A Perspective on Challenges to Recreational Fisheries Management: Summary of the Symposium on Active Management of Recreational Fisheries

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We convened a symposium at the Midwest Fish and Wildlife Conference in December 2000 on the challenges of developing and implementing active management programs for recreational fisheries. We were motivated by our experiences managing mixed commercial and recreational fisheries in Minnesota and Wisconsin. Experience told us that increasing angler proficiency and competition between commercial and recreational fisheries would lead to increased risk of overharvest of the underlying fish stocks. In thinking about that risk, we raised several questions that we hoped could be answered by a symposium on the subject of active recreational fisheries management: Why has so little experience been gained in actively managing recreational fisheries? When is active management of recreational fisheries necessary? What are the components of an active recreational fisheries management plan? And what are the challenges when trying to actively manage recreational fisheries? Below, we summarize the most important findings that emerged during the symposium.

Active versus Passive Management

Active management of recreational fisheries implies that a complete management procedure is in place, with clear goals or objectives for the fishery, management schemes to keep the total harvest or exploitation rate within prescribed limits or targets, and methods for assessing whether the goals or objectives have been met. Many recreational fisheries in North America are managed passively, without specific management plans detailing all aspects of the management process. If recreational fisheries have management plans, the plans are often vague or generically applied to many lakes, rivers, or streams. Our treatment of active management in this symposium can be considered one of the primary components of active adaptive management. Within the larger context of adaptive management, active management procedures would be applied in semicontrolled settings, often to multiple water bodies, in a manner that addresses the sources of uncertainty in the recreational fishery. An example would be the application of new regulations across multiple lakes with a clear suite of testable objectives (e.g., to increase the mean size of fish in the catch while maintaining spawner abundance above a predetermined level). Lester et al. (2003, this issue) describe how such management may be implemented for recreational fisheries across Ontario.

Reasons for the Paucity of Active Recreational Fishery Management

Why has so little experience been gained in actively managing recreational fisheries? We identify three primary reasons for the paucity of active management procedures, though many secondary reasons exist. First, many agencies are responsible for managing an extensive and diverse array of recreational fisheries, and they may not have adequate resources for monitoring either the fishery (e.g., recreational angling surveys may be relatively costly) or the fish stocks supporting the fishery. As a result, agencies often apply the same regulatory scheme (e.g., season closures, bag limits, or size limits) to most of the fisheries in their jurisdiction. Second, relatively few recreational fisheries are of such singular importance that they provide strong sociopolitical or economic motives for active management. Exceptions include fisheries that support multiple commercial, recreational, and subsistence users in the oceans (e.g., Pacific halibut *Hippoglossus stenolepis*; Williams and Blood 2003, this issue), inland lakes (e.g.,

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walleye *Sander vitreus* [formerly *Stizostedion vitreum*] in Lake Mille Lacs, Minnesota; Radomski 2003, this issue), and Great Lakes (e.g., walleye in Lake Erie; Ryan et al. 1999). Post et al. (2002) documented examples from across Canada wherein traditional management schemes did not adequately sustain recreational fisheries. Third, in contrast to true active management, many passive management actions are in response to natural disturbances or to complaints or requests raised by anglers or some other party with an interest in the fishery. This type of management is at best ''passively'' active (Walters 1986). A management response may appear to be active (in the sense that an agency ''actively'' responds to a perceived need). However, such a response is not in a controlled setting and will probably do little to further our understanding of the dynamics and uncertainty of recreational fisheries.

When is Active Management Necessary for Recreational Fisheries?

When is active management of recreational fisheries necessary? Clearly, agencies operating on behalf of the public trust are obligated to intervene when a fishery declines through overfishing. We recognize that a fishery may decline for reasons external to the fishery itself, such as loss of limited, critical habitat, but herein we consider only the direct effects of fishing. Determining the cause for a decline due to overfishing is complex. In addition, one fundamental assumption of recreational fisheries that may obscure underlying management problems is that recreational fisheries are self-regulating, that is, when some aspect of the fishery declines (such as catch rates), anglers leave the fishery to fish elsewhere.

