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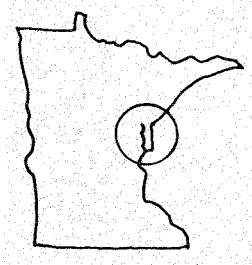

Minnesota's First Wild River- Its Use and User Preferences

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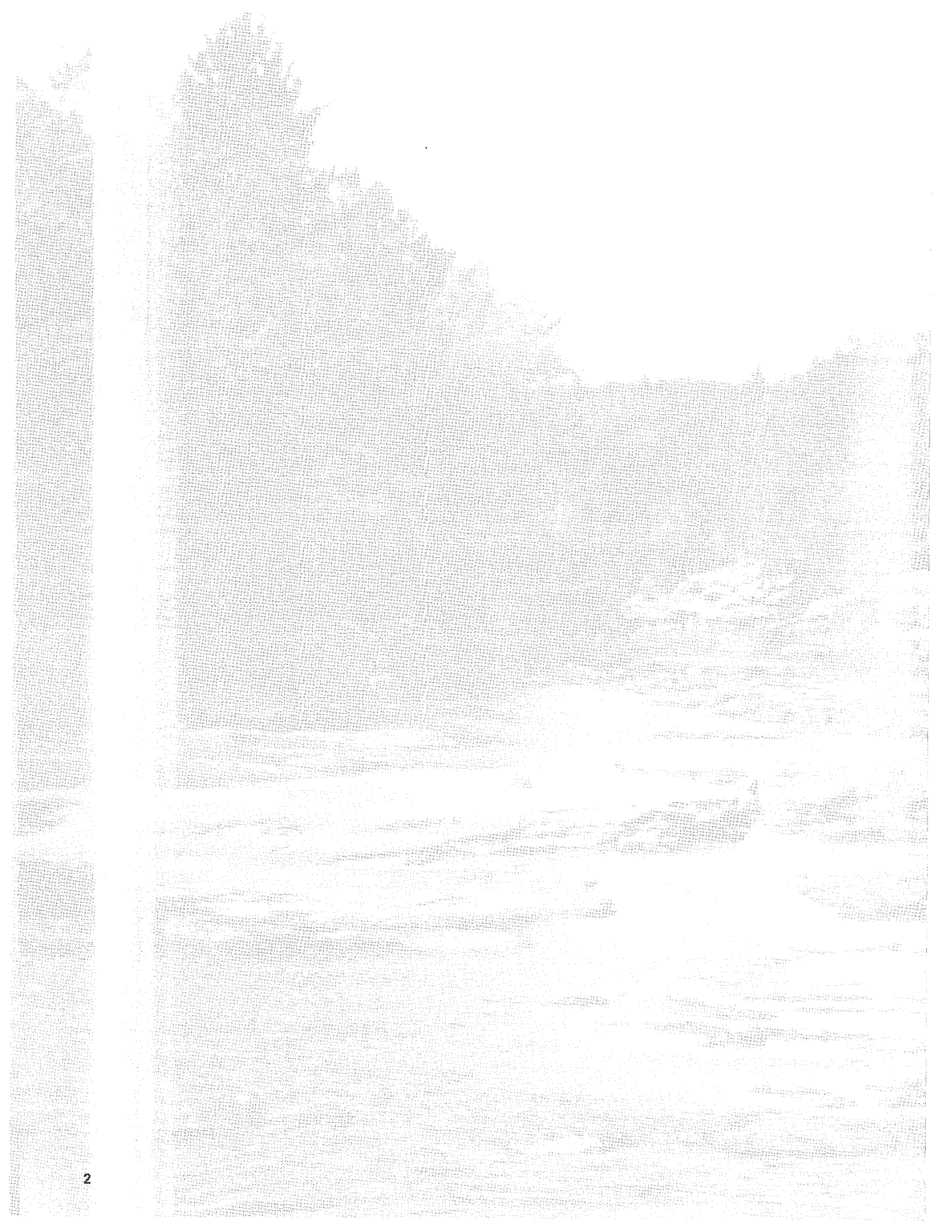

CONTENTS

THE KETTLE—MINNESOTA'S FIRST WILD RIVER—ITS USE AND USER PREFERENCES

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ABSTRACT

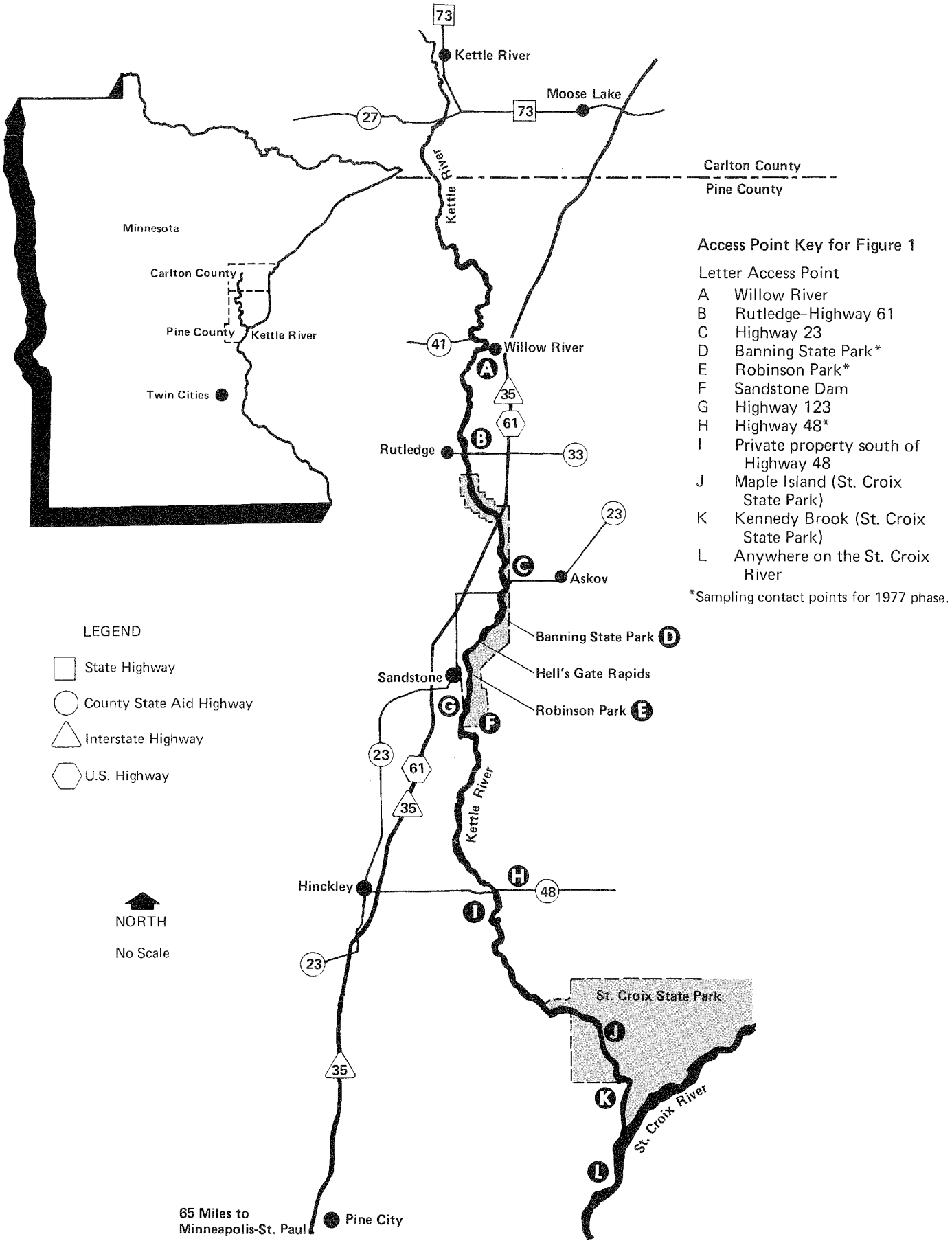
A three-year study of the recreational use of the Kettle River in Minnesota culminated in the application of a refined survey questionnaire and sampling system in 1977. Use patterns are described in simple, graphic terms to facilitate comparisons. Use was segmented with local and motorboat use concentrated near major access points. User preferences were measured by the desirability of specific, concrete elements in the river environment. Cluster analysis revealed several "packages" of elements which correlated according to desirability. This type of analysis is a first step in determining which elements belong together in the sense of providing for the needs of different user groups. Concrete, unambiguous definitions of recreational environments can help to reduce user conflicts and can improve the public involvement component of the land use planning process.

Preface

The authors wish to acknowledge the assistance and support of many persons in connection with this study. First, we thank the many interviewees who kindly gave of their time and knowledge in providing study data. Dr. Dave Lime of the U.S. Forest Service, North Central Forest Experiment Station, reviewed this manuscript and his organization supported the original study in 1975 and 1976.

Michael Priesnitz and the staff of the rivers section of the Department of Natural Resources provided helpful data and guidance as did other parks and recreation division personnel—particularly at Banning State Park and St. Croix State Park. The City of Sandstone staff helped with historical data and Jeff Kirwan, Ray Norrgard, Dr. Mike Loesch, and Dr. Leo McAvoy assisted with interviewing. Dr. Merle Meyer and the University of Minnesota Remote Sensing Laboratory provided aerial photography of the study area.

Our grateful thanks to all these people and to the Cooperative States Research Service, USDA, North Central Forest Experiment Station, Dean R. A. Skok, College of Forestry, University of Minnesota, and Director Keith Huston of the University of Minnesota Agriculture Experiment Station for making study funds available.



Access Point Key for Figure 1

Letter	Access Point
A	Willow River
B	Rutledge–Highway 61
C	Highway 23
D	Banning State Park*
E	Robinson Park*
F	Sandstone Dam
G	Highway 123
H	Highway 48*
I	Private property south of Highway 48
J	Maple Island (St. Croix State Park)
K	Kennedy Brook (St. Croix State Park)
L	Anywhere on the St. Croix River

*Sampling contact points for 1977 phase.

Purpose

The purpose of this study was not merely to describe the use of the Kettle River and the preferences of those who used the river. The investigators also attempted to develop techniques which would facilitate a comparison of use and preferences over time, space, and different groups of people. In addition, we sought results which could be readily translated into planning and management objectives.

Many river studies—indeed most outdoor recreation research efforts—have been deficient in this respect. For example, the response items provided in most questionnaires are often quite ambiguous and require several levels of inference in order to derive management guidelines. This is not due to a deliberate or accidental oversight; it is very difficult to develop meaningful terms which will elicit the same mental image for every respondent. Even a concept as basic as occupancy of recreational areas has been clouded by the use of measurement units which are only appropriate for certain types of use and situations.

The Kettle River study was designed to avoid these deficiencies as much as possible; first by utilizing response items which represent specific, concrete elements of the environment. Second, use, or occupancy, was recorded in sufficient detail so that it could be summarized in a meaningful way. The resulting measures were used to compare some easily identified groups. In the future these measures can be used to compare the Kettle with other rivers and the Kettle in 1977 with the use of the river in other years.

River Recreation and the Kettle River of Minnesota

River recreation has become increasingly popular in Minnesota. One of the streams offering particularly attractive opportunities is the Kettle River in Pine and Carlton counties—Minnesota's first wild and scenic river designated under the 1973 State Legislative Act.

Located 100 miles north of the Minneapolis-St. Paul metropolitan area, the Kettle River is 79 miles long with a total fall of 484 feet. (Figure 1). It originates in cultivated agricultural land, flows through stretches of sandstone gorge, and joins the St. Croix River in a somewhat remote river bottom forest. In effect, a central two-mile rapids (Hell's Gate Rapids) breaks the stream into three use zones.

The Hell's Gate Rapids is well known as a challenging white water run, while the zones above and below offer intermittent rapids with opportunities for solitude, fishing, and related activities. All river activities are influenced by water levels fluctuating with rainfall and snowmelt. The optimal use season is generally from April through June.

Historical records indicate that the Kettle River has been used for boating and fishing by Minnesotans for more than 100 years and prior to that by Native Americans. Following the Civil War the river was used extensively for log drives in connection with timber harvesting and milling. Sandstone quarrying operations commenced along its banks in the 1880's giving rise to the river towns of Sandstone and Banning. A hydroelectric power dam was put in below Sandstone prior to 1910. These activities affected river use. Apparently, there was some running of the tricky, white water rapids (Hell's Gate) before 1900. In the 1930-50 period there were small river parks near Askov and east of Hinckley. In recent years the city of Sandstone created a river park at the site of the old quarry.

The upper Kettle is characterized by towns and active farms adjoining the river. Interstate 35 (between Duluth and the Twin Cities) crosses the river 31 miles above its confluence with the St. Croix River. The lower portion passes through two state parks, a game refuge, and a state forest, and is relatively wild with limited access. The banks of the river are heavily forested with hardwoods (maple, ash, elm on the flood plain, aspen, birch, and, oak on higher ground) with associated jack, Norway, white pine, and black spruce. Forest cover extends to the river edge enclosing it in many places. A combination of existing public ownership, and perhaps the river's relationship to the St. Croix (a federal Wild and Scenic River), encouraged interest in its classification as a Minnesota Wild and Scenic River under the responsibility of the Department of Natural Resources in 1975.

