Visions for Recreational Fishing Regulations

fisheries management **feature**

ABSTRACT

We review sportfishing regulations in Minnesota and across North America and discuss potential visions for the future of sportfishing regulations. Creel limits are ubiquitous across North America and they have been generally set arbitrarily with little biological justification. Anglers may not accept reductions in creel limits that actually decrease total harvest. Length-based regulations are now common and most North American sport fish management agencies had numerous water-specific length-based regulations. The future of fishing regulations could continue to get more complex but there are substantial shortcomings to this future. We present four visions of the future of freshwater recreational fishing, and we pose the question "Does the fact we are managing a pleasure sport mean that we need to rethink our fisheries management philosophy?" Future management of sport fish may rely less on biology and more on social science as we learn to optimize angler satisfaction. Although biology should be the basis for future management, other aspects of the fishing experience besides the number and size of fish caught could be managed. We will need to manage "how people fish" and understand "why people fish" to improve the angling experience. Since many of us chose this profession for nobler reasons than pleasure or sport management, we have difficulties addressing the social issues of fishing quality.

Paul J. Radomski
Gerold C. Grant
Peter C. Jacobson
Mark F. Cook

Paul J. Radomski is a fisheries biologist at the Minnesota Department of Natural Resources (MNDNR), 1601 Minnesota Drive, Brainerd, MN 56401, paul.radomski@dnr.state.mn.us. Gerold C. Grant is senior fisheries biologist at MNDNR, 1601 Minnesota Drive, Brainerd, MN 56401, 218/828-2665, gerold.grant@dnr.state.mn.us. Peter C. Jacobsonis a research scientist at MNDNR, 14583 Co. Rd 19, Detroit Lakes, MN 56501, 218/847-1579, peter.jacobson@dnr.state.mn.us. Mark F. Cook is a senior fisheries biologist at MNDNR, 2114 Bemidji Ave., Bemidji, MN 56601, 218/755-2974, mark.cook@dnr.state.mn.us.

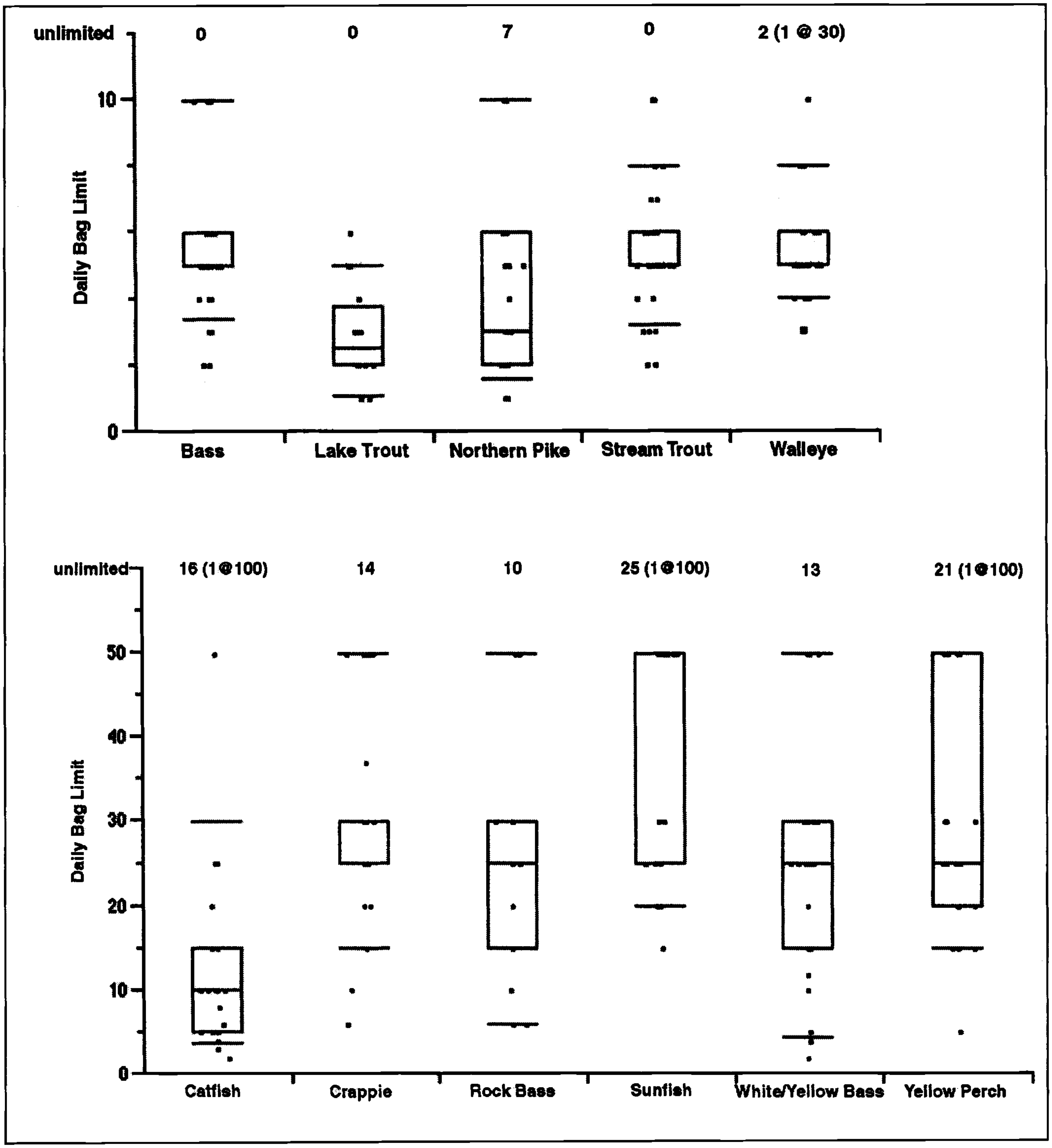
Here in Minnesota

The historical trend in Minnesota regulations has been toward more restrictive daily creel limits, increased use of length-based regulations on specific water bodies, and greater complexity. Daily creel limits and length-based regulations are often cited as the primary tools for regulating sport harvest (Dawson and Wilkins 1981; Noble and Jones 1993), and in Minnesota the principal fishing regulations are statewide daily creel limits (daily and possession limits are the same here). Creel limits have decreased historically even though some have not changed in the last 70 years (Cook et al. 2001, this issue). There appear to be discrepancies between the public perception of the effectiveness of creel limits and the perception held by many fisheries biologists. Minnesota anglers generally believe that daily creel limits along with possession limits are important in conserving fish populations. However, enacting creel limits that are low enough to restrict harvest may be socially unacceptable (Larscheid 1992; Cook et al. 2001, this issue). Fisheries managers, therefore, consider creel limits ineffective in controlling fish harvest for most species, citing various reports and investigations (Redmond 1974; Snow 1982; Cook and Younk 1998). However, some managers believe that creel limits are effective at distributing the harvest among more anglers or reducing total harvest during periods of high catchability. There are no data, to our knowledge, to support these two hypotheses. In addition to statewide creel limits, Minnesota has also implemented a growing number of length-based regulations for specific waters every year, and it now has 130 waterbodies with site-specific length-based regulations. Minnesota has also seen an increase in angling pressure, which has been accompanied by a decrease in average fish size and catch rates (Olson and Cunningham 1989; Cook et al. 1997; Cook and Younk 1998).

