WALLEYE REFERENCES

S.J. Naylor and R.D. Moccia

Aquaculture Extension Centre University of Guelph Guelph, Ontario, Canada N1G 2W1

> April 1996 485 AGDEX 01

Summary

New regulations under the Game & Fish Act allow for the culture and sale of walleye (*Stizostedion vitreum vitreum*) in Ontario. Pond culture of walleye from fry to fingerlings has occurred for many years in Ontario under the Community Fisheries Involvement Programs. Recent developments in the intensive culture of larval walleye has initiated the start up of a few walleye farms in the province. The culture of walleye at any particular location in Ontario is still subject to approval by the local District Office of the Ontario Ministry of Natural Resources. It is highly recommended that anyone interested in walleye culture obtain a copy of "*The Walleye Culture Manual*", a recent publication detailing the start-of-the-art in walleye culture, from the North Central Regional Aquaculture Centre in the United States (see listings). The following is a brief listing of research publications, popular press articles and consultants' reports which should be useful to anyone wishing to learn more about walleye. Published research papers can be accessed through most University libraries. Any questions concerning this reference listing can be directed to the Aquaculture Centre, University of Guelph, 519-824-4120 ext. 52689.

General

- 1. Colby, P.J., R.E. McNicol and R.A. Ryder. 1979. Synopsis on biological data on the walleye *Stizostedion v. vitreum* (Mitchill 1818), FAO Fish. Synop. 119, Food and Agriculture Organization, Rome, 1.
- 2. Nickum, J.G. 1978. Intensive culture of walleyes: the state of the art, *In* Selected Coolwater Fishes of North America, Spec. Publ. No. 11, Kendall, R.L. (Ed.), American Fisheries Society, Washington, D.C., 187.
- 3. Nickum, J.G. 1993. Walleye. *In* Culture of Nonsalmonid Freshwater Fishes, R.R. Stickney (Ed.). CRC Press Inc., Boca Raton, Florida. pp. 115-126.
- 4. North Central Regional Aquaculture Center. 1996. The Walleye Culture Manual. NCRAC Culture Series #101. (see Sources of Other Information).
- 5. Richard, P.D. and J. Hynes. 1986. Walleye Culture Manual. Ontario Ministry of Natural Resources, pp. 1-68. (available from the Aquaculture Extension Centre).

