Minnesota Department of Natural Resources
Investigational Report 422, 1992

OPINIONS OF ANGLER GROUPS AND FISHERIES PROFESSIONALS IN MINNESOTA[1]

Paul K. Cunningham and Charles S. Anderson

Minnesota Department of Natural Resources
Section of Fisheries
500 Lafayette Road
St. Paul, Minnesota 55155-4012

Abstract.-The Minnesota Department of Natural Resources considers angler opinions in setting goals, choosing fish management activities, and in evaluating agency performance. Managers recognize that perspectives vary, yet they lack information on how anglers might respond to management activities or where perspectives differ. The Department therefore surveyed Minnesota resident anglers, nonresident anglers, two types of fishing club members, and fisheries professionals by mail in 1987 to compare angling motivations, opinions of fish management activities, and views of agency policies. Five angling motive components, seven fish management components, and four agency performance components were identified by principal component analyses. For resident anglers, motivations related to nature were strongest, those related to social, catch, and food aspects were less, and social-competitive motives were lowest. Opinions of resident anglers about fish management activities most supported resource protection, with decreasing levels of support for activities related to access, stocking inland, fish removal, stocking Lake Superior, harvest restrictions, and fish size. Groups differed on 14 of the 16 components. Anglers belonging to statewide or nationally chartered fishing clubs (i.e. Bass Federation, Muskies Incorporated, Federation of Fly Fishermen, Trout Unlimited, or Walleyes Unlimited) had relatively low food motives, and high catch and social-competitive motives. They favored resource protection, harvest restrictions, and management for quality-sized fisheries more than resident anglers. Club anglers identified as belonging to local fishing clubs had relatively high social-competitive motives, supported most management activity components slightly more than residents, but joined with other clubs in being most critical of agency performance. Nonresident anglers placed more importance on food and social-competitive aspects of angling than resident anglers did, but were otherwise similar. Fisheries professionals attached even more importance to resource protection than resident and nonresident anglers did, yet their opinions about harvest restrictions were similar to those of local fishing clubs, resident and nonresident anglers. Professionals had lower component scores than other groups on axes related to fish size, stocking Lake Superior, and fish removal. The identification of many differences among groups should guide conflict resolution efforts, educational plans, and moves to obtain representative public participation in the decision making process.

[1] This project was funded in part by the Federal Aid in Sport Fish Restoration (Dingell-Johnson) Program. Based on Completion Report, Study 667/313, D-J Project F-26-R Minnesota.

Introduction

Fisheries management decisions are becoming increasingly complex and controversial, and public interests are demanding a greater voice in decision making (Peyton 1985, 1987). In the past, agency goals were couched as vague calls for wise stewardship, and management decisions based on opinions of professionals were accepted. This allowed fisheries management to "focus on issues related to stock size and yield rather than on equally important issues such as the long-run costs, benefits, and social impacts of the regulatory controls developed to meet the yield or stock objectives" (Sylvia 1992). Hampton and Lackey (1975) described a disparity between the traditional objectives of fisheries management and the desires of anglers, and advocated using more human oriented objectives in fisheries planning rather than maximizing yield. Since Larkin (1977) summarized the inherent limitations of the maximum sustainable yield concept, more attention has been directed toward optimum sustainable yield, especially in recreational fisheries. A policy of optimum sustainable yield seeks to integrate biology, economics, allocation of catch, aesthetics, and other factors with a goal of maximizing social benefits while protecting fishery resources (Roedel 1975). To optimize yield and fairly allocate sport fishing opportunities among angling interests, management must understand the preferences of various interest groups and the values they place on different social objectives (Dror 1968; McFadden 1969; Talhelm and Libby 1987, Peyton and Gigliotti 1989; Sylvia 1992).

Fishing trip satisfaction is the principal product sought by recreational anglers. Satisfaction includes catch and noncatch components, and individuals use different styles or policies in evaluating their fishing experiences (Holland and Ditton 1992). Satisfaction depends on what motivations (or expectations) were important to the individual and what the experiences (or perceived outcomes) actually were (Spencer and Spangler 1992). Our first objective was to identify what Minnesota anglers were seeking, so we examined motivations without direct comparisons to satisfaction or experience. Another objective was to compare the views of organized interest groups (fishing clubs and fisheries professionals) to those of randomly sampled anglers. These groups span a wide range of levels of involvement in the political aspects of decisions in fisheries management. Decisions regarding resource allocations are ultimately political (Usher 1987) and fisheries management is under considerable influence by the clientele groups served (Culhane 1981; Clark and Kellert 1988). Anglers have been classified into groups based on specialization theory (Bryan 1977; Chipman and Helfrich 1988), psychological motives (Driver and Cooksey 1977), site and attributes preferences (Kikuchi 1986), fishing frequency (Renyard and Hilborn 1986), consumptive orientation (Ditton and Fedler 1984), or special interests (King et al. 1978; Loomis and Ditton 1987).

Growing angling pressure and technological advances have changed the size structure of many fish populations in Minnesota (Olson and Cunningham 1989), and contributed to conflicting demands from various angling groups. In Minnesota, management objectives are beginning to target the diverse demands of anglers (Buchanan et al. 1982). Fisheries managers acknowledge that anglers' motives and preferences vary, yet they lack social information to accommodate this diversity when making decisions (Voiland and Duttweiler 1984). Instead, managers rely on vague impressions of their clientele. Resource managers often communicate with members of clubs, however, views of other resident and nonresident anglers are heard less.

This study describes the angling motivations of various angling groups in Minnesota, and compares their views of fish management activities and agency performance with views of Minnesota Department of Natural Resource's fisheries professionals. We selected four groups of anglers--resident anglers, nonresident anglers, anglers

identified as belonging to local fishing clubs, and anglers belonging to statewide fishing clubs that are nationally chartered, and then conducted a mail survey to compare their views.

Methods

The Minnesota Department of Natural Resources contracted with Tri-College University's Center for Environmental Studies to conduct a statewide angling survey and tabulate results (Leitch and Baltezore 1987). The resident (RES) and nonresident (NONRES) survey samples were drawn at random from a representative population of 70,000 fishing licenses (carbon copies of one license from each book of licenses sold). Resident license addresses were stratified according to six geographic management regions. For resident anglers, random samples of 800 license addresses each were randomly drawn from the four rural regions (regions 1, 3, 4, and 5), and 2,000 licenses were randomly selected from each of the two urban regions (regions 2 and 6, which contain Duluth and the Twin Cities). Nonresident anglers account for 25 percent of the total licensed anglers in Minnesota (U.S. Fish and Wildlife Service 1989). For nonresidents, 1,000 license addresses were randomly drawn. Samples of Minnesota anglers belonging to nationally chartered fishing clubs were selected at random from membership lists provided by the clubs. These target-sampled club members (TSCLUB) consisted of 500 anglers belonging to the Bass Federation, Muskies Incorporated, Federation of Fly Fishermen, Trout Unlimited, or Walleyes Unlimited. Minnesota has over 425 sporting clubs or associations with interests in fisheries management activities (MN DNR, unpublished data). To obtain some measure of the opinions of these more local clubs, another group was identified post-hoc from the responses to resident random sample questionnaires (RSCLUB). This group consisted of 159 resident anglers who indicated they belonged to one or more fishing clubs, however, affiliations of the RSCLUB respondents were not identified. Surveys were also sent to 107 fisheries professionals employed by the Minnesota Department of Natural Resources.

A short cover letter in the initial mailing asked anglers for their involvement and provided information about why the survey was being conducted. The survey questioned anglers about their angling motives, methods and modes of angling, fish species sought, their opinions of fish management activities and agency performance, and socio-demographic information. Most questions required responses on a seven point Likert type scale (Likert 1967). Three mailings were sent to resident and nonresident anglers, two to TSCLUB members, and two to DNR fisheries professionals. Response rates for resident anglers, nonresident anglers, TSCLUB anglers, and the DNR were 34, 49, 51, and 88%, respectively.

We selected 23 survey questions as variables for classifying anglers motivations (Table 1). We chose 26 questions to describe fisheries management activities (Table 2), and 14 to represent agency performance (Table 3). Questionnaires that were missing responses for an entire section were removed from the sample. Remaining missing values were replaced with variable means (Babbie 1989). This resulted in useable questionnaires from 1,926 residents, 392 nonresidents, 229 TSCLUB members, 159 RSCLUB members, and 98 DNR professionals.

