in 1971. Percentage distribution data are given for operator age, occupation, size of operation, location, government assistance, feed source, and other variables. Financing, equipment, marketing procedures and problems, and expansion plans are discussed, as well as reasons for poor returns, factors affecting demand (population of surrounding area, location with respect to population centers and highways, size of ponds, harvest per pond and/or stock rate, price, concessions, and facilities), and demand relationships.

Subject descriptors:

Catfish; recreation; fee fishing; recreation demand.

049

McCoy, E. W.; Sherling, A. B.

1973.

Economic analysis of the catfish processing industry.

Auburn Univ., Agri. Exp. Sta., Circ. 207, 20 pp.

On the basis of information obtained in a 1971 survey of 19 of 21 Southeastern United States catfish processing plants, and specified assumptions, the authors estimate that the industry operated at 36% of capacity in 1970. Anticipated raw material purchases for 1971 would have allowed operation at 59% of capacity, but actual purchases fell short. The problems are rapid industry growth, and extreme seasonality of production (summer raw material shortage). Cost, employment, and other information are provided. Itemized costs for producing a pound of output total 80 cents (1971) for a hypothetical plant operating at 36% of capacity, and 66 cents, at 100% of capacity. Alternatives for improvement are analysed.

Subject descriptors:

Catfish; processing; revenue; costs; returns.

050

McCoy, E. W.; Ruzic, J. E.

1973.

Raise catfish for fun and profit--or neither.

Auburn Univ., Agri. Exp. Sta., Highlights Agri. Res., 20(1): 8. With growing demand for recreation and the remoteness of many previously used sites from urban population centers, special complexes and facilities are being built, including public fishout ponds. Ponds with catfish increased from 50 in 1965 to 700 in 1970 in Alabama, meaning a shift to catfish, since bass and bream were once the leading kinds of fish stocked. Net return to land, labor and management is higher for the ponds fished for a short while, after which they are drained and the remaining fish are commercially harvested. Where recreational fishout is the only harvesting device, this net return is lower per acre. It is higher per pound harvested, but fewer pounds are harvested. Other factors affecting profits and losses, and operator satisfaction are discussed.

Subject descriptors:

Catfish; recreation; fee fishing; revenue; costs; returns.

051

Madewell, Carl E.

1971.

Economic and related considerations before entering or expanding a commercial catfish or trout farming operation.

Paper presented to Fish Farming Conference, Nov. 4, 1971, Montgomery Bell State Park, Burns, Tenn. T.V.A., 20 pp.

Pre-investment considerations, and some production and marketing challenges are discussed. The former include legal, environmental, technical, marketing, financial, assistance sources, management, and economic factors. An expanding market is foreseen, for which trout and catfish both have suitable characteristics, but some processing problems existed in 1970 (location, seasonally excess capacity and other problems). Initial investment, annual costs and returns, and net return may be compared economically with similar measures for other farm enterprises; such data are shown for catfish ponds, and catfish and trout raceways. Comparisons for a limited number of Alabama producers indicate that net returns to land, labor, and management for catfish equal or exceed returns for peanuts, cotton, and soybeans (Yeager, 1971). Improvements in technology, efficiency, product, and competitive ability are among the industry challenges, as suggested in part by a comparison of farmer-to-consumer prices and expenses for catfish, trout, and pork.

Subject descriptors:

Catfish; trout; revenue; costs; returns; forecasts; outlook.

052

Madewell, Carl E.

1973.

Economics of catfish raceway production.

Paper presented at Fish Farming Conference sponsored by Tenn. Fish Producers Assoc., Dec. 5-6, 1973, Montgomery Bell State Park, Burns, Tenn. T.V.A., 11 pp.

Demand, market, supply, processing, and production (farm) information and data from several sources are summarized and updated (to 1973). The outlook for expansion of catfish production appears good, because it offers several advantages to farmers, processors, distributors, and consumers. While per capita consumption (edible weight basis) is estimated as about 1 pound in the Tennessee Valley region, another estimate (Cordouk, 1970) is that U.S. per capita consumption of catfish may reach 7 pounds by 1990. Processing costs are indicated along with the effect of operation at 36% of capacity (after McCoy and Sherling, 1973, using 1970 data), since below-capacity operation is still a problem, although the number of plants has declined (21 in 1971 and 10 in 1973) and output has increased. Prices and expenses from farmer to consumer are compared for catfish and pork. Catfish and catfish-trout raceway investment costs, annual costs, and annual returns are itemized based on preliminary data provided by Georgia researchers.

Subject descriptors:

Catfish; trout; production data; forecasts; revenue; costs; returns; consumption data; processing; method comparison.

053

Madewell, Carl E.; Ballew, Ralph J.

1972.

Historical development of catfish farming.

Amer. Fish Farmer World Aquacult. News 3(3): 8-11.

This article presents a brief history of how fish farming began and expanded in the United States, with particular emphasis on catfish farming. The Saltonstall-Kennedy Act for commercial fisheries in the 1950's triggered an increased interest in R&D in fish culture among colleges and fish culture labs. Intensive catfish farming began in the 1960's. Acreage increased from 400 in 1960 to 45,000 in 1970 while average yield per acre increased from 800 pounds in 1960 to 1,200 pounds in 1970. The projection for 1975 is that there will be 75,000 acres of food fish and yields of 1,500 pounds per acre. The value of catfish at the farm level soared from \$150,000 in 1960 to \$19 million in 1970. Some problems which the catfish farming industry must overcome are listed. They include: (a) decreasing high production costs, (b) improving quality and making a variety of catfish products available to consumers on a year-round basis, and (c) improving production efficiency.

Subject descriptors:

Catfish; history; technology; methods; problems; outlook; costs.

054

Madewell, Carl E.; Carroll, Billy B.
1969.

Intensive catfish production and marketing.

T.V.A., Rep. F69ACD6, 30 pp.

This report summarizes available literature on industry growth, nature of the catfish farm enterprise, current production, and marketing; interprets the meaning of this information so far as a potential Tennessee Valley industry is concerned; and suggests possible approaches for industry development. Literature for 1961-68 is cited. While the U.S. catfish industry is in its infancy, specialization is beginning to occur among farmers, economies of scale and complexities are evident, and returns to land and management may equal those for any other farm enterprise, although these returns are quite variable among operators. Factors that make farm-raised catfish a new product are discussed. Marketing channels, expected market growth, market development needs, and approaches to industry development are considered in the remainder of the report. Appendix tables contain 1947-67 Tennessee Valley fish production data; forecasts of channel catfish market, production, acreage, and output per acre to year 2020 (after Mitchell and Usry, 1967); and seven budget statements for different kinds of catfish operation (after Grizzell, 1967).

Subject descriptors:

Catfish; production data; forecasts; marketing; revenue; costs; returns; technology.

055

Mange, Frank A.; Thompson, Russell G.
1969.

An application of an investment model to channel catfish farming. U.S. Dep. Commer., Natl. Mar. Fish. Serv., Econ. Mark. Res. Div., unpubl. manusc., 40 pp.

The purpose of the model is to identify some important aspects that should influence investment decisions in channel catfish farming enterprises. The results exhibit a number of economic relations of which the following were most important: (1) When initial average profits were 20 cents per pound and the initial price of land, buildings, and equipment was close to \$800 per acre, the initial investment policy of the firm was one of continuous purchase of new capacity. (2) Higher initial average profits resulted in larger maximum capacities up to a limiting size, beyond which further increases in profits resulted in increases in net worth, but not in capacity. (3) The investment policy of the firm was found to be very sensitive to initial prices of capacity higher than \$800 per unit, and no new capacity was added if prices of capacity reached \$1,500 per acre. (4) Profit accumulation and, thus, investment decisions were found to be sensitive to changes in the interest rate paid for financing new capacity. (Authors' abstract.)

Subject descriptors:

Catfish; investment model.

056

Meyer, Fred P.; Sneed, Kermit E.; Eschmeyer, Paul T.

1973.

Second report to fish farmers (the status of warmwater fish farming and progress in fish farming research).

U.S. Dep. Inter., Bur. Sport Fish. Wildl., Resource Publ. 113, 123 pp.

This is a practical handbook. Several business and industry practices and choices are discussed in terms of their economic impact, sometimes in terms of cost or revenue. Topics include: culture methods, feeding and feeds, diseases, pond management, harvesting, marketing and processing, high-density culture methods, stock improvement, mixed species culture, noncatfish species culture (golden shiner, fathead minnow, goldfish, buffalofish, crayfish, and bass, black, white and striped), and fish and arable land crop rotation. Per-acre gross and net returns (to land, management, and risk) are shown for various alternative land and fish crops (1970 data). Investment (initial) cost and operating costs and returns are shown for a business with two 10-acre ponds (1970 data).

Subject descriptors:

Catfish; general description; revenue; costs; returns.

057

Miller, Morton M.; Nash, Darrel A.

1969.

The development of catfish as a farm crop and an estimation of its economic adaptability to radiation processing.

U.S. Dep. Commer., Natl. Mar. Fish. Serv., Econ. Mark. Res. Div., unpubl. manusc., 136 pp.

Economic activity relating to wild and farmed catfish is described so far as possible with available, often insufficient secondary data through about 1966-67. Costs and returns for harvesting wild stocks, farming, processing, marketing, and distribution are discussed and shown in tables, along with price, consumption, market, seasonality, estimated price elasticity, and other information. Market output is then projected for the period 1975-85; the benefits and costs of fresh, radiation-pasteurized, and frozen catfish products are compared; and it is concluded that the radiation-pasteurized form would provide considerable economic benefits over the alternatives, given the assumptions and methodology used in quantification.

Subject descriptors:

Catfish; production data; consumption data; marketing; processing; demand analysis; forecasts; benefits; technology; radiation processing.

058

Mullins, Troy.

1970.

Capital requirements for initiating a catfish production enterprise.

Amer. Fish Farmer 1(3): 12-14.

This article relays the results of a 1966 study on the capital requirements for starting a catfish farm. A sample of 28 farmers reported their acreage, their choice of having growth ponds or growing fingerlings, costs of construction of service buildings and reservoirs, harvesting costs, costs of water supply, and feeding costs. Several tables report the number of reservoirs and approximate investment (averaging \$399 per acre). Also reported are the increase in fish farm acreage (from 1,600 in 1963 to 29,000 in 1969) and the decrease in construction costs in 1968 and 1969.

Subject descriptors:

Catfish; survey data; costs; investment.

059

Nelson, Roy.

1972.

The marketing point of view: processing or pay lakes?

Catfish Farmer 4(2): 13-14.

Potential marketable output has been estimated as 200 million pounds of catfish (live weight). While the largest part now moves through the fee ponds, a declining percentage of output is being sold in this market (87% in 1969 and 67% in 1971, with 50% estimated for 1973). The lower priced processing market is judged to be more stable and continuing, but growers must be able to satisfy requirements, such as large enough quantities on a consistent basis with a seasonal flow pattern that would allow processing plant operation at steadier rate of output throughout the year.

Subject descriptors:

Catfish; markets; marketing; industry development; outlook.

060

Nichols, John P.; Lacewell, Ronald P.

1971.

A marketing system: the step beyond production.

Amer. Fish Farmer World Aquacult. News 2(5): 18-20.

The functions and importance of the marketing system are discussed briefly. Some of the present problems of the catfish industry are due to the nonperformance of some of these functions. To achieve increased output, producers will have to understand what is being communicated about consumer tastes and preferences by the marketing system, for example preferences for quality, convenience, and dependable supplies. Research can help solve marketing problems.

Subject descriptors:

Catfish; marketing.

061

Pippin, Kenneth; Morrison, W. R.
1975.

Retail market potential for farm-cultured catfish.

Univ. Ark., Agri. Exp. Sta., Bull. 799, 22 pp.

Results of a 1973 survey (Little Rock, Ark.) to evaluate the market potential and consumer preferences for farm-cultured catfish are reported. Potential is expressed in terms of sales (pounds purchased) per thousand supermarket patrons. Preferences are related to socioeconomic characteristics. Chi square analysis was employed. Purchases tended to increase with household income, homemaker education, and occupational status of the head of household; purchases tended to decrease, but less clearly, with family size and with the presence of younger members. Other results are indicated.

Subject descriptors:

Catfish; markets; demand; consumption; evaluation.

062

Raulerson, Richard C.; Trotter, Warren K.
1973.

Demand for farm-raised channel catfish in supermarkets: analysis of a selected market.

U.S. Dep. Agri., Econ. Res. Serv., Mark. Res. Rep. 993, 21 pp.

In March and April 1972, a controlled Latin square market experiment was performed in six Atlanta grocery stores to determine the demand for fresh channel catfish in supermarkets. Prices ranging from \$0.79 to \$1.29 per pound in 10-cent increments were used to elicit quantity responses. These responses were used to estimate linear, log-linear, and log-log forms of a demand curve. The resulting demand curves indicate an elastic demand for catfish within the experimental price range. Results of a consumer questionnaire indicate the possibility of expanding the market by introducing more convenient product forms at a reasonable cost to the consumer. (Modified authors' abstract.)

Subject descriptors:

Catfish; demand analysis.

063

Rogers, Bruce D.; Madewell, Carl E.
1971.

Catfish farming--cost of producing in the Tennessee Valley region.

T.V.A., Natl. Fert. Dev. Cent., Circ. Z-22, 20 pp.

This report indicates estimated catfish production in the Tennessee Valley for alternative operations. Costs are based on interviews, estimates, and specified assumptions. The operations are compared with respect to key variables in one summary table. Initial cost, and annual costs and returns are itemized in 17 appendix tables. The summary table indicates for 17 operations

the acreage, capital cost per firm and per acre, price received, profit (return to management) per acre and as a percentage of initial investment, and production cost per pound of catfish or fingerling. Eight pond, two fingerling, three fishout, and four raceway operations are compared. A case example of poor management is analysed. An appendix contains questions for a potential catfish farmer to ask in evaluating the situation.

Subject descriptors:

Catfish; revenue; costs; returns; enterprise comparison.

064

Russell, Jesse R.

1972.

Catfish processing--a rising southern industry.

U.S. Dep. Agri., Econ. Res. Serv., Agri. Econ. Rep. 224, 33 pp.

This report describes the catfish processing industry in nine southern states in 1970, and attempts to determine factors affecting the economic operation of the 16 plants surveyed. The infant industry--only 3 of the 16 processors marketed any fish before 1968--is still experimenting with different methods of processing and marketing. Processing methods include hand labor, machine use, and a combination of both. Obtaining a steady supply of fish--especially in slack summer months--to increase the utilization of capacity is the major problem facing the industry. In contrast to a total capacity of 21.3 million pounds (live weight), the plants processed only 6.4 million pounds in 1970. This study was made in response to both the rapid growth of catfish farming and the importance of processing in developing markets for increased production.

Subject descriptors:

Catfish; processing; methods; problems.

065

Sullivan, Edward G.

1970.

The role of the Soil Conservation Service in the catfish industry in Mississippi.

Catfish Farmer 2(3): 25-26.

Since the Soil Conservation Service (SCS), an agency of the U.S. Department of Agriculture, views catfish farming as a farm (agricultural) enterprise, it provides technical assistance in site selection, and in pond and water system lay out. It works through county offices and Soil Conservation Districts, which usually coincide with counties geographically. SCS made a special survey of catfish farming in Mississippi in spring 1969. Of 11,648 acres in commercial production, SCS has provided complete engineering design on 7,259 acres and technical advice and guidance on another 3,988 acres. While some large farms are in a position to hire their own engineers for design work, SCS will continue to provide soil interpretations and soil maps.

Subject descriptors:

Catfish; government assistance; survey data.

066

Yeager, J. H.
1971.

Factors determine the suitability of catfish farming (to be or not to be a fish farmer).

Amer. Fish Farmer World Aquacult. News 2(12): 19-21.

Several aspects of fish farming are reviewed for the prospective aquaculturist. The prospective fish farmer will want to consider legal, technical, financial, economic, and managerial aspects of growing catfish before beginning an operation. Revenue, cost, and return information is itemized briefly for 58 Alabama catfish producers categorized into small, medium, and large pond operations. (See abstract under J. L. Adrian and E. W. McCoy for more details.)

Subject descriptors:

Catfish; revenue; costs; returns; survey data; prospectus factors.

TROUT

067

Anonymous.
1972.

Bob Erkins talks trout marketing.

Fish Farming Ind. 3(2,3, and 5): 20-24; 31, 32, and 34; and 30.

An interview with Robert A. Erkin, operator of the 1000 Springs Trout Farm, Inc., Buhl, Idaho, concerning markets and marketing is provided in three parts using questions and answers. The trout market is somewhat concentrated in northern States with people who are fish eaters by experience, it is restaurant (gourmet item) centered, it does not have ethnic patterns, and it has become less seasonal than in the past with year-round production and freezing. The product is sold in 8-, 10-, or 12-ounce drawn form (gilled and eviscerated, but with head, fins, and tail intact). Shelf life, freezing techniques, and packaging are discussed. In contrast to most of the past 20 years, the last 2 years have brought a sellers' market because Danish and Japanese products virtually disappeared from the market. Accurate production data are not available, but the 1971 market is estimated to have been about 6 million pounds of processed, farm-raised rainbow trout, including 1.5 million pounds of imports, and excluding live trout sold for private and public stocking. Estimates for 1972 are 9.4 million pounds, including 2.5 million pounds of imports. Estimates for 1973 are 11.8 million pounds, including 4.0 million pounds of imports. Output is limited by market (demand) rather than by production (supply). Output could be increased 25% without depressing price, if promotion began 12 to 14 months in advance. Promotion is by product, rather than by firm or brand. In terms of a 10-year

market outlook, Erkins indicates that (1) product competition comes from fish in general, (2) fish market expansion is on the basis of population rather than per-capita-consumption growth, but population growth rates have slowed, (3) fish prices have advanced considerably in the past 10 years, but this is not true for catfish and trout, and (4) with a good marketing program, output of processed trout could reach 25 million pounds by 1980. Subject descriptors:
Trout; markets; marketing.

068

Anonymous.

1972.

Georgia researchers look at trout-catfish rotation.

Fish Farming Ind. 3(5): 12-13.

Information is given on a study by E. Evan Brown, T. K. Hill, and J. L. Chesness on trout only in South Georgia where winter temperatures are usually suitable for trout, and where summer weather is suitable for catfish growth, allowing the possibility of two crops. Weather records suggest fewer than 120 days with water temperatures below the critical 70 degrees F., and the winter, 1971-72, growing effort lasted 105 days. Initial cost, annual cost, annual return, computational assumption, feed conversion, production method, average and actual market price (involving fishout lake, processor, and local markets) data are provided.

Subject descriptors:

Trout; markets; techniques; revenue; costs; returns; biology; survey data.

069

Anonymous.

1973.

Pointers to consider when planning to farm trout.

Fish Farming Internatl. 1(1): 92-94.

The growth of trout farming in Northern Ireland (1968-73) is discussed, along with information from an advisory leaflet for prospective farmers (The development feasibility and economics of rainbow trout farming in Northern Ireland, by Stuart Fidgeon). Land area, water requirements, construction and operating costs, prices and returns are estimated for farm units of 25, 100, and 150 ton capacity. Feed, fry, labor, and other costs are indicated. The trout are assumed to reach 6 to 8 ounce marketable size 16 months from fry stage.

Subject descriptors:

Trout; costs; returns; marketing; Ireland.

070

Araji, A. A.

1972.

An economic analysis of the Idaho rainbow trout industry.

Univ. Idaho, Coll. For., Wildl. Range Sci., Dep. Agri. Econ., AE Series No. 118, 9 pp.

This preliminary report describes the current status of the industry in terms of its economic and business dimensions, including per capita consumption, production, processing, demand, and marketing. Major headings include: cost structure of the Idaho trout industry, demand potential, production, and marketing problems. Revenue, cost, return, and value added analysis for trout production, processing and marketing, and Idaho agricultural receipts from farm marketing are illustrated and discussed.

Subject descriptors:

Trout; demand; marketing; revenue; costs; returns; value added; problems.

071

Arroyo, Igor Solar.

1973.

Chile develops the cultivation of trout in cages.

Fish Farming Internatl. 1(1): 99-104.

An account is given of aquacultural developments in Chile since 1968, when the Fish and Game Division of the Agriculture and Livestock Service began experiments. Details of rearing experiments are given, including trout cage construction, feeding, economics and output levels. Estimated initial costs, and annual revenue, costs and returns for a 70-cage operation are itemized. Less detailed data are shown in a comparison of operations with 30, 50, 70 and 100 cages.

Subject descriptors:

Trout; Chile; revenue; costs; general description.

072

Berge, Leidolv; Farstad, Nelvin.

1971.

Norwegian pondfish farming.

Paper presented at Internatl. Symposium on Fisheries Economics, Paris, Nov. 29-Dec. 3, 1971. O.E.C.D., FI/T(71)1//25, 29 pp.

This is a condensed version of a longer, Norwegian-language report. Based on 1966 and 1970 survey information, the Norwegian pondfish industry is described and analysed in economic terms to explain variations in profits and costs. The output, mainly rainbow trout, increased from 200 metric tons in 1962 to 1,000 metric tons in 1969. Variable, fixed, and total costs for some of the 260 firms are shown and discussed along with other data to show variation in labor and capital costs per kilogram of output. Investment, stocking, feed, and other cost items are discussed. Small firms (10 to 15 metric tons per year of output) provide

supplementary part-time income. Larger firms can consider natural resource and market points in location. Output range is about 1 to 70 metric tons per firm. Feed consists mainly of waste and small fish, some of which is operator caught, with conversion at 6 to 7 kg per kilogram of fish produced. Very little dry feed is used; future feed may include krill. Marketing problems relate to the competitive nature of the firms, product competition with salmon and sea trout, luxury-fish price (about three times cod prices), inability of many producers to hold ("store") live fish past Christmas, quality variations, and other factors.

Subject descriptors:

Trout; Norway; revenue; costs; returns; production data.

073

Brown, E. Evan; Hill, T. K.; Chesness, J. I.

1972.

Rainbow trout--a new money crop for South Georgia.

Univ. Ga., Ga. Agri. Res., Fall, 1972, pp. 10-12.

Problems, a trial operation, itemized initial costs and annual costs and returns, computational assumptions, and other information are given relative to the growth of rainbow trout in a new eight-segment raceway on University property at Tifton, Ga. The trout were stocked on December 10, 1971. Data for the previous year indicate that one might expect less than 120 days with temperatures below the critical 70 degrees F., and 6- to 8-inch fingerlings were stocked to reach 10- to 12-ounce market size in this time. Harvest occurred after 105 days. Sales were made locally, to fishout ponds, and to a fish processor, with the price averaging \$0.664/lb. Even counting an unexplained (one-night) loss that caused most of the 17 percent mortality, feed conversion was quite good (1.3 lb commercial, floating, dry feed per 1.0 lb of fish, live weight basis).

Subject descriptors:

Trout; revenue; costs; returns; raceways.

074

Collins, Richard A.

1972.

Cage culture of trout in warmwater lakes.

Amer. Fish Farmer World Aquacult. News 3 (7): 4-7.

The results of a study are reported briefly, along with methods, materials, and technical details. Inspection of surface water temperature of lakes indicates that southern Arkansas, northeast Texas and central parts of Mississippi, Alabama, and Georgia should provide about a 150-day winter growing season, during which time 3-ounce trout may grow to 12 ounces. The following data are provided for a nine-cage, 115-day experiment: stocking rate, mortality, number harvested, average and total weight, total weight gained, and feed conversion rates. Information is also given on fingerling, feed, cage, and labor costs, revenue, and computational assumptions.

Subject descriptors:
Trout; experiment; method evaluation.

075

Gooby, Dick.
1971.

Idaho trout farmer profits on 10-cent margin.

Fish Farming Ind. 2 (3): 36-38.

Large firms grow, process, and market trout, but it has not been feasible for them to develop small springs. One way for these large firms to increase output to the rate necessary for profitable operation has been to provide fingerlings to land holders with smaller springs and to offer compensation for grow-out services at a specified rate, 10 cents per pound of trout in this case. The firm's 1970 output was 70,000 pounds, and two or three crops may be put through the grow-out process in a year, with stocking at 4 to 5 inches and selling at about 12 inches. The 1970 gross was \$7,000; feeding labor, \$1,080; pond amortization, \$700; and total annual costs, \$1,780. The net return exceeded that for an 80-animal beef cattle operation, for which similar revenue and cost data are indicated.

Subject descriptors:

Trout; revenue; costs; returns; enterprise comparison.

076

Klontz, George W.
1973.

A survey of fish health management in Idaho.

Univ. Idaho, For., Wildl., Range Exp. Stn., Info. Ser. 3, 34 pp. The text and some of the tables of this report are published in Amer. Fishes U.S. Trout News 18(9): 8, 9, 11-13, 16, 17 and 20. To better understand fish health problems, Federal, State, and commercial fish-raising systems were surveyed in Idaho in 1973, and resulting 1972 production, costs, employment, and other information are reported. The commercial production of trout, salmon, and catfish has several component operations. Rainbow trout output totaled 27.4 million pounds in 1972, compared to 0.75 million pounds in 1956; catfish output was 0.1 million pounds in 1972; and output of both is expanding, judging by information for 1973. Mortality rates and costs for eggs and fish (three sizes of fish, 1 to 3, 3 to 6, and 6 to 12 inches long) are detailed, and consequent losses are estimated for private growers only. While mortality rates decline with age (e.g., eggs, 16.5%; 6- to 12-inch fish, 6.4%), mortality among 6- to 12-inch fish accounts for 75% of the loss, because production cost is higher for the older fish. Production costs for purposes of loss estimation include feed, labor, and egg costs, but not capital outlay, return on investment, and other components of gross revenue; losses totaled \$0.56 million out of production costs of \$7.95 million.