Across North America

Creel limits are ubiquitous in regulating individual angler harvest per fishing event or day in North America. In our examination of freshwater fishing regulations in 54 U.S. states and Canadian provinces, black bass (*Micropterus dolomieu* and *M. salmoides*), and trout (*Salmo trutta*, *Oncorhynchus mykiss*, *Salvelinus fontinalis*, and *S. namaycush*) always had a daily creel limit where they occurred. Larger piscivorous fish species had lower creel limits than smaller insectivorous or planktivorous species (Figure 1). For example, the median creel limit for northern pike (*Esox lucius*) and walleye (*Stizostedion vitreum*) was 3 and 5 fish, respectively, whereas, yellow perch (*Perca flavescens*) and sunfish (*Lepomis spp.*), had median creels of 25 and 50 fish, respectively. Moreover, many states and provinces do not have limits for yellow perch and sunfish. A wide range of creel limits exist for catfish (*Ictalurus punctatus* and *Pylodictis olivaris*), crappie (*Pomoxis nigromaculatus* and *P. annularis*), rock bass (*Ambloplites rupestris*), and temperate

Figure 1. A comparison of creel limits across North America. Fifty-four agency regulations for the 2000 fishing season were reviewed. Data are interquartile boxes with medians, 10th and 90th percentiles (horizontal lines), and points for individual agencies.



bass (*Morone chrysops* and *M. mississippiensis*).

We looked for correlations between daily creel limits of walleye, northern pike and bass, and angler effort as compiled by U.S. Department of the Interior and U.S. Department of Commerce (1997). We hypothesized that states with higher angler effort might have lower creel limits; however, this was not the case. Creel limits for walleye, northern pike, and bass were not correlated with total angler effort or number of anglers (Figure 2; $P > 0.05$) in different states. Many assumptions are required for such an analysis (e.g., similar quality and quantity of fisheries resources, creel limits reduce harvest, sport fisheries are appropriately regulated in all states to reduce overharvest). If, on the other hand, creel limits are not based on angler effort, the number of anglers, or some other variable directly or indirectly related to the level of sport fish harvest and pressure, we are led to wonder, "On what criteria are creel limits based?" Fox (1975) perceptively stated, "How creel limits are derived is something of a mystery, as they appear to have been determined arbitrarily, with little data to support them." Fisheries agencies rarely address creel limit rationale or effectiveness (Hess 1991). Long ago, agencies presumably enacted daily creel limit regulations to prevent large, but occasional, catches. Today, there may be some value in daily creel limits since these regulations remind anglers that fish populations are finite.

Many fish management agencies have recently proposed or implemented reduced daily creel limits for the stated purpose of preserving fishing quality. In 1974, the mean daily creel limit for bass (*Micropterus* spp.) in the U.S. was approximately 9 fish (range 5–25; Fox 1975). By 2000, the mean bass limit was 6 fish (range 2–10) across North America. In 2000, Minnesota proposed a reduction in yellow perch creel limits statewide, and recently it has reduced creel limits for various species on specific waters. Wisconsin has recently reduced panfish creel limits, and it has proposed to reduce panfish, bass, and northern pike creel limits on specific waters. Wisconsin fisheries managers also use reduced creel limits for walleye on specific water bodies to suppress angling effort and limit total harvest. North Dakota and Ontario implemented new or reduced creel limits for crappie and yellow perch in 2000.

Although recreational fishing regulations have grown more restrictive over the last century and creel limits usually have been reduced, biologically meaningful reductions that significantly restrict total harvest generally have not been implemented. Porch and Fox (1991) demonstrated that the amount of total harvest reduction is a function of the size of the creel limit, the mean catch per angler-day, and the variance of the angler catch. For many fish species, a few sport anglers account for most of the harvest (e.g., Hilborn 1985; Cook and Younk 1998). Because creel limits have historically been higher than the daily angler catch of most anglers, creel limit reductions commonly proposed and implemented are generally unsuccessful in reducing angler harvest or affecting fish populations (Webb and Ott 1991; Munger and Kraai 1997; Newman and Hoff 2000). Earlier, several fisheries biologists advocated that creel limits were not necessary or that statewide regulations were likely having little effect (Pelton 1948; Patterson 1952; Snow 1982).

Drastic reductions in existing creel limits likely would be necessary to reduce total fish harvest in Minnesota. Predicting harvest reductions resulting from lower creel limits using simple censoring or truncating of harvest per trip distributions for Minnesota anglers based on creel survey data suggests that walleye creel limits would have to be reduced to two fish and northern pike creel limits to one fish to realize a 20% harvest reduction Table 1; (Cook et al. 2001, this issue).

Sunfish and crappie creel limits would likely require a 70% reduction from present limits to achieve a 25% reduction in harvest. Truncating creel distributions to a reduced creel limit may underestimate the harvest because it assumes stock density does not benefit from reduced harvest limits and angler dynamics does not change (Porch and Fox 1991), but it gives some insight into possible consequences of creel limit reductions. Reducing creel limits to the average trip catch, often zero to two fish for piscivorous species as indicated above, would likely not be accepted by Minnesota anglers.

Length-based regulations are now widely used in regulating recreational fishing harvest. Twenty-one state and provincial governments of 54 examined had general (i.e., state-wide or region-wide) minimum length regulations for largemouth bass. The mode of minimum length limits for largemouth bass across North America was 12 inches. Seventeen of 54 state and provincial governments had general minimum length limits for walleye and northern pike. The mode of these limits was 15 inches (range 14–18 inches) for walleye and 24 inches (range 18–30 inches) for northern pike. Five agencies had general minimum length limits for crappie (range 6–10 inches). In addition to general length-based regulations, most North American sport fish management agencies had numerous water-specific length-based regulations. The median number of these exemptions to a state's or province's general regulations was 36 per agency (interquartile range 14–85), and many agencies had 100 or more exemptions (Figure 3). Forty-five agencies, or 83%, had at least one water-specific length-based regulation for largemouth bass (Table 2.)

