

AQUACULTURE DRUGS: EFFECTIVENESS OF FLORFENICOL, OXYTETRACYCLINE, CHLORAMINE-T, AND HYDROGEN PEROXIDE [\(12\)](#)

Project Termination Report for the Period
October 1, 1999 to August 31, 2001

NCRAC FUNDING LEVEL: \$8,415 (October 1, 1999 to August 31, 2001)

PARTICIPANTS:

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Fish Culture Research Facility

Non-Funded Collaborators:

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REASON FOR TERMINATION

The project objectives were completed.

PROJECT OBJECTIVES

(1) To evaluate the effectiveness of florfenicol and oxytetracycline to control mortalities caused by *Flavobacter columnare* in selected cultured fish and to evaluate the effectiveness of chloramine-T to control mortalities caused by bacterial gill disease in selected cultured fish.

(2) To collect tissue residue depletion data for florfenicol, oxytetracycline, chloramine-T, and hydrogen peroxide in selected cultured fish.

PRINCIPAL ACCOMPLISHMENTS

OBJECTIVE 1

In 2000, work conducted at Iowa's Department of Natural Resources Rathbun Fish Culture Research Facility was designed to test the effectiveness of oxytetracycline to control systemic infections of *Flavobacter columnaris* in walleye. In this study walleye were induced by stress to break out with a columnaris infection. Fish were divided into two replicate groups of three controls receiving untreated feed and three treated groups receiving oxytetracycline feed treated at 82.7 mg active ingredient/kg fish. Each replicate contained 145 walleye. Treated feed was fed for 10 consecutive days, and a 14 day post-treatment period was used to monitor fish mortality. Two days into the study an infection

of the protozoan *chilodonella* was detected and a 1.0% salt treatment was administered to cure the infection.

The three tanks that received treated feed had fish mortalities of 29.7%, 32.4%, and 17.2%. Tanks receiving untreated feed had total mortalities of 31.0%, 20.7%, and 26.9%.

Data analysis was performed after the September 18, 2000 post-treatment period. Analysis showed no significant difference between groups fed oxytetracycline treated feed and groups fed untreated feed.

During August 2001, walleye were stressed and became infected with *Flavobacter columnare*. A study was begun August 17 to test the effectiveness of feeding oxytetracycline to control this bacteria. Fish were randomly divided into groups of three controls receiving untreated feed and three groups receiving oxytetracycline treated feed. Each replicate tank contained 187 walleye.

The study was terminated after only two days because the walleye developed an infection of bacterial gill disease. Food and Drug Administration guidelines do not allow the acceptance of results compounded by a secondary infection.

Work that was planned for September 1, 2001 to May 30, 2002, using a no-cost grant extension was not performed because disease outbreaks of *Flavobacter columnare* could not be generated during this period.

OBJECTIVE 2

In October 1999, a study performed at the Rathbun Fish Culture Research Facility was designed to gather residue depletion data of oxytetracycline in cultured fishes. This data was gathered for walleye during the contract period. The label currently restricts the administration of oxytetracycline to control specific diseases in salmonids and catfish. This residue depletion study was conducted to support the extension of the label to include all cool water fish species cultured at public and private aquaculture facilities.

In this study, 461 walleye weighing a mean of 61.2 g (2.2 oz) each were offered 3.87% of their total body weight per day of a slow sinking walleye diet (Walleye Grower 9206). The diet top-coated with oxytetracycline (89.0 mg/kg/day) was fed for 10 consecutive days. Fifty fish were sampled as control fish before feeding of the treated feed and 20 fish were sampled 1, 2, 3, 4, 7, 9, 11, and 14 days after treatment. Skin-on fillets were analyzed for oxytetracycline-base concentration at the U.S. Geological Service Biological Resource Division's Upper Midwest Environmental Sciences Center (UMESC). Water temperature during the treatment period ranged from 16.7-18.4°C (62.1-65.1°F) and was 12.9-17.0°C (55.2-62.6°F) during the depuration period.

The maximum mean oxytetracycline-base concentration in the fillet tissues of walleye fed the medicated grower was 721 ng/g. This concentration is below the current oxytetracycline-base tolerance limit of 2,000 ng/g.

Expanded Scope of Work (Hydrogen Peroxide)

The scope of work for this project was expanded to include the efficacy testing of hydrogen peroxide for fungus on channel catfish eggs, *Flavobacter columnare* on channel catfish, hydrogen peroxide for parasites on walleye, and hydrogen peroxide and chloramine-T for *Flavobacter columnare* infections on walleye.

Research was conducted to expand the label of 35% Perox-Aid™ to include channel catfish eggs for the treatment of fungus. Treatments were run at 500 mg/L and 750 mg/L Perox-Aid™ as a flow through. There were three replicates for the control and each treatment concentration. Egg volumes ranged from 6,600-7,700/jar. Eggs were treated for four consecutive days until they began to hatch on day 5. No fungus was present in any of the treatment groups, but fungus was present in all untreated control groups. Even though fungus was present, no affect on hatch was detected. Perox-Aid™ concentrations did not reach desired levels in any treatments with a mean of 324 mg/L at the 750 mg/L treatment concentration and 241 mg/L at the 500 mg/L treatment concentration. It was later determined the Perox-Aid™ concentration had been inadvertently diluted by the company from 35% to 15%.

Another study was conducted in 2000 at the Rathbun Fish Culture Research Facility to evaluate the effectiveness of hydrogen peroxide and chloramine-T to control *Flavobacter columnare* in walleye.

Fish held in a rearing tank, prior to the study, were naturally infected with *Flavobacter columnare*. When a columnaris infection was detected on some of the test fish and mortalities began to increase, treatment began. Treatments were conducted in two portable systems with one system containing 12 tanks and one system containing 9 tanks. All tanks contained 40 L (10.6 gal) of water.

Hydrogen peroxide (commercial grade 35% active, DuPont, Memphis, Tennessee) and chloramine-T (commercial grade 99-100% active ingredient, AKZO Chemicals, Dobb Ferry, New York) were prepared as stock solutions. Treatments were 50, 100, and 150 mg/L hydrogen peroxide, and 10, 20, and 30 mg/L chloramine-T. Controls in three tanks were used for both treatments. Hydrogen peroxide was administered as 30 min exposures and chloramine-T as 60 min exposures.

Active chemical concentrations calculated by water testing were 50.9, 101.2, and 149.3 mg/L for hydrogen peroxide and 9.7, 18.5, and 27.5 mg/L for chloramine-T.

Results showed mean fish mortalities in the hydrogen peroxide trial were 17.3% (control), 17.3% (50 mg/L), 38% (100 mg/L), and 90% (150 mg/L). Hydrogen peroxide treatments were toxic at 100 mg/L or greater.

Mean fish mortalities in the chloramine-T trial were 17.3% (control), 16.0% (10 mg/L), 23.3% (20 mg/L), and 18.7% (30 mg/L).

None of the treatments resulted in a statistically significant reduction in fish mortalities. These data also support the conclusions of other researchers that walleye are one of the most sensitive species to hydrogen peroxide.

During July 2001, walleye held in rectangular tanks contracted a natural infection of the protozoan parasite *chilodonella*. A study was conducted to test the efficacy of 35% Perox-Aid™ in eradicating the parasite.

Tests were conducted in six 288-L (76 gal) circular tanks. A prestudy parasite evaluation on 31 walleye showed 21 fish had >25 *chilodonella* per gill arch and 10 fish had from 1-16 per gill arch. Each circular tank was stocked with 250 walleye in a random order to give three treatment tanks receiving Perox-Aid™ and three untreated control tanks.

Treatment tanks received 100 mg/L Perox-Aid™ for 30 min. Water samples were taken 15 min into the treatment from each treatment tank and one control tank for titration to determine the hydrogen peroxide concentration. At the end of 30 minutes all tanks were drawn down and flushed to eliminate the hydrogen peroxide. Dissolved oxygen, pH, temperature, and mortalities were recorded for each tank on a daily basis.

Two Perox-Aid™ treatments were administered on alternate days and fish were then evaluated for the presence of *chilodonella* 2 days and 8 days post treatment. Ten fish were examined per tank on day 2 and six fish on day 8 post treatment.

Post-treatment examination of treated fish for *chilodonella* showed no parasites present at day 2 or day 8. The number of *chilodonella* on untreated control fish ranged from 0-11/gill arch on day 2 post treatment and from 0-181 on day 8 post treatment, with a mean of 49 per gill arch.

Mean mortality after one treatment was 22 in treated tanks and 38 in control tanks; however, after the second treatment, mean mortality was 87 in treated tanks and 14 in control tanks. By day 7 post treatment, mean mortalities were 20 in the control tanks and two in the treated tanks. While Perox-Aid™ is effective in controlling *chilodonella*, care must be taken when treating walleye due to chemical sensitivity.

A second study was conducted in 2001 to evaluate the efficacy of Perox-Aid™ 35% hydrogen peroxide to control *Flavobacter columnare* on channel catfish. Six raceways containing a mean of 1,940 channel catfish were naturally infected with columnaris. Three raceways were randomly selected as treatment groups to receive 75 mg/L hydrogen peroxide, and three were selected as untreated controls. Treatments were administered daily for 30-45 min depending on the behavior of the fish in the raceway.

Perox-Aid™ treatments began on July 18 and were applied through July 25. The columnaris reappeared in one of the treatment raceways on July 30 and in another on August 2. The first raceway was treated again on July 30, 31, and August 1 and the second raceway was treated on August 2 only. These subsequent treatments halted the infection. Mortalities became unacceptable in the control group on July 20 and Reward™

Diquat was administered for six consecutive days. Mean mortalities during the first eight days of the study were 8.8/day for the Perox-Aid™ treated fish and 11.5 for the control fish. Maximum mortalities per day for treated fish were 59 and were 150 for the control fish. Perox-Aid™ will effectively control *Flavobacter columnare* and channel catfish are less sensitive to the chemical than walleye.

The chloramine-T residue depletion was completed at the UMESC using yellow perch. Walleye dedicated to this study that were transferred from Rathbun to the UMESC were not used because of disease problems.

Work with florfenicol that was planned for September 1, 2001 to May 30, 2002, using a no-cost grant extension was not performed because of INAD problems during this period. Hydrogen peroxide work also planned was not performed because disease outbreaks could not be generated.

IMPACTS

Work from this project has provided data that will be used toward gaining NADA approval for several aquaculture drugs. If approved, these drugs will benefit the entire aquaculture community, including federal, state, and private aquaculture interests located throughout the United States.

This project demonstrated the following:

- The problem of complicating, unwanted diseases and the difficulty of designing and performing disease field studies.
- Hydrogen peroxide will effectively control *chilodonella* on walleye.
- Walleye are extremely sensitive to hydrogen peroxide.
- Hydrogen peroxide will control *Flavobacter columnare* on channel catfish.
- Channel catfish are less sensitive to hydrogen peroxide than walleye.
- Oxytetracycline residue did not reach upper tolerance limits when fed to walleye under cool water conditions.
- Hydrogen peroxide will control fungus on channel catfish eggs
- Chloramine-T is not toxic to walleye up to 30 mg/L for a 60 min exposure.

In addition:

- Data from these studies were submitted to the Food and Drug Administration as pivotal or supportive data packages in support of NADA work on these drugs.
- The work done under this grant led to additional unfunded pivotal studies with hydrogen peroxide for the treatment of *Flavobacter columnaris* on walleye. These studies were conducted in 2002.

RECOMMENDED FOLLOW-UP ACTIVITIES

Additional aquaculture drug-related studies are needed to complete other data packages required by the Food and Drug Administration for approval and labeling of other much needed drugs for the aquaculture community.

PUBLICATIONS, MANUSCRIPTS, OR PAPERS PRESENTED

See the Appendix for a cumulative output for all NCRAC-funded Aquaculture Drugs activities. **SUPPORT**

YEARS	NCRAC- USDA FUNDING	OTHER SUPPORT					TOTAL SUPPORT
		UNIVER- SITY	INDUSTRY	OTHER FEDERAL	OTHER	TOTAL	
1999-01	\$8,415						\$8,415
TOTAL	\$8,415						\$8,415

APPENDIX

EXTENSION

NCRAC Extension Fact Sheet Series

Garling, D.L. 1992. Making plans for commercial aquaculture in the North Central Region. NCRAC Fact Sheet Series #101, NCRAC Publications Office, Iowa State University, Ames.

Harding, L.M., C.P. Clouse, R.C. Summerfelt, and J.E. Morris. 1992. Pond culture of walleye fingerlings. NCRAC Fact Sheet Series #102, NCRAC Publications Office, Iowa State University, Ames.

Kohler, S.T., and D.A. Selock. 1992. Choosing an organizational structure for your aquaculture business. NCRAC Fact Sheet Series #103, NCRAC Publications Office, Iowa State University, Ames.

Swann, L. 1992. Transportation of fish in bags. NCRAC Fact Sheet Series #104, NCRAC Publications Office, Iowa State University, Ames.

Swann, L. 1992. Use and application of salt in aquaculture. NCRAC Fact Sheet Series #105, NCRAC Publications Office, Iowa State University, Ames.

Morris, J.E. 1993. Pond culture of channel catfish in the North Central Region. NCRAC Fact Sheet Series #106, NCRAC Publications Office, Iowa State University, Ames.

Morris, J.E., C.C. Kohler, and C.C. Mischke. 1999. Pond culture of hybrid striped bass in the North Central Region. NCRAC Fact Sheet Series #107, NCRAC Publications Office, Iowa State University, Ames.

Cain, K., and D.Garling. 1993. Trout culture in the North Central Region. NCRAC Fact Sheet Series #108, NCRAC Publications Office, Iowa State University, Ames.

Riepe, J.R. 1999. Marketing seafood to restaurants in the North Central Region. NCRAC Fact Sheet Series #110, NCRAC Publications Office, Iowa State University, Ames.

Riepe, J.R. 1997. Costs for pond production of yellow perch in the North Central Region, 1994-95. NCRAC Fact Sheet Series #111, NCRAC Publications Office, Iowa State University, Ames.

Riepe, J.R. 1999. Supermarkets and seafood in the North Central Region. NCRAC Fact Sheet Series #112, NCRAC Publications Office, Iowa State University, Ames.

Garling, D. In press. Whirling disease. NCRAC Fact Sheet Series #113, NCRAC Publications Office, Iowa State University, Ames.

Garling, D., and M. Riche. In press. Feeding tilapia in intensive recirculating systems. NCRAC Fact Sheet Series #114, NCRAC Publications Office, Iowa State University, Ames.

NCRAC Technical Bulletin Series

Thomas, S.K., R.M. Sullivan, R.L. Vertrees, and D.W. Floyd. 1992. Aquaculture law in the north central states: a digest of state statutes pertaining to the production and marketing of aquacultural products. NCRAC Technical Bulletin Series #101, NCRAC Publications Office, Iowa State University, Ames.

Swann, L. 1992. A basic overview of aquaculture: history, water quality, types of aquaculture, production methods. NCRAC Technical Bulletin Series #102, NCRAC Publications Office, Iowa State University, Ames.

Kinnunen, R.E. 1992. North Central Region 1990 salmonid egg and fingerling purchases, production, and sales. NCRAC Technical Bulletin Series #103, NCRAC Publications Office, Iowa State University, Ames.

Hushak, L.J., C.F. Cole, and D.P. Gleckler. 1993. Survey of wholesale and retail buyers in the six southern states of the North Central Region. NCRAC Technical Bulletin Series #104, NCRAC Publications Office, Iowa State University, Ames.

Meronek, T., F. Copes, and D. Coble. 1998. The bait industry in Illinois, Michigan, Minnesota, Ohio, South Dakota, and Wisconsin. NCRAC Technical Bulletin Series #105, NCRAC Publications Office, Iowa State University, Ames.

Lichtkoppler, F.P. 1993. Factors to consider in establishing a successful aquaculture business in the North Central Region. NCRAC Technical Bulletin Series #106, NCRAC Publications Office, Iowa State University, Ames.

Swann, L., and J. R. Riepe. 1994. Niche marketing your aquaculture products. NCRAC Technical Bulletin Series #107, NCRAC Publications Office, Iowa State University, Ames.

Swann, L., J. Morris, and D. Selock. 1994. Cage culture of fish in the North Central Region. NCRAC Technical Bulletin Series #110, NCRAC Publications Office, Iowa State University, Ames.

Riepe, J.R. 1997. Enterprise budgets for yellow perch production in cages and ponds in the North Central Region, 1994/95. NCRAC Technical Bulletin Series #111, NCRAC Publications Office, Iowa State University, Ames.

Brown, P., and J. Gunderson, editors. 1997. Culture potential of selected crayfishes in the North Central Region. NCRAC Technical Bulletin Series #112, NCRAC Publications Office, Iowa State University, Ames.

Riepe, J.R. 1998. Walleye markets in the North Central Region: results of a 1996/97 survey. NCRAC Technical Bulletin Series #113, NCRAC Publications Office, Iowa State University, Ames.

Morris, J.E., and C.C. Mischke. 1999. Plankton management for fish culture ponds. NCRAC Technical Bulletin Series #114 NCRAC Publications Office, Iowa State University, Ames.

Lane, R.L., and J.E. Morris. 2000. Biology, prevention, and effects of common grubs (Digenetic trematodes) in freshwater fish. NCRAC Technical Bulletin Series #115, NCRAC Publications Office, Iowa State University, Ames.

Ramseyer, L.J., and D. Garling. In review. Fish nutrition and aquaculture waste management. NCRAC Technical Bulletin Series #116, NCRAC Publications Office, Iowa State University, Ames.

Daily, S., Selock, D., and Kohler, S. 2002. Fish-farm business plan workbook. NCRAC Technical Bulletin Series #117, NCRAC Publications Office, Iowa State University, Ames.

NCRAC Video Series

Swann, L. 1992. Something fishy: hybrid striped bass in cages. VHS format, 12 min. NCRAC Video Series #101, NCRAC Publications Office, Iowa State University, Ames.

Pierce, R., R. Henderson, and K. Neils. Aquacultural marketing: a practical guide for fish producers. 1995. VHS format, 19 min. NCRAC Video Series #102, NCRAC Publications Office, Iowa State University, Ames.

Swann, L., editor. 1993. Investing in freshwater aquaculture. VHS format, 120 min. NCRAC Video Series #103, NCRAC Publications Office, Iowa State University, Ames.

Morris, J.E., and C.C. Mischke. 1998. Sunfish (*Lepomis* spp.) culture. NCRAC Video Series #104, NCRAC Publications Office, Iowa State University, Ames.

Ingham, S. 1999. A guide to making safe smoked fish. NCRAC Video Series #105, NCRAC Publications Office, Iowa State University, Ames.

Swenson, W. 2000. Fish farming: some industry perspectives. NCRAC Video Series #106, NCRAC Publications Office, Iowa State University, Ames.

Ingham, S. 2000. Fish processing plant sanitation. NCRAC Video Series #107, NCRAC Publications Office, Iowa State University, Ames.

NCRAC Culture Series

Summerfelt, R., editor. 1996. Walleye culture manual. NCRAC Culture Series #101, NCRAC Publications Office, Iowa State University, Ames.

Mischke, C.C., and J.E. Morris, editors. In review. Sunfish culture guide. NCRAC Culture Series #102, NCRAC Publications Office, Iowa State University, Ames.

Morris, J.E. In preparation. Yellow perch culture guide. NCRAC Culture Series #103, NCRAC Publications Office, Iowa State University, Ames.

Other Videos

Kayes, T.B., and K. Mathiesen, editors. 1994. Investing in freshwater aquaculture: a reprise (part I). VHS format, 38 min. Cooperative Extension, Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln.

Kayes, T.B., and K. Mathiesen, editors. 1994. Investing in freshwater aquaculture: a reprise (part II). VHS format, 41 min. Cooperative Extension, Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln.

CD-ROMs

Swann, L. 1998. Getting started in freshwater aquaculture. NCRAC CD-ROM Series #101, NCRAC Publications Office, Iowa State University, Ames.

Kinnunen, R. 2002. Environmental Strategies for Aquaculture Symposium proceedings. NCRAC CD-ROM Series #102, NCRAC Publications Office, Iowa State University, Ames.

Boylan, J., and J. Morris. In press. Invertebrate identification for fish culturists. NCRAC CD-ROM Series #103, NCRAC Publications Office, Iowa State University, Ames.

Situation and Outlook Report

Hushak, L.J. 1993. North Central Regional aquaculture industry situation and outlook report, volume 1 (revised October 1993). NCRAC Publications Office, Iowa State University, Ames.