Subject descriptors:

Trout; production data; revenue; costs; biology; general description.

077

McGuinness, Fred.

1973.

Prairie pot hole trout: hard way to make a buck.

Fish Farming Ind. 4(2): 22-26.

Grow-out of trout from fingerling to market size in Canadian Prairie Province pot holes has become an income-supplementing enterprise for about 1,500 operators, mostly grain and cattle farmers. The pot holes generally range in size from 1 to 20 acres, and there is a wide range in productivity owing primarily to differences in water quality and natural food supplies (freshwater shrimp). Some data on fingerlings, permits, harvest, and yield are provided individually for the provinces. Total catch was estimated at 0.4 million pounds in 1972. Harvest is by gill net and boat in October or by gill net through the ice in December. A 1970 experiment by the Fisheries Research Board of Canada involved stocking 18 pot holes, which averaged 16.3 acres in size (293.4 acres total), and a 39.1% average recovery (range 0% to 70%) in the 23,000-pound harvest (78.4 pounds per acre, average). Marketing restraints were removed in 1972 because of adverse effects on the industry, and a processing breakthrough appears to have occurred in 1973.

Subject descriptors:

Trout; development; general description.

078

Meade, James W.

1971.

A reference list for trout culturists, revised December 1971.

Penn. Fish Comm., Div. Fish., Benner Spring Fish Res. Stn. (R. D. No. 1, Box 200-C, Bellefonte, Pa., 16823), unpubl., 5 pp.

This reference list provides the names, authors, and publishers of books, periodicals, booklets, pamphlets, articles in publications, and addresses of other sources of information about trout and other fish culture.

Subject descriptors:

Trout; technology; bibliography.

079

Mull, Wilbur C.; Fair, Armor John.

1970.

Selected aspects of the market demand for rainbow trout in Atlanta and Northeast Georgia.

Univ. Ga., Coll. Bus. Adm., 9 pp.

This report summarizes the results of an initial local market

survey based on information from 20 agencies and firms. Retail stores and restaurants are the primary consumer outlets. The market is supplied by rainbow trout from Georgia and nearby States, Idaho, and other countries. A frozen product is generally preferred. Large retail chains are primarily interested in attractive packaging, uniform quality and cost. Rainbow trout is served in the more exclusive restaurants where it appeals to a limited clientele; its bones and price appear to limit consumption on a mass-market basis. Georgia producers might be able to increase sales by promotion to differentiate their product, by making the product more competitive in price in retail chain stores, and by supplying the larger national market. The results are limited to the area and by the absence of secondary data on national and regional markets.

Subject descriptors:

Trout; markets; survey data.

080

Pritchard, G. I.

1973.

Fish farm projects in Canada.

Fish Farming Ind. 1(1): 112-114.

Canada has some 300 private trout hatcheries, mostly small firms. The growing use of fingerlings relates to planting in lakes, streams and pot-holes, again mostly by small firms. Some salmonids are grown near larger cities. There has been a resurgence of oyster culture, along with research into the culture possibilities for other species, and the development of more supportive attitudes and economic conditions. Yet, the industry is still viewed as having high risks, high development costs, low market concentration (mainly small firms), local market penetration, low profits and a low degree of vertical integration.

Subject descriptors:

Canada; trout; oysters.

081

Scott, Clyde A.; Fessler, Floyd R.

1970.

There's profit in trout production.

Fish Farming Ind. 1(3): 18, 21 and 22.

Based on a 1969 Soil Conservation Service (SCS) survey of 286 private trout growers in 16 States and on other information, several topics are briefly discussed, notably water use, marketing, raceway design, feeding, stocking, and costs and returns. Nonthermal springs are the major source of water which must range from 45 to 70 degrees F., and preferably 55 to 64 degrees. Groundwater temperature is about the same as mean annual air temperature. A flow of 1 cfs can support annual output of 10,000 to 14,000 pounds of trout. Information is given on raceway design and preferences by region, feeding (dry feeds,

uses of automatic and hand feeding), and two kinds of fishout ponds. An itemized cost-return table shows initial costs, annual costs and returns, and computational assumptions for a synthesized operation producing 26,000 pounds of trout annually. Subject descriptors: Trout; survey data; marketing; raceways; revenue; costs; returns; biology; fee fishing.

SALMON

082

Anonymous.
1975.

Salmon farming: an emerging industry.

Commercial Fish Farmer Aquacult. News 2 (1): 6-20.

Factors, firms, agencies, people and problems involved in the emergence of this industry are discussed. NMFS conducted initial net-pen experiments in 1969, and the rapid expansion of the industry is indicated by the increase in output between the 1973-74 and 1974-75 seasons, from 350 to 740 metric tons, including output from ocean ranching as well as net pens. Factors and problems of importance include institutional and legal constraints for both methods, site selection, feed costs and availability, technique improvements (to reduce costs), and commercial feasibility. It may be 3 to 5 years before economic feasibility can be determined, owing to uncertainty about market demand for pan-sized salmon, prices, and costs.

Subject descriptors:

Salmon; outlook; general description.

083

Anonymous.
1972.

To market, to market, to buy a small salmon.

Pac. NW SEA 5(1): 3-8 and 12-13.

A pilot salmon aquaculture project conducted by Ocean Systems, Inc. (OSI) and funded partially by Sea Grant is discussed. The project was categorized into four phases: (1) incubation, (2) freshwater cultivation, (3) saltwater cultivation, and (4) test marketing and analysis. Problems in the incubation stage include faulty fertilization, siltation due to heavy rains, low water temperatures, and a fungus. In the freshwater cultivation stage, the food conversion rate is discussed as is Sea Grant's \$100,000 matching funds-type grant. Water temperatures, current flow, and storm protection are among the main items discussed in the saltwater cultivation stage. Losses were also caused by dogfish sharks chewing holes in the pens and consuming the salmon and by birds scooping out some fish. In a sample of 27 brokers,

wholesalers, etc., taken in July 1970, in 9 major cities, the National Marine Fisheries Service found that verbal commitments were made for about 300,000 pounds of the cultivated salmon. Subject descriptors: Salmon; biology; cage culture; experiment; hatcheries; markets; survey data.

084

Bollman, Frank Herbert.

1971.

River basin development and the management of anadromous fisheries: an economic analysis of the Columbia River experience.

Ph. D. thesis, Univ. Calif. (Berkeley), Dep. Agri. Econ., 793 pp. Large main-stream dams have affected the habitat for anadromous fish runs in the Columbia River, which accounts for 40% of the U.S. hydroelectric power potential and 25% of the salmon and steelhead catch in the Northwest. This study focuses on an evaluation of the costs and benefits of mitigation programs (fish passageways and hatcheries) and on the institutional setting for these programs. Capital outlay, annual costs of operation and maintenance, costs of biological research and investigation and public and private power company costs are estimated for 1939-69 and for future continuation of the programs. Benefits and costs are compared. Methodology problems for sport fishery evaluation are reviewed, and future demands for sport fishing are estimated. With respect to institutions, an analysis is made of tenure status of the resource, conceptual validity and operational usefulness of limited entry, legal and social institutional fish protection, and the effectiveness of State fishery regulations.

Subject descriptors:

Salmon; hatcheries; benefit-cost analysis; method evaluation; demand analysis; government assistance; production data; recreation demand; investment model.

085

Fraser, Jim; Martin, Stephen G.

1972.

The economic and biological feasibility study of rearing chinook salmon, chum salmon and Pacific oysters at the Squaxin Island, Port Gamble and Skokomish reservations.

Federal Way, Wash., Small Indian Tribes Org. W. Wash., Inc., Final Report, 60 pp. (Obtain from NTIS, COM-73-10110.)

The techniques are described for experimentally growing chinook and chum salmon in nylon webbed pens. Results at Squaxin Island indicate that chinook salmon did well, but chum salmon suffered high mortality in the summer. Preliminary data suggest that Squaxin Island and Port Gamble may be able to support commercial raft culture of Pacific oysters, and that this may be quite profitable, but further investigation is suggested for all three reservation sites. The authors warn that member tribes lack

business experience and may consequently face crop failures in aquaculture. (Based on NTIS abstract.)

Subject descriptors:

Salmon; oysters; biological feasibility; experiment; economic feasibility; problems; techniques; returns.

086

Gates, J. M.; Mueller, J. J.

1975.

Optimizing the growth and marketing of fish in a controlled environment.

Mar. Tech. Soc. J. 9 (5): 13-16.

An optimizing model is presented for salmonid aquaculture, although it is adaptable to any species of interest. It is illustrated using hypothetical data; it can be solved using any standard linear programming algorithm. Physical plant and related fixed costs are assumed, so that the optimization decisions relate to operating costs (which are functionally dependent on biomass and temperature regimes) and revenues. Fish size at time of sale and seasonal phasing of marketing are considered.

Subject descriptors:

Salmon; systems analysis.

087

Joyner, Timothy; Mahnken, Conrad V. W.; Clark, Robert C., Jr.

1974.

Salmon--future harvest from the Antarctic Ocean?

Mar. Fish. Rev. 36 (5): 20-28.

Salmon has been chosen as the most likely candidate for the introduction of fish farming in the Antarctic Ocean. Scientists are anxious to introduce fish farming into the Antarctic region primarily because of the high potential of using krill, a small shrimplike crustacean, as food for the translocated fish. The natural abundance of krill in the Antarctic Ocean would provide food for the salmon and thus reduce production costs for the farming operation. The authors discuss the oceanography of the Antarctic, wind patterns, and probability of adaptation of each salmon species to the Antarctic climate. Several maps and tables are also presented.

Subject descriptors:

Salmon; Antarctic Ocean; techniques; oceanography; biology.

088

Koposov, A. F.

1964.

Some problems concerning the efficiency and economics of artificial rearing of salmon in the Sakhalins (Nekotorye Voprosy effektivnosti i ekonomiki iskusstvennogo razvedeniya lososei na Sakhaline.)

Lososevov Khozyaistvo Dal'nego Vostoka, E. N. Pavlovskii et al, editors, pp. 179-183. (Copy of translation available on loan from NMFS).

Problems concerning economies of scale and location of hatcheries in the Sakhalins are discussed. The size of the hatchery is limited by the availability of spawners and the water supply. An example is given involving the construction of 13 small hatcheries with a total capacity of 111 million eggs. To put most of the hatcheries into operation, roads, river crossings, and settlements with the necessities of life had to be constructed at a cost of about 20 million rubles.

Subject descriptors:

Salmon; hatcheries; economies of scale; location factors.

089

MacDonald, C. R.; Meade, T. L.; Gates, J. M.

1975

A production cost analysis of closed system culture of salmonids. Univ. R. I. Mar. Tech. Rep. 41, 11 pp.

This report considers systems design and operation, production processes, and costs for a model commercial salmon culturing operation with the capacity to produce about 1 million smolts at a cost of about 10 cents each, or \$0.97 to \$1.07 per pound. Two culture systems are involved, one for egg hatching and the growth of fingerlings, and the other for growth of fingerlings to smolts. The production cycle lasts 270 days. Costs, input usage and factor prices are carefully detailed and itemized in tables to allow updating and application to other circumstances.

Subject descriptors:

Salmon; closed system culture; costs.

090

Mahnken, Conrad V. M.; Novotny, Anthony J.; Joyner, Timothy.

1970.

Salmon mariculture potential assessed.

Amer. Fish Farmer World Aquacult. News 2(1): 12-15, and 27.

The authors discuss environment and facilities of the NMFS Aquacultural Experiment Station, Manchester, Wash., experimental stocks, feeding schedules, growth measurement, diseases and predators, and possible problems. Puget Sound tidal currents provide an almost continuous flow of water through floating enclosures, allowing a loading density of 1 pound of fish per cubic foot of water. One year of encouraging experimental work with this system and the years of work in developing a successful freshwater salmon hatchery system "provide the basis for an optimistic outlook for the future development of intensive, egg-to-market culture of Pacific salmon." Technical problems are indicated and judged solvable. The institutional problem of a prospective salmon farmer's acquiring land and water use rights is viewed as a possible barrier, unless zoning authorities accept

floating systems of fish culture as an appropriate use of inshore marine waters.

Subject descriptors:

Salmon; cage culture; general description; legal barriers.

091

Novotny, Anthony J.; Mahnken, Conrad V. W.
1971.

Farming Pacific salmon in the sea: from the "womb to the tomb."
Fish Farming Ind. 2(5): 6-9; 3(1): 19-21.

The authors report various aspects of a 2-year biological study on growing salmon in enclosed mesh cages, and indicate that the system should prove to be commercially feasible. Topics include the environment, feeds and feeding, fish transfer from freshwater to saltwater and related variations among species as to acclimation requirements, genetics and breeding work, survival rates in the system developed, diseases, and floating pen design (both nursery and growing pens). The purposes of the study were to determine coho salmon growth rates using specific dietary conditions and to determine problems with the system described. The study was made at the NMFS marine research station, Manchester, Wash.

Subject descriptors:

Salmon; cage culture; biology; experiment; biological feasibility.

092

Richards, Jack A.
1968.

An economic evaluation of Columbia River anadromous fish programs.

Ph. D. thesis, Oreg. State Univ., 274 pp.

Columbia River irrigation, flood control, navigation, and recreation are important, often complementary products with hydroelectric power, but dam and reservoir construction blocks the migration of the anadromous fish. Costs of passage way, hatchery, and related mitigating items are developed and discussed in this thesis. Owing to the lack of appropriate market prices as a basis of valuation, benefits of commercial (including Indian) and sport fishing are estimated according to specified methodology. Benefits and costs of the programs are compared. Benefits for commercially caught fish are estimated on the basis of the cost of regulated inefficiency. Benefits for sport caught fish are estimated using transfer costs as proxies. Conclusions are made concerning the economic justification of the program in the 1930's and in 1965.

Subject descriptors:

Salmon; hatcheries; benefit-cost analysis; method evaluation; production data; demand analysis; costs; government assistance; recreation demand; investment model.

093

Richards, Jack A.; Mahnken, Conrad V. M.; Tanoñaka, George K.
1972.

Evaluation of the commercial feasibility of salmon aquaculture in Puget Sound.

U.S. Dep. Commer., Natl. Mar. Fish. Serv., N.W. Fish. Cent., unpubl. prelim. analysis, 35 pp.

Topics include descriptions of biological and ecological systems, and analyses of production costs, marketing, and cost and returns for a salmon aquaculture operation the size and structure of Ocean Systems, Inc. (now Domsea) activity, which is based on R&D work by NMFS and partial funding by Sea Grant. Capital equipment initial costs, estimated lives, and amortized annual amounts are shown, along with operation and maintenance costs (for labor, eggs, utilities, maintenance, heated water, leasing, and permits), and finally total annual costs, by function (incubation, pond rearing, and pen rearing, then total) and cost item. Uncertainty ("risk") returns necessary to encourage investment are discussed as to causes, results, effects of reduction, and relation to limitations and restrictions of entry into aquaculture. Assuming the market would support prices sufficient to cover the opportunity costs of resources used, plus an initial return for risk, preliminary analysis suggests that salmon aquaculture is economically feasible, but there are some serious information gaps.

Subject descriptors:

Salmon; costs; returns; marketing; risks; investment model.

094

Roberts, Kenneth J.
1972.

Economics of hatchery salmon disposal in Oregon.

Oreg. State Univ., Mar. Advisory Progr., Sea Grant 17, 20 pp. The sale of salmon returned to hatcheries as opposed to the sale of commercial salmon in Oregon is discussed. The Fish Commission of Oregon (FCO) set up a grading system in 1971 to judge the quality of returned hatchery salmon. A grade of 1 is given those fish returned in good condition. No restrictions are put on their use. Grade 2 means that fish could be used for any purpose other than in the fresh or fresh frozen market. Grade 3 indicates that the fish is in poor condition and may be used for nonhuman consumption only. Hatchery sales from 1968 to 1971 were between 4.7% and 6.5% of commercial landings. A tabled comparison is given of utilization of surplus coho and chinook (as fresh market, canned, smoked or kippered, animal food, crab bait, rendered, or dumped). More salmon was used in the fresh market in 1970 (36%), but that figure declined to 19% in 1971. Oregon is a surplus producer of seafood. Data on markets are given for FCO hatchery sold salmon (1968-71) in Oregon, Washington, California, other States, and other countries. The conclusions include (1) due to the FCO grading system, the sale of poor quality returned salmon for human consumption has

decreased, (2) salmon sold from hatcheries have had only a minimal effect on the prices of commercial salmon because poundage of hatchery salmon used for human consumption has been less than 5% of commercial landings, and (3) the effect that the sale of poor quality salmon has on the fresh market has been eliminated.

Subject descriptors:

Salmon; hatcheries; markets.

095

Stevens, Joe B.; Mattox, Bruce W.

1973.

Augmentation of salmon stocks through artificial propagation: methods and implications.

Adam A. Sokoloski, editor, Ocean fishery management: discussions and research. U.S. Dep. Commer., Natl. Mar. Fish. Serv., NOAA Tech. Rep. Circ. 371, pp. 133-145.

The Pacific Coast has 81 hatcheries that rear significant numbers of salmon and steelhead for sport and commercial fisheries. Annual operation and maintenance costs are \$6.6 million. A production function analysis of 15 Oregon Fish Commission hatcheries led to tentative conclusions that (1) controlled inputs were combined in fixed proportions, (2) constant returns to size were realized, and (3) some degree of factor substitution existed between the controlled "fixed proportion input" and water temperature. The latter relationship may allow hatchery managers to improve efficiency at the hatchery level. Uncertainty about the downstream environment, however, must be considered along with returns to scale for the hatchery production function when new investments are undertaken. Fixed asset theory was used to conceptualize exit and entry of salmon-harvesting resources between 1947 and 1966. Net entry followed years of good catches, but net exit did not occur following the bad years. If a major objective of hatchery programs is to augment fishermen's incomes, consideration must be given to increasing the opportunity costs of extant resources as well as to limiting entry of new resources. (Modified authors' abstract).

Subject descriptors:

Salmon; hatcheries; costs; returns; economies of scale.

096

Wagner, Louis C.

1973.

An evaluation of the market for pan-sized salmon.

U.S. Dep. Commer., Natl. Mar. Fish. Serv., Market Res. Serv. Div., Res. Contract Rep. N208-0344-72N, 50 pp.

During mid-1972 the first cultured, pan-sized salmon were test marketed in several U.S. cities, mostly on the West Coast. Information was gathered on market acceptance via interviews of brokers, wholesalers, and restaurateurs. Reactions are summarized by product characteristics and by market area. The

producing units (Domsea, Lummi Indian Tribes, and Small Indian Tribes), methods, estimated harvest, and factors affecting market potential are also discussed. Restaurant reactions concerned ways of preparing, menu description, relative price, lunch vs. supper offerings, packaging, quality, size, color, boned vs. unboned forms, and popularity. Over two-thirds of the restaurants charged more for pan-sized salmon than other varieties of fish on the menu, but the product is discussed in terms of competition primarily with trout and fresh or frozen salmon items from larger fish. The pan-sized salmon was dressed, heads-on, eviscerated, glazed, and sized (6-8, 8-10, 10-12, or 12-14 ounces) by the producer (Domsea).

Subject descriptors:

Salmon; market; marketing.

097

Wahle, Roy J; Vreeland, Robert R.; Lander, Robert H.
1974.

Bioeconomic contribution of Columbia River hatchery coho salmon, 1965 and 1966 broods, to the Pacific salmon fisheries.

U.S. Dep. Commer., Natl. Mar. Fish. Serv., Fishery Bull. 72(1):
139-169.

Marked coho salmon, *Oncorhynchus kisutch*, smolts of the 1965 and 1966 broods were released from 20 hatcheries on four sections of the Columbia River and tributaries. Commercial and sport fisheries in marine waters from Pelican, Alaska, to Avila Beach, Calif., and on the Columbia River were sampled during 1967-69 for marks. The net value of the estimated total catch of hatchery fish was calculated after adjusting for the effects of marking. Also estimated for each brood were the total costs of rearing including amortized capital outlay. Total benefits of \$8.58 million for the 1965 brood and \$9.11 million for the 1966 brood were estimated as applicable to normal production years when no marking takes place. Corresponding costs were estimated as \$1.29 million for the 1965 brood and \$1.23 million for the 1966 brood. Estimated benefit/cost ratios for the 20 Columbia River coho salmon hatcheries, as operated under production regimes prevailing during the study, may prove useful in decisions affecting management policies. The ratios are 6.6/1 for the 1965 brood, 7.4/1 for the 1966 brood, and 7.0/1 for both broods combined. (Authors' abstract.)

Subject descriptors:

Salmon; hatcheries; benefit-cost analysis.

OYSTERS AND OTHER MOLLUSKS

098

Agnello, Richard J.; Donnelley, Lawrence P.
1975.

The interaction of economic, biological, and legal forces in the Middle Atlantic oyster industry.

U.S. Dep. Commer., Natl. Mar. Fish. Serv., Fishery Bull. 73(2): 256-261.

Economic, environmental, and legal forces are contributing factors in the decline of the Middle Atlantic oyster industry. This paper determines the interactions and importance of these forces by quantifying and integrating some of the relevant variables into a supply and demand model of the oyster industry. The statistical results yield significant and expected parameter values with useful information on price and income demand elasticities. Also implications of common property legal frameworks on resource utilization are revealed. The main conclusions are that efforts to rehabilitate the industry by cleaning up pollution, replacing cultch, and encouraging legal private property rights may have large social values. (Authors' abstract.)

Subject descriptors:

Oysters; supply; demand analysis; model.

099

Castagna, Mike.
1972.

Economic potential of clam operation and economic survey of scallop operation.

Va. Inst. Mar. Sci., unpubl. prelim. rep., 16 pp.

Preliminary information is provided on an experimental VIMS operation at Watchapreague, Va. Estimated capital costs, borrowing requirements, and 10-year flows of operating costs, revenues and cash are detailed. Some suggestions for reducing costs and improving profit performance are made. [For discussion of the biology, cultural techniques employed, and some aspects of the bay scallop's economic suitability for culture, see Michael Castagna, 1975, Culture of the bay scallop, *Argopecten irradians*, in Virginia. Mar. Fish. Rev. 37(1): 19-24.]

Subject descriptors:

Clams; scallops; costs; revenue; returns.

100

Cavanagh, Carroll.
1974.

Luck, management, laws result in Connecticut oyster 'boomlet'.

Natl. Fisherman, 54(12): 4-C.

For the first time in decades, a boat began buying oyster seed in the narrow lower estuary of the Housatonic River. The seed were harvested by boats with small hand-haul dredges. Outside of the

mouth of the river lies the virtually unused, but historically important, public-ground Bridgeport Natural-Bed (4,800 acres). Laws, changed to allow dredging instead of hand tonging (1968); shell spreading, lifting, and desilting; predator control in the seeding area; grower association expansion; leasing of recently unused grounds; widespread and intense spat set in summer 1973 and other factors suggest a possible industry regrowth. Some data are given on such items as catch, yield, and spat-per bushel.

Subject descriptors:

Oysters; problems; general description; legal barriers.

101

Charbonneau, Joseph John.

1974.

A spatial analysis of selected impacts on the South Atlantic oyster processing industry.

Ph.D. Thesis, Univ. Md., 92 pp.

While the "primary objective of this study is to determine the regional impacts of a shift in the processing cost structure" associated with both pollution abatement and introduction of an automatic shucking machine, some of the results may be of use in evaluations of oyster aquaculture. A simultaneous equations approach was used to estimate supply and demand functions. Income elasticities of demand were in the range -0.297 to $+0.389$, and were based upon three procedures and 1969 cross-section household survey data for nine regions of the country.

Subject descriptors:

Oysters; supply; demand analysis; model.

102

Costello, Frederick A.; Marsh, Brent L.

1972.

Systems engineering of oyster production.

Univ. Del., Coll. Mar. Studies, Dep. Mech. Aero. Eng., Pub. no. 2EN066, Sea Grant GH-109, Rep. no. DEL-SG-5-72, 55 pp.

An interim report describing briefly some aspects of the methodological approach used to optimize a system with stochastic properties, unknown distribution functions, large numbers of variables and equations, and other problems. The application discussed is to algae production which is a subsystem process that is part of the larger system, production of oysters in a closed environment. Algae production costs for a cost-optimized American Cyanamid originated process are shown; they form the baseline for sensitivity analysis. The results of the sensitivity analysis that are shown are based on changing certain stochastic variables 10% and 20% from their nominal values. Those variables requiring further study are identified in terms of their frequency-distribution deviation values (investment or initial cost deviation values and amortized annual equivalent cost deviation values). The discussion is technical in setting,

and 45 of the 55 pages of the report contain computer program listings and printouts, but the report does not contain a program documentation (flow diagrams, user guides, term definitions, etc.).

Subject descriptors:

Oysters; closed system culture; systems analysis; sensitivity analysis; costs; experiment.

103

Gibson, Gary G.; Lund, Dennis S.

1973.

A pilot economic study of oyster raft culture in Yaquina Bay, Oregon.

Abstract only is in Proc. Natl. Shellfish Assoc. Convention, 1972, vol. 73, p. 7. (Authors are with Fish Comm. Oreg. and Newport Oyster Co., Newport, Oreg.)

Based on recorded costs for a single raft (12 ft by 20 ft), adjustment of capital costs for larger scale operation (addition of costs for concrete anchors, piling, boom logs and harvesting equipment), and adjustment in the number of 6 ft strings of suspended Japanese oyster seed, gross revenue of \$3.33, costs of \$1.37 and net return of \$1.96 per string were estimated. A price of \$20 per bu (in-shell, cocktail-sized oysters, 100 meats per pint) and 206 strings per raft were assumed.

Subject descriptors:

Oysters; revenue; costs; returns; raft culture.