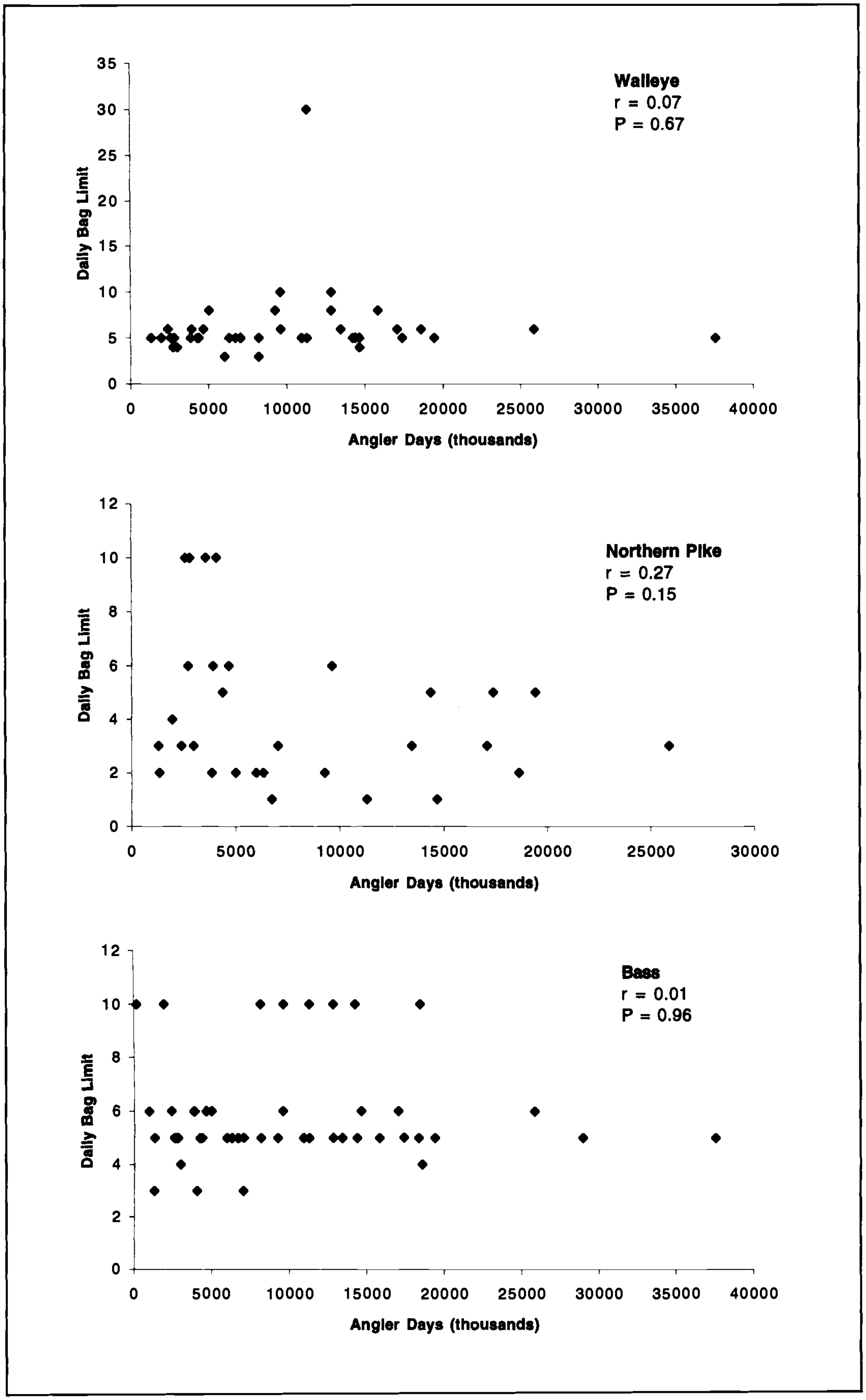
Because creel limits have historically been higher than the daily angler catch of most anglers, creel limit reductions commonly proposed and implemented are generally unsuccessful in reducing angler harvest or affecting fish populations.

Walleye was another species that agencies often regulated by water body. Most exemptions for bass, walleye, and northern pike were for minimum length limits, but slot length limits, one-fish-over length limits, and maximum length limits were also common. Crappie were only regulated with minimum length limits—18 agencies (33%) had water-specific regulations.

What is the Purpose of Recreational Fishing Regulations?

Purposes of recreational fishing regulations include managing social issues, preventing overfishing, and aquatic community manipulation (e.g., managing against an exotic species or manipulating predator-prey interactions). Managing social issues and preventing overfishing are the most common objectives of recreational fishing regulations and we will limit our discussion to them. Scalet et al. (1996) provided students of fisheries management reasoned rationale for the use of creel limits, stating that the primary purpose of these limits is to regulate social issues (e.g., an attempt to distribute harvest more equitably) or political matters, and

Figure 2. Creel limits for walleye, northern pike, and bass in relation to angler effort. Sample size was 39 states for walleye, 30 for northern pike, and 47 for bass.



these limits generally do not regulate total fish harvest. If harvest reductions are not likely with acceptable creel limit reductions, and there is no evidence that lower creel limits distribute fish to more anglers, then why do we continue to marginally manipulate creel limits? Is it possible that limiting successful anglers' daily harvest with a creel limit reduction would result in some previously unsuccessful anglers catching fish? The significance of spreading the harvest could be offset by changes in angler behavior. For example, increased success could lead to increased angling effort if additional anglers are attracted. Lower daily creel limits, which are pragmatically trip limits for local anglers, could result in previously successful anglers making more trips to the lake or stream analogous to a commercial fishery (Richards 1994). Simulations on regulation and angler dynamics may provide guidance on the range of potential consequences. This has been done for some commercial fisheries (e.g., Gillis et al. 1995), but not for freshwater sport fisheries.

The biological effects of length-based regulations need further evaluation using properly designed and replicated experiments. Some length-based regulations, like the one-over, two-over, and three-over length limits appear to codify angler values of large fish. One might conclude that fine-tuned harvest control is possible with length-based regulations considering the plethora of these regulations across North America. We wonder, analogous to the history of enhancing sport fisheries through fish stocking, if are we applying length-based regulations ad hoc without adequate experimentation to determine what worked and why Perhaps like fish stocking (Li et al. 1996a, 1996b), we will know which length-based regulations are effective only after 50 years of use.

The other oft-mentioned purpose of sportfishing regulations is to protect against overfishing. However, the meaning of the term overfishing in a recreational fishery context is usually ambiguous or poorly defined. Perhaps we are envious of commercial fisheries managers who often see drastically different fish population characteristics after fishing with impressively efficient fleets and who often talk of fishery collapse. Commercial fisheries managers often refer to overfishing as meaning something similar to the U.S. Magnuson-Stevens Fisheries Conservation and Management Act definition, "a rate or level of fishing mortality that jeopardizes the capacity of a fishery to produce the maximum sustainable yield on a continuing basis." Overfishing is often classified into one of two kinds: growth or recruitment overfishing (Hilborn and Walters 1992). Both kinds represent conditions of decreased harvest in weight over time due to high fishing mortality. Growth overfishing is taking too many fish when they are too small, and recruitment overfishing is taking too many fish overall causing reductions in the number of spawners and young fish recruiting to the fishery. Scalet et al. (1996) reported that there are no documented cases of recruitment overfishing where the primary factor was sportfishing mortality. In addition, growth overfishing is rarely specifically cited with sport fisheries (but see Maceinia et al. 1998). Undocumented cases of growth or recruitment overfishing may exist, but since most sport fisheries are poorly monitored for total harvest or yield those occurrences may be open to speculation. While length-based regulations have been proposed and used for community or species population stability (Anderson 1975; Forney 1980; Redmond 1986), they are increasingly being proposed to maximize value per recruit (Jensen 1981; Milon 1991; Jacobson 1996) or to increase angler satisfaction (i.e., optimize satisfaction yield). Perhaps fisheries managers need another adjective for overfishing to clarify the consequence of sport angling harvest on fish populations. We suggest "quality overfishing."