Other Publications in Print

Myers, J.J., and R.A. Pierce. 2000. Missouri aquaculture directory. Missouri Department of Agriculture, Jefferson City, Missouri.

Pierce, R.A., and C. Hicks. 2000. Understanding aquaculture businesses and their financial needs. Pages 75-76 in R. Plain, editor. Missouri farm financial outlook 2001. University Outreach and Extension, Department of Agricultural Economics, University of Missouri-Columbia.

Swann, D.L., and M.E. Einstein. 2000. User analysis and future directions of the web-based Aquaculture Network Information Center. *Journal of Extension* 38(5).

Workshops and Conferences

Salmonid Culture, East Lansing, Michigan, March 23-24, 1990. (Donald L. Garling)

Midwest Regional Cage Fish Culture Workshop, Jasper, Indiana, August 24-25, 1990. (LaDon Swann)

Aquaculture Leader Training for Great Lakes Sea Grant Extension Agents, Manitowoc, Wisconsin, October 23, 1990. (David J. Landkamer and LaDon Swann)

Regional Workshop of Commercial Fish Culture Using Water Reuse Systems, Normal, Illinois, November 2-3, 1990. (LaDon Swann)

First North Central Regional Aquaculture Conference, Kalamazoo, Michigan, March 18-21, 1991. (Donald L. Garling, Lead; David J. Landkamer, Joseph E. Morris and Ronald Kinnunen, Steering Committee)

Crayfish Symposium, Carbondale, Illinois, March 23-24, 1991. (Daniel A. Selock and Christopher C. Kohler)

Fish Transportation Workshops, Marion, Illinois, April 6, 1991 and West Lafayette, Indiana, April 20, 1991. (LaDon Swann and Daniel A. Selock)

Regional Workshop on Commercial Fish Culture Using Water Recirculating Systems, Normal, Illinois, November 15-16, 1991. (LaDon Swann)

National Aquaculture Extension Workshop, Ferndale, Arkansas, March 3-7, 1992. (Joseph E. Morris, Steering Committee)

Regional Workshop on Commercial Fish Culture Using Water Recirculating Systems, Normal, Illinois, November 19-20, 1992. (LaDon Swann)

In-Service Training for CES and Sea Grant Personnel, Gretna, Nebraska, February 9, 1993. (Terrence B. Kayes and Joseph E. Morris)

Aquaculture Leader Training, Alexandria, Minnesota, March 6, 1993. (Jeffrey L. Gunderson and Joseph E. Morris)

Investing in Freshwater Aquaculture, Satellite Videoconference, Purdue University, April 10, 1993. (LaDon Swann)

National Extension Wildlife and Fisheries Workshop, Kansas City, Missouri, April 29-May 2, 1993. (Joseph E. Morris)

Commercial Aquaculture Recirculation Systems, Piketon, Ohio, July 10, 1993. (James E. Ebeling)

Yellow Perch and Hybrid Striped Bass Aquaculture Workshop, Piketon, Ohio, July 9, 1994. (James E. Ebeling and Christopher C. Kohler)

Workshop on Getting Started in Commercial Aquaculture Raising Crayfish and Yellow Perch, Jasper, Indiana, October 14-15, 1994. (LaDon Swann)

Aquaculture in the Age of the Information Highway. Special session, World Aquaculture Society, San Diego, California, February 7, 1995. (LaDon Swann)

Second North Central Regional Aquaculture Conference, Minneapolis, Minnesota, February 17-18, 1995. (Jeffrey L. Gunderson, Lead; Fred P. Binkowski, Donald L. Garling, Terrence B. Kayes, Ronald E. Kinnunen, Joseph E. Morris, and LaDon Swann, Steering Committee)

Walleye Culture Workshop, Minneapolis, Minnesota, February 17-18, 1995. (Jeffrey L. Gunderson)

Aquaculture in the Age of the Information Highway. Multimedia session, 18 month meeting of the Sea Grant Great Lakes Network, Niagra Falls, Ontario, May 6, 1995. (LaDon Swann)

AquaNIC. Annual Meeting of the Aquaculture Association of Canada, Nanaimo, British Columbia, June 5, 1995. (LaDon Swann)

Yellow Perch Aquaculture Workshop, Spring Lake, Michigan, June 15-16, 1995. (Donald L. Garling)

Rainbow Trout Production: Indoors/Outdoors, Piketon, Ohio, July 8, 1995. (James E. Ebeling)

North Central Regional Aquaculture Center Hybrid Striped Bass Workshop, Champaign, Illinois, November 2-4, 1995. (Christopher C. Kohler, LaDon Swann, and Joseph E. Morris)

Third North Central Regional Aquaculture Conference, Indianapolis, Indiana, February 6-7, 1997. (LaDon Swann)

Overview of Sunfish Culture. Missouri Joint Aquaculture Conference, Springfield, Missouri, March 4-6, 1998. (Joseph E. Morris)

Seafood and Food Safety Issues Related to Aquaculture, North Central Regional Aquaculture Conference, Columbia, Missouri, February 24-26, 1999. (Ronald E. Kinnunen)

Overview of Sunfish Culture. North Central Aquaculture Conference, Columbia, Missouri, February 24-26, 1999. (Joseph E. Morris and Charles C. Mischke)

Angel Fish Production, North Central Regional Aquaculture Conference, Columbia, Missouri, February 24-26, 1999. (LaDon Swann)

Potential of Recirculating Systems in the North Central Region, North Central Regional Aquaculture Conference, Columbia, Missouri, February 24-26, 1999. (LaDon Swann)

Overview of Freshwater Shrimp Culture, North Central Regional Aquaculture Conference, Columbia, Missouri, February 24-26, 1999. (Laura Tiu)

Fertilization Regimes for Fish Culture Ponds, Wisconsin Aquaculture Conference, Green Bay, Wisconsin, March 12-13, 1999. (Joseph E. Morris)

Extension Programming in the North Central Region, SERA-IEG-9, Frankfort, Kentucky, March 14-16, 1999. (Joseph E. Morris)

Description of the Aquaculture and Bait Fish Industries: Threat Evaluation and Identification of Critical Control Points, International Joint Commission Workshop on Exotic Policy, Milwaukee, Wisconsin, September 22-26, 1999. (Jeffrey L. Gunderson)

Fisheries Management in the North Central Region, 9th National Extension Wildlife, Fisheries, and Aquaculture Conference, Portland, Maine, September 29-October 2, 1999. (Joseph E. Morris, and S.K. Whitcomb)

Internet Resources for Aquaculture Education and Communications: Present and Future, 9th National Extension Wildlife, Fisheries, and Aquaculture Conference, Portland, Maine, September 29-October 2, 1999. (LaDon Swann)

Proceedings

Proceedings of the North Central Regional Aquaculture Conference. 1991. First North Central Regional Aquaculture Conference, Kalamazoo, Michigan, March 18-21, 1991.

Gunderson, J., editor. 1995. Proceedings of the Combined North Central and Ninth Annual Minnesota Aquaculture Conference and Tradeshow. Second North Central Regional Aquaculture Conference, Minneapolis, Minnesota, February 17-18, 1995.

Swann, L., editor. 1997. Proceedings of the 1997 North Central Regional Aquaculture Conference. Third North Central Regional Aquaculture Conference, Indianapolis, Indiana, February 6-7, 1997. Illinois-Indiana Sea Grant Program, Publication CES-305. (Also available electronically at: <http://ag.ansc.purdue.edu/aquanic/publicat/state/il-in/ces-305.htm>)

Morris, J.E., editor. 1999. Aquaculture at the crossroads: linking the past to the future. Compilation of abstracts, papers, and supporting articles for the Fourth North Central Regional Aquaculture Conference, Columbia, Missouri, February 24-26, 1999.

ECONOMICS/MARKETING

Publications in Print

Aubineau, C.M. 1996. Characterization of the supply of walleye fingerlings in the north central region of the U.S. Master's thesis. Illinois State University, Normal.

Brown, G.J. 1994. Cost analysis of trout production in the North Central states. Master's thesis. Ohio State University, Columbus.

Edon, A.M.T. 1994. Economic analysis of an intensive recirculating system for the production of advanced walleye fingerlings in the North Central Region. Master's thesis. Illinois State University, Normal.

Floyd, D.W., and R.M. Sullivan. 1990. Natural resources and aquaculture: the policy environment in the North Central states. Proceedings of the Third Symposium on Social Science and Resource Management, Texas A&M University, College Station, Texas.

Floyd, D.W., R.M. Sullivan, R.L. Vertrees, and C.F. Cole. 1991. Natural resources and aquaculture: emerging policy issues in the North Central states. *Society and Natural Resources* 4:123-131.

Gleckler, D.P. 1991. Distribution channels for wild-caught and farm-raised fish and seafood: a survey of wholesale and retail buyers in six states of the North Central Region. Master's thesis. Ohio State University, Columbus.

Hushak, L.J. 1993. North Central Regional aquaculture industry situation and outlook report, volume 1 (revised October 1993). NCRAC Publications Office, Iowa State University, Ames.

Hushak, L., C. Cole, and D. Gleckler. 1993. Survey of wholesale and retail buyers in the six southern states of the North Central Region. NCRAC Technical Bulletin Series #104, NCRAC Publications Office, Iowa State University, Ames.

Hushak, L.J., D.W. Floyd, and R.L. Vertrees. 1992. Aquaculture: a competitive industry in North Central states? *Ohio's Challenge* 5:3-5.

Makowiecki, E.M.M. 1995. Economic analysis of an intensive recirculating system for the production of walleye from fingerling to food size. Master's thesis. Illinois State University, Normal.

O'Rourke, P.D. 1996. Economic analysis for walleye aquaculture enterprises. Pages 135-145 *in* R.C. Summerfelt, editor. Walleye culture manual. NCRAC Culture Series #101, NCRAC Publications Office, Iowa State University, Ames.

O'Rourke, P.D. 1996. The economics of recirculating aquaculture systems. *In* Proceedings of successes and failures in commercial recirculating aquaculture, Roanoke, Virginia, July 19-21, 1996.

- Riepe, J.R. 1997. Costs for pond production of yellow perch in the North Central Region, 1994-95. NCRAC Fact Sheet Series #111, NCRAC Publications Office, Iowa State University, Ames.
- Riepe, J.R. 1997. Enterprise budgets for yellow perch production in cages and ponds in the North Central Region, 1994/95. NCRAC Technical Bulletin Series #111, NCRAC Publications Office, Iowa State University, Ames.
- Riepe, J.R. 1997. Yellow perch markets in the North Central Region: results of a 1996/97 survey. Office of Agricultural Research Programs, Department of Agricultural Economics, Purdue University, West Lafayette, Indiana.
- Thomas, S.K. 1991. Industry association influence upon state aquaculture policy: a comparative analysis in the North Central Region. Master's thesis. Ohio State University, Columbus.
- Thomas, S.K., R.L. Vertrees, and D.W. Floyd. 1991. Association influence upon state aquaculture policy--a comparative analysis in the North Central Region. *The Ohio Journal of Science* 91(2):54.
- Thomas, S.K., R.M. Sullivan, R.L. Vertrees, and D.W. Floyd. 1992. Aquaculture law in the North Central states: a digest of state statutes pertaining to the production and marketing of aquacultural products. NCRAC Technical Bulletin Series #101, NCRAC Publications Office, Iowa State University, Ames.
- Tudor, K., and P.D. O'Rourke. 2002. Potential wholesale demand for farm-raised sunfish and walleye hybrids in Illinois. Pages 228-232 *in* Proceedings of the Fourth International Conference on Recirculating Aquaculture, Roanoke, Virginia, July 18-21, 2002.
- Tudor, K.W., R.R. Rosati, P.D. O'Rourke, Y.V. Wu, D. Sessa, and P. Brown. 1996. Technical and economical feasibility of on-farm fish feed production using fishmeal analogs. *Journal of Aquacultural Engineering* 15(1):53-65.

Papers Presented

- Brown, G.J., and L.J. Hushak. 1991. The NCRAC producers survey and what we have learned: an interim report. First North Central Regional Aquaculture Conference, Kalamazoo, Michigan, March 18-21, 1991.
- Foley, P., R. Rosati, P.D. O'Rourke, and K. Tudor. 1994. Combining equipment components into an efficient, reliable, and economical commercial recirculating aquaculture system. 25th Annual Meeting of the World Aquaculture Society, New Orleans, Louisiana, January 12-18, 1994.
- Gleckler, D.P., L.J. Hushak, and M.E. Gerlow. 1991. Distribution channels for wild-caught and farm-raised fish and seafood. First North Central Regional Aquaculture Conference, Kalamazoo, Michigan, March 18-21, 1991.
- Kohler, S.T. 1995. Hybrid striped bass cost of production. North Central Regional Aquaculture Center Hybrid Striped Bass Workshop, Champaign, Illinois, November 2-4, 1995.
- O'Rourke, P.D. 1995. Profitability and volume-cost business analysis tools for the aquaculture enterprise. Presented at Illinois-Indiana Aquaculture Conference and North Central Regional Aquaculture Center Hybrid Striped Bass Workshop, Champaign, Illinois, November 2-4, 1995.
- O'Rourke, P.D. 1996. The economics of recirculating aquaculture systems. Conference on Successes and Failures in Commercial Recirculating Aquaculture, Roanoke, Virginia, July 19-21, 1996.

O'Rourke, P.D., and A.M.T. Edon. 1995. Economic analysis of advanced walleye fingerling production in an intensive recirculating system. Combined North Central and Ninth Annual Minnesota Aquaculture Conference and Tradeshow (Second North Central Regional Aquaculture Conference), Minneapolis, Minnesota, February 17-18, 1995.

O'Rourke, P.D., K. Tudor, and R. Rosati. 1994. The selection and use of economic tools in the aquacultural engineering decision making process to determine the comparative costs of alternate technical solutions. 25th Annual Meeting of the World Aquaculture, New Orleans, Louisiana, January 12-18, 1994.

O'Rourke, P.D., K. Tudor, and R. Rosati. 1994. Economic risk analysis of production of tilapia (*Oreochromis niloticus*) in a modified Red Ewald-style recirculating system operated under commercial conditions. 25th Annual Meeting of the World Aquaculture Society Silver Anniversary Meeting, New Orleans, Louisiana, January 12-18, 1994.

Palmer, R. 2002. Marketability of hybrid walleye: preliminary results of industry and consumer surveys. NCRAC Hybrid Walleye Workshop, Cadillac, Michigan, February 7, 2002.

Riepe, J.R. 1994. Production economics of species cultured in the North Central Region. Animal Science, AS-495, one-week summer course "Aquaculture in the Midwest," Purdue University, West Lafayette, Indiana, June 13-17, 1994.

Riepe, J.R. 1994. Getting started in commercial aquaculture: economics. Workshop on Getting Started in Commercial Aquaculture Raising Crayfish and Yellow Perch, Jasper, Indiana, October 14-15, 1994.

Riepe, J.R. 1997. Revisiting retail and wholesale markets (walleye and yellow perch). Third North Central Regional Aquaculture Conference, Indianapolis, Indiana, February 6-7, 1997.

Riepe, J.R., J. Ferris, and D. Garling. 1995. Economic considerations in yellow perch aquaculture. Yellow Perch Aquaculture Workshop, Spring Lake, Michigan, June 15-16, 1995.

Robinson, M., D. Zepponi, and B.J. Sherrick. 1991. Assessing market potential for new and existing species in the North Central Region. First North Central Regional Aquaculture Conference, Kalamazoo, Michigan, March 18-21, 1991.

Rosati, R., P.D. O'Rourke, K. Tudor, and P. Foley. 1994. Production of tilapia (*Oreochromis niloticus*) in a modified Red Ewald-style recirculating system when operated under commercial conditions. 25th Annual Meeting of the World Aquaculture Society, New Orleans, Louisiana, January 12-18, 1994.

Rosati, R., P.D. O'Rourke, K. Tudor, and P. Foley. 1994. Technical and economical considerations for the selection of oxygen incorporation devices in a recirculating aquaculture system. 25th Annual Meeting of the World Aquaculture Society, New Orleans, Louisiana, January 12-18, 1994.

Tudor, K., R. Rosati, P.D. O'Rourke, Y.V. Wu, D. Sessa, and P. Brown. 1994. Technical and economical feasibility of on-farm fish feed production using fishmeal analogs. 25th Annual Meeting of the World Aquaculture Society, New Orleans, Louisiana, January 12-18, 1994.

YELLOW PERCH

Publications in Print

Brown, P.B., and K. Dabrowski. 1995. Zootechnical parameters, growth and cannibalism in mass propagation of yellow perch. In Kestemont, P., and K. Dabrowski, editors. Workshop on aquaculture of percids. Presses Universitaires de Namur, Namur, Belgium.

Brown, P.B., K. Dabrowski, and D.L. Garling. 1995. Nutritional requirements and commercial diets for yellow perch. In Kestemont, P., and K. Dabrowski, editors. Workshop on aquaculture of percids. Presses Universitaires de Namur, Namur, Belgium.

Brown, P.B., K. Dabrowski, and D.L. Garling. 1996. Nutrition and feeding of yellow perch (*Perca flavescens*). Journal of Applied Ichthyology 12:171-174.

Dabrowski, K., and D.A. Culver. 1991. The physiology of larval fish: digestive tract and formulation of starter diets. Aquaculture Magazine 17:49-61.

Dabrowski, K., D.A. Culver, C.L. Brooks, A.C. Voss, H. Sprecher F.P. Binkowski, S.E. Yeo, and A.M. Balogun. 1993. Biochemical aspects of the early life history of yellow perch (*Perca flavescens*). Pages 531-539 in Proceedings of the International Fish Nutrition Symposium, Biarritz, France, June 25-27, 1991.

Garling, D.L. 1991. NCRAC research programs to enhance the potential of yellow perch culture in the North Central Region. Pages 253-255 in Proceedings of the North Central Regional Aquaculture Conference, Kalamazoo, Michigan, March 18-21, 1991.

Glass, R.J. 1991. The optimum loading and density for yellow perch (*Perca flavescens*) raised in a single pass, flow-through system. Master's thesis. Michigan State University, East Lansing.

Hayward, R.S., and N. Wang. 2001. Failure to induce over-compensation of growth in maturing yellow perch. Journal of Fish Biology 59:126-140.

Ko, K. 1996. Effect of isoflavones and estradiol-17 on growth and reproductive function in yellow perch (*Perca flavescens*). Master's thesis. University of Wisconsin-Madison.

Ko, K., J.A. Malison, and J.D. Reed. 1999. Effect of genistein on the growth and reproductive function of male and female yellow perch (*Perca flavescens*). Journal of the World Aquaculture Society 30:73-79.

Kolkovski, S., and K. Dabrowski. 1998. Off-season spawning of yellow perch. Progressive Fish-Culturist 60:133-136.

Kolkovski, S., S. Czesny, and K. Dabrowski. 2000. Use of krill hydrolysate as a feed attractant for fish larvae and juveniles. Journal of the World Aquaculture Society 31:81-88.

Kolkovski, S., C. Yackey, S. Czesny, and K. Dabrowski. 2000. The effect of microdiet supplementation of dietary digestive enzymes and a hormone on growth and enzyme activity of yellow perch juveniles. North American Journal of Aquaculture 62:130-134.

Malison, J.A. 1999. Current status of yellow perch: markets and culture. Aquaculture Magazine 25:28-41.

Malison, J.A., and M.A.R. Garcia-Abiado. 1996. Sex control and ploidy manipulations in yellow perch (*Perca flavescens*) and walleye (*Stizostedion vitreum*). Journal of Applied Ichthyology 12:189-194.

Malison, J.A., and J.A. Held. 1992. Effects of fish size at harvest, initial stocking density and tank lighting conditions on the habituation of pond-reared yellow perch (*Perca flavescens*) to intensive culture conditions. Aquaculture 104:67-78.

Malison, J., and J. Held. 1995. Lights can be used to feed, harvest certain fish. Feedstuffs 67(2):10.

Malison, J.A., T.B. Kayes, J.A. Held, T.B. Barry, and C.H. Amundson. 1993. Manipulation of ploidy in yellow perch (*Perca flavescens*) by heat shock, hydrostatic pressure shock, and spermatozoa inactivation. *Aquaculture* 110:229-242.

Malison, J.A., L.S. Procarione, J.A. Held, T.B. Kayes, and C.H. Amundson. 1993. The influence of triploidy and heat and hydrostatic pressure shocks on the growth and reproductive development of juvenile yellow perch (*Perca flavescens*). *Aquaculture* 116:121-133.

Oetker, M.A. 1998. Effects of parental size and age on larval growth and development: implications for improved intensive larval yellow perch (*Perca flavescens*) culture techniques. Master's thesis. Michigan State University, East Lansing.