For each topic (i.e. motivations, fish management activities, and performance) a principal component analysis (PCA) identified groups of questions that were redundant, allowing answers to be summarized by a smaller set of component scores amenable to interpretation. Principal component analysis is a multivariate procedure which identifies the best linear combination of variables that accounts for the most variance in the data set. The number of components to retain was determined by initially removing components with eigenvalues below 1.0, examining scree plots of variance explained

by successive components, and considering interpretability of the loading variables (Kikuchi 1986; Wilkinson 1987). PCA based on the correlation matrix was followed by a varimax rotation to produce high or low eigenvector coefficients for each component (Nie et al. 1975). The resulting breaks between high and low coefficients simplify description of each component. Responses from all anglers and DNR professionals were used to describe the PCA solution for fish management and agency policy topics. Responses of DNR fisheries professionals were excluded from PCA of angling motivations as we had no reason to compare the recreational motivations of DNR employees to the other groups.

PCA scores from motivation, management, and performance analyses were then compared across angler groups. Significance or angling group effects was tested by nonparametric analysis of variance. A Kruskal-Wallis test, a nonparametric multiple comparisons procedure (Wilkinson 1987), was calculated to test differences between scores of specific angling groups, and Bonferoni adjustments controlled the overall error rate at $P < 0.05$ independent of the number of multiple comparisons (Wilkinson 1987). Four comparisons between specific angling groups were of interest: RES-NONRES, RES-TSCLUB, RES-RSCLUB, and TSCLUB-RSCLUB. Opinions of nonresidents are heard least of all groups, so we contrasted their opinions to those resident anglers. RSCLUB and TSCLUB members were contrasted to RES anglers to test whether angling motives and

Table 1. Statements to identify angler motivations.

STATEMENT	KEYWORDS
I fish so I can....[a]	
be with family members or friends	FAMILY-FRIENDS
be alone	ALONE
compete with my friends who fish	COMPETE
be around a lot of other anglers	CROWD
use my fishing equipment	EQUIPMENT
be with people who are enjoying themselves	SOCIALIZE
learn about nature	LEARN NATURE
relax	RELAX
catch food for my family	FOOD
get exercise	EXERCISE
enjoy nature and the outdoors	OUTDOORS
catch a trophy	TROPHY
share my skills and knowledge with others	SHARE SKILLS
meet new people	MEET OTHERS
think about my personal values	CONTEMPLATIVE
be in a quiet and peaceful place	PEACEFUL
How important is...[b]	
catching fish	CATCHING FISH
catching a particular kind of fish	KIND OF FISH
catching at least one fish	ONE FISH
the size of fish you catch	FISH SIZE
catching your limit	LIMITS
catching more than one different kind of fish	DIVERSITY
catching some fish to eat	MEAL

[a] Possible responses were strongly disagree, disagree, slightly disagree, neutral, slightly agree, agree, or strongly agree.
[b] Possible responses were very unimportant, unimportant, somewhat unimportant, doesn't matter, slightly important, important, or very important.

Table 2. Statements to identify opinions of fish management activities.

MANAGEMENT ISSUE	KEYWORDS
The Minnesota Section of Fisheries should....[a]	
provide more public access	MORE ACCESS
improve existing public accesses	IMPROVE ACCESS
designate catch and release lakes and streams	CATCH-RELEASE
designate catch and release lakes and streams in my area	CATCH-RELEASE MY AREA
put more emphasis on crappie and sunfish management	MORE SUNFISH
reduce the walleye limit to prevent overfishing	REDUCE WALLEYE LIMIT
manage lakes to have many fish though the average size would be smaller	MANY FISH
manage lakes to have big fish thought the number caught would be less	BIG FISH
It is my understanding that....[b]	
stocking walleye in a lake to increase walleye populations is	STOCK WALLEYE
using size limits to protect fish populations is	SIZE LIMITS
using catch and release regulations to increase walleye size is	CATCH-RELEASE WALLEYE
prohibiting dark house spearing of northern pike to protect large pike is	SPEARING
reducing the walleye limit from 6 to 2 in order to increase the walleye catch rate is	WALLEYE LIMIT 6-2
stocking heavily fished brown trout streams to maintain trout fishing success is	STOCK BROWNS
stocking heavily fished rainbow trout streams to maintain trout fishing success is	STOCK RAINBOWS
removing rough fish in a lake to increase harvest of game fish is	ROUGHFISH REMOVAL
managing shoreline to protect fish spawning sites is	SPAWNING SITES
using nets to reduce sunfish numbers and increase their size is	NET SUNFISH
removing bullheads to improve fishing for other species is	BULLHEAD REMOVAL
using conservation programs to reduce soil erosion to improve fishing is	CONSERVE SOIL
controlling wetland drainage to improve fishing is	CONSERVE WETLAND
Stocking walleye in natural bass lakes will not decrease angler catch of bass[a]	WALLEYE VS BASS
Stocking northern pike in a natural walleye lake will decrease the catch of walleye[a]	PIKE VS WALLEYE
Salmon stocking in Lake Superior should be[c]	SALMON STOCKING
Steelhead stocking in Lake Superior should be[c]	STEELHEAD STOCKING
Lake trout stocking in Lake Superior should be[c]	LAKE TROUT STOCKING

[a] Strongly disagree, disagree, slightly disagree, neutral, slightly agree, agree, or strongly agree.

[b] Very ineffective, ineffective, somewhat ineffective, neither, somewhat effective, effective, or very effective.

[c] greatly reduced, reduced, somewhat reduced, maintained at present level, somewhat increased, increased or greatly increased.

Table 3. Statements to measure opinions of agency performance. Possible responses ranged from strongly disagree to strongly agree, as in Table 1.

POLICY ISSUE	KEYWORDS
The Minnesota DNR Section of Fisheries....	
should have more authority	MORE AUTHORITY
should have less authority	LESS AUTHORITY
listens to anglers concerns	LISTENS
responds to anglers concerns	RESPONDS
manages fisheries for tourists	TOURISTS
manages fisheries for local residents	LOCALS
manages fisheries for special interests	SPECIAL INTERESTS
needs more funding to do a better job	MORE FUNDING
does not need more funding to do a better job	NO MORE FUNDING
is doing as good a job as neighboring states	NEIGHBORING STATES
adequately manages Minnesota's fishing waters	ADEQUATELY
should allow greater angler participation in making fisheries decisions	PARTICIPATION
should encourage more nonresident anglers to fish in Minnesota	MORE NONRESIDENTS
should charge special fees on certain waters and for certain types of fishing	SPECIAL FEES

management views of fishing clubs differ from the general public. Opinions of TSCLUB and RSCLUB members were contrasted to test whether angling motives and management views related to club affiliation. In addition, management and performance component scores of DNR professionals were compared to those from each angler-group.

Results

Angling Motivations

Responses indicate anglers participate in fishing for various reasons. Most fish to enjoy nature and the outdoors, escape their daily routine, and relax. Non-catch statements such as "I fish so I can enjoy nature and the outdoors," "I fish so I can relax," and "I fish so I can be in a quiet and peaceful place" ranked highest and displayed the lowest standard deviations (Table 4). Anglers were less concerned with "catching many kinds of fish" and "catching their limit." In turn, anglers tend to be less interested in a competitive, crowded atmosphere. The statements "be around a lot of other anglers" and "compete with my friends who fish" ranked lowest among the angler motivation statements. Variables with lower importance or agreement ratings generally had higher standard deviations.

Five principal components best described associations among angling motivations and accounted for 54% of variance in the data. The five components describe nature, catch, social-competitive, food, and social aspects of angling motivation (Table 5).

The five statements which most influence the first principal component were: "enjoy nature and the outdoors, be in a peaceful and quiet place, relax, learn about nature," and "think about my personal values." Since most variables related to nature and outdoors, factor(1) was labeled **nature**. After varimax rotation, **nature** accounted for 12.5% of the variance in the data.

Five catch-related statements--"catching fish, the size of fish you catch, catching a particular kind of fish, catching at least one fish," and "catching your limit"--influenced the second principal component, so we labeled it the **catch** component. It accounted for 13.2% of the variance in the data.