104

Gunter, Gordon; Demoran, William J.

1971.

Mississippi oyster culture.

Amer. Fish Farmer World Aquacult. News 2(5): 8-12.

Oyster species, behavior, feeding, shell deposits, commercial production, human food nutritional qualities, and cultural methods are described. Leased beds are employed in Virginia and Louisiana, but not Mississippi and Texas, for example. An agency of Mississippi State can open and close oyster reefs, plant shells or seed, move oysters for purposes of depurification, and administer culling and harvest restrictions. The agency is credited with a fivefold increase in oyster output in 20 years, but its efforts are limited by funding, which is dependent on a severance tax. Data for 1960 to 1970 are given on amounts of shell and seed planted, and oysters moved for depurification.

Subject descriptors:

Oysters; government assistance; public grounds; industry development.

105

Hidu, Herbert.

1969.

The feasibility of oyster hatcheries in the Delaware-Chesapeake Bay region.

Kent S. Price, Jr., and Don L. Maurer, editors, Proceedings, Conference on Artificial Propagation of Commercially Valuable Shellfish, Oysters, Oct. 22-23, 1969, Univ. Del., Coll. Mar. Studies, pp. 111-131.

Feasibility is examined from the biological, economic, and socio-political viewpoints. The emphasis is on research progress on the biological systems in a hatchery (conditioning and spawning, larval rearing, and spat rearing) and on experimental progress on biological hatchery production costs. Some paradoxes are raised. The region provides an excellent growth medium, but natural seed has sometimes not been fully utilized. Private growers and public-agency buyers who were questioned indicated unwillingness to pay more than the price of natural seed, with some oyster grounds going unworked for lack of seed. Since the estimated cost of hatchery seed is 3 to 7 times the price of natural seed, hope for its use is seen only via further research and experimental work to reduce production costs. Socio-political factors affecting possible use of hatchery seed are discussed briefly.

Subject descriptors:

Oysters; hatcheries; R&D role; problems.

106

MacKenzie, Clyde L., Jr.

1970.

Oyster culture modernization in Long Island Sound.

Amer. Fish Farmer World Aquacult. News 1(6): 7-10.

Increased oyster seed productivity in Long Island Sound is discussed. This is the result of improved equipment, control of major causes of mortality, better preparation of oyster-setting beds, and production of oyster seed from hatcheries. Techniques of seeding beds, controlling predators (common starfish and boring snail), and controlling suffocation by silt are explained. Yields obtained by oyster companies today have increased from about 1 to 10 or more bushels of oysters from 1 bushel of young seed oysters. Greater production of better quality oysters is forecasted.

Subject Descriptors:

Oysters; ground culture; biology; general description; government assistance.

107

MacKenzie, Clyde L., Jr.

1970.

Oyster culture in Long Island Sound, 1966-1969.

Commer. Fish. Rev. 32(1): 27-40.

Topics discussed include oyster culture practices, problems, BCF (now NMFS) activity, practice-improving effects on yield, seeding, equipment and other factor-use, and some cost information. Seed shortages were traced to lack of property (lease) rights on public beds and to improper seed bed preparation on private (leased) beds. Predators must be removed, and clean shell spread only when larvae abundance is high. Cultural practices for growth from seed to market size include predator and competitor removal, seed planting, annual thinning and transplanting (3-4 times), and harvesting (4- to 5-year old oysters, at which time costs are estimated at \$2.50 per bushel, including \$1.25 for culling). Equipment and improvements, causes of oyster mortality, and remaining problems (i.e., as determined in the BCF project, but requiring further work to solve) are discussed.

Subject descriptors:

Oysters; problems; biology; private grounds; government assistance; costs.

108

Marsh, B. L.; Morrison, A. W.; Costello, F. A.

1972.

Systems engineering of oyster production.

Univ. Del., Mech. Aero. Eng. Dep., Sea Grant 2-35223, 21 pp.

Results of systems engineering analysis are discussed in terms of cost reduction effects for a synthetic closed-environment oyster culture system originally designed by American Cyanamid (1968). Given certain assumptions (e.g., 15-year, 8% amortization; 100,000-bushel annual output; 70 degrees F. water temperature), costs are itemized. Per bushel costs are estimated as: \$64, without water recycling; \$49, with 85% recycling; \$22, with an optimized system and available technology; and as low as \$13, with a modest research program, a cost said to be competitive with costs of cultured, natural environment oysters for the half-shell trade. Specified research projects are evaluated in terms of expected return (cost reduction multiplied by probability of project success).

Subject descriptors:

Oysters; closed system culture; systems analysis; R&D role; costs.

109

Marsh, Brent Luther.

1973.

Techniques for design of large-scale systems.

Ph. D. thesis, Univ. Del., Dep. Mech. Aero. Eng, 223 pp.

The primary concern is the presentation of methods developed to optimize large systems with stochastic properties, to select from among the many large-system variables the ones requiring design work and optimization, and to do this selection using computer language notation. Application is to a hypothetical, closed-environment oyster production system with output of 100,000 bushels annually, and average cost is reduced from about \$49 to \$22 per bushel. Three kinds of uncertainty are considered, namely in design variables, parameters, and functional relationships. Sensitivity analysis is used to isolate aspects of the system requiring design work, given some reasonable base design, and the least sensitive variables or aspects of the system are then "fixed," allowing design work to be concentrated on the smaller "dominant problem" (p. 90). The often obscure nature of computer-language equations is overcome by the use of a print-out matrix (rows represent equations; columns, variables).

Subject descriptors:

Oysters; closed system culture; systems analysis; costs.

110

Mason, J.

1972.

Mollusc culture in Scotland.

World Fish. 21 (9): 42-44.

Extensive beds of oysters once existed in Scottish waters, but they have diminished for several reasons. Because of market demand, new methods are being developed to culture both oysters and mussels. Rather than the native oyster *Ostrea edulis*, *Crassostrea gigas* is being emphasized, with output of 1 million seed oysters per month. Cultural techniques have been adapted from those used in other countries for mussels, and the difficulty of rearing natural larvae means that dependence is placed on natural spat fall. (Based on ASFA abstract.)

Subject descriptors:

Scotland; oysters; mussels; general description.

111

Matthiessen, George C.

1970.

A review of oyster culture and the oyster industry in North America.

Woods Hole Oceanogr. Inst., Contrib. No. 2528, 52 pp.

The conclusion section reviews several factors which account for past and prospective progressive development of oyster culture. The report has sections on eight geographical areas of the North American continent. Each section discusses species grown,

production practices, oyster ground control and rights (public vs. private grounds), prices, problems, economic incentives, industry organization, research, government involvement and assistance, and the use or potential use of certain cultural methods (e.g., hatcheries, raft culture, pond culture, selective breeding, and closed-environment culture). The factors accounting for progressive development are high market demand, legislation favorable to leasing of oyster grounds, willingness and ability to invest in research, and maintenance of water quality favorable to oyster culture.

Subject descriptors:

Oysters; biology; R&D role markets; demand; legal barriers; development; general description.

112

Matthiessen, G. C.; Toner, R. C.

1966.

Possible methods of improving the shellfish industry of Martha's Vineyard, Duke's County, Massachusetts.

Edgartown, Mass., Mar. Res. Found., 138 pp. (Obtain from NTIS, PB 173 095.)

While not the primary focus of this report, the last part of the report (pp. 110-131) includes recommendations, estimated capital and operating costs for an oyster hatchery, other cost information, computational and other assumptions, institutional and other constraints affecting the potential expansion of the Duke's County mollusk industry, and an effort to assess return on investment for an oyster hatchery.

Subject descriptors:

Mollusks; oysters; bay scallops; hard clams (quahog clams); soft shell clam; biology; hatcheries; biological feasibility; experiment; development rationale; institutions; constraints; method comparison; costs.

113

Menzel, Winston.

1971.

The mariculture potential of clam farming.

Amer. Fish Farmer World Aquacult. News 2 (8): 8-14.

Quahog clam (genus Mercenaria) behavior, biology, suitability for culture, problems, experimental results and recommendations are discussed. While predators and labor costs, especially in the nursery or hatchery stage, pose problems, estimated gross revenue would seem to suggest as good a return as for other animal species being considered for culture, judging by preliminary experimental data.

Subject descriptors:

Clams; biology; experiment; outlook.

114

Morse, N. H.

1971.

An economic study of the oyster fishery of the Maritime Provinces.

Fish. Res. Board Can., Bull. 175, 81 pp.

The fishery is characterized by low productivity, low investment per firm (low capital to labor ratio), slow adoption of mechanized harvesting technology and certain other problems, but the most critical problem relates to the economic provision and use of seed oysters, such as via hatcheries. The industry's development and institutional setting is analyzed. Policy options appear to lie between "support of numerous small oyster producers and opening the oyster areas to the highest bidders who probably would develop the largest and strongest industry with the minimum of public assistance." Some cost estimates are presented. Based upon a 1966 survey, output (both market and seed oysters), number of enterprises, number of leasehold enterprises, investment, net income and other information is provided. While there is some analysis of supply and demand, lack "of adequate quantitative data has made it impossible to arrive at answers to many relevant questions."

Subject descriptors:

Oysters; Canada; costs; survey data.

115

Pesson, L. L.

1974.

The coastal fisherman of Louisiana: their characteristics, attitudes, practices, and responsiveness to change.

LSU, Cent. Agri. Sci. Rural Dev., Coop. Ext. Serv., Sea Grant 04-3-1518-19, 60 pp.

There were 16 oyster farmers in the stratified random sample of 500 (7% sample) Louisiana coastal parish fishermen. The 467 usable schedules were obtained in August 1972 to April 1973. The report's eight sections deal with respondent characteristics; fishing operations; opinions, attitudes, and problems; knowledge of and contact with Cooperative Extension; usage, opinion, and source of new ideas; leadership and participation patterns; shrimping practices, and other fishing practices. By comparison, oysterers have large operations (p. 54). Sample percentage distribution data are given for method (75%, dredges), type and size of boat, number of crew, acreage cultivated (under 200 acres, 38%; 200-400 acres, 24%; over 400 acres, 38%), acreage planted in past year, problems, harvest last year, and time commitment (73%, part-time). Generally, coastal fishermen tend to be middle-aged, have a low level of education, live in a rural area, value self-reliance, and have a pattern of change indicating normal adoptive behavior.

Subject descriptors:

Oysters; socio-economic data; survey data; techniques.

116

Quayle, D. B.
1969.

Pacific oyster culture in British Columbia.

Fish. Res. Board Can., Bull. 169, 192 pp.

While the primary concerns of this report relate to the biology and cultural techniques for oysters, information of interest in economic evaluations is included, such as historical quantity and value data (oysters, from 1884; Pacific oysters and seed imports, for more recent years only), estimated ground (1969) and raft (1953) culture costs, and a discussion of marketing, products, processing and institutional factors. Problems include pollution and growth-related encroachments into traditional (more productive) grounds.

Subject descriptors:

Biology; general description; costs; problems.

117

Rockwood, Charles E.
1973.

A management program for the oyster resource in Apalachicola Bay, Florida.

Fla. State Univ., Tallahassee, Fla., 350 pp.

This report recommends a management program for the oyster resource in Apalachicola Bay to improve efficiency, enhance the oyster output potential, and improve marketing for the product. Franklin County (which borders on the Bay) is profiled as to social and economic indicators of its economic growth or nongrowth. The scope and size of the oyster industry is also discussed. Several tables of employment and oyster data are presented. Price data, demand, supply, investment, and value added in the oyster industry are discussed. Conclusions as to the status of these factors in the economic development of Franklin County are made.

Subject descriptors:

Oyster; costs; demand analysis; marketing; methods.

118

Shaw, William N.
1971.

Oyster culture research--off-bottom growing techniques.

Amer. Fish Farmer World Aquacult. News 2 (9): 16-19 and 21.

An off-bottom oyster culture project undertaken by the Natl. Mar. Fish. Serv. in 1968, is discussed. Three methods (longline, rigid structure, and raft) were tested. In November, 1969, growth and meat quality were compared for the three methods. Very little difference was found. The two largest companies using off-bottom methods are in California. They produce about 30,000 gallons of oyster meats annually.

Subject descriptors:

Oysters; method comparison; general description.

119
Tarr, Marvin A.; Carr, Mark I; Westley, Ronald E.
1971.

Biological evaluation of floating oyster culture (Section B), and Economic evaluation of the floating oyster culture (Section C) of final report of investigations for the Lummi Aquaculture Project. Wash. State Dep. Fish., Manage. Res. Div., 20 pp.
Biology: Using facilities of the Western Oyster Company, floating and bottom culture methods were compared during the period November 1970 to September 1971. Study methodology, limitations, and results are given. Raft culture was found superior to ground culture, except for fouling.

Economics: Raft culture costs (for Western Oyster Company) are compared to bottom culture costs for Puget Sound, Grays Harbor, and Willapa Bay for 1971 (questionnaires and interviews, data for 50% of Washington Pacific oyster, *Crassostrea gigas*, production). Raft-cultured oysters were harvested after 1 year on the raft (16-20 per half pint), and ground-culture oysters, at 3 years (medium oysters, 8-10 per pint). Costs per gallon of oyster meat for the two methods are itemized to include seed, planting and culture, and harvesting.

Subject descriptors:

Oysters; raft culture; ground culture; method comparison; costs; returns; survey data; biology.

120
Vaughn, Charles L.
1973.

National survey of the oyster industry's problems.

Natl. Mar. Fish. Serv., Market Res. Serv. Div., Contract Rep. N-043-41-72, 92 pp.

Based upon NMFS processing-firm population data, oyster processing firms were stratified on the basis of location (East, Gulf, and Pacific Coasts) and dollar volume of oyster product sales (less than \$0.1, \$0.1 to 0.5 and over \$0.5, in millions) in 1970. Of 523 firms, 192 were sampled. The 1972-73 survey employed mail questionnaires and nonrespondent interviews. It was intended to ascertain and rank specific industry problems. The survey results are summarized in discussion and detailed tables. Topics include: attitude about future business prospects, problems, market outlets, capital expenditure plans, role of the Shellfish Institute of North America, product forms, areas of the business with greatest future, and employment. The tables employ frequency distributions, U.S., by size of firm and by region. The firms buy oysters, shuck, and sell oyster products, mostly fresh. Sales concentration is apparent. Supply problems, relating to pollution mainly, and production problems, relating especially to shortages of qualified labor, are among the leading difficulties. Aquaculture of seed and market-size (processor-input size) oysters ranks fairly low among "aspects of the oyster business with greatest future," and "finished

convenience items" leads, followed by the shelling and shucking of oysters (raw). The survey results differ somewhat by size of firm and by region.

Subject descriptors:

Oysters; survey data; markets; prospectus factors; problems.

SHRIMP AND OTHER CRUSTACEANS

121

Anderson, Lee G.; Tabb, Durban C.

1971.

Some economic aspects of pink shrimp farming in Florida.

Proc., Gulf Caribb. Fish. Inst., 23d Annu. Sess., Nov. 11, 1970, pp. 113-124.

Using estimated cost data, specified assumptions, three sizes of farms (100, 500, and 1000 acres), two kinds of output (bait and food shrimp), six prices of land (\$250 to \$15,000 per acre) and other information, the authors compute and show internal rates of return (IRR), along with tables of net cash flows (and computational components, namely capital and operating costs with some detail, and gross revenue) for 16-year hypothetical operating periods. Economies of scale are apparent. Labor is a significant cost. Only two of the six operations proved profitable, given the land prices and crop prices assumed. With higher food shrimp prices (72 cents per pound assumed for 36-count shrimp) the situation might be less pessimistic. However, increasing the number of crops from one to three (110-count instead of 36-count shrimp) did not improve profits. Market price effects are discussed and would be significant for a large (1,000-acre) bait-shrimp farm. [Annotator's note: for partially revised investment data, see Lee G. Anderson, 1973, An economist looks at mariculture, ..., Mar. Tech. Soc. J. 7(3): 9-15.]

Subject descriptors:

Shrimp; investment model; economic feasibility; revenue; costs; returns; sensitivity analysis; demand analysis; markets; outlook.

122

Anonymous.

1972.

Marifarms Incorporated.

Estabrook and Co., Faherty and Swartwood Inc., 40 pp.

This prospectus contains information typically provided to investors and stockholders, such as descriptions, operations, balance sheet, income statement, risk factors, and information on stocks, and legal and other matters. "The Company is developing the business at its facilities located on 2,500 acres of bay near Panama City, Florida. The business consists of the location and

collection of gravid mother shrimp, the hatching of young shrimp from eggs spawned by the mother shrimp (using Japanese-derived hatching techniques), the cultivation of the hatched shrimp in open water through the Company's proprietary technology and the harvesting and sale of the cultivated shrimp."

Subject descriptors:

Shrimp; investment; techniques; R&D role; markets; outlook; general description; financing.

123

Avault, James W., Jr.

1972.

Crayfish farming in the United States.

Paper presented at the First International Symposium on Freshwater Crayfish, Sept. 12 to 15, 1972, Hinterthal, Salzburger Land, Austria. La. State Univ., Cent. Wetland Resour., Sea Grant Preprint No. 897, 23 pp.

Topics include species, biology, farming, and other items. The industry is primarily centered in Louisiana, with live-weight output of over 10 million pounds annually, valued at \$5 million. Until recently this came mostly from wild stocks. Rice-field ponds, wooded ponds, and open ponds are used in farming, and cultural practices are essentially similar. The crop is harvested about 1 year after the brood fish are stocked, and lift nets and funnel traps of chicken wire are used, as for the wild harvest. Professional crayfishermen are employed by farmers for harvesting with compensation of half the value of the live crayfish at the market. Productivity ranges generally from 200 to 800 pounds per acre. Early season farm-raised crayfish bring over 60 cents per pound, but the price declines as the wild crop enters the market, and price averages about 25 cents per pound. At 15 cents per pound, the crayfishermen find it is not worth their while to continue trapping. Pond acreage is increasing in Louisiana. There were 12,000 acres in 1969, 25,000 in 1970, and 40,000 in 1971.

Subject descriptors:

Crayfish; crawfish; development; prices; techniques; biology; outlook.

124

Avault, James W., Jr.; de la Bretonne, Larry W., Jr.; Jaspers, Edmonde J.

1970.

Culture of the crawfish, Louisiana's crustacean king.

Amer. Fish Farmer World Aquacult. News 1(10): 8-14, 27.

Crawfish (crayfish) biology, behavior, production, cultural techniques, market potential for food and bait ("soft craws"), and studies are discussed. Crawfish are being reared in three types of ponds: rice ponds, wooded ponds, and open ponds. Cultural practices are essentially similar in all ponds. Yields range from about 200 to 800 pounds per acre generally. Louisiana

crawfish pond acreage was 12,000 acres in 1969 and perhaps 25,000 acres in 1970. Live-market prices average about 25 cents per pound for the season, but early-crop farm-raised crawfish bring 60 cents per pound. The price declines if the cyclical (among years) wild crop enters the market in sufficient amount. Harvesting is by lift net and funnel traps of chicken wire, and farmers hire professional crawfishermen who operate 5 to 10 traps per acre and receive one-half of the live-market crawfish price for harvesting. No food is used. Trapping rights are leased. Capital requirements are relatively small compared to catfish, and returns to land, family labor, and management range from \$50 to \$100 per acre. Results of studies on mineral requirements (soil and water hardness effects) and brackish water culture are reported. Work is mentioned relating to feeding, possible meal use of crawfish waste (85% of the crawfish), crawfish peeler equipment, and crawfish as aquatic weed control agents.

Subject descriptors:

Crawfish; crayfish; development; prices; techniques; returns; markets; research.

125

Carroll, James C.; Blades, Holland C., Jr.
1974.

A quantitative analysis of the amounts of South Louisiana crawfish that move to market through selected channels of distribution.

Univ. Southwestern La., Dep. Mark., Res. Series 35, 32 pp.

Results of a 1974 survey of South Louisiana processors, seafood markets and restaurants selling crawfish items are reported. Processor volume and value of sales, distribution channels, and the ranking of various crawfish entrees served in restaurants are indicated. While the marketing channel processor to seafood market to consumer accounted for the largest percentage of processor shipments, and while 65% of the volume (62% of the value) of processor shipments consist of live crawfish, it is concluded that since "non-natives of South Louisiana are not knowledgeable concerning methods of preparing crawfish entrees at home, ... peeled crawfish tails could be more successfully marketed to restaurants in out-of-state locations than to seafood markets."

Subject descriptors:

Crawfish; crayfish; markets; marketing.

126

Franz, Robert S.
1974.

An investigation of the potential for expansion of the supply of South Louisiana crawfish and crawfish processing facilities.

Univ. SW. La., Dep. Mark., Res. Ser. 34, 20 pp.

Results of a 1974 survey of South Louisiana crawfish processors are reported. Processors handled about 14.5 million pounds

live-weight basis) of crawfish in the 1973-74 season. Prices paid and received, processor activity, utilization of capacity, expansion interest and other survey results are discussed. Ponds accounted for about one-third of their purchases. While 42,000 acres of ponds were farmed, it is estimated that 100,000 acres could be, and that with potential yields obtained in the survey, good management and optimum conditions, ponds alone could supply some 100 million pounds.

Subject descriptors:

Crawfish; crayfish; survey data; productivity; processing; prices.

127

Fujimura, Takuji.

1972.

Development of prawn culture industry.

Proceedings, Kauai Aquaculture Conference, Hawaii Dep. Planning Econ. and Kauai County Off. of Econ. Dev., pp. 5-13.

During 5 years of research effort, costs of producing stockable size juveniles (about 1 cm in average length) were reduced from \$6.63 to \$1.93 per 1,000, not counting fixed costs. Also, a practical mass culturing technique was developed and a breeding stock was established to supply commercial needs. Topics include rearing trials and problems; growth rates; feeding, culling, cover-plant, and harvesting practices; yield, feed, survival, timing, and other data. Small (0.20 to 0.36 ha) ponds with mud or earth bottoms were used for rearing, and yields reached 3,820 kg/ha or 3378 lb/acre annually. The conversion ratios of weight of feed to weight of prawn were in the 3.3 to 3.4/1 range; feed consisted of chicken feed and fresh whole fish, and other feeds on an experimental basis.

Subject descriptors:

Prawns; techniques; biology; experiment; costs; research; biological feasibility; development.

128

Garino, David P.

1972.

Commodities-shrimp farming attracts new interest as demand outpaces supply, lifts prices.

Wall St. J., April 3, 1972, p. 18.

Because of the relatively faster growth in demand compared to supply, shrimp prices are increasing, and some researchers expressed the hope that the fledgling shrimp farming industry may someday slow the rate of price increase. Interest and activity of several large companies are indicated (e.g., Dow Chemical, Ralston Purina, and San Diego Gas & Electric, as well as Marifarms), but some companies (e.g., Greyhound's Armour & Co. subsidiary) withdrew as costs mounted. Some of the formidable obstacles to profitable operation and industry success are mentioned, such as shrimp survival, cultural methods generally, feeding, R&D, proper scale of operation, and water temperature

regulation. The views and opinions of industry and university people who were interviewed indicate that a profitable industry may be operational in say 10 years, that some of the obstacles are being overcome, or at least being attacked, and that even now, "barring a disaster, shrimp farming can be marginally successful."

Subject descriptors:

Shrimp; problems; R&D role; outlook.

129

Gary, Don I.

1974.

The commercial crawfish industry of South Louisiana.

La. State Univ., Cent. Wetland Resour., LSU-SG 74-01, 59 pp.

This report is an abridged version of a thesis submitted to Oregon State Univ., 1973, entitled "A geographic systems analysis of the commercial crawfish industry in South Louisiana." Topics include history of crawfishing, biology, cultural techniques, and various factors affecting processing plants and ponds, and their location. Information is provided on the number, type, and location of ponds, including frequency distribution graphs on the number of ponds by size and type (open, swamp, and rice-field ponds). Estimated acreage of commercially managed ponds is shown for selected years; and it grew from 40 acres in 1949 to 44,000 acres in 1973, but growth is expected to taper off. The 33 studied processing plants have annual input of live crawfish ranging from 2,000 to 450,000 pounds, and 57% of these plants are owned along with a complementary restaurant, grocery store, or fish market outlet. A consensus is that 50-acre ponds maximize returns on investment. Both total and per-acre estimated revenue, cost, and returns are shown for a hypothetical 50-acre pond operation.

Subject descriptors:

Crawfish; crayfish; acreage data; history; development; R&D role; pond culture; techniques; revenue; costs; returns; processing; outlook.

130

Helfrich, Philip.

1973.

The feasibility of brine shrimp production on Christmas Island.

Univ. Hawaii, Sea Grant Progr., Sea Grant Tech. Rep., UNIHI-SEAGRANT-TR-73-02, 173 pp.

Discussed is a scheme to culture brine shrimp on Christmas Island, the largest of the Line Islands, 1,100 miles due south of Maui Island in the Hawaiian Archipelago. Details on the island's location, weather, government, and history are given along with details on geology, physiography, lake circulation, and biology of the brine shrimp. The market potential for cultured brine shrimp is discussed. Aquarium hobbyists and consumers of the shrimp as a food source create the market. Estimated annual

sales of brine shrimp eggs in the United States, Europe, and Japan are greater than 14,000 gallons. The present U.S. retail price is \$50 per gallon. The wholesale price is \$25 per gallon. A pesticide-free egg would allow the food market to expand and lower the costs. Two plans, A and B, are discussed in terms of output, costs, and receipts throughout a 4-year period, including construction costs. Under plan A, tabled data shows expenditures of \$0.7 million and receipts of \$1.05 million. Plan B has total expenditures of \$1.2 million and receipts of \$1.75 million. Other tables itemize numerous other input and output items. Frozen brine shrimp is predicted to cost 17.5 cents per pound for processing, but to command a wholesale price of 30 to 35 cents per pound. With production at 1,000 pounds per day, the projected margin would total \$125 to \$175. Christmas Island's facilities such as labor force, ports, electrical power, fuel, and freshwater supply are also discussed.