6. Walker, T.A. 1992. Are we ready for walleye. Northern Aquaculture 8: 17-21.

Husbandry and Production Systems

- 1. Barrows, F.T., W.A. Lellis and J.G. Nickum. 1988. Intensive culture of larval walleyes with dry or formulated feed: Note on swim bladder inflation. Progressive Fish-Culturist 50: 160-166.
- 2. Barrows, F.T., R.E. Zitzow and G.A. Kindschi. 1993. Effects of surface water spray, diet, and phase feeding on swim bladder inflation, survival, and cost of production of intensively reared larval walleyes. Progressive Fish-Culturist 55: 224-228.
- 3. Buttner, J.K. 1989. Culture of fingerling walleye in earthen ponds. State of the Art 1989. Aquaculture Magazine March/April: 37-43.
- 4. Cai, Y. and R.C. Summerfelt. 1992. Effects of temperature and size on oxygen consumption and ammonia excretion by walleye. Aquaculture 104: 127-138.
- 5. Colesante, R.T. 1980. Walleye fry: Shipping and stocking mortality. Progressive Fish-Culturist 42: 238-239.
- 6. Fox, M.G., J.A. Keast and R.J. Swainson. 1989. The effect of fertilization regime on juvenile walleye growth and prey utilization in rearing ponds. Environmental Biology of Fishes 26: 129-142.
- 7. Fox, M.G. and D.D. Flowers. 1990. Effect of fish density on growth, survival, and food consumption by juvenile walleyes in rearing ponds. Transactions of the American Fisheries Society 119: 112-121.
- 8. Fox, M.G., D.D. Flowers and C. Watters. 1992. The effect of supplementary inorganic fertilization on juvenile walleye (*Stizostedion vitreum*) reared in organically fertilized ponds. Aquaculture 106: 27-40.
- 9. Harding, L.M., C.P. Clouse, R.C. Summerfelt and J.E. Morris. 1992. Pond culture of walleye fingerlings. North Central Regional Aquaculture Center 102: 1-4.
- 10. Hokanson, K.E.F. and W.M. Koenst. 1986. Revised estimates of growth requirements and lethal temperature limits of juvenile walleyes. Progressive Fish-Culturist 48: 90-94.
- 11. Howey, R.G., G.L. Theis and P.B. Haines. Intensive culture of walleye (*Stizostedion v. vitreum*). Lamar Information Leaflet, pp. 80-05. U.S. Fish and Wildlife Service, Lamar Fish Cultural Development Center, P.O. Box 75, Lamar, Pennsylvania 16848.
- 12. Johnson, S.R. and I.J. Schlosser. 1991. Effects of organic enrichment on zooplankton abundance and walleye fry growth and survival in artificial rearing ponds. Journal of Freshwater Ecology 6: 315-322.
- 13. Kindschi, G.A. and E. MacConnell. 1989. Factors influencing early mortality of walleye fry reared intensively. Progressive Fish-Culturist 51: 220-226.
- 14. Kindschi, G.A. and F.T. Barrows. 1991. Optimal screen mesh size for restraining walleye fry. Progressive Fish-Culturist 53: 53-55.
- 15. Kindschi, G.A. and F.T. Barrows. 1991. Evaluation of an electronic counter for walleye fry. Progressive Fish-Culturist 53: 180-183.
- 16. Krise, W.F. and J.W. Meade. 1986. Review of intensive culture of walleye fry. Progressive Fish-Culturist 48: 81-89.

- 17. Lajeone, L.J. and D.L. Bergerhouse. 1991. A liquid nitrogen freeze-branding apparatus for marking fingerling walleyes. Progressive Fish-Culturist 53: 130-132.
- 18. Li, S. and G.B. Ayles. 1981. Preliminary experiments on growth, survival, production and interspecific interactions of walleye (*Stizostedion vitreum vitreum*) fingerlings in constructed earthen ponds in the Canadian prairies. Canadian Technical Report on Fisheries and Aquatic Sciences No. 1041, 1.
- 19. Li, S. and J.A. Mathias. 1982. Causes of high mortality among cultured larval walleyes. Transactions of the American Fisheries Society 111: 710-721.
- 20. Loadman, N.L., J.A. Mathias and G.E.E. Moodie. 1989. Method for the intensive culture of walleye. Progressive Fish-Culturist 51: 1-9.
- 21. Loadman, N.L., G.E.E. Moddie and J.A. Mathias. 1986. Significance of cannibalism in larval walleye (*Stizostedion vitreum*). Canadian Journal of Fisheries and Aquatic Sciences 43: 613.
- 22. Madon, S.P. and D.A. Culver. 1993. Bioenergetics model for larval and juvenile walleyes An in situ approach with experimental ponds. Transactions of the American Fisheries Society 122: 797-813.
- 23. Malison, J.A., T.B. Kayes, J.A. Held and C.H. Amundson. 1990. Comparative survival, growth, and reproductive development of juvenile walleye and sauger and their hybrids reared under intensive culture conditions. Progressive Fish-Culturist 52: 73-82.
- 24. McIntyre, D.B., F.J. Ward and G.M. Swanson. 1987. Factors affecting cannibalism by pond-reared juvenile walleyes. Progressive Fish-Culturist 49: 264-269.
- 25. Moodie, G.E.E., J.A. Mathias and N.L. Loadman. 1992. A comparison of 2 production-scale modules for the intensive culture of larval walleye. Aquacultural Engineering 11: 171-182.
- 26. Moore, A., M.A. Prange, B.T. Bristow and R.C. summerfelt. 1994. Influence of stocking densities on walleye fry viability in experimental and production tanks. Progressive Fish-Culturist 45: 194-201.
- 27. Moore, A., M.A. Prange, R.C. Summerfelt and R.P. Bushman. 1994. Evaluation of tank shape and a surface spray for intensive culture of larval walleyes fed formulated feed. Progressive Fish-Culturist 56: 100-110.
- 28. Peterson, M.S. and J.P. Key. 1992. Evaluation of hand-tagging juvenile walleyes with binary-coded wire microtags. North American Journal of Fisheries Management 12: 814-818.
- 29. Qin, J. and D.A. Culver. 1992. The survival and growth of larval walleye, *Stizostedion vitreum*, and trophic dynamics in fertilized ponds. Aquaculture 108: 257-276.
- 30. Qin, J., D.A. Culver and N. Yu. 1994. Comparisons of larval walleye and Sauger (Walleye x Sauger hybrid) growth and impacts on zooplankton in experimental ponds. Progressive Fish-Culturist 56: 91-99.
- 31. Qin, J.G., S.P. Madon and D.A. Culver. 1995. Effect of larval walleye (*Stizostedion vitreum*) and fertilization on the plankton community: Implications for larval fish culture. Aquaculture 130: 51-65.
- 32. Qin, J.G. and D.A. Culver. 1995. Effect of young-of-the-year walleye (Percidae: *Stizostedion vitreum*) on plankton dynamics and water quality in ponds.