The third component was labeled **social-competitive** because statements associated with social aspects of fishing techniques and competitive angling influenced it. The social-competitive component summarizes responses to "meet new people," "compete with my friends who fish," "share my skills and knowledge with others," "be around a lot of other anglers," "catch a trophy," and "use my fishing equipment." The **social-competitive** scores accounted for 13.3% of the variance in the data.

The fourth factor was called the **food** component and accounted for 8.5% of the variance. The two statements with greatest weight were "catch food for my family" and "catching some fish to eat." "Exercise," "catching more than one different kind of fish," and "catching your limit" also correlated with the food component, though their loadings were less than 0.50.

Because statements had explicit connection to the companionship of other friends or family members, the fifth motivational component was classified as the **social** component. The three statements with greatest weight were "be alone" (negative coefficient), "be with family members or friends," and "be with people who are enjoying themselves." The **social** component accounted for 6.4% of the variance in the data. The social factor lacked descriptors about angling or a competitive atmosphere, consequently it was distinctly different from the social-competitive component.

Group comparisons.--We found significant angler group effects across all five angling motivation components ($P \leq 0.05$;

Table 4. Relative importance of angling motives, in order of responses by resident anglers. The number of responses to statements ranged from 1,900-1,926 for residents, 388-392 for nonresidents, 157-159 for random sample club members (RSCLUB), and 224-229 for target sample club members (TSCLUB).

	ANGLING GROUP							
	RESIDENTS		NONRESIDENTS		RSCLUB		TSCLUB	
KEYWORDS[a]	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
OUTDOORS	6.31	0.91	6.30	0.96	6.45	0.86	6.45	0.75
RELAX	6.29	0.86	6.18	1.06	6.33	0.82	6.24	0.93
PEACEFUL	6.17	1.00	6.13	1.04	6.23	1.00	6.18	1.04
FAMILY-FRIENDS	5.58	1.44	5.70	1.28	5.53	1.56	5.28	1.50
ONE FISH	5.48	1.52	5.54	1.60	5.31	1.66	5.81	1.20
SOCIALIZE	5.41	1.44	5.48	1.35	5.52	1.39	5.32	1.44
CATCHING FISH	5.39	1.38	5.42	1.52	5.34	1.36	5.71	1.20
LEARN NATURE	5.37	1.35	5.36	1.30	5.65	1.25	5.69	1.25
KIND OF FISH	4.95	1.50	5.06	1.48	5.36	1.45	5.98	1.09
MEAL	4.93	1.61	5.28	1.56	4.80	1.66	3.40	1.91
FISH SIZE	4.89	1.38	4.98	1.42	4.99	1.50	5.49	1.22
CONTEMPLATIVE	4.67	1.58	4.65	1.48	5.04	1.55	4.94	1.60
EQUIPMENT	4.67	1.68	4.89	1.60	5.07	1.72	5.19	1.55
FOOD	4.60	1.72	4.59	1.62	4.59	1.80	3.38	1.89
SHARE SKILLS	4.49	1.62	4.72	1.54	5.12	1.49	5.32	1.44
TROPHY	4.49	1.84	4.47	1.78	5.11	1.83	5.14	1.75
EXERCISE	4.32	1.71	4.41	1.63	4.73	1.57	4.25	1.79
ALONE	4.21	1.90	3.90	1.86	4.46	1.96	4.93	1.77
MEET OTHERS	4.23	1.61	4.58	1.55	4.88	1.54	4.71	1.59
LIMIT	3.86	1.56	4.12	1.60	3.89	1.61	3.49	1.80
DIVERSITY	3.81	1.55	4.25	1.60	3.85	1.64	3.58	1.76
COMPETE	3.37	1.85	3.47	1.84	3.90	2.00	3.83	2.06
CROWD	2.85	1.66	3.09	1.68	3.20	1.86	3.31	1.88

[a] Scale of responses; 1-strongly disagree or very unimportant, 2-disagree or unimportant, 3-slightly disagree or somewhat unimportant, 4-neutral or no opinion, 5-slightly agree or slightly important, 6-agree or important, 7-strongly agree or very important.

Table 5. Coefficients of angling motive components. The most heavily weighted variables contributing to each component are in bold. Percent of total variance explained by nature, catch, social-competitive, food, and social were 12.5, 13.2, 13.3, 8.5, and 6.4, respectively. Together they explain 54% of the total variance.

	Principal Component				
KEYWORDS	NATURE	CATCH	SOCIAL-COMPETITIVE	FOOD	SOCIAL
OUTDOORS	**0.756**	0.102	-0.022	-0.002	0.091
PEACEFUL	**0.750**	0.027	-0.008	0.060	-0.089
RELAX	**0.690**	0.071	-0.064	0.012	0.171
LEARN NATURE	**0.621**	-0.019	0.241	0.077	0.067
CONTEMPLATIVE	**0.536**	-0.081	0.347	0.108	-0.251
CATCHING FISH	0.017	**0.798**	-0.037	0.126	0.071
FISH SIZE	0.035	**0.758**	0.140	0.030	-0.086
KIND OF FISH	0.087	**0.753**	0.154	-0.031	-0.109
ONE FISH	0.054	**0.729**	-0.045	0.089	0.085
LIMIT	-0.156	**0.513**	0.210	0.451	0.029
MEET OTHERS	0.200	-0.037	**0.717**	0.128	0.086
COMPETE	-0.169	0.119	**0.659**	0.021	-0.004
SHARE SKILLS	0.285	0.101	**0.657**	0.061	-0.011
CROWD	-0.220	-0.009	**0.653**	0.067	0.135
TROPHY	0.108	0.307	**0.561**	-0.058	-0.122
EQUIPMENT	0.130	0.038	**0.541**	0.109	0.127
FOOD	0.131	-0.045	0.078	**0.799**	-0.008
MEAL	0.018	0.361	-0.095	**0.738**	0.120
ALONE	0.272	0.018	0.110	0.029	**-0.665**
FAMILY-FRIENDS	0.242	0.011	0.162	0.068	**0.662**
SOCIALIZE	0.314	-0.037	0.389	0.027	**0.597**
EXERCISE	0.288	-0.137	0.352	0.478	-0.122
DIVERSITY	-0.040	0.399	0.199	0.486	0.026

Table 6). Resident anglers differed from TSCLUB members across all angling benefit components.

The **nature** component was most similar across angler groups, reflecting the near consensus on the original statements (Table 4). Nature scores differed significantly in only one comparison; TSCLUB members valued nature even higher than RES anglers ($P \leq 0.05$; Table 6).

Catch scores differed significantly in two comparisons. TSCLUB members placed more importance on catch aspects of angling than RES anglers and RSCLUB members ($P \leq 0.05$; Figure 1). Catch scores for resident anglers were similar to those of NONRES anglers and RSCLUB members.

Social-competitive scores differed significantly in three of the four comparisons (Table 6). TSCLUB and RSCLUB members placed more importance than RES anglers on catching a trophy, sharing knowledge and skills with others, and competing with friends while fishing. The mean social-competitive score of TSCLUB members was highest, followed by RSCLUB, NONRES, and RES anglers (Figure 1). This was the only motivation component where RES angler and RSCLUB member scores differed ($P \leq 0.05$). Mean scores of TSCLUB and RSCLUB members were not different ($P=0.218$).

For the **food** component, we found significant differences between mean scores in three of the four comparisons. Nonresi-

Table 6. Tests of differences among groups for their principal component scores for angling motivations, fish management, and agency performance. Kruskal-Wallis, nonparametric multiple comparisons of 16 principal component scores for resident anglers (RES), nonresident anglers (NONRES), target sampled club anglers (TSClub), randomly sampled club anglers (RSClub), and DNR fisheries professionals. Significant differences among comparisons are shown in bold. The first column of probabilities, entitled ALL, are tests for a significant group effect (Kruskal-Wallis, ANOVA) at 0.05 error level. Bonferoni adjustments were used to control an overall error rate of multiple comparisons at 0.05; thus, critical error rates for angler-motive components were set at 0.013 (four multiple comparisons), and critical error rates for management issues and agency policy were set at 0.006 (8 multiple comparisons).