In recent years the Hell's Gate Rapids above Sandstone have become popular with white water canoeists and kayakists, particularly from the Twin Cities. Sections of the river above and below the rapids provide good canoeing, boating, and fishing. Heavy rains can cause a rise in the river in late summer with a resurgence of canoe, kayak, and other uses, while fishing continues at most levels, but drops off during the heat of the summer.

SUMMARY OF INVESTIGATIONS AND METHODS

This study was originally undertaken in 1975 and 1976 to obtain baseline information useful for river management and to contribute to survey techniques for other United States recreation rivers. It was refined and intensified in 1977, building on earlier results. Principal study objectives focused on determining: 1) patterns of river use, and, 2) users preferences and satisfaction. In addition, supplementary data on user characteristics and attitudes toward management alternatives were collected. Financial support for the study came from a cooperative-aid grant to the College of Forestry from the USDA, Forest Service, North Central Forest Experiment Station, and from McIntire-Stennis Cooperative Forestry Research funds.

Because this was the first detailed study of Kettle River users, it began with a reconnaissance of the river, activity on the river, and contact with local residents in 1975. This provided the basis for the 1976 procedures which included river craft user interviews, mailback

questionnaires, bank user interviews, a mail survey of members of the Minnesota Canoe Association, the collection of river level and weather data, observation, and aerial photo counting. Results in 1976 were limited due partly to low river water levels (Merriam, Knopp, 1977). In 1977, effort was concentrated on weekend user interviews and the distribution of questionnaires at three principal access points during the April to July use period. A sampling scheme derived from the experience gained in 1976 maximized the number of contacts which could be obtained with the personnel and resources available. The questionnaire solicited four types of information: 1) trip characteristics; 2) user preferences and satisfaction; 3) user experience; and 4) user characteristics.

In addition to obtaining baseline data on the Kettle River we were also interested in comparing local (Pine county) users and those residing at greater distances from the river, particularly the Twin Cities metropolitan area. Previous investigations conducted by the College of Forestry, University of Minnesota, compared the attitudes of local residents in northern Minnesota to those of visitors and potential visitors from distant communities (Mills, 1976; Merriam, 1973; Losech, 1977). In 1977, emphasis was placed on comparing Pine County Kettle River visitors, use patterns, perceptions, and satisfaction with those of visitors from greater distances, especially the Twin Cities. Table 1 is a summary of objectives, methods, and principal findings from 1975 to 1977. A detailed description of the methods utilized in each phase of the study is contained in Appendix A. Appendices B and C are the survey instruments utilized in the 1977 phase.

RESULTS AND DISCUSSION OF 1977 DATA

User Characteristics

The tables in Appendix D present data showing characteristics of Kettle River users contacted during the study. The data is further broken down into three origin groups: Pine County, metro region and other Minnesota residents. Census data (1970) from the State of Minnesota are provided for comparison. The tables should be self-explanatory and the importance of differences between groups can be judged by the reader. We will direct your attention to a few of the more significant findings.

The preponderance of metro residents is not surprising when one considers the relative sizes of the populations, the accessibility of the Kettle and the unique opportunities provided by the river. These figures help to define the character of the conflict be-

Table 1. Summary of principal findings—1975-1977 Kettle River study.

Year	Objectives	Activity and Location	Principal Results
1975	Obtain information useful for river management. Study use patterns. Monitor river use.	River reconnaissance. Use of self-registration box at four locations.	General information on river users. Returns limited by vandalism of registration boxes. Bank users engage in many activities. These vary with segments of the river. Use seemed to be concentrated in time and place, varying with river level and season.
1976	Baseline data, watercraft and bank user characteristics, perceptions, count of use. Interviews of river users to determine attitudes toward river management, satisfaction and perceptions.	May 15 - September 15. Bank and river interviews, area from Willow River to St. Croix State Park. Test of aerial photography flights. MCA members interview.	Indication of local vs. urban user differences: 48 percent bank users locals, fishing, etc; 58 percent river craft users from Twin Cities. In late summer lower river, Hell's Gate to Highway 48 most used. Locals opposed to use charges (54 percent); only 15 percent opposed from other Minnesota areas including Twin Cities. Limitations on use of aerial photos. Use count not adequate.
1977	To obtain optimal data on visitors at specific river locations. Obtain use counts. Observation of interview setting. Test environmental perception of experience, management acceptance, and relationship.	April 16 - July 3. Contacts with river users at three access points: Banning Park, Robinson Park, Highway 48. Observation of interview setting.	Use patterns graphically displayed, can be compared to other rivers, times. Preferences for sets of environmental elements in the river experience identified. These have implications for river management considering the objectives of river protection. A possible total use counting formula was devised. Interview results were uniformly successful despite great variations in congestion at access points. There are differences between some local (Pine County) user preferences, interests and those of metro and other Minnesota users. Conflicts of interest must be considered by management agencies.

tween local and statewide interests in the management of the river.

Sex and age differences are not very pronounced between Pine County and metro origin users. The youngest (14-18) users are better represented by Pine County and the older users by the metro region. Consistent with other investigations of this kind there is a falling off of use by the elderly, although the 35-65 age group from the metro region is close to the proportion of the state population.

Income, education and occupation are often treated as indices of social status. There have been frequent attempts to correlate these categories with recreational preferences. Generally our data show that users have a higher average level of education and income than the state population. Occupational distribution is more difficult to interpret. The professional/technician category is considerably larger among the user group. There are pronounced differences between Pine County users and metro region users in all three dimensions. The metro user tends to have more formal education, a higher income, and a more prestigious occupation. Here again the comparison may help to explain the nature of the conflict between local users and those from other parts of the state. However, the importance of status-related differences may have been exaggerated in the past. Some additional insights into the relationship between user characteristics and preferences will be provided later.

River Use Patterns

The use of the Kettle River varies over time and space. As our description has indicated, the Kettle River is not a uniform, linear water pathway. Rather it is divided into distinct segments which are utilized as discrete units, even though many users may perceive the river as a whole. This characteristic is a major factor in the determination of use patterns.

Our description of use patterns serves two primary purposes: First, to measure the activity that is taking place. This type of data will enable planners and managers to better accommodate that use. A second purpose is to suggest a means of monitoring changes in a way which is systematic, consistent, and capable of encompassing diverse use patterns.

An important consideration in describing use patterns is the selection of appropriate units of time and behavior. We have chosen individuals rather than craft. The individual is the decision-making unit and, therefore, deserves the most attention in management policy. For some purposes it may be important to distinguish use by different individuals and total visits, which includes repeaters. Time must also be taken into account. It has been quite common to describe use in terms of "visitor days." A visitor day is defined by the U.S. Forest Service as one individual using an area for a period of 12 hours; thus an overnight camp plus a 12-hour day would constitute two visitor days even though the entire trip took place within a 24-hour period. This system conceals a great deal of information and is inappropriate for comparing different types of use. Any summarization will probably suffer these shortcomings. There is no universally acceptable measure of recreational use. All measures are more properly labeled indices rather than absolute measures. No matter what method is used it is important that it be applied consistently and that the measure is appropriate for the comparison being made. In the Kettle River study we have attempted to keep use measures in the simplest, most basic units so that comparisons can be made over a wide range of situations. For example, it is easier to compare day use and overnight use if use is recorded in hours than when the data has been summarized in terms of "visitor days." Our data are first expressed in terms of trips by individuals on different segments of the river. We have also summarized the time spent on each type of trip.

Table 2. Total use by the sample for each segment of the Kettle River. Camping and stopping time is included (1977 data).

Segment[1]		Visits[2]	Average hours	Range (min./max.)	Total hours
A-D	Willow River to Banning State Park	9	6	—	54
B-D	Rutledge to Banning State Park	4	6.8	5-8	88
C-D	Highway 23 to Banning State Park	5	2	—	10
C-E	Highway 23 to Robinson Park	24	3.6	3-5	87
D	Banning State Park	27	4.6	1-49	125
D-E	Banning State Park to Robinson Park	30	2.4	1-3	72
D-F	Banning State Park to Sandstone Dam	4	4	—	16
E	Robinson Park	46	7.6	1-48	348
E-H	Robinson Park to Highway 48	12	13	4-28	156
F-H	Sandstone Dam to Highway 48	6	7	5-8	42
H	Highway 48	79	16.9	1-69	1,334
H-J	Highway 48 to Maple Island	10	5.7	5-6	51
H-K	Highway 48 to Kennedy Brook	8	6.5	3-13	52
H-L	Highway 48 to St. Croix River	16	7.4	5-10	118
E-L	Robinson Park to St. Croix River	3	2.3	22-24	69
Totals		280			2,628

[1]Location of access points can be determined by reference to letter key on map and schematics (Figures 1-4).
[2]A total of 384 individuals were contacted and 280 provided usable information regarding the segment of the river used and the time spent on the river; thus the total hours must be adjusted to account for the total use represented by our sample.

Table 2 is a summary of the use of each segment of the river; different segments may be contained within others or they may overlap. Each segment is identified by the letters corresponding to put-in and take-out points. A single letter describes trips where watercraft enter and leave the river at the same point. The table shows how many individuals used each segment of the river, how many "visits" are accounted for by each segment, and the range and average number of hours spent on each segment.

The overall use of the Kettle River by our sample is displayed graphically in Figure 2. The graphic repre-

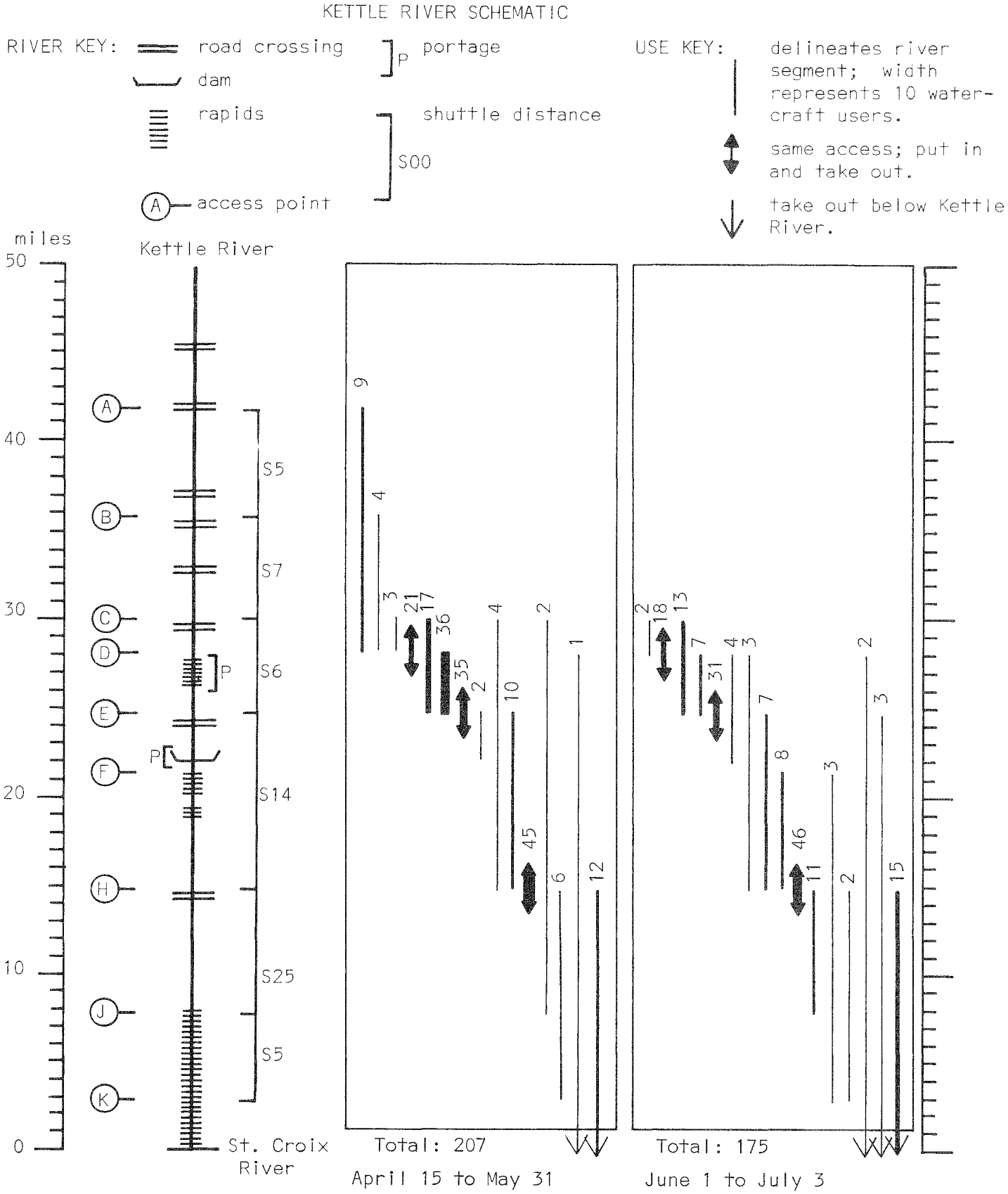


Figure 2. Use patterns of watercraft users contacted at Kettle River access points in 1977. A comparison of spring and early summer use. Numbers represent individual persons using a segment of the river.

