January 1992

Overview of the Symposium on Walleye Stocks and Stocking

Daryl G. Ellison
Lake McConaughy Fisheries Research Laboratory, Nebraska Game and Parks Commission, Ogallala, Nebraska

William G. Franzin
Department ofFisheries and Oceans, Freshwater Institute, Winnipeg, Manitoba R3T 2N6, Canada

North American Journal of Fisheries Management 12:271–275, 1992

Overview of the Symposium on Walleye Stocks and Stocking

DARYL G. ELLISON

Lake McConaughy Fisheries Research Laboratory
Nebraska Game and Parks Commission, Ogallala, Nebraska 69153, USA

WILLIAM G. FRANZIN

Department of Fisheries and Oceans, Freshwater Institute
501 University Crescent, Winnipeg, Manitoba R3T 2N6, Canada

Abstract.—Rising angler interest in walleye *Stizostedion vitreum*, a general decline in natural recruitment in some waters, and increasing demands for stocking have produced a need to evaluate stocking strategies. Such evaluations were the subject of the Walleye Stocks and Stocking Symposium summarized herein. Among walleye stocking evaluations reported in the symposium, 32% of fry stockings, 32% of small-fingerling stockings, and 50% of advanced-fingerling stockings were considered successful. Further improvement in stocking success requires research into the factors that affect survival. Matching stocking times and places to appropriate food resources appears to be a key element in successful introductions of young walleyes. Walleye stocking should be tailored to each system, not based on a set number and size of fish. Genetic and chemical markers facilitate comparisons of fry stocking with fingerling stocking under similar biological and environmental conditions. Anglers surveyed contended that fishing experience is more important than catch rate, an attitude that will help managers shift the public's attention from stocking to maintenance of habitat and water quality.

A fishing boom for walleye *Stizostedion vitreum* developed during the 1980s, reminiscent of the explosion in angling demand for largemouth bass *Micropterus salmoides* during the late 1960s through the 1970s. Advances in biological knowledge of the species, improved fishing gear and techniques, angling seminars, magazine articles, and television coverage first generated and then fed an accelerating interest in walleye fishing. The growth of angling clubs and fishing tournaments and concurrent increases in the number of anglers who fish only for walleyes have placed great pressure on walleye resources. At the same time, however, habitat changes have reduced the productivity of walleye waters. Creation of new reservoirs to provide additional fishing opportunities is less feasible now than it once was. Many existing reservoirs have matured and become less suitable for natural walleye reproduction. Even many natural lakes, where walleyes evolved over thousands of years, have been so altered by human activities that they should be viewed as artificial. Growing demand for walleye angling, combined with declining walleye habitat, has given walleye management a sense of urgency. It is essential that managers coordinate their activities to eliminate ineffective practices and duplication of effort if they are to reach their goal of improving fishing opportunities over the range of the species.

It was with this goal in mind that fisheries biologists from the midwestern USA and Canada formed, in 1986, the Walleye Technical Committee within the North Central Division of the American Fisheries Society. As one of its projects, the Walleye Technical Committee cosponsored—along with the Fish Genetics Technical Committee—a symposium at the North Central Division's annual meeting in Minneapolis, Minnesota, on December 4, 1990. The symposium brought together more than 400 biologists to exchange information on walleye programs. Most of the papers given in the symposium, now peer-reviewed and revised, appear in this issue of *North American Journal of Fisheries Management,* which constitutes the symposium's proceedings. Two papers that were not part of the symposium but were submitted independently to the journal (Franzin and Harbicht 1992; Jude 1992) also appear in this issue because they are related to walleye reproduction.

The symposium papers collectively addressed three general topic areas: use of genetic and other marks to identify walleye stocks and stocking groups, evaluation of walleye stocking programs, and communication between fishery managers and walleye anglers. Here, we briefly highlight the contributions of these papers.

Genetic and Other Marks

Stocked fish have to be recognizable if stocking programs are to be evaluated meaningfully. Stocked walleyes were marked by symposium authors in several ways. Physical marks included coded wire tags, fin clips, and freeze branding. Stocked fish also were identified by growth patterns in otoliths, and genetic marks were used successfully for identification of walleye fry. Marks must not impair the fish carrying them, they must be easily recognized, and they should be inexpensive to apply and recover. Kayle (1992, this issue) showed that oxytetracycline marks remain visible on walleye otoliths at least a year after fingerlings are marked, but detection of the mark requires dissection of the fish. In some situations, detection of the mark should be nonlethal (e.g., for catch-and-release fishing) and the mark and its detection should be nonmutilating (especially for trophy fisheries). These requirements can be met by some coded wire tags, visible implant tags, and genetic marks, but not by otolith marks, fin clips, or brands.