We consider the challenge of determining when to apply active management in light of various degrees of overfishing, including quality, growth, and recruitment overfishing (Radomski et al. 2001). Quality overfishing may be relatively innocuous and is the easiest to identify because it depends on the (subjective) definition of quality. Quality may be defined in terms of the average size of fish caught or the catch rate by the angler. Identification of quality overfishing requires a fishery creel survey. Growth overfishing depends on the size selectivity of the fishery. In growth overfishing, the total yield of the fishery is below the maximum because fish are removed before they reach optimal size. If the objective of the recreational fishery is to maximize utility (Die et al. 1988; Jacobson 1996), however, foregone yield in the biomass of harvested fish may not jeopardize the total utility of the fishery. Recruitment overfishing is the most serious type of overfishing and occurs when the level of fishing mortality reduces spawning potential, so that total utility is below potential.

When considering recruitment overfishing, we distinguish between fishing mortality rates (F) that leave spawner abundance below some theoretical optimum (i.e., actual $F > F_{MSY}$, where MSY refers to the maximum sustainable yield) and rates that cause stock collapse. This distinction is important for recreational fisheries managers because a relatively benign level of recruitment overfishing may significantly reduce the utility of the fishery for future users but be difficult to detect, especially in the absence of an effective, quantitative stock assessment program. This is especially true if we consider the potential affect of Pauly's (1995) shifting baseline on recreational fisheries. A recreational fishery may decline very gradually, each succeeding generation of recreational fishers accepting a fishery with a lower total utility due to a lack of intergenerational transfer of knowledge. Combine this with limited and irregular recreational fisheries surveys and we can see how recruitment overfishing may occur. Furthermore, we suggest that the shifting-baseline syndrome and self-regulation are not conflicting processes in recreational fisheries. For example, assessment of a fishery may show that effort responds to some utility function of the fishery. Effort may increase when catch rates increase and decline when catch rates decline. However, the baseline may be shifting at the same time but over a longer temporal scale than angler response. As a result, the shift in baseline may not be detected by assessments unless the assessments have been in place for a relatively long time and are of sufficiently high precision.

The dynamic spatial and temporal relationship between anglers and the species they pursue is another important but largely unquantified aspect of recreational fisheries that limits our ability to assess the long-term sustainability of the fishery. At a simple level, the question is, what is the relationship between catchability and stock abundance for recreational fisheries? Is recreational fishery catchability independent of density or does it change with density (i.e., is it characterized by hyperstability or hyperdepletion; Hilborn and Walters 1992; Quinn and Deriso 1999)? This important relationship has been quantified for only a few recreational fisheries (Peterman and Steer 1981;

Hansen et al. 2000; Newby et al. 2000) and is clearly needed to understand the susceptibility of any fishery to overfishing. At a more complex level, the question is, what are the detailed spatial and temporal dynamics among angler effort, fish abundance, and fishery utility? This is a relatively new area of research in recreational fisheries that has only recently been addressed (Johnson and Carpenter 1994; Cox and Walters 2002; Beard et al. 2003b, this issue; Cox et al. 2003, this issue). Such complex dynamics suggest that we apply concepts such as utility per recruit (Die et al. 1988; Jacobson 1996) to recreational fisheries with caution because the relationship between fishing mortality or effort and fishery utility may be two-way, with changes in the utility of the fishery affecting fishing effort or the type of angler participating in the fishery. Finally, simplifying assumptions about angler behavior are tempting when predicting the effects of changes in fishery regulations. Beard et al. (2003b) and Sullivan (2003a) showed that angler behavior could be dynamic and evolve over time in response to regulation changes, both of which illustrate the nonstationary nature of the functional response between anglers and their prey. These experiences also indicate that the angler response function is a primary source of uncertainty in recreational fisheries management, and active adaptive management may be the most effective way to address this uncertainty. The details of this ''predator–prey'' relationship are an important area for future research.