Quality overfishing likely occurs when existing fishing mortality exceeds the fishing mortality of optimal satisfaction yield or the safe satisfaction return (Figure 4). Quality overfishing and the safe satisfaction return are directly related to "optimal sustainable yield"—a concept now more than 25 years old (Roedel 1975). Quality overfishing occurs at much lower fishing mortality levels than maximum sustainable yield—above which growth and recruitment overfishing occur. Like optimal sus-

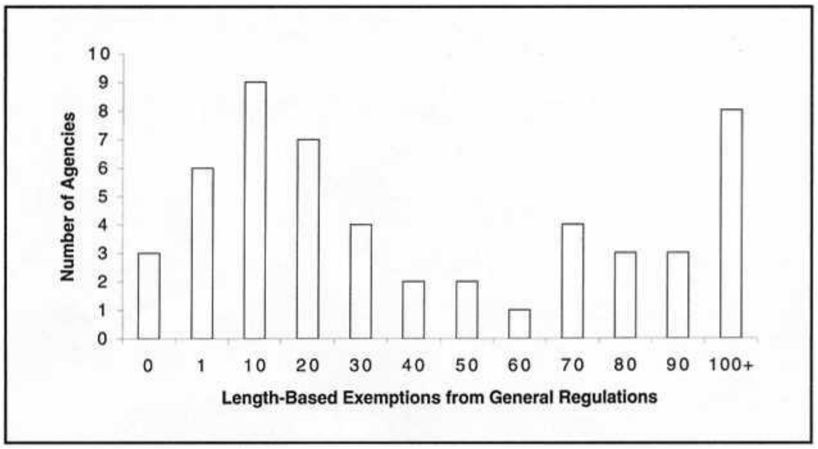
Table 1. Potential harvest reductions (percent) for walleye, largemouth bass, northern pike, sunfish, crappie, and yellow perch using simple censoring or truncating of harvest per trip distributions for Minnesota anglers based on creel survey results. Current creel limit is 6 walleye, 6 largemouth bass, 3 northern pike, 30 sunfish, 15 crappie, and 100 yellow perch.

CREEL LIMIT											
					5	4	3	2	1	0	
					2.8	6.7	13.5	24.1	48.3	100	Walleye
					0.9	3.1	7.1	13.0	24.6	100	Largemouth bass
								6.8	22.5	100	Northern pike
29	27	24	21	18	15	12	9	6	3	0	
0.1	0.4	1.5	3.6	6.7	10.9	16.8	25.5	39.1	61.4	100	Sunfish
						0.8	4.3	14.3	34.5	100	Crappie
	90	80	70	60	50	40	30	20	10	0	
	0.0	0.0	0.0	0.0	0.1	0.3	0.8	4.4	19.1	100	Yellow perch

tainable yield, determining the safe satisfaction return for a fishery is difficult. To determine the safe satisfaction return it is necessary to quantify angler preferences, values, and behavior. Without applying social science to quantify angler values, fisheries managers often fail to predict angler responses on factors dealing with fishing quality (Miranda and Frese 1991).

The preferences of different angler populations are increasingly being measured and considered in recreational fisheries management. In many cases, such studies of angler values lead to clear solutions for fisheries managers. For example, Dawson and Wilkins (1981) found that anglers preferred sportfishing regulations that were perceived to have the least impact on future participation, prefering minimum length regulations to creel limits. A study on angler values of Lubbock, Texas residents found that they preferred to catch fewer large fish rather than more small fish (Schramm and Dennis 1992). Petering et al. (1995) surveyed anglers fishing two Ohio lakes and found that anglers were more satisfied with bigger crappie than the number of crappie in hypothetical catches, and due to this preference, the use of length-based regulations would increase angler satisfaction. Scarnecchia et al. (1996) noted that results from an angler survey were used to implement a reduced creel limit and catch-and-release fishing periods for paddlefish (Polyodon spathula) because most snaggers preferred to catch one big paddlefish rather than two small ones. In all these cases, studies of angler values led to obvious management choices.

Figure 3. Frequency distribution of the number of length-based exemptions to a state's or province's general regulations for 54 agencies in the year 2000 (classes include 0, 1–9, 10–19,...100 or more).



But angler values are not always homogenous, leading to difficult decisions about the best management strategy. Jacobson (1996) found a bimodal distribution of walleye angler values which he classified into meat-oriented and trophy-oriented groups. A fishing mortality rate that optimized satisfaction for each group of anglers could be determined, but then the fisheries manager would still have to decide which value to manage for or whether to manage for some intermediate goal which would be suboptimal for both types of anglers. Renyard and Hilborn (1986) found that frequent anglers had different regulation preferences than occasional anglers. Fisher (1997) also found that opinions on regulations were different among angling groups, and he stated, "Although uniform management would simplify enforcement, a diverse management regime may increase public support for fisheries management and conservation." Several studies have shown that anglers are concerned with aspects of the fishing experience besides the amount and size of fish they catch (Spencer and Spangler 1992; Fedler and Ditton 1994). Hunt and Ditton (1997) found that anglers placed considerable importance on waters that were familiar and close to home, areas with adequate fishing cover, places where they could escape other recreationalists, fishing in an area of high scenic beauty, and where there were no user fees. Where will further study of angler preferences take us?

What has really been missing in the management of sportfishing is the lack of focus on the word "sport." Hummel and Foster (1986) stated that "the essence of sport is contrived, self-imposed difficulties in pursuit of some goal." Contrived regulations in Minnesota include gear restrictions, such as one hook and one line, although there are many exceptions to this rule (e.g., an angler can use a treble hook if it is part of a lure, two lines can be used in the winter, etc.). Self-imposed difficulties are often codified at the request of anglers in Minnesota; examples include spring fish sanctuaries, live bait restrictions, and seasonal catch and release fishing seasons. Sport anglers are fishing for pleasure and not necessarily for a lot of fish. Some anglers also voluntarily restrict the gear they use and the fish they harvest.