PRINCIPAL COMPONENT	ALL	RES VS NONRES	RES VS TSCLUB	RES VS RSCLUB	TSCLUB VS RSCLUB	RES VS DNR	NONRES VS DNR	TSCLUB VS DNR	RSCLUB VS DNR
FOOD	**0.000**	**0.001**	**0.000**	0.254	**0.000**				
SOCIAL	**0.000**	0.023	**0.000**	0.042	**0.007**				
NATURE	**0.002**	0.054	**0.008**	0.052	0.680				
CATCH	**0.000**	0.013	**0.000**	0.862	**0.000**				
SOCIAL-COMPETITIVE	**0.000**	**0.004**	**0.000**	**0.000**	0.218				
PROTECT RESOURCE	**0.000**	**0.000**	**0.000**	**0.000**	0.025	**0.000**	**0.003**	0.663	0.029
HARVEST RESTRICTIONS	**0.000**	0.018	**0.000**	0.296	**0.000**	0.427	0.050	**0.000**	0.982
FISH SIZE	**0.000**	0.041	**0.000**	0.171	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
ACCESS	**0.013**	0.084	0.615	0.013	0.093	0.132	0.026	0.355	0.536
STOCKING INLAND	0.427	0.539	0.213	0.523	0.205	0.183	0.410	0.726	0.154
STOCKING SUPERIOR	**0.000**	**0.000**	0.016	0.035	0.956	**0.003**	0.505	**0.000**	**0.000**
FISH REMOVAL	**0.000**	0.977	0.013	0.753	0.166	**0.000**	**0.000**	**0.000**	**0.000**
OTHER INTERESTS	0.256	0.840	0.482	0.715	0.862	0.037	0.036	0.030	0.078
RESPONSIVE	**0.015**	0.046	0.785	0.544	0.624	**0.003**	0.096	**0.002**	0.061
FUNDING-AUTHORITY	**0.000**	0.650	**0.000**	0.009	**0.000**	**0.000**	**0.000**	**0.001**	**0.000**
PERFORMANCE	**0.000**	**0.001**	**0.000**	**0.000**	0.946	**0.000**	**0.000**	**0.000**	**0.000**

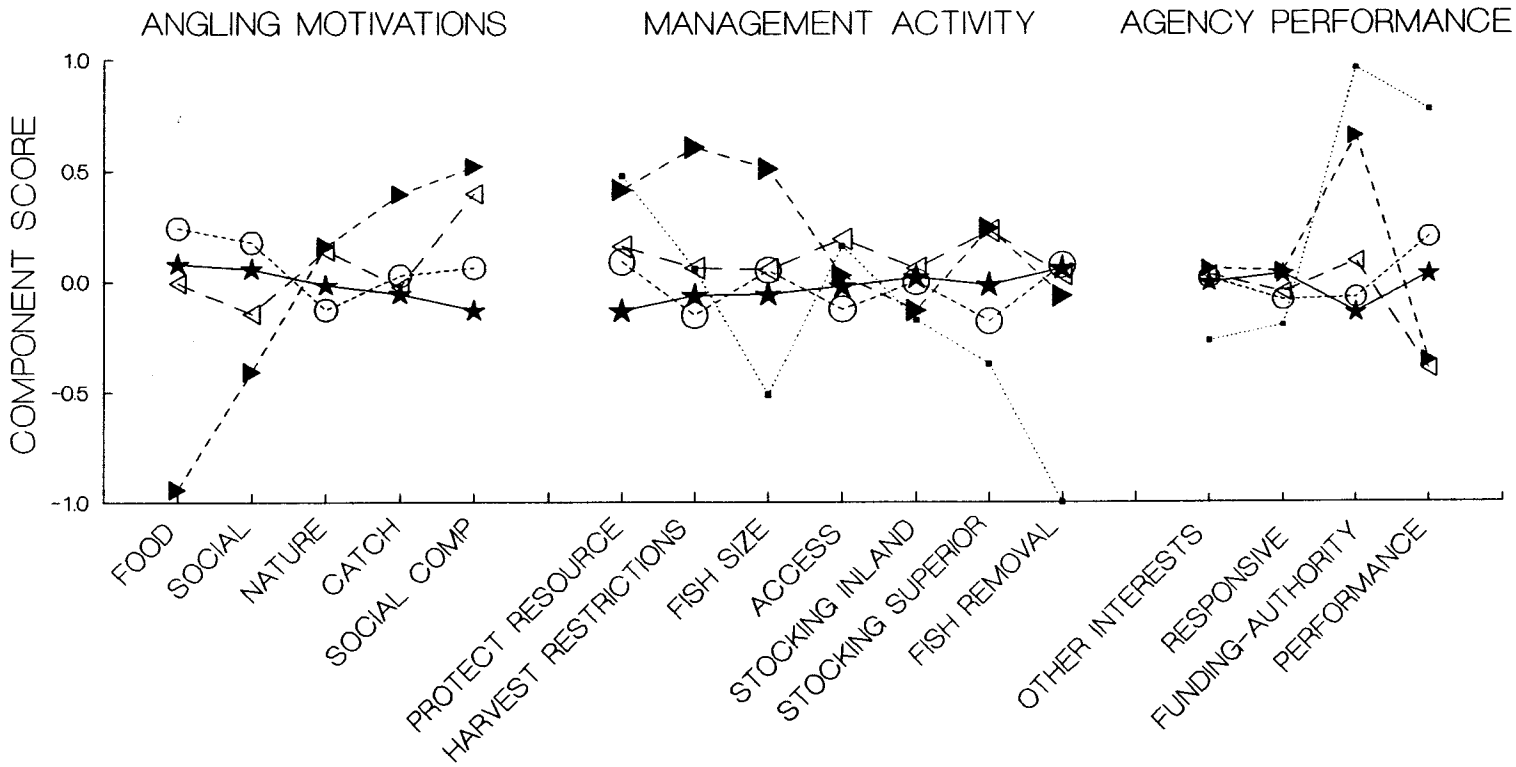

Figure 1. Relative scores of angling groups on angling motivation, fish management activity, and agency performance components. Each component has a mean = 0.0 and s = 1.0. ■ = DNR, ○ = NONRES, ▶ = TSCLUB, ★ = RESIDENT, and ◁ = RSCLUB angler groups.

dents valued catching fish for food the most (Figure 1). Mean food scores of RES anglers and RSCLUB members were similar ($P=0.254$), and both placed more value on food aspects of fishing than TSCLUB members ($P \leq 0.05$). TSCLUB members' mean score for the food component was the most negative value found among motive components for all angling groups (Figure 1).

Group rankings for the **social** component were nearly opposite those of the **social-competitive** component. NONRES anglers placed the most importance to the social component, followed by RES, RSCLUB, and TSCLUB anglers (Figure 1). Social scores for RES anglers were not significantly different from scores among NONRES and RSCLUB anglers, while TSCLUB members had significantly lower scores than RES and RSCLUB anglers (Table 6).

Fish Management Issues

Angler responses approached consensus on some management issues. For example, environmental resource protection measures such as managing shoreline habitat to protect spawning sites, soil erosion control, and wetland conservation were all highly valued as effective ways to improve fishing (Table 7). Stocking walleye in lakes to increase walleye populations, using size limits to protect fish populations, improving access facilities, and rough fish removal were other approaches that anglers viewed favorably. Anglers unfavorably viewed management for "lakes to have many fish though their average size would be smaller." Nonetheless, anglers somewhat disagreed with specific harvest reduction proposals such as "reduce the walleye limit to prevent overfishing," "reducing the walleye limit from six to two in order to increase walleye catch rate," and "designating catch and release lakes and streams in my area."

Seven composite fisheries management issues were identified by PCA and accounted for 54.5% of the variance. Statements with high loadings showed the composite issues related to harvest restrictions, stocking Lake Superior, protecting resources, access, stocking inland waters, fish removal, and fish size (Table 8).

The **harvest restrictions** component reflected similarities in answer to statements such as "designate catch and release lakes in my area," "reduce the walleye limit to prevent overfishing, designate catch and release lakes and streams," and "reducing the walleye limit from six to two in order to increase walleye catch rate." This component accounted for 9.7% of the variance. "Using catch and release regulations to increase walleye size" and "prohibiting dark house spearing of northern pike to protect large pike" were two statements that also contributed to this component, though their loadings were less than 0.50 (Table 8).