Subject descriptors:

Shrimp; Hawaii; biology; biological feasibility; revenue; costs; returns; economic feasibility.

131

Jhingran, V. G.; Gopalakrishnan, V.

1973.

Prospects for the development of brackishwater fish and shrimp culture in India.

J. Fish. Res. Bd. Can., 30(12, part 2): 2341-2343.

Topics include: estimated actual and potential area, methods, experimental yields, research progress, estimated potential costs and returns, and development recommendations. Some 10,000 ha of brackish water area were used for fish and shrimp "trap and grow" culture in 1968 (perhaps 15,200 ha by 1973). Tidal water enters open sluices of embanked ponds, sluice gates are closed, the fish and shrimp grow for some months, and they are harvested. Yields average 200 kg/ha/year (range 100-1,000). Based on improved technology (used in experimental and pilot farm operations), estimated costs and returns for a 10 to 20 ha suggested (hypothetical) farm operation are given on a per-hectare basis. Assumed yield is 1,500 kg/ha/year of unspecified species. Experimental work mentioned relates to prawn (*Penaeus monodon*), mullet (*Mugil parsia*) and bhekti (*Lates calcarifer*).

Subject descriptors:

Shrimp; India; biology; revenue; costs; returns; experiment; development; techniques; research.

132

Johnston, W. E.; Allen, P. G.

1974.

Technology assessment and the direction of future research: use of computerized budgeting for lobster aquaculture.

Paper presented at annual meeting of the American Agricultural Economics Association, Aug. 1974, College Station, Texas, 28 pp.

In multidisciplinary research endeavors, objectives may be clearly defined but central evaluation lacking. Additionally, where models cannot be well specified, simulation techniques are unusable. For research directed towards commercial lobster aquaculture, the application of computerized budgeting in evaluating state-of-the-arts and in assessing alternative research strategies is illustrated. (Authors' abstract; more recent results of this research are annotated under Schuur and others.)

Subject descriptors:

Lobsters; systems analysis; engineering design; costs.

133

Kensler, Craig B.

1970.

The potential of lobster culture.

Amer. Fish Farmer World Aquacult. News (11): 8-12, 27.

The author discusses past and present work with lobster culture, biological criteria, culture suitability, and problems of the lobster. The development rationale is expressed in terms of mentioning world supply-demand and price situations for this luxury-food crustacean. Hatchery efforts to augment natural stocks began in Europe in 1865 and in North America in 1885, but their effectiveness and feasibility was never established. The "golden age" of lobster culture saw as many as 20 North American stations involved, of which only 1 remained in 1950. Recent price advances and general improvements in aquaculture technology help explain the present rationale for four major and other efforts to develop the state of the art of lobster culture. Biological problems include the lobster's natural environment, temperature-related slow growth, cannibalism, territorial behavior, and possible high mortality in a culture environment, due to diet, disease, molting, cannibalism, or other factors.

Subject descriptors:

Lobsters; biology research; history; state of the art; R&D role.

134

Mock, C. R.

1973.

Shrimp culture in Japan.

Mar. Fish. Rev., 35(3,4): 71-74.

In this extract of a longer paper, growing procedures, research, production data, and some economic forces are discussed. Live shrimp are used in preparing meals in tempura fashion, helping to explain high 1971 prices for "Kuruma-Ebi" (*Penaeus japonicus*) shrimp. (Annotator's note: "Kuruma" prawn prices in 1965 to 1970 were 6 to 10 times the price for other prawns and shrimp in Japan.) "Kuruma-Ebi" cultured output doubled from 1964-65 to 1967-69, but was less than 1 percent of utilization in all years; natural harvest declined, but was still about five times larger in 1969; imports dominate utilization. It is not economical to

completely culture these shrimp and egg-bearing females are purchased from commercial fishermen. Increased feed costs and wages, and disease problems led to increased research.

Subject descriptors:

Shrimp; Japan; biology; research; techniques; production data; import data; general description.

135

Neal, Richard A.

1973.

Progress toward farming shrimp in the United States.

Mar. Fish. Rev., 35 (3,4): 67-70.

While no commercially viable U.S. shrimp farms exist today, growing demand and increasing prices, shrimp hatchery and farm trial efforts by private firms, government and university research on rearing methods, and various aspects of biology, physiology, and nutrition all suggest that methods may be sufficiently improved and costs sufficiently reduced to allow operation of a profitable U.S. shrimp farming industry sometime in the future. The proprietary nature of private firms' data and the experimental nature of government-university data preclude accurate cost estimates for commercial scale operations for publication. Yet, the experimental work does provide the basis for quantifying some aspects of production, such as the output effects of fertilizer, feed and water exchange, and the growth-rate declines as shrimp reach 3 to 5 inches in size. Price alone would suggest growing shrimp beyond the 3- to 5-inch size (at which size the bait shrimp price exceeds the food shrimp price), since food shrimp prices increase faster than size as size increases. But mortality, labor, feed, and facility-opportunity costs of the farm operation must also be considered. The article also discusses high mortality, inefficient feed use, other problems, and problem-oriented research.

Subject descriptors:

Shrimp; biology; techniques; research; problems; outlook.

136

Schuur, A.M.; Allen, P. G.; Botsford, L. M.

1974.

An analysis of three facilities for the commercial production of *Homarus Americanus*.

Paper (number 74-5517) presented to the American Society of Agricultural Engineers, Dec. 10-13, 1974, Conrad Hilton, Chicago, Ill., 19 pp.

Biological, physical and engineering aspects of lobster aquaculture are integrated via a flexible computer program. Variations in cost components of three design concepts--stacked trays, raceway, and silo--suggest that evaluation must be within a systems context. Under baseline assumptions the stacked tank proved least expensive (\$3.60 per 500g). The program contains

120 variables, most of which are assumptions that can be changed. Itemized costs are shown for the three design concepts for both 24 and 30 month growth periods.

Subject descriptors:

Lobsters; systems analysis; engineering design; costs.

137

Shang, Yung Cheng.

1972.

Some economic aspects of fresh water prawn farming in Hawaii. Proc., Kauai Aquaculture Conference, Lihue, Kauai, June 25, 1972. Hawaii Dep. Plan. Econ. Dev., and Kauai County Off. Econ. Dev., pp. 14-16.

Some information is given. (For a more complete presentation see Yung Cheng Shang, Economic Feasibility of Fresh Water Prawn Farming in Hawaii.)

Subject descriptors:

Prawns; revenue; costs; returns; investment model; economies of scale; markets; sensitivity analysis; general description.

138

Shang, Yung Cheng.

1972.

Economic feasibility of fresh water prawn farming in Hawaii.

Univ. Hawaii, Econ. Res. Cent., 49 pp.

The investment criteria of positive net present value (NPV) and break-even price in excess of expected price are explained and used. Cost estimates are based on actual hatchery data and preliminary prawn farm data. Sensitivity analysis is employed to show the effect of changes in several variables: (1) for the hatchery, three output levels, five discount rates, and two water costs (associated with the use of domestic water and well water); and (2) for the prawn farm, two yield levels, four farm sizes, five discount rates, and three prices. Economies of scale occur in the hatchery with respect to labor and other input costs and in prawn farming with respect to management, labor, feed, and other input costs. That is, according to the estimated cost data, the costs of various factors of production change in different percentages as output increases. Available information suggests that the market would be local (Hawaiian), although the potential on the U.S. mainland and Japan are discussed. While the product can be taste-test distinguished, it would likely compete with 10- to 15-count shrimp (count referring to the number of heads-off shrimp per pound), and it would be a luxury item purchased mainly by hotels and restaurants.

Subject descriptors:

Prawns; revenue; costs; returns; investment model; economies of scale; markets; sensitivity analysis; general description.

139

Wear, R. G.

1975.

SEAFDEC aquaculture: a seafood revolution in the Philippines.
Fish Farming Internatl. 2 (2): 6-11.

The discussion of plans, budgets, activities and significance of the new aquaculture department at the Philippine headquarters of the Southeast Asian Fisheries Development Centre (SEAFDEC) includes information on efforts to develop the culture of *Penaeus monodon* and other penaeid species. Japan provides a ready export market, and shrimp have been harvested as a source of secondary, supplemental income on milkfish (*Chanos chanos*) farms. Experimental cultural techniques are indicated. Information is provided on yields, prices, capital and operating costs, along with an assessment of possible profitability on the basis of 1-ha experimental ponds. With the SEAFDEC interest and support, 5-ha farm ponds are being operated on a cooperative basis with farmers to determine if yields, costs and other factors will indicate an economically viable situation over a 5-year period.

Subject descriptors:

Philippines; R&D role; biology; economic feasibility; experiment; shrimp.

140

Webber, Harold H.

1975.

Crustacean aquaculture in Middle America.

Mar. Fish. Rev. 37(1): 24-30.

The author discusses market, culture technology, enterprise siting, and business plan aspects of his firm's establishment of a large shrimp farm in Central America. The author's general scheme of siting criteria is specifically applied (see Webber, 1972, elsewhere in this bibliography, for the scheme). Among the aspects of the firm's business plan which are discussed are the following: capital costs, use of a pilot scale operation (at least 3 200-acre modules, horizontally integrated), vertical integration, labor intensive technology, and farm management. Economic development benefits include employment, foreign exchange, and infrastructure, but not food directly, due to price.

Subject descriptors:

Shrimp; economic feasibility; economies of scale.

141

Welsh, James P.

1974.

Mariculture of the crab *Cancer magister* (Dana) utilizing fish and crustacean wastes as food.

Humboldt State Univ., Sea Grant Publ., HSU-SG-4, 76 pp.

The objective of research reported in this paper was twofold: (1) to investigate the biological feasibility of establishing

methods of culturing crab using locally produced fish and crustacean wastes as the major food support, and (2) to investigate the possibility of holding wild-captured adult crabs in pens over long periods of time at an acceptable level of mortality loss in order to allow a more predictable supply of crabs to market, steady the price structure throughout the season, and provide a supply during periods of wild crab scarcity. In the 3-year study, local fish and crustacean wastes were chosen as food base for crab culture because they were available at minimum purchase costs ranging from 2 cents per pound for fish to free for crustaceans. Crab prices are lower in the early part of the season (Dec. to Jan.) because the catches are large. After January the catches drop steeply and the price rises with the shortage. Crab culture would accelerate the postmolt recovery period and extend the labor season of crab workers. Among other topics discussed are previous and current research on Cancer magister, stocking procedures, problems, results as to rates of meat recovery (cultured vs. wild crabs), weekly percentages of crab losses due to cannibalism, disease, etc., chemical composition of waste, and some suggestions about techniques of culture.

Subject descriptors:

Crabs; waste use; biological feasibility; state of the art.

142

Williams, Robert James.

1973.

Economic feasibility of commercial shrimp farming in Texas.

M. S. thesis, Texas A&M Univ., 57 pp.

The purpose of the research was to develop a model which would aid a prospective investor in evaluating the economic feasibility of shrimp farming. Cost and revenue data based upon assessments of individuals associated with Texas A&M University's experimental shrimp farms are used for illustration. The investment criteria return on equity and net present value are employed, along with sensitivity analysis to show the effects of changes in key variables. Key variables include land, feed, seed-stock and heading costs; number of crops per year; stocking densities; and wholesale prices. For the variates assumed, returns appeared attractive.

Subject descriptors:

Shrimp; investment model; economic feasibility.

143

Winget, Rodner R.; Maurer, Don; Anderson, Leon.

1973.

The feasibility of closed system mariculture: preliminary experiments with crab molting.

Proceedings, Natl. Shellfish Ass. 63 (June), reprint, Univ. Del., Coll. Mar. Studies, Sea Grant Publ. DEL-SG-3-74, pp. 88-92.

A recirculation system for inducing shedding in the blue crab,

Callinectes sapidus Rathbun, and preliminary experiments on crab molting are described. The most important result was the inducement of out of season molting (January-March) in the Delaware Bay area. By developing methods to molt blue crabs in the winter the soft shell industry can be pursued throughout the year. In addition, by inducing molting the year round, faster growth rates are realized and market size crabs can be obtained much quicker. It is concluded that the reported work, along with that of other researchers, establishes the feasibility of the procedure in a technical, not economic sense.

Subject descriptors:

Crabs; technology; experiment; biological feasibility.

144

Yee, William C.

1970.

Potential of aquaculture at nuclear energy centers--a systems study.

Oak Ridge Natl. Lab., Oak Ridge, Tenn., ORNL-4488, 78 pp. (Obtain from NTIS.)

This report shows the potential merits of utilizing heated seawater from nuclear or fossil-fueled energy centers (power stations or desalting plants) for intensive aquaculture. An evaluation is made of an intensive aquaculture facility using shrimp as a model since more biological, technical, and marketing data are available for this aquatic species than for any other marine life. The analysis includes a conceptual design based on present technology, a cost estimate of a facility sited at an United Arab Republic energy center, cost sensitivity studies of the facility, and a brief market study that indicates the future export market potential of shrimp to industrialized nations. Capital and annual operating costs for the facility are shown, along with graphed functions for the sensitivity analysis which shows the effects of changes in land improvement costs, food conversion ratio, wage rates and labor productivity, price of product, and shrimp yield on annual production cost.

Subject descriptors:

Shrimp; United Arab Republic; revenue; costs; returns; markets; sensitivity analysis; engineering design; powerplant heat use.

145

Dukhnovski, M. K.

1970.

Economic efficiency of breeding herbivorous fishes in ponds (Ekonomicheskaya effektivnost' vyrashchivaniya rastitel' noyadnkh ryb v prudakh).

Rybn. Khoz. 46(11): 101-107. (Obtain translated copy on loan from NMFS).

This report compares the economic efficiency of the increasingly important herbivorous fish culture with that for carp. Output data are given, and operations in the Konstantinovka district of the Donetsk fishery combine (firm) are used for purposes of the study. Two-thirds of the district's assets are in production ponds (totaling 44 ha), and amortization of the capital cost is allocated between fry and market fish culture. Several tables and discussion are used to indicate acreage, capital investment, labor expenditure, production, revenue, and itemized cost and return data. For example, among the comparisons made, the 18.4 ha water supply pond had a yield of 0.69 metric ton/ha of carp, and 0.19 ton/ha of herbivorous fish, but profit was 14.0% of expenditures (12.2% of market receipts) for carp and 37.8% of expenditures (27.5% of market receipts) for the herbivorous fish in 1967. This activity produced market fish. A similar comparison is made for fry production.

Subject descriptors:

Carp; herbivorous fish; firm data; revenue; costs; returns; investment; enterprise comparison.

146

Folsom, William B.

1973.

Japan's eel fishery.

Mar. Fish. Rev. 35(5,6): 41-45.

Discussed are culture methods, output (1952-70 data), marketing, recent prices (1971 to 1973), import data (1970 to 1972), quantity and value, and prices by country, import duties, and U.S. export opportunities. In the period 1952-70 output from inland fisheries remained relatively stable around 3 to 4 metric kilotons, while cultured output rose from less than 1 to over 20 metric kilotons. Juvenile eel (elver) prices increase as size decreases for culture purposes.

Subject descriptors:

Eel; Japan; techniques; production data; import data; prices.

147

Gordon, William G.

1968.

The bait minnow industry of the Great Lakes.

U.S. Dep. Int., Fish Wildl. Serv., Bur. Commer. Fish., Fish. Leafl. 608, 6 pp.

The nonaquaculture bait minnow industry of the Great Lakes is described, and methods for increasing the harvest are demonstrated by results of exploratory bait fishing activities completed by the Bureau of Commercial Fisheries. Nets, equipment, and gear are described, and improved harvesting methods are recommended as a means of increasing supplies during summer when sport fish demand is at a peak. Harvesting has been from shallow Great Lakes waters, but substantial stocks are available during the summer in deeper, offshore waters if proper harvesting techniques are applied. Such harvesting would help satisfy the demand now being partially met by hauling commercially cultured bait minnows for great distances to the Great Lakes area.

Subject descriptors:

Minnows; baitfish; natural-stock production.

148

Herrick, Samuel F., Jr.; Baldwin, Wayne, J.

1975.

The commercial production of topminnows--a preliminary economic analysis.

Univ. Hawaii, Sea Grant Rep. UNIHI-SEAGRANT-AR-75-02, 18 pp.

Based on techniques developed by the Hawaii Institute of Marine Biology, the possible commercial production of topminnows (*Poecilia vittata*) as an alternative to the use of Nehu (*Stolephorus purpureus*) for live bait in the skipjack tuna fishery is analysed. Topics include water quality, production processes, biology, facility design and economic analysis. Capital and operating costs are itemized, and other information is presented in the context of the net present value analysis of three levels of output, 3,000, 30,000 and 60,000 buckets of topminnows per year (each bucket containing about 6 pounds or about 3,000 topminnows). The largest two levels of operation were judged profitable at discount rates of 10, 20 and 30%, but the smallest, only at 10%, assuming a 20-year period of operation. Because of the preliminary nature of the data used, the authors recommend further investigation.

Subject descriptors:

Topminnows; revenue; costs; returns; economic feasibility.

149

Hudson, Stanton.

1974.

Minnow farming, an American enterprise, then-now-and the future. *Catfish Farmer World Aquacult. News* 6 (1): 31, 32, 37, and 38.

Expanding recreational demand and fishing area, and decreasing wild harvests led to the increasing demand for farm-raised minnows. Yet, there are several risks and problems. The market is seasonal, with sales concentrated in the summer, demand fluctuates from year to year, and droughts or floods, which affect recreational lakes, shift demand among locations. Chronic

overproduction in the past 15 years has kept prices low; for example, small-minnow prices were \$5 per pound in 1951 and \$1 per pound in 1973. Fish may grow rapidly from a profitable to unprofitable size. The author views minnow farming as a typical farm venture involving large capital investment in land and equipment, with present prices allowing expansion of existing operations, but not development of separate operations. Even so, he views the future optimistically. U.S. bait fish pond area acreage is estimated to be 50,000 acres, with 29,091 acres in Arkansas, 12,900 acres in Minnesota, 1,740 acres in Mississippi, 1,500 acres in Louisiana, and 1,200 acres in Missouri.

Subject descriptors:

Minnows; baitfish; risks; problems; industry development; production data; outlook.

150

Lewis, William M.; Heidinger, Roy.
1971.

Aquaculture potential of hybrid sunfish.

Amer. Fish Farmer World Aquacult. News 2 (5): 14-16.

On the basis of certain characteristics established in biological experiments and the researchers' assessment of product characteristics relative to catfish, it is expected that hybrid sunfish will be produced in substantial quantities for food and recreational markets. With respect to density control in ponds, feed response, oxygen-depletion tolerance, growth rate, and other measures, for all of which some data are provided, hybrid sunfish are judged suitable for commercial production.

Subject descriptors:

Hybrid sunfish; biology; biological feasibility; experiment; method evaluation; outlook.

151

Martino, K. V.; Mustafin, R. M.
1972.

The economic effectiveness of acclimatizing grass carp in the lower reaches of the Volga (Ekonomicheskaya effektivnost' akklimatizatstii belogo amura v nizov'yakh Volgi).

Ryb. Khoz., 48(9): 86-87. (Copy of translation available on loan from NMFS.)

Expenditures and prime cost of breeding and raising grass carp from the egg to its release into the Volga are discussed. The prime cost of raising one grass carp underyearling from the egg to its release is 2 kopeks. The cost of 1 kg of grass carp raised in the river and capable of being fished ranges from 1.61 rubles to 2.14 rubles, depending on the size of the stock, specified assumptions, and other factors. These costs are declining and were 37% lower in 1970 than in 1966. Product form affects profitability. Adding fishing (harvesting) and delivery costs (0.48 rubles) to prime costs brings total cost (2.09 to 2.62 rubles) above the market price for wild carp (0.67 rubles).

Adding prime costs and costs of fishing, delivery, and processing (0.77 rubles) would allow a profit only at the specified higher stock amount, given certain assumptions because the wholesale market price is 2.82 rubles (with costs totaling 2.37 and 2.91 rubles per kg for the two stock amounts) for fillets.

Subject descriptors:

Grass carp; Russia; economic feasibility; method evaluation; revenue; costs; returns.

152

Minamisawa, A.; Sakai, H.

1969.

Cultivation of a hamachi (*Seriola quinqueradiata*, Temminck et Schlegel). (Hamachi no yoshoku.)

Suisan Zoyoshoky Sosho 18: 1-56. (Copy of translation available on loan from NMFS.)

Various aspects of Japanese hamachi culture (young or infant yellowtail, *Seriola quinqueradiata*) are discussed. The fry (mojako) are caught in coastal waters; hatcheries have not yet proven feasible. Three types of enclosures are used: diked ponds, net pens (fenced-off areas), and smaller net enclosures (suspended net "boxes", etc.). The advantages and disadvantages of each are discussed, along with design variations. Other topics include fry planting (numbers of fry caught and planted are given by Prefecture for the years 1965-68), environment, feed and growth, diseases, a 12-month description and schedule of culture activities, marketing, and enterprise management considerations. Prices are affected by season, quantity of fish, market (city), size of fish, freshness and other factors. The fry are caught and planted about early May, and may be harvested about August when they reach 300 g. Winter prices (October to January) are lowest. The fish are killed at the production site beginning in October or may be shipped by boat, rail truck, and even airplane. At-market killing and other preference factors affect price. Prices are highest in the spring when the overwintered fish are marketed. As to management, the importance of feed and labor costs and their reduction are discussed, along with cooperative forms of business. Itemized costs are shown for farms using 4,000 to 20,000 fry (Ehime Prefecture, 1967). By-item percentages of cost are shown for the three methods of culture, based on a sample of 37 firms, Seto Island Sea, 1967.

Subject descriptors:

Yellowtail; hamachi; Japan; methods; techniques; biology; sts; method comparison; economies of scale.

153

Priddy, John M.; Culley, Dudley D., Jr.

1972.

Frog culture industry, past, present, future?

Amer. Fish Farmer World Aquacult. News 3(9): 4-7.

Bullfrogs are used for education and research as well as food.

The research market has requirement or preferences for particular strains, and consequently the U.S. frog culture industry has supplied pond or breeding stock, but its price (costs) have kept it out of the direct-use aspects of this market. Frogs for food (frog legs) and 50% of those used for educational purposes have been imported from Japan and India, where there have been successful pond culture industries since the the early 1900's. However, the industries in these countries face increased domestic demand, destruction of frog habitat, DDT contamination, or over-exploitation in varying combinations. Growing demand by education and research groups has accelerated depletion of U.S. wild stocks to the point where biological supply houses indicate that they will be unable to justify collection and marketing within the next 10 to 15 years.

Subject descriptors:

Frogs; indoor culture; demand; techniques; problems.

154

Shang, Yung C.

1974.

Economic potential of the eel industry in Taiwan.

Aquacult. 3(4): 415-423.

Capital and operating costs are detailed. Sensitivity of annual profits and return on investment to changes in survival rate, eel price and seed eel price is demonstrated. The analysis is based on data obtained in a 1973 survey of 30 eel farms. An aggregate demand function for eel in Japan is estimated. Although demand is growing, and Japanese eel imports come primarily from Taiwan (96% in 1972), constraints on the supply of seed eel, along with possible competition from the Peoples Republic of China in the Japanese market represent significant problems.

Subject descriptors:

Eels; Taiwan; costs; revenue; returns; demand analysis; Japan.

155

Shang, Yung Cheng; Iversen, Robert T. B.

1971.

The production of threadfin shad as live bait for Hawaii's skipjack tuna fishery: an economic feasibility study.

Univ. Hawaii, Econ. Res. Cent., 42 pp.

Nehu, a small anchovy, has been the predominant bait used in the Hawaiian skipjack tuna pole-and-line fishery, but catching nehu requires about 30 to 40% of the fleet's time and nehu mortality is high. NMFS research has shown that the threadfin shad is a potential substitute and can be cultured in ponds. Since no nehu bait market exists, the opportunity cost method, and comparison of tuna catching rates and mortalities between the two bait fishes were used to estimate bait value. Investment feasibility was determined using the net present value (NPV) criterion and estimated data, which are shown in tables and figures. The NPV analysis involved two output levels, two levels of shad

mortality, five discount rates, two sources of water, two operating or evaluation periods, and two modes of operation. It was concluded that the higher output rate only was economically feasible. Discount rates, mortality rates, and terms of operation, but not source of water, significantly affect profitability. Because the study was based on preliminary information, further research in specified areas is suggested.

Subject descriptors:

Nehu; baitfish; revenue; costs; returns; investment model; biological feasibility; economic feasibility; sensitivity analysis.

156

Shpet, G. I.

1972.

Comparative efficiency of fish culture and other agricultural activities per unit of area used.

Hydrobiological J. 8 (3): 46-51.

The author compares the output per unit of area used for pond fish culture (carp) and livestock (cattle for beef) in the U.S.S.R., using two purely physical, not economic measures. Concepts and data used relate to such things as food chain links (plants, herbivores, and carnivores), input-output factors, energy (calorie) consumption or use, and product form (live, meat, and protein weight of output). Natural carp productivity is 200 to 300 kg/ha; pond fertilization raises this to 300 to 600 kg/ha, and supplementary feeding, to 900 to 1,200 kg/ha, which is a conservative yield, given that some of the best Ukrainian fish farms achieve 2,000 kg/ha or more. In the carp-cattle comparisons, adjustments are made to account for acreage used to grow the carp feed, which is assumed to be human food-quality wheat grain, although in actual fish farming practice grain waste and oil-seed meal not usually acceptable as human food are fed to carp. Using several indices, it is concluded that carp are physically, (not necessarily economically) more productive than cattle. For example, carp produce more live, meat, and protein weight of product per hectare (of hay-producing area for cattle and pond plus wheat-producing area for carp). Similarly, output per fodder unit, a measure of weight gain per kilogram of feed input, is greater for carp, and this does not count the effect of natural pond productivity of carp. Even on the basis of natural pond productivity (the 200 to 300 kg/ha), carp win, and ponds may occupy area that is really not suitable for other agricultural purposes.