Does the fact that we are managing a pleasure sport mean that we need to rethink our fisheries management philosophy? Should sport fisheries managers be viewed as both league officials and commissioners of the sport, and conservation officers as referees or umpires? We want to see our jobs as more noble than regulating a sport, since we care deeply about the environment and nature. We speak often about overexploitation and conservation. But, except when we are protecting and restoring the integrity of the natural and native resources, is our job something different than a manager of a baseball stadium or a golf course? Perhaps the reason recreational fishing is not always managed for the entire fishing experience (i.e., from fish to lake and stream settings) is because we have not all faced the true reality of our jobs. The manager of the baseball stadium cares about the team (fish population characteristics), as well as the food and beverages sold and bought (bait sales and resort businesses), the rules of the game (fishing regulations), the quality of seats and cleanliness of stadium (lake and river aesthetics), the convenience of parking and ticket purchasing (boat access and license distribution), in essence, the total satisfaction of the fan (angler). Likewise, the manager of a golf course cares about the layout of the course (conditions that make catching fish sporting), the amenities, the clubhouse (the lake or river aesthetics), the rules of the game (fishing regulations), and crowding and spacing of players (fishing effort and fishing disturbances). Is our job complete if we do less than what a manager of any other sport does?

Future Visions of Recreational Fishing Regulations

Costanza (2000), who recently laid out four visions on the potential state of the world in 2100, emphasized the importance of envisioning for moving from opinion to judgement. Here, we lay out visions for a topic smaller than a future culture for humanity. We summarize four plausible scenarios on the future of recreational fishing regulations in 2025 for Minnesota, assuming our current culture continues to exist. The scenarios were developed by reviewing trends in fishing regulations in Minnesota and across North America, thoughts of prominent fisheries managers (e.g., Wingate 1999), and recent sportfishing management research. The four scenarios follow.

World Wild Fishing (WWF)—a future in which fishing entertainment and trendy regulations predominate. In this scenario, corporate socialism has expanded and many recreational activities are driven by consumerism and convenience. In addition, an increase in "enthusiast" (i.e., zealous) fishing groups, ever more afflicted with faction, have become hyperactive participants within the agency in setting regulations. Regulations are quickly applied and are dependent on the current ethic of the day (big fish are sacred, then little fish are sacred, and then medium-sized fish are sacred, etc.). There exists a patchwork of regulations across the state with high complexity overall; however, angling regulations are weakly enforced because wardens see little value in strict application of the rules. Most wardens, when dealing with fishing regulations, are involved with the enforcement of "time-allocation" rules on the heavily-used waterbodies. Fisheries biology is important within the agency, but its role is mostly focused on the creation of new species or, as the agency TV programs state, "the improvement of our native species, such as bass and walleye, with advanced genetic engineering." Marketing specialists are more valuable to the agency and are paid more than biologists. Customer-driven regulations are widespread. For example, the use of new technology to decrease "time-between-bites" is allowed even though obvious detrimental consequences occur. Management for catch-per-hour is important and the agency is driven to manage the sport for pleasure and angler preferences. Fishing is again one of the major outdoor sports in Minnesota, and license sales are at record levels.

The assumptions of this vision are that angling groups take ownership of the resource and that the management regimes for which they lobby actually increase catch rates and maintain healthy fish stocks. Since regulations are driven by angler preferences and not biologically sound principles, these assumptions likely will not be met. The consequences of this scenario could be devastating to local fish stocks, leading to angling pressure shifting to remaining healthy stocks, and subsequently harming these stocks as well. Management agencies, having surrendered their power to interest groups, may find it difficult to regain regulatory power and rehabilitate damaged fish stocks. This weakening of agency power may be compounded by the loss of credibility due to the deteriorating resource base.

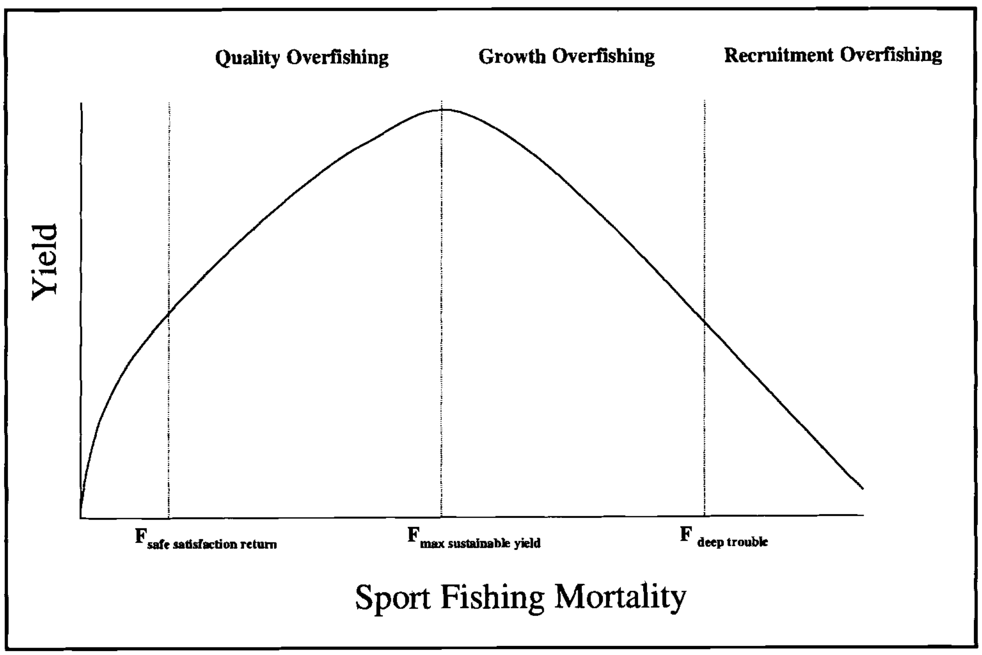
Neighborhood Fishing Leagues (NFL)—a future based on waterbody specific management and agency delusion and aggrandizement. This pes-

Table 2. Number of state and provincial governments (with percent) with general and water-specific regulations for walleye, northern pike, largemouth bass, smallmouth bass, and crappie for the year 2000. The number of agencies with four types of length-based regulations applied on individual waters were also tallied, which included slot length limits, minimums, only-one-over length limits, and maximums. Fifty-four agencies' regulations were reviewed.