- Hydrobiologia 297: 217-227.
- 33. Siegwarth, G.L. and R.C. Summerfelt. 1990. Growth comparison between fingerling walleyes and walleye x sauger hybrids reared in intensive culture. Progressive Fish-Culturist 52: 100-104.
- 34. Siegwarth, G.L. and R.C. Summerfelt. 1992. Light and temperature effects on performance of walleye and hybrid walleye fingerlings reared intensively. Progressive Fish-Culturist 54: 49-53.
- 35. Siegwarth, G.L. and R.C. Summerfelt. 1993. Performance comparison and growth models for walleyes and walleye x Sauger hybrids reared for two years in intensive culture. Progr. Fish Culturist 55: 229-235.
- 36. TeBrugge, G. and D.J. McQueen. 1991. In situ enclosure culture of walleye. Progressive Fish-Culturist 53: 91-94.

Nutrition and Feeding

- 1. Barrows, F.T., J.L. Sell and J.G. Nickum. 1988. Effects of dietary protein and energy levels on weight gains, body composition, and RNA:DNA ratios of fingerling walleyes. Progressive Fish-Culturist 50: 211-218.
- 2. Beamish, F.W.H. and P.D. MacMahon. 1988. Apparent heat increment and feeding strategy in walleye, *Stizostedion vitreum vitreum*. Aquaculture 68: 73-82.
- 3. Colesante, R.T., N.B. Youmans and B. Ziolkoski. 1986. Intensive culture of walleye fry with live food and formulated diets. Progressive Fish-Culturist 48: 33-37.
- 4. Colesante, R.T. 1989. Improved survival of walleye fry during the first 30 days of intensive rearing on brine shrimp and zooplankton. Progressive Fish-Culturist 51: 109-111.
- 5. Corazza, L. and J.G. Nickum. 1983. Rate of food passage through the gastrointestinal tract of fingerling walleyes. Progressive Fish-Culturist 45: 183-184.
- 6. Forsberg, J.A. and R.C. Summerfelt. 1992. Effect of temperature on diel ammonia excretion of fingerling walleye. Aquaculture 102: 115-126.
- 7. Forsberg, J.A. and R.C. Summerfelt. 1992. Ammonia excretion by fingerling walleyes fed two formulated diets. Progressive Fish-Culturist 54: 45-48.
- 8. Fox, M.G. 1991. Food consumption and bioenergetics of young-of-the-year walleye (*Stizostedion vitreum vitreum*) Model predictions and population density effects. Canadian Journal of Fisheries and Aquatic Sciences 48: 434-441.
- 9. Graham, D.M. and W.G. Sprules. 1992. Size and species selection of zooplankton by larval and juvenile walleye (*Stizostedion vitreum vitreum*) in Oneida Lake, New York. Can. J. Zool. 70: 2059-2067.
- 10. Johnston, T.A. and J.A. Mathias. 1993. Mortality of first-feeding postlarval walleye (*Stizostedion vitreum*) in culture ponds. Canadian Journal of Fisheries & Aquatic Sciences 50: 1835-1843.
- 11. Johnston, T.A. and J.A. Mathias. 1994. The effects of temperature on feeding in zooplanktivorous walleye, *Stizostedion vitreum*, larvae. Environmental Biology of Fishes 40: 189-198.
- 12. Johnston, T.A. and J.A. Mathias. 1994. Feeding ecology of walleye, Stizostedion