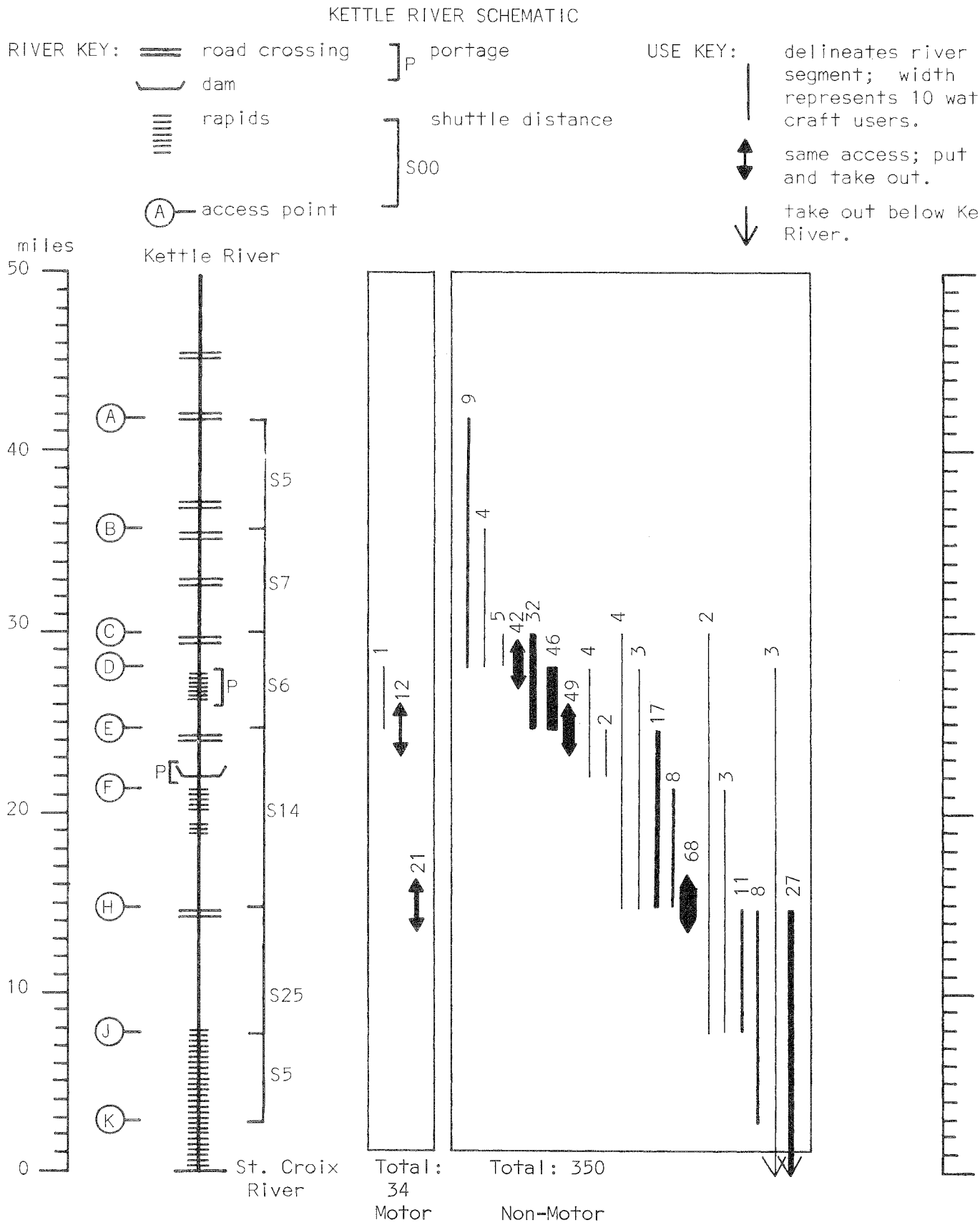


Figure 3. Use patterns of watercraft users contacted at Kettle River access points in 1977. A comparison of motor craft users and non-motor craft users. Numbers represent individual persons using a segment of the river.

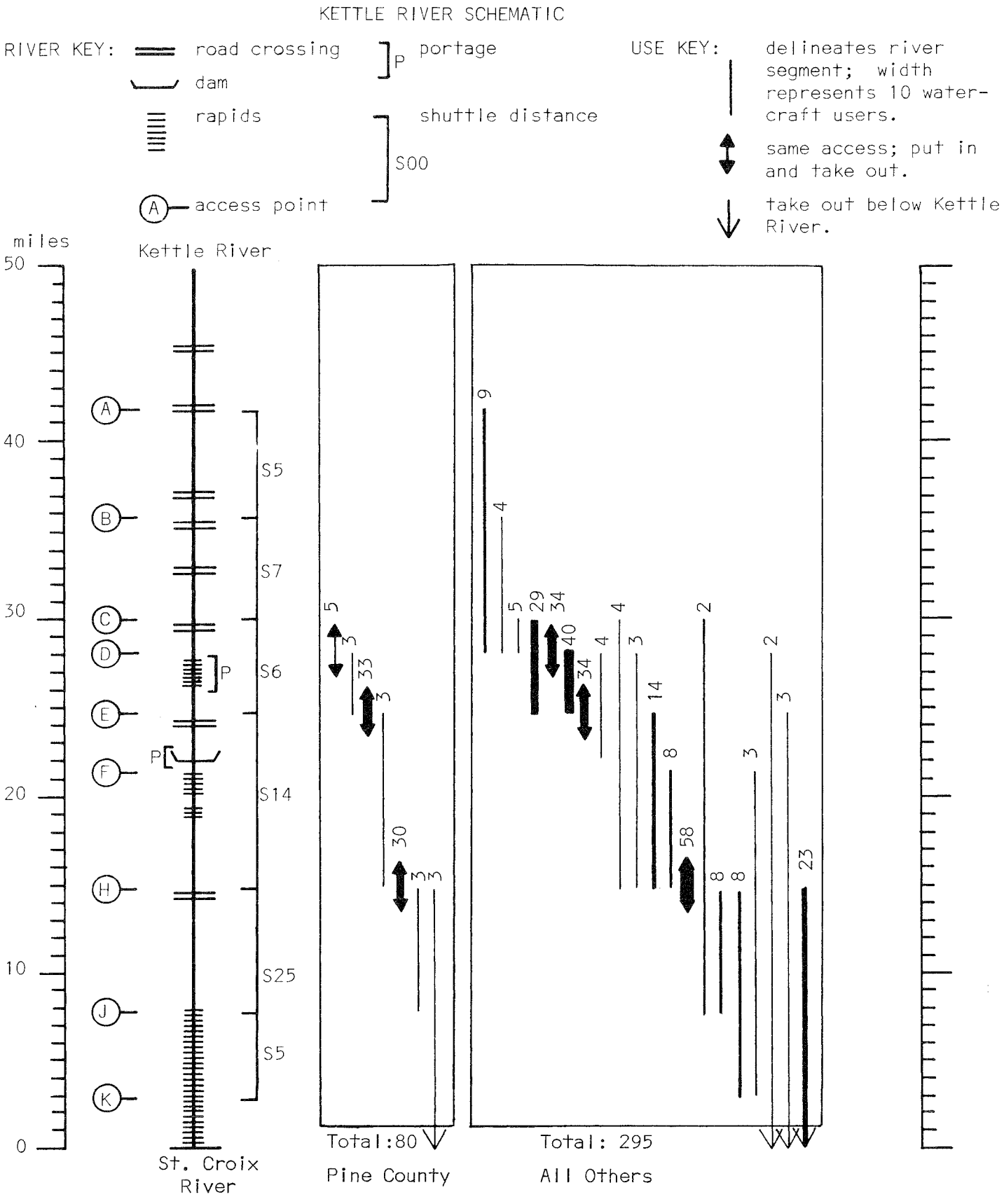


Figure 4. Use patterns of watercraft users contacted at Kettle River access points in 1977. A comparison of Pine County resident and all other users. Numbers represent individual persons using a segment of the river.

sentation is an attempt to "standardize" the river by showing it as a straight line. This technique simplifies the task of relating use to various segments of the river and comparing the essential attributes of different rivers.

Several assumptions were made regarding weekday use and those entering the river at other than the major access points. Previous investigations had shown that little use occurred on weekdays and that relatively few people entered the river at points other than those sampled.

The schematic shows clearly the segmented character of river use. It also illustrates seasonal variation in use, *i.e.,* use tends to shift toward the lower reaches of the river in the latter part of the season. Most segments are quite sharply defined by access points which determine the beginning and the termination of a river trip. There is a considerable amount of use from a single access point which means that the user had to back-track, either upstream or downstream, to return to the put-in point. This type of use occurs primarily where there are pools of relatively deep water, *e.g.,* the two-mile pool formed by the dam at Robinson Park and the long stretch of quiet water near the Highway 48 access.

Use estimates expressed in visits and hours will provide a basis for comparison in the future. For example, we may want to measure the change in impact on a particular segment of the river or a change in the distribution of use in response to various management practices. Subsequent reports will be able to demonstrate how our descriptions of use patterns facilitate comparisons with other rivers and changes over time. Within the scope of the 1977 Kettle River study the following comparisons of user groups will serve to illustrate the approach.

In Figure 3 those using motor craft are compared to those using non-motor powered craft. It is quite apparent, at least during the 1977 season, that motors were confined primarily to the pools at two of the access points. Motors may be used to eliminate the need for shuttling back and forth. The schematic does not indicate the distance a motorboat was able to reach from a single access point. The river segment accessible from Robinson Park was quite well defined by the dam at the lower end and a rapids at the upper end. Those entering the river at Highway 48 could conceivably reach a point several miles downstream with a small motor.

Figure 4 compares the use patterns of Pine County residents to all other use. It is quite clear that local residents make less use of the river for extended trips and tend to concentrate their use near the access points.

Total Use Estimates

A total use estimate can be derived from the data if we accept the assumptions stated earlier. Previous investigations (Ballman, 1977) have shown relatively low use during the weekdays; approximately 14.7 percent, according to the 1976 data. Total number of visits (individuals/trips) can be estimated by first summarizing the number of contacts made as individuals put-in at the three access points and those who took out at these points and had put in above the three access points. This sum is then multiplied by four. We have assumed that the seven-hour sampling unit represents a fourth of the possible contact hours during the weekend use period. The formula is as follows:

Total number of visits on weekends during sampling period = Number of users contacted at three access points as they put-in + Number of users contacted as they took-out who had put-in above access points × 4

For our sample the figures are: $1{,}164 = (237 + 54) \times 4$.

In order to obtain an estimate of the total person-hours spent on the river we must adjust the total hours from Table 2. The table represents all those contacted during the sampling period who provided usable trip information for their party. There is a great deal of overlap, *i.e.,* if we were to sample 100 percent of the period we would be contacting many of the same people twice. An adjustment is made by taking the same proportion of the total hours from the table as that resulting from dividing visits into number of people putting-in at access points plus those taking out who had put-in above access points. Again this figure should be multiplied by four to obtain total hours. The formula is as follows:

$$\text{Estimate of total hours on river for sampling period} = \frac{(\text{Number contacted at access points putting-in}) + (\text{those taking-out who had put-in above access points})}{\text{Total visits from table}} \times \text{Total person hours from table} \times 4$$

For our sample: $2{,}731 = \frac{291 \times 3{,}585 \times 4}{382}$

In our example the total hours from Table 2 (2,628) has been corrected for missing data to get the figure 3,585. This estimate is somewhat biased because of the greater likelihood of contacting those who were making longer trips. A better estimate could be obtained by summarizing only the trips of those contacted as they put-in and those taking-out who had put-in above and multiplying this sum by four. We have not included those who put-in to the Kettle during the weekdays preceding the sampling period and left the river during the weekend. This type of use was very small in our sample, but may have to be considered in other situations.

Some Factors Influencing the Use of the Kettle

We have already commented on the segmented character of the river which results from a combination of the physical attributes of the river itself and the location of access points. One segment deserves special attention. The segment of rapids approximately two miles long within Banning State Park (Hell's Gate) has a special appeal to white water enthusiasts. At the same time the rapids can be intimidating to novice

canoeists and those without the proper equipment. The water level varies tremendously in this area and has a profound effect on the character of the rapids. The level is at a maximum during the spring runoff and may even be too dangerous for most whitewater kayakers. Quite often the water is too low to produce good rapids by the end of June. At low water levels (1-2 feet at the Highway 23 gauge) there is little danger for those who run the rapids in open canoes, although there may be some risk to equipment. This short segment of the river effectively divides the river in two and acts to impose an upper terminus to the use of the lower river. This unique segment can attract or repel users, depending on their experience and purpose.

Seasonal variation in water level is a major factor influencing the use of the Kettle River. The Kettle is a series of rapids and pools and thus its "canoeability" is altered significantly by small fluctuations in water level. During the 1977 study period the level began low but remained relatively stable throughout the sampling period. During normal years use falls off somewhat later in the season and tends to shift downstream. During the drought of 1976 water levels were near an all time low and use dropped off even more sharply. Short-term fluctuations caused by heavy rains can also influence use. However, it is much more difficult for individuals to respond to these temporary rises because they cannot be anticipated very far in advance.