Subject descriptors:

Carp; beef cattle; productivity; comparison.

157

Smith, Theodore Isaac Jogues.
1973.

The commercial feasibility of rearing pompano, *Trachinotus carolinus* (Linnaeus), in cages.

Univ. Miami Sea Grant Progr., Tech. Bull. No. 26, 62 pp.

Pompano are believed to be suitable for aquaculture, but success has been limited. This study was conceived to rear pompano in cages at five stocking densities. Estimates are made of costs (for cages, labor, feed and fingerlings, but not for water column leasing, on-shore installation, equipment and supplies, and marketing) and gross revenue. The estimates are based on the researcher's study and other information. Present markets are for a 1-pound fish, but an 8- to 10-ounce pan-sized fish may be acceptable and would be advantageous, since growth seems to slow once this weight is reached. Higher prices are assumed because the quality of the cultured fish is thought to be superior to wild fish. Factors relating to cost reduction are discussed: stocking, wild-fish usage of food (from outside the cage), the possibility of conditioning pompano for noncage culture, fingerling cost, feed conversion rates, and other factors.

Subject descriptors:

Pompano; biology; biological feasibility; experiment; economic feasibility; markets; revenue; costs.

158

Sneed, Kermit E.
1971.

The white amur: a controversial biological control.

Amer. Fish Farmer World Aquacult. News 2(6): 6-9.

The article discusses mechanical and biological vegetation control as alternatives to chemical controls. Mechanical methods involve the physical removal of weeds from lake areas. These methods are expensive, time-consuming, and inefficient. Two possible methods of biological control are available, pathogenic viruses and herbivorous fish. Viral methods are still in experimental stages of development and at present are not feasible. Among the herbivorous fish, the white amur (*Ctenopharyngodon idellus*) seems most promising. Native to Asia, it is a member of the Cyprinidae family, which includes carp and minnow species. These fish grow at a rapid rate and may become 4 feet long and weigh up to 100 pounds over a period of several years. They begin to feed on aquatic vegetation when about 1 inch long. The white amur eats as much as two to three times its body weight per day. Also mentioned are the possibilities of sport and commercial fishing, reproduction, possible adverse effect on lake habitats, and control.

Subject descriptors:

White amur; biology; biological feasibility; problems; benefits.

159

White, James T.

1970.

Minnows--by the million.

Amer. Fish Farmer World Aquacult. News 1(9): 8-11 and 27.

Information is given on sport-fishing bait demand for minnows, farm location factors, culture methods, production, development, and history of the I. F. ("Fay") Anderson minnow farm operation. Demand growth relates to increased leisure time and expenditures, and expanded reservoir water area and fish stocking.

Subject descriptors:

Minnows; baitfish; recreation; demand; techniques; state of the art.

160

Yamamoto, Tadasu.

1972.

Raising young yellowtail in Japan.

Economic aspects of fish production, International Symposium on Fisheries Economics, Paris, Nov. 29 to Dec. 2, 1971, O.E.C.D., pp. 349-362.

Production volume data (natural, cultured, and total) for 1965-69, more complete data by Prefectures for 1969, culture technique, and cost information are given. Growing demand, complemented by Japanese Government policies to assist coastal fisheries, has prompted increased output of young, usually live-shipped yellowtail (1-yr., 1-2 kg at market stage). Output doubled between 1965 and 1969, and is expected to account for an increasing share of total Japanese production of yellowtail. Natural fry are used. Embanked ponds, net-enclosed ponds, floating net cages, and other devices are used. The table of estimated itemized costs indicates that food is the largest cost item (49% of gross revenue); profit is next (21.7%), as computed after deducting fry, food, wage, medicine, repair, depreciation, interest, and selling costs from gross.

Subject descriptors:

Japan; yellowtail; production data; supply; revenue; costs; returns; outlook.

161

Zaidinar, Yu. I.

1970.

Calculation of the economic effect of commercial fish culture (Raschet ekonomicheskogo effekta promyshlennogo rybovodstva).

Rybn. Khoz. 1970(11): 108-117. (Copy of translation available on loan from NMFS.)

Analysis of the economic effect of fish culture enterprises is discussed. Methods and concepts of determining cost, profit and return on investment (as developed by the U.S.S.R. Academy of Sciences) are illustrated using 1966 data for sturgeon-breeding (fry release or hatchery) enterprises in the basin of the Asov

Sea. The principal parameters that determine the economic efficiency of investment are output and its value, labor productivity, production costs and capital returns.

Subject descriptors:

Hatcheries; sturgeon; U.S.S.R.; method evaluation; benefit-cost analysis; economic concepts; methodology.

SEAWEEEDS

162

Dawes, Clinton J.

1974.

On the mariculture of the Florida seaweed, *Eucheuma isiforme*.

Univ. S. Fla., Sea Grant Rep. No. 5, 10 pp.

Biological information, and growing demand for the specific product (iota carrageenan) from *Eucheuma isiforme*, along with comparison of yields from tank and field culture suggest that a carefully designed pilot project to ascertain costs and returns under cultured conditions is merited. Under the author's specified assumptions, gross revenue per square meter of growth area per year would be \$9.72 for tank culture and \$0.16 for dense, wild populations in the Florida keys. While the author discusses aspects of cost and production, he cautions that actual production under cultured conditions is necessary for determining economic feasibility.

Subject descriptors:

Seaweeds.

163

Doty, Maxwell S.; Alvarez, Vicente B.

1975.

Status, problems, advances and economics of *Eucheuma* farms.

Mar. Tech. Soc. J. 9(4): 30-35.

Eucheuma farming has been successful only in the Philippines to date. While it is likely that this country could produce as much as twice last year's world supply, past interruptions of market flows in other countries suggest that economy and stability might be achieved if production occurred in several economically and politically independent countries. Among the biological problems in farming are seasonality and senescence. A recently introduced strain may overcome part of the difficulty. Cost and return information is incomplete for any farm anywhere for a given year or farm cycle. Costs are low relative to gross revenue. For family farms the input is largely labor, with nominal capital investment, and labor opportunity costs are low.

Subject descriptors:

Seaweeds; Philippines; problems; revenue; costs.

164
Doty, Maxwell S.; Alvarez, Vicente B.
1973.

Seaweed farms: a new approach for U.S. industry.
Proceedings, 9th Annual Conference, Marine Technology Society,
Washington, D. C., Sept 10-12, 1973, pp. 701-708.
The authors discuss the demand for farmed seaweed; establishment
of successful indigenous, private, individually operated 1 ha
farms (140 farms in early 1973) in part of Southeast Asia; farm
production methods, output, costs, and returns; labor input and
other data; and the institutional setting required. Demand for
the marine colloid carrageenin led to overharvesting and
destruction of natural seaweed (Eucheuma) sources in the primary
supply area, Southeast Asia. Success of the program is due to
government, university and industry support and interest.
Subject descriptors:
Seaweeds; Southeast Asia; R&D role; input-output ratios; revenue;
costs.

165
Ffrench, Rudolph A.
1972.
The demand for Canadian seaweeds with special reference to Irish
moss.
Canadian J. Agri. Econ. 20(2): pp. 1-6.
A demand model is presented for carrageenin (one of several food
additives used for its emulsifying, stabilizing and gelling
characteristics), from which the demand for Irish moss derives.
The characteristics of the Canadian seaweed industry, and the
carrageenin market are discussed, along with the demand equations
and their statistical properties, data (1953-68) sources and
limitations, equation-forecasted and actual demand, and the
implications of a possible short-run growth decline (i.e., the
management implications of reduced demand and income in the
Maritime Provinces).
Subject descriptors:
Seaweeds; demand analysis.

166
Hunter, Charles J.
1975.
Edible seaweeds--a survey of the industry and prospects for farm-
ing the Pacific Northwest.
Mar. Fish. Rev. 37(2): 19-26.
The culture of seaweeds offers the possibility of increasing the
resource base for producing certain food, fiber and chemical
products. The U.S. market for industrial products from seaweeds
is well established, but current prices of the leading natural
raw materials, kelp and Irish moss, would require a high-bulk,
low-cost product, if seaweed culture for this market were to
become competitive. However, the smaller market for edible

seaweeds appears promising, both for domestic U.S. consumption and export. Tables and graphs are used to indicate Japanese production, trade, consumption and prices, and U.S. imports.

Subject descriptors:

Seaweeds; production data; trade data; consumption data; prices; outlook.

167

Parker, Henry S.

1974.

The culture of the red algal genus *Eucheuma* in the Philippines.

Aquacult. 3(4): 425-439.

The author discusses uses, culture-method investigations, biological factors, harvesting pressures on natural beds, cultivation potential and methods, current productivity and economics of farming, and the outlook. Based on data from a pilot farm and specified assumptions, revenue, costs and returns are estimated for a family farm using a two-module operation. Each module consists of 200 net structures and occupies about 0.25 ha. Allowing for purchased or leased nets, other capital equipment, and necessary farm tools, it is estimated that most of the gross revenue would accrue to the farmer and his family for labor and management input. The work is familiar to the area's people, the culture is suited to many parts of the Philippines, and the product has a ready market. Labor returns exceed those in alternative pursuits. Some problems are indicated.

Subject descriptors:

Seaweeds; Philippines; revenue; costs; revenue; returns.

168

Silverthorne, Wesley; Sorensen, Philip E.

1971.

Marine algae as an economic resource.

Preprints of the 7th Annual Conf. of the Mar. Tech. Soc., Wash., D. C., August 16 to 18, 1971, pp. 523-533.

The present study is designed to complement the many widely-known surveys of the economic value of marine animal and mineral resources. The total market value of the world's current annual production of unprocessed seaweeds is estimated to be \$350 million. Estimates of the quantity and value of world production of important seaweed products are also given and prospects for further growth considered. Despite much speculation concerning the potential for food and drugs from marine algae, the evidence presented in this paper indicates that seaweed will continue to contribute only marginally to human nutrition and medication in the decade ahead. Its major uses will continue to be as a specialty food in the Orient and as the raw material for the production of specialized colloids, fodder, and fertilizer supplements in the industrialized countries. Furthermore, the large amounts of labor involved in present methods of cultivation of marine algae lead us to conclude that such intervention is

only feasible for algae which are either extremely valuable or uniquely tractable, and are therefore not likely to produce any substantial change in the level of utilization of the marine algal resource. (Authors' abstract.)

Subject descriptors:

Seaweeds; world; production data; demand; supply; uses.

169

Tanonaka, George.

1973.

Summary assessment on the industry and market for seaweed products in the world and United States.

Natl. Mar. Fish Serv., NW Fish. Cent., unpubl. manuscr., 44 pp.

The U.S. and Japanese seaweed product industries and markets are discussed using numerous tables and figures, and it is concluded that prospects may be better for a cultured seaweed industry in the United States if the food market is served. Lower prices for seaweed raw material for the industrial products market, plus its organization, size and structure might not be conducive to development of culture. Extensive data on the Japanese seaweed situation indicates culture production for some kinds of seaweeds. Japan is the world's largest producer and consumer of seaweed food products. U.S. industrial market use of marine colloids from seaweeds account for an estimated 1/2 or more of world output of algin and carrageenin, but only 2-5% of the world agar output. The "industrial" market serves food, medical, pharmaceutical and other processors or manufacturers. Some seaweed is used as meal or fertilizer.

Subject descriptors:

Seaweeds; Japan; U.S.; supply; production data; import data; uses; markets; outlook.

GENERAL

170

Allen, George; Conversano, Guy; Colwell, Bryan.

1972.

A pilot fish-pond system for utilization of sewage effluents, Humboldt Bay, Northern California.

Calif. State Univ., Humboldt, Mar. Advisory Ext. Serv., Sea Grant Progr., HSU-SG-3, 25 pp.

This paper documents all out-of-pocket and other costs in the construction of two experimental fish ponds. These ponds will be fertilized with waste materials to enhance fish growth. Engineering, construction, and environmental problems are discussed. Detailed descriptions of the project site as well as of the construction process itself are provided. The out-of-pocket and other costs are divided into categories

according to source of funds. The total cost of the project is \$53,732. Nine recommendations concerning future construction of such facilities are outlined. Several tables itemize all costs in detail.

Subject descriptors:

Sewage effluent use; problems; pond culture; experiment; facility; engineering design; costs.

171

Anderson, Iee G.

1973.

An economist looks at mariculture (the assessment of human needs and some problems of applying technology: the mariculture case).

Mar. Tech. Soc. J. 7(3): 9-15.

Topics include economists' approaches to need and demand, mariculture development, and interdisciplinary research strategies in measuring and determining the significance of spillover effects (externalities) of new technology. Social and/or market willingness to pay is posed as a guide to assigning priorities to competing and multiple demands ("needs" qualified), so long as market imperfections are recognized as limitations. Following a discussion of the technological barriers to mariculture development, previous estimates (Anderson and Tabb, 1970) of return on investment in shrimp mariculture are reconsidered to demonstrate the importance of underlying data. The effects of higher prices, two instead of one annual food crop, white instead of pink shrimp, and other changes are considered, all with a caution to recognize data limitations.

Subject descriptors:

Concepts; methodology; evaluation; market role; public sector role; sensitivity analysis; externalities.

172

Anonymous.

1973.

Aquaculture in Canada, the opportunities and the risks.

Canadian Fishermen Ocean Sci. 59(4): 18-21.

The discussion at a government-industry seminar (Freshwater Institute, Winnipeg, Manitoba, May 31 to June 1, 1973) is summarized. Opportunities for commercial development to 1985 are identified, and priorities are assigned on the basis of demand outlook, technical and economic feasibility, and social payoff (article lists species ranked into three groups, and opportunities in supportive and ancillary service industries are listed unranked). Legal, institutional, policy, and attitudinal constraints are listed. R&D needs and priorities are given in a high-priority group (ranked as follows: diseases and parasites, genetics, applied research, and culture systems), and in a low priority group (unranked, as follows: marketing, pollution, economics, thermal and nutrient effluents, information flow, pilot projects, environmental management, and improved

harvesting). The question of having new financial instruments to help absorb risks was discussed, but not resolved at the conference.

Subject Descriptors:
R&D priorities; Canada.

173

Anonymous.

1975.
Economic impact of pollution abatement regulations on the fish farming industry.

Aquacult. Fish Farmer 2(4): 8, 9, 11, 15, 17, 19 and 27.
Comments by Donald R. Whitaker (at the Commercial Fish Farmers Convention, Little Rock, Ark., Jan. 31, 1975) and Bruce C. Moorehead (at the U.S. Trout Farmers Association, Huron, Ohio, Oct. 6, 1975), both of the National Marine Fisheries Service, are reported. National, fish processing industry and fish farming industry costs, economic effects and problems are discussed, using available data. Economies of scale in abatement place the smaller firm at a cost disadvantage. The industry may experience capital financing problems, suffer from competition by overseas producers not required to install abatement equipment, and experience plant closures.

Subject descriptors:
Effluent guidelines; problems; costs.

174

Anonymous.

[1972].

Fisheries statistics of the Phillipines, 1971.
Phillipines Dep. Agri. Nat. Resour., Bur. Fish., Econ. Inform. Div., 107 pp.

Table 1 of this general fishery statistics publication shows fishpond output quantity and value, along with that for commercial fishing, municipal fisheries, and sustenance fishing, and the total for 1951 to 71. Fishponds have the highest average price. Table 24 indicates for 1971 the regional, provincial, and national data on privately owned, leased and total area and output; and swamplands available for development (freshwater and mangrove area). Table 25 indicates area, investment (estimated at 2,000 pesos/ha), men employed (estimated at one man/ha), production quantity and value, all for the years 1967-71. During the years 1967-71, fishpond area increased from 0.140 to 0.171 million ha and the value of output from 135 to 328 million pesos. By definition, fishponds "include all developed brackishwater ponds where juvenile of immature bangos (chanos-chanos) or other kinds of fish and crustaceans are introduced, fed, protected, and eventually caught."

Subject descriptors:

Phillipines; production data; acreage data; investment data.

175

Anonymous.

1969.

Fish farming today, a rapidly expanding multi-million dollar business.

Amer. Fish Farmer 1 (1): 11.

Fish farming is expanding, and there is interest in growing mullet, salmon, bass, carp, crayfish, and other species, in addition to the more familiar species, trout, catfish, and bait minnows. It is expected to become a major food supplier; demand is assumed on the basis of growing U.S. fish consumption and dependence on imports. Recreation demand also exists, and fish farming has an economic impact on local communities. Estimated data on investment, output, total farm (primary producer) value and total retail value are given for trout, catfish, bait minnows, oysters, and crayfish.

Subject descriptors:

Development rationale; outlook; markets; benefits; investment; supply.

176

Anonymous.

1974.

The fish farming market.

Obtain copies from Frost & Sullivan, Inc., 106 Fulton Street, New York, New York 10038, 197 pp.

Markets are analysed and forecast through 1982 for catfish, trout, crawfish, shrimp, clams, oysters, salmon and lobster. Also, the chapters on catfish, trout, crawfish and salmon detail cultural methods. Other chapters are devoted to marketing strategies, fish processing, fish feeds, and equipment requirements and developments. (Based on the firm's book availability announcement.)

Subject descriptors:

Trout; catfish; salmon; crawfish; shrimp; lobsters; clams; oysters; markets; marketing; forecasts.

177

Anonymous.

1973.

Fish from farming.

Fish Farming Internatl. 1 (1): 14-15.

Tables are presented subdivided according to country for estimated production of fish, shrimps and prawns, and mollusks.

Subject descriptors:

World; production data.

178

Anonymous.

1973.

International developments in fish production.

O.E.C.D., Paris, 179 pp.

Contents include: discussions for regional oceanic waters, certain fisheries and fish culture with respect to member country fishing activity; a survey of world fishing capacity; and appendix tables. Growing demand for fishery products, and natural-stock supply growth limitations and problems are the primary justifications for fish culture development. Limitations include high ratios of initial investment to annual output (perhaps 2:1 or 3:1) compared to natural stock harvesting firm ratios (perhaps 0.3:1 to 1:1), additional investment during the start-up period when money outflow exceeds money inflow (negative net cash flows), technology problems, and risks. A belief that cultured output could be increased fivefold by 1985 is viewed more in the realm of technical than of economic possibility.

Subject descriptors:

General description; outlook; development rationale.

179

Anonymous.

1973.

NOAA aquaculture survey, 1972, summary report to participants. (Also called the Mardela report.)

Burlingame, Calif., Mardela Corp., a Sea Grant project report, 60 pp.

The objective "was to define priority research areas in order to move from the laboratory to commercially viable aquaculture at the earliest possible time." Twelve 1-day regional workshops were held involving some 180 participants from universities, business, and government, so as to "achieve a representative cross section of individuals and organizations active in the region," although the "(e)xpertise and experience of respondents lay mostly in the biological disciplines." Preworkshop questionnaires and structured meetings were used to identify transition obstacles for marine, anadromous, and brackish-water species, but not for aquarium and freshwater species. Briefly, three general areas of concern are detailed: policy and organization, other nontechnical factors, and technical needs. Research priority needs and feasibility evaluations are scaled in tables based on participant responses.

Subject descriptors:

Development rationale; state of the art; R&D priorities; constraints; problems; outlook; conference; survey data; species selection.

180

Anonymous.

1974.

[Production estimates:] though still in early stages, fish farms could be major protein source by 1990.

U.S. Dep. Commer., Commer. Today 5(4): 12 and 13.

Based upon available information and opinions of specialists in different parts of the country, aquaculture production for various species was estimated (in "A draft outline for the National Fisheries Plan," Natl. Mar. Fish. Serv., 1974, 225 pp.) for the 1969-73 period and for 1990. For 1969-73, the estimates are as follows (in millions of pounds, round weight, except for shell mollusks): salmon, 23; oysters, 20; shrimp, 0.5; freshwater prawns, 0.005; clams, 2.6; trout, 35; catfish, 50; and crawfish, 10. These amounts total 141.1 million pounds; those for 1990 total about 1.2 billion pounds.

Subject descriptors:

Production data.

181

Anonymous.

1973.

Report of Pacific Island mariculture conference.

Univ. Hawaii, Hawaii Inst. Mar. Biol., Coconut Island, Kanehoe, Hawaii, Feb. 6-8, 1973, 21 pp.

This paper summarizes the objectives, procedure, and recommendations of a conference in establishing a course of development for mariculture programs in the Pacific Islands. First priority organisms include sea turtles, siganids, mullets, milkfish, mollies, cardinalfish, and other baitfish. Second-priority vertebrates are Mahimahi, goatfishes, and jacks. An explanation of the selections is outlined. The same procedure is followed in the discussion of invertebrates. Top-priority invertebrates are Malaysian prawn, brine shrimp, marine shrimp, and oysters. Second priority invertebrates include coconut crab, northern lobster, mangrove crab, pearl oyster, and Tridacna clams. The rejected species are also outlined and listed as spiny lobsters, small clams, octopus, mussels, Triton, and Trochus. Additional priorities are listed to emphasize certain elements of technology. Estimates of the levels of funding and effort are given for each top-priority species in both the vertebrate and invertebrate categories. Organizations willing to assist in funding and effort are also listed.

Subject descriptors:

Pacific Islands; species selection; R&D role; R&D priorities.

182

Anonymous.

1963.

Rural recreation enterprises for profit (an aid to rural area development).

U.S. Dep. Agri., Agri. Inform. Bull. 277, 44 pp.

This bulletin indicates opportunities for development in rural areas on privately owned land and indicates services available from USDA. Financial statements (investment, annual income, and annual expenses) are contained in the appendix for five examples of enterprises, including fishing lakes in the Midwest, and the section on income discusses each example. While the bulletin is addressed to private land owners and operators, it is also a comprehensive guide for a prospective investor, and it briefly discusses the numerous factors involved in making an investment decision.

Subject descriptors:

Recreation; fee fishing; revenue; costs; returns; prospectus factors.

183

Anonymous.

1973.

Sea fish farming progress.

Fish Ind. Rev. 3(2): 2-6.

Initiation of White Fish Authority (WFA) R&D in aquaculture and progress in several areas are discussed. Early experimental work to develop and cost a mass hatching and rearing technology for plaice and dover sole in 1961-68 was the basis of beginning operations at a WFA fish farm. There are hatchery development and demonstration operations for plaice, dover sole, lemon sole and turbot, listed in order from most to least successful. Grow-out (from hatchery to market size) of plaice and dover sole has been shown to be technically and biologically feasible in high-density, open-sea mesh enclosures and in onshore tanks using powerplant thermal effluent to warm the water. Cultured plaice have also been subjected to successful tests of consumer and market acceptability. While information is not yet sufficient to demonstrate commercial feasibility of large-scale culture operations, a model has been developed into which data can be fed to show the effect on cost per unit of output (average cost) for purposes of managing R&D funds and projects.

Subject descriptors:

Britain; state of the art; public sector role; R&D role; R&D evaluation; plaice; dover sole; lemon sole; turbot.

184

Anonymous.

1972.

Summary of proceedings for the aquaculture conference, Honolulu, Hawaii, Nov. 9 to 10, 1972, Environmental conferences on public understanding of science in Hawaii.

Univ. Hawaii, Cent. Eng. Res., 60 pp.

Some 27 speakers' presentations are given or summarized (in 48 text pages) for the five-session conference. Sessions included the topics: aquaculture background for Hawaii, constraints to

aquaculture in Hawaii, the future of aquaculture in Hawaii, Hawaii's role in assisting development in the Pacific basin. Speakers' presentations included items of interest to economists, even though economics and marketing are mentioned specifically in only two of the presentation titles.

Subject descriptors:

Hawaii; outlook; R&D role.

185

Asakawa, Kenji.

1961.

Inland water fishing in Communist China.

Development of the Fishing Industry in Communist China, pp. 24-45. (Copy of translation available on loan from NMFS.)

The author discusses the growth of inland water fishing in the Peoples Republic of China. Prior to 1957, most of the output increase came from expanded fishing of inland waters, and this is associated with land reform (1950-52), the formation of cooperatives (virtually completed for fishermen by 1956), and Government policies during the first 5-year plan (1953-57). After 1958, communes, water resource projects, increased emphasis on the development of agriculture and fishing after the first 5-year plan, and the nation's climate and water endowments are cited in explaining the growth in output of fish breeding [here, assumed to mean freshwater aquaculture]. Other factors of importance are the alteration of consumer tastes and production activities, improved breeding techniques, and the locational advantage of fish breeding relative to the newly industrialized inland cities. Inland water fishing output was about 0.37 to 0.45 million metric tons in 1936, or about 25% to 30% of the nation's total fish catch. In 1959, the inland water catch came to 2.28 million metric tons (45%) of the nation's total catch, 5.02 million metric tons, freshwater aquaculture accounting for 0.81 million metric tons (16%) of this. Problems include the adequacy of seed stocks, water availability during droughts, expected deterioration of water quality in industrialized areas and the inability of freshwater aquaculture production growth to keep pace with fish consumption growth. It is expected that the nation will turn to ocean fisheries for increased production, since the maximum water area available [allocated?] for inland fish culture is 3.33 million ha, of which 1.0 million ha were in use in 1957, 2.0 million ha in 1958, and 3.0 million ha in 1959.

Subject descriptors:

Peoples Republic of China; history; production data; country data; development rationale; institutions.

186

Bardach, John.

1972.

Some remarks on aquaculture.