The second factor contained three statements which related to stocking levels of steelhead, salmon, and lake trout in Lake Superior. This component accounted for 9.4% of the total variance in the data and was appropriately labeled **stocking Superior**.

The **protect resource** component summarized three statements related to controlling wetland drainage, conservation of soil erosion, and managing shoreline to protect fish spawning sites. The protect resource component accounted for 8.5% of the total variance.

Two statements weighing the **access** component were "improve existing accesses" and "provide more public access." The public access component explained 6.2% of the total variance.

The **stocking inland** component was associated with three statements--"stocking walleye in a lake to increase walleye populations," "stocking heavily fished brown trout streams to maintain trout fishing success," and "stocking heavily fished rainbow trout streams to maintain trout fishing success." This component explained 7.7% of the total variance.

The **fish removal** factor was associated with removing rough fish or bullheads to improve fishing, and netting to reduce sun-

Table 7. Relative effectiveness of fish management activities, in order of responses by resident anglers. The number of responses to statements ranged from 1,898-1,926 for residents, 388-391 for nonresidents, 157-159 for random sample club members, 224-229 for target sample club members, and 97-98 for DNR employees.

	ANGLING GROUP									
	RES		NONRES		RSCLUB		TSCLUB		DNR	
KEYWORDS[a]	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
SPAWNING SITES	5.69	1.31	5.74	1.33	5.91	1.28	6.23	1.08	5.98	1.05
STOCK WALLEYES	5.50	1.26	5.72	1.23	5.75	1.19	5.26	1.33	5.04	1.23
SIZE LIMITS	5.47	1.34	5.50	1.44	5.72	1.32	5.97	1.10	4.91	1.33
CONSERVE SOIL	5.44	1.38	5.64	1.37	5.74	1.37	6.08	1.08	6.08	0.87
IMPROVE ACCESS	5.29	1.48	5.09	1.56	5.50	1.48	5.27	1.47	5.32	1.14
ROUGHFISH REMOVAL	5.23	1.53	5.28	1.58	5.41	1.52	5.40	1.38	2.93	1.62
CONSERVE WETLAND	5.23	1.48	5.46	1.48	5.54	1.45	5.86	1.25	5.85	0.97
CATCH-RELEASE WALLEYE	5.10	1.52	5.08	1.46	5.31	1.47	5.78	1.27	5.01	1.21
MORE ACCESS	4.99	1.77	4.88	1.71	5.31	1.77	5.12	1.67	5.33	1.41
STOCK RAINBOWS	4.78	1.34	4.62	1.26	4.82	1.30	4.74	1.49	4.99	1.42
SPEARING	4.76	1.86	5.10	1.80	4.82	1.96	5.95	1.62	3.86	1.56
BULLHEAD REMOVAL	4.64	1.63	4.54	1.74	4.74	1.68	4.49	1.52	2.91	1.56
STOCK BROWNS	4.58	1.32	4.51	1.21	4.54	1.26	4.56	1.59	4.55	1.47
CATCH-RELEASE	4.54	1.80	4.50	1.70	5.05	1.81	5.91	1.52	4.98	1.60
LAKE TROUT STOCKING	4.51	1.07	4.30	0.87	4.74	1.26	4.60	1.25	4.35	1.11
SALMON STOCKING	4.51	1.10	4.34	0.90	4.76	1.27	4.78	1.30	3.95	1.19
STEELHEAD STOCKING	4.44	1.08	4.31	0.85	4.71	1.25	4.85	1.31	3.95	0.97
PIKE VS WALLEYE	4.23	1.58	4.08	1.58	3.98	1.71	3.94	1.68	5.06	1.30
MORE SUNFISH	4.25	1.74	4.36	1.67	4.39	1.93	4.13	1.69	5.13	1.63
WALLEYE VS BASS	4.25	1.41	4.36	1.37	4.45	1.60	4.17	1.66	3.74	1.60
NET SUNFISH	4.22	1.46	4.35	1.55	4.37	1.57	4.22	1.56	2.79	1.61
BIG FISH	4.00	1.67	4.10	1.76	4.08	1.80	4.82	1.69	4.28	1.39
CATCH-RELEASE, MY AREA	3.97	1.82	3.90	1.49	4.40	1.97	5.28	1.70	4.40	1.79
WALLEYE LIMIT 6-2	3.73	1.87	3.56	1.90	3.55	1.98	4.11	1.85	3.54	1.77
MANY FISH	3.54	1.71	3.47	1.77	3.60	1.90	2.77	1.61	3.43	1.50
REDUCE WALLEYE LIMIT	3.53	1.92	3.27	1.89	3.56	2.11	4.08	1.85	2.97	1.53

[a] Scale of responses: 1 strongly disagree or very ineffective, 2 disagree or ineffective, 3 slightly disagree or somewhat ineffective, 4 neutral or neither, 5 slightly agree or slightly effective, 6 agree or effective, 7 strongly agree or very effective.

Table 8. Coefficients of fisheries management activity components. The most heavily weighted variables contributing to each components are in bold. Percent of total variance explained by harvest restrictions, stocking Superior, protect resource, access, inland stocking, fish removal, and fish size were 9.7, 9.4, 8.5, 6.2, 7.7, 7.1, and 5.7, respectively. Together they explain 54.3% of the total variance.

	PRINCIPAL COMPONENT						
KEYWORDS	HARVEST RESTRICTIONS	STOCKING SUPERIOR	PROTECT RESOURCE	ACCESS	STOCKING INLAND	FISH REMOVAL	FISH SIZE
CATCH-RELEASE, MY AREA	**0.734**	0.028	0.118	0.054	-0.036	-0.143	0.118
REDUCE WALLEYE LIMIT	**0.678**	0.028	-0.083	-0.101	-0.103	0.113	-0.118
CATCH-RELEASE	**0.670**	0.056	0.178	0.098	0.002	-0.145	0.191
WALLEYE LIMIT 6-2	**0.650**	-0.064	-0.127	-0.130	0.077	0.211	-0.104
SALMON STOCKING	0.017	**0.901**	0.037	0.045	0.075	0.018	0.018
STEELHEAD STOCKING	0.015	**0.899**	0.064	0.037	0.083	0.017	0.080
LAKE TROUT STOCKING	0.025	**0.868**	0.068	0.032	0.112	-0.006	-0.022
CONSERVE WETLAND	0.047	0.042	**0.847**	0.026	0.015	0.083	-0.036
CONSERVE SOIL	0.031	0.018	**0.840**	-0.014	0.045	0.141	-0.027
SPAWNING SITES	0.099	0.026	**0.592**	0.066	0.195	0.221	0.072
IMPROVE ACCESS	-0.027	0.028	0.045	**0.867**	0.047	0.035	-0.002
MORE ACCESS	-0.036	0.038	-0.003	**0.867**	-0.006	0.039	-0.028
STOCK BROWNS	0.106	0.091	0.005	-0.008	**0.776**	0.123	-0.227
STOCK RAINBOWS	0.056	0.108	0.093	0.035	**0.756**	0.181	-0.205
STOCK WALLEYE	-0.122	-0.009	0.166	0.070	**0.560**	0.089	0.155
BULLHEAD REMOVAL	0.001	0.014	0.127	0.044	0.037	**0.771**	0.024
NET SUNFISH	0.075	0.030	0.106	-0.032	0.081	**0.721**	0.005
ROUGH FISH REMOVAL	-0.017	0.054	0.197	0.101	0.211	**0.637**	0.136
MANY FISH	0.040	0.027	-0.020	0.013	0.131	-0.043	**-0.708**
BIG FISH	0.276	0.028	-0.055	0.006	-0.052	0.193	**0.532**
SIZE LIMITS	0.313	-0.001	0.299	0.029	0.415	0.023	0.421
CATCH-RELEASE WALLEYE	0.479	-0.031	0.263	0.016	0.355	-0.055	0.384
SPEARING	0.399	0.032	0.236	-0.033	0.076	0.186	0.205
WALLEYE VS BASS	-0.093	0.094	-0.044	-0.070	0.193	-0.025	0.112
PIKE VS WALLEYE	-0.003	0.123	-0.055	-0.028	-0.015	0.068	-0.093

fish numbers and increase their size. The fish removal component accounted for 7.1% of the total variance.