The availability of camping sites affects overnight use. The most attractive sites are in the region from below Banning Park to the area north of Highway 48. Below this area there are long stretches of the river with low, sometimes wet, heavily vegetated banks which have much less appeal as campsites. Most of the camping we were aware of took place in the Robinson Park/Banning Park vicinity or on extended trips which terminated on the St. Croix River below the mouth of the Kettle. The former were more in the nature of "base"camps rather than "transient" camps. A combination of factors including segmented character of the river, limited campsites and close proximity to the metro area may mean that the Kettle is primarily a day use river, although a significant number of watercraft users operated out of "base" camps in Banning or Robinson Park areas. This is reflected by the long hours spent on relatively short segments of the river shown in Table 2.

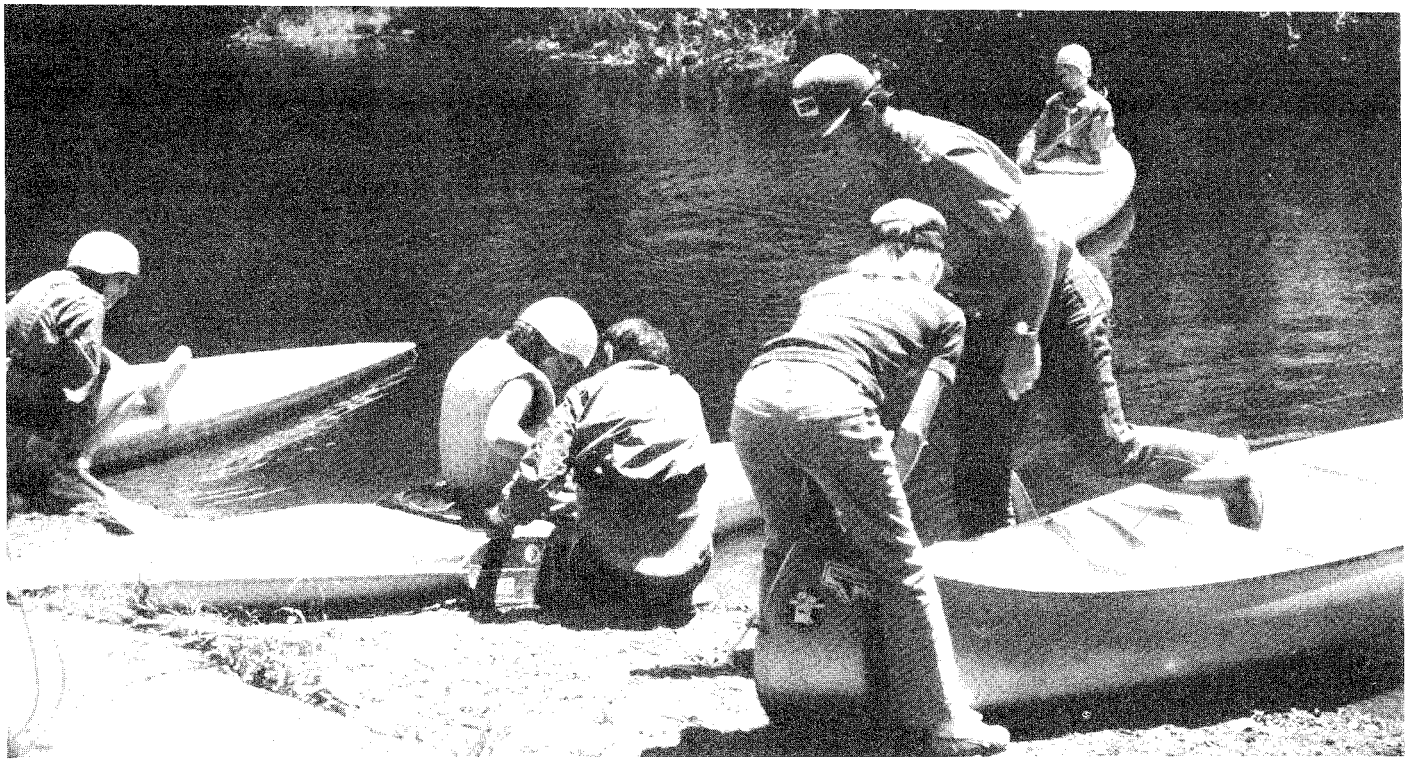
Weather has a dramatic and immediate effect on use. During the 1977 phase of the study two weekends with cool, windy, rainy weather provided the fewest number of contacts. Later in the summer extremely hot weather may discourage some types of use. The prevailing winds tend to blow upstream and can be very frustrating to those who thought they could just drift along without any effort. Weather, which fluctuates rather quickly in Minnesota, probably has a greater effect on day use than on extended overnight trips. The latter involve considerable previous planning and commitment and thus are less likely to be abandoned because of inclement weather.

Minnesota has a fair reputation for its variety and quantity of biting insects. Because of the previous year's drought, insects were not too abundant during our 1977 study period. During the 1976 investigation mosquitoes discouraged the leisurely use of the banks or access points, especially during the evening hours. By July of 1977, soon after our sampling period had terminated, a good population of deer flies had developed. These insects can be quite troublesome even to those who are on the water and moving quickly.

Logistical factors can be as important as the character of the river itself in determining use patterns. The location of access points is obviously critical. The character of the access points may have a significant effect on the individual's initial impression of the river. The perceived security provided by the parking area, especially for those planning an extended overnight trip, is also a consideration. We were not aware of any cases of break-ins or damage to vehicles during our study. Some people camping near the access points were bothered by noisy party groups and late night traffic. In some instances canoes and other equipment were left unattended for several hours near a landing without being molested. Some access points may be considered safer than others. Robinson Park is well-developed, close to the city of Sandstone, and has a large paved parking area. Activity levels are quite high and there is some "hot rodding" by local youths. Yet, this site may be considered more secure than a remote site with little activity which is still readily accessible to vehicles, *e.g.,* Highway 48. Banning Park is probably the most secure because of the controlled access and resident management staff.

Shuttling distance is shown on the schematics (Figures 2, 3, and 4). Quite often this distance bears little relationship to the river miles between access points. It is logical to assume that most users will attempt to maximize their time on the river relative to the time spent driving a vehicle back and forth between access points. All other factors being equal, those portions of the river with the shortest, easiest shuttle distance are the most appealing. It was evident that shuttle distance and difficulty influenced the use of the lower portion of the Kettle. The segment from Highway 48 to St. Croix State Park, although attractive in most respects, received relatively little use. Not only was the shuttle distance greater, it also required driving half the distance on narrow gravel roads. Later in the season a wind storm closed the access within St. Croix State Park altogether. An additional factor was the permit required to enter a state park. As Figure 2 illustrates, most of the use by our sample of this lower segment of the river was a part of extended, overnight trips which terminated on the St. Croix River.

A number of ways of dealing with the shuttling problem were observed. Some parties were able to get by with one vehicle by hitchhiking or jogging back to the starting point; others stashed bicycles at the take-out point. Small motors were used by some—mainly fishermen—to expedite upstream travel where the water was sufficient. This option was probably not



Canoeists and kayakers preparing to leave Banning State Park access.

considered too seriously by most canoeists or kayakers who would view it as inconsistent with the purpose of their trip. One individual was observed poling upstream through an area of rapids. Shuttling is obviously a major consideration in implementing a river trip; this suggests the feasibility of a service operation which would aid users in making connections between starting and finishing points. It would probably require a much higher rate of use than that which exists to justify this kind of operation on the Kettle River.

Many of the factors we have already discussed vary, often predictably, throughout the season. For example, late in the summer a combination of low water, hot temperatures, insects and poor fishing probably accounts for a decline in use of the river. Another less obvious factor also may be operating. The Kettle River is relatively close to the Twin Cities metropolitan area. Because of this proximity it is one of the first rivers to be attempted at the beginning of the season. Later many canoeists may tire of this area and seek other experiences at more distant locations. On examining our data we were rather surprised to find that there were very few repeaters, *i.e.,* individuals who were contacted more than once during the sampling period.

There is little doubt that the nearby, highly-publicized, St. Croix River has a profound effect on the use of the Kettle. Aside from the visibility factor, the St. Croix also offers more reliable water depths and the opportunity for more variations in trip length. Some river users are attracted to the Kettle because it is relatively more obscure and, therefore, perceived as being less crowded. There are many other alternatives to the Kettle River. These alternatives are used according to the individual's purpose, experience, and knowledge. Our study was not designed to measure the effect of alternative opportunities; however, Table 3 may provide some insights into this relationship. The table describes how Minnesota river users with various levels of experience use the Kettle relative to other rivers in the area. It is interesting to note the rise in use of rivers outside Minnesota by the more experienced participants, while their use of the Kettle and other Minnesota rivers tends to level off.

Table 3. Number of river trips taken per individual on the Kettle River, other Minnesota rivers, Wisconsin rivers and rivers outside Minnesota and Wisconsin by respondents according to the length of time they used watercraft on rivers.

Number of years of participation in use of watercraft on rivers	Number of river trips per individual in last 12 months			
	Kettle River (excluding contact)	Other Minnesota rivers	Wisconsin rivers	Rivers outside Minnesota and Wisconsin
Less than 1 (N=51)	1.2	.7	.4	.1
1 to 5 (N=96)	2.4	3.9	1.2	.4
More than 5 (N=148)	3.0	3.3	1.4	2.0

The purpose for a trip has an obvious effect on use patterns (Table 4). Fishing was a major activity for some, incidental for others, and of no importance to most of the whitewater enthusiasts or organized canoe parties. Certain stretches of the Kettle River have a better reputation for fishing and thus were more likely to attract those with this purpose in mind. Solitude may have been an important objective for some users and helps to explain why they were willing to put up with logistical problems, poor campsites, etc., characteristic of some portions of the river. This objective

may also influence the timing of a trip. Early season use during cool, wet weather may be motivated by an effort to beat the crowds. Others may sacrifice a vacation day in order to use the river during the week when very few others are present.

These are just a few examples of the influence of trip purpose. There are many, less obvious reasons which no doubt have subtle effects. Table 4 summarizes the reasons given by our respondents for their trip on the Kettle River. The kind of question eliciting these responses invites easy, acceptable answers and thus the results must be interpreted cautiously. Finally, we should not overlook as a motivating factor the urge to explore and discover. Some users may visit the Kettle simply because it promises a new experience; they have no specific expectations and they are willing to risk disappointment.

Table 4. Summary of the responses given by Kettle River users sampled during the 1977 season to the question: "Briefly tell why you took this trip on the Kettle River."

Reasons given	Number of responses*
Lack of restraints, freedom	70
Socialize, be with family	50
Physical activity	95
Natural environment	39
Outdoor environment	21
New experience	37
Exploitive, extractive	50
Learn or improve skills	12
Convenience	27
Challenge, thrill, etc.	16

*Total number responding to question = 303 (7 did not respond). More than one reason was given by some respondents; average number of reasons per respondent = 1.376.

The quality and distribution of information is a major factor influencing river use. The Kettle has always had a certain amount of visibility, especially among whitewater runners and local fishermen. The river has been written up in several guides to canoeing and whitewater streams. It is even included in a guide dealing primarily with Wisconsin river opportunities. The recent designation of the Kettle as the first component of Minnesota's wild and scenic river system has increased its visibility. The Department of Natural Resources (DNR) has published individual river guides which are distributed at various DNR offices and state park contact stations. In the past several years two state publications have been printed which described most of the canoeing opportunities in the state. The Kettle has been the subject of a number of articles in state newspapers and at least one television special. Exposure of this type serves not only to make people aware of the river; it also supplies them with the information they need to plan and implement their trip.

Our study did not systematically deal with the effect of information on river use. Some of those contacted volunteered that they had read about the river in various state publications. A group from Nebraska indicated that their knowledge of the Kettle was obtained entirely from the state's river guide book.

Approximately 9 percent of our sample were members of the Minnesota Canoe Association (MCA). This organization, through its activities and publications, disseminates information about canoeing and kayaking opportunities to its members. The group also contributes directly to the use of the river by sponsoring several trips to the Kettle during the season. A large percentage of the whitewater activity is conducted by MCA members; this includes competition in the Hell's

A kayaker challenges the Hell's Gate Rapids.

Gate area during the early part of the season. Several other groups sponsor trips to the Kettle River. These groups serve to introduce people to the activity and the specific site; they also aid in coping with some of the logistical problems such as supplying equipment and shuttling back and forth.

Environmental Preferences of Kettle River Users

Recreational experiences can be defined in terms of the environmental elements encountered in a recreation situation. These elements can be derived by identifying those specific, concrete entities which contribute to the reasons or satisfactions associated with the motivation to occupy a given environment or place. For example, "naturalness" (an objective revealed by numerous previous studies) is a function of unaltered landscape, native vegetation, wildlife, etc.

River users were asked to state their preferences for 39 environmental elements and 11 management alternatives along a five-point scale (1 = very undesirable; 5 = very desirable). They were also asked to indicate whether they expected to encounter each of the environmental elements, whether they did in fact encounter each of the elements, and, if encountered, did that element add or detract from their experience.