Proceedings, Fourth National Sea Grant Conference, Madison, Wis., Oct. 12 to 13, 1972, Univ. Wis., Sea Grant Communications Off., Sea Grant Publ. WIS-SG-72-112, pp. 83-88.

Interest in aquaculture has increased and will increase further, given the problems created by rapid human population growth and the growing, but finite potential output of protein. Diverse problems must be recognized in aquaculture's development. A schema of four phases is presented, during which a decision to proceed or discard a species can be made. The four phases include species selection, biological research, field trials, and assessment of socio-economic factors. Phases are sub-divided, and indicate a multidisciplinary approach, with government-supported R&D, and government-industry partnership ventures suggested at various steps.

Subject descriptors:

Development planning; development rationale; R&D role; problems; concepts.

187

Bardach, John E.; Ryther, John H.; McLarney, William O.

1972.

Aquaculture; the farming and husbandry of freshwater and marine organisms.

New York, John Wiley and Sons, Inc., 868 pp.

This text explains and describes most, if not all, aquatic plants and animals that are cultivated for food and the methods by which this is accomplished. The book also includes biological and ecological considerations of the organisms, the current and projected state-of-the-art of their cultivation, and yields, diseases, and other problems.

Subject descriptors:

State of the art; world; biology; revenue; costs; returns; methods; techniques; problems; research; bibliography; input-output data.

188

Bardach, John E.; Ryther, John H.; McLarney, William O.

1972.

General principles and economics.

Ch. 1 of their aquaculture; the farming and husbandry of freshwater and marine organisms. John Wiley and Sons, Inc., pp.1-28.

The economics of particular aquaculture ventures are considered. The focus is on costs of production, rates of return of investment, price cross elasticities of demand among fishery products, and the supply and demand for various species. Comparisons are made among countries engaged in aquaculture as to

capital and labor intensity, and trade outlets internationally.

Subject descriptors:

World; revenue; costs; returns; demand.

189

Bell, Frederick W.; Nash, Darrel A.; Carlson, Ernest W.; Waugh, Frederick V.; Kinoshita, Richard K.; Fullenbaum, Richard F. 1975.

A world model of living marine resources.

Walter C. Labys, editor, Quantitative models of commodity markets. Cambridge, Mass., Ballinger Publishing Co., pp. 291-323.

This study integrates relevant biological and utilization factors into one model of the world demand and supply for seafoods. Decennial projections of anticipated consumption and prices are made for the period 1970 to 2000 within the framework of the model. Fish studied include tuna, salmon, groundfish, halibut, sardines, shrimp, crabs, oysters, clams, scallops, other food fish, and reduction fish (for oil and fishmeal). With the exception of sardines, oysters, clams, and scallops, it is estimated that all of the species will reach the point of maximum sustainable supply (MSS, not necessarily the same as maximum sustainable yield, MSY) in the period 1985 to 2000. Aquaculture is specifically considered in the projections for oysters, clams, and salmon (hatcheries only).

Subject descriptors:

World; demand analysis; supply analysis; bio-economic model; conventional fisheries; aquaculture; production data; methodology.

190

Bell, Frederick W.; Canterbury, E. Ray. 1976.

Aquaculture for developing countries. a feasibility study. Cambridge, Mass., Ballinger Publishing Co., forthcoming. (The authors are with Dep. Econ., Fla. State Univ. and provided a copy of a preliminary draft, 138 pp., as submitted to U.S. Dep. State, Agency for International Development, under contract, 1974.)

The authors selected 14 presently cultured plant or animal species and 90 less developed countries to test hypotheses about the feasibility of technology transfer of aquaculture operations. Species and country groupings are employed in accord with combined scores which are based upon separate scores for substitution, demand and technological acceptability. A bioeconomic model is developed for estimating production, employment and foreign exchange effects in relation to small farm operations. Judging by one or more of these effects, about one-third of the countries could benefit from aquaculture. The importance and difficulty of economic analysis are emphasized.

Subject descriptors:

Economic development role; development planning; technology transfer; model.

191

Bond, B. J.; Madewell, Carl E.; Martin, John B.; Mays, David A.
1973.

T.V.A. projects--beneficial uses of waste heat.

Paper presented at National Conference on Complete Water Reuse,
Wash., D.C. April 23 to 27, 1973, 20 pp.

TVA projects show several ways in which the energy or heat discharged at condensers of powerplants can be used for agricultural and aquacultural development. The use of warm water heat exchangers to replace conventional greenhouse heating and cooling equipment, the use of warm water pumped thru raceways in catfish production, hot water use for heating livestock and poultry houses, and hot water use for recycling nutrients from livestock wastes are all discussed, and a few results from actual TVA experiments are given. The treatise on catfish production in warm water cites reasons why a new development like this is needed. Techniques and results of an experiment are outlined as well as the various problems involved which now prevent the new warm water system from commercialization. The authors also recognize managerial and environmental issues connected with adoption of the new plan. Results of the experiment did show that growth rates of catfish were significantly enhanced by the addition of heated water and that the growing season was significantly lengthened, though no data are given in the paper.

Subject descriptors:

Powerplant heat use; benefits; techniques.

192

Boozer, David.

1973.

Tropical fish farming.

Amer. Fish Farmer World Aquacult. News 4(8): 4-5.

Some of the tropical fish industry's problems include the adverse effect of the protein shortage, increasing feed costs, and some unfair selling and pricing policies within the industry. Sales of ornamental fish account for more than \$200 million in retail sales in the United States. Some 20% of the fish are imported mainly from the Caribbean and South America. The rest is raised domestically. About 150,000 retail outlets sell tropical fish; a minimum of 20% of the over 7,000 pet shops deal exclusively in fish. Tropical fish represent the second largest hobby in the U.S. as 20 to 26 million households have aquariums. Approximately 500 million tropical fish are owned by households. A survey cited gives figures showing that the likelihood of having an aquarium increases with family size.

Subject descriptors:

Tropical fish; ornamental fish; general description; consumption data; survey data.

193

Brown, E. Evan.

1973.

Mariculture and aquaculture.

Food Tech. 27(12): 60-66.

This paper presents information on United States and Japanese aquaculture, including a brief discussion of species, prices, feed conversion, industry growth, and aquaculture's importance as a protein supplier. In Japan, the total harvest of cultured marine species increased by 742% from 1950, but the 1966 harvest amounted to less than 6% of Japan's total seafood sales. Freshwater fish culture in the United States is reviewed. For catfish, the three methods of production are explained (ponds, raceways, and cages) and data are given on the production percentages of each method.

Subject descriptors:

Japan; U.S.; general description.

194

Cohee, Melville H.

1970.

Private outdoor recreation businesses: pond fishing enterprises. Wis. Dep. Nat. Resour., Res. Rep 53, 32 pp.

Results of a sample survey of Wisconsin recreational, fee-fishing enterprises are reported. Some information is presented using two-way classifications. Among the items of information reported are size of ponds, participation days, season length, fish used (mostly trout), labor usage, gross income, factors influencing gross income, capital investment, planned investment, fees charged, and sources of information.

Subject descriptors:

Recreation; fee fishing; survey data.

195

Cowan, Dorian.

1971.

A specific legal perspective: Florida.

Thomas A. Gaucher, editor, Aquaculture: A New England Perspective. Univ. R.I., New Engl. Mar. Resour. Inform. Progr., pp. 57-70.

Although Florida was the first state to adopt laws authorizing aquaculture's use of the water column, legal problems were not fully appreciated at the time of adoption. Some of the problems encountered with the guidelines provided by the Florida State Cabinet under the 1969 statute are discussed. They relate to the effect of aquaculture on navigation, the adequacy of public access and navigational safety, the effect of aquaculture law and upland ownership, the need for stronger antipollution protection, the failure of aquaculture law to deal with conflicting interests, the inadequate provision for onshore installations, the State indecision about competitive bidding, and legal limi-

tations on aquaculture ventures. The actual guidelines in a few of the above areas are also given.

Subject descriptors:

Institutions; law; concepts; problems.

196

Culley, Dudley D., Jr.

1973.

Raceways; exotic species most affected by proposed E.P.A. discharge permits.

Amer. Fish Farmer World Aquacult. News 4(8): 9-12.

A proposed Environmental Protection Agency (EPA) ruling is quoted from the Environmental Reporter (May 4, 1973) pertaining to the waste discharge by fish and other aquatic animal production facilities. The cited ruling specifically refers to raceways and similar structures with continuous discharge, and to facilities containing nonnative species, regardless of continuity of discharge flow. An exception is made for carp, goldfish, and brown trout because of their relatively long U.S. residency time and widespread distribution. Alternative to obtaining National Pollutant Discharge Elimination System (NPDES) permits, these operations could build discharge holding structures (lagoons) or treatment facilities (chemical and/or biological) and recirculate the water. The problems with discharge of pollutants and nonnative plants and animals are discussed. Except for raceways and nonnative species, the proposed ruling is viewed as having little effect on aquaculture. Recirculation would conserve water and reduce nutrient losses in culture systems. Although cost information is not provided, "(t)here is reason to believe that through increased efficiency of reclaiming wastes and recirculating ... water the culturist can increase profits."

Subject descriptors:

Effluent guidelines; problems; evaluation.

197

Dassow, J. A.; Steinberg, M. A.

1973.

The technological basis for development of aquaculture to produce low-cost food fish.

Mar. Fish. Rev. 35 (11): 6-13.

Future protein and fish demand, limited natural stocks, and present concentration on the culture of high-valued species are the rationale for raising questions about the potential for low-cost food fish production via aquaculture. Known high-productivity (output per acre) fish include freshwater species with short food chains, but consumers have shown a higher degree of preference for other fish. Recent developments in food technology have made high meat recovery (up to 45% to 65% compared to hand or machine filleting yields of 30% to 33%) and control of flavor, texture, and stabilization practicable for the output of frozen fish blocks, which in turn may be used to

produce items that have received consumer acceptance. Of course, technological problems require further work in developing a system for high-yield, low-cost cultured fish, and they relate to space (area or land), water (temperature, treatment), feeds and feeding (the largest cost item), mechanization of present labor-intensive activities, disease, efficient processing technology, pollution controls, and the development of markets and consumer acceptance.

Subject descriptors:

Processing; fish blocks; technology; development rationale.

198

Davidson, Jack R.

1972.

Economics of aquaculture development.

Proceedings, Fourth National Sea Grant Conference, Madison, Wis., Oct. 12 to 13, 1972. Univ. Wis. Sea Grant Communications Off., Sea Grant Publ. WIS-SG-72-112., pp. 75-83.

A perspective of the problems of aquaculture development and the role of economics are discussed. While the agriculture-aquaculture analogy is often cited, certain institutions have become established for agriculture, but not for aquaculture, namely tenure and use rights, credit, research, extension, and cost-price controls, many with government involvement. Economists can assist in the development process by providing analyses of institutions, demand, simulated costs and returns, capital budgets, and regional and local impacts. Early, cooperative interdisciplinary efforts to determine species selected, information needs and uses, etc., are suggested. A large, social R&D commitment (as to agriculture) is essential to aquaculture development.

Subject descriptors:

Institutions; problems; outlook; R&D role; public sector role; economic concepts.

199

Dobson, W. D.

1972.

Aquaculture: economic feasibility in the Great Lakes area.

Proceedings, Fourth National Sea Grant Conference, Univ. Wis., Oct. 12-13, 1972. Univ. Wis., Sea Grant Communications Off., Sea Grant Publ. WIS-SG-72-112, pp. 89-98.

Potential interest in aquaculture in the Great Lakes region is suggested on the basis of preliminary findings respecting both commercial food and recreational fishing. Processors and dealers formerly dependent on higher Great Lakes landings would provide a marketing medium, especially for such species as yellow perch, pike, and trout, but perhaps not catfish, except for certain areas. However, consumer and market preferences vary within the region. Lack of information dissemination, credit to start risky ventures, and a technology to provide warm water are among the

constraints to aquaculture development. Use of powerplant thermal effluent is in the promising experimental stage, with recognized, but hopefully manageable problems. Long-term market demand may be slow growing without promotion, because of relative (cited) income elasticities for fish and meat from warm-blooded animals.

Subject descriptors:

Great Lakes; development rationale; problems; outlook; economic feasibility.

200

Fedyaev, V. E.

1971.

Method of planning, recording and calculating the prime cost of pond fish (O metodike planirovaniya, ucheta i kal'kulirovaniya sebestoimosti prudovoi ryby).

Rybn. Khoz. 1971(12): 74-77. (Copy of translation available on loan from NMFS.)

Methods of recording expenditures and calculating the production costs of pond fisheries are discussed. The processing method is recommended. In the process of fish breeding there are stages or phases, each with a marketable output. They are (1) breeding of fingerlings, (2) breeding of underyearlings, (3) wintering, and (4) fattening of the fish. For each phase the calculation for the fish bred and their marketable quantity should be prepared. How to calculate and record direct and indirect expenditures as well as how to distinguish between production expenditures on the output of commodities and those on unfinished products is discussed and illustrated. What should constitute prime costs for each stage of unfinished production is outlined.

Subject descriptors:

Methodology; economic concepts; Russia.

201

Fijan, N.

1971.

Present status and prospects of fish culture in Yugoslavia.

Proceedings, Symposium on New Ways of Freshwater Fishery Intensification, Ceske Budejovice, September 22-24, 1971. Vodnany, Czech., Fish. Res. Inst., pp. 17-21.

The author reviews the history, current developments, and future prospects for fish farming in Yugoslavia. There are 20,000 hectares of carp ponds. Output doubled in 10 years to 20,000 metric tons of carp in 1970, with carp representing 89% of the weight of cultured fish production. Also, 300 metric tons of rainbow trout were produced. The use of pelleted feeds is increasing. Chemical stimulation of carp ovulation, carp disease studies, preventive measures, and treatments are also discussed. (Based on ASFA abstract.)

Subject descriptors:

Yugoslavia; carp; trout; production data; history; outlook; biology.

202

Gates, J. M.

1972.

Appraising the feasibility of fish culture.

Economic aspects of fish production, International Symposium on Fisheries Economics, Paris, Nov. 29 to Dec. 3, 1971. O.E.C.D., pp. 327-348.

Biological and economic criteria are developed and applied to the selection of species for relatively large scale commercial aquaculture development and/or support by public agencies. The biological criteria include environmental adaptability and intensive culture adaptability (specifically, after Ryther and Bardach, 1968, reproduction in captivity, hardiness of eggs and larvae, easily satisfied food requirements, and growth speed). The economic criteria include market price and volume, potential interregional competition, competition from natural supplies, and the institutional or legal setting (regarding rights to water column or bottom, and environmental quality). By assigning numerical values to 6 of the criteria, 6 of 21 species or fish groups evaluated were selected for possible development and support in New England.

Subject descriptors:

Economic feasibility; biological feasibility; concepts; New England.

203

Gates, J. M.

1971.

Aquaculture in less developed countries: some economic considerations.

Preprints of 7th Annual Conference of Marine Technology Society, Wash., D. C., Aug. 16-17, 1971, pp. 579-583.

The benefits of aquacultural development, transforming traditional aquaculture (analogous T.W. Schultz's analysis of agriculture), and the public sector role in this transformation are discussed. Benefit-cost analysis is suggested, with special attention to factors that may affect benefits, such as supply-shift effects on price, current prices, potential market size and growth, and marketing efficiency and cost. The importance of market incentives, public R&D, use rights, credit, the relationship between urbanization and market system efficiency, and other factors are discussed. The public sector role relates to institutional aspects of rights, externality effects of new technology, research funding and direction, and the recognition of the importance of fish in the consumers' diets so far as R&D leadership are concerned.

Subject descriptors:

Economic development role; economic concepts; institutions; externalities; evaluation; public sector role; market role; R&D role.

204

Gates, John M.; Matthiessen, George C.
1971.

An economic perspective.

Thomas A. Gaucher, editor, Aquaculture: a New England perspective. Univ. R.I., New Engl. Mar. Resour. Inform. Progr., pp. 22-50.

Biotechnical and economic criteria are presented and applied for the selection of species with aquaculture potential. The biotechnical criteria include environmental and intensive culture adaptability (ability to reproduce, egg and larvae hardiness, nature of food requirements, and growth speed). The economic criteria include market price and volume, interregional competition, and competition from natural supplies. The market volume criterion requires application of income and price elasticities of demand to see if a minimum \$1 million increase in sales volume could be absorbed within 10 years. Rejection under the sales volume criterion is intended to suggest low aggregate payoff, although individuals could find the species profitable to culture. Several species with possible potential are then accepted or rejected for aquaculture in New England according to these criteria, which are suitable for application to other areas.

Subject descriptors:

Economic feasibility; biological feasibility; concepts.

205

Gates, J. M.; Matthiessen, G. C.; Grisom, C. A.
1974.

Aquaculture in New England.

Univ. R.I., Mar. Tech. Rep. Ser. No. 18, 77 pp.

Topics include criteria for species selection, analysis of selected species, production costs, environmental and institutional considerations, summary and recommendations, and references. Biotechnical criteria include environmental adaptability (to New England condition), and cultural adaptability (reproduction ability in captivity, egg and larvae hardiness, easily satisfied food requirements, and rapid rate of growth, after Ryther and Bardach, 1968). Economic criteria include market volume and price, minimum sales volume, market demand, interregional competition and natural-supply competition. Five selected species, American oyster, hard clam, bay scallop, silver salmon, and American lobster are analysed respecting supply, demand, and state of the art (reproduction, larvae rearing, juvenile rearing, food, major technical problems, and culture in the natural environment). Production cost information is provided for salmon and lobster.

Subject descriptors:

Biological feasibility; economic feasibility; concepts; species selection; costs; New England.

206

Gaucher, Thomas A., editor.

1971.

Aquaculture: a New England perspective.

Univ. R.I., Narragansett, R.I., New Engl. Mar. Resour. Inform. Progr., 119 pp.

This publication is based on recommendations and several key documents from a conference to plan for aquaculture in northern New England (October 21-23, 1970, Durham, N. H.). Contents include: Conference recommendations, Donald B. Horton; A technological perspective, Thomas A. Gaucher; A general legal perspective, Harriet P. Henry; A specific legal perspective, Florida, Dorian Cowan; Hatchery design and operation information, Ronald D. Mayo; Useful references; and Conference notes.

Subject descriptors:

Technology; institutions; law; economics; biology; state of the art; New England.

207

Goodwin, Harold L.

1973.

Aquaculture in perspective.

Paper presented at the Sea Grant Association Meeting, Oct. 1973, U. S. Dep. Commer., Natl. Ocean. Atmos. Adm., Sea Grant Progr., 17 pp.

The United States has imported a substantial growing share of the fish consumed. Natural limits, growing world demand, and the consequent adverse effects on natural-stock fishing productivity and returns will make aquaculture an increasingly interesting alternative production medium. Yet, present world output from aquaculture is dominated by herbivores (carp, milkfish, and mullet), production is often labor intensive, the state of the art is often problem-ridden, U.S.-preferred species are not easily cultured, and utilization of U.S. industrial and economic development byproducts or wastes present legal, aesthetic, taste-preference, and institutional problems. If aquaculture is to develop, a holistic, interdisciplinary approach is required, and its case should not be overstated in terms of immediacy of returns and speed of development. NOAA's role via NMFS and Sea Grant is discussed, along with establishment of national goals, funding and other constraints, and requirements for project and research complementarity.

Subject descriptors:

Development rationale; outlook; research; R&D role; state of the art; problems.

208

Goodwin, Harold L.

1973.

The aquaculture state of the art: comments on problems and progress.

Presented at FISH EXPO, New Orleans, La., Nov. 26, 1973, 15 pp. This paper explores the potential for aquacultural development. Overfishing for some natural fish stocks and underutilization of others is discussed in light of the protein shortage. Underutilized stocks include squid, dogfish shark, and blue mussels. Reasons for the shortage of protein are listed as well as reasons why aquaculture has not yet taken a strong foothold in the United States to alleviate a worsening of the shortage in the future. Some of them are: (1) slow technological advance and adaptation to aquaculture, (2) environmental problems, (3) lack of knowledge of economics and engineering of aquaculture, (4) ignorance of the biology of aquatic systems and inability to control diseases on a large scale. Species listed and analyzed as to their potential for U.S. mass culturization include shrimp, oysters, lobsters, scallops, mussels, finfish, salmon, prawns, and herbivores. Net culture and ocean ranching are also discussed.

Subject descriptors:

Development rationale; constraints; outlook; state of the art.

209

Griffin, Charles.

1970.

Loans for fish farmers and the types available.

Amer. Fish Farmer 1(5): 18-20.

Factors considered by the Lonoke County, Arkansas Production Credit Association (PCA), in granting credit are discussed briefly, and a few comments on experiences with fish farmers are made. PCA's grant operating loans, with maturities of 1 year or less, and intermediate term loans, with maturities of up to 7 years. The Lonoke County PCA has an annual loan volume (amount of loans granted) of about \$30 million, with 20% to 25% in fish-related business. Of those who began fish farming in the early 1950's in the County, only 10% to 15% remain, but they have become successful and prosperous. Factors considered in granting credit are: (1) the man and his family, (2) financial position and progress, (3) repayment ability, (4) purpose of the loan, and (5) collateral.

Subject descriptors:

Financing; credit; prospectus factors.

210

Hammack, Gloria M.

1971.

Bibliography of aquaculture.

Coastal Plains Cent. Mar. Dev. Serv., Wilmington, N.C., Publ. 71-4, 245 pp.

References and abstracts are given for 787 papers published in 1960-70, except for a few published in 1959. The three major divisions are related to marine and freshwater fishes, crustaceans, and mollusks, and each division has four subdivisions, which are general, biological factors, detrimental factors, and technical factors. Permuted-title and author indexes are included. The needs of the Coastal Plains Region were kept in mind when selecting entries from foreign countries. "While the basic orientation of the bibliography is to biological and technical factors, it will be useful not only to those involved in basic research, but also to beginning students, administrators, and fish farmers themselves." Entries by and of interest to economists are included but not in a separate subdivision.

Subject descriptors:

Bibliography.

211

Henry, Harriet P.

1971.

A general legal perspective.

Thomas A. Gaucher, editor, Aquaculture: a New England Perspective, Univ. R.I., New Engl. Mar. Resour. Inform. Progra., pp. 51-56.

The author discusses some of the laws and legal problems concerning aquaculture enterprises. State laws vary according to the State's historical, economic, and social heritage. Location of the enterprise (distance from shore) determines under whose jurisdiction it rests, i.e., whether it is State, Federal or international. High and low water marks as they pertain to State and private ownership of waters are discussed as are riparian owner rights, allocation of land, size of the area to be used for aquacultural activity and the time allowed for use, and the granting of the lease. Maryland, Virginia, and Rhode Island laws are discussed briefly. Other legal concerns include prohibition against allocating natural growing areas of shellfish for cultivation, State residency requirements for obtaining a lease, and effects of water pollution on the aquacultural enterprise.

Subject descriptors:

Legal barriers; institutions; concepts; problems.

Marine aquaculture: problems and prospects.

J. Fish. Res. Board of Can. 30(12, part 2): 2178-2183.

Aquaculture is expected to supplement, but not displace fishing; to have substantial, but inestimable potential output (say at least 10 times its present world output of 5 million metric tons); and to be unable to supply low-cost protein to solve protein-deficiency problems in the foreseeable future. Confusion has occurred among four kinds of culture, relating to hatcheries that supplement natural stocks (few such efforts have been proven beneficial), use of wild stock young, use of eggs from wild-stock parents, and use of cultured brood stocks. The relatively unaided rate of aquacultural development could be expedited by worldwide efforts to solve technical and engineering problems. Yet, "there are other constraints, legal, economic, and social," which are not tractable by research effort and they may be more significant. Research in several areas is discussed as follows: suitable species selection, nutrition and feeds, pathology, behavior, engineering, adverse effects of pollution, beneficial use of thermal and sewage effluents, legal constraints, economics (e.g., feasibility and cost "bottleneck" evaluations), and social constraints (e.g., attitudes toward use of relatively expensive shoreline property).

Subject descriptors:

Research; biology; benefits; constraints; problems; methods; outlook.

Economic assessment of marine fish farming development projects. Economic aspects of fish production, International Symposium on Fisheries Econ., Paris, Nov. 29 to Dec. 3, 1971, O.E.C.D., pp. 319-326.

This paper highlights some of the problems and considerations in appraising investment in marine fish farming. The demand for cultured marine fish can be identified only in terms of presently preferred species, thereby limiting information on the eventual size of the market or its species composition. Such factors as population size, increasing real incomes, price of product and availability of competing protein foodstuffs, and the effect of marketing techniques are discussed as determinants of demand. Some techniques which have made mass rearing of mollusk seed in London, England, possible are touched upon as are the feasibility trials of culturing plaice and sole in a Scottish loch enclosure. Among the conclusions reached are (1) that R&D on the culture of a mixture of species is needed to further expand the use of economic appraisal, (2) that R&D is needed before any economic analysis or appraisals of fish farming can be attempted, (3) that the amount of R&D resources required to reach objectives of development must be commensurate with possible returns and

benefits, (4) that governmental financing of fish farming would create new jobs, a new industry, and new export opportunities, and (5) that economic analysis is no more than a formal method of isolating judgement areas.

Subject descriptors:

Development rationale; concepts; economic development role; public sector role; R&D role; R&D evaluation.

214

Iversen, E. S.

1968.

Farming the edge of the sea.

London, Fishing News (Books), Ltd., 301 pp.