	General length-based regulations	Water-specific length-based regulations	Minimum length limits	Slot length limits	1-Over	Maximum length limits
Walleye	20 (37%)	29 (54%)	23	10	14	2
Northern pike	21 (39%)	17 (31%)	13	4	5	4
Largemouth bass	26 (48%)	45 (83%)	41	31	13	3
Smallmouth bass	25 (46%)	40 (74%)	36	26	11	2
Crappie	5 (9%)	18 (33%)	18	0	0	0

simistic scenario is based on a common trend where the stated rationale is: that each population and waterbody is unique, therefore unique regulations to optimize social yield are required. In this scenario, the future is cast because a well-intentioned agency aggressively promoted untested length-based regulations by lake and stream in an ad hoc way. Governmental reform, mandating greater public participation and review of regulations along with an increase in public initiatives at the state, county, and city level, increased the proliferation of different fishing regulations across the state. Minnesota's moderate-sized and large lakes all have special, and mostly different, regulations for the common sport fish species. For some lakes, the regulations change annually or biannually. Sportfishing groups and the agency are satisfied with what they have accomplished—each can point to regulations that are "progressive" and "proactive" for the benefit of fish populations and fishing enthusiasts and each are their greatest supporters. However, it is difficult to determine which regulations were effective in shifting population size structure because the process of implementation, much like earlier fish stocking efforts, was not conducive to hypothesis testing due to lack of experimental design. Hypothesis testing is further confounded by constantly changing regulations. In addition, the regulations implemented were weak in changing selectivities, and thus harvest. For many fisheries, the inherent variability in both fish populations and angler catchability overwhelmed the small regulatory changes. The false belief (but easily modeled power) of being able to tailor a fishing mortality vector to a size structure of fish was intoxicating, but the benefits were evanescent. Angler satisfaction has not measurably improved, nor has participation in the sport increased.

Figure 4. A conceptual graph of overfishing types based on yield and sport fishing mortality.



This vision assumes that 1) regulations for individual waters are successful in changing the fish population structure toward some desired goal, and 2) that adequate resources are available to monitor and enforce regulations on every water body. If the first assumption is not met (e.g., for minimum length limits recruitment to catchable size is too slow, causing fish to stack up below the limit, or a concentration of fishing mortality, leading to overharvest of spawning stock), the desired population structure is not met. However, even in the worst outcome of this scenario, the ability to change regulations from year-to-year would allow adjustments in the regulations before long-term damage occurs. Of course, if adequate resources aren't available to monitor individual waters (which is likely at current funding levels in the land of 10,000 lakes), fisheries could suffer before biologists are aware of any problems. Non-compliance and lack of enforcement would render individual water management useless.

Need Beauty or Affluence (NBA)—a vision in which sportfishing is regulated within enclaves of wealth by community factions who have taken ownership of water resources. These factions, such as private owners and lake associations, control access to lakes and streams in their area. Non-members are restricted unless they have political clout, insider connections, or money. The people living around the lakes in style found it comforting to guarantee that outsiders were not exploiting or degrading their peace, their resource, and their image or lifestyle. The state's fish management agency focuses on publicly accessible resources, a small fraction of the original resource base. Because the agency work load is greatly diminished, most fisheries biologists work primarily as consultants to private powers. Local control leads to varying environmental conditions depending on visions of the owners or their consultants. Stocking and management regimes also vary drastically, although mostly with limited knowledge on the biological consequences of their actions. Rotenone treatment and walleye culture are big businesses, and angling success follows a boom and bust cycle.

This vision assumes that wealthy property owners desire greater involvement in limiting access to the commons, and that privatizing fisheries management and limiting outside access would increase recreational satisfaction. Since fishing quality for some species can be reduced at relatively light angling effort, the assumption of increased fishing satisfaction may not be met for some. However, because many private owners are not frequent anglers, even with the worst outcome to the fishery, limited access likely would still produce substantial though exclusive benefits.

Proven Good Angling (PGA)—a future in which fundamental social and biological science guide the implementation of regulations with the noted lack of substantial regulation change due to politicians or fanatical anglers. This is an optimistic scenario where the agency operates for the public trust (McEwan 1997), although under much political pressure. Fisheries managers, who increasingly have considerable social science skills developed with formal education, recognize the value of managing for quality angling experiences (Hunt and Ditton 1997). Fisheries managers continue to allocate ample time to biological issues, but increasingly are involved in shoreline ordinance and zoning issues, habitat protection and restoration, and family-friendly concerns (e.g., simple regulations, safe and convenient places to fish, etc.). Potential fishing regulations are carefully reviewed. Potential biological and social consequences, determined using the predictive science developed from past experimentation and adaptive management, are the important variables in the decision-making process. Implemented regulations are aggressive in that they significantly alter harvest selectivity patterns, and they generally attempt to flatten the typically observed negative binomial distribution pattern of catch rates. Regulations are regionally specific rather than lake-specific, with some exceptions in place because of special conservation reasons. In addition, there are a number of waterbodies scattered across the state with catch-and-release only type regulations and stricter rules pertaining to shoreline development—these are termed legacy regulations for distinguished waterbodies with characteristics for outstanding fishing experiences.

The assumptions of this vision are that the natural resource management agency is mostly apolitical and that healthy skepticism exists within practicing fisheries managers and biologists. If the agency is mostly political, then staff proposed or supported policies are compromised or subjugated with controversy-averse policies and thus the consequences of this scenario to aquatic resources and fishing quality will be mixed. In addition, the backlash from fervent anglers who perceive an agency less responsive to their needs could mean a dramatic loss of funding and grassroots support for fisheries management activities. The potential benefits of this vision, if it is achieved, are widespread improvements to recreational fishing and fish habitat. If current fisheries managers do not suspect or question the current direction of fishing regulations, then little actually will change.

Further Discussion

Current creel limits likely have little effect on total harvest for most species, and their function appears to be social in that they may be only limitations on human greed or, as speculated by Fox (1975), a gauge used by anglers to measure their fishing success. Hence, Cook et al. (2001, this issue) proposed to actively use creel limits to alter perceptions of fishing success. Many Minnesota fish managers and anglers, however, were upset with this proposal because they felt uncomfortable openly "using mind games" or psychology versus stating or believing that the regulations were for biological reasons or conserving fish stocks. Because of the failure to accept that we are often regulating a sport and not stopping the collapse of a fish population from overexploitation, we implement many regulations for our own aggrandizement. Fishing regulations have gone through a period of liberalization (Fox 1975; Redmond 1986), but we are in a period of proliferating length-based regulations and high regulatory complexity across North American as fisheries managers attempt to restructure some fish populations toward larger-sized fish and react to the direct and indirect demands of fanatical anglers. Regulation differences between states and provinces in fishing regulations were minor, in the sense that many states have a complex set of rules which include codifying local ethics or values.

Fisheries managers realize that more quantification of angler preferences, values, and behavior is needed along with greater scientific experimentation of creel and length-based limits.

Fisheries managers realize that more quantification of angler preferences, values, and behavior is needed along with greater scientific experimentation of creel and length-based limits. Without applying social science to quantify angler values, fisheries managers often fail to predict angler responses on factors dealing with fishing quality (Miranda and Frese 1991). Smith (1999) recently quantified and modeled angler response, in terms of fishing time, to angling success to better understand sport angler dynamics. Similar novel studies are needed to determine the effects of management actions on angler behavior. In addition, we need to quantify fishing quality—how do we measure fishing quality, how do we evaluate our actions to improve fishing quality, and what is a significant improvement and why? Formal experiments with adequate replication and control (see Hurlbert 1984) are also needed to fully evaluate the effects of length-based regulations. The inherent within- and between-population variability requires a large number of lakes and populations be measured to determine regulation effects. Adding an adequate number of control lakes to the design (equal to the number of treatment lakes in a simple one treatment experiment) quickly turns the experiment into a large-scale, long-term, expensive effort. Statistical power analyses of potential experiments with Minnesota fish populations routinely suggest that sample sizes of 10 or more lakes are required to detect significant treatment (regulation) effects. Regardless, it is time that we try some of these large scale experiments if we truly want to know if some of these length-based regulations work (i.e., significantly change the biological properties of a fish population and the social yield of the fishery).