Mean Preference Scores. Table 5 shows the responses to each item according to "mean preference score" and standard deviation. The items are ordered by standard deviation which provides a crude measure of consensus. This table helps to identify those elements which most users agree are desirable or undesirable. The lack of consensus toward the end of the list suggests conflicting interests among the individuals utilizing rivers for recreational purposes. Mean scores provide a measure of intensity, but these become less meaningful as the standard deviation increases.

Several non-controversial items rank high on the list. For example, clean water, natural vegetation, small wildlife and clear, warm weather are generally thought of as universal "goods." Most people agree that industrial development, litter and biting insects are undesirable, at least in the context of a river recreation experience. Further down the list it is easy to identify those items on which there is less agreement. These are the elements which make planning and management decisions difficult.

Many of the "ambivalent" items have to do with the type or volume of use which is encountered and the various types of facilities and services. Because our sample is limited to those people who have chosen the Kettle River, we would expect a greater consensus than if we were surveying the population of the entire state. The next step is to determine where trade-offs can occur in respect to some of the ambivalent elements. Some clues are provided by the cluster analysis described later in this report.

Effect of Encounters. The encounter categories displayed in Table 6 also help to identify critical elements. It may be reasonable to assume that those items an individual expected to encounter, did encounter and added to his or her experience, were important motivational factors. Those items not expected, encountered and detracting, probably contribute the most to dissatisfaction. In the first category several items were indicated by over 50 percent of these responding. These were: water clean enough for swimming, natural vegetation, rock formations, variety of small wildlife, and some easy rapids. Relatively fewer items were encountered, unexpected and detracting. Some of the most notable were residential development and litter.

A number of people expected detractions such as litter, power lines, worn campsites and biting insects. A few enjoyed unexpected encounters which added to their experience. These included rock formations, clear warm weather, and no shallows to hinder progress. A relatively large number of users expected elements which were not encountered. The desirability of these elements on the part of users will tell us some-

Table 5. Responses to 39 environmental elements by Kettle River users contacted at access sites in 1977 (ordered according to standard deviation (S.D.), from least to most).

Item	N=310 S.D.	Mean[1]
Water clean enough for swimming	.63	4.57
Industrial/commercial development	.67	1.23
Natural vegetation, landscape	.67	4.57
Rock formations	.69	4.31
Litter	.70	1.22
Variety of small wildlife	.70	4.51
Clear, warm weather	.77	4.28
Residential development	.78	1.50
Some easy rapids	.78	4.15
Biting insects	.85	1.66
Power lines crossing river	.89	2.20
A campsite all to ourselves	.90	4.22
Bare, worn ground at campsite	.91	1.97
10 to 30 other craft with motors	.92	1.46
Roads and railroads crossing river	.94	2.34
Very good fishing	.94	4.23
Water clean enough to drink	.94	4.26
Large wildlife	.94	4.26
1 or 2 craft without motors	.95	3.72
Others sharing campsite	.98	2.35
No shallows to hinder progress	.98	3.02
Booklet on natural features	.98	3.53
Rural farm, ranch landscape	1.01	2.69
Rangers on river to give aid	1.01	2.88
Makeshift structures at camp	1.03	2.26
Some difficult rapids	1.03	4.03
Rare wildlife	1.04	4.12
Signs indicating location	1.05	3.20
Historic site and buildings	1.07	3.31
No other groups on river	1.08	3.33
Detailed map of route	1.09	3.83
Firewood at campsites	1.10	3.24
1 or 2 craft with motors	1.12	2.08
Prepared tent space	1.13	3.07
Pit latrines	1.15	3.22
Rangers enforcing regulations	1.16	3.20
A few fish in river	1.16	3.74
Tables and fireplaces	1.21	3.18
10 to 30 other craft without motors	1.27	2.56

[1]Means were derived from assigning values of 1-5 to preference scale: 1 = most undesirable, 5 = most desirable. Thus 3.00 is the midpoint or neutral score.

Table 6. Responses to 39 environmental elements by Kettle River users (contacted at access sites in 1977 when they were asked if they expected to encounter a particular element, whether they did encounter the element, and if encountered did it add or detract from their experience).

N[1]	Item	Percent[2] expected, encountered, added.	Percent expected, encountered, detracted.	Percent not expected, encountered, added.	Percent not expected, encountered, detracted.	Percent expected, not encountered.	Percent not expected, encountered, no effect.	Percent expected, encountered, no effect.
221	Water clean enough for swimming	53.4	.5	14.5	.5	16.7	6.8	7.7
37	Industrial/commercial development	2.7	13.5	2.7	10.8	54.1	16.2	.0
265	Natural vegetation, landscape	58.5	.4	19.2	.0	11.7	4.9	5.3
219	Rock formations	52.5	1.8	22.4	.0	13.7	5.5	4.1
151	Litter	.7	31.1	1.3	29.1	28.5	8.6	.7
249	Variety of small wildlife	51.0	.4	16.1	.0	23.7	6.4	2.4
229	Clear, warm weather	44.1	.9	24.5	.4	18.3	6.6	5.2
80	Residential development	1.2	18.8	1.2	31.3	31.3	12.5	3.7
224	Some easy rapids	55.4	1.3	16.1	1.3	14.7	6.7	4.5
209	Biting insects	5.3	33.5	.5	16.3	30.1	5.7	8.6
147	Power lines crossing river	5.4	23.8	3.4	20.4	19.7	16.3	10.9
118	A campsite all to ourselves	38.1	.0	15.3	.0	31.4	11.0	4.2
97	Bare, worn ground at campsite	.0	25.8	2.1	22.7	30.9	14.4	4.1
35	10 to 30 other craft with motors	2.9	.0	.0	11.4	74.3	11.4	.0
185	Roads and railroads crossing river	11.9	17.3	7.6	16.8	14.6	12.4	19.5
87	Very good fishing	17.2	1.1	5.7	.0	63.2	11.5	1.1
83	Water clean enough to drink	30.1	.0	9.6	.0	49.4	10.8	.0
135	Large wildlife	26.7	.7	18.5	.0	45.2	5.2	3.7
215	1 or 2 craft without motors	29.3	7.9	14.9	4.7	19.1	12.6	11.6
78	Others sharing campsite	10.3	1.3	6.4	12.8	52.6	12.8	3.8
112	No shallows to hinder progress	14.3	7.1	23.2	10.7	26.8	12.5	5.4
51	Booklet on natural features	7.8	.0	7.8	3.9	70.6	7.8	2.0
85	Rural farm, ranch landscape	15.3	2.4	9.4	4.7	49.4	8.2	10.6
86	Rangers on river to give aid	11.6	2.3	14.0	3.5	57.0	8.1	3.5
50	Makeshift structures at camp	6.0	8.0	14.0	6.0	42.0	22.0	2.0
178	Some difficult rapids	47.2	2.8	15.2	1.1	24.2	6.7	2.8
67	Rare wildlife	13.4	.0	17.9	.0	62.7	6.0	.0
163	Signs indicating location	22.7	6.1	14.7	4.9	36.8	6.1	8.6
79	Historic site and buildings	31.6	1.3	16.5	3.8	27.8	13.9	5.1
97	No other groups on river	14.4	4.1	19.6	7.2	34.0	17.5	3.1
131	Detailed map of route	22.9		20.6	1.5	43.5	8.4	3.1
77	Firewood at campsites	7.8	1.3	9.1	2.6	61.0	16.9	1.3
132	1 or 2 other craft with motors	6.8	17.4	3.8	22.7	26.5	15.2	7.6
103	Prepared tent space	12.6	6.8	8.7	7.8	40.8	16.5	6.8
116	Pit latrines	22.4	5.2	13.8	10.3	27.6	14.7	6.0
84	Rangers enforcing regulations	13.1	7.1	2.4	2.4	59.5	10.7	4.8
168	A few fish in river	26.8	1.2	9.5	3.0	45.8	12.6	3.4
130	Tables and fireplaces	22.3	3.8	10.0	7.7	38.5	10.8	6.9
87	10 to 30 other craft without motors	13.8	4.6	12.6	8.0	44.8	12.6	3.4

[1]N pertains only to those responding when asked if element was encountered.
[2]Percentages based on only those who responded to items when asked whether element was encountered; varied from 35 to 265.

thing about whether they would have added or detracted from the user's experience. The last two columns in the table provide little information other than to indicate that some people felt indifferent or neutral toward some of the elements encountered.

Overall, we did not get as complete a response to the "encounter" question as we would have liked. The question may have been too complex and many respondents may not have felt it necessary to check an item if they had not encountered it on their trip. Nevertheless, this type of question does provide a good means of evaluating the satisfaction derived from an experience and how well a recreation environment fits the needs of the users.

The Environmental Package. The recreationist may be likened to the shopper entering a supermarket; each individual is seeking a slightly different "package" of items. Our environmental elements are analogous to the items on the supermarket shelves. Although no one leaves the "store" with one of everything, the recreational situation differs in that the participant is often forced to accept undesirable items. Because only a few elements are actually taken home in a physical sense (*e.g.,* fish and berries) we have used stated preferences as a substitute for the shopping list. Cluster analysis provides a means of summarizing the data into groups of elements which correlate according to preference.

Figure 5 displays the results of a cluster analysis on the 39 environmental elements. There is an apparent logical consistency in the groups formed by this process. Preference for physical comforts, such as tables, fireplaces, and a prepared tent space, are associated with items which contribute to a sense of security, *e.g.,* signs, rangers, others sharing campsite. On another branch of the dendrogram, a preference for encounters with wildlife is correlated with a desire for solitude and natural vegetation. At the other extreme, an indication of the desirability of encountering motorboats is associated with a relatively higher tolerance for

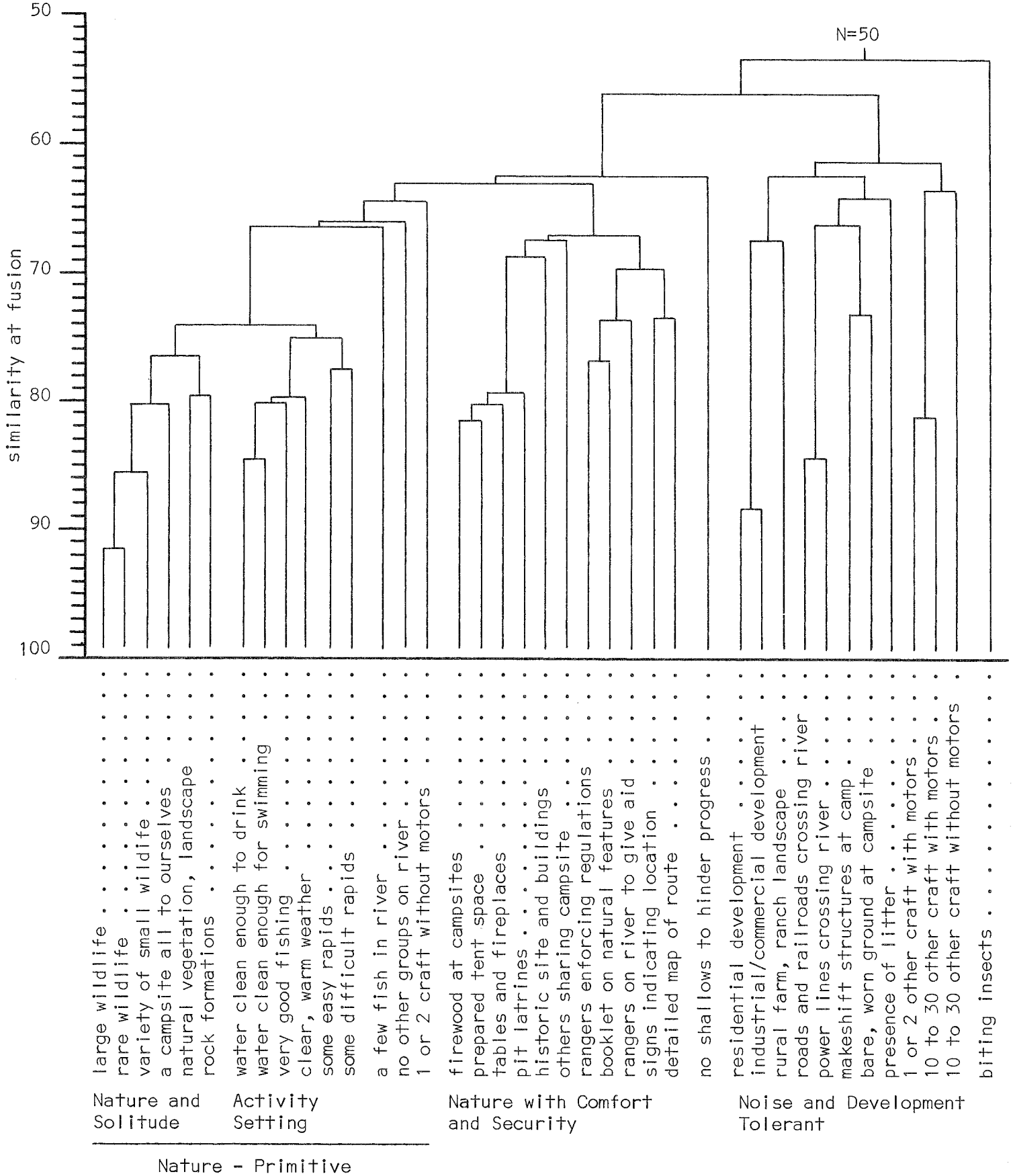


Figure 5. Hierarchical cluster analysis of 39 environmental preference items on stated preferences of 310 Kettle River users contacted in 1977. Relationship measured using correlation coefficients of responses on a five-point preference scale.

noise, altered landscapes, and more intensive recreational use.