Recreational fisheries are heterogeneous and vary greatly in their need to be actively managed. The characteristics of a recreational fishery system that determine its sensitivity to fishing effects and the need for active management include the life history of the target fish species and the underlying productivity of the ecosystem. Long-lived, late-maturing fishes, such as lake sturgeon *Acipenser fulvescens* (Radomski 2003) and lake trout *Salvelinus namaycush* (Shuter et al. 1998; Post et al. 2002), and relatively prolific species that are restricted to low-productivity systems, such as walleyes in Alberta (Sullivan 2003b, this issue), will be at greater risk of severe overfishing than fishes such as panfish species that have higher turnover rates. Although panfish species (e.g., yellow perch *Perca flavescens* and bluegill *Lepomis macrochirus*) may be relatively immune to recruitment overfishing because they can mature at sizes smaller than those accepted by anglers, they are susceptible to quality overfishing (Olson and Cunningham 1989; Cook et al. 2001; Radomski 2003). Other fisheries that may warrant more intensive management actions are those of singular importance, such as the walleye fishery of western Lake Erie, which alone makes a significant contribution to local economies (Hushak et al. 1998).

Components of an Active Recreational Fishery Management Program

What are the components of an active recreational fisheries management plan? Active management of recreational fisheries must include (1) clear goals and objectives, (2) rules and regulations to constrain the fishery so that the objectives are met, (3) angler and stock assessment procedures to determine the sustainability of the stock and whether management objectives are reached, and (4) enforcement and monitoring programs to ensure compliance by fishers (Krueger and Decker 1999). Objectives should be defined for a particular fishery and may include such parameters as the total amount of fish killed or the catch rate. This is particularly true for the larger fish in the population, given that a decline in recreational fishing quality may be equated to smaller catches of larger, memorable fish (Sullivan 2003b; Williams and Blood 2003). However, if the sustainability of a particular fish population is an implicit goal, a parameter related to the total kill or exploitation rate of all fish should be included in the goals and objectives for the fishery. Stock assessment procedures may be challenging for recreational fish populations that are not subjected to routine assessment (Radomski 2003). Fisheries of singular or local importance should be surveyed regularly, as in the case of the 10 largest walleye lakes in Minnesota (Wingate and Schupp 1985; Radomski 2003) and the extensive systems for assessment of numerous lakes throughout Ontario (Lester et al. 2003; Morgan et al. 2003) and Wisconsin (Beard et al. 1997, 2003a; Hansen et al. 2000). In an ideal management system, total kill would be estimated every year in combination with some type of fishery-independent survey to allow sequential population analysis for estimating abundance and fishing mortality. In the absence of the annual creel surveys on all of Minnesota's large walleye lakes that would be needed for sequential population analyses, Gangl and Pereira (2003, this issue) initiated development of tools for assessing the health of these fisheries to signal further stock declines that may warrant more restrictive regulation.

Devising rules and regulations for recreational fisheries can pose unique challenges, especially when it is desirable not to limit access to the fishery. Radomski (2003) describes challenges in estimating future angler harvests for a walleye fishery characterized by high annual variability in catchability. Most user groups probably desire regulatory schemes that are relatively straightforward and easy to understand and that will not change dramatically from year to year. In the Pacific halibut fishery of the U.S. West Coast, where the rules and regulations are quite complex, most users cope reasonably well with the system (Williams and Blood 2003). In contrast to the Pacific halibut management program, Lester et al. (2003) found that anglers in Ontario may be calling for a new, simplified regulatory scheme for walleyes. We suggest that the complex history and mix of multiple users in the Pacific halibut fishery may have predisposed users to be tolerant of complex regulations. In contrast, anglers in Ontario have historically partaken in a recreational fishery with an increasingly complex regulatory history that does not include painful memories of overexploitation and reduced fishing quality. The tolerance of specific angling communities for new regulatory schemes is a complex subject that we identify as a primary area for additional research.