Listing of contents: general (why farm the sea?; sea farming, present and future), procedures, presently farmed species (seaweeds, oysters, clams and mussels, shrimps, milkfish, mullet, and miscellaneous pondfishes), potentially cultivable species, problems and evaluation (includes a glossary and an extensive list of selected references). This descriptive book is not a handbook or "how-to" book, but it does review important principles of sea farming. It attempts to help answer many of the questions asked increasingly of people at fishery laboratories, and it emphasizes biological aspects of sea farming. There is also emphasis on farming of the sea by developed nations in temperate and subtropical waters of the Northern Hemisphere. Significant differences may be expected in tropical waters and developing countries.

Subject descriptors:

Methods; techniques; state of the art; problems; research; biology; bibliography.

215

Johnston, Warren E.; Collinsworth, Don W.

1973.

An annotated bibliography for economic evaluations of the aquaculture of selected crustaceans and mollusks.

Univ. Calif., La Jolla, Calif., UC-IMR Ref. No. 74-3, Sea Grant Publ. No. 2, 26 pp.

A selected, preliminary bibliography with the following major headings: bibliographies (general aquaculture and specific species), abstracts and indexes, statistical sources (FAO, U.S. Government, States, other), aquaculture (general and descriptive, and specific species), natural fisheries and fisheries with potential for aquaculture (general and descriptive, and specific species), marketing (general market demand for specific species, other marketing), and author index. Many of the economic items annotated provide information related primarily to the supply, demand, and economics of wild-stock fish. This kind of information is directly useful in evaluating aquaculture where markets, product forms, and economic activities (such as processing and distribution) are the same or similar for

wild-stock and cultured fish, and it is also useful in understanding the degree of competition between the two sources of supply.

Subject descriptors:

Bibliography; economics; crustaceans; mollusks.

216

Jones, A.

1972.

Marine fish farming: an examination of the factors to be considered in the choice of species.

U. K. Min. Agri. Fish. Food Lab., Leaflet. (New Ser.) 24, 16 pp.

In the absence of established U.K. commercial operations from which revenue, cost, and return data might be obtained, any attempt at an assessment of the economic feasibility of marine fish farming must be rather speculative. Yet, it is useful to examine some of the possible production costs for guidance as to which species are most likely to provide positive returns. Items of cost are listed in the leaflet and costs estimated for labor, tanks, juvenile stock, and feed, with 10% added for overhead, repairs, and clerical expenses. Various prevailing technical and economic factors affect the assessment and judgement on species ranking at any point in time, but it now appears that effort should be concentrated on the R&D for high-priced species in the United Kingdom, such as turbot, dover sole, hake, and halibut, but not red sea bream and plaice. (Based on ASFA abstract.)

Subject descriptors:

United Kingdom; outlook; evaluation; concepts.

217

Jones, Walter.

1970.

Commercial fish farming; how to get started.

Amer. Fish Farm. World Aquacult. News 1 (2): 5-8. Reprinted in 1972, 4 (1): 10-13, 19.

This article presents a checklist of items to consider before investing any sizeable sum in a fish-farming endeavor. Among the items are information sources, economics, management, marketing, physical features of the production complex, source of fingerlings, feeding, harvesting, transporting, and marketing.

Subject descriptors:

Prospectus factors; risks.

218

Joyner, Timothy; Richards, Jack A.; Tanonaka, George K.

1971.

Improving productivity of Washington's water resources through aquaculture.

U.S. Dep. Commer., Natl. Mar. Fish. Serv., NW. Fish. Cent., unpubl. manusc., 27 pp.

Topics include: market demand growth for salmon and some

shellfish, the potential for sea farming in Washington, the potential economic impact, and institutional constraints. U. S. past and projected consumption, production, and import trends are discussed. Washington resources, adverse fishery changes (pollution and development related), and recent aquaculture developments are discussed, along with the technical requirements for several culture systems (feedlots, grazing, hatcheries). The authors provide estimates of the net inflow of money payments to Washington State from three kinds of culture operations and developments. The discussion of institutions centers around property rights, ownership and control, and the necessity of sufficiently long tenure to assure investment. The mariculture medium, the coastal "water column" and sea floor, is viewed as a common property natural resource.

Subject descriptors:

Benefits; demand; development rationale; benefit-cost analysis; evaluation.

219

Joyner, Timothy; Safsten, C. Gunnar.

1971.

Prospects for sea farming in Pacific Northwest.

Mar. Fish. Rev. 33(9): 22-26.

Mariculture may have many benefits, including an economic incentive to control despoilment of coastal waters by other industrial and urban activities. Specific attention is given to the Puget Sound area of the Pacific Northwest. Mariculture systems (feedlots, grazing, and hatcheries) and their products are explained. Products include salmon, oysters, prawns, and seaweeds. The state of the art, stage of development, research, and the commercial feasibility outlook for these products are discussed.

Subject descriptors:

Benefits; methods; development stage.

220

Kildow, Judith; Huguenin, John E.

1974.

Problems and potentials of recycling wastes for aquaculture.

Mass. Inst. Tech., Sea Grant Rep. No. MITSG 74-27, 170 pp.

Contents include the use of thermal and domestic sewage effluent in marine aquaculture, related problems and advantages, and social, legal, political, and economic factors in marine waste-food recycling systems. Legal aspects, consumer acceptance, and marketing strategies are discussed in detail to indicate that care must be taken to avoid past errors and possible problems. Appendices contain references, a decision making model, proposed EPA rules, pilot consumer survey results, and other information.

Subject descriptors:

Power plant heat use; sewage effluent use.

221

Krupauer, V.

1971.

Czechoslovak fishery and piscicultural research.

Proceedings, Symposium on New Ways of Freshwater Fishery Intensification, Ceske Budejovice, Sept. 22-24, 1971. Vodnany, Czech., Fish. Res. Inst., pp. 110-124.

The history of Czech pond fish culture is briefly outlined. Most fish ponds are now subject to standardized fish-farming methods. In the last 25 years fish production has increased threefold, and duck breeding, introduced 20 years ago, now accounts for 7,800 metric tons of output annually. Growth and success are attributed to: (1) national interest in fish and fowl breeding, which is regulated by grants, and price and marketing policies; and (2) creation of the State Fishery, which manages 78% of the Czech fish ponds. Supplementary feeding is not significant. The production season lasts 5 months and total annual output of fish and poultry averages 460 kg/ha. While river and lake fishing is considerable, pisciculture in the waters is endangered by pollution. Other problems include breeding, feeding, and cultural methods. (Based on ASFA abstract.)

Subject descriptors:

Czechoslovakia; history; production data; problems.

222

Lampe, Harlan C.; Marshall, Nelson; Sutinen, Jon G.; Vidaeus, Lars O.; Westin, Deborah T.

1974

Prospects for fisheries development assistance.

Univ. R. I., Mar. Tech. Rep. Ser. No. 19, 41 pp.

The potential of aquaculture and capture fisheries in developing countries is examined and assessed with a global view in relation to development assistance. In their assessment the authors provide supportive information on forecast fish demand (to the year 2000), relative costs of fish and other protein (i.e., estimated producer prices expressed in U.S. dollars per kilogram of protein) in various countries, comparisons of aquacultural enterprises (e.g., yields or economic gains; revenue, cost and return statements), and other factors.

Subject descriptors:

Economic development role; world; demand analysis.

223

Landis, Robert C.

1971.

A technology assessment methodology: mariculture (sea farming). Mitre Corp., contract No. 26, project No. 1310 for Ex. Office of the President, Office Sci. Tech. Assessment, MTR-6009, vol. 5, 180 pp.

A general technology assessment methodology is used to determine the impacts of mariculture on the developing countries. The

technology is confined to application in coastal and brackish waters. A quantitative impact analysis of economic and social factors is shown for the years 1975-1989. Various action options are posed. The problems and constraints to accelerated mariculture application are analysed, and a forecast of 20 million tons of mariculture production in 1985 is made.

Subject descriptors:

Methodology; model; forecasts; evaluation; economic development role.

224

MacCrimmon, H. R.; Stewart, J. E.; Brett, J. R.

1974

Aquaculture in Canada--the practice and promise.

Bull. Fish. Res. Board Can. No. 188, 84 pp.

Some forms of aquaculture have existed in Canada for many years on a small scale. This Bulletin reviews the current practices and identifies opportunities for establishing a substantial and viable industry based upon freshwater fisheries, marine fishes, and invertebrates. It focuses on the scientific and technical basis for such an industry and on the constraints to be encountered, and identifies areas that need experimental development to provide pilot-scale production data and economic assessments. (Authors' abstract. See G. I. Pritchard for comments relating to the same seminar where the authors originally presented their work.)

Subject descriptors:

Canada; outlook; constraints; general description.

225

Milne, P. H.

1973.

Development of fish farms in Japan.

Fishing News Internatl. 12(12): 17-20, 23-24.

Japanese aquaculture output grew from 94 kilotons in 1951 to 340 kilotons in 1961 and to 608 kilotons in 1971 when it accounted for 6.7% of the total fish catch. Seaweeds accounted for half of the 1971 weight of output, and oysters, 200 kilotons, with the remainder consisting of yellowtail, prawn, sea bream, abalone, and octopus. Government assistance of various sorts is provided to the 29,000 fishermen involved (out of total of 550,000 in Japan). Additional information is provided on the several species.

Subject descriptors:

Japan; production data; government assistance.

226

Moore, J. Jamison.

1970.

The ocean--an economic perspective.

Mar. Tech. Soc. J. 4(6): 33-37.

The results of three surveys of ocean-oriented industries and activities (1963, 1966, and 1969) are discussed and used to estimate past and future investment growth. Limitations and problems are discussed. Estimated annual expenditures are \$7.9 billion. The total investment (capital or asset level) is \$165.2 billion (1968-69), and it is estimated to increase 47% by 1980 and threefold by 2000. Coastal zone capital will increase at a faster rate, 76% by 1980. Aquaculture investment is included in one of four resource categories without a separate amount, and petroleum is the most important among these four categories. Rapid coastal zone growth (where aquaculture development is expected to occur) will bring problems of management (competing, compatible, and low- and high-density uses).

Subject descriptors:

Investment; forecasts; outlook; survey data.

227

Nash, Colin.

1972.

Marine fish farming development.

Proceedings, Kauai Aquaculture Conference, Lihue, Kauai, June 25, 1972, pp. 22-28.

Under three headings (general considerations, economic and technical factors, and conclusions), recommendations of possible finfish species for Hawaiian aquaculture are made. The following economic and technical factors are considered, with supportive discussion and both input-output and price range estimates where appropriate: local environmental advantages and disadvantages, juvenile availability, costs of suitable food and labor, growth time to market size, original stock survival, commercial value (price), and cost of facilities. It is concluded that Hawaii has certain limitations respecting the culture of finfish, such as limited markets, feeds for carnivores, and suitable offshore topography. Yet, the water quality is high and technical expertise is available. The tropical or semitropical carnivores, dolphin (mahimahi), and grouper are suggested for consideration, along with the herbivores or omnivores, mullet, and rabbitfish species. Even so, cultural methods specific to these fish are not ready for use, and the prospects for immediate commercial culture are consequently not good. Yet, it is believed that investment in R&D and pilot operations, if carefully made, will payoff.

Subject descriptors:

Hawaii; species selection; outlook; development rationale; problems.

228

Neal, R. A.
1973.

Alternatives in aquacultural development: consideration of extensive versus intensive methods.

J. Fish. Res. Board Can. 30(12, part 2): pp. 2218-2222.

This paper briefly compares legal, biological, economic, environmental, and social aspects of intensive and extensive animal aquaculture. While commercial choices and feasibility are ultimately matters of economics, research is being planned on the basis of available general information and insufficient specific data. It is concluded that intensive culture is more likely to become feasible for most carnivores and omnivores, and extensive culture (culture with few modifications of the environment), only for a few herbivores (such as oysters, mussels and milkfish). Most species of interest fall into the intensive culture category, and research is being planned accordingly. Biological factors considered (non-interactively) are feeding, environmental control, disease and density; economic factors include facility costs, competing uses of natural water, operational costs (related to biological factors), and reliability (risks).

Subject descriptors:

Research; species selection; problems.

229

Odum, William E.
1973.

The potential of pollutants to adversely affect aquaculture.

Proceedings, 25th Annual Session, Gulf and Caribbean Fisheries Institute, Miami, Fla., Nov. 1972, pp. 163-174.

The potential of pollutants to act as limiting factors on aquaculture is discussed, with reference to organic wastes, industrial wastes, power plant effluents, and large-scale environment modifications. Documented cases of damage are few. Intensive (closed) culture affords better control than extensive (open) culture. Deleterious effects of organic wastes manifest themselves indirectly. Minamata Bay, Japan, industrial waste (mercury) consequences are cited. Petroleum products can affect survival, growth, and taste, depending on concentration. Pesticides from feed, water runoff, and other sources are a problem. While bioaccumulation of isotopes from nuclear powerplants is discounted as a danger, copper and chlorine may be serious contaminants in powerplant aquaculture.

Subject descriptors:

Pollutants; biology; research; problems; outlook.

230

Okolo-Kulak, S.

1970.

Sea fisheries and agriculture: comparison of two fields of economy (Rybolowstwo morskie an rolnictwo-porownanie miedzygaleziowe).

Tech. Gosp. Morska 20(2): 63-65. (Copy of translation available on loan from NMFS.)

While the author does not discuss aquaculture per se, some differences between and similarities of sea fisheries and agriculture are discussed with particular emphasis on the methods and tools of comparison. Among the differences are: (1) geographical placement of fisheries reach far beyond national boundaries and enlarges the country's territorial food base, (2) decreasing returns appear in all cases where arable land and fishing banks are constant and the remaining production factors increase successively, though less in fisheries than farms, (3) no capital expenditures occur for fish production base, (4) structure of fixed assets and variety of farm produce differ. The main similarity is the close connection of productive activity and nature and the accompanying risks. Weighing products, wages in the two fields, scope of the comparison, assumption of certain operating conditions and circumstances in both branches, selection of reference units to calculate indexes, and proper interpretation of results are among the items included in a discussion of methodological problems and procedures pertaining to comparison.

Subject descriptors:

Economic concepts; methodology; agriculture; ocean fisheries; Poland.

231

Owens, Gerald P.

1964.

Income potential from outdoor recreation enterprises in rural areas in Ohio.

Ohio Agri. Exp. Sta., Res. Bull. 964, 51 pp.

Fishing and pay-lake operations are included in the report. The purposes of the study were to provide information on the number of recreational enterprises in the unglaciated area of southeastern Ohio, and to provide data on land, labor, and capital requirements; costs and income; operator characteristics; and management and technical problems for seven of the more popular types of rural enterprises commonly provided via private capital. A sample of 31 enterprises (5 pay lakes) was selected from an estimated population of over 250 firms in a 23-county area, and the financial data are for 1961. Catfish, bass, and bluegills are the most popular stocked fish, but some lakes also stock other species. Itemized capital investment, income and expenses, net cash income, and returns to family labor and management for the five paylake operations are shown (average and range data for all items). Numerous factors are analysed using

tables and text in the section on comparative analysis of recreational enterprises (pp. 24-45), and a shorter section is devoted to factors to consider in establishing or changing an enterprise.

Subject descriptors:

Recreation; fee fishing; survey data; revenue; costs; returns; socio-economic data.

232

Palfreman, D. A.

1973.

The economics of marine fish farming.

Fish Farming Internatl. 1(1): 47-52.

Preliminary economic analyses have been made by the British White Fish Authority. The basic objectives and methodological considerations are described briefly. The purpose is to guide R & D to cost-critical areas, so only partial cost estimates are made, disregarding non-critical aspects of cost.

Subject descriptors:

Economic concepts; methodology; evaluation.

233

Palmer, H. V. R., Jr.

1974.

Biologist finds sewage, aquaculture compatible.

Natl. Fisherman, 55(2): 12-B.

Progress is described in the experimental development of a system to produce clean water from secondarily-treated sewage and to provide food for shellfish and finfish under culture conditions. This concerns work by Dr. John Ryther, marine biologist, Woods Hole Oceanographic Institution, Mass. An expanded operation was begun in fall, 1973, with 6 ponds (each holding 36,000 gal. seawater-sewage mixture containing about 2/3 sewage), capacity of 100,000 gal. sewage per day, algal output of equivalent volume, and capability of serving a city of about 500,000 people. The experimental system is of interest to sanitary engineers for tertiary sewage treatment. Oysters and quahogs feed on the algae, and abalone feed on Irish moss. The algae and moss depend in turn on the nutrients in the sewage-seawater mixture. Seaworms (*Capitella*) and bait worms (*Nereis*) feed on the oyster and quahog droppings, respectively, and serve as feed for finfish. Viruses from the sewage are an obstacle, but the system can also be operated using commercial fertilizers as a nutrient medium in place of sewage.

Subject descriptors:

Sewage effluent use; experiment; techniques; state of the art; mollusks; finfish.

234

Pillay, T. V. R.

1972.

Coastal aquaculture in the Indo-Pacific region.

Fishing News (Books), Ltd., 497 pp.

Papers and/or abstracts presented at the Indo-Pacific Fisheries Council Symposium on Coastal Aquaculture, Bangkok, Thailand, Nov. 18-21, 1970, are organized into eight sections. Sections one (region and country reports), four and five (techniques), and eight (economics) contain information of particular interest to economists, such as area and scope, manpower, yield and production, source of seed, culture management, costs and returns, and problems. Costs and returns for culture operations of various kinds in Taiwan, Japan, Korea, Malaysia, and Thailand are reported (pp. 13-15, 35-81, 310, 314, 351, and 490-7).

Subject descriptors:

Asia; costs; returns; general description; problems; biology.

235

Pillay, T. V. R.

1973.

The role of aquaculture in fishery development and management.

J. Fish. Res. Board Can. 30(12, part 2): 2202-2217.

Contents include present status, role in fishery development, role in fishery management, and potential. Present world production is estimated as about 5 million metric tons. Estimates for 2000 range from 15 to 50 million metric tons. Usage of low-grade fish, waste and sewage-fed ponds, employment, rural development, and other subjects are discussed. Appendix tables give production by country, and cost information for aquaculture operations in various countries: trout (Ireland and Norway), carp (Poland and India), grey mullet and China carp (Hong Kong), milkfish (Philippines), yellowtail (Japan), catfish (United States), shrimp (Japan and Thailand), and oysters (Japan).

Subject descriptors:

World; production data; state of the art; development stage; revenue; costs; returns.

236

Pinchuk, V. A.

1970.

Economico-mathematical model for optimum exploitation of fish-culture production resources (Ob odnoi ekonomiko-matematicheskoi modeli optimal'nogo ispolzovaniya proizvodstvennykh resursov rybovodstva).

Rybn. Khoz. 1970(11): 118-122. (Copy of translation available on loan from NMFS.)

The purpose of this paper is to present an example of the use of linear programming for the optimization of exploitation of fish culture production resources in the Donetsk fishery group. The

model illustrated attempts to discover means for economizing on expenditures while maintaining the actual output volume of each district within the Donetsk area. In Donetsk, the 1968 fishery output was 26,268 centners of food fish and 3,533 centners of fingerlings; prices were 90 to 120 rubles and 120 rubles per centner, respectively. (One centner = 100 kg, also called a quintal.) The model's objective function, constraints, and related computational formulas are given. Tables of actual, optimized, and saved (according to the model) input usage are given for eight production districts of the Donetsk fishery group, with itemized data for feeds, fertilizers, labor, fingerlings, electric power, and pond area.

Subject descriptors:

Economic concepts; methodology; input-output data; firm data; Russia.

237

Prewitt, Roy.

1971.

Rambling along.

Amer. Fish Farmer World Aquacult. News 2(12): 17-18.

In relation to expected Corps of Engineers requirements that fish farmers obtain effluent discharge permits, a concern is whether or not fish farmers would be eligible to receive Department of Agriculture cost-sharing assistance for relevant conservation practices. Several precedents are cited to argue that fish farming has been viewed as an agricultural or farming activity and should therefore be eligible for this cost-sharing assistance.

Subject descriptors:

Conservation; effluent guidelines; legal barriers; government assistance; cost-sharing.

238

Prewitt, Roy.

1972.

Rambling along.

Amer. Fish Farmer World Aquacult. News 3(7): 16-19.

Legal barriers to the development of aquaculture, their removal, especially in Arkansas, and fish farming investment, revenue, and returns are discussed briefly. Beneficial aspects of fish farming are reviewed briefly using data for all or parts of Lonoke County, Ark. New jobs have been created, youth interest stimulated, and soil and water conservation practices promoted. Capital investment has totaled about \$833 per acre (\$208, ponds and water supply; \$400, land; other, \$225; total, \$833). Production Credit Association loans total about \$6 million and are increasing at about \$1 million annually. Data on other financial sources are not readily available. Net returns per acre are indicated for soybeans, rice, cotton, and several fish crops.

Subject descriptors:

Legal barriers; benefits; returns.

239

Pritchard, G. I.

1973.

Constraints to aquacultural development.

Canadian Fisherman and Ocean Science 59(4): 22-27.

Several Canadian constraints are discussed: development costs, feedstuffs, risks, habitat, seed stock, monoculture and government policies. The complexity of aquaculture systems requires high R&D and lead (viability testing) time in excess of the 2 to 3 years industrial managers are usually willing to accept. Aquaculture is essentially a feed-lot operation that converts, but does not produce food. Low-cost food supplies are essential. Risks (disease, predator, storm, and market uncertainties) may limit fish feed-lot size and require dispersion. Habitat problems range from site selection and climatic zone limitations to protection. Seed stocks represent an important cost, following feed and labor; hatcheries afford genetic and health control, but also call for different culture and management than grow-out stages. Mono and multiculture systems and government policies present questions and problems.

Subject descriptors:

Canada; constraints; concepts.

240

Pritchard, G. I.

1973.

With the decline of natural fish stocks other sources must be used.

West. Fish. 86(4): 38-43.

The author discusses the future of aquaculture in Canada and the need for it to be market oriented and competitive. More than 300 private trout hatcheries exist in Canada as a result of demand for fry and fingerlings for planting in private lakes and recreational ponds. Government-sponsored and operated hatcheries produce annually more than 1 million pounds of fry, fingerlings, or smolts for public waters. Constraints to aquacultural development in Canada are discussed. They include underestimation of the project scale needed to cover costs, the lack of low-cost feed for fish, and the unwillingness of producers to bear the risk burdens inherent in aquacultural development.

Subject descriptors:

Canada; outlook; problems; constraints.

241

Richards, Jack; Tanonaka, George.

1971.

Mariculture in the United States.

U.S. Dep. Commer. Natl. Mar. Fish. Serv., NW Fish. Cent., unpubl. manusc., 9 pp.

U.S. interest, national policy, and the NOAA role in policy implementation are discussed. Increasing U.S. dependence on

imports, increased world product-market and resource (fishery) competition among fishing nations and consequent rising prices, jurisdictional problems, mariculture's efficient use of space, and other reasons are cited to explain U.S. interest in mariculture. As to national policy, market demand should essentially determine what is produced and production-efficiency R&D choices. Institutional arrangements require various actions at several levels. The NOAA role in policy implementation would appear to lie in initial R&D, information transfer, continued supportive research, and leadership.

Subject descriptors:

Outlook; development rationale; institutions; demand; R&D role; public sector role; market role.

242

Rouzaud, Pierre.

1973.

General situation of aquaculture in France.

Brackishwater Aquaculture in the Mediterranean Region, FAO, General Fisheries Council for the Mediterranean, Stud. Rev. (52): 25-33.

Private and public sector research and experimental commercial activity are described (to 1971), and proposed work is indicated. One firm is operating a commercial eel farm, using juveniles obtained from natural stocks. Research relates to reproduction, feeds and feeding, growth and other cultural study areas for bass and gilthead bream, turbot, shrimp, Pacific salmon, trout in sea water, and mullet.

Subject descriptors:

France; research; experiments; state of the art.

243

Rutka, Justin.

1969.

Evolution of public policies affecting exclusive use of coastal zone fishery resources: a comparison of public policies of Japan and the United States with implications on the status and potential of aquaculture in Hawaii.

Univ. Hawaii, Dep. Agri. Econ., unpubl. paper, 27 pp.

The author compares definitions of aquaculture, food output from land and ocean resources, distribution and intensity patterns, agricultural and aquacultural yields (which are rejected as comparisons since they refer to only one input and are therefore without much meaning), and the importance of aquaculture in Japan and the United States. Then the legal history of use and ownership patterns of tidal lands are explored briefly for the United States, Japan, and Hawaii. Owing to its shortage of arable land and dependence on the sea, Japan developed institutions of exclusive use and formalized them into law in the Meiji Restoration of 1848. In 1949, "demarcation rights" were established for shallow sea culture. The U.S. system derives

from the English common law system, with private property and public-trust or common rights, the latter applying to submerged coastal lands and tidelands. Presumptions of ownership, Federal-State conflicts, and court cases ensued. The Hawaiian system was closer to that of Japan until the U.S. Congress manifested its intent to preclude private fishing rights in the territorial legislation of 1900, except for ponds or artificially enclosed areas. Again, court cases ensued and the situation is uncertain, thereby serving as a disincentive to investment in aquaculture.

Subject descriptors:

Institutions; Japan; Hawaii; U.S.; constraints; history; legal barriers.

244

Ryther, John H.; Bradach, John E.

1968.

The status and potential of aquaculture, parts 1, 2 and 3. Clearinghouse Fed. Sci. Tech. Inform., 531 pp. (The publisher supplies vol. 1, containing parts 1 and 2 as PB 177 767, and vol. 2, containing parts 1 and 3 as PB 177 768.)

Part 1 includes introduction, general principles, conclusions, summary and recommendations; part 2, shellfish; part 3, finfish. While it was not possible for the authors to conduct an exhaustive survey of aquacultural practices for the world, they did select examples which are representative of as many as possible of the different species of organisms in culture, the different countries or regions of the world with respect to climate, race, and economic development where aquaculture is carried out, and the different levels of intensity and technological sophistication which are in use and may be included within the broad definition of aquaculture. For each example, as much information as possible has been obtained on the basic biology and ecology of the organism in culture, the procedures and techniques employed in the practice, and yields and economics of the operation, if commercial. (Authors' statement modified.)