This type of analysis must be interpreted very cautiously. Simply because two elements are found on widely divergent branches of the dendrogram does not mean that there are not individuals with a high degree of preference for both elements. For example, there are certainly a few persons who would like to encounter both large wildlife and 10 to 30 other craft with motors. We must be prepared to accept the individual's concept of what is or is not consistent with the experience he or she is seeking. Nevertheless, cluster analysis does provide a beginning, systematic means of determining which elements belong together and which do not. In any case it is impossible to cater to every possible taste and this technique helps to identify the most important combinations of elements.

Local Preferences Compared to Other Users. It is often important to compare the preferences of previously identified groups. In our study of the Kettle River we felt it would be valuable to identify any differences in preferences betweeen users from Pine County and those from the metro region.

Table 7 shows 19 items (14 environmental elements and 5 management alternatives) for which there was a significant difference in preference. The Cramer's V statistic provides a measure of association between residence and preference. It appears that natural amenities and solitude are more important to the persons from the metro area, although it is largely a matter of degree and there are no reversals in preferences between the two groups of users.

The source of the differences in preference may be explained by one or two hypotheses. The first would derive from an assumption that those from an urban environment are seeking elements lacking in their own routine experience. Another hypothesis states that those traveling a greater distance to visit the area are motivated by a desire to enjoy a specific experience, while local residents are more likely to seek a variety of experiences in a convenient area. The latter hypothesis suggests that local residents will have a greater tolerance for deviations from a natural environment which allows for a greater variety of activities.

Table 8 compares the preferences of Pine County users with those of Minnesota users other than those from the metro region. There are fewer elements with a significant difference in preference. However, a few of the critical management items, such as the use of motorboats, or limiting numbers of people, show about the same relationship as in the comparison with the metro region.

It is possible that both urban residency and distance are affecting preference and motivation. We may have attributed too much of the conflict to the urban vs. rural interests in the past. Our data suggests that simple differences in proximity may account for much of the differences in attitudes toward recreational areas. We should not overlook the selection process which determined the population from which our sample was taken. This population was influenced by current uses and management policy which may tend to displace certain types of use and users.

Conclusions and Implications for Research, Planning, and Management

This study has helped to establish an approach to describing river use and user preferences which can facilitate comparison over time and space. A graphic, systematic representation of use patterns permits ready comparison with other rivers and the monitoring of changes which may occur on the Kettle River.

Table 7. A comparison of the responses of Pine County residents and metro area residents[1] to preference items where significant differences existed.

Sign.	Item	V[3]	Percent[2] Pine County			Metro		
			−	0	+	−	0	+
.047	Signs indicating location	.20	13.1	45.9	41.0	24.7	28.7	46.6
.000	Detailed map of route	.34	26.2	31.1	42.6	9.0	14.8	76.1
.003	Booklet on natural features	.26	22.9	41.0	36.1	11.4	24.0	64.6
.051	No other groups on river	.20	18.0	57.4	24.6	44.7	36.7	18.7
.034	10 to 30 other craft without motors	.20	43.6	40.3	16.1	56.0	21.7	22.2
.000	1 or 2 other craft with motors	.36	39.6	34.9	25.3	75.4	17.7	6.9
.001	10 to 30 other craft with motors	.29	73.8	24.6	1.6	87.3	8.6	4.0
.001	Natural vegetation, landscape	.28	1.6	14.5	83.8	1.7	1.7	96.7
.017	Residential development	.22	80.4	18.0	1.6	93.2	5.1	1.7
.000	Water clean enough to drink	.36	11.9	23.7	64.4	1.7	8.6	89.6
.001	Rock formations	.26	1.6	21.0	77.4	0.0	8.4	91.6
.004	Litter	.26	87.1	9.7	3.2	96.0	.6	3.4
.012	Bare, worn ground at campsites	.23	61.3	32.3	6.4	75.7	22.0	2.3
.001	Historic site and buildings	.28	9.9	37.7	52.4	21.4	37.7	41.1
.000	Allow motor powered craft on river	.38	33.9	38.7	27.4	75.3	14.7	10.0
.005	Limit number of people on river at one time	.25	58.1	32.3	9.7	43.0	31.5	25.5
.000	Charge fee to finance management	.33	61.9	25.4	12.6	42.8	35.5	21.7
.001	Limit group size to 10	.28	54.0	27.00	19.1	30.3	29.8	39.9
.013	Encourage commercial outfitters	.23	73.1	14.3	12.7	80.0	17.6	2.4
				N=(59-63)			N=(165-178)	

[1]Seven county region including St. Paul and Minneapolis.
[2]Percent indicates those who responded to item "most undesirable" or "undersirable" (−); those who responded "neutral" (0); and those who responded "most desirable" or "desirable" (+).
[3]Cramer's V statistic provides a measure of association between residence and preference.

Table 8. A comparison of the responses of Pine County residents and other Minnesota residents[1] to preference items where significant differences existed.

Sign.	Item	V[3]	Percent[2] Pine County			Other Minnesota		
	Environmental elements		−	0	+	−	0	+
.008	Detailed map of route	.38	26.2	31.1	42.6	6.1	21.2	72.8
.046	1 or 2 other craft with motors	.32	39.6	34.9	25.3	72.8	18.2	9.1
.006	Rock formations	.36	1.6	21.0	77.4	0.0	8.8	91.2
	Management alternatives							
.007	Allow motor powered craft	.39	33.9	38.7	27.4	74.2	12.9	12.9
.031	Limit number of people on river at one time	.35	58.1	32.3	9.7	38.7	29.0	33.3
.019	Limit group size to 10	.35	54.0	27.0	19.1	23.3	30.0	46.6
.022	Provide highly visible signs	.35	23.8	17.5	58.8	48.4	29.0	20.6
			N=(61-63)			N=(30-34)		

[1]Does not include metro area.
[2]Percent indicates those who responded to item "most undesirable" or "undesirable" (−); those who responded "neutral" (0); and those who responded "most desirable" or "desirable" (+).
[3]Cramer's V statistic provides a measure of association between residence and preference.

Our measure of the desirability of various environmental elements also contributes to the ability to make comparisons. Concrete, physical entities are more likely to elicit the same mental images among different individuals at different points in time than are statements about "feelings." It is obvious that the items used in this study could be refined and/or supplemented with additional items to further reduce ambiguities. Additional analytical methods could derive more meaning from the data. However, we would like to emphasize that items representing concrete environmental elements are critical to the formulation of valid inferences.

Another byproduct of this study was an appreciation of the need to become thoroughly familiar with a river and how it is used before systematic surveys can be initiated. Our approach was to phase the intensity of the investigation over a period of three years. In order to establish an efficient sampling design it is essential to have considerable knowledge of the distribution of use over time and space. If greater resources (especially personnel) were available the process could be telescoped considerably; this is particularly true where less complex use patterns are evident. For example, on some of the western Canyon rivers access is quite limited, and use is subject to strict regulation and confined to relatively few well-defined segments.

A principal task of recreation planners is the "packaging" of environmental elements into viable sets. In other words, the planner must determine which things belong together and which things do not. Once this has been accomplished, the public should be given the opportunity to decide how much of each set they desire. In a real life situation this should be presented in the context of financial and political constraints which necessitate choices and trade-offs.

The Kettle River study has demonstrated the first stages of an attempt to systematically and empirically define recreation land use sets. Cluster analysis is an exploratory technique which aids in the initial packaging of the environmental elements. Other types of surveys and analysis can further refine the sets, while we keep in mind that the public is the final judge of what belongs together.

Within our packages or sets we can look at individual items in an effort to determine which are the most critical and which can be the most easily sacrificed. Any system is a compromise with the ideal. In some situations we may have to combine closely related sets; every individual cannot expect an environment designed expressly for himself. On the other hand, it is worthwhile to look closely at apparently homogeneous groups (such as the participants in a given activity) in order to ascertain the range of experiences these people are seeking. Our study dealt with the users of a single river in Minnesota; the approach could be applied at any level, such as the total recreational needs of a nation.

Outdoor recreation programs are frequently referred to as efforts to develop a "system." A system, in the words of William H. Hart (1966), means that: "within a given land area all parks, no matter how large they may be, or for what purpose they were established, are related to each other, to the use of the resources in the landscape which includes them, and to the society which supports them." The management of a single recreation area cannot respond to the multitude of human needs; however, a system and its complementary components should be designed to serve the needs of an entire population.

The Kettle River is a part of Minnesota's wild and scenic river "system." The assumption and implications are quite clear; there is a recognized need to create and/or protect some river environments in a way that preserves a particular set of values. Rivers present a unique problem in that they must be utilized where they exist; we cannot dictate their location to suit our needs or political expediencies. In addition, rivers are linear, which means that more often than not they traverse several categories of land ownership and jurisdiction. Most people will agree that "wild and scenic rivers" are desirable. The bind comes when it is time to decide which rivers and how exactly they will be managed. In the context of our study we are most concerned with the effects of management alternatives on recreational opportunities, rather than jobs, real estate values, etc. The local population is more likely to seek a variety of experiences from the river and thus they are reluctant to accept restraints which

may be necessary to protect a particular kind of experience. All of this adds up to a problem of land/water use conflict.

Our study, and the experience of the implementing agency, has shown that the conflict appears to focus on the issue of local vs. statewide interests. It is easy to see that those living closer to the river are affected differently than those who come for a short visit in order to enjoy a specific type of activity. Any change or the deliberate perpetuation of the status quo is going to influence the local residents' daily routine or their expectations. Because of this very direct and profound effect, local residents are much more likely to respond intensely to the state's efforts to implement management for the river. There is little doubt that local interests must be dealt with in a sincere and sympathetic way. The important questions are: how do we determine precisely what the local interests are and how, if possible, do we accommodate these interests without overly compromising the intent to provide a unique opportunity for the larger public?

The first part of our question must be answered before we can deal with the second. It is easy to overreact to dramatic, isolated incidents. For example, the Minnesota Department of Natural Resources placed barriers along the river to prevent motor vehicles from driving along the banks. These barriers were repeatedly torn down or circumvented. Should we interpret this behavior as the "will of the local people?" It is difficult for those who favor the restrictions to express themselves in a similar dramatic fashion; and they may be less likely to resort to these kinds of tactics. Nevertheless, this is the sort of conflict that must be resolved. The management intent is extremely vulnerable to those who are not restrained by the law or regulations. Furthermore, if the management agency responds too harshly the violators are likely to attract sympathizers from those who are relatively indifferent to the river itself, yet have considerable loyalty to their neighbors.

Our data shows that although there are significant differences between the users from Pine County and those from other parts of the state on several preference items, the majority of the local users concur with the preferences of the other users. This tells us that the conflicting preferences are not necessarily representative of all local users. There still remains a substantial minority of locals who must be accommodated in some way. The results of this study can help to pinpoint the specific areas of conflict (*e.g.,* the use of motorboats) and the approximate magnitude of the conflict. Managers and planners can utilize this information in several ways.

One approach is to provide areas for incompatible activities on portions of the river where they will least compromise the intent of the wild and scenic river program. Because motorboat users, as a group, seem to be more tolerant of development, it might be logical to concentrate this activity in areas where the landscape has already been altered. A close look at existing use patterns, *e.g.,* Figure 3 (motor and non-motor craft), can also help to avoid unnecessarily antagonizing some groups. Another approach is to provide the best possible information on alternative opportunities for all potential users. This information should provide a clear indication of the "environmental package" each area has to offer so that a user can make the most rational decision to meet his or her expectations. Although locals are generally less mobile than those who visit from afar, a great deal of conflict can be eliminated by separating incompatible uses at the point where a recreationist is deciding which area to visit.

Conflicts of the type described cannot be completely eliminated; they are inherent in the process of planning for a recreation system. With the aid of appropriate knowledge they can be reduced significantly. Knowledge can also help to sensitize the implementing agency so that they can communicate more effectively with the various conflicting interests.

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APPENDIX A - METHODOLOGY

1975 Reconnaissance Phase

The 1975 reconnaissance study utilized self-registration stations placed at four major access points (Banning State Park, Robinson Park, Highway 48, and St. Croix State Park) shown in Figure 1. Signs at these stations asked users to complete a short questionnaire and drop it in the lock box provided. Respondents were asked to indicate date, time of visit, watercraft type, number of people in group, length of time at river, and purpose of trip. Observation and conversations with users, local landowners and outfitters also provided supplementary information. Although there was some vandalism of the boxes and returns were erratic, the reconnaissance did indicate a variety of activities that fluctuated both spatially and temporally. The results provided a knowledge base for the 1976 and 1977 studies.