Twibell, R.G., and P.B. Brown. 1997. Dietary arginine requirement of juvenile yellow perch. *Journal of Nutrition* 127:1838-1841.

Twibell, R.G., and P.B. Brown. 2000. Dietary choline requirement of juvenile yellow perch (*Perca flavescens*). *Journal of Nutrition* 130:95-99.

Twibell, R.G., K.A. Wilson, and P.B. Brown. 2000. Dietary sulfur amino acid requirement of juvenile yellow perch fed the maximum cystine replacement value for methionine. *Journal of Nutrition* 130:612-616.

Williams, F., and C. Starr. 1991. The path to yellow perch profit through planned development. Pages 49-50 in *Proceedings of the North Central Regional Aquaculture Conference*, Kalamazoo, Michigan, March 18-21, 1991.

Manuscripts

Yackey, C. In preparation. Improving acceptance, efficiency, and quality of formulated feeds for juvenile yellow perch *Perca flavescens*. Ohio State University.

Papers Presented

Batterson, T., R. Craig, and R. Baldwin. 1995. Advancing commercial aquaculture development in the North Central Region. Yellow Perch Aquaculture Workshop, Spring Lake, Michigan, June 15-16, 1995.

Binkowski, F. 1995. Intensive yellow perch fry rearing. Yellow Perch Aquaculture Workshop, Spring Lake, Michigan, June 15-16, 1995.

Brown, P.B. 1994. Yellow perch culture in the Midwest. Vocational Agriculture Training Workshop, Greencastle, Indiana.

Brown, P.B. 1997. Recent developments in perch nutrition. Martinique '97, Island and Tropical Aquaculture, Les Trois Ilets, Martinique, French West Indies, May 4-9, 1997.

Brown, P.B. 2000. Percids-The American experience. 31st Annual Meeting of the World Aquaculture Society, Nice, France, May 2-6, 2000.

Brown, P.B., and K. Dabrowski. 1995. Zootechnical parameters, growth and cannibalism in mass propagation of yellow perch. Workshop on Aquaculture of Percids, Vaasa, Finland, August 21-25, 1995.

- Brown, P.B., K. Dabrowski, and D. Garling. 1995. Nutritional requirements and commercial diets for yellow perch. Workshop on Aquaculture of Percids, Vaasa, Finland, August 21-25, 1995.
- Brown, P.B., and R.G. Twibell. 1997. Dietary arginine requirement of juvenile yellow perch. 28th Annual Meeting of the World Aquaculture Society, Seattle, Washington, February 19-23, 1997.
- Brown, P.B., K. Wilson, J. Wetzel, J. Mays, F. Binkowski, and S. Yeo. 1994. Culture characteristics of juvenile yellow perch (*Perca flavescens*) from different geographical locales grown at three temperatures. 25th Annual Meeting of the World Aquaculture Society, New Orleans, Louisiana, January 12-18, 1994.
- Brown, P.B., K. Wilson, J. Wetzel, J. Mays, F. Binkowski, and S. Yeo. 1994. Strain evaluations with yellow perch. Indiana Aquaculture Association Annual Meeting, Indianapolis, Indiana, February 26, 1994.
- Crane, P., G. Miller, J. Seeb, and R. Sheehan. 1991. Growth performance of diploid and triploid yellow perch at the onset of sexual maturation. 53rd Midwest Fish and Wildlife Conference, Des Moines, Iowa, November 30- December 4, 1991.
- Culver, D.A., and K. Dabrowski. 1998. Fertilization and stocking procedures for pond culture of percids. 29th Annual Meeting of the World Aquaculture Society, Las Vegas, Nevada, February 15-19, 1998.
- Dabrowski, K. and S. Kolkovski. 1997. Larval fish rearing--diets, enzymes, endocrine systems and what else. 14th Annual Meeting of the Canadian Aquaculture Association, Quebec City, Quebec, Canada, June 10-13, 1997.
- Garling, D.L. 1991. NCRAC research programs to enhance the potential of yellow perch culture in the North Central Region. First North Central Regional Aquaculture Conference, Kalamazoo, Michigan, March 18-21, 1991.
- Garling, D.L. 2000. Current status of flow-through grow-out production systems. North Central Regional Aquaculture Center Yellow Perch Producer Forum, Hudson, Wisconsin, January 21-22, 2000.
- Garling, D.L. 2000. Current status/recent advances of tank fry culture. North Central Regional Aquaculture Center Yellow Perch Producer Forum, Hudson, Wisconsin, January 21-22, 2000.
- Held, J.A. 1996. Yellow perch fingerling production--Gone is the black magic. Aqua '96, the Tenth Anniversary Minnesota Aquaculture Conference and Trade Show, Alexandria, Minnesota, March 8-9, 1996.
- Held, J.A. 1997. Yellow perch production. Minnesota Aquaculture Association and North American Fish Farmers Cooperative Aquaculture Conference and Tradeshow, Brainerd, Minnesota, March 7-8, 1997.
- Held, J.A. 1997. Advances in yellow perch production. North Central Regional Aquaculture Center Symposium on Yellow Perch Production, Piketon, Ohio, June 21, 1997.
- Held, J.A., and J.A. Malison. 1997. Yellow perch aquaculture. Annual Conference of the Wisconsin Agricultural Teachers Association, Madison, Wisconsin, July 9-10, 1997.
- Held, J.A., J.A. Malison, and T.E. Kuczynski. 1998. Techniques for the commercial production of feed-trained yellow perch *Perca flavescens* fingerlings. 29th Annual Meeting of the World Aquaculture Society, Las Vegas, Nevada, February 15-19, 1998.
- Kayes, T. 1994. Yellow perch aquaculture. Workshop on Getting Started in Commercial Aquaculture Raising Crayfish and Yellow Perch, Jasper, Indiana, October 14-15, 1994.

- Kayes, T. 1994. Investing in freshwater aquaculture: a reprise. Nebraska Aquaculture Update & Autumn Meeting, North Platte, Nebraska, November 19, 1994.
- Kayes, T. 1995. Yellow perch aquaculture. Combined North Central and Ninth Annual Minnesota Aquaculture Conference and Tradeshow (Second North Central Regional Aquaculture Conference), Minneapolis, Minnesota, February 17-18, 1995.
- Kayes, T. 1995. Yellow perch culture studies at Pleasant Valley Fish Farm. Nebraska Aquaculture Update & Spring Meeting, North Platte, Nebraska, March 25, 1995.
- Kayes, T. 1995. Harvesting perch and walleye fingerlings from ponds. Nebraska Aquaculture Update & Spring Meeting, North Platte, Nebraska, March 25, 1995.
- Kayes, T. 1995. Spawning and incubation of yellow perch. Yellow Perch Aquaculture Workshop, Spring Lake, Michigan, June 15-16, 1995.
- Kayes, T. 1995. Fingerling yellow perch production in ponds. Yellow Perch Aquaculture Workshop, Spring Lake, Michigan, June 15-16, 1995.
- Kayes, T. 1995. Yellow perch food fish production in ponds and cages. Yellow Perch Aquaculture Workshop, Spring Lake, Michigan, June 15-16, 1995.
- Kolkovski, S., K. Dabrowski, and C. Yackey. 1997. Larval rearing of yellow perch *Perca flavescens* spawning out of the season. 2nd International Workshop on Aquaculture of Percid Fish, Island and Tropical Aquaculture, Les Trois Ilets, Martinique, French West Indies, May 3-7, 1997.
- Kolkovski, S., K. Dabrowski, and C. Yackey. 1997. Weaning diets for yellow perch *Perca flavescens*-- suitability of commercial, semi-commercial, and experimental dry formulations. Fish Feed and Nutrition Workshop, Frankfort, Kentucky, September 12-13, 1997.
- Kolkovski, S., S. Dzesny, C. Yackey, and K. Dabrowski. 1998. The use of krill hydrolysate as feed attractant for fish juveniles. Fish Feed and Nutrition Workshop, Pine Bluff, Arkansas, September 13-15, 1998.
- Malison, J.A. 1994. Pond production of yellow perch fingerlings. Wisconsin Aquaculture '94, Stevens Point, Wisconsin, February 18-19, 1994.
- Malison, J.A. 1995. Production methods for yellow perch. Wisconsin Aquaculture '95, Stevens Point, Wisconsin, March 17-19, 1995.
- Malison, J.A. 1997. Reproduction and sex reversal in yellow perch and walleye. Third North Central Regional Aquaculture Conference, Indianapolis, Indiana, February 6-7, 1997.
- Malison, J.A. 1997. Factors promoting and constraining the commercial culture of yellow perch, *Perca flavescens*. 28th Annual Meeting of the World Aquaculture Society, Seattle, Washington, February 19-23, 1997.
- Malison, J.A. 1998. Raising food-size yellow perch in ponds. Wisconsin Aquaculture '98, Eau Claire, Wisconsin, March 13-14, 1998.
- Malison, J.A. 1999. Current status of yellow perch (*Perca flavescens*) markets and culture. Aquaculture America '99, Tampa, Florida, January 27-30, 1999.

Malison, J.A. 1999. Sex control and ploidy manipulations in yellow perch (*Perca flavescens*) and walleye (*Stizostedion vitreum*). Aquaculture America '99, Tampa, Florida, January 27-30, 1999.

Malison, J.A., and J.A. Held. 1995. Sex control and ploidy manipulations in yellow perch (*Perca flavescens*) and walleye (*Stizostedion vitreum*). Percid II, the Second International Percid Fish Symposium and the Workshop on Aquaculture of Percids, Vaasa, Finland, August 21-25, 1995.

Malison, J.A., and J.A. Held. 1996. Pond design, construction and management. Wisconsin Aquaculture Conference '96, Wausau, Wisconsin, February 16-17, 1996.

Malison, J.A., and J.A. Held. 1997. Pond design and construction for aquaculture. Wisconsin Aquaculture '97, Stevens Point, Wisconsin, March 14-15, 1997.

Malison, J.A., J.A. Held, and C.H. Amundson. 1991. Factors affecting the habituation of pond-reared yellow perch (*Perca flavescens*), walleye (*Stizostedion vitreum*), and walleye-sauger hybrids (*S. vitreum* female \times *S. canadense* male) to intensive culture conditions. 22nd Annual Meeting of the World Aquaculture Society, San Juan, Puerto Rico, June 16-20, 1991.

Malison, J.A., D.L. Northey, J.A. Held, and T.E. Kuczynski. 1994. Habituation of yellow perch (*Perca flavescens*) fingerlings to formulated feed in ponds using lights and vibrating feeders. 25th Annual Meeting of the World Aquaculture Society, New Orleans, Louisiana, January 12-18, 1994.

Malison, J.A., J.A. Held, M.A.R. Garcia-Abiado, and L.S. Procarione. 1996. The influence of triploidy and heat and hydrostatic pressure shocks on the growth and reproductive development of perch (*Perca flavescens*) reared to adult size under selected environmental conditions. International Congress on the Biology of Fishes, San Francisco, California, July 14-18, 1996 and Midwest Endocrinology Conference, Madison, Wisconsin, June 22-23, 1996.

Malison, J.A., J.A. Held, L.S. Procarione, T.B. Kayes, and C.H. Amundson. 1991. The influence on juvenile growth of heat and hydrostatic pressure shocks used to induce triploidy in yellow perch. 121st Annual Meeting of the American Fisheries Society, San Antonio, Texas, September 8-12, 1991.

Malison, J.A., J. Mellenthin, L.S. Procarione, T.P. Barry, and J.A. Held. 1997. The effects of handling on the physiological stress responses of yellow perch (*Perca flavescens*) and walleye (*Stizostedion vitreum*) at different temperatures. 2nd International Workshop on Aquaculture of Percid Fish, Island and Tropical Aquaculture, Les Trois Ilets, Martinique, French West Indies, May 4-9, 1997.

Malison, J.A., J. Mellenthin, A.B. Head, L.S. Procarione, T.P. Barry, and J.A. Held. 1998. Cortisol stress responses and growth of yellow perch *Perca flavescens* reared under selected intensive culture conditions. 29th Annual Meeting of the World Aquaculture Society, Las Vegas, Nevada, February 15-19, 1998.

Oetker, M., and D.L. Garling. 1997. The effects of maternal size on growth and survivorship of larval yellow perch. 127th Annual Meeting of the American Fisheries Society, Monterey, California, August 24-28, 1997.

Riepe, J.R., J. Ferris, and D. Garling. 1995. Economic considerations in yellow perch aquaculture. Yellow Perch Aquaculture Workshop, Spring Lake, Michigan, June 15-16, 1995.

Selock, D. 1995. Floating raceways for yellow perch culture. Yellow Perch Aquaculture Workshop, Spring Lake, Michigan, June 15-16, 1995.

Starr, C. 1995. Yellow perch food fish production in flowing water systems. Yellow Perch Aquaculture Workshop, Spring Lake, Michigan, June 15-16, 1995.

Twibell, R.G., and P.B. Brown. 1999. Dietary choline requirement of juvenile yellow perch. Aquaculture America '99, Tampa, Florida, January 27-30, 1999.

Williams, F. 1995. Federal grant opportunities? Yellow Perch Aquaculture Workshop, Spring Lake, Michigan, June 15-16, 1995.

Williams, F., and C. Starr. 1991. The path to yellow perch profit through planned development. First North Central Regional Aquaculture Conference, Kalamazoo, Michigan, March 18-21, 1991.

Yackey, C., S. Kolkovski, and K. Dabrowski. 1997. Weaning diets for yellow perch (*Perca flavescens*)-- suitability of commercial, semi-commercial, and experimental dry formulations. Fish Feed and Nutrition Workshop, Frankfort, Kentucky, September 21, 1997.

Yackey, C., S. Czesny, S. Kolkovski, and K. Dabrowski. 1998. Effect of digestive enzyme and hormone on growth and digestive tract enzyme activity of yellow perch *Perca flavescens*. International Congress on the Biology of Fish, Baltimore, Maryland.

HYBRID STRIPED BASS

Publications in Print

Allyn, M.L., R.J. Sheehan, and C.C. Kohler. 2001. The effects of capture and transportation stress on white bass semen osmolality and their alleviation via sodium chloride. Transactions of the American Fisheries Society:130:706-711.

Anonymous. 1995. Proceedings of the NCRAC Hybrid Striped Bass Workshop. NCRAC Publications Office, Iowa State University, Ames.

Brown, P.B., R. Twibell, Y. Jonker, and K.A. Wilson. 1997. Evaluation of three soybean products in diets fed to juvenile hybrid striped bass *Morone saxatilis* × *M. chrysops*. Journal of the World Aquaculture Society 28:215-223.

Kelly, A.M., and C.C. Kohler. 1996. Sunshine bass performance in ponds, cages, and indoor tanks. Progressive Fish-Culturist 58:55-58.

Kelly, A.M., and C.C. Kohler. 1999. Cold tolerance and fatty acid composition in striped bass, white bass and their hybrids. North American Journal of Aquaculture 61:278-285.

Kemeh, S., and P.B. Brown. 2001. Evaluation of different stocking densities for hybrid striped bass in small-scale recirculation systems. North American Journal of Aquaculture 63:234-237.

Kohler, C.C. 1997. White bass production and broodstock development. Pages 169-185 in R.M. Harrell, editor. Striped bass and other *Morone* culture. Elsevier Press, Amsterdam.

Kohler, C.C. 2000. Striped bass and hybrid striped bass culture. Pages 898-907 in R.R. Stickney, editor. Encyclopedia of aquaculture. John Wiley & Sons, Inc., New York.

Kohler, C.C., R.J. Sheehan, C. Habicht, J.A. Malison, and T.B. Kayes. 1994. Habituation to captivity and controlled spawning of white bass. Transactions of the American Fisheries Society 123:964-974.

Kohler, C.C., R.J. Sheehan, J.J. Myers, J.B. Rudacille, M.L. Allyn, and A.V. Suresh. 2001. Performance comparison of geographic strains of white bass (*Morone chrysops*) to produce sunshine bass. *Aquaculture* 202:351-357.

Morris, J.E., C.C. Kohler, and C.C. Mischke. 1999. Pond culture of hybrid striped bass in the North Central Region. NCRAC Fact Sheet Series #107, NCRAC Publications Office, Iowa State University, Ames.

Myers, J.J. 1999. Acute responses to salinity for sunshine bass and palmetto bass. Master's thesis. Southern Illinois University-Carbondale.

Myers, J.J., and C.C. Kohler. 2000. Acute responses to salinity for sunshine bass and palmetto bass. *North American Journal of Aquaculture* 62:195-202.

Settor, K. 1998. Evaluation of different densities for hybrid striped bass (*Morone saxatilis* × *M. chrysops*) in cages and small-scale recirculation system. Master's thesis. Purdue University, West Lafayette, Indiana.

Woods, L.C., C.C. Kohler, R.J. Sheehan, and C.V. Sullivan. 1995. Volitional tank spawning of female striped bass with male white bass produces hybrid offspring. *Transactions of the American Fisheries Society* 124:628-632.

Manuscripts

Brown, G.G., R.J. Sheehan, C.C. Kohler, C. Habicht, L. Koutnik, L. Ellis, and L.D. Brown. In preparation. Short-term and long-term storage of striped bass *Morone saxatilis* semen. *Journal of the World Aquaculture Society*.

Kohler, C.C. In press. Striped bass and hybrid striped bass aquaculture. In R.R. Stickney, editor. *Encyclopedia of aquaculture*, Wiley Science, New York.

Suresh, A.V., J.B. Rudacille, M.L. Allyn, V. Sheehan, R.J. Sheehan, and C.C. Kohler. In review. Induction of ovulation in white bass (*Morone chrysops*) using hCG and LHRHa. *Aquaculture*.

Papers Presented

Brown, P.B., R. Twibell, Y. Hodgin, and K. Wilson. 1995. Soybeans in diets fed to hybrid striped bass. 24th Annual Fish Feed and Nutrition Workshop, Columbus, Ohio, October 19-21, 1995.

Brown, P.B., Y. Hodgin, R. Twibell, and K.A. Wilson. 1996. Use of three soybean products in diets fed to hybrid striped bass. 27th Annual Meeting of the World Aquaculture Society, Bangkok, Thailand, January 29-February 2, 1996.

Brown, G.G., L.D. Brown, K. Dunbar, C. Habicht, R.J. Sheehan, C.C. Kohler, and L. Koutnik. 1991. Evaluation of white bass semen with 31P-NMR for the improvement of transportation, storage, and fertility methods. 53rd Midwest Fish and Wildlife Conference, Des Moines, Iowa, November 30-December 4, 1991.

Brown, G.G., R.J. Sheehan, C.C. Kohler, C. Habicht, L. Koutnik, L. Ellis, and L.D. Brown. 1995. Use of cryopreservatives. North Central Regional Aquaculture Center Hybrid Striped Bass Workshop, Champaign, Illinois, November 2-4, 1995.

Brown, G.G., R.J. Sheehan, C.C. Kohler, C. Habicht, L. Koutnik, L. Ellis, and L.D. Brown. 1998. Short-term storage of striped bass *Morone saxatilis* semen. 29th Annual Meeting of the World Aquaculture Society, Las Vegas, Nevada, February 15-19, 1998.