- *vitreum*, larvae: Effects of body size, zooplankton abundance, and zooplankton community composition. Canadian Journal of Fisheries & Aquatic Sciences 51: 2077-2089.
- 13. MacConnell, E. and F.T. Barrows. 1993. Pathological changes associated with Vitamin C deficiency in walleyes. Journal of Aquatic Animal Health 5: 287-293.
- 14. Reinitz, G. and R. Austin. 1980. Practical diets for intensive culture of walleyes. Progressive Fish-Culturist 42: 212-214.
- 15. Rust, M.B., R.W. Hardy and R.R. Stickney. 1993. A new method for force-feeding larval fish. Aquaculture 116: 341-352.
- 16. Stettner, C.R., R.C. Summerfelt and K.L. Kuipers. 1992. Evaluation of commercial feeds for rearing advanced fingerling walleye. Proceedings of the Annual Conference of the Southeast Association of Fish and Wildlife Agencies 46: 402-412.
- 17. Wahl, D.H., L.M. Einfalt and M.L. Hooe. 1995. Effect of experience with piscivory on foraging behavior and growth of walleyes. Transactions of the American Fisheries Society 124: 756-763.
- 18. Yager, T.K. and R.C. Summerfelt. 1993. Effects of fish size and feeding frequency on metabolism of juvenile walleye. Aquacultural Engineering 12: 19-36.
- 19. Yager, T.K. and R.C. Summerfelt. 1994. Effects of feeding frequency on metabolism of juvenile walleye. Aquacultural Engineering 13: 257-282.

Physiology

- 1. Barrows, F.T., G.A. Kindschi and R.E. Zitzow. 1993. Detecting swim bladder inflation in fingerling walleyes. Progressive Fish-Culturist 55: 90-94.
- 2. Beamish, F.W.H. 1990. Metabolism and photoperiod in juvenile lake charr and walleye. Environmental Biology of Fish 29: 201-208.
- 3. Beamish, F.W.H. 1990. Swimming metabolism and temperature in juvenile walleye, *Stizostedion vitreum vitreum*. Environmental Biology of Fish 27: 309-314.
- 4. Bergerhouse, D.L. 1992. Lethal effects of elevated pH and ammonia on early life stages of walleye. North American Journal of Fisheries Management 12: 356-366.
- 5. Ewing, R.R., C.G. Scalet and D.P. Evenson. 1991. Flow cytometric identification of larval triploid walleyes. Progressive Fish-Culturist 53: 177-180.
- 6. Kindschi, G.A. and F.T. Barrows. 1993. Survey of swim bladder inflation in walleyes reared in hatchery production ponds. Progressive Fish-Culturist 55: 219-223.