Two primary statements most influencing the **fish size** component were "manage lakes to have many fish though the average size would be smaller" (negative loading), and "manage lakes to have big fish though the number caught would be less." The statement "using size limits to protect fish populations" contributed to this component, though its loading coefficient was less than 0.50. The fish size component explained 5.7% of the total variance.

Group comparisons.--We found significant differences among three of the four angler-group comparisons for the protect resource component (Table 6). Resident anglers valued the resource protection component least ($P \leq 0.05$; Figure 1). DNR fisheries professionals appraised the protect resource component similarly to RSCLUB and TSCLUB members ($P=0.663$ and $P=0.029$). The mean score of NONRES anglers was between those of club members and RES anglers.

Comparisons among harvest restriction scores indicate TSCLUB members placed a greater emphasis on restricting harvest than any other group (Figure 1). None of the comparisons among RES, NONRES, RSCLUB, and the DNR were significantly different (Table 6).

Comparisons of the component scores for fish size between the angler groups showed a pattern similar to that of harvest restriction scores. TSCLUB members stressed management for fish size rather than numbers caught; size scores did not differ between RES, NONRES, and RSCLUB groups (Figure 1). Fish size scores for DNR professionals were much lower than all other groups ($P \leq 0.05$; Figure 1).

In general, angler-groups had similar views regarding public access, inland stocking, Lake Superior stocking, and fish removal. Of the 16 multiple comparisons on these components, only one was significant (Table 6). Resident anglers viewed increased stocking of trout and salmon in Lake Superior more positively than nonresident anglers. DNR fisheries professionals viewed increased stockings for Lake Superior, particularly for steelhead and salmon, significantly less favorably than resident anglers or either type of club members (Table 6). Of all management techniques considered, DNR fisheries professionals most doubted the effectiveness of fish removal (i.e. bullheads, rough fish, and sunfish) to improve fishing. Here, DNR component scores were much lower than all the other angler-groups (Figure 1). No DNR-angler group differences were found for access and stocking inland components.

Agency Policy

Fourteen statements examining policies of the Minnesota Department of Natural Resources are listed in Table 9 in order of resident angler level of agreement. Anglers agreed most with statements the DNR Section of Fisheries...."listens to anglers concerns," "responds to anglers concerns," and "should allow greater angler participation in making fisheries decisions." Anglers least agreed with charging fees on special fishing waters, giving the DNR less authority, and the statement "does not need more funding to do a better job."

PCA of the agency policy questions identified four components, or groups of questions which individuals tend to view similarly. Statements with high component loadings show components measured opinion on areas of funding-authority, responsiveness, performance, and other interests (Table 10).

The **funding-authority** component was defined by statements "The Minnesota DNR Section of Fisheries...should have less authority, ...should have more authority, ...needs more funding to do a better job, and ...does not need more funding to do a better job." It accounted for 17.7% of the total variance.

Three statements, "The Minnesota DNR Section of Fisheries...responds to anglers concerns, ...listens to anglers concerns, and

Table 9. Relative evaluation of agency performance, in order of responses by resident anglers. The number of responses to statements ranged from 1,916-1,925 for residents, 388-391 for nonresidents, 158-159 for random sample club members, 226-229 for target sample club members, and 97-98 for DNR employees.

	ANGLING GROUP									
	RES		NONRES		RSCLUB		TSCLUB		DNR	
KEYWORDS[a]	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD	MEAN	SD
LISTENS	5.29	1.57	5.17	1.56	5.08	1.78	5.36	1.57	5.69	1.15
PARTICIPATION	5.18	1.46	5.05	1.44	5.55	1.36	5.24	1.55	3.53	1.61
RESPONDS	5.06	1.59	4.96	1.51	4.94	1.74	5.19	1.57	5.33	1.23
LOCALS	4.92	1.62	4.73	1.52	4.87	1.78	4.99	1.64	4.62	1.50
ADEQUATELY	4.41	1.68	4.55	1.53	3.89	1.72	3.99	1.66	4.97	1.32
NEIGHBORING STATES	4.49	1.64	4.74	1.58	4.05	1.83	4.04	1.83	5.69	1.37
TOURISTS	4.51	1.61	4.54	1.60	4.44	1.78	4.70	1.56	4.29	1.75
MORE AUTHORITY	4.19	1.72	4.26	1.48	4.51	1.81	5.25	1.52	5.37	1.43
MORE FUNDING	4.20	1.88	4.37	1.64	4.52	2.00	5.29	1.67	5.74	1.54
SPECIAL INTERESTS	4.07	1.80	3.91	1.67	4.13	1.94	4.01	1.88	4.26	1.94
MORE NONRESIDENTS	3.94	1.92	4.78	1.60	3.79	1.96	4.15	1.87	4.20	1.44
NO MORE FUNDING	3.74	1.99	3.71	1.74	3.34	2.10	2.69	1.82	2.22	1.67
LESS AUTHORITY	3.44	1.63	3.45	1.40	3.42	1.75	2.55	1.37	2.03	1.26
SPECIAL FEES	2.85	1.88	2.76	1.69	3.00	2.02	3.43	2.13	3.37	1.84

[a] Scale of responses: 1 strongly disagree or very ineffective, 2 disagree or ineffective, 3 slightly disagree or somewhat ineffective, 4 neutral or neither, 5 slightly agree or slightly effective, 6 agree or effective, 7 strongly agree or very effective.

Table 10. Coefficients of agency performance components. The most heavily weighted variables contributing to each component are in bold. The percent of total variance explained by funding-authority, responsive, performance, and other interests were 17.7, 15.7, 11.9, and 9.7, respectively. Together they explain 55% of the total variance.

	PRINCIPAL COMPONENT			
KEYWORDS	FUNDING-AUTHORITY	RESPONSIVE	PERFORMANCE	OTHER INTERESTS
MORE FUNDING	**0.819**	0.094	0.028	0.064
NO MORE FUNDING	**-0.787**	-0.038	0.025	0.032
MORE AUTHORITY	**0.730**	0.167	0.071	0.077
LESS AUTHORITY	**-0.686**	-0.169	-0.109	0.070
RESPONDS	0.126	**0.881**	0.111	-0.047
LISTENS	0.139	**0.862**	0.086	-0.091
LOCALS	0.105	**0.663**	0.072	0.197
NEIGHBORING STATES	0.047	0.124	**0.838**	0.064
ADEQUATELY	0.025	0.196	**0.828**	0.128
SPECIAL INTERESTS	-0.004	-0.223	-0.052	**0.753**
TOURISTS	0.084	0.141	0.036	**0.740**
PARTICIPATION	-0.262	0.191	-0.447	0.313
MORE NONRESIDENTS	0.088	0.080	0.160	0.233
SPECIAL FEES	0.231	-0.004	0.054	0.100

...manages fisheries for local residents" loaded on the second component. This component was therefore named **responsive**, and accounted for 15.7% of the total variance.

The third principal component measures **performance**, since the two loading variables were "The Minnesota DNR Section of Fisheries... adequately manages Minnesota's fishing waters, and ...is doing as good a job as neighboring states." The performance component contributed 11.9% to the total variance.

The fourth principal component was associated with two statements related to managing fisheries for special interests or tourists. This component accounted for 9.7% of the variance and was labeled **other interests**.

Group comparisons.--Angler-groups differed in responses on performance and funding-authority components (Table 6). TSCLUB and RSCLUB members gave significantly lower evaluations of DNR Fisheries performance than resident anglers did ($P \leq 0.05$). In spite of this, TSCLUB members were more apt to support greater funding and authority for the Section of Fisheries (Figure 1). Predictably, DNR fisheries professionals rated their performance and needs for more funding and authority higher than any of the angler groups ($P \leq 0.05$; Figure 1). No significant differences were found among groups on policy components measuring other interests or agency responsiveness.