- Habicht, C., R.J. Sheehan, C.C. Kohler, G.G. Brown, and L. Koutnik. 1991. Routine collection, storage, and shipping of white bass sperm. 29th Annual Meeting Illinois Chapter of the American Fisheries Society, Champaign, Illinois, March 5-7, 1991.
- Kohler, C.C. 1993. The farm fish of the future: hybrid stripers. Aqua '93: 7th Annual Minnesota Aquaculture Conference, Alexandria, Minnesota, March 5-6, 1993. (Invited paper)
- Kohler, C.C. 1994. Hybrid striped bass aquaculture. Yellow Perch and Hybrid Striped Bass Production: From Fry to Frying Pan, Piketon, Ohio, July 3, 1994. (Invited speaker)
- Kohler, C.C. 1995. Broodstock management of white bass. North Central Regional Aquaculture Center Hybrid Striped Bass Workshop, Champaign, Illinois, November 2-4, 1995.
- Kohler, C.C. 1996. Induced out-of-season spawning of fishes. Missouri Aquaculture Industry Association Annual Meeting, Jefferson City, Missouri, February 3-4, 1996 .
- Kohler, C.C. 1996. Advancing hybrid striped bass culture in the North Central Region and elsewhere. U.S. Chapter of the World Aquaculture Society, Arlington, Texas, February 14-17, 1996.
- Kohler, C.C. 1997. Induced spawning of fishes. Third North Central Regional Aquaculture Conference, Indianapolis, Indiana, February 6-7, 1997.
- Kohler, C.C. 1998. Hybrid striped bass culture in the Midwest. Joint Missouri-Kansas Aquaculture Conference, Springfield, Missouri, March 4-6, 1998.
- Kohler, C.C., and R.J. Sheehan. 1991. Hybrid striped bass culture in the North Central Region. First North Central Regional Aquaculture Conference, Kalamazoo, Michigan, March 18-21, 1991.
- Kohler, C.C., R.J. Sheehan, M.L. Allyn, J.B. Rudacille, and A. Suresh. 1996. Controlled spawning of white bass. U.S. Chapter of the World Aquaculture Society, Arlington, Texas, February 14-17, 1996.
- Kohler, C.C., R.J. Sheehan, C. Habicht, J.A. Malison, and T.B. Kayes. 1992. Acclimation to captivity and out-of-season spawning of white bass. 23rd Annual Meeting of the World Aquaculture Society, Orlando, Florida, May 21-25, 1992.
- Kohler, C.C., R.J. Sheehan, J.J. Myers, J.B. Rudacille, M.L. Allyn, and A.V. Suresh. 1998. Performance comparison of geographically distinct strains of white bass to produce sunshine bass. Striper 2000, College Park, Maryland, June 6-7, 1998.
- Kohler, C.C., R.J. Sheehan, C. Habicht, V. Sanchez, J. Finck, J.A. Malison, and T.B. Kayes. 1991. Domestication and out-of-season spawning of white bass. 53rd Midwest Fish and Wildlife Conference, Des Moines, Iowa, November 30-December 4, 1991.
- Kohler, C.C., R.J. Sheehan, C. Habicht, V. Sanchez, J.A. Malison, and T.B. Kayes. 1992. Collection, acclimation to captivity, and out-of-season spawning of white bass. 122nd Annual Meeting of the American Fisheries Society, Rapid City, South Dakota, September 14-17, 1992.
- Kohler, C.C., R.J. Sheehan, C. Habicht, V. Sanchez, J.A. Malison, and T.B. Kayes. 1993. Development of white bass brood stock and spawning protocol. U.S. Chapter of the World Aquaculture Society, Hilton Head Island, South Carolina, January 27-30, 1993. (Invited paper)

Kohler, C.C., R.J. Sheehan, and T.B. Kayes. 1989. Advancing hybrid striped bass culture in the Midwestern United States. 51st Midwest Fish and Wildlife Conference, Springfield, Illinois, December 5-6, 1989.

Kohler, C.C., R.J. Sheehan, V. Sanchez, and A. Suresh. 1994. Evaluation of various dosages of hCG to induce final oocyte maturation and ovulation in white bass. 25th Annual Meeting of the World Aquaculture Society, New Orleans, Louisiana, January 12-18, 1994.

Kohler, C.C., R.J. Sheehan, A. Suresh, L. Allyn, and J. Rudacliffe. 1996. Effect of hCG dosage on hatching success in white bass. International Congress on the Biology of Fishes, San Francisco, California, July 15-18, 1996.

Kohler, C.C., R.J. Sheehan, J.J. Myers, J.B. Rudacille, M.L. Allyn, and A.V. Suresh. 1999. Performance comparison of geographically distinct strains of white bass to produce sunshine bass. Aquaculture America '99, Tampa, Florida, January 27-30, 1999.

Kohler, S.T. 1995. Cost of production. North Central Regional Aquaculture Center Hybrid Striped Bass Workshop, Champaign, Illinois, November 2-4, 1995.

Koutnik, L.A., R.J. Sheehan, C.C. Kohler, C. Habicht, and G.G. Brown. 1992. Motility and fertility of extended and cryopreserved *Morone* sperm: when is cryopreservation the best option? Annual Meeting, Illinois/Wisconsin Chapters of the American Fisheries Society, Waukegan, Illinois, February 10-13, 1992. (Awarded Best Student Paper)

Morris, J. 1995. Pond preparation for larval fish. North Central Regional Aquaculture Center Hybrid Striped Bass Workshop, Champaign, Illinois, November 2-4, 1995.

Myers, J.J., C.C. Kohler, R.J. Sheehan, M.L. Allyn, J.B. Rudacille, and A.V. Suresh. 1998. Geographic strain comparison of hybrid striped bass (*Morone chrysops* × *M. saxatilis*) to a market size in earthen ponds. Illinois Renewable Natural Resources Conference, Springfield, Illinois, March 4-6, 1998.

Rudacille, J.B., and C.C. Kohler. 1996. Relative performance of white bass, sunshine bass, and palmetto bass fed a commercial diet. U.S. Chapter of the World Aquaculture Society, Arlington, Texas, February 14-17, 1996. (Awarded Best Student Presentation)

Rudacille, J.B., and C.C. Kohler. 1997. Performance of Phase III palmetto bass, sunshine bass and white in a recirculating water system. 28th Annual Meeting of the World Aquaculture Society, Seattle, Washington, February 19-23, 1997.

Rudacille, J.B., and C.C. Kohler. 1997. Relative performance of Phase III sunshine bass, palmetto bass, and white bass in an indoor recirculating system. 35th Annual Meeting of the Illinois Chapter of the American Fisheries Society, Collinsville, Illinois, March 4-6, 1997. (Awarded Lewis L. Osborne Best Student Paper)

Sheehan, R.J. 1995. Use of sperm extenders. North Central Regional Aquaculture Center Hybrid Striped Bass Workshop, Champaign, Illinois, November 2-4, 1995.

Swann, L. 1995. Cage culture. North Central Regional Aquaculture Center Hybrid Striped Bass Workshop, Champaign, Illinois, November 2-4, 1995.

WALLEYE

Publications in Print

Aubineau, C.M. 1996. Characterization of the supply of walleye fingerlings in the North Central Region of the U.S. Master's thesis. Illinois State University, Normal.

Barry, T.P., A.F. Lapp, L.S. Procarione, and J.A. Malison. 1995. Effects of selected hormones and male cohorts on final oocyte maturation, ovulation, and steroid production in walleye (*Stizostedion vitreum*). *Aquaculture* 138:331-347.

Billington, N., R.J. Barrette, and P.D.N. Hebert. 1992. Management implications of mitochondrial DNA variation in walleye stocks. *North American Journal of Fisheries Management* 12:276-284.

Bristow, B.T. 1993. Comparison of larval walleye stocks in intensive culture. Master's thesis. Iowa State University, Ames.

Bristow, B.T., and R.C. Summerfelt. 1994. Performance of larval walleye cultured intensively in clear and turbid water. *Journal of the World Aquaculture Society* 25:454-464

Bristow, B.T., and R.C. Summerfelt. 1996. Comparative performance of intensively cultured larval walleye in clear, turbid, and colored water. *Progressive Fish-Culturist* 58:1-10.

Clayton, R.D., T.L. Stevenson, and R.C. Summerfelt. 1998. Fin erosion in intensively cultured walleye and hybrid walleye. *Progressive Fish-Culturist* 60:114-118.

Clouse, C.P. 1991. Evaluation of zooplankton inoculation and organic fertilization for pond-rearing walleye fry to fingerlings. Master's thesis. Iowa State University, Ames.

Czesny, S., M.A. Garcia-Abiado, K. Dabrowski, P. Bajer, and M. Zalewski. 2002. Comparison of foraging performance of diploid and triploid saugeyes (sauger \times walleye). *Transactions of the American Fisheries Society* 131:980-985.

DiStefano, R.J., T.P. Barry, and J.A. Malison. 1997. Correlation of blood parameters with reproductive problems in walleye in a Missouri impoundment. *Journal of Aquatic Animal Health* 9:223-229.

Garcia-Abiado, M.A.R., W.E. Lynch, Jr., K. Dabrowski, S. Czesny, and J. Rinchar. 2002. Juvenile growth and survival of heat-shocked triploid hybrid saugeyes, *Stizostedion vitreum* \times *S. canadense*. *Fisheries Management and Ecology* 9:105-110.

Gunderson, J., P. Gaeden, and T. Hertz. 1996. Case study: walleye fingerling culture in undrainable, natural ponds. Pages 157-160 in R.C. Summerfelt, editor. *Walleye culture manual*. NCRAC Culture Series #101, NCRAC Publications Office, Iowa State University, Ames.

Harder, T., and R.C. Summerfelt. 1996. Effects of tank color and size on the success of training walleye fingerlings to formulated feed. Pages 631-636 in G.S. Libey and M.B. Timmons, editors. *Successes and failures in commercial recirculating aquaculture*. Northeast Regional Agricultural Engineering Service (NRAES), NRAES-98, volume 2. Cornell University, Ithaca, New York.

Harding, L.M., and R.C. Summerfelt. 1993. Effects of fertilization and of fry stocking density on pond production of fingerling walleye. *Journal of Applied Aquaculture* 2(3/4):59-79.

Harding, L.M., C.P. Clouse, R.C. Summerfelt, and J.E. Morris. 1992. Pond culture of walleye fingerlings. NCRAC Fact Sheet Series #102, NCRAC Publications Office, Iowa State University, Ames.

- Held, J.A., and J.A. Malison. 1996. Culture of walleye to food size. Pages 231-232 in R.C. Summerfelt, editor. Walleye culture manual. NCRAC Culture Series #101, NCRAC Publications Office, Iowa State University, Ames.
- Held, J.A., and J.A. Malison. 1996. Pond culture of hybrid walleye fingerlings. Pages 311-313 in R.C. Summerfelt, editor. Walleye culture manual. NCRAC Culture Series #101, NCRAC Publications Office, Iowa State University, Ames.
- Kapuscinski, A.R., chair. 1995. Performance standards for safely conducting research with genetically modified fish and shellfish. Part I. Introduction and supporting text for flowcharts. In USDA, Agricultural Biotechnology Research Advisory Committee, Working Group on Aquatic Biotechnology and Environmental Safety. Office of Agricultural Biotechnology, Document No. 95-04.
- Kapuscinski, A.R., chair. 1995. Performance standards for safely conducting research with genetically modified fish and shellfish. Part II. Flowcharts and accompanying worksheets. In USDA, Agricultural Biotechnology Research Advisory Committee, Working Group on Aquatic Biotechnology and Environmental Safety. Office of Agricultural Biotechnology, Document No. 95-05.
- Kapuscinski, A.R. 1996. Selective breeding of walleye: building block for indoor aquaculture. Pages 331-338 in R.C. Summerfelt, editor. Walleye culture manual. NCRAC Culture Series #101, NCRAC Publications Office, Iowa State University, Ames.
- Kinnunen, R.E. 1996. Walleye fingerling culture in undrainable ponds. Pages 135-145 in R.C. Summerfelt, editor. Walleye culture manual. NCRAC Culture Series #101, NCRAC Publications Office, Iowa State University, Ames.
- Luzier, J.M. 1993. The ecology of clam shrimp in fish culture ponds. Master's thesis. Iowa State University, Ames.
- Luzier, J.M., and R.C. Summerfelt. 1993. A review of the ecology and life history of clam shrimp (Order Spinicaudata, Laevicaudata, Formerly Order Conchostraca: Branchiopoda). *Prairie Naturalist* 25:55-64.
- Luzier, J.M., and R.C. Summerfelt. 1996. Effects of clam shrimp on production of walleye and northern pike and a review of clam shrimp control strategies. *Journal of Applied Aquaculture* 6(4):25-38.
- Luzier, J.M., and R.C. Summerfelt. 1996. Experimental demonstration of the effects of clam shrimp on turbidity of microcosms. *Progressive Fish-Culturist* 58:68-70.
- Malison, J.A., and M.A.R. Garcia-Abiado. 1996. Sex control and ploidy manipulations in yellow perch (*Perca flavescens*) and walleye (*Stizostedion vitreum*). *Journal of Applied Ichthyology* 12:189-194.
- Malison, J.A., and J.A. Held. 1996. Reproductive biology and spawning. Pages 11-18 in R.C. Summerfelt, editor. Walleye culture manual. NCRAC Culture Series #101, NCRAC Publications Office, Iowa State University, Ames.
- Malison, J.A., and J.A. Held. 1996. Habituating pond-reared fingerlings to formulated feed. Pages 199-204 in R.C. Summerfelt, editor. Walleye culture manual. NCRAC Culture Series #101, NCRAC Publications Office, Iowa State University, Ames.
- Malison, J.A., and J.A. Held. 1996. Reproduction and spawning in walleye. *Journal of Applied Ichthyology* 12:153-156.

Malison, J.A., J.A. Held, L.S. Procarione, and M.A.R. Garcia-Abiado. 1998. The production of monosex female populations of walleye (*Stizostedion vitreum*) using intersex broodstock. *Progressive Fish-Culturist* 60(1):20-24.

Malison, J.A., L.S. Procarione, A.R. Kapuscinski, T.P. Barry, and T.B. Kayes. 1994. Endocrine and gonadal changes during the annual reproductive cycle of the freshwater teleost, *Stizostedion vitreum*. *Fish Physiology and Biochemistry* 13:473-484.

Malison, J.A., L.S. Procarione, T.B. Kayes, J. Hansen, and J.A. Held. 1998. Induction of out-of-season spawning in walleye (*Stizostedion vitreum*). *Aquaculture* 163:151-161.

Malison, J.A., J.A. Held, L.S. Weil, T.B. Kayes, and G.H. Thorgaard. 2001. Manipulation of ploidy in walleye (*Stizostedion vitreum*) by heat shock and hydrostatic pressure shock. *North American Journal of Aquaculture* 63:17-24.

Marty, G.D., D.E. Hinton, R.C. Summerfelt. 1995. Histopathology of swimbladder noninflation in walleye (*Stizostedion vitreum*) larvae: role of development and inflammation. *Aquaculture* 138:35-48.

Rieger, P.W. 1995. Behavior of larval walleye. Doctoral dissertation. Iowa State University, Ames.

Rieger, P.W., and R.C. Summerfelt. 1997. The influence of turbidity on larval walleye, *Stizostedion vitreum*, behavior and development in tank culture. *Aquaculture* 159:19-32.

Rieger, P.W., and R.C. Summerfelt. 1998. Microvideography of gas bladder inflation in larval walleye. *Journal of Fish Biology* 53:93-99.

Summerfelt, R.C. 1991. Non-inflation of the gas bladder of larval walleye (*Stizostedion vitreum*): experimental evidence for alternative hypotheses of its etiology. Pages 290-293 in P. Lavens, P. Sorgeloos, E. Jaspers, and F. Ollevier, editors. LARVI '91 - Fish & Crustacean Larviculture Symposium. European Aquaculture Society, Special Publication No. 15, Gent, Belgium.

Summerfelt, R.C. 1995. Pond- and tank-culture of fingerling walleyes: A review of North American practices. Pages 31-33 in P. Kestemont and K. Dabrowski, editors. Workshop on aquaculture of percids. First meeting of the European Workgroup on Aquaculture of Percids, Vaasa, Finland, August 23-24, 1995.

Summerfelt, R.C. 1995. Production of advanced fingerling to food size walleye. Pages 48-52 in P. Kestemont and K. Dabrowski, editors. Workshop on aquaculture of percids. First meeting of the European Workgroup on Aquaculture of Percids, Vaasa, Finland, August 23-24, 1995.

Summerfelt, R.C., editor. 1996. Walleye culture manual. NCRAC Culture Series #101, NCRAC Publications Office, Iowa State University, Ames.

Summerfelt, R.C. 1996. Walleye culture manual: Preface. Pages xiii-xiv in R.C. Summerfelt, editor. Walleye culture manual. NCRAC Culture Series #101. NCRAC Publications Office, Iowa State University, Ames.

Summerfelt, R.C. 1996. Introduction. Pages 1-10 in R.C. Summerfelt, editor. Walleye culture manual. NCRAC Culture Series #101. NCRAC Publications Office, Iowa State University, Ames.

Summerfelt, R.C. 1996. Intensive culture of walleye fry. Pages 161-185 in R.C. Summerfelt, editor. Walleye culture manual. NCRAC Culture Series #101, North Central Regional Aquaculture Center Publications Office, Iowa State University, Ames.

Summerfelt, R.C., R.C. Clayton, T.K. Yager, S.T. Summerfelt, and K.L. Kuipers. 1996. Live weight-dressed weight relationships of walleye and hybrid walleye. Pages 241-250 in R.C. Summerfelt, editor. Walleye culture manual. NCRAC Culture Series #101. NCRAC Publications Office, Iowa State University, Ames.

Summerfelt, R.C., C.P. Clouse, L.M. Harding, and J.M. Luzier. 1996. Walleye fingerling culture in drainable ponds. Pages 89-108 in R.C. Summerfelt, editor. Walleye culture manual. NCRAC Culture Series #101, North Central Regional Aquaculture Center Publications Office, Iowa State University, Ames.

Summerfelt, R.C., C.P. Clouse, and L.M. Harding. 1993. Pond production of fingerling walleye, *Stizostedion vitreum*, in the northern Great Plains. *Journal of Applied Aquaculture* 2(3/4):33-58.

Summerfelt, S.T., and R.C. Summerfelt. 1996. Aquaculture of walleye as a food fish. Pages 215-230 in R.C. Summerfelt, editor. Walleye culture manual. NCRAC Culture Series #101. NCRAC Publications Office, Iowa State University, Ames.

Manuscripts

Bielik, I., and T.B. Kayes. In preparation. Effects of aeration, fertilization, and sac-fry stocking rate on the large-scale pond production of fingerling walleye. *Progressive Fish-Culturist*.

Malison, J.A., and J.A. Held. In preparation. Organoleptic and carcass characteristics of purebred walleye (*Stizostedion vitreum*) and hybrids (*S. Vitreum* × *S. canadense*) produced from several geographic stocks. *Aquaculture*.

Papers Presented

Barry, T.P., L.S. Procarione, A.F. Lapp, and J.A. Malison. 1992. Induced final oocyte maturation and spawning in walleye (*Stizostedion vitreum*). 23rd Annual Meeting of the World Aquaculture Society, Orlando, Florida, May 21-25, 1992. Also presented at the Midwestern Regional Endocrinology Conference, Illinois State University, Normal, May 15-16, 1992, and the Endocrinology Reproductive Physiology Program Research Symposium, Madison, Wisconsin, September 10, 1992.

Bielik, I., and T.B. Kayes. 1995. Effects of aeration, fertilization, and sac-fry stocking rate on the large-scale production of fingerling walleye, *Stizostedion vitreum*, in earthen ponds. 26th Annual Meeting of the World Aquaculture Society, San Diego, California, February 1-4, 1995.

Bristow, B., and R.C. Summerfelt. 1993. The timing of critical events in the early development of larval walleye reared on formulated feed. Joint meeting, 31st annual meeting of the Illinois Chapter and 25th Annual Meeting of the Iowa Chapter of the American Fisheries Society, Bettendorf, Iowa, February 16-18, 1993.

Bristow, B.T., and R.C. Summerfelt. 1995. A production-scale evaluation of training and grower diets for the extensive-intensive production of advanced fingerling walleyes. 1995 Coolwater Fish Culture Workshop, State College, Pennsylvania, January 8-10, 1995.

Bristow, B.T., R.C. Summerfelt, and R. Clayton. 1995. Culture of larval walleye in clear, turbid, and colored water. Mid-Continent Fish Culture Workshop. Kansas City, Kansas, February 14-15, 1995.

Bristow, B.T., R.C. Summerfelt, and R. Clayton. 1995. Culture of larval walleye in clear, turbid, and colored water. Iowa-Minnesota State Chapters, American Fisheries Society, Okoboji, Iowa, February 21-23, 1995.