Reproduction and Genetics

- 1. Colesante, R.T. and N.B. Youmans. 1983. Water-hardening walleye eggs with tannic acid in a production hatchery. Progressive Fish-Culturist 45: 126-127.
- 2. Ewing, R.R., C.G. Scalet and D.P. Evenson. 1991. Flow cytometric identification of larval triploid walleyes. Progressive Fish-Culturist 53: 177-179.
- 3. Hearn, M.C. 1980. Ovulation of pond-reared walleyes in response to various injection levels of human chorionic gonadotropin. Progressive Fish-Culturist 42:

- 228-230.
- 4. Henderson, B.A. and S.J. Nepszy. 1994. Reproductive tactics of walleye (*Stizostedion vitreum*) in Lake Erie. Canadian Journal of Fisheries & Aquatic Sciences 561: 986-997.
- 5. Koupal, K.D., J.R. Satterfield and S.A. Flickinger. 1995. Evaluation of walleye semen: Extender ratios in relation to hatching percentage. Progressive Fish-Culturist 57: 188-191.
- 6. Krise, W.F., L. Bulkowski-Cummings, A.D. Shellman, K.A. Kraus and R.W. Gould. 1986. Increased walleye egg hatch and larval survival after protease treatment of eggs. Progressive Fish-Culturist 48: 95-100.
- 7. Krise, W.F. 1988. Optimum protease exposure time for removing adhesiveness of walleye eggs. Progressive Fish-Culturist 50: 126-127.
- 8. Lessman, C.A. 1978. Effects of gonadotropin mixtures and two steroids on inducing ovulation in the walleye. Progressive Fish-Culturist 40: 3-5.
- 9. Malison, J.A., L.S. Procarione, T.P. Barry, A.R. Kapuscinski and T.B. Kayes. 1994. Endocrine and gonadal changes during the annual reproductive cycle of the freshwater teleost, *Stizostedion vitreum*. Fish Physiology & Biochemistry 13: 473-484.
- 10. Moore, A.A. 1987. Short-term storage and cryopreservation of walleye semen. Progressive Fish-Culturist 49: 40-43.
- 11. Nagel, T. 1985. Development of a domestic walleye broodstock. Progressive Fish-Culturist 47: 121-122.
- 12. Satterfield, J.R. and S.A. Flickinger. 1995. Factors influencing storage potential of preserved walleye semen. Progressive Fish-Culturist 57: 175-181.
- 13. Satterfield, J.R. and S.A. Flickinger. 1995. Field collection and short-term storage of walleye semen. Progressive Fish-Culturist 47: 182-187.
- 14. Serns, S.L. 1982. Influence of formalin on size of walleye eggs. Progressive Fish-Culturist 44: 149.
- 15. Waltemyer, D.L. 1975. The effect of tannin on the motility of walleye (*Stizostedion vitreum*) spermatozoa. Transactions of the American Fisheries Society 104: 808.
- 16. Waltemyer, D.L. 1977. Tannin as an agent to eliminate adhesiveness of walleye eggs during artificial propagation. Transactions of the American Fisheries Society 109: 731.
- 17. Wiggins, T.A., T.R. Bender Jr., V.A. Mudrak and M.A. Takacs. 1983. Hybridization of yellow perch and walleye. Progressive Fish-Culturist 45: 131-132.
- 18. Zitzow, R.E. 1991. Extended incubation of walleye eggs with low-flow incubators. Progressive Fish-Culturist 53: 188-189.

Sources of Walleye

The Annual Buyers Guide published by Aquaculture Magazine has a listing of fish farms in North America that have walleye for sale. Copies of the Annual Buyers Guide are available from Aquaculture Magazine, P.O. Box 2329, Asheville, North Carolina 28802,

USA or call (704) 254-7334 or FAX (704) 253-0677.

Sources of Other Information

Aquaculture Information Centre National Agricultural Library 10301 Baltimore Boulevard Beltsville, Maryland 20705-2351 Phone (301) 504-5558 FAX (301) 504-6409

The Walleye Culture Manual is available from:
ISU Extension Distribution
119 Printing and Publications Building
Iowa State University
Ames, Iowa 50011-3171
Phone (515) 294-5247
FAX (515) 294-2945

North Central Region Aquaculture Centre Room 13, Natural Resources Bldg. Michigan State University East Lansing, Michigan 48824-1222 Phone (517) 353-1962 FAX (517) 353-7181