Discussion

The results of this and other similar studies should be used by the DNR Section of Fisheries to establish priorities, gain informed consent, and explain program rationale, for there were many differences of opinion between professionals and other groups to be reconciled. The results may also prompt anglers to recognize the variety of their motives and demands, turning attention toward common problems and cooperative solutions. Opportunities for cooperation

are easily identified in the near consensus on importance of environmental resource protection through management of shoreline, spawning site protection, soil erosion control, and wetland conservation.

The way anglers are categorized will influence conclusions about differences between groups. The most common typologies are based on recreational specialization (Bryan 1977) or on various statistical methods; we have used elements of each. Bryan (1977) and Chipman and Helfrich (1988) suggested the recreational specialization of anglers can be described as a series of categories starting as novice and generalist anglers, then becoming technique specialists, and then becoming technique-setting specialists. The theory was formalized by Ditton et al. (1992) in a set of hypotheses linking recreational specialization to level of dependency on specific resources, sources of information, support for rules, and other aspects of social worlds. We were influenced by this theory in our decision to survey target clubs that exchanged information statewide and focused on particular species or fishing methods, believing that comparison to other clubs and general resident anglers would allow description of the full spectrum of views. We also statistically examined the areas of consensus and variation within the large group of resident anglers in detail, for there was considerable variation within this key group. Of our study groups, TSCLUB members appeared most specialized because they fished more frequently (Leitch and Baltezore 1987), were more competitive, placed more emphasis on catch, equipment, and skills, placed less emphasis on family experience and consumptive aspects of angling, supported restrictive regulations, and had joined statewide clubs. RSCLUB anglers appeared more specialized than RES anglers because they placed greater importance on social-competitive settings and fish size, and had joined some club.

Quinn (1992) characterized walleye angler subgroups as differing in many ways, including relationship to management agencies, economic impacts, and potential effects on walleye populations. Because walleye were the species most often targeted by Minnesota anglers (Leitch and Baltezore 1987), Quinn's typology of occasional anglers, generalist anglers, tourist anglers, lake residents, walleye specialists, and professional walleye anglers summarizes much of the variation in people so often lumped as the 'general public.' Still, anglers belonging to fishing clubs or special interest groups often have different angling motivations and preferences than the general public (King 1978; Loomis and Ditton 1987). Saltwater tournament anglers had higher catch-related motives than other saltwater anglers, although non-catch motivations were similar (Loomis and Ditton 1987). In our study, resident anglers and TSCLUB members (i.e. anglers belonging to Bass Federation, Muskies Incorporated, Federation of Fly Fishermen, Trout Unlimited or Walleyes Unlimited) differed across all catch and non-catch angling motives.

The questionnaire return rate from resident anglers was lower than for targeted club or DNR samples, a potential source of bias in the RES responses. Avid anglers would be more likely than occasional anglers to answer a long questionnaire, so any non-response bias may have reduced the variance in RES responses and reduced any differences between RES and RSCLUB or TSCLUB means. RES responses spanned a wide range of ages, incomes, and species sought (Leitch and Baltezore 1987), so they should still identify both areas of consensus and the important components where opinions vary.

Several DNR respondents said questions about effectiveness of management activities were too general, that each activity was effective in some situations and ineffective in others, and that they judged effectiveness against what they thought the public would accept. This would tend to reduce the variance in DNR responses. As the DNR moves toward developing strategic management plans based on the ecological classification of lakes or streams rather than on single fish species, it will be necessary for

the agency to identify and explain what it considers effective and ineffective methods for various environmental situations. Some areas were especially problematic.

Minnesota anglers placed highest value on nature in their motivations for angling, yet the various angler groups differed from DNR fisheries professionals by rating some other fish management activities as effective as habitat conservation efforts. They diverge more in their evaluation of DNR performance. The variation in what groups consider effective management activities and the low club evaluations of DNR performance reflect a fundamental failure of the DNR to explain its fish management activities. This failure should be corrected, since conservation is the focus of the DNR Fish and Wildlife Division mission statement, and habitat conservation was rated far more effective than other activities by fisheries professionals.

Anglers who prize the opportunity to catch a trophy and also place a high value on consumption bear unrealistic expectations. Size-structures of most game fish species in many Minnesota waters are declining, presenting an increasing problem for anglers seeking larger fish (Olson and Cunningham 1989). Expectations of RSCLUB members will therefore be most difficult to satisfy because this group values both consumptive and social-competitive aspects of angling. Catching a trophy was an important variable in the social-competitive dimension. In contrast to RSCLUB members, TSCLUB anglers' high catch and social-competitive motives coincided with low food consumptive motives. The secondary motivations for angling appeared to influence how groups judged the effectiveness of management activities. TSCLUB members were most supportive of management by harvest restriction and of designating more catch and release lakes or streams, thus the management tools that would satisfy this group are easy to identify and may help reach their objectives. RES anglers are not a homogeneous group; principal components summarized the consistent patterns of variation in this largest group. Even among Minnesota trout stream anglers, people using different gear and people of different ages place different values on fish size (Wiechman 1990).

The strength of food consumption motivations appeared to limit the fish management activities that groups could support, as groups ranked harvest restrictions or management for large fish size in the reverse order of their food motivation ranks. TSCLUB anglers appeared more willing than other groups to accept greater harvest restrictions in order to manage fish populations for larger size-structures. Their lower interest in retaining a catch for food may explain why TSCLUB members view increased harvest regulations favorably, though anglers may retain catches for reasons other than food. Likewise, lower food consumption motives of TSCLUB members perhaps result from their understanding of how harvest affects their opportunity to catch the larger fish they value. Nonresident, resident, and RSCLUB anglers placed higher values on food aspects of their fishing experience, therefore they may view restrictions in harvest as more limiting to their own angling opportunities.

Fisheries managers face a dilemma in trying to satisfy diverse expectations while maintaining understandable and effective angling regulations that anglers will endorse. The optimal regulations will depend on what social values are held, and regulations will fail to meet objectives if anglers change behavior in unexpected ways (Sylvia 1992). Most Minnesota resident anglers (61%) perceived a decline in fish sizes over the previous 10 years (Leitch and Baltezore 1987). Whether the public and the profession are willing to endorse and implement changes that affect personal angling behavior remains uncertain. Indeed, the views of fisheries professionals toward harvest restrictions and fish size issues reflect this uncertainty. Fisheries professionals were generally neutral on harvest restriction issues, as were other groups except TSCLUB members. Professionals appeared

to place less importance on management for larger-sized fish than other groups (Figure 1), however this score was deceptive. Fisheries professionals actually valued management for big fish more than RSCLUB members, resident, and nonresident anglers. Fisheries professionals rated the effectiveness of "using size limits to protect fish populations" much less than the angler groups did, thereby producing an unusually low fish size component score.

Past experiences have made professionals skeptical about the abilities of angling regulations to change size-structures for many fish populations (Kempinger and Carline 1977, 1978; Snow 1982; Austen and Orth 1988). Angler non-compliance and its potential effects may also contribute to professionals' skepticism about regulations (Glass 1984; Gigliotti and Taylor 1990). Perhaps DNR professionals view harvest restrictions more as a tool for protecting fish populations, rather than a prospective tool for managing characteristics of size-structure to suit the desires of different anglers. DNR professionals may also underestimate anglers' preferences for large fish. Miranda and Frese (In Press) compared preferences of Mississippi anglers with fishery scientists' predictions of angler preferences, and found predictions of fisheries scientists to be opposite of actual preferences of resident anglers with regard to size and catch-rate questions. Mississippi anglers more often preferred catching large fish at slow rates rather than small fish at fast catch rates.

The divergent opinions of angler groups concerning food consumption, harvest restrictions, and size-structure suggest angling regulations will become an increasingly important and controversial issue. To account for different demands and the variety of lakes and streams in Minnesota, a wider variety of regulations must be considered. Liberal harvest regulations may be maintained on many fisheries to provide opportunities for anglers who value retaining a meal of fish. Elsewhere, regulations other than traditional bag or size limits may be used to improve or maintain size-structures for larger fish. Maximum-size limits, slot limits, and season possession tags may offer a balance between anglers who desire food aspects of angling and others who want opportunities to catch larger fish. Opening additional seasons with no harvest or other special regulations may help satisfy the demand of avid anglers, while having little effect on fish populations.