- Bushman, R.P., and R.C. Summerfelt. 1991. Effects of tank design on intensive culture of walleye fry. Coolwater Fish Culture Workshop, Springfield, Missouri, January 7-9, 1991.
- Bushman, R.P., and R.C. Summerfelt. 1992. The effect of pH on gas bladder inflation of larval walleye. Coolwater Fish Culture Workshop, Carbondale, Illinois, January 6-8, 1992.
- Clayton, R., and R.C. Summerfelt. 1995. Toxicity of hydrogen peroxide to juvenile walleye. 1995 Coolwater Fish Culture Workshop, State College, Pennsylvania, January 8-10, 1995.
- Clayton, R., and R.C. Summerfelt. 1995. Toxicity of hydrogen peroxide to juvenile walleye. Mid-Continent Fish Culture Workshop Kansas City, Kansas, February 14-15, 1995.
- Clouse, C., and R.C. Summerfelt. 1991. Evaluation of zooplankton inoculation and organic fertilization as management strategies for pond-rearing walleye fry to fingerlings. Coolwater Fish Culture Workshop, Springfield, Missouri, January 7-9, 1991.
- Dabrowski, K. 2002. Status report on hybrid walleye rearing, polyploidy, and sex determination. NCRAC Hybrid Walleye Workshop, Cadillac, Michigan, February 7, 2002.
- Dabrowski, K, and M.A.R. Garcia-Abiado. 2002. All-female triploid production. Lake Erie- Inland Waters. Annual Research Review, Museum of Biological Diversity, Ohio State University. February 14-15, 2002.
- Garcia-Abiado, M.A.R., K. Dabrowski, and M. Penn. 2002. Viability and sex ratios of progenies between sex-reversed, gynogenetic sauger males and walleye females. Aquaculture America 2002, San Diego, California, January 27-30, 2002.
- Hayward, R.S. 2000. Review of aquaculture research at the University of Missouri-Columbia. Harry K. Dupree National Aquaculture Center, September 29, Stuttgart, Arkansas.
- Hayward, R. S. 2002. Growth rates of walleye in southern Missouri ponds. NCRAC Hybrid Walleye Workshop, Cadillac, Michigan, February 7, 2002.
- Held, J.A. 1996. Hybrid walleye - A candidate for intensive aquaculture? Aqua '96, Tenth Anniversary Minnesota Aquaculture Conference and Trade Show, Alexandria, Minnesota, March 8-9, 1996.
- Held, J.A. 2002. Growth and sex control of hybrid walleye. NCRAC Hybrid Walleye Workshop, Cadillac, Michigan, February 7, 2002.
- Held, J.A. 2002. Stress responses of salmonids and percids. Michigan Aquaculture Association Annual Conference, Cadillac, Michigan, February 7-8, 2002.
- Held, J.A., and J.A. Malison. 1998. Performance of hybrid walleye (*Stizostedion vitreum* × *S. canadense*) derived from several geographic stocks. 29th Annual Meeting of the World Aquaculture Society, Las Vegas, Nevada, February 15-19, 1998.
- Kapuscinski, A.R. 1995. The role of selective breeding in sustainable aquaculture. University of Minnesota, Lake Itasca Summer Program, Course on Sustainable Fisheries and Aquaculture.
- Kapuscinski, A.R., R.C. Summerfelt, B. Bristow, and M.C. Hove. 1994. Genetic components of early performance traits of intensively cultured walleye. Fifth International Symposium on Genetics in Aquaculture, Halifax, Nova Scotia, June 19-25, 1994.

Kayes, T.B. 1995. Harvesting perch and walleye fingerlings from ponds. Nebraska Aquaculture Update & Spring Meeting, North Platte, Nebraska, March 25, 1995.

Malison, J.A. 1995. Reproductive biology and control of spawning in walleye. Combined North Central and Ninth Annual Minnesota Aquaculture Conference and Tradeshow (Second North Central Regional Aquaculture Conference), Minneapolis, Minnesota, February 17-18, 1995.

Malison, J.A. 1997. Reproduction and sex reversal in yellow perch and walleye. Third North Central Regional Aquaculture Conference, Indianapolis, Indiana, February 6-7, 1997.

Malison, J. A., and J.A. Held. 1995. Reproduction and spawning in walleye. PERCIS II, the Second International Percid Fish Symposium and the Workshop on Aquaculture of Percids, Vaasa, Finland, August 21-25, 1995.

Malison, J.A., J.A. Held, and L.S. Procarione. 1994. The production of all-female populations of walleye (*Stizostedion vitreum*) using partially sex-inverted broodstock. 25th Annual Meeting of the World Aquaculture Society, New Orleans, Louisiana, January 12-18, 1994.

Malison, J.A., T.B. Kayes, L.S. Procarione, J.F. Hansen, and J.A. Held. 1994. Induction of out-of-season spawning in walleye (*Stizostedion vitreum*). 25th Annual Meeting of the World Aquaculture Society, New Orleans, Louisiana, January 12-18, 1994.

Malison, J.A., J. Mellenthin, L.S. Procarione, T.P. Barry, and J.A. Held. 1997. The effects of handling on the physiological stress responses of yellow perch (*Perca flavescens*) and walleye (*Stizostedion vitreum*) at different temperatures. Martinique '97, Martinique, French West Indies, May 4-9, 1997.

Malison, J.A., L.S. Procarione, A.R. Kapuscinski, and T.B. Kayes. 1992. Endocrine and gonadal changes during the annual reproductive cycle of walleye (*Stizostedion vitreum*). 23rd Annual Meeting of the World Aquaculture Society, Orlando, Florida, May 21-25, 1992. Also presented at the Endocrinology Reproductive Physiology Program Research Symposium, Madison, Wisconsin, September 10, 1992.

Marty, G.D., D.E. Hinton, and R.C. Summerfelt. 1994. Histopathology of swimbladder noninflation in walleye (*Stizostedion vitreum*) larvae: role of development and inflammation. International Symposium on Aquatic Animal Health, September 4-8, 1994.

Moore, A., M. Prange, R.C. Summerfelt, B.T. Bristow, and R.P. Bushman. 1995. Culture of larval walleye, *Stizostedion vitreum*, fed formulated feed. 26th Annual Meeting of the World Aquaculture Society, San Diego, California, February 1-4, 1995.

Phillips, T.A., and R.C. Summerfelt. 1995. Effects of feeding frequency on metabolism and growth of fingerling walleye in intensive culture. 1995 Coolwater Fish Culture Workshop, State College, Pennsylvania, January 8-10, 1995.

Phillips, T.A., and R.C. Summerfelt. 1995. Effects of feeding frequency on metabolism and growth of fingerling walleye in intensive culture. Iowa-Minnesota State Chapters, American Fisheries Society, Okoboji, Iowa, February 21-23, 1995.

Riepe, J.R. 1997. Revisiting retail and wholesale markets (walleye and yellow perch). Third North Central Regional Aquaculture Conference, Indianapolis, Indiana, February 6-7, 1997.

Summerfelt, R.C. 1989. Research of activities of the NCRAC Walleye Work Group on pond and intensive culture of walleye. Symposium on Aquaculture: Current Developments and Issues. 51st Midwest Fish & Wildlife Conference, Springfield, Illinois, December 5-6, 1989.

Summerfelt, R.C. 1991. Pond production of fingerling walleye in the northern Great Plains. Symposium on Strategies and Tactics for Management of Fertilized Hatchery Ponds, 121st Annual Meeting of the American Fisheries Society, San Antonio, Texas, September 12, 1991.

Summerfelt, R.C. 1991. Non-inflation of the gas bladder of larval walleye (*Stizostedion vitreum*): experimental evidence for alternative hypotheses of its etiology. Larvi '91: International Symposium on Fish and Crustacean Larviculture, Ghent, Belgium, August 27-30, 1991.

Summerfelt, R.C. 1991. Walleye culture research sponsored by the North Central Regional Aquaculture Center (NCRAC). Walleye Technical Committee, North Central Division, American Fisheries Society, Work Group Meeting, Dubuque, Iowa, July 15-17, 1991.

Summerfelt, R.C. 1991. Culture of walleye for food: a status report. 5th Annual Minnesota Aquaculture Conference, St. Paul, Minnesota, March 8-9, 1991.

Summerfelt, R.C. 1992. Intensive walleye fry production. Aqua '92, 6th Annual Minnesota Aquaculture Conference, Duluth, Minnesota, March 6-7, 1992. (Invited speaker)

Summerfelt, R.C. 1992. Intensive culture of walleye fry on formulated feeds: status report on problem of non-inflation of the gas bladder. Iowa Department of Natural Resources, Fisheries Bureau Statewide Meeting, Springbrook, March 3, 1992.

Summerfelt, R.C. 1993. Production of fingerling walleye in drainable ponds. Aqua '93, 7th Annual Minnesota Aquaculture Conference, Alexandria, Minnesota, March 5-6, 1993. (Invited speaker)

Summerfelt, R.C. 1994. Fish biology: a problem-solving tool for aquaculture. 56th Midwest Fish and Wildlife Conference, Indianapolis, Indiana, December 4-7, 1994. (Invited speaker)

Summerfelt, R.C. 1994. Intensive culture of walleye from fry to food fish. Wisconsin Aquaculture '94, Wisconsin Aquaculture Conference, Stevens Point, Wisconsin, February 18-19, 1994.

Summerfelt, R.C. 1995. Status report on the walleye culture manual. North Central and Ninth Annual Minnesota Aquaculture Conference and Tradeshow (Second North Central Regional Aquaculture Conference), Minneapolis, Minnesota, February 17-18, 1995. (Invited speaker)

Summerfelt, R.C. 1995. Pond culture of walleyes. Aquaculture Conference '95. Wisconsin Aquaculture Association, Stevens Point, Wisconsin March 17-18, 1995. (Invited speaker)

Summerfelt, R.C. 1997. Water quality considerations for aquaculture. Third North Central Regional Aquaculture Conference, Indianapolis, Indiana, February 6-7.

Summerfelt, R.C., and B.T. Bristow. 1995. Culture of larval walleye in clear, turbid, and colored water. 1995. Coolwater Fish Culture Workshop, State College, Pennsylvania, January 8-10, 1995.

SUNFISH

Publications in Print

Brunson, M.W., and J.E. Morris. 2000. Species profile: sunfish. SRAC Publication No. 724, Southern Regional Aquaculture Center, Stoneville, Mississippi.

- Bryan, M.D., J.E. Morris, and G.J. Atchison. 1994. Methods for culturing bluegill in the laboratory. *Progressive Fish-Culturist* 56:217-221.
- Hayward, R.S., and H.P. Wang. 2002. Inherent growth capacity and social costs of bluegill and hybrids of bluegill and green sunfish: which fish really grows faster? *North American Journal of Aquaculture* 64:34-46.
- Hayward, R.S., D.B. Noltie, and N. Wang. 1997. Use of compensatory growth to double hybrid sunfish growth rates. *Transactions of the American Fisheries Society* 126:316-322.
- Hayward, R.S., N. Wang, and D.B. Noltie. 1999. Group holding impedes compensatory growth of hybrid sunfish. *Aquaculture* 183:43-52.
- Lane, R.L. 2001. Comparisons between bluegill and hybrid sunfish for food fish production. Master's thesis. Iowa State University, Ames, Iowa.
- Miller, S. 1995. Tetraploid induction protocols for bluegill sunfish, *Lepomis macrochirus*, using cold and pressure shocks. Master's thesis. Michigan State University, East Lansing.
- Mischke, C.C. 1995. Larval bluegill culture in the laboratory. Master's thesis. Iowa State University, Ames.
- Mischke, C.C., and J.E. Morris. 1997. Out-of-season spawning of sunfish *Lepomis* spp. in the laboratory. *Progressive Fish-Culturist* 59:297-302.
- Mischke, C.C., and J.E. Morris. 1998. Growth and survival of larval bluegills in the laboratory under different feeding. *Progressive Fish-Culturist* 60:206-213.
- Mischke, C.C., and J.E. Morris. 1998. Review of bluegill and bluegill hybrid aquaculture. *Aquaculture Magazine* 24(5):30-38.
- Mischke, C.C., G.D. Dvorak, and J.E. Morris. 2001. Growth and survival of hybrid sunfish larvae in the laboratory under different feeding and temperature regimes. *North American Journal of Aquaculture* 63:265-271.
- Montes-Brunner, Y. 1992. Study of the developmental stages of bluegill (*Lepomis macrochirus*) eggs using selected histological techniques. Master's thesis. Michigan State University, East Lansing.
- Read, E.R. 1994. Cage culture of black, white and F₁ hybrid crappie (*Pomoxis* species). Master's thesis. Pittsburg State University, Pittsburg, Kansas.
- Thomas, G.L. 1995. Culture of white crappie (*Pomoxis annularis*) in a Recirculating System. Master's thesis, Pittsburg State University, Pittsburg, Kansas.
- Wang, N., R.S. Hayward, and D.B. Noltie. 1998. Effect of feeding frequency on food consumption, growth, size variation, and feeding pattern of age-0 hybrid sunfish. *Aquaculture* 165:261-267.
- Wang, N., R.S. Hayward, and D.B. Noltie. 1998. Variation in food consumption, growth, and growth efficiency among juvenile hybrid sunfish held in isolation. *Aquaculture* 167:43-52.
- Wang, N., R.S. Hayward, and D.B. Noltie. 2000. Effects of social interaction on growth of juvenile hybrid sunfish held at two densities. *North American Journal of Aquaculture* 62:161-167.

Westmaas, A.R. 1992. Polyploidy induction in bluegill sunfish (*Lepomis macrochirus*) using cold and pressure shocks. Master's thesis. Michigan State University, East Lansing.

Wills, P.S. 1998. Induced triploidy in *Lepomis* sunfish and assessment of uses for triploid hybrid sunfish using a risk/benefit model. Doctoral dissertation. Southern Illinois University, Carbondale.

Wills, P.S., J.P. Paret, and R.J. Sheehan. 1994. Induced triploidy in *Lepomis* sunfish and hybrids. *Journal of the World Aquaculture Society* 25(4):47-60.

Wills, P.S., R.J. Sheehan, and S.K. Allen, Jr. 2000. Histology and DNA content in diploid and triploid hybrid sunfish. *Transactions of the American Fisheries Society* 129:30-40.

Manuscripts

Dvork, G., J.E. Morris, and C.C. Mischke. In review. Spawning behavior and early life history. Pages 4-11 in C.C. Mischke and J.E. Morris, editors. Sunfish culture guide. NCRAC Culture Series #102, NCRAC Publications Office, Iowa State University, Ames.

Garling, D. In review. Fee fishing. Pages 44-50 in C.C. Mischke and J.E. Morris, editors. Sunfish culture guide. NCRAC Culture Series #102, NCRAC Publications Office, Iowa State University, Ames.

Garling, D., P. Wilbert, A. Westmaas, S. Miller, R. Sheehan, P. Wills, and J. Paret. In review. Production of polyploid sunfishes. Pages 35-43 in C.C. Mischke and J.E. Morris, editors. Sunfish culture guide. NCRAC Culture Series #102, NCRAC Publications Office, Iowa State University, Ames.

Lane, R.I., and J.E. Morris. In press. Comparison of prepared feed versus natural food ingestion between pond-cultured bluegill and hybrid sunfish. *Journal of the World Aquaculture Society*.

Mischke, C.C., and J.E. Morris, editors. In review. Sunfish culture guide. NCRAC Culture Series #102, NCRAC Publications Office, Iowa State University, Ames.

Mischke, C.C., and J.E. Morris. In review. Historical background. Pages 1-3 in C.C. Mischke and J.E. Morris, editors. Sunfish culture guide. NCRAC Culture Series #102, NCRAC Publications Office, Iowa State University, Ames.

Mischke, C.C., and J.E. Morris. In review. Culture methods. Pages 12-19 in C.C. Mischke and J.E. Morris, editors. Sunfish culture guide. NCRAC Culture Series #102, NCRAC Publications Office, Iowa State University, Ames.

Mischke, C.C., and J.E. Morris. In review. Brood stock management. Pages 20-25 in C.C. Mischke and J.E. Morris, editors. Sunfish culture guide. NCRAC Culture Series #102, NCRAC Publications Office, Iowa State University, Ames.

Mischke, C.C., and J.E. Morris. In review. Water temperature influences on survival and growth. Page 30 in C.C. Mischke and J.E. Morris, editors. Sunfish culture guide. NCRAC Culture Series #102, NCRAC Publications Office, Iowa State University, Ames.

Mischke, C.C., and J.E. Morris. In review. Industry status. Pages 32-33 in C.C. Mischke and J.E. Morris, editors. Sunfish culture guide. NCRAC Culture Series #102, NCRAC Publications Office, Iowa State University, Ames.

Mischke, C.C., G. Dvorak, and J.E. Morris. In review. Hybridization. Pages 26-29 in C.C. Mischke and J.E. Morris, editors. Sunfish culture guide. NCRAC Culture Series #102, NCRAC Publications Office, Iowa State University, Ames.

Morris, J.E., R. Lane, and C.C. Mischke. Submitted. Culture and propagation of bluegill *Lepomis macrochirus* and its hybrids. In Aquatic species cultured since 1897. American Fisheries Society.

Riche, M., and D. Garling. In review. Calculating chemical treatment rates. Pages 51-59 in C.C. Mischke and J.E. Morris, editors. Sunfish culture guide. NCRAC Culture Series #102, NCRAC Publications Office, Iowa State University, Ames.

Riche, M., and D. Garling. In review. Collecting and submitting fish samples for disease diagnoses. Pages 72-81 in C.C. Mischke and J.E. Morris, editors. Sunfish culture guide. NCRAC Culture Series #102, NCRAC Publications Office, Iowa State University, Ames.

Sampson, T., and D. Garling. In review. Common parasites of sunfish. Pages 63-71 in C.C. Mischke and J.E. Morris, editors. Sunfish culture guide. NCRAC Culture Series #102, NCRAC Publications Office, Iowa State University, Ames.

Papers Presented

Brown, P.B., and K. Wilson. 1994. Experimental and practical diet evaluations with hybrid bluegill. 25th Annual Meeting of the World Aquaculture Society, New Orleans, Louisiana, January 12-18, 1994.

Hayward, R.S. 1998. Strategies for increasing growth rates and reducing size variation in hybrid sunfish. Missouri Joint Aquaculture Conference. Springfield, Missouri, March 4-6, 1998.

Hayward, R.S. 1999. New feeding strategies for sunfish. North Central Regional Aquaculture Conference, Columbia, Missouri, February 24-26, 1999.

Hayward, R.S. 2001. New developments in ongoing sunfish aquaculture research. Meeting of the Missouri Aquaculture Coordinating Council, Warsaw, Missouri, July 10, 2001.

Hayward R.S. 2001. Contrasting results from efforts to elicit growth over-compensation in two fishes. Cost 827 Final Workshop--Voluntary Food Intake in Fish, Reykjavik, Iceland, August 16-18, 2001.

Hayward, R.S. 2002. Rearing sunfish for the food market: overview of relevant research at the University of Missouri. Michigan Aquaculture Association Annual Conference, Cadillac, Michigan, February 7-8, 2002.

Hayward, R.S. 2002. Update on sunfish aquaculture research at the University of Missouri. Missouri Aquaculture Association Annual Conference, Jefferson City, Missouri, February 12-13, 2002.

Hayward, R.S. 2002. Techniques for rearing big bluegill faster. Nebraska Game and Parks Commission's Urban Fisheries Program, Gretna, Nebraska, September 18, 2002.

Hayward, R.S., C.V. Bove, D.B. Noltie, and N. Wang. 1997. Does the compensatory growth response of hybrid sunfish reflect patterns of food availability in nature? 127th Annual Meeting of the American Fisheries Society, Monterey, California, August 24-28, 1997.

Kohler, C.C., and J.E. Wetzel. 1997. Protein requirements of hybrid sunfish, *Lepomis cyanellus* × *L. macrochirus*, diets. 28th Annual Meeting of the World Aquaculture Society, Seattle, Washington, February 19-23, 1997.

Kohler, C.C., and J.E. Wetzel. 1999. Sunfish nutrition. North Central Regional Aquaculture Conference, Columbia, Missouri, February 24-26, 1999.

Lane, R.L., and J.E. Morris. 2001. Evaluation of bluegill *Lepomis macrochirus* and F₁ hybrid sunfish *L. cyanellus* × *L. macrochirus* pond culture. Annual Meeting of the World Aquaculture Society, Orlando, Florida, January 21-25, 2001.

Mischke, C.C., and J.E. Morris. 1996. Growth and survival of larval bluegill (*Lepomis macrochirus*) and hybrid sunfish (green sunfish, *L. cyanellus* × bluegill) in the laboratory under different feeding regimes. Iowa-Nebraska American Fisheries Society Meeting, Council Bluffs, Iowa, January 29-31, 1996.

Mischke, C.C., and J.E. Morris. 1996. Early spawning of bluegill. Midcontinent Warmwater Fish Culture Workshop, Council Bluffs, Iowa, February 7, 1996.

Mischke, C.C., and J.E. Morris. 1996. Growth and survival of larval bluegill, *Lepomis macrochirus*, in the laboratory under different feeding regimes. U.S. Chapter of the World Aquaculture Society, Arlington, Texas, February 14-17, 1996. (Awarded Best Student Poster)

Morris, J.E. 1995. Hybrid bluegill culture update. Combined North Central and Ninth Annual Minnesota Aquaculture Conference and Tradeshow (Second North Central Regional Aquaculture Conference), Minneapolis, Minnesota, February 17-18, 1995.