Enforceability and compliance with regulations are also strongly affected by the complexity of regulations, so enforcement experts should be involved in the development and evaluation of new regulatory schemes. Sullivan (2003a, 2003b) provided a sobering case study of the potential for noncompliance by anglers confronted with new, more stringent restrictions. While reluctant to directly limit effort or access to traditional recreational fisheries, recreational fisheries managers may attempt to do so indirectly with season closures. Walters (1998) argued that the Pacific salmon *Oncorhynchus* spp. and Pacific herring *Clupea pallasi* fisheries of British Columbia were effectively managed by tightly restricting space and time for commercial fishers. Reserves, or areas closed to fishing, provide a novel way for recreational fishery managers to directly control effort, and we suggest further exploration of this tool (Sumaila 1998; Pauly et al. 2002).

Challenges in Implementing Active Management of Recreational Fisheries

What are the challenges in actively managing recreational fisheries? To define them, we looked at two active-management objectives common to commercial fisheries: constraining fishery harvest so that it does not exceed an annual quota or total allowable catch and limiting fishing effort to a level that achieves a sustainable annual exploitation rate. The application of such objectives to recreational fisheries poses several questions. First, can managers determine when to restrict recreational fisheries to such stringent objectives? Second, what new challenges will arise that may be unique to recreational fisheries when trying to limit harvest or effort? Our interest in this problem was motivated by the mixed-use fishery (recreational angling and tribal subsistence) for walleyes in Lake Mille Lacs (Radomski 2003).

We began exploring the application of common active-management goals for commercial fisheries to recreational fisheries by comparing the fundamental principles of the two types of fisheries. Commercial fisheries have high catchability and low effort, whereas recreational fisheries have low catchability and high effort. This contrast leads to differences in the preferred schemes for managing commercial and recreational fisheries. Low effort may mean that commercial fisheries have relatively few individual participants, and if so effort control may be the most effective management option. In contrast, recreational fisheries usually have a large number of individual participants, so that effort control (such as limited entry) presents significantly different technical and sociopolitical challenges.

Applying simple economic principles to the difference in catchability and effort, we identified other differences between commercial and recreational fisheries that must be considered before applying commercial fishery management schemes to a recreational fishery. From the perspective of the individual fisher, maximizing catch per unit effort (CPUE) will increase net profits in a commercial fishery and so may be considered a management goal. In a recreational fishery, CPUE is a key indicator of fishing quality because recreational fisheries with high CPUE are more desirable than those with low CPUE (Holland and Ditton 1992; Cox et al. 2003); for this reason, high CPUE may increase the economic value of the fishery by increasing effort, including income for local businesses that benefit from the fishery. Gross proceeds from a commercial fishery arise from the sale of fish for consumption, so that the pursuit of optimal yield (expressed in terms of biomass harvested) is a clear goal. Optimal yield can be achieved by applying relatively simple controls that minimize the negative effects of growth overfishing (i.e., that fishers harvest fish when they reach optimal size). In contrast, recreational fisheries may value large fish for trophy potential and small fish for consumption, thereby justifying the harvest of smaller fish while requiring the release of some larger individuals. In response to these multiple objectives in recreational fisheries, managers have implemented complex, length-based regulations for some recreational fisheries in Minnesota (Radomski 2003). While limited entry may be considered an undesirable management tool for controlling effort in recreational fisheries, agencies are showing increased application of length-based restrictions to restore or maintain quality in recreational fisheries. In essence, management agencies are hoping to manage the catchability portion of fishing mortality without directly managing or controlling fishing effort. However, the success of such management schemes will partly depend on the level of fishing effort and whether the length-based restrictions are acceptable to both the management agency and the fishing public. For example, when attempting to limit total kill with length-based restrictions in a high-effort recreational fishery, large losses of fish to post-catch-and-release mortality are likely. This scenario has already occurred in several recreational fisheries, including the contentious fishery for walleyes in Lake Mille Lacs in 2002 (Radomski 2003), walleye fisheries in Alberta (Sullivan 2003b), that for Atlantic striped bass *Morone saxatilis* (Stock Assessment Review Committee 2003), and that for common snook *Centropomus undecimalis* in Florida (Muller et al. 2001).