Fisheries professionals need to demonstrate where lake or stream specific management and regulations are required to protect sensitive resources or to satisfy diverse sport fishing demands. The DNR must also inform anglers about the limitations of using size-limits to improve size-structures of fish populations, especially where lakes differ in productivity, and where fish populations differ in natural mortality rates.

Differences of opinions concerning stocking levels and rough fish removal may be a problems of the DNR's own creation. For many years rough fish removal was the largest program in the Section of Fisheries, but use has been essentially eliminated because managers learned it did not help the sport fishery in most lakes. Stocking is now the second largest program and managers are learning about where it does not work. DNR respondents were nearly neutral on questions of increased stocking of trout and salmon in Lake Superior, while both club members and resident anglers slightly supported it. There was no indication anglers identified a conflict over which species should be stocked in Lake Superior. Angler groups were similar in their views of inland stocking, however, anglers were more apt to credit stocking as an effective way to increase walleye populations than fisheries professionals. DNR employees viewed rough fish removal as somewhat ineffective for improving fishing quality, whereas anglers perceived it as beneficial.

Management Implications

In part because of this study, the Section of Fisheries has hosted two Fishing Roundtables, meetings of fishing stakehold-

ers, to form a common vision for the future of fishing in Minnesota, and to improve communication and cooperation. The Roundtable has reached a critical period of moving from communication to action.

Managers must recognize the variety of angler opinions, and identify specific pathways to improve communication and cooperation at their local level. The Section of fisheries is developing strategic plans that place more emphasis on designing lake or stream management plans that are appropriate, or environmentally sustainable, based on the ecological classification of the habitat. Anglers strongly support many conservation efforts, so managers should build on this base by discussing with anglers where and why certain management activities may be considered appropriate. Regulation changes are especially volatile issues because regulations directly effect angler behavior, and because angler opinions about effectiveness differ markedly from those of professionals. More effective ways to solicit opinions from occasional or general anglers are needed.

References

Austen, D.J., and D.J. Orth. 1988. Evaluation of a 305-mm minimum-length limit for smallmouth bass in the New River, Virginia and West Virginia. North American Journal of Fisheries Management 8:231-239.

Babbie, E. 1989. The practice of social research. Wadsworth Publishing Company, Belmont, California.

Bryan, H. 1977. Leisure value systems and recreational specialization: The case of trout fishermen. Journal of Leisure Research 9:174-187.

Buchanan, T., D.A. Warder, M.A. Collins, and G. Phillips. 1982. Assessing the benefits of special fisheries management. Pages 58-63 *in* W.W. Lime, editor. Forest and river recreation: research update. University of Minnesota Agriculture Experiment Station, St. Paul.

Chipman, B.D., and L.A. Helfrich. 1988. Recreational specializations and motivations of Virginia River Anglers. North American Journal of Fisheries Management 8:390-398.

Clark, T.W., and S.R. Kellert. 1988. Toward a policy paradigm of the wildlife sciences. Renewable Resources Journal 6:7-16.

Culhane, P.J. 1981. Public lands politics: interest group influences on the Forest Service and Bureau of Land Management. John Hopkins University Press, Baltimore, Maryland.

Ditton, R.B., and A.J. Fedler. 1984. Preferences of urban anglers. Pages 55-63 *in* L.J. Allen, editor. Urban Fishing Symposium Proceedings. American Fisheries Society, Fisheries Management Section and Fisheries Administrators Sections, Bethesda, Maryland.

Driver, B., and R.W. Cooksey. 1977. Preferred psychological outcomes of recreational fishing. Pages 27-40 *in* R.A. Barnhard and T.D. Roelofs, editors. Catch-and-release fishing as a management tool: a national sport fishing symposium. Humboldt State University, Arcata, California.

Dror, Y. 1968. Public policy making reexamined. Chandler Press, San Francisco, California.

Gigliotti, L.M., and W.W. Taylor. 1990. The effect of illegal harvest on recreational fisheries. North American Journal of Fisheries Management 10:106-110.

Glass, R.D. 1984. Angler compliance with length limits on largemouth bass in an Oklahoma reservoir. North American Journal of Fisheries Management 4:457-459.

Hampton, E.L., and R.T. Lackey. 1976. Analysis of angler preferences and fisheries management objectives with implications for management. Proceedings of the Annual Conference of the Southeastern Association of Game and Fish Commissioners 29:310-316.

Holland, S. M., and R. B. Ditton. 1992.

Fishing trip satisfaction: a typology of anglers. North American Journal of Fisheries Management 12:28-33.

Kempinger, J.J., and R.F. Carline. 1977. Dynamics of the walleye (*Stizostedion vitreum*) population in Escanaba Lake, Wisconsin, 1955-72. Journal of the Fisheries Research Board of Canada 34:1800-1811.

Kempinger, J.J., and R.F. Carline. 1978, Changes in population density, growth, and harvest of northern pike in Escanaba Lake after implementation of a 22-inch size limit. Wisconsin Department of Natural Resources, Technical Bulletin 104, Madison.

Kikuchi, H. 1986. Segmenting Michigan's sport fishing market: Evaluation of two approaches. Doctoral dissertation. Michigan State University, East Lansing.

King, T.P., R.R. Thompson, and J.C. Buntz. 1978. Comparison of attitudes of average fishermen and fishing club members. Proceedings of the Annual Conference of Southeast Fish and Wildlife Agencies 32:657-665.

Larkin, P.A. 1977. An epitaph for the concept of maximum sustained yield. Transactions of the American Fisheries Society 106:1-11.

Leitch, J.A., and J.F. Baltezore. 1987. Attitudes of Minnesota anglers. Minnesota Department of Natural Resources, Division of Fish and Wildlife, Final Project Report, St. Paul.

Likert, R. 1967. The method of construction an attitude scale. Pages 90-95 *in* M. Fishbein, editor. Readings in attitude theory and measurement. John Wiley and Sons, Inc., New York.

Loomis, D.K., and R.B. Ditton. 1987. Analysis of motive and participation differences between saltwater sport and tournament fishermen. North American Journal of Fisheries Management 7:482-487.

McFadden, J.T. 1969. Trends in freshwater sport fisheries of North American Transactions of the American Fisheries Society 98:136-150.

Miranda, L.E., and W. Frese. In press. Can fishery scientists predict angler preferences? American Fisheries Society Symposium 0:000-000.

Nie, N.H., C.H. Hull, J.G. Jenkins, K. Steinbrenner, and D.H. Bent. 1975. Statistical Package For Social Sciences. 2nd Edition, McGraw-Hill Inc., New York.

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

Peyton, R.B. 1985. A typology of natural resource issues with implications for resource management and education. Michigan Academician 18:49-58.

Peyton, R.B. 1987. Mechanisms affecting public acceptance of resource management policies and strategies. Canadian Journal of Fisheries and Aquatic Sciences 44:306-312.

Peyton, R.B., and L.M. Gigliotti. 1989. The utility of sociological research: a re-examination of the East Matagorda Bay experience. Fisheries (Bethesda) 14:5-8.

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

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

Roedel, P.M. 1975. A summary and critique of the symposium on optimum yield. American Fisheries Society Special Publication 9:79-89.

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.

Sylvia, G. 1992. Concepts in fisheries management: interdisciplinary gestalts and socioeconomic policy models. Society and Natural Resources 5:115-133.

Talhelm, D.R., and L.W. Libby. 1987. In search of a total value assessment framework: SAFR symposium overview and synthesis. Transactions of the American Fisheries Society 116:293-301.

U.S. Fish and Wildlife Service. 1989. 1985 national survey of fishing, hunting, and wildlife-associated recreation, Minnesota. U.S. Department of Interior, Washington, D.C.

Usher, A.J. 1987. Ontario Lake of the Woods Fishery: Economic and social analysis. Transactions of the American Fisheries Society 116:352-366.

Voiland, M.P., and M.W. Duttweiler. 1984. Where's the humanity? A challenge and opportunity for the fisheries community. Fisheries (Bethesda) 9(4):10-12.

Wiechman, J. D. 1990. Evaluation of fishing quality indices and sizes of brown trout preferred by anglers in southeast Minnesota. Minnesota Department of Natural Resources, Section of Fisheries, Investigational Report 403, St. Paul.

Wilkinson, L. 1987. Systat: The system for statistics. Systat, Inc., Evanston, Illinois.