Morris, J.E. 1995. Culture of bluegills under laboratory conditions. Nebraska Aquaculture Conference, North Platte, Nebraska, March 25, 1995.

Morris, J.E. 1999. Overview of sunfish culture. North Central Regional Aquaculture Conference, Columbia, Missouri, February, 1999.

Morris, J.E. 2000. Overview of sunifsh culture in the U.S. Mid-Continental Warmwater Fish Culture Workshop, Council Bluffs, Iowa, February 7-9, 2000.

Morris, J.E., and C.C. Mischke. 1999. Overview of sunfish culture. Aquaculture America '99, Tampa, Florida, January 27-30, 1999.

Morris, J.E., C.C. Mischke, and G. Dike. 1997. Overview of *Lepomis* spp. culture in the U.S. 28th Annual Meeting of the World Aquaculture Society, Seattle, Washington, February 19-23, 1997.

Morris, J.E., R. Lane, and C.C. Mischke. 2001. Culture potential of bluegill *Lepomis macrochirus* and its hybrids. Annual Meeting of the World Aquaculture Society, Orlando, Florida, January 21-25, 2001.

Paret, J.M., R.J. Sheehan and S.D. Cherck. 1993. Growth performance of *Lepomis* diploid hybrids, triploid hybrids and parental species at five temperatures. Meeting of the Illinois and Iowa Chapters of the American Fisheries Society, Bettendorf, Iowa, February 16-18, 1993.

Read, E.R., and J.R. Triplett. 1994. Cage culture of crappie. 56th Midwest Fish and Wildlife Conference, Indianapolis, Indiana, December 4-7, 1994.

Read, E.R., and J.R. Triplett. 1995. Cage culture of black, white and F₁ hybrid crappie (*Pomoxis* species). Kansas Commercial Fish Growers Association, McPherson, Kansas, February 2, 1995.

Sheehan, R.J., J.P. Paret, P.S. Wills, and J.E. Seeb. 1993. Induced triploidy and growth of *Lepomis* parental species, hybrid, and triploid hybrid at five temperatures, 8 to 28C. Prospects for Polyplloid Fish in Fisheries

Management Symposium, 123rd Annual Meeting of the American Fisheries Society, Portland, Oregon, August 29-September 2, 1993. (Invited paper)

Sheehan, R.J., J.M. Hennessy, J.M. Paret, and P.S. Wills. 1999. Selection of sunfish species. North Central Regional Aquaculture Conference, Columbia, Missouri, February 24-26, 1999.

Tetzlaff, B., and P. Wills. 1991. Current trends in the culture of hybrid sunfish. First North Central Regional Aquaculture Conference, Kalamazoo, Michigan, March 18-21, 1991.

Thomas, G.L., and J.R. Triplett. 1994-1995. Close-loop white crappie (*Pomoxis annularis*) culture. 56th Midwest Fish and Wildlife Conference, Indianapolis, Indiana, December 4-7, 1994. Also presented at the Kansas Commercial Fish Growers Association Meeting, McPherson, Kansas, February 2, 1995 and Kansas Academy of Science Annual Meeting, Pittsburg State University, Pittsburg, Kansas, April 7, 1995.

Wang, N., R.S. Hayward, and D.B. Noltie. 1997. Individual variation in growth, food consumption, and growth efficiency of hybrid sunfish due to genetic differences. 127th Annual Meeting of the American Fisheries Society, Monterey, California, August 24-28, 1997.

Westmaas, A.R., W. Young, and D. Garling. 1991. Induction of polyploids in bluegills and chinook salmon. First North Central Regional Aquaculture Conference, Kalamazoo, Michigan, March 18-21, 1991.

Wetzel, J.E., and C.C. Kohler. 1997. Effects of protein levels in hybrid sunfish, *Lepomis cyanellus* × *L. macrochirus*, diets. Illinois Chapter of the American Fisheries Society Annual Meeting, Collinsville, Illinois, March 5-7, 1997.

Wills, P.S., R.J. Sheehan, and S.A. Allen, Jr. 1997. Sperm production, histology, and relative DNA content in gonadal tissues from diploid and triploid hybrid *Lepomis* sunfish. 127th Annual Meeting of the American Fisheries Society, Monterey, California, August 24-28, 1997.

Wills, P.S., R.J. Sheehan, and S.K. Allen, Jr. Sperm production, histology, and relative DNA content in gonadal tissues from diploid and triploid hybrid *Lepomis* sunfish. Illinois Chapter of the American Fisheries Society Annual Meeting, Collinsville, Illinois, March 4-6, 1997.

SALMONIDS

Publications in Print

Adelizi, P.D., R.R. Rosati, K. Warner, Y.V. Wu, T.R. Muench, M.R. White, and P.B. Brown. 1998. Evaluation of fish meal-free diets for rainbow trout, *Oncorhynchus mykiss*. *Aquaculture Nutrition* 4:255-262.

Cain, K.D., and D.L. Garling. 1995. Pretreatment of soy bean meal for salmonid diets with phytase to reduce phosphorus concentration in hatchery effluents. *Progressive Fish-Culturist* 57:114-119.

Finck, J.L. 1994. Activity of all-female and mixed-sex rainbow trout (*Oncorhynchus mykiss*) and their early growth and survival in comparison to all-female triploids. Master's thesis, Southern Illinois University-Carbondale.

Lee, K.J., K. Dabrowski, J.H. Blom, and S.C. Bai. 2001. Fish meal replacement by a fish meal analog in juvenile rainbow trout. *Journal of North American Aquaculture* 63:109-117.

- Pan, J.Z., K. Dabrowski, L. Liu, and A. Ciereszko. 1995. Characteristics of semen and ovary in rainbow trout (*Oncorhynchus mykiss*) fed fish meal and/or animal by-product based diets. Proceedings of the 5th International Symposium on the Reproductive Physiology of Fish, Austin, Texas, July 2-8, 1995.
- Procarione, L.S., T.P. Barry, and J.A. Malison. 1999. Effects of high rearing densities and loading rates on the growth and stress responses of juvenile rainbow trout. North American Journal of Aquaculture 61:91-96.
- Ramseyer, L.J. 1995. Total length to fork length relationships of juvenile hatchery-reared coho and chinook salmon. Progressive Fish-Culturist 57:250-251.
- Ramseyer, L.J. 1997. Nutritional strategies for reducing pollutants in aquaculture effluents. Doctoral dissertation, Michigan State University, East Lansing.
- Ramseyer, L., D.L. Garling, Jr., G. Hill, and J. Link. 1999. Effect of dietary zinc supplementation and phytase pre-treatment of soybean meal or corn gluten meal on growth, zinc status and zinc-related metabolism in rainbow trout, *Oncorhynchus mykiss*. Fish Physiology and Biochemistry 20:251-261.
- Riche, M. 1993. Phosphorus absorption coefficients for rainbow trout (*Oncorhynchus mykiss*) fed commercial sources of protein. Master's thesis. Purdue University, West Lafayette, Indiana.
- Riche, M., and P.B. Brown. 1996. Absorption of phosphorus from feedstuffs fed to rainbow trout. Aquaculture 142:269-282.
- Riche, M. and P.B. Brown. 1999. Incorporation of plant protein feedstuffs into fish meal diets for rainbow trout increases phosphorus availability. Aquaculture Nutrition 5:101-105.
- Riche, M., M.R. White, and P.B. Brown. 1995. Barium carbonate as an alternative indicator to chromic oxide for use in digestibility experiments with rainbow trout. Nutrition Research 15:1323-1331.
- Shasteen, S.P. 1995. Benefits of artificial swimbladder deflation for depressurized largemouth bass, walleye, and rainbow trout in catch and release fisheries. Master's thesis. Southern Illinois University-Carbondale.
- Sheehan, R.J., S.P. Shasteen, A.V. Suresh, A.R. Kapuscinski, and J.E. Seeb. 1999. All-female triploids and diploids outgrow mixed-sex diploid rainbow trout. Transactions of the American Fisheries Society 19:491-498.
- Suresh, A.V. 1996. Fiber growth and DNA, RNA, and protein concentrations in white muscle tissue as indicators of growth in diploid and triploid rainbow trout, *Oncorhynchus mykiss*. Doctoral dissertation. Southern Illinois University-Carbondale.
- Suresh, A.V., and R.J. Sheehan. 1998. Muscle fiber growth dynamics in diploid and triploid rainbow trout. Journal of Fish Biology 52:570-587.
- Suresh, A.V., and R.J. Sheehan. 1998. Biochemical and morphological correlates of growth in diploid and triploid rainbow trout. Journal of Fish Biology 52:588-599.
- Weil, L.S., T.P. Barry, and J.A. Malison. 2001. Fast growth in rainbow trout is correlated with a rapid decrease in post-stress cortisol stress concentrations. Aquaculture 193:373-380

Manuscripts

Lee, K.J., K. Dabrowski, S.C. Bai, and P.C. Stromberg. In press. Mixture of animal and plant protein sources can completely replace fish meal in a diet for juvenile rainbow trout (*Oncorhynchus mykiss*). *Journal of Animal Nutrition*.

Lesiow, T., H. Ockerman, and K. Dabrowski. Submitted. Chemical composition, functional properties and sensory evaluation of rainbow trout fillets as affected by different feed formulations. *Journal of the World Aquaculture Society*.

Sheehan, R.J., C. Habicht, and J.E. Seeb. In preparation. Tolerance of diploid and triploid chinook Salmon, coho salmon, and rainbow trout during simulated transportation. *Transactions of the American Fisheries Society*.

Papers Presented

Adelizi, P., P. Brown, V. Wu, and R. Rosati. 1995. Fish meal-free diets for rainbow trout. 24th Annual Fish Feed and Nutrition Workshop, Columbus, Ohio, October 19-21, 1995.

Adelizi, P., P. Brown, V. Wu, K. Warner, and R. Rosati. 1996. Alternative feed ingredients in diets fed to rainbow trout. *Aquaculture America*, Dallas, Texas, February 14-17, 1996.

Barry, T.P., T.B. Kayes, T.E. Kuczynski, A.F. Lapp, L.S. Procarione, and J.A. Malison. 1993. Effects of high rearing density and low-level gas supersaturation on the growth and stress responses of lake trout (*Salvelinus namaycush*). 123rd Annual Meeting of the American Fisheries Society, Portland, Oregon, August 28-September 3, 1993.

Bharadwaj, A., and P.B. Brown. 1999. Growth response of rainbow trout fed fish meal and plant based diets. *Aquaculture America '99*, Tampa, Florida, January 27-30, 1999.

Brown, P.B. 1993. Salmonid aquaculture in the North Central Region. Seventh Annual Minnesota Aquaculture Conference, Alexandria, Minnesota, March 5-6, 1993.

Brown, P.B., Y. Hodgin, K. Wilson, and J. Stanley. 1996. Review of lecithin in aquaculture and evaluation of three commercial lecithin products in diets fed to coho and Atlantic salmon. 87th Annual Meeting of the American Oil Chemists' Society, Indianapolis, Indiana, June 22-24, 1996.

Dabrowski, K. 2002. Utilization of cottonseed meal as fishmeal replacement in rainbow trout diets. Michigan Aquaculture Association Annual Conference, Cadillac, Michigan, February 7-8, 2002.

Dabrowski, K., A. Ciereszko, and S.C. Bai. 1998. Effects of fish meal replacement in rainbow trout diets on sperm quality. 29th Annual Meeting of the World Aquaculture Society, Las Vegas, Nevada, February 15-19, 1998.

Dabrowski, K., J.H. Blom, K.J. Lee, A. Cierszki, and J. Rinchar. 1998. Cottonseed meal in grow-out and brood stock diets for rainbow trout. Fish Nutrition Workshop, Pine Bluff, Arkansas, August 13-15, 1998.

Finck, J.L., and R.J. Sheehan. 1993. Daily activity patterns of mixed-gender and all-female rainbow trout in raceways. Presented at the 55th Midwest Fish & Wildlife Conference, Annual Meeting of the North-Central Division of the American Fisheries Society, St. Louis, Missouri, December 11-15, 1993. (Invited paper)

Finck, J.L., and R.J. Sheehan. 1993. Daily activity patterns of mixed-sex and all-female rainbow trout in raceways. Presented at the Joint Meeting of the Illinois and Iowa Chapters of the American Fisheries Society, Bettendorf, Iowa, February 16-18. (Awarded Best Student Paper)

Haley, D.I., and D.L. Garling. 1999. Evaluation of phytase pretreatment on all plant diets in rainbow trout (*Oncorhynchus mykiss*). 30th Annual Meeting of the World Aquaculture Society, Sydney, Australia, April 26-May 2, 1999.

Lee, K.J., K. Dabrowski, J.H. Blom, S.C. Bai, and P. Stromberg. 1998. Fish meal replacement by animal and plant protein sources in juvenile rainbow trout, *Oncorhynchus mykiss* diets. Fish Nutrition Workshop, Pine Bluff, Arkansas, August 13-15, 1998.

Lee, K.J., K. Dabrowski, and G. Mbahinzireki. 2000. Utilization of cottonseed meal in rainbow trout and Nile tilapia. Gossypol enantiomers in fish tissues. Aquaculture America 2000, New Orleans, Louisiana, February 2-5, 2000.

Procarione, L.S., T.P. Barry, and J.A. Malison. 1996. A rapid corticosteroid stress response is correlated with superior growth in rainbow trout. Midwest Endocrinology Conference, The Society of Integrative and Comparative Biology, Madison, Wisconsin, June 22-23, 1996.

Ramseyer, L.J., and D.L. Garling. 1997. Fish nutrition and aquaculture waste management. Third North Central Regional Aquaculture Conference, Indianapolis, Indiana, February 6-7, 1997.

Riche, M., and P.B. Brown. 1993. Apparent phosphorus absorption coefficients for rainbow trout fed common feedstuffs. 24th Annual Meeting of the World Aquaculture Society, Torremolinos, Spain, May 26-28, 1993.

Riche, M., M.E. Griffin, and P.B. Brown. 1994. Effect of dietary phytase pretreatment on phosphorus leaching from rainbow trout feces. 25th Annual Meeting of the World Aquaculture Society, New Orleans, Louisiana, January 12-18, 1994.

Sheehan, R.J. 1995. Applications of chromosome set manipulation to fisheries resource management. Presented at the University of Peru, Amazonia, Iquitos, Peru, August 17, 1995. (Invited paper)

Sheehan, R.J., C. Habicht, and J.E. Seeb. 1994. Tolerance of triploid *Oncorhynchus* (coho, chinook, and rainbow trout) to aquaculture stressors. Presented at the 56th Midwest Fish and Wildlife Conference, Indianapolis, Indiana, December 4-7, 1994.

NORTH CENTRAL REGIONAL AQUACULTURE CONFERENCES

Proceedings

Proceedings of the North Central Regional Aquaculture Conference. 1991. First North Central Regional Aquaculture Conference, Kalamazoo, Michigan, March 18-21, 1991.

Morris, J.E., editor. 1999. Aquaculture at the crossroads: linking the past to the future. Compilation of abstracts, papers, and supporting articles for the Fourth North Central Regional Aquaculture Conference, Columbia, Missouri, February 24-26, 1999.

NATIONAL AQUACULTURE EXTENSION WORKSHOP/CONFERENCE

Publications in Print

Proceedings of the National Extension Aquaculture Workshop. 1992. National Extension Aquaculture Workshop, Ferndale, Arkansas, March 3-7, 1992.

National Aquaculture Extension Conference: A Program Summary of Presentations, Posters and Aquaculture Short Courses. 1997. National Extension Aquaculture Conference, Annapolis, Maryland, April 8-12, 1997. Maryland Sea Grant Extension Publication Number UM-SG-MAP-97-01, College Park, Maryland. (Also available electronically at: <http://www.mdsg.umd.edu:80/extensionconf/summary.html>)

CRAYFISH

Publications in Print

Brown, P., and J. Gunderson, editors. 1997. Culture potential of selected crayfishes in the North Central Region. NCRAC Technical Bulletin Series #112, NCRAC Publications Office, Iowa State University, Ames.

Fetzner, J.W., Jr., R.J. Sheehan, and L.W. Seeb. 1997. Genetic implications of broodstock selection for crayfish aquaculture in the Midwestern United States. *Aquaculture* 154:39-55.

Gunderson, J.L. 1995. Rusty crayfish: a nasty invader, the biology, identification, and impacts of the rusty crayfish. Minnesota Sea Grant Extension Publication, University of Minnesota, Duluth.

Richards, C., J.L. Gunderson, P. Tucker, and M. McDonald. 1995. Crayfish and baitfish culture in wild rice paddies. Technical Report No. NRRI/TR-95/39. Natural Resources Research Institute, Duluth, Minnesota.

Papers Presented

Brown, P.B. 1994. Pond production of crayfish. Workshop on Getting Started in Commercial Aquaculture Raising Crayfish and Yellow Perch, Jasper, Indiana, October 14-15, 1994.

Brown, P.B. 1994. Crayfish and aquatics: raising fish for profit. Indiana Horticultural Congress, Indianapolis, Indiana.

Brown, P.B. 1995. Crayfish aquaculture in the north. Nebraska Aquaculture Conference, North Platte, Nebraska, March 25, 1995.

Gunderson, J.L. 1994. Raising crayfish commercially. Development 94, Detroit Lakes, Minnesota, February 18, 1994.

Gunderson, J.L. 1994. Softshell crayfish production. Aqua '94, 8th Annual Minnesota Aquaculture Conference, Alexandria, Minnesota, March 4, 1994.

Gunderson, J.L. 1994. Outdoor culture systems and crayfish production. Minnesota Extension Service Aquaculture Seminar, Thief River Falls, Minnesota, April 25, 1994.

Gunderson, J.L. 1994. Softshell crayfish production. Workshop on Getting Started in Commercial Aquaculture Raising Crayfish and Yellow Perch, Jasper, Indiana, October 14-15, 1994.

Gunderson, J.L. 1995. Diversity in aquaculture -- crawfish. Wisconsin Aquaculture '95, Stevens Point, Wisconsin, March 17, 1995.

BAITFISH

Publications in Print

Meronek, T.G. 1994. Status of the bait industry in the North Central Region of the United States. Master's thesis. University of Wisconsin, Stevens Point.

Meronek, T.G., F.A. Copes, and D.W. Coble. 1995. A summary of bait regulations in the north central United States. *Fisheries* 20(11):16-23.

Papers Presented

Copes, F.A. 1993. Aquaculture shortcourse. Sponsored by University of Wisconsin-Sea Grant and Wisconsin Department of Agriculture, Greenwood, Wisconsin, March 1993.

Copes, F.A. 1995. Baitfish aquaculture. North Central Regional Aquaculture Conference/Ninth Annual Minnesota Aquaculture Conference, Minneapolis, Minnesota, February 1995.

Meronek, T.G. 1993. Survey of the bait industry in the north central United States. Annual Meeting of the Michigan Fish Farmers Association, Cadillac, Michigan, February 1993.

Meronek, T.G. 1993. Survey of the bait industry in the north Central United States. Seventh Annual Minnesota Aquaculture Conference, Alexandria, Minnesota, March 1993.

Meronek, T.G. 1993. Survey of the bait industry in the north central United States. Illinois Fish Farmers Association, Pana, Illinois, March 1993.

Meronek, T.G. 1994. Status of the bait industry in the North Central Region. Annual Meeting of the Wisconsin Chapter of the American Fisheries Society, Marinette, Wisconsin, January 1994.

Meronek, T.G. 1994. Baitfish aquaculture and production. Governor's Conference: Wisconsin Aquaculture '94. University of Wisconsin, Stevens Point, February 1994.

WASTES/EFFLUENTS

Publication in Print

Rosati, R., P.D. O'Rourke, K. Tudor, and R.D. Henry. 1993. Performance of a raceway and vertical screen filter while growing *Tilapia nilotica* under commercial conditions. Pages 303-214 in J-K. Wang, editor. Techniques for modern aquaculture. Publication No. P-0293, American Society of Agricultural Engineering, St. Joseph, Michigan.

Manuscript

Maher, J.P., I.R. Adelman, and J.N. Connor. In preparation. Suspended solids in recirculating aquaculture systems and their effect on growth of tilapia (*Oreochromis niloticus*) and bluegill (*Lepomis macrochirus*). North American Journal of Aquaculture.

Papers Presented

Hinrichs, D., J. Webb, R. Rosati, and P. Foley. 1994. Effluent characterization from the production of *Oreochromis niloticus* in a modified Red Ewald-style recirculating system. 25th Annual Meeting of the World Aquaculture Society, New Orleans, Louisiana, January 12-18, 1994.