The future of recreational fishing regulations could continue to get more complex with different creel and length-based regulations for each waterbody. Agencies may also continue to codify ethical rules or contrived difficulties in the capture of fish. These regulations may increase angler pleasure, but they also have costs. Certainly, the complexity of fishing regulations detracts from the fishing experience. The loss of agency credibility, or popular regulations which are biologically detrimental, are potential costs (Johnson and Martinez 1995). A social cost may include resentment from anglers who usually try to comply with sporting regulations, but make mistakes after being confused from an overwhelming milieu of complex restrictions and are issued citations (Schill and Kline 1995; Schill and Scarpella 1997). The management for pleasure and the reduction or elimination of difficult conditions in sportfishing also has subtle social costs on our culture and on the personal strength of individuals (Skinner 1987).

We are managing a sport, yet it is based on biology to protect or enhance fish populations in their natural habitat, and on sociology, to enhance the quality of the sport.

As fisheries managers, we manage a sport, but envision our central responsibility is to ensure fish stock health and fishing sustainability. We believe that sportfishing is an extensive and effective method of fish harvest, but the effects to date in many sport fisheries appear mostly manifested in changes to size and age structure of the fish population, with some species (e.g., lake trout, northern pike) more vulnerable than others (Goedde and Coble 1981; Mosindy et al. 1987; Pierce et al. 1995). Walleye size structure appears to be relatively resilient to angling in Minnesota and similar areas, but northern pike populations in many Minnesota waters now lack large fish (Olson and Cunningham 1989; Hansen et al. 1991). Sportfishing mortality is size-selective, with exploitation often greatest on the larger-sized fish, e.g., northern pike (Pierce et al. 1995), crappie (Colvin 1991), and bluegill (Coble 1988) but not walleye (Serns and Kempinger 1981; Payer et al. 1987; Jacobson 1994) and sauger (Maceina et al. 1998). Would general, broad-based, conservative regulations that are robust enough to protect fish stocks of high quality in a wide variety of lake and population types applied regionally be preferable to an amalgam of many different water-specific regulations? Although this system would not result in an optimal harvest or even optimal social yield for any one waterbody, the overall benefit, which includes the positive benefits from a simpler regulation system, may be maximized.

There appears to be no shared vision on the future of sportfishing management within agencies or across North America. However, we will need to manage "how people fish" and understand "why people fish" to improve the angling experience. We are managing a sport, yet it is based on biology to protect or enhance fish populations in their natural habitat, and on sociology, to enhance the quality of the sport.

Acknowledgements

We thank Dennis Schupp, Paul "Jack" Wingate, Tim Goeman, David Willis, Lee Redmond, and an anonymous reviewer for their valuable contributions.

References

Anderson, R. O. 1975. Optimal sustainable yield in inland recreational fisheries management. American Fisheries Society Special Publication 9:29-38.

Coble, D. W. 1988. Effects of angling on bluegill populations: management implications. North American Journal of Fisheries Management 8:277-283.

Colvin, M. A. 1991. Evaluation of minimum size limits and reduced daily limits on crappie populations and fisheries in five large Missouri reservoirs. North American Journal of Fisheries Management 11:585-597.

Cook, M. F., J. A. Younk, and **D. H. Schupp.** 1997. An indexed bibliography of creel surveys, fishing license sales, and recreational surface use of lakes and rivers in Minnesota. Minnesota Department of Natural Resources, Investigational Report 455, St. Paul.

Cook, M. F., and **J. A. Younk.** 1998. A historical examination of creel surveys from Minnesota's lakes and streams. Minnesota Department of Natural Resources, Investigational Report 464, St. Paul.

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.

Costanza, R. 2000. Visions of alternative (unpredictable) futures and their use in policy analysis. Conservation Ecology 4(1):5. Available online: http://www.consecol.org/vol4/iss1/art5.

Dawson, C. P., and **B. T. Wilkins.** 1981. Motivations of New York and Virginia marine boat anglers and their preferences for potential fishing constraints. North American Journal of Fisheries Management 1:151-158.

Fedler, A. J., and **R. B. Ditton.** 1994. Understanding angler motivations in fisheries management. Fisheries 19(6):6-13.

Fisher, M. R. 1997. Segmentation of the angler population by catch preference, participation, and experience: a management-oriented application of recreation specialization. North American Journal of Fisheries Management 17:1-10.

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.

Fox, A. C. 1975. Effects of traditional harvest regulations on bass populations and fishing. Pages 392-398 *in* R. H. Stroud and H. Clepper, eds. Black bass biology and management. Sport Fishing Institute, Washington, D.C.

Gillis, D. M., R. M. Peterman, and **E. K. Pikitch.** 1995. Implications of trip regulations for high-grading: a model of the behavior of fisherman. Canadian Journal of Fisheries and Aquatic Sciences 52:402-415.

Goedde, L. E., and **D. W. Coble.** 1981. Effects of angling on a previously fished and an unfished warmwater fish community in two Wisconsin lakes. Transactions of the American Fisheries Society 110:594-603.

Hansen, M. J., M. D. Staggs, and **M. H. Hoff.** 1991. Derivation of safety factors for setting harvest quotas on adult walleyes from past estimates of abundance. Transactions of the American Fisheries Society 120:620-628.

Hess, T. B. 1991. The impact of daily creel limits on sport fish harvest in Georgia. Proceedings of the Annual Conference of Southeastern Fish and Wildlife Agencies 281-287.

Hilborn, R. 1985. Fleet dynamics and individual variation: why some people catch more fish than others. Canadian Journal of Fisheries and Aquatic Sciences 42:2-13.

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

Hummel, R. L., and **G. S. Foster.** 1986. A sporting chance: relationships between technological change and concepts of fair play in fishing. Journal of Leisure Research 18:40-52.

Hunt, K. M., and **R. B. Ditton.** 1997. The social context of site selection for freshwater fishing. North American Journal of Fisheries Management 17:331-338.

Hurlbert, S. H. 1984. Psuedoreplication and the design of ecological field experiments. Ecological Monographs 54:187-211.

Jacobson, P. C. 1994. Population dynamics of large walleye in Big Sand Lake. Minnesota Department of Natural Resources, Investigational Report 436.

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

Jensen, A. L. 1981. Optimal size limits for trout fisheries. Canadian Journal of Fisheries and Aquatic Sciences 38:657-661.