Increasing attention is being given, therefore, to genetic marks, which are permanent and nondebilitating to the fish, and which can be detected via discrete biopsies. Large batches of genetically marked fish can be obtained at fertilization. Jennings and Philipp (1992, this issue) and Koppelman et al. (1992, this issue), for example, simultaneously created three different batch-marked walleye groups to evaluate stocking success. In these and most other genetic-marking studies, the frequencies of variant alleles that code particular proteins were manipulated, and the fish were subsequently identified by their protein phenotypes. Recent studies indicate that genetic marks can be read directly. Billington et al. (1992, this issue) used natural variation in the nucleotide sequences of mitochondrial DNA (mtDNA) to identify major geographic stocks of walleye and their probable origins, and they suggested ways to create uniquely marked stocks by manipulations of nucleotide sequences in mtDNA. Because mtDNA is maternally inherited, the success of reproduction and the contribution of introduced fish to resident populations can be followed for several generations.

Stocking Evaluations

From the stocking evaluations reported in the symposium came one overriding lesson: the success of any stocking practice remains largely unpredictable. Ten studies are documented in this issue: Fielder (1992a, 1992b), Jennings and Philipp (1992), Kayle (1992), Koppelman et al. (1992), LaJeone et al. (1992), Mathias et al. (1992), McWilliams and Larscheid (1992), Mitzner (1992), and Paragamian and Kingery (1992). These studies included 96 stocking efforts involving fry, small fingerlings, or large fingerlings (some intensively and some extensively reared). Of the 96, only 38 were considered successful to some degree—11 of 34 (32%) fry stockings, 7 of 22 (32%) small-fingerling stockings, and 20 of 40 (50%) large-fingerling stockings. Almost all of these were maintenance stockings, for which the success rate has progressed little since Laarman (1978) calculated a 32% success rate for maintenance stocking of fry and small fingerlings in 40 lakes and impoundments.

Few of the studies reported in the symposium were designed to reveal the mechanisms governing stocking success or failure, but several authors suggested potential factors. Prime among these appears to be the availability of appropriate natural food at the time of an introduction, which is especially important for introduced fry but also, apparently, for small fingerlings. Studies going back to Hjort (1914) have demonstrated a "critical period" for feeding after fish larvae absorb their yolk sacs; if food of proper size is not available in sufficient quantities, fry quickly starve. Li and Mathias (1982) demonstrated this for walleyes in hatchery contexts. Among symposium participants, Jennings and Philipp (1992) correlated the success of fry introductions with the density of small cladocerans in Illinois impoundments, and Fielder (1992a) found that fingerlings stocked 30 d after fry in Lake Oahe did much better than the fry; the tripling of zooplankton biomass during the 30-d interim may have contributed to fingerling success.

Physical and chemical variables affect stocked fry and fingerlings just as they do naturally produced walleyes. Water temperature—not only its magnitude but also its rate of change and variability—influences growth of the fish and development of the planktonic food base, and it can have much to do with walleye year-class strength (Busch et al. 1975; Lysack 1986). Wind-driven and other water currents can disperse or aggregate walleye fry with respect to their food supply. Intense photosynthesis during phytoplankton blooms can markedly increase the pH of local water patches, and Bergerhouse (1992, this issue) has shown experimentally that the combination of sublethal un-ionized ammonia concentrations and sublethal pH values can cause mortality of walleye fry. These and other environmental factors rarely are monitored closely during stocking studies. They may account for the 12–26% daily mortality of stocked walleye fry that Mitzner (1992) measured in an Iowa lake.

Stocking and Evaluation Methods

The choice of source fish for stocking and the way the fish are handled can affect the success of a program. Mitzner (1992) and McWilliams and Larscheid (1992) stocked fingerling walleyes from the same extensively reared population in two lakes and obtained dissimilar results; the main treatment difference was in transport and handling time. They also stocked intensively reared fingerlings from separate hatcheries into the same two lakes and again found contrary results; this variability was attributed to differences in quality or condition of fingerlings from the two hatcheries. Evidence for physiological differences among stocks of juvenile walleyes reared in similar conditions was provided by Brown (1990). Innate or culture-related differences in fish quality may underlie the variable success of fall fingerling stockings; if the fish cannot reach a critical size or condition before the onset of winter, overwinter survival is likely to be low. But stock quality is important at any time of year, and its influence on stocking success needs further research in general.