Raabe, J.K., and S.E. Yeo. 2002. Vermicomposting and vermiculture as a beneficial use for aquaculture waste. National Science Foundation Research Experience for Undergraduates, Milwaukee, Wisconsin, August 16, 2002.

Rosati, R., D. Hinrichs, and J. Webb. 1994. Biofilter performance during the production of *Oreochromis niloticus* in a modified Red Ewald-style recirculating system. 124th Annual Meeting of the American Fisheries Society, Halifax, Nova Scotia, August 21-25, 1994.

Rosati, R., P.D. O'Rourke, K. Tudor, and R.D. Henry. 1993. Performance of a raceway and vertical screen filter while growing *Tilapia nilotica* under commercial conditions. Techniques for Modern Aquaculture, Special Session at the Annual Meeting of the American Society of Agricultural Engineering, Spokane, Washington, June 21-23, 1993.

Rosati, R., J. Webb, D. Hinrichs, and P. Foley. 1993. Characteristics of the effluent from a recirculating aquaculture system. U.S. Chapter of the World Aquaculture Society, Hilton Head, South Carolina, January 27-30, 1993.

Smydra, T.M., and J.E. Morris. 1994. Characterization of aquaculture effluents from two Iowa hatcheries. Iowa Chapter, American Fisheries Society, Council Bluffs, Iowa, February 15-16, 1994.

Smydra, T.M., and J.E. Morris. 1994. Characterization of aquaculture effluents. 56th Midwest Fish and Wildlife Conference, Indianapolis, Indiana, December 4-7, 1994.

NATIONAL AQUACULTURE INAD/NADA COORDINATOR

Publications in Print

Griffin, B.R., R.A. Schnick, and W.H. Gingerich. 2000. Update on the Federal-State Aquaculture Drug Approval Project. *Aquaculture Magazine* 26(3):56-58.

Schnick, R.A. 1996. Chemicals and drugs. Pages 347-354 in R.C. Summerfelt, editor. Walleye culture manual. NCRAC Culture Series # 101, North Central Regional Aquaculture Center Publications Office, Iowa State University, Ames.

Schnick, R.A. 1996. Cooperative fish therapeutic funding initiative: States in partnership with federal agencies to ensure the future of public fish culture. *Transactions of the 61st North American Wildlife and Natural Resources Conference* 61:6-10.

Schnick, R.A. 1997. International regulatory aspects of chemical and drug residues. Pages 186-194 in R.E. Martin, R.L. Collette, and J.W. Slavin, editors. *Fish inspection, quality control, and HACCP: a global focus*. Technomic Publishing Company, Inc., Lancaster, Pennsylvania.

Schnick, R.A. 1998. Approval of drugs and chemicals for use by the aquaculture industry. *Veterinary and Human Toxicology* 40(Supplement):9-17.

Schnick, R.A. 1999. Use of chemicals in fish management and fish culture: past and future. Chapter 1, pages 1-14 in D.J. Smith, W.H. Gingerich, and M. Beconi-Barker, editors. *Xenobiotics in fish*. Kluwer Academic/Plenum Publishers, New York.

Schnick, R.A. 2000. Efficacy data needed for high priority aquaculture drugs. *American Fisheries Society Fish Health Newsletter* 28(2):3.

Schnick, R.A., and R.D. Armstrong. 1997. Aquaculture drug approval progress in the United States. Northern Aquaculture Supplement (Salmon Health Report):22-28.

Schnick, R.A., and P. Smith. 1999. International harmonisation of antibacterial agent approvals and susceptibility testing. EAFP Bulletin 19(6):293-294.

Schnick, R.A., W.H. Gingerich, and K.H. Koltas. 1996. Federal-state aquaculture drug registration partnership: A success in the making. Fisheries 21(5):4.

Schnick, R.A., D.J. Alderman, R. Armstrong, R. Le Gouvello, S. Ishihara, E.D. Lacierda, S. Percival, and M. Roth. 1997. Worldwide aquaculture drugs and vaccine registration progress. Bulletin of the European Association of Fish Pathologists 17(6):251-260.

Papers Presented

Gingerich, W.H. and R.A. Schnick. 1997. Federal-state aquaculture drug approval partnership program. 28th Annual Meeting of the World Aquaculture Society, Seattle, Washington, February 19-23, 1997.

Gingerich, W.H. and R.A. Schnick. 1997. Aquaculture drug registration study progress report. Meeting of the International Association of Fish and Wildlife Agencies, Inland Fisheries Committee, Washington, D.C. March 16, 1997.

Ringer, R.K. 1993. Workshop on INADs, NADAs, and the IR-4 Project. California Aquaculture Association, Oakland, October 11, 1993.

Ringer, R.K. 1993. INAD workshop: proper drug and chemical use in aquaculture. 9th Annual Florida Aquaculture Association Conference, Fort Pierce, November 6, 1993.

Ringer, R.K. 1994. National INAD Coordinator's role in aquaculture. 25th Annual Meeting of the World Aquaculture Society, New Orleans, January 12-18, 1994.

Ringer, R.K. 1994. State of current USDA regulations on drug, therapeutic, and chemical use. North Carolina Aquaculture Development Conference, New Bern, February 5, 1994.

Ringer, R.K. 1994. Investigational New Animal Drugs Workshop. Tropical and Subtropical Regional Aquaculture Center Industry Advisory Council Meeting, Honolulu, Hawaii, March 14, 1994.

Schnick, R.A. 1995. Idaho Aquaculture Association Annual Meeting, Twin Falls, Idaho, May 19-22, 1995.

Schnick, R.A. 1995. Chemistry in Aquaculture Symposium. Convener and presenter, Cullowhee, North Carolina, May 31-June 2, 1995.

Schnick, R.A. 1995. FWS/INAD Coordination Workshop. Presenter and coordinator, Bozeman, Montana, August 1-4, 1995.

Schnick, R.A. 1995. Funding crisis for drugs/therapeutants and coordination of aquaculture INADs/NADAs. Annual meeting of the U.S. Trout Farmers Association, Twin Falls, Idaho, September 27-30, 1995.

Schnick, R.A. 1995. Activities of the National Coordinator for Aquaculture New Animal Drug Applications. Annual meeting of the National Research Support Program Number 7 (NRSP-7), Rockville, Maryland, October 2, 1995.

Schnick, R.A. 1995. INAD/NADA Coordinators workshop under the sponsorship of CVM. Organizer and presenter, Rockville, Maryland, November 1-2, 1995.

Schnick, R.A. 1996. Status of aquaculture INADs and NADAs. Presenter and coordinator, Midcontinent Warmwater Fish Culture Workshop and INAD/NADA Coordination Meetings, Council Bluffs, Iowa, February 6-8, 1996.

Schnick, R.A. 1996. INAD/NADA update. Western Regional Aquaculture Expo '96, Sacramento, California, February 7-9, 1996.

Schnick, R.A. 1996. National Aquaculture NADA Coordinator update. Working Group on Quality Assurance in Aquaculture Production, Arlington, Texas, February 14, 1996.

Schnick, R.A. 1996. Proper use of fish therapeutants based on legal requirements-gill lice, bacterial gill disease, furunculosis, etc. Annual Meeting of the Michigan Aquaculture Association, East Lansing, Michigan, February 23, 1996.

Schnick, R.A. 1996. Status of aquaculture drug development. Great Lakes Fish Disease Workshop, La Crosse, Wisconsin, February 28, 1996.

Schnick, R.A. 1996. Advances in therapeutants. Southeastern Fish Diagnosticians' Workshop, Mississippi State, Mississippi, March 13-14, 1996.

Schnick, R.A. 1996. Report on progress and research study objectives of the Federal-State Drug Registration Partnership. Meeting of the International Association of Fish and Wildlife Agencies, *ad hoc* Committee on Aquaculture, Tulsa, Oklahoma, March 24, 1996.

Schnick, R.A. 1996. Cooperative fish therapeutic funding initiative--States in partnership with Federal agencies to ensure the future of public fish culture. 61st North American Conference on Wildlife and Natural Resources, Tulsa, Oklahoma, March 24-28, 1996.

Schnick, R.A. 1996. International regulatory aspects of chemical and drug residues. International Conference on Fish Inspection and Quality, Arlington, Virginia, May 19-24, 1996.

Schnick, R.A. 1996. Aquaculture drug approval progress in the United States. Aquaculture Canada '96, 13th Annual Meeting of the Aquaculture Association of Canada, Ottawa, Ontario, June 2-5, 1996.

Schnick, R.A. 1996. Summary of activities of the National Coordinator for Aquaculture New Animal Drug Applications (NADAs): (May 15, 1995 to May 14, 1996). Meeting of the Aquatic Remedies Steering Committee, American Pet Products Manufacturers Association, Minneapolis, Minnesota, June 18-19, 1996.

Schnick, R.A. 1996. Overview of NADA Coordinator activities, International Project update, short-term INAD/NADA needs. FWS INAD Coordination Workshop, Bozeman, Montana, August 14-15, 1996.

Schnick, R.A. 1996. The procedures and responsibilities related to the amoxicillin INAD. Meeting of the Fish Growers of America, Memphis, Tennessee, October 2, 1996.

Schnick, R.A. 1996. Overview of pivotal study protocol requirements. Chloramine-T Pivotal Efficacy Protocol Development Workshop, Kansas City, Missouri, November 7-8, 1996.

Schnick, R.A. 1997. INAD and drug clearance update. Midcontinent Warmwater Fish Culture Workshop, Springfield, Missouri, February 3-5, 1997.

Schnick, R.A. 1997. Overview of partnerships for aquaculture drug approvals. Partnerships for Aquaculture Drug Approvals: Models for Success. Chair of Special Session at 28th Annual Meeting of the World Aquaculture Society, Seattle, Washington, February 19-23, 1997.

Schnick, R.A. 1997. Current status and future needs for drugs in aquaculture: regional needs. Workshop on International Harmonization for Drugs and Biologics, Seattle, Washington, February 24, 1997.

Schnick, R.A. 1997. Aquaculture drug approval progress for the catfish industry. Catfish Farmers of America 1997 National Convention, Nashville, Tennessee, February 27-March 1, 1997.

Schnick, R.A. 1997. Aquaculture drugs and chemicals approvals. Wisconsin Aquaculture Conference '97, Stevens Point, Wisconsin, March 14-15, 1997.

Schnick, R.A. 1997. History of the IAFWA drug approval project; review of FDA's decisions on drug use in aquaculture; and negotiations by NADA coordinator. First Meeting of the IAFWA Drug Approval Oversight Subcommittee, Hot Springs, Arkansas, May 5, 1997.

Schnick, R.A. 1997. Review of the November 1996 chloramine-T data requirements; Data call-in. Chloramine-T INAD Coordination Workshop, Bozeman, Montana, August 5, 1997.

Schnick, R.A. 1997. Overview of NADA Coordinator activities. FWS-INAD Coordination Workshop, Bozeman, Montana, August 7, 1997.

Schnick, R.A. 1997. NADA Coordinator update. JSA Working Group on Quality Assurance in Aquaculture Production, Washington, D.C., August 21-22, 1997.

Schnick, R.A. 1997. Worldwide aquaculture drug approvals through partnerships in the United States. Seminar to Schering-Plough Animal Health, Union, New Jersey, August 26, 1997.

Schnick, R.A. 1997. Progress with registration of drugs and vaccines for aquaculture: introduction and the United States. Chair and presenter at Workshop on "Models of Partnership for Registration of Drugs and Vaccines" and "Round Table on Progress with Registration of Drugs and Vaccines for Aquaculture," EAAP Eighth International Conference on Diseases of Fish and Shellfish, Edinburgh, Scotland, September 14-19, 1997.

Schnick, R.A. 1997. Role of the national NADA office in aquaculture drug approval activities. Aquaculture Drugs and Chemicals Approval Update, Arlington, Virginia, September 30, 1997.

Schnick, R.A. 1997. Partial support for National Coordinator for Aquaculture New Animal Drug Applications. WRAC IAC/TC Meeting, Reno, Nevada, October 20-21, 1997.

Schnick, R.A. 1998. Priorities subcommittee report. Workshop on International Harmonization of Aquaculture Drugs and Biologics, Las Vegas, Nevada, February 15, 1998.

Schnick, R.A. 1998. Upcoming successes for aquaculture drug approvals in the United States through unique partnerships. Special Session, "Aquaculture drug approvals-a success story about to happen," 29th Annual Meeting of the World Aquaculture Society, Las Vegas, Nevada, February 15-19, 1998.

Schnick, R.A. 1998. Progress on 5-year plan items (Plan items 1, 2, 12, and 13). Working Group on Quality Assurance in Aquaculture Production, 29th Annual Meeting of the World Aquaculture Society, Las Vegas, Nevada, February 15-19, 1998.

Schnick, R.A. 1998. Introduction and discussion of INADs and extra-label use. Special Session, "Aquaculture drug approvals through producer INADs?," 29th Annual Meeting of the World Aquaculture Society, Las Vegas, Nevada, February 15-19, 1998.

Schnick, R.A. 1998. INADs and other drug business. PNFHPC meeting, 29th Annual Meeting of the World Aquaculture Society, Las Vegas, Nevada, February 15-19, 1998.

Schnick, R.A. 1998. Aquaculture drug approval update. Meeting of the Aquaculture & Seafood Advisory Committee, American Veterinary Medical Association, 29th Annual Meeting of the World Aquaculture Society, Las Vegas, Nevada, February 15-19, 1998.

Schnick, R.A. 1998. Progress on aquaculture drug approvals. Fisheries Management and Habitat Protection Statewide Training Conference, Green Bay, Wisconsin, March 10-12, 1998.

Schnick, R.A. 1998. IAFWA Project status and progress. Meeting of the Inland Fisheries Committee, North American Natural Resources Conference, Orlando, Florida, March 20-24, 1998.

Schnick, R.A. 1998. Use of chemicals in fish management and fish culture: past and future. Symposium, "Xenobiotic metabolism in fish," American Chemical Society, Dallas, Texas, March 29-April 2, 1998.

Schnick, R.A. 1998. Drug approval partnership. American Fisheries Society, Fisheries Administrator's Section, Phoenix, Arizona, April 17-19, 1998.

Schnick, R.A. 1998. Overview of NADA Coordinator activities. FWS-INAD Coordination Workshop, Bozeman, Montana, August 4-5, 1998.

Schnick, R.A. 1998. NADA Coordinator update. Meeting of the JSA Working Group on Quality Assurance in Aquaculture Production, Washington, D.C., September 4, 1998.

Schnick, R.A. 1998. Overview of the activities of the National Coordinator for Aquaculture New Animal Drug Applications and suggestions for enhancing dialogue with the Minor Use Animal Drug Program. Meeting of the Minor Use Animal Drug Program Technical Committee for NRSP-7, Rockville, Maryland, September 22, 1998.

Schnick, R.A. 1998. The effect of the Animal Drug Availability Act of 1996 and the FDA Modernization Act of 1997 on approvals of animal health products for minor species/minor uses. 1998 Animal Health Institute Joint Meeting, San Diego, California, November 9, 1998.

Schnick, R.A. 1998. Overview of IAFWA Project Status. Coordination meeting for IAFWA Aquaculture Drug Approval Project, La Crosse, Wisconsin, November 19-20, 1998.

Schnick, R.A. 1998. Overview of the international aspects of antimicrobial sensitivity determination and the need for harmonization in aquaculture drugs. Workshop on MIC Methodology (EU Concerted Action - Fair-CT97-3760), Weymouth, England, November 24-27, 1998.

Schnick, R.A. 1999. National NADA Office aquaculture drug approval activities. Aquaculture Drugs and Chemicals Approval Update--1999, Arlington, Virginia, January 11, 1999.

Schnick, R.A. 1999. Introduction and discussion of INADs and new NADAs. "Aquaculture drug approvals through producer INADs," Aquaculture America '99, Tampa, Florida, January 27-30, 1999.

Schnick, R.A. 1999. Update on activities of the National Coordinator for Aquaculture New Animal Drug Applications. Meeting of the Joint Subcommittee on Aquaculture, Working Group on Quality Assurance in Aquaculture Production, Aquaculture America '99, Tampa, Florida, January 27-30, 1999.

Schnick, R.A. 1999. Update on the IAFWA drug approval process. 1999 Mid-Continent Fish Culture Workshop, North Kansas City, Missouri, February 2-3, 1999.

Schnick, R.A. 1999. Aquaculture drug approval progress for the catfish industry. Annual Meeting of the Catfish Farmers of America, New Orleans, Louisiana, February 18-20, 1999.

Schnick, R.A. 1999. Advances in fishery chemicals. 1999 Colorado/Wyoming AFS Meeting, "Reeling in the next millennium," Cheyenne, Wyoming, March 1-3, 1999.

Schnick, R.A. 1999. Overview of florfenicol approval process. Coordination meeting for florfenicol efficacy studies, La Crosse, Wisconsin, March 17-18, 1999.

Schnick, R.A. 1999. Progress and issues related to the federal-state aquaculture drug approval partnership. Meeting of the IAFWA Drug Approval Oversight Subcommittee, San Francisco, California, March 25-28, 1999.

Schnick, R.A. 1999. International cooperation toward aquaculture drug approvals. 30th Annual Meeting of the World Aquaculture Society, Sydney, Australia, April 26-May 2, 1999. (Keynote address)

Schnick, R.A. 1999. USA programs related to aquaculture drug approval development and issues. Australian Department of Agriculture, Fisheries and Forestry, Canberra, Australia, May 3, 1999.

Schnick, R.A. 1999. Overview of NADA Coordinator activities. USFWS - INAD Coordination Workshop, Bozeman, Montana, August 4-5, 1999.

Schnick, R.A. 1999. Aquaculture NADA Coordinator update. Meeting of the JSA Working Group on Quality Assurance in Aquaculture Production, Washington, D.C., September 9, 1999.

Schnick, R.A. 1999. International harmonisation of antibacterial agent approvals and susceptibility testing. Chaired Workshop at European Association of Fish Pathologists 9th International Conference, "Diseases of Fish and Shellfish," Rhodes, Greece, September 19-24, 1999.

Schnick, R.A. 2000. National Coordinator for Aquaculture New Animal Drug Applications update. Working Group on Quality Assurance in Aquaculture Production at Aquaculture America 2000, New Orleans, Louisiana, February 2, 2000.

Schnick, R.A. 2000. Introduction and background to the MUMS legislation. Special Session "Future drug approval process: MUMS opportunities," Aquaculture America 2000, New Orleans, Louisiana, February 2-5, 2000.

Schnick, R.A. 2000. You can make a difference. Special Session "Future drug approval process: MUMS opportunities." Aquaculture America 2000, New Orleans, Louisiana, February 2-5, 2000.

Schnick, R.A. 2000. Drug approvals. Mid-Continent Warmwater Fish Culture Workshop, Council Bluffs, Iowa, February 7-8, 2000.

Schnick, R.A. 2000. New drug approval progress. Missouri Aquaculture Association Annual Meeting, Cape Girardeau, Missouri, February 22-23, 2000.

Schnick, R.A. 2000. Update on the Federal-State Aquaculture Drug Approval Project. International Association for Fish and Wildlife Agencies, Drug Approval Working Group Meeting, Chicago, Illinois, March 26, 2000.

TILAPIA

Publications in Print

Booton, G.C., L. Kaufman, M. Chandler, R. Oguto-Ohwayo, W. Duan, and P. Fuerst. 1999. Evolution of the ribosomal RNA internal transcribed spacer one (ITS-1) in cichlid fishes of the Lake Victoria region. *Molecular Phylogenetics and Evolution* 11:273-282

Fiumera, A.C. 1997. Use of microsatellite DNA to estimate the loss of genetic diversity in the Lake Victoria cichlid Species Survival Plan captive breeding program. Master's thesis. Ohio State University, Columbus.

Fiumera, A.C., and P.A. Fuerst. 1997. Use of DNA microsatellite loci to estimate the effective population size of a captive-bred Lake Victoria cichlid managed within the Species Survival Plan (SSP). *Ohio Journal of Science* 97 (2):A-31.

Fiumera, A.C., and P.A. Fuerst. 1997. Use of DNA microsatellite loci to study the maintenance of genetic variation in the captive managed populations of the Lake Victoria cichlid Species Survival Plan. Contribution No. 1 (1997), Museum of Zoology, Fish Division, Ohio State University, Columbus.

Fiumera, A.C. 1997. Use of microsatellite DNA to estimate the loss of genetic diversity in the Lake Victoria cichlid Species Survival Plan captive breeding program. Master's thesis. Ohio State University, Columbus.