Subject descriptors:

State of the art; world; research; methods; techniques.

245

San Feliu, J. M.

1973.

Present state of aquaculture in the Mediterranean and South Atlantic coasts of Spain.

Brackishwater Aquaculture in the Mediterranean Region, FAO, General Fisheries Council for the Mediterranean, Stud. Rev. (52): 1-24.

Based on information gathered in a survey-tour, production volume and value, input data (area, rafts, lines, etc.), techniques and other description are provided for commercial aquaculture, with annual data for one or more production seasons in the period

1967-71. Government research center activity is indicated. Expansion, intensification, and diversification possibilities are given, along with indications of the restrictions caused by increased harbor traffic in some culture-site areas and agricultural pollutants in others. The Spanish coastline consists largely of beaches and rocky cliffs, reducing the amount of area suitable for culture. Commercial culture species include mussels (grown on specially constructed rafts, called "bateas"), flat oysters (but the northwest Spanish coast has more commercial activity), Portugese oysters, and in confined coastal waters, eels, elvers, bass, gilthead bream, carp, goldfish and other species. Mollusk cleansing (purification) plants are also described.

Subject descriptors:

Spain; survey data; general description; mussels; oysters; eels; bass; gilthead bream; carp; goldfish; depuration plants.

246

Sarig, S.
1972.

Fisheries and fish culture in Israel in 1971.

Bamidgeh 24 (3): 55-75.

This article contains graphs, tables, and other data on fisheries and fish culture in Israel in 1971. Total catch rose by 5,000 metric tons compared to 1969, a 24% increase. Fish culture accounted for 50% of the increase. Compared to 1970, the 1971 catch increased by 3,100 tons (13.5%), of which fish culture was responsible for 21%. Per capita consumption in 1969-71 according to sources and use is given in table form. Data on marine fisheries, the inland fishery (Lake Kinerith), and the canning industry are also graphed, tabled, and summarized. The section on fish culture includes data on fish pond area and yields (1963-71), and average annual yields of marketable fish by regions (1969-71) and by productivity groups. A section on fish species cultivated in ponds reveals that mullet decreased by 24% compared to 1971. Marketing of the pond fishes is discussed and tabled by month from 1968 to 1971. The average national yield of pondfish increased by 3.2% compared to 1970.

Subject descriptors:

Production data; consumption data; acreage data; productivity; markets.

247

Sarig, S.
1973.

Fisheries and fish culture in Israel in 1972.

Bamidgeh 25(2): 35-55.

This article contains graphs, tables, and other statistical data on fisheries and fish culture in Israel in 1972. Total Israeli fishery catch for that year was 26,741 tons, which represented a 3.3% increment over 1971. There has been a 30% increase (3,016

tons) in pond culture since 1970. Pond culture catch is 50% of the total Israeli catch. Graphs show the distribution of fish pond catch by year and total catch by year and source. Data on catch by species, source, and percentage increases in catch are given for the 1960's and through 1972. The number of fish farms decreased by 2.4% in 1972. The cultured species discussed are carp, tilapia, mullet, and silver carp. The increment in 1972, compared to 1971, of cultured carp was 400 tons (3%) and for tilapia it was 132 tons (12%). Cultured mullet decreased by 55 tons (6%). Ton amounts, increases, and decreases in marketed pondfish from 1969 to 1972 are illustrated graphically and in table form. The portions of carp, tilapia, mullet, and silver carp in all pondfish marketed amounted to 84.7%, 9.2%, 4.2%, and 1.9%, respectively. A summary of major points is also given.

Subject descriptors:

Israel; production data; consumption data; acreage data; productivity.

248

Scott, Anthony.

1970.

Economic obstacles to marine development.

William J. McNeil, editor, Marine aquiculture, Selected papers from Conference on Marine Aquaculture, Oreg. State Univ., Mar. Sci. Cent., Oreg. State Univ. Press, pp. 153-167.

Topics related to aquaculture include: control over resources, demand, research, and innovation, and property, tenure and externalities (exclusion and spillover, permanence and flexibility). Markets for aquacultural products now relate either to luxury or to cost-advantage items. It is suggested that R&D proposals be submitted to more rigorous evaluation as to economic payoff. Innovation (the actual implementation of methods determined in the R&D process) in the fishing industry is as likely as in other industries, but the business operators are properly skeptical, given the risks of their ventures and their interest in payoff. Natural resource use and development require exclusiveness (to assure returns and for protection from adverse spillovers of other activities), permanence (to secure returns which accrue through time) and flexibility (to allow changes in technique without penalties).

Subject descriptors:

Economic concepts; institutions; R&D role; R&D evaluation; risks.

249

Secretan, P. A. D.

1975.

Insurance for fish farmers.

Fish Farming Internatl. 2 (1, 2, 3): 26 and 28, 22-23, 26-27.

Three aspects of insurance for fish farmers are discussed: stock losses, inflation protection, and risk management. Insurance is viewed as a device for handling major losses, but the

accumulative effect of numerous small losses must also be recognized in a risk management program. Several suggestions are made to achieve risk reduction and a satisfactory insurance program. Good records to establish loss values, loss-preventive action, loss-mitigative action, large deductibles, timely adjustment of coverage in inflationary periods, and risk management analysis are among the factors considered.

Subject descriptors:

Insurance; risks; general description.

250

Shang, Yung C.

1973.

Comparison of the economic potential of aquaculture, land animal husbandry and ocean fisheries: the case of Taiwan.

Aquaculture 2(4): 187-195.

The comparison is based on productivity, cost, internal rate of return (IRR), Taiwanese consumer demand, expected growth, and nutritional information and analyses. Taiwanese aquaculture includes brackish water (milkfish), freshwater (carps and tilapia) and shallow sea (mostly oysters) production. Ocean fisheries are divided into deep-sea (mostly tuna and tunalike species for export), inshore, and coastal fisheries categories. Hog raising is the most important and well established form of land animal husbandry. At present, the IRR's for all culture methods exceed those for ocean fisheries and hog farming. With some government and industry development programs, culture technology and management are expected to improve, allowing for lower costs, whereas ocean fishery costs are not expected to change (given the present advanced state of technology). In terms of calorie and protein content, protein cost, quality, and consumer preference comparisons, fish culture seems to have a distinct advantage in Taiwan. Labor productivity (kilograms of output per man year), geographic productivity (kilograms per hectare), and average costs of output (U.S. \$ per kilogram) may result in different rankings than the IRR criterion. Data for some of these variables are given for both average and superior management conditions.

Subject descriptors:

Taiwan; enterprise comparison; costs; returns; productivity; consumption data; demand; supply; outlook.

251

Smith, Leah J.; Huguenin, John E.

1975.

The economics of waste water--aquaculture systems.

1975 IEEE [Institute of Electrical and Electronics Engineers] Conference Record on Engineering in the Ocean Environment, Ocean '75, September 22-25, 1975, pp. 285-293.

Based on a system developed at Woods Hole Oceanographic Institution, the "design, performance, and resulting costs of

operational systems for commercial production scaled up by factors of 10, 100, and 1000 are projected and compared. Despite uncertainties in the systems, our analysis shows that large-scale systems using sewage as a nutrient source and free heat from power plant effluent (or located in a warm climate) could be profitable."

Subject descriptors:

Power plant heat use; sewage effluent use; costs.

252

Sysoev, N. P.

1970.

Economics of the Soviet fishing industry (Ekonomika rybnoi promyshlennosti SSSR).

D. Daneman, transl., Israel Progr. for Sci. Transl., Jerusalem, 1974, 386 pp. (Obtain from NTIS.)

This book is approved by the U.S.S.R. Ministry of Fisheries as a textbook for institutions of higher learning, and describes the fishing industry, its development, management, and analysis in economic terms. Capital investment, enterprise cost, profit, labor productivity, price formation, financing, and other concepts are explained. While pond fish culture is not identified as a separate topic in the table of contents (there is no index), it is discussed. (See e.g., pp. 30, 46, 101-105, and 225.) Pond fish have accounted for 0.6% of the U.S.S.R. catch for 30 years, with their output increasing from 8.4 (in 1940) to 52.4 (in 1968) metric kilotons. Productivity averaged 0.67 tons/ha in 1968. Economic indicators are shown for six advanced farms in 1968, and include output in tons per hectare, prime cost per ton, profit per ton, profit as a percent of prime cost, profit as a percent of fixed assets, and normal working capital (10 to 30%), and time to recover asset investment (3-8 years). Carp account for up to 90% of the warmwater output. Herbivores accounted for 11% of total pond output in 1968. Profit and productivity improvements relate to mechanization, mineral (nonorganic) fertilizers, multiple species culture, sufficiency of juvenile supplies, pure-strain breeding, use of granular feeds, etc.

Subject descriptors:

U.S.S.R.; economic concepts; methodology; development rationale; production data; outlook; revenue; costs; returns; history.

253

Szamborski, Jerzy.

1967.

Calculation of economic effectiveness of investments in fish farms (Rachunek efektywnosci ekonomicznej inwestycji w obiektach rybackich).

Gcsp. Rybn. 19(7): 3-5. (Copy of translation available on loan from NMFS.)

The main factors that influence the evaluation of the economic

effectiveness of an investment include: (1) duration of the investment cycle (period from construction initiation to first use of project), (2) the mass of envisaged production and the birth rate, (3) costs of production (operating costs plus the annual equivalent of capital costs, which are called costs of adaptation or transformation), and (4) length of time of exploitation of a planned investment. An example involving the computation of an index of effectiveness of a planned capital repair for a particular pond project is given, following an explanation and discussion of the variables and assumptions in the index. This index is essentially an annual cost benefit ratio and was obtained from the Polish Ministers' Planning Commission instructions on the economic comparison and evaluation of the efficiency of investments. A previous application by the author is cited (1967, Gosp. Rybn. 19(2): 3-5).

Subject descriptors:

Investment model; benefit-cost analysis; economic concepts; methodology; Poland.

254

Szamborski, Jerzy.

1967.

Some elements of the economic efficiency of pond production (Niektóre elementy ekonomicznej efektywności produkcji stawowej).

Gosp. Rybn. 19 (2): 3-5. (Copy of translation available on loan from NMFS.)

Output per hectare of carp (ponds) and beef cattle (pasture) are compared on the basis of meat and protein weight, and live-animal value. This is done for the primary (natural) increase, then with specified amounts of fertilizer, and finally fertilizer and feed in specified amounts. Carp is clearly more productive. However, investment projects for the two kinds of production differ in several particulars and the author then explains and applies a general formula for comparing the efficiency of investments, as obtained from the Polish Ministers' Planning Commission instructions. This formula takes account of various costs in the numerator and the value of output in the denominator all on an annual basis. It is an annual cost/benefit ratio.

[Annotator's note: certain computational assumptions differ from those sometimes used in U.S. water resource agency benefit-cost analyses respecting the interest rate or discounting rate effects of time, although a time-adjustment factor is used.] In terms of annual cost-benefit ratios, beef and carp are similar or closer in investment efficiency than they are on the basis of simple productivity, but if the flood prevention effects of carp ponds are counted, carp are again the winner over beef. Of course, possible exceptions for individual projects are recognized.

Subject descriptors:

Enterprise comparison; carp; beef cattle; productivity; benefit-cost analysis; economic concepts; economic feasibility; investment model; Poland.

255

Tal, S.

1973.

New prospects in fishculture in Israel.

Bamidgeh 25(3): 67-71.

New intensive fish culture methods are discussed. The 1972 yield from pond culture was 13,350 metric tons with an average productivity of 2.7 tons/ha of pond area. The Israeli market can handle up to 17,000 tons of all kinds of pondfish in 1973, but the actual yield will be only 15,000 tons. Since 1965, output has increased by 82%. The demand forecast for 1974/75 is 19,000 tons. To supply this demand, 4 tons per hectare from 5,000 hectares of ponds is necessary. Water limitation problems are also discussed. Unpotable, brackish waters are used for pisciculture to avoid fish farming at agriculture's expense. Investment, transition (from conventional to intensive fish culture), feed problems, and the possibility of marine farming are discussed. The new intensive culture method will introduce more efficient work methods.

Subject descriptors:

Israel; productivity; investment; outlook; forecasts.

256

Treasurer, J. W.

1974.

Fish farming--the future.

Fish Marketing, Processing, Packaging (17): 11 and 13.

While not discouraging fish farming, the author briefly challenges the views expressed by specific writers for possible overoptimism.

Subject descriptors:

Constraints.

257

Trimble, Gordon M.

1972.

Legal and administrative aspects of an aquaculture policy for Hawaii: an assessment.

Hawaii, Dep. Plan. Econ. Dev., Cent. Sci. Policy Tech. Assessment, and West. Interstate Comm. Higher Educ., Resour. Dev. Internship Progr., 61 pp.

This report discusses an assessment of legal and administrative aspects of aquaculture in Hawaii initiated by the Governor's Advisory Committee on Science and Technology. Background information on laws, water rights, regulatory institutions, coastal zone statutes, water quality standard enforcement, State land use regulations, and the agencies responsible for each category are detailed. Fishing regulations, and agencies which provide technical and financial assistance for aquaculture activities and their programs are also outlined. A table of permits required for aquaculture activities is presented along

with a discussion of the impact of existing laws and institutions on aquaculture. Laws affecting aquaculture in other States are also presented.

Subject descriptors:

Institutions; legal barriers.

258

Webber, Harold H.

1972.

The design of an aquaculture enterprise.

Proc., Gulf Caribb. Fish. Inst., 24th Annu. Sess., Nov. 1971, pp. 117-125.

Among the factors judged to be important in determining the success of an aquaculture operation are those having to do with site selection, which the author emphasizes in this paper. Selection of sites is discussed with reference to ranch, pond, raceway, cage and closed (high-density) methods of culture. A comprehensive, extensive list of site selection criteria is provided.

Subject descriptors:

Site selection criteria.

259

Webber, Harold H.

1973.

Risks to the aquaculture enterprise.

Aquaculture 2(2): 157-172.

Successful operation of an aquaculture business requires entrepreneurship, knowledge of biological process uncertainties, management skill, and sufficient capital resources to achieve appropriate economies of scale. Risk aspects of commonly used problem or management areas for a hypothetical enterprise in the American Tropics are discussed independently, but their interdependence is recognized. Biological risks include diseases and parasites (a major problem), seed production, predation and competition, inventory control (serious since it impairs management), nutrition, and natural productivity. Physical risks include water quality and storm damage. Social and economic risks relate to political stability (in developing countries), land, labor, poaching, feed costs, and market changes. The discussion details the nature of various risks, and offers suggestions on possible degrees of risk interaction and risk losses in qualitative terms.

Subject descriptors:

Risks.

Wildman, Robert D.

1974.

Aquaculture in the National Sea Grant Program.

William N. Shaw, editor, Proceedings of the First U.S.-Japanese Meeting on Aquaculture at Tokyo, Japan, October 18-19, 1971. U.S. Dept. Commer., Natl. Mar. Fish. Serv., NOAA Tech. Rep. Circ. 388, pp. 41-56.

The National Sea Grant Program's aquaculture projects are described by type of organism being studied: crustaceans (shrimp, crabs, lobster, and crayfish), mollusks (oysters, clams, scallops, abalone, octopus, and limpets), finfish (salmonids, mullet, dolphin, and miscellaneous), and seaweeds (red and brown algae). As of June 30, 1971, the National Sea Grant Program was helping to support over 50 projects directly related to aquaculture with a total (joint or shared) cost of \$5 million, and with over \$3 million being from the Program. The research work, technological developments in rearing species, and specific universities and other institutions doing the work are discussed. Market potential of species, reproductive ability, environmental effects on species' productivity and feed data are among the specific terms discussed under each species. Also, programs in marine pathology directed at diseases of seafood organisms are discussed as well as new aquaculture sites. A listing of National Sea Grant Aquaculture Programs by organization is provided.

Subject descriptors:

Research; R&D role; public sector role; investment.

Williams, Simon.

1975.

Conflict of interest and its resolution as factors in the commercialization of aquaculture in the Americas.

Mar. Fish. Rev. 37(1): 48-51.

The author focuses on what he views to be a neglected area, "organizing the business of aquaculture so that its benefits ensure the maximum satisfaction of the people of a host country." Host country aspirations of national development, reactions to enclave and exploitive kinds of operations, actions to produce change, and problems are discussed, along with attitude and objective changes by private enterprise (e.g., acceptance of responsibility for general economic development, use of return on investment criteria that include interests of the host country, and willingness to share or eventually transfer ownership). Some examples of operating institutions in Mexico are given in the context of helping to resolve conflicts of interest between private (often foreign) investors and people of the host country.

Subject descriptors:

Economic development role; development planning; externalities; institutions.

Yee, William C.

1972.

Thermal aquaculture: engineering and economics.

Environ. Sci. Technol. 6(3): 232-237.

Thermal effluent from electric power generating plants is expected to be a matter of increasing concern as power output grows. The author provides information on his surveys of the experimental uses of this waste heat to hasten the growth of various aquatic species in several countries. Also, a design concept is discussed for an integrated shrimp culture operation at a power plant site. Operating and capital costs are estimated (including hatchery, growth to market size, and processing operations) in the context of using sensitivity analysis to determine economic feasibility at any site.

Subject descriptors:

Powerplant heat use; technology; method evaluation.

Adrian, J. L.	1, 2	Fullenbaum, Richard F.	189
Agnello, Richard J.	98		
Allen, George	166		
Allen, P. G.	132, 136	Garino, David P.	128
Alvarez, Vicente B.	163, 164	Garner, Carroll R.	30
Anderson, Lee G.	121, 171	Gary, Don L.	129
Anderson, Leon	143	Gates, John M.	86, 89, 202-205
Araji, A. A.	70	Gaucher, Thomas A.	206
Arroyo, Igcr Solar	71	Gibson, Gary G.	103
Asakawa, Kenji	185	Gooby, Dick	75
Avault, James W., Jr.	123, 124	Goodwin, Harold L.	207, 208
Ayers, James W.	18	Gopalakrishnan, V.	131
		Gordon, William G.	147
		Gray, D. LeRoy	31
Baldwin, Wayne J.	148	Greenfield, John E.	32-37
Ballew, Ralph J.	53	Griffin, Charles	209
Bardach, John	186, 187, 188, 244	Grisom, C. A.	205
Bartonek, Frank A.	19	Grizzell, Roy A., Jr.	38, 39, 40
Bell, Frederick W.	189, 190	Gunter, Gordon	104
Berge, Leidolv	72		
Billy, Thomas	20, 21, 54		
Blades, Holland C., Jr.	125	Halbrook, W. A.	30
Bollman, Frank Herbert	84	Hammack, Gloria	210
Bond, B. J.	191	Heffernan, Bernard E.	41
Boozer, David	192	Heidinger, Roy	150
Botsford, L. M.	136	Helfrich, Philip	130
Brett, J. R.	224	Henry, Harriet P.	211
Brown, E. Evan	22, 23, 73, 193	Herrick, Samuel F.	148
Buettner, Howard J.	24	Hidu, Herbert	105
		Hill, T. K.	73
		Hclemo, Frederick J.	22
Canterbery, E. Ray	190	Hudson, Horace	22
Carlson, Ernest W.	189	Hudson, Stanton	149
Carr, Mark I.	119	Hughes, Janice S.	26
Carroll, Billy B.	54	Huguenin, John E.	220, 251
Carroll, James C.	125	Hunter, Charles J.	166
Castagna, Michael	99		
Cavanaugh, Carroll	100		
Charbonneau, J. J.	101	Idyll, C. P.	212
Chesness, J. L.	73	Insull, A. D.	213
Clark, Robert C., Jr.	87	Iversen, Robert T. B.	155
Cohee, Melville H.	194	Iversen, E. S.	214
Collins, Charles M.	25		
Collins, Richard A.	74	Jaspers, Edmonde J.	124
Collinsworth, Don W.	215	Jhingran, V. G.	131
Colwell, Bryan	170	Johnston, Warren E.	132, 215
Conversano, Guy	170	Jones, A.	216
Costello, Frederick A.	102, 108	Jones, Walter G.	42, 43, 217
Covey, L. H.	23	Joyner, Timothy	87, 90, 218, 219
Cowan, Dorian	195		
Culley, Dudley D., Jr.	153, 196		
Dassow, J. A.	197	Kensler, Craig	136
Davidson, Jack R.	198	Kildow, Judith	220
Davis, James T.	26	Kinnear, H. M.	44
Dawes, Clinton J.	162	Kinoshita, Richard K.	189
de la Bretonne, Larry W., Jr.	126	Kirby, Martin	45
Demoran, William J.	104	Klontz, George W.	76
Dillon, Clan W.	40	Koposov, A. F.	88
Dobson, W. D.	199	Krupauer, V.	221
Donahue, John R.	27		
Donnelley, Lawrence P.	98	Lacewell, Ronald P.	60
Doty, Maxwell S.	163, 164	Lampe, Harlan C.	222
Duknovski, M. K.	145	Lander, Robert H.	97
		Landis, Robert C.	223
		LaPlante, M. G.	23
Eschmeyer, Paul T.	56	Lee, Jasper S.	46, 47
		Lewis, William M.	150
		Lund, Dennis S.	103
Fair, Armor John	79	McCoy, E. W.	1, 2, 48, 49, 50
Farstad, Nelvin	72	MacCrimmon, H. R.	224
Fedyaev, V. E.	200	MacDonald, C. R.	89
Fessler, Floyd R.	81	McGuinness, Fred	77
Ffrench, Rudolph A.	165	MacKenzie, Clyde L., Jr.	106, 107
Fijan, N.	201	McLarney, William O.	187, 188
Folsom, William B.	146	Madewell, Carl E.	51, 52, 53, 54, 63, 193
Ford, Erwin C.	28	Mahnken, Conrad V. M.	87, 90, 91, 93
Foster, Thomas H.	29	Mange, Frank A.	55
Franz, Robert S.	126	Marsh, Brent L.	102, 108, 109
Fraser, Jim	85		
Fujimura, Takuji	137		

Marshall, Nelson	222	Safsten, C. Gunnar	219
Martin, John B.	191	Sakai, H.	152
Martin, Stephen G.	85	San Feliu, J. M.	245
Martino, K. V.	151	Sarig, S.	246, 247
Mason, J.	110	Schuur, A. M.	136
Matthiessen, George C.	111, 112, 204, 205	Scott, Anthony	248
Mattox, Bruce W.	95	Scott, Clyde A.	81
Maurer, Don	143	Secretan, P. A. D.	249
Mays, David A.	191	Shang, Yung Cheng	137, 138, 154, 155, 250
Meade, James W.	78	Shaw, William N.	118
Meade, T. L.	89	Sherling, A. B.	49
Menzel, Winston	113	Shpet, G. I.	156
Meyer, Fred P.	56	Silverthorne, Wesley	168
Miller, Morton M.	57	Smith, Leah J.	251
Milne, P. H.	225	Smith, Theodore Isaac Jogues	157
Minamisawa, A.	152	Sneed, Kermit E.	56, 158
Mock, C. R.	134	Sorenson, Philip E.	168
Moore, J. Jamison	226	Steinberg, M. A.	197
Morrison, A. W.	108	Stevens, Joe B.	95
Morrison, W. R.	61	Stewart, J. E.	224
Morse, N. H.	114	Sullivan, Edward G.	40, 65
Mueller, J. J.	86	Sutinen, Jon G.	222
Mull, Wilbur C.	79	Sysoev, M. P.	252
Mullins, Troy	58	Szamborski, Jerzy	253, 254
Mustafin, R. M.	151		
Nash, Colin	227	Tabb, Durbin C.	121
Nash, Darrell A.	57, 189	Tal, S.	255
Neal, Richard A.	135, 228	Tanonaka, George K.	93, 169, 218, 241
Nelson, Roy	59	Tarr, Marvin A.	119
Nichols, John P.	60	Thompson, Russell G.	55
Novotny, Anthony J.	90, 91	Toner, R. C.	112
		Treasurer, J. W.	256
		Trimble, Gordon M.	257
		Trotter, Warren K.	62
Odum, William E.	229	Vaughn, Charles L.	120
Okolo-Kulak, S.	230	Vidaeus, Lars O.	222
Owens, Gerald P.	231	Vreeland, Robert R.	97
Palfreman, D. A.	232	Wagner, Louis C.	96
Palmer, H. V. R., Jr.	233	Wahle, Roy J.	97
Parker, Henry S.	167	Waldrop, John E.	29
Pesson, I. L.	115	Waugh, Frederick V.	189
Pillay, T. V. R.	234, 235	Wear, R. G.	139
Pinchuk, V. A.	236	Webber, Harold H.	140, 258, 259
Pippin, Kenneth	61	Welsh, James P.	141
Prewitt, Roy	237, 238	Westin, Deborah T.	222
Priddy, John M.	153	Westley, Ronald E.	119
Pritchard, G. I.	80, 239, 240	White, James T.	159
		Wildman, Robert D.	260
		Williams, Robert James	142
		Williams, Simon	261
		Winget, Rodner R.	143
Quayle, D. B.	116	Yamamoto, Tadasu	160
		Yeager, J. H.	66
		Yee, William C.	144, 262
Raulerson, Richard C.	62	Zaidinar, Yu. I.	161
Richards, Jack A.	92, 93, 218, 241		
Richardson, I. D.	213		
Roberts, Kenneth J.	94		
Rockwood, Charles E.	117		
Rogers, Bruce D.	63		
Rouzaud, Pierre	242		
Russell, Jesse R.	64		
Rutka, Justin	243		
Ruzic, J. E.	48, 50		
Ryther, John H.	187, 188, 244		