Summary and Conclusions

In summary, we identify several topics as key areas for future research on recreational fisheries management. As indicated by several papers in this symposium (Beard et al. 2003b; Cox et al. 2003; Radomski 2003), great uncertainty exists as to how anglers may respond to the dynamics of their prey and their direct and indirect responses to changes in regulations (as mediated through changes in the targeted fish population). Consequently, this is a primary area for additional research. However, as initially described by Johnson and Carpenter (1994) and further developed by Cox and Walters (2002), these complex relationships are subject to both spatial and temporal dynamics. Consequently, research investment will be substantial and should be conducted as active adaptive management experiments (Lester et al. 2003).

The type of angler using a particular fishery may change in response to regulatory changes. For example, a fishery that was historically managed with generic regulations but then subjected to trophy management regulations may experience a shift from consumptive users to those more drawn to trophy fishing. Market segmentation (Jacobson 1996) and other economic analyses should ideally accompany such research, including angler surveys to determine the factors that contribute to angler satisfaction (Radomski et al. 2001; Radomski 2003).

While knowledge may be borrowed from commercial fishery management systems, we do not advocate wholesale application of these systems to recreational fisheries. First, and most obvious, few of the agencies responsible for managing numerous, small-scale inland fisheries have sufficient resources to develop and apply such management practices, especially because the cost will greatly exceed the benefit for smaller recreational fisheries. Second, as we described above, the dynamics unique to recreational fisheries indicate that commercial fishery regulatory schemes could be inefficient when applied to recreational fisheries; most of these inefficiencies may arise from the possibility that predator–prey dynamics (i.e., between the fisher and the fish) are more dynamic in recreational fisheries than commercial fisheries. However, recreational fisheries should be identified and considered for detailed stock assessments and experimental regulatory regimes, such as those in Escanaba Lake, Wisconsin (Hansen et al. 1998), and Oneida Lake, New York (Forney 1980).

We also advocate development of less intensive stock assessment methods that may be useful for identifying overfishing or declining trends as indicators of population sustainability. Gangl and Pereira (2003) developed indicators that have the advantage of being based primarily on assessment data rather than models, which have a higher degree of overall uncertainty (Hilborn 2002). We also argue that the effects of new regulatory methods such as limited entry and closed fishing areas, including the economic effects, are largely unknown, so that the consequences of such regulations may not be negative. In fact, the most suitable way to address the uncertainties of such management actions is to try them in an adaptive management setting accompanied by appropriate evaluations, including economic and human dimensions evaluations.

In closing, the Symposium on Active Management of Recreational Fisheries raised compelling questions regarding recreational fisheries management. We recognize that recreational fisheries may exhibit some level of self-regulation (e.g., that fishing effort is directly correlated with the utility of the fishery), but other arguments (e.g., the shifting-baseline syndrome) suggest that our current understanding of the dynamics between anglers and their prey is rudimentary, so that it should not be assumed that self-regulation will sustain the current level of utility for future generations of recreational fishers.

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References

Beard, T. D., Jr., S. W. Hewett, Q. Yang, R. M. King, and S. J. Gilbert. 1997. Prediction of angler catch rates based on walleye population density. North American Journal of Fisheries Management 17: 621–627.

Beard, T. D., Jr., M. J. Hansen, and S. R. Carpenter. 2003a. Development of a regional stock–recruitment model for understanding factors affecting walleye recruitment in northern Wisconsin lakes. Transactions of the American Fisheries Society 132:382–391.

Beard, T. D., Jr., S. P. Cox, and S. R. Carpenter. 2003b. Impacts of daily bag limit reductions on angler effort in Wisconsin walleye lakes. North American Journal of Fisheries Management 23:1283–1293.