1976 Phase

The methodology used during the summer of 1976 attempted to take into account the anticipated variability in use. One aspect of this variability was the apparent north to south shift of use of the river as the season progressed and water levels declined.

The sampling scheme reflected this type change. The use season was divided into two periods: May 15 to June 30, a time usually characterized by higher than normal water levels and July 1 to September 15, a time usually characterized by lower than normal water levels. Sampling locations during the first period were limited to Highway 48 and major access points north of there: Highway 27, Willow River, Rutledge, Highway 23, and Robinson Park (see Figure 1). Sampling locations for the second period of the study were limited to the major access points at Highway 23, Robinson Park, Highway 48, and Maple Island in St. Croix State Park. This north to south shift in sampling was aimed at removing access points from the sample which were probably not useable by watercraft during low water.

Another anticipated source of variation in use was day of week. Therefore, the sampling design was stratified by weekend days (Friday, Saturday, and Sunday) and weekdays (Monday-Thursday).

Within the above described framework for the 1976 study phase, four weekdays and four weekend days were randomly selected as sampling days for the first period, May 15 to June 30; and four weekend days and six weekdays for the second period. A sampling day was defined as being from 7:00 a.m. to 9:00 p.m. Next, the sampling days were divided into four 3½ hour time blocks: 7:00 a.m. to 10:30 a.m., 10:30 a.m. to 2:00 p.m., 2:00 p.m. to 5:30 p.m., and 5:30 p.m. to 9:00 p.m. Two time blocks were then chosen without replacement for each of the selected sampling days. A constraint imposed here was that no two consecutive time blocks would be selected. Even though this affected the random feature of the sampling scheme, it was necessary to allow for travel time between sampling locations. Finally, one sampling location was selected with replacement for each of the selected time blocks. Following this process, a total of 36 time block-location combinations were selected as sampling times for the period May 15 to September 15, 1976. This sampling design can be conceptualized as a stratified multi-stage cluster sample (Kish, 1967).

During each of the sampling time blocks, a field worker, using a prepared instrument, was stationed at the specified access point to interview all watercraft users over 14 years of age as they put in or took out. Users were then given a four-page questionnaire to take home and complete. Observations were recorded during the sampling times on prepared observation forms. During the second part of the season, bank users were also interviewed. The results of the 1975-1976 studies have been reported elsewhere (Merriam, Knopp, 1977; Ballman, 1977). Some aspects are covered in the summary (Table 1) and were related to the 1977 study.

1977 Phase

The severe drought of 1976 caused the Kettle River water level to drop farther and sooner than had been anticipated. As a result, some of the northern access points included in the sample were virtually unusable early in the study. The drought no doubt also contributed to the low number of interviews conducted during the 1976 phase of the study. A major consideration in designing the 1977 sampling scheme was to insure an adequate sample size. Generally, the approach taken was to sample heavily for a shorter time rather than sampling lightly the entire summer.

The first change made was that sampling commenced and ended earlier in the season: April 16 to July 3, 1977. Even if the water did drop later in the season, this would take advantage of the spring runoff. A second change was to simultaneously sample three locations rather than just a single location per sample period as had been done in 1976. The same three locations were used the entire summer: Banning State Park, Robinson Park, and Highway 48. Robinson Park and Highway 48 had been the most heavily used access points the previous year. Banning State Park was included because it was known to be heavily used in the early spring when the water level is adequate in the Hell's Gate Rapids.

Another change concerned the time periods sampled each day. Rather than sample two, 3½ hour periods each day as was done in 1976, the 1977 design called for sampling a single 7-hour period each day. This proved to be more efficient than attempting two shorter periods. A fourth change introduced into the 1977 sampling design was that only weekends (Saturday and Sunday) were sampled. During the weekday sampling periods in 1976, only two interviews were recorded.

The 1977 sampling scheme was designed to equally sample Saturdays and Sundays and a.m. periods and p.m. periods. It was important that this equal

representation be spread out across the entire 12-week sampling period (April 15 to July 3). To accomplish this, the 12-week sampling period was first divided into three, four-week blocks. Then, within each of these four-week blocks, one of the four possible combinations of Saturdays and Sundays with a.m.'s and p.m.'s was selected as a sampling time for each weekend. The same combination was not repeated in the same four-week block. Therefore, each four-week block contained one Saturday a.m., one Saturday p.m., one Sunday a.m., and one Sunday p.m. sampling period, all of which were on different weekends. The end result was a 12-week schedule in which sampling was done simultaneously at three locations every weekend. Three Saturday a.m., three Saturday p.m., three Sunday a.m., and three Sunday p.m. sampling periods were spread rather evenly across this 12-week schedule (Table 2). The a.m. schedule included the period from 7:00 a.m. to 2:00 p.m. and p.m. included the period from 2:00 p.m. to 9:00 p.m. This design could be characterized as a stratified cluster sample.

During each of the twelve, seven-hour sampling periods selected in the manner just described, field workers at three sampling locations conducted brief interviews and handed out questionnaires in stamped return envelopes to all watercraft users over 14 years of age as they put in or took out of the Kettle. A "party form" was used to record information on group size, mode of travel, put-in and take-out times, and locations. This form could be completed by observation supplemented by a brief interview with one of the party members. The interviews were kept brief for two reasons: 1) to avoid detaining people anxious to get on with their river trip, and 2) to avoid being tied up with one party and missing others.

After getting the party information from a party member, a questionnaire and stamped return envelope in a protective plastic bag were distributed to each party member. Stapled to the outside of each plastic bag was a questionnaire control card keyed by number to the accompanying questionnaire. Each user was requested to fill in his/her name and address on the control card. These cards were retained by the interviewer and later then used to send out followup letters to nonrespondents.

The five-page questionnaire was divided into four parts. Part I requested river trip information: date, time, and place the river was left; activities engaged in on the trip; others seen; expected future use of the Kettle. Part II asked the users to indicate on a five-point scale the desirability of encountering various environmental elements and management alternatives on a river trip. The 39 environmental items included on the questionnaire represented a wide range of things that could be a part of the river recreation environment: other users, amenities, presence of management personnel, wildlife, shoreline landscape, water characteristics, evidences of prior use, and miscellaneous elements of the natural environment. Users also were asked to indicate whether they had expected to encounter each environmental item and whether it added or detracted from their river trip. The eleven management items represented possible management strategies that could be implemented on the Kettle.

The river level gauge at Highway 48 enables canoeists to evaluate the conditions of the river. River use, especially in the rapids area, is influenced by water levels.

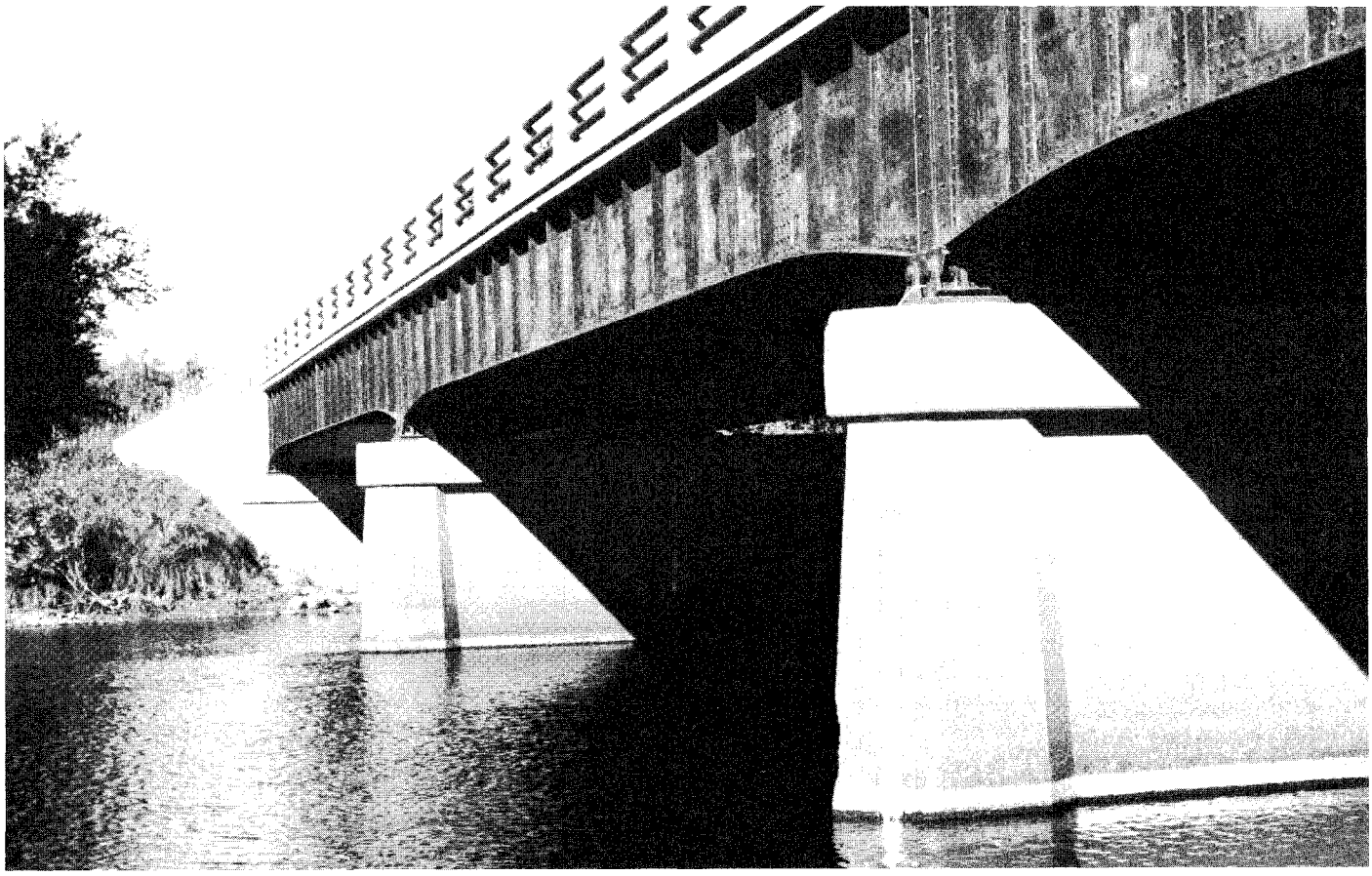


Table 1. Conditions and amount of use recorded at three locations on the Kettle River during the 1977 study period.

Date:	Day of week	Time period	Highway 48 river level (ft.)	Weather	Number of bank users			Number of watercraft users		
					Highway 48	Robinson Park	Banning Park	Highway 48	Robinson Park	Banning Park
April 16	Sat	AM	5.1	PC	10	103	28	4	6	2
April 24	Sun	AM	6.1	CW	16	45	18	5	11	11
April 30	Sat	PM	5.1	C	17	191	12	12	10	5
May 8	Sun	PM	4.5	C	26	264	32	12	12	5
May 15	Sun	AM	4.4	PC	16	181	55	8	7	0
May 22	Sun	PM	4.5	RC	36	132	20	5	0	0
May 28	Sat	PM	4.8	C	83	290	34	28	33	23
June 4	Sat	AM	6.1	C	6	113	24	12	17	11
June 12	Sun	AM	5.1	C	23	126	14	19	2	10
June 18	Sat	PM	4.8	C	26	62	41	15	9	0
June 25	Sat	AM	4.6	C	18	38	31	14	21	10
July 3	Sun	PM	4.7	PC	69	124	105	20	11	2
AVERAGES (nearest whole number)					29	134	34	13	12	7

KEY
AM: 7 AM to 2 PM PC: Partly Cloudy C: Clear
PM: 2 PM to 9 PM RC: Rainy & Cloudy W: Windy

Part III requested information about the extent of the user's river recreation experience: length of involvement, rivers most frequently used, types of river trips taken in the past, and planned future involvement in river recreation. The last section of the questionnaire asked for socioeconomic information.

In addition to interviewing users and distributing questionnaires, field workers acquired much valuable information by recording observations on an additional form. This included systematically recording the total number of people seen (bank users, drive-in traffic, etc.), the time they were on the site, and their activities while at the access points.

The procedure outlined here for handling the user contact proved to be efficient as well as unobtrusive. It permitted the distribution of questionnaires to all users, even at busy access points, causing minimal interference with user's activities. Only two people refused to take questionnaires. A total of 372 questionnaires were distributed during the 12-week study period in 1977 to watercraft users over 14 years of age. The response: 310 usable questionnaires were returned (83 percent) after three follow-up letters were sent at about ten-day intervals after initial contact. Table 1 summarizes the sampling times, locations, conditions, and contacts.

Interview Setting

The three interview locations used in 1977, in addition to being launching and loading areas for watercraft, are also popular locations for river bank activities. For example, the Highway 48 area east of Hinckley, with river access roads on both sides of the bridge, provides a place for local drive-in swimmers, bank fishermen, and evening beer parties. The access at Sandstone is located in a city park which is used for picnicking, fishing, camping, and informal gathering. At Banning State Park the access is primarily for watercraft with the picnic and camping sites some distance away. However, it is located at the head of the Hell's Gate Rapids and can be congested at the time of high water or kayak races.