Walleye fry and fingerlings generally have been stocked in proportion to surface areas of lakes; stocking rates have ranged from 100 to over 10,000 fry/hectare and from 15 to 250 fingerlings/hectare. Walleye fry usually being life in the surface limnetic zone of lakes, but they move to benthic (inshore) habitats when they grow to 24–35 mm in length (Eschmeyer 1950). Johnson (1971) and Kuehn (1983) have shown that the amount of fingerling habitat may control stocking success. In the symposium, Fielder (1992b) related stocking density to lake surface area, littoral-zone area, shoreline development value, and shoreline length. All four methods provided significant correlations ($P < 0.02$) with gill-net catches of young-of-year walleyes, but the two shoreline indices accounted for the greatest variation in catch rate of young walleyes. Thus, better knowledge of the habitats actually used by fingerlings may lead to more appropriate stocking rates for water bodies.

As exemplified by the symposium papers, the period of stocking evaluations ranges from a few weeks to a few years after walleye fry or fingerlings are introduced. Each approach supplies different information, and the best approach for a particular program depends to some degree on the fishery and on the manager's goal in stocking. Evaluation must come either before or during the fishery to which stocked fish are recruited. Within this constraint, the longer an evaluation can extend, the more information can be gained on overwinter and other natural mortality—and thus on the factors that affect stocking success.

Communication with Anglers

Both Quinn (1992, this issue) and Spencer and Spangler (1992, this issue) found that the fishing experience is more important to walleye anglers than stocking or catch rate. This is encouraging, because stocking into natural, self-sustaining walleye populations should be avoided if possible so as not to introduce potentially negative genetic effects of artificial selection. Stocking to maintain and supplement artificial walleye populations is expensive and without guarantee of success. Many anglers are sympathetic to these problems, as indicated by their involvement in fisheries and habitat enhancement projects nearly everywhere. Such involvement emphasizes the need for renewed communication between fisheries professionals and anglers. Communication is vital to maintain and enhance angler support of management efforts to conserve resources in the face of increasing demand and shrinking habitat. Quinn (1992) pointed out that managers can gain important information from local specialized anglers, and from commercial fishermen as well. As angler groups specialize they usually organize to lobby for their favorite species, sometimes even obtaining their own biologists to influence fishery managers and legislators on their behalf. Communicating freely is the best way for all parties to inform others of their goals and to avoid adversarial situations.

Conclusions

As more anglers specialize in walleye fishing, fishery managers must accept a greater role in informing them that stocking is only one of several tools available to manage walleye populations. Although collective attitudes are changing, many anglers still focus on hatcheries as the principal means to provide more and larger walleyes. We must fine-tune our restoration strategies to achieve the most from the angler dollar without undue biological and economic penalties. Without solid data to document the results of our stocking efforts, the fishing public eventually may narrow our domain politically to a level where our professional judgment is no longer valued. Despite pressures to maintain or increase stocking efforts, we must shift the public's attention to the importance of habitat and water quality. Healthy ecosystems provide the only assurance that quality fish communities will be available for future anglers.

Nevertheless, stocking will retain an important role in the management of walleye fisheries, and we have much to learn about the practice. Less than half of the walleye stockings reported during the symposium were considered successful, and these results challenge us to do better. Symposium participants reconfirmed that there are no simple answers to problems of complex systems. We must improve our understanding of the important factors determining the survival of stocked and wild walleyes so we can improve not only our stocking practices but our restoration and enhancement strategies as well.

The following points emerge as conclusions of the symposium.

(1) The success rate of stocking walleyes of all sizes has improved only marginally since the review by Laarman (1978).

(2) Methodologies for quantitative evaluation of fry and fingerling stocking are well developed and need only be applied. Genetic and chemical marking offers great promise for simultaneously evaluating different sizes and qualities of stocked walleyes.

(3) Environmental factors governing survival of young walleyes—including food availability, predation, temperature, and weather—require further study to determine how they affect the success or failure of fry and fingerling stockings.

(4) Research is needed on fish health assessment and on the critical size that fingerling walleyes must reach in their first summer to survive their first winter at the relevant latitude.

Acknowledgments

The symposium evolved from contributions of time and resources by many members of the Walleye and Fish Genetics technical committees. Jeffrey B. Koppelman, Timothy C. Modde, David P. Philipp, and Lee C. Redmond were involved in developing the foundations of the committees. P. J. (Jack) Wingate challenged the committees with the symposium concept and provided the excellent facilities and venue for the symposium. It was a pleasure to work with the authors and speakers who contributed to the symposium and to its published record. Many reviewers made valuable contributions to the symposium manuscripts, and we thank John A. Babaluk, Roy C. Heidinger, Jack A. Mathias, and Richard S. Wydoski for constructive comments on ours. We thank former journal coeditor William L. Shelton for seeing the manuscripts through the review and revision stages, and we also appreciate the editorial and production assistance of Dan Guthrie, Deborah Sanders, Sally Kendall, and Robert Kendall of the American Fisheries Society's editorial office. Finally, we thank the many others who gave their personal time to make the symposium more than just a distant memory.