Cook, M. F., T. J. Goeman, P. J. Radomski, J. A. Younk, and P. C. Jacobson. 2001. Creel limits in Minnesota: a proposal for change. Fisheries 26(5):19–26.

Cox, S. P., and C. Walters. 2002. Modeling exploitation in recreational fisheries and implications for effort management on British Columbia rainbow trout lakes. North American Journal of Fisheries Management 22:21–34.

Cox, S. P., C. J. Walters, and J. R. Post. 2003. A model-based evaluation of active management of recreational fishing effort. North American Journal of Fisheries Management 23:1294–1302.

Die, D. J., V. R. Restrepo, and J. M. Hoenig. 1988. Utility-per-recruit modeling: a neglected concept. Transactions of the American Fisheries Society 117: 274–281.

Forney, J. L. 1980. Evolution of a management strategy for the walleye in Oneida Lake, New York. New York Fish and Game Journal 27:105–141.

Gangl, R. S., and D. L. Pereira. 2003. Biological performance indicators for evaluating exploitation of Minnesota's large-lake walleye fisheries. North American Journal of Fisheries Management 23: 1303–1311.

Hansen, M. J., M. A. Bozek, J. R. Newby, S. P. Newman, and M. D. Staggs. 1998. Factors affecting recruitment of walleyes in Escanaba Lake, Wisconsin, 1958–1996. North American Journal of Fisheries Management 18:764–774.

Hansen, M. J., T. D. Beard, Jr., and S. W. Hewett. 2000. Catch rates and catchability of walleyes in angling and spearing fisheries in northern Wisconsin lakes. North American Journal of Fisheries Management 20:109–118.

Hilborn, R. 2002. The dark side of reference points. Bulletin of Marine Science 70:403–408.

Hilborn, R., and C. J. Walters. 1992. Quantitative fisheries stock assessment: choice, dynamics, and uncertainty. Chapman and Hall, New York.

Holland, S. M., and R. B. Ditton. 1992. Fishing trip satisfaction: a typology of anglers. North American Journal of Fisheries Management 12:28–33.

Hushak, L. J., J. M. Winslow, and N. Dutta. 1988. Economic value of Great Lakes sportfishing: the case of private-boat fishing in Ohio's Lake Erie. Transactions of the American Fisheries Society 117:363–373.

Jacobson, P. C. 1996. Trophy and consumptive value-per-recruit analysis for a walleye fishery. North American Journal of Fisheries Management 16:75–80.

Johnson, B. M., and S. R. Carpenter. 1994. Functional and numerical responses: a framework for fish–angler interactions? Ecological Applications 4:808–821.

Krueger, C. C., and D. J. Decker. 1999. The process of fisheries management. Pages 31–59 *in* C. C. Kohler and W. A. Hubert, editors. Inland fisheries management in North America. American Fisheries Society, Bethesda, Maryland.

Lester, N. P., T. R. Marshall, K. Armstrong, W. I. Dunlop, and B. Ritchie. 2003. A broad-scale approach to management of Ontario's recreational fisheries. North American Journal of Fisheris Management 23:1312–1328.

Morgan, G. E., M. D. Malette, R. S. Kushneriuk, and S. E. Mann. 2003. Regional summaries of walleye life history characteristics based on Ontario's fall walleye index netting (FWIN) program 1993–2001. Ontario Ministry of Natural Resources, Fish and Wildlife Branch, Diagnostics and Sampling Standards Working Group, Percid Community Synthesis, Peterborough.

Muller, R. G., M. D. Murphy, and F. S. Kennedy. 2001. The 2001 stock assessment update of common snook, *Centropomus undecimalis*. Fish and Wildlife Conservation Commission, Florida Marine Research Institute, St. Petersburg.