During the interview periods, April 16 through July 3, people on the bank engaged in various activities at the three areas interacted with the interviewing process. Bank users during sampling periods were greatest at Robinson Park on May 28 (290+) and least at Highway 48 (6)-June 4. See previous table.

The people themselves seemed to react to the interviewer in a number of ways. Some responded as though we had invaded their special territory and interfered with their usual pursuits (*e.g.* beer drinking, sex, picnicking, etc.). Others were indifferent to the interviewer or asked questions about our activities.

In general, these bank users were not a problem to the study, and only their great numbers, as on May 28, may have required a special effort to avoid confusion. Some of the researchers did notice a territorial effect in that once an interviewer established a location to sit, placed a chair, etc. for study purposes, this became his territory while he was there and most users stayed away during the study time.

While the bank users probably represent only a small portion of the local population, and not all are local residents, they generally have different recreation objectives from the river users. In large numbers they could compete for access and use with those using the river with watercraft. Bank users are an important group to consider in Kettle River management.

APPENDIX B—SURVEY INSTRUMENT: QUESTIONNAIRE

College of Forestry
University of Minnesota

No. _____

RECREATIONAL RIVER USE STUDY

Questionnaire

General Instructions: This questionnaire should be completed and returned within one to three days after you have returned from the trip on which you were contacted.

PART 1. TRIP INFORMATION

1. At what place did you leave the Kettle River? (name of highway crossing, park, etc.) _____

2. At what time did you leave the Kettle River? _____ : _____ Hour, _____ Date.

3. a. Please circle the activities which were a part of your river trip.

____ paddling or rowing	____ picnicking	____ shooting rapids
____ floating	____ camping	____ swimming
____ driving power craft	____ photography	____ socializing
____ fishing	____ nature study	____ other: _____

b. Now go back (using blanks) and rank the activities you checked in the order of their importance to you (1, most important; 2, next most important; etc.).

4. About how many other individuals (other than members of your party) did you see while you were on the river?

____ in watercraft on the river or on tubes, swimming
____ along the banks or swimming (other than at access or campsite)
____ at campsite
____ at access (put in or take out points)

5. Briefly tell why you took this trip on the Kettle River. _____
_____

6. Please indicate how well satisfied you were with this river trip by checking one of the following:

_____ / _____ / _____ / _____ / _____
very dissatisfied dissatisfied "so so" satisfied very satisfied

7. In the future, to what extent do you plan to use the Kettle River? (circle one)

a. More than I have in the past
b. About the same as I have in the past
c. Less than I have in the past

8. If you plan to use this river less in the future, briefly explain why. _____
_____.

PART II. ENVIRONMENTAL PREFERENCES

1. Please read carefully before proceeding. Below you will find a list of 39 things which you may encounter on a river trip. Proceed through the entire list and check the response which best describes your preference. (You may go through the list very quickly; don't spend much time on individual items.)

	Most Undesirable	Undesirable	Neutral	Desirable	Most Desirable
1. Signs indicating location					
2. Detailed map of route					
3. Rangers on river to give aid					
4. Tables and fireplaces					
5. Firewood at campsites					
6. Pit latrines					
7. Prepared tent space					
8. Booklet on natural features					
9. Rangers enforcing regulations					
10. No other groups on river					
11. One or two craft without motors					
12. Ten to thirty other craft without motors					
13. One or two other craft with motors					
14. Ten to thirty other craft with motors					
15. A campsite all to ourselves					
16. Others sharing campsite					
17. Variety of small wildlife					
18. Large wildlife (e.g., deer, bear)					
19. Rare wildlife (e.g., cougar, otter)					
20. Natural vegetation, landscape					

Ignore these columns until you have completed the above instructions.

	expected	encountered	added	detracted
1. Signs indicating location				
2. Detailed map of route				
3. Rangers on river to give aid				
4. Tables and fireplaces				
5. Firewood at campsites				
6. Pit latrines				
7. Prepared tent space				
8. Booklet on natural features				
9. Rangers enforcing regulations				
10. No other groups on river				
11. One or two craft without motors				
12. Ten to thirty other craft without motors				
13. One or two other craft with motors				
14. Ten to thirty other craft with motors				
15. A campsite all to ourselves				
16. Others sharing campsite				
17. Variety of small wildlife				
18. Large wildlife (e.g., deer, bear)				
19. Rare wildlife (e.g., cougar, otter)				
20. Natural vegetation, landscape				

(continued next page)

	Most Undesirable	Undesirable	Neutral	Desirable	Most Desirable
21. Rural farm, ranch landscape					
22. Residential development					
23. Industrial/commercial development					
24. No shallows to hinder progress					
25. Water clean enough to drink					
26. Water clean enough for swimming					
27. Some easy rapids					
28. Some difficult rapids					
29. A few fish in river					
30. Very good fishing					
31. Clear, warm weather					
32. Biting insects					
33. Rock formations					
34. Presence of litter					
35. Makeshift structures at camp					
36. Bare, worn ground at campsite					
37. Roads and railroads crossing river					
38. Power lines crossing river					
39. Historic site and buildings					

Ignore these columns until you have completed the above instructions.

I expected to encounter this item on this river trip.	I did encounter this item on this river trip.	This item added to my satisfaction from the trip.	This item detracted from my satisfaction from the trip.

Now please go back through the list of 39 items and answer the questions indicated for the four columns on the right. We are interested in finding out how these items effected your trip on the Kettle River. In the first column indicate with a check if you expected to encounter that item on your river trip. In the second column make a check if you did in fact encounter that item on your trip. Check one of the last two columns only if column two is checked.

2. Ways of controlling river use: Below you will find a list of different management alternatives for recreational use of rivers. Proceed through the list and indicate how desirable each is to you.

	Most Undesirable	Undesirable	Neutral	Desirable	Most Desirable
1) Allow motor powered craft . . .					
2) Users responsible for carrying out their own litter .					
3) Permit lightning fires to burn .					
4) Limit number of people on river at one time .					
5) Do not allow hunting					
6) Charge fee to finance management.					
7) Construct more campsites . . .					
8) Provide more access points . .					
9) Limit group size to 10					
10) Encourage commercial outfitters .					
11) Provide highly visible signs to help people locate themselves and avoid hazards. .					

PART III. RIVER EXPERIENCE

1. How long have you been participating in this kind of activity (i.e., using similar craft on rivers)?

____ first trip ____ one to five years ____ over ten years
____ less than one year ____ five to ten years

2. Please list the three rivers you have used most frequently in the past five years. Begin with the most frequently used:

Name of River	Location (nearest town to access)
1. _____	1. _____
2. _____	2. _____
3. _____	3. _____

3. Please indicate the number of single day and overnight river trips that you have taken during the past 12 months in each of these catagories:

Type of Trip	Kettle	Other rivers in Mn.	Rivers in Wisc.	Other Rivers
Day	_____	_____	_____	_____
Over one day camping	_____	_____	_____	_____

4. In the future to what extent do you plan to participate in river recreation (circle one):

   A. More than I have in the past
   B. About the same as I have in the past
   C. Less than I have in the past

5. If you plan to do less, briefly explain why? _____

_____

PART IV. USER INFORMATION

Next we would like to know more about what kind of people use the Kettle River. This information is an important aid in predicting the future demand for river recreation. The following information is strictly confidential and will not be associated with you as an individual.

1. Age ____. 2. Sex: ____male ____female

2. What is the highest year of formal schooling that you have completed: (circle)

   1 2 3 4 5 6 7 8 elementary 9 10 11 12 highschool 13 14 15 16 ____ college 13 14 15 16 ____ vocational/technical

3. Please indicate what general income category you are in, i.e., total gross income (before taxed) for you and all members of your household in 1976. Include income from all sources such as wages, salaries, social security, interest dividents, rent, etc.

   ____ less than $6,000
   ____ $6,000 to $14,000
   ____ $15,000 to $24,000
   ____ $25,000 and over

4. Occupation:

   ____ student ____ homemaker
   ____ if unemployed, what sort of work do you normally do? _____
   ____ if employed, what sort of work do you do? _____
   ____ if retired, what sort of work did you do? _____

   (Please be specific, for example, "telephone operator", not telephone company.)

5. Are you a member of the Minnesota Canoe Association? ____ Yes ____ No

6. Comments: _____

_____

THANK YOU VERY MUCH FOR YOUR COOPERATION !

PLEASE USE THE ENCLOSED ENVELOPE TO RETURN COMPLETED QUESTIONNAIRE TO:

Dr. Tim B. Knopp, College of Forestry, 1530 N. Cleveland Ave., University of Minnesota, St. Paul, Minnesota 55108

APPENDIX C—SURVEY INSTRUMENT: PARTY FORM

Date:_____
AM_____; PM_____
Access_____
Party No.:_____

College of Forestry
University of Minnesota

RECREATIONAL RIVER USE STUDY
Party Observation and Interview Form

QUESTIONNAIRE NUMBERS: _____ through _____. Total Number in Party _____.

PART I. RIVER AND WEATHER CONDITIONS

1. Name of River _____

2. Water Conditions: _____Low; _____Average; _____High.
_____Clear; _____Muddy.
Gauge readings: Name Reading
_____ _____
_____ _____

3. Weather Conditions During Trip: _____High Temperature; _____Low Temperature.
_____% Time Cloudy; _____% Time Rain.

Describe unusual weather:_____

PART II. PARTY CHARACTERISTICS

1. Mode of Travel (record number of each type of craft used by party)
_____canoe; _____kayak; _____raft; _____sailboat;
_____canoe with motor; _____raft with motor; _____motorboat;
_____other(describe)_____.

Observed Asked

( )( ) 2. Starting Point: Name_____, Mile_____.
( )( ) 3. Finish Point: Name_____, Mile_____.
( )( ) 4. Start Time: Hour_____:_____, Date_____.
( )( ) 5. Finish Time: Hour_____:_____, Date_____.
( )( ) 6. If repeated use of same stretch of river, ask to estimate number of "runs" _____.

7. Type of Group (check all those which apply to party):
____single person
____one family
____professionally guided trip
____commercially organized trip
____more than one family
____friends
____organization sponsored trip
____children under 14

8. To what extent is the party "outfitted"?
____own all of their equipment;
____rented craft and camping gear;
____borrowed equipment;
____rented craft only;
____completely outfitted;

OTHER SPECIAL CONDITIONS: (use back side of form, check here _____)

APPENDIX D—TABLES DESCRIBING CHARACTERISTICS OF KETTLE RIVER USERS SAMPLED IN 1977

Table 1. Residence of Kettle River users contacted at access points in 1977, compared with population of Minnesota.

Residence	Total Users		State of Minnesota[1]
	Number	Percent	Percent
Pine County	65	21.2	.4
Metro region	183	59.6	49.3
Other Minnesota	35	11.4	50.3
Other states	24	7.8	
Totals	307	100.0	100.0

[1]Minnesota data from 1970 census.

Table 2. Sex of Kettle River users contacted at access sites in 1977, compared with Minnesota residents.

Sex	KETTLE RIVER USERS								State of Minnesota[1]
	Total users		Pine County		Metro region		Other Minnesota		
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Percent
Male	225	72.6	41	63.1	130	71.0	29	82.9	49.0
Female	78	25.2	21	32.2	50	27.3	5	14.3	51.0
Missing	7	2.3	3	4.6	3	1.6	1	2.9	
Totals	310	100.1	65	99.9	183	99.9	35	100.1	100.0

[1]Minnesota data from 1970 census.

Table 3. Age distribution of Kettle River users contacted at access site in 1977, compared with Minnesota residents.

Age category	KETTLE RIVER USERS								State of Minnesota[1]
	Total users		Pine County		Metro region		Other Minnesota		
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number
Percent									
14-18	64	20.6	20	30.8	30	16.4	6	17.1	9.9
19-24	77	24.8	17	26.2	49	26.8	6	17.1	7.5
25-34	98	31.6	15	23.1	55	30.1	17	48.6	11.9
35-64	58	18.7	9	13.8	43	23.5	4	11.4	29.6
65 & over	4	1.3	2	3.1	1	.5	0	.0	10.8
Missing data	9	2.9	2	3.1	5	2.7	2	5.7	
Totals	310	99.9	65	100.1	183	100.0	35	99.9	

[1]State of Minnesota data from 1970 census. Percentages based on total population which includes those younger than 14. Lower age category includes 15 to 18.

Table 4. Income categories of Kettle River users contacted at access sites in 1977, compared with Minnesota residents.

Income category	KETTLE RIVER USERS								State of Minnesota[1]
	Total users		Pine County		Metro region		Other Minnesota		
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Percent
0-5,999	56	18.1	13	20.0	34	18.6	3	8.6	23.9
6,000-14,999	93	30.0	25	38.5	46	25.1	14	40.0	55.8
15,000-24,999	110	35.5	15	23.1	75	41.0	12	34.3	16.0
25,000 & over	31	10.0	2	3.1	22	12.0	4	11.4	4.3
Missing data	20	6.5	10	15.4	6	3.3	2	5.7	
Totals	310	100.1	65	100.1	183	100.0	35	100.0	100.0

[1]Minnesota data from 1970 census.

Table 5. Level of formal education completed by Kettle River users contacted at access sites in 1977, compared with Minnesota residents.