Fiumera, A.C., and P.A. Fuerst. 1997. Use of DNA microsatellite loci to estimate the effective population size of a captive-bred Lake Victoria cichlid managed within the Species Survival Plan (SSP). *Ohio Journal of Science* 97 (2):A-31.

Fiumera, A.C., and P.A. Fuerst. 1997. Use of DNA microsatellite loci to study the maintenance of genetic variation in the captive managed populations of the Lake Victoria cichlid Species Survival Plan. Contribution No. 1 (1997), Museum of Zoology, Fish Division, Ohio State University, Columbus.

Fiumera, A.C., L. Wu, P.G. Parker, and P.A. Fuerst. 1999. Effective population size in the captive breeding program of the Lake Victoria Cichlid *Paralabidochromis chilotes*. *Zoological Biology* 18:215-222.

Fiumera, A.C., P.G. Parker, and P.A. Fuerst. 2000. Effective population size and loss of genetic diversity in captive bred populations of a Lake Victoria cichlid. *Conservation Biology* 14:886-892.

Fuerst, P., W. Mwanja, L. Kaufman, and G. C. Booton. 1997. Genetic phylogeography of introduced *Oreochromis niloticus* (Pisces: Cichlidae) in Uganda. Pages 87-96 in K. Fitzsimmons, editor. *Tilapia aquaculture, Proceedings of the Fourth International Symposium on Tilapia in Aquaculture (ISTA IV)*, Volume 1. Northeast Regional Agricultural Engineering Service, Ithaca.

Fuerst, P.A., Mwanja, W.W., and L. Kaufman. 2000. The genetic history of the introduced Nile Tilapia of Lake Victoria (Uganda, East Africa): the population structure of *Oreochromis niloticus* (Pisces: Cichlidae) revealed by DNA microsatellite markers. Pages 30-40 in *Proceedings of the Fifth International Symposium on Tilapia in Aquaculture (ISTA V)*.

Kasper, C.S., M.R. White, and P.B. Brown. 2000. Choline is required by tilapia when methionine is not in excess. *Journal of Nutrition* 130:238-242.

Mwanja, W.W., L. Kaufman, and P.A. Fuerst. 1997. Genetic population structure and meristic characterization of populations of *Oreochromis niloticus* (Pisces: Cichlidae) of Lake Victoria Region and Lake Edward-Albert System (Uganda - E. Africa). *Proceedings of the 7th International Aquaculture Symposium*, Swansea.

Mwanja, W.W., F. Bugenyi, L. Kaufman, and P. Fuerst. 1997. Genetic characterization of tilapiine stocks in the Lake Victoria Region. Pages 33-34 in R.S.V. Pullin, C.M.V. Casal, E.K. Abban, and T.M. Falk, editors. *Characterization of Ghanaian tilapia genetic resources for use in fisheries and aquaculture*. 52nd ICLARM Conference Proceedings.

Mwanja, W., L. Kaufman, and P.A. Fuerst. 1998. A note on recent advances in the genetic characterization of Tilapia stocks in Lake Victoria region. *African Journal of Tropical Hydrobiology and Fisheries* 6:51-53.

Mwanja, W.W., L. Kaufman, and P.A. Fuerst. 2000. Randomly amplified polymorphic DNA markers: conservation and management implications. *Ohio Journal of Science* 100(1):A38.

Riche, M.A. 2000. Effect of phytic acid on nitrogen retention in tilapia (*Oreochromis niloticus*). Doctoral dissertation. Michigan State University, East Lansing, Michigan.

Twibell, R.G., and P.B. Brown. 1998. Optimum dietary crude protein for hybrid tilapia *Oreochromis niloticus* × *O. aureus* fed all-plant diets. *Journal of the World Aquaculture Society* 29:9-16.

Wu, L., L. Kaufman, B. Porter, and P. Fuerst. 1997. Genetic variability and inter-population gene flow of *Astatoreochromis alluaudi* revealed by microsatellite data. Pages 316-317 in *Proceedings of the 77th Annual Meeting of the American Society of Ichthyologists and Herpetologists*.

Manuscripts

Kelly, A.M., and C.C. Kohler. In press. Effects of *Yucca shidigera* extract on growth, nitrogen retention, ammonia excretion, and toxicity in channel catfish (*Ictalurus punctatus*) and hybrid tilapia (*Oreochromis mossambicus* × *O. Niloticus*). *Journal of the World Aquaculture Society*.

Riche, M., and D. Garling. In press. Feeding tilapia in intensive systems. North Central Regional Aquaculture Center Fact Sheet Series #114, NCRAC Publications Office, Iowa State University, Ames.

Riche, M., N.L. Trottier, P. Ku., and D.L. Garling. In press. Apparent digestibility of crude protein and apparent availability of individual amino acids in tilapia (*Oreochromis niloticus*) fed phytase pretreated soybean meal diets. *Fish Physiology and Biochemistry*.

Riche, M., M. Oetker, D.I. Haley, T. Smith, and D.L. Garling, Jr. In preparation. Optimal feeding frequency for growth and efficiency in juvenile tilapia (*Oreochromis niloticus*). *Aquaculture Research*.

Riche, M., D.I. Haley, M. Oetker, S. Garbrecht, and D.L. Garling, Jr. In preparation. Influence of feeding frequency on gastric evacuation in tilapia (*Oreochromis niloticus*). *Aquaculture Nutrition*.

Riche, M., M. Oetker, D. Haley, T. Smith, and D.L. Garling, Jr. In preparation. Effects of feeding frequency on intake, growth efficiency and body composition of Nile tilapia (*Oreochromis niloticus*). *Aquaculture Research*.

Papers Presented

Brown, P.B., R.G. Twibell, and J. Weigel. 1997. Minimum dietary crude protein for tilapia fed diets free of fish meal. 28th Annual Meeting of the World Aquaculture Society, Seattle, February 19-23, 1997.

Fuerst, P.A., W.W. Mwanja, and L. Kaufman. 1998. Use of DNA microsatellite markers to study genetic diversity in the species of the genus *Oreochromis* from the Lake Victoria region. Fisheries Society of the British Isles Symposium on Tropical Fish Biology.

Fuerst, P.A., W. Mwanja, I. Batjakas, G. Booton, and L. Kaufman. 1998. Of Lake Victoria region Tilapiines: the isolated and displaced; the shrunk and native; the restricted and exotic; and the expanded and introduced. African Fish and Fisheries: Diversity and Utilisation, Grahamstown, South Africa.

Fuerst, P.A., and W.W. Mwanja. 2000. The opportunities and challenges to conservation of genetic biodiversity of the fishery of the Lake Victoria Region, East Africa. International Conference on the Conservation of African Inland Fisheries, Jinja, Uganda.

Kaufman, L., W.W. Mwanja, and P.A. Fuerst. 1998. Conservation genetics of Tilapiine refugia in the Lake Victoria region. Fisheries Society of the British Isles Symposium on Tropical Fish Biology.

Mbahinzireki, G., and K. Dabrowski. 1997. Production of male tilapia by heat-treatment of embryos and growth on different diets in recirculation systems. 28th Annual Meeting of the World Aquaculture Society, Seattle, February 19-23, 1997.

Mwanja, W., and P.A. Fuerst. 1999. How issues of genetic diversity affect management of African inland water fisheries: the example of the Lake Victoria Region (LVR) fishery. Symposium on Aquatic Conservation and Management in Africa, University of Florida, Gainesville.

Riche, M., and D.L. Garling, Jr. 1999. Digestibility and retention of nitrogen in tilapia (*Oreochromis niloticus*) fed phytase treated soybean meal in a recirculating system. 30th Annual Meeting of the World Aquaculture Society, Sydney, Australia., April 26-May 2, 1999.

AQUACULTURE DRUGS

Publications in Print

Malison, J.A., J.A. Held, L.S. Procarione, and M.A.R. Garcia-Abiado. 1998. The production of monosex female populations of walleye from intersex broodstock. *Progressive Fish Culturist* 60:20-24.

Reports

Bernardy, J.A., C. Vue, and M.P. Gaikowski. 2000. Oxytetracycline residue depletion from walleye fillet tissue (CAP-98-00084-07). Submitted to the Center for Veterinary Medicine, U.S. Food and Drug Administration. 1,517 pp.

Gaikowski, M.P., J.J. Rach, A. Moore, J. Hamilton, D. Smith, and T. Harder. 2002. Efficacy of hydrogen peroxide to control mortality associated with saprolegniasis on eggs of channel catfish (*Ictalurus punctatus*), paddlefish (*Polydon spahula*), smallmouth bass (*Micropterus dolomieu*), and walleye (*Stizostedion vitreum*). Study report submitted to the Center for Veterinary Medicine, U.S. Food and Drug Administration for supporting clinical field trials under INAD 10-023. 23 pp.

Green, B.W. 1996. Direct review submission to Division of Toxicology and Environmental Science, Center for Veterinary Medicine, U.S. Food and Drug Administration in support of the Tilapia 17 - Methyltestosterone INAD (INAD #9647 A0000, January 24, 1996).

Kohler, C.C., A.M. Kelly, M.J. DeJesus, E.M. Carnevale, S.R. Syska, and W.M. Muhlach. 1998. The safety of 17 - Methyltestosterone for induction of sex reversal in walleye. Final Report of the Safety Study for INAD 9647 E0009 and E0011. 602 pp.

Rach, J.J., M.P. Gaikowski, and V.K. Dawson. 2002. Freedom of Information summary: Perox-Aid for the treatment of external flavobacter infections on all freshwater finfish. Submitted to the Center for Veterinary Medicine, U.S. Food and Drug Administration for INAD 10-023.

Manuscripts

Bernardy, J.A., C. Vue, M.P. Gaikowski, G.R. Stehly, W.H. Gingerich, and A. Moore. In review. Residue depletion of oxytetracycline from fillet tissues of northern pike and walleye. *Aquaculture*.

Papers Presented

Bernardy, J.A., C. Vue, J.R. Meinertz, M.P. Gaikowski, G.R. Stehly, S.L. Greseth, N.J. Spanjers, and W.H. Gingerich. 2000. Residue depletion of oxytetracycline from fillet tissues of coho salmon, walleye, and northern pike. 41st Annual Western Fish Disease Workshop, Gig Harbor, Washington, June 28-29, 2000.

Gaikowski, M.P., M. Drobish, J. Hamilton, T. Harder, L.A. Lee, C. Moen, A. Moore, D. Smith, and J.J. Rach. 2001. Evaluation of the efficacy of hydrogen peroxide to control mortality associated with saprolegniasis on eggs of cool- and warmwater fish. Mid-Continent Warmwater Fish Culture Conference, Council Bluffs, Iowa, February 2001.

Kohler, C.C., A.M. Kelly, E.M. Carnivale, and W.L. Muhlach. 1997. Target animal safety studies for aquaculture. 28th Annual Meeting of the World Aquaculture Society, Seattle, Washington, February 19-23, 1997.

Malison, J.A. 1997. Reproduction and sex reversal in yellow perch and walleye. Presented at the 1997 North Central Aquaculture Conference, Indianapolis, Indiana, February 6-7, 1997.

Rach, J.J. 2001. Application of hydrogen peroxide treatment regimens. U.S. Fish and Wildlife Service Region Three Fisheries Biologists meeting, La Crosse, Wisconsin, September 5, 2001.

Rach, J.J., and M.P. Gaikowski. 2001. An overview of hydrogen peroxide research and techniques used to ensure accurate application of chemical treatment regimens. Minnesota Aquaculture Association, Minneapolis, Minnesota, February 23-24, 2001.

Rach, J.J., M.P. Gaikowski, and C.A. Perkins. 2001. Hydrogen peroxide, a potential broad spectrum therapeutant for treatment of fish diseases. *Aquaculture America '01*, Orlando, Florida, January 21-25, 2001.

Riche, M., and D.L. Garling, Jr. 1999. Digestibility and retention of nitrogen in tilapia (*Oreochromis niloticus*) fed phytase treated soybean meal in a recirculating system. 30th Annual Meeting of the World Aquaculture Society, Sydney, Australia, April 26-May 2, 1999.

WHITE PAPERS

Publications in Print

Gunderson, J.L., and P. Tucker. 2000. A white paper on the status and needs of baitfish aquaculture in the North Central Region. NCRAC, Michigan State University, East Lansing.

Heidinger, R.C. 2000. A white paper on the status and needs of largemouth bass culture in the North Central Region. NCRAC, Michigan State University, East Lansing.

Kinnunen, R.E. 2000. A white paper on the status and needs of salmonid aquaculture in the North Central Region. NCRAC, Michigan State University, East Lansing.

Kohler, C.C. 2000. A white paper on the status and needs of hybrid striped bass aquaculture in the North Central Region. NCRAC, Michigan State University, East Lansing.

Kohler, C.C. 2000. A white paper on the status and needs of tilapia aquaculture in the North Central Region. NCRAC, Michigan State University, East Lansing.

Malison, J.A. 2000. A white paper on the status and needs of yellow perch aquaculture in the North Central Region. NCRAC, Michigan State University, East Lansing.

Morris, J.E., and C.C. Mischke. 2000. A white paper on the status and needs of sunfish aquaculture in the North Central Region. NCRAC, Michigan State University, East Lansing.

Summerfelt, R.C. 2000. A white paper on the status and needs of walleye aquaculture in the North Central Region. NCRAC, Michigan State University, East Lansing.

Westers, H. 2000. A white paper on the status and concerns of aquaculture effluents in the North Central Region. NCRAC, Michigan State University, East Lansing.

Swann, L., and J.E. Morris. 2001. A white paper on the status and needs of aquaculture extension outreach for the North Central Region. NCRAC, Michigan State University, East Lansing.

SOME COMMONLY USED ABBREVIATIONS AND ACRONYMS

×	cross; times
ANS	aquatic nuisance species
AquaNIC	Aquaculture Network Information Center
BMPs	best management practices
BOD	Board of Directors biochemical oxygen demand
°C	degrees Celsius
CES	Cooperative Extension Service
cm	centimeter
EAA	essential amino acid
°F	degrees Fahrenheit
FFO	Freshwater Farms of Ohio, Inc.
FPL	[USDA] Forest Products Laboratory
ft, ft ³	foot, cubic foot
G	gram(s)
gal	gallon(s)
gpm	gallons per minute
H	hour(s)
ha	hectare(s)
HACCP	Hazard Analysis Critical Control Points

IAC	Industry Advisory Council
in	inch(es)
INAD	Investigational New Animal Drug
ISU	Illinois State University Iowa State University
kg	kilogram(s)
L	liter(s)
lb	pound(s)
LMSFH	Lake Mills State Fish Hatchery
Lpm	liters per minute
m, m ³	meter, cubic meter
m	micrometer
mg	milligram(s)
min	minute(es)
mm	millimeter(s)
MSU	Michigan State University
<i>N</i>	number
NADA	New Animal Drug Applications
NCC	National Coordinating Council
NCR	North Central Region
NCRAC	North Central Regional Aquaculture Center
NDSU	North Dakota State University
OAA	Ohio Aquaculture Association
OSU	Ohio State University
oz	ounce(s)
<i>P</i>	probability
POW	Plan of Work
ppm	parts per million
PREC	Piketon Research and Extension Center
Purdue	Purdue University
RAC(s)	Regional Aquaculture Center(s)
SIUC	Southern Illinois University-Carbondale
TC	Technical Committee (TC/E = Technical Committee/Extension; TC/R = Technical Committee/Research)
TN	total nitrogen
TP	total phosphorus
TSS	total suspended solids
UM	University of Missouri
UMESC	Upper Midwest Environmental Sciences Center
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
UW-Madison	University of Wisconsin-Madison
UW-Milwaukee	University of Wisconsin-Milwaukee
YOY	young-of-the-year
yr	year(s)

1. NCRAC has funded eight Extension projects. The first three were chaired by Donald L. Garling, the fourth project was chaired by Fred P. Binkowski and projects 5-8 chaired by Joseph E. Morris. A Project Component Termination Report for one of the objectives

of the fifth Extension project is contained in the 1997-98 Annual Progress Report. The eighth project is a 2-year project that began September 1, 2001.

2. NCRAC has funded four Extension/Marketing projects. Termination reports for the first two projects are contained in the 1989-1996 Compendium Report; a termination report for the third project is contained in the 1996-97 Annual Progress Report. The first project was chaired by Donald W. Floyd; the second was chaired by Leroy J. Hushak; and the third was chaired by Patrick D. O'Rourke. This progress report is for the fourth Economics/Marketing project which is chaired by Edward M. Mahoney. It was originally a 2-year project that began September 1, 1999 but has been lengthened for no additional cost.

3. NCRAC has funded eight Yellow Perch projects. Termination reports for the first three projects are contained in the 1989-1996 Compendium Report; a termination report for the fourth and fifth projects is contained in the 1997-98 Annual Progress Report; a project component termination report for two objectives of the sixth project is contained in the 1999-00 Annual Progress Report; and a project component termination report for the remainder of the sixth project and the seventh Yellow Perch project is contained in the 2000-01 Annual Progress Report. This progress report is for the eighth Yellow Perch project which is chaired by Jeffrey A. Malison. It is a 3-year project that began September 1, 2001.

4. Sunny Meadow Fish Farm and Willow Creek Aquaculture, who were included in the Project Outline as non-funded commercial cooperators, have withdrawn from the study. Red Lake Hatchery has chosen not to participate in the first year of the project.

5. NCRAC has funded seven Hybrid Striped Bass projects. Termination reports for the first four projects are contained in the 1989-1996 Compendium Report; a project component termination report for the two research objectives of the fifth project is contained in the 1997-98 Annual Progress Report; and a termination report for the remaining objective of the fifth project as well as the objectives of the sixth project is contained in the 2000-01 Annual Progress Report. The first five projects were all chaired by Christopher C. Kohler and the sixth project was chaired by Joseph E. Morris. This progress report is for the seventh Hybrid Striped Bass project which is chaired by Christopher C. Kohler. It is a 3-year project that began September 1, 2001.

6. NCRAC has funded seven Walleye projects. Termination reports for the first, third, and Objective 1 of the fourth projects are contained in the 1989-1996 Compendium Report; a termination report for the second, fifth, sixth and the remainder of the fourth projects is contained in the 1996-97 Annual Progress Report. This termination report is for the seventh Walleye project, which was chaired by Konrad Dabrowski. It was a 3-year project that began September 1, 1999.

7. NCRAC has funded five Sunfish projects. Termination reports for the first two projects, or components thereof, are contained in the 1989-1996 Compendium Report; a termination report for the third and fourth projects is contained in the 1998-99 Annual

Progress Report. This project component termination report is for the first of two objectives of the fifth Sunfish project which was chaired by Robert S. Hayward. It was originally a 2-year project that began September 1, 1999 but was lengthened for no additional cost. A progress report for the second objective of the fifth Sunfish project is contained elsewhere in this annual report.

8. NCRAC has funded five Sunfish projects. Termination reports for the first two projects, or components thereof, are contained in the 1989-1996 Compendium Report; a termination report for the third and fourth projects is contained in the 1998-99 Annual Progress Report; and a termination report for one of the two objectives of the fifth project is contained elsewhere in this annual report. This progress report is for the second objective of the fifth Sunfish project which is chaired by Robert S. Hayward. It was originally a 2-year project that began September 1, 1999 but has been lengthened for no additional cost.

9. NCRAC has funded three Wastes/Effluents projects. The termination report for the first project is contained in the 1989-1996 Compendium Report; a termination report for one of the two objectives of the second project is contained in the 1998-99 Annual Progress Report, and a termination report for other objective of the second project, which was chaired by Fred P. Binkowski, is contained in the 1999-00 Annual Progress Report. This progress report is for the third Wastes/Effluents project which is chaired by Robert C. Summerfelt. It is a 3-year project that began September 1, 2001.

10. NCRAC has funded two Tilapia projects. A termination report for the first project is contained in the Annual Progress Report for 1998-1999. This termination report is for the second Tilapia project which was chaired by Paul B. Brown. It was originally a 2-year study that began September 1, 1998 but was lengthened for no additional cost.

11. Collaboration with Myron Kloubec, Kloubec Fish Farms, Amana, Iowa ended in 2001. Collaboration with Chris Shimp, Grayson Hills Farms, Harrisburg, Illinois ended July 2001 after completing their participation in Objective 2.

12. NCRAC has funded three Aquaculture Drugs projects. A termination report for the first project is contained in the 1996-97 Annual Progress Report; a termination report for the second project is contained in the 1997-98 Annual Progress Report. This termination report is for the third Aquaculture Drugs project which was chaired by Alan A. Moore. It was originally a 1-year study that began October 1, 1999 but was expanded and lengthened for no additional cost.