Newby, J. R., M. J. Hansen, S. P. Newman, and C. J. Edwards. 2000. Catchability of walleyes to angling in Escanaba Lake, Wisconsin, 1980–1995. North American Journal of Fisheries Management 20: 873–881.

Olson, D. E., and P. K. Cunningham. 1989. Sport-fish-

eries trends shown by an annual Minnesota fishing contest over a 58-year period. North American Journal of Fisheries Management 9:287–297.
Pauly, D. 1995. Anecdotes and the shifting baseline syndrome of fisheries. Trends in Ecology and Evolution 10:430.
Pauly, D., V. Christensen, S. Guénette, T. J. Pitcher, U. R. Sumaila, C. J. Walters, and R. W. D. Zeller. 2002. Towards sustainability in world fisheries. Nature 418:689–694.
Peterman, R. M., and G. J. Steer. 1981. Relation between sport-fishing catchability coefficients and salmon abundance. Transactions of the American Fisheries Society 110:585–593.
Post, J. R., M. Sullivan, S. Cox, N. P. Lester, C. J. Walters, E. A. Parkinson, A. J. Paul, L. Jackson, and B. J. Shuter. 2002. Canada's recreational fisheries: the invisible collapse? Fisheries 27(1):6–17.
Quinn, T. J. II, and R. B. Deriso. 1999. Quantitative fish dynamics. Oxford, New York.
Radomski, P. J., G. C. Grant, P. C. Jacobson, and M. F. Cook. 2001. Visions for recreational fisheries regulations. Fisheries 26(5):7–18.
Radomski, P. 2003. Initial attempts to actively manage recreational fishery harvest in Minnesota. North American Journal of Fisheries Management 23: 1329–1342.
Ryan, P. A., L. D. Witzel, J. Paine, M. Freeman, M. Hardy, S. Scholten, L. Sztramko, and R. MacGregor. 1999. Recent trends in fish populations in eastern Lake Erie in relation to changing lake trophic state and food web. Pages 241−289 in M. Munawar, T. Edsall, and I. F. Munawar. State of Lake Erie: past, present, and future. Backhuys Publishers, Leiden, The Netherlands.
Shuter, B. J., M. L. Jones, R. M. Korver, and N. P. Lester. 1998. A general, life-history based model for regional management of fish stocks: the inland lake trout (*Salvelinus namaycush*) fisheries of Ontario. Canadian Journal of Fisheries and Aquatic Sciences 55:2161–2177.
Stock Assessment Review Committee. 2003. Report of the 36th Northeast Regional Stock Assessment Workshop: consensus summary of assessments. National Marine Fisheries Service, Northeast Fisheries Science Center, Reference Document 03-06, Woods Hole, Massachusetts.
Sullivan, M. G. 2003a. Exaggeration of walleye catches by Alberta anglers. North American Journal of Fisheries Management 23:573–580.
Sullivan, M. 2003b. Active management of walleye fisheries in Alberta: dilemmas of managing recovering fisheries. North American Journal of Fisheries Management 23:1343–1358.
Sumaila, U. R. 1998. Protected marine reserves as hedges against uncertainty: an economist's perspective. Pages 303−309 *in* T. J. Pitcher, P. J. B. Hart, and D. Pauly, editors. Reinventing fisheries management. Kluwer, London.
Walters, C. 1986. Adaptive management of renewable resources. Macmillan, New York.
Walters, C. 1998. Designing fisheries management systems that do not depend upon accurate stock assessment. Pages 279−288 *in* T. J. Pitcher, P. J. B. Hart, and D. Pauly, editors. Reinventing fisheries management. Kluwer, London.
Williams, G. H., and C. L. Blood. 2003. Active and passive management of the recreational fishery for Pacific halibut off the U.S. West Coast. North American Journal of Fisheries Management 23:1359–1368.
Wingate, P. J., and D. H. Schupp. 1985. Large lake sampling guide. Minnesota Department of Natural Resources, Division of Fish and Wildlife, Section of Fisheries, Special Publication 140, St. Paul.