Johnson, B. M., and **P. J. Martinez.** 1995. Selecting harvest regulations for recreational fisheries: opportunities for research/management cooperation. Fisheries 20(10):22-29.

Larscheid, J. G. 1992. Contribution of stocked walleye and population dynamics of adult walleye in Spirit and East and West Okoboji lakes. Iowa Department of Natural Resources, Federal Aid in Sport Fish Restoration, Natural Lakes Investigations, Annual Performance Report, Project F-135-R, Study 2, Des Moines.

Li, Y., Y. Cohen, D. H. Schupp, and **I. R. Adelman.** 1996a. Effects of walleye stocking on population abundance and fish size. North American Journal of Fisheries Management 16:830-839.

_____. 1996b. Effects of walleye stocking on year-class strength. North American Journal of Fisheries Management 16:840-850.

Maceina, M. J., P. W. Bettoli, S. D. Finely, and **V. J. DiCenzo.** 1998. Analyses of the sauger fishery with simulated effects of a minimum size limit in the Tennessee River of Alabama. North American Journal of Fisheries Management 18:66-75.

McEwan, D. 1997. Customers, constituents, and the public trust. Fisheries 22(12):4.

Milon, J. W. 1991. Measuring the economic value of anglers' kept and released catches. North American Journal of Fisheries Management 11:185-189.

Miranda, L. E., and **W. Frese.** 1991. Can fishery scientists predict angler preferences. American Fisheries Society Symposium 12.

Mosindy, T. E., W. T. Momot, and **P. J. Colby.** 1987. Impact of angling on the production and yield of mature walleyes and northern pike in a small boreal lake in Ontario. North American Journal of Fisheries Management 7:493-501.

Munger, C. R., and **J. E. Kraai.** 1997. Evaluation of length and creel limits for walleyes in Meredith Reservoir, Texas. North American Journal of Fisheries Management 17:438-445.

Newman, S. P., and **M. H. Hoff.** 2000. Evaluation of a 16-inch minimum length limit for smallmouth bass in Pallette Lake, Wisconsin. North American Journal of Fisheries Management 20:90-99.

Noble, R. L., and **T. W. Jones.** 1993. Managing fisheries with regulations. Pages 383-404 *in* C. C. Kohler and W. A. Hubert, eds. Inland fisheries management in North America. American Fisheries Society, Bethesda, Maryland.

Olson, D. E., and **P. K. Cunningham.** 1989. Sport-fisheries trends shown by an annual Minnesota fishing contest over a 58-year period. North American Journal of Fisheries Management 9:287-297.

Patterson, D. L. 1952. The walleye population in Escanaba Lake, Vilas County, Wisconsin. Transactions of the American Fisheries Society 82:34-41.

Payer, R. D., D. L. Pereira, M. L. Larson, J. A. Younk, R. V. Frie, D. H. Schupp, and **T. C. Osborn.** 1987. Status and simulation model of Lake of the Woods, Minnesota, walleye fishery. Minnesota Department of Natural Resources, Investigational Report 389, St. Paul.

Pelton, J. Z. 1948. Three years of liberalized fishing at Lake Alma, Ohio. Transactions of the American Fisheries Society 78:64-69.

Petering, R. W., G. L. Isbell, and **R. L. Miller.** 1995. A survey method for determining angler preference for catches of various fish length and number combinations. North American Journal of Fisheries Management 15:732-735.

Pierce, R. B., C. M. Tomcko, and **D. H. Schupp.** 1995. Exploitation of northern pike in seven small north-central Minnesota lakes. North American Journal of Fisheries Management 15:601-609.

Porch, C. E., and **W. W. Fox, Jr.** 1991. Evaluating the potential effects of a daily creel limit from the observed frequency distribution of catch per fisher. American Fisheries Society Symposium 12:435-456.

Redmond, L. C. 1974. Prevention of overharvest of largemouth bass in Missouri impoundments. American Fisheries Society Special Publication 3:54-68.

_____. 1986. The history and development of warmwater fish harvest regulations. Pages 186-195 *in* G. E. Hall and M. J. Van Den Avyle, editors. Reservoir fisheries management: strategies for the 80's. American Fisheries Society, Bethesda, Maryland.

Renyard, T. S., and **R. Hilborn.** 1986. Sport angler preferences for alternative regulatory methods. Canadian Journal of Fisheries and Aquatic Sciences 43:240-242.

Richards, L. J. 1994. Trip limits, catch, and effort in the British Columbia rockfish trawl fishery. North American Journal of Fisheries Management 14:742-750.

Roedel, P. M., ed. 1975. Optimum sustainable yield as a concept in fisheries management. American Fisheries Society Special Publication 9.

Scalet, C. G., L. D. Flake, and **D. W. Willis.** 1996. Introduction to wildlife and fisheries: an integrated approach. W.H. Freeman and Company, New York.

Scarnecchia, D. L., P. A. Stewart, and **Y. Lim.** 1996. Profile of recreational paddlefish snaggers on the lower Yellowstone River, Montana. North American Journal of Fisheries Management 16:872-879.

Schill, D. J., and **P. A. Kline.** 1995. Use of random response to estimate angler noncompliance with fishing regulations. North American Journal of Fisheries Management 15:721-731.

Schill, D. J., and **R. L. Scarpella.** 1997. Barbed hook restrictions in catch-and-release trout fisheries: a social issue. North American Journal of Fisheries Management 17:873-881.

Schramm, H. L., Jr., and **J. A. Dennis.** 1993. Characteristics and perceptions of users and nonusers of an urban fishery program in Lubbock, Texas. North American Journal of Fisheries Management 13:210-216.

Serns, S. L., and **J. J. Kempinger.** 1981. Relationship of angler exploitation to the size, age, and sex of walleyes in Escanaba Lake, Wisconsin. Transactions of the American Fisheries Society 110:216-220.

Skinner, B. F. 1987. Upon further reflection. Prentice-Hall, Inc. Englewood Cliffs, New Jersey.

Smith, B. D. 1999. A probabilistic analysis of decision-making about trip duration by Strait of Georgia sport anglers. Canadian Journal of Fisheries and Aquatic Sciences 56:960-972.

Snow, H. E. 1982. Hypothetical effects of fishing regulations in Murphy Flowage, Wisconsin. Wisconsin Department of Natural Resources, Technical Bulletin 131, Madison.

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.

U.S. Department of the Interior, Fish and Wildlife Service and U.S. Department of Commerce, Bureau of the Census. 1997. 1996 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. Washington D.C.

Webb, M. A., and **R. A. Ott,** Jr. 1991. Effects of length and creel limits on population structure and harvest of white crappie in three Texas reservoirs. North American Journal of Fisheries Management 11:614-622.

Wingate, J. 1999. Should we change our approach to fish management? My personal opinion. Ryba: Newsletter of the Minnesota Chapter of the American Fisheries Society, September Issue. Available online: www.fw.umn.edu/mnafs/newsletters.