References

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.

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.

Brown, J. G. 1990. Examination of walleye (*Stizostedion vitreum*) stocks using morphometrics and meristics, biochemical genetic analysis and standard rate of oxygen consumption. Master's thesis. Department of Zoology, University of Manitoba, Winnipeg.

Busch, W.-D. N., R. L. Scholl, and W. L. Hartman. 1975. Environmental factors affecting the strength of walleye (*Stizostedion vitreum vitreum*) year-classes in western Lake Erie, 1960–70. Journal of the Fisheries Research Board of Canada 32:1733–1743.

Eschmeyer, P. H. 1950. The life history of the walleye, *Stizostedion vitreum vitreum* (Mitchill), in Michigan. Michigan Department of Conservation, Institute of Fisheries Research Bulletin 3, Ann Arbor.

Fielder, D. G. 1992a. Evaluation of stocking walleye fry and fingerlings and factors affecting their success in lower Lake Oahe, South Dakota. North American Journal of Fisheries Management 12:336–345.

Fielder, D. G. 1992b. Relationship between walleye fingerling stocking density and recruitment in lower Lake Oahe, South Dakota. North American Journal of Fisheries Management 12:346–352.

Franzin, W. G., and S. M. Harbicht. 1992. Tests of drift samplers for estimating abundance of recently hatched walleye larvae in small rivers. North American Journal of Fisheries Management 12:396–405.

Hjort, J. 1914. Fluctuations in the great fisheries of northern Europe viewed in the light of biological research. Rapports et Procès-Verbaux des Réunions, Conseil Permanent International pour l'Exploration de la Mer 20:1–228.

Jennings, M. J., and D. P. Philipp. 1992. Use of allozyme markers to evaluate walleye stocking success. North American Journal of Fisheries Management 12:285–290.

Johnson, F. H. 1971. Survival of stocked walleye fingerlings in northern Minnesota lakes as estimated from the age-composition of experimental gill net catches. Minnesota Department of Natural Resources, Section of Fisheries, Investigational Report 314.

Jude, D. J. 1992. Evidence for natural reproduction by stocked walleyes in the Saginaw River tributary system, Michigan. North American Journal of Fisheries Management 12:386–395.

Kayle, K. A. 1992. Use of oxytetracycline to determine the contribution of stocked fingerling walleyes. North American Journal of Fisheries Management 12:353–355.

Koppelman, J. B., K. P. Sullivan, and P. J. Jeffries, Jr. 1992. Survival of three sizes of genetically marked walleyes stocked into two Missouri impoundments. North American Journal of Fisheries Management 12:291–298.

Kuehn, J. H. 1983. Lake management planning guide. Minnesota Department of Natural Resources, Special Publication 132, St. Paul.

Laarman, P. W. 1978. Case histories of stocking walleyes in inland lakes, impoundments and the Great Lakes—100 years with walleyes. American Fisheries Society Special Publication 11:254–260.

LaJeone, L. J., T. W. Bowzer, and D. L. Bergerhouse. 1992. Supplemental stocking of fingerling walleyes in the upper Mississippi River. North American Journal of Fisheries Management 12:307–312.

Li, S., and J. A. Mathias. 1982. Causes of high mortality among cultured larval walleyes. Transactions of the American Fisheries Society 111:710–721.

Lysack, W. 1986. Towards a predictive capability for management of the Lake Winnipeg fishery. Manitoba Department of Natural Resources, Manuscript Report 86-15, Winnipeg.

Mathias, J. A., W. G. Franzin, J. F. Craig, J. A. Babaluk, and J. F. Flannagan. 1992. Evaluation of stocking walleye fry to enhance a commercial fishery in a large, Canadian prairie lake. North American Journal of Fisheries Management 12:299–306.

McWilliams, R. H., and J. G. Larscheid. 1992. Assessment of walleye fry and fingerling stocking in the Okoboji lakes, Iowa. North American Journal of Fisheries Management 12:329–335.

Mitzner, L. 1992. Evaluation of walleye fingerling and fry stocking in Rathbun Lake, Iowa. North American Journal of Fisheries Management 12:321–328.

Paragamian, V. L., and R. Kingery. 1992. A comparison of walleye fry and fingerling stockings in three rivers in Iowa. North American Journal of Fisheries Management 12:313–320.

Quinn, S. P. 1992. Angler perspectives on walleye management. North American Journal of Fisheries Management 12:367–378.

Spencer, P. D., and G. R. Spangler. 1992. Effect that providing fishing information has on angler expectations and satisfaction. North American Journal of Fisheries Management 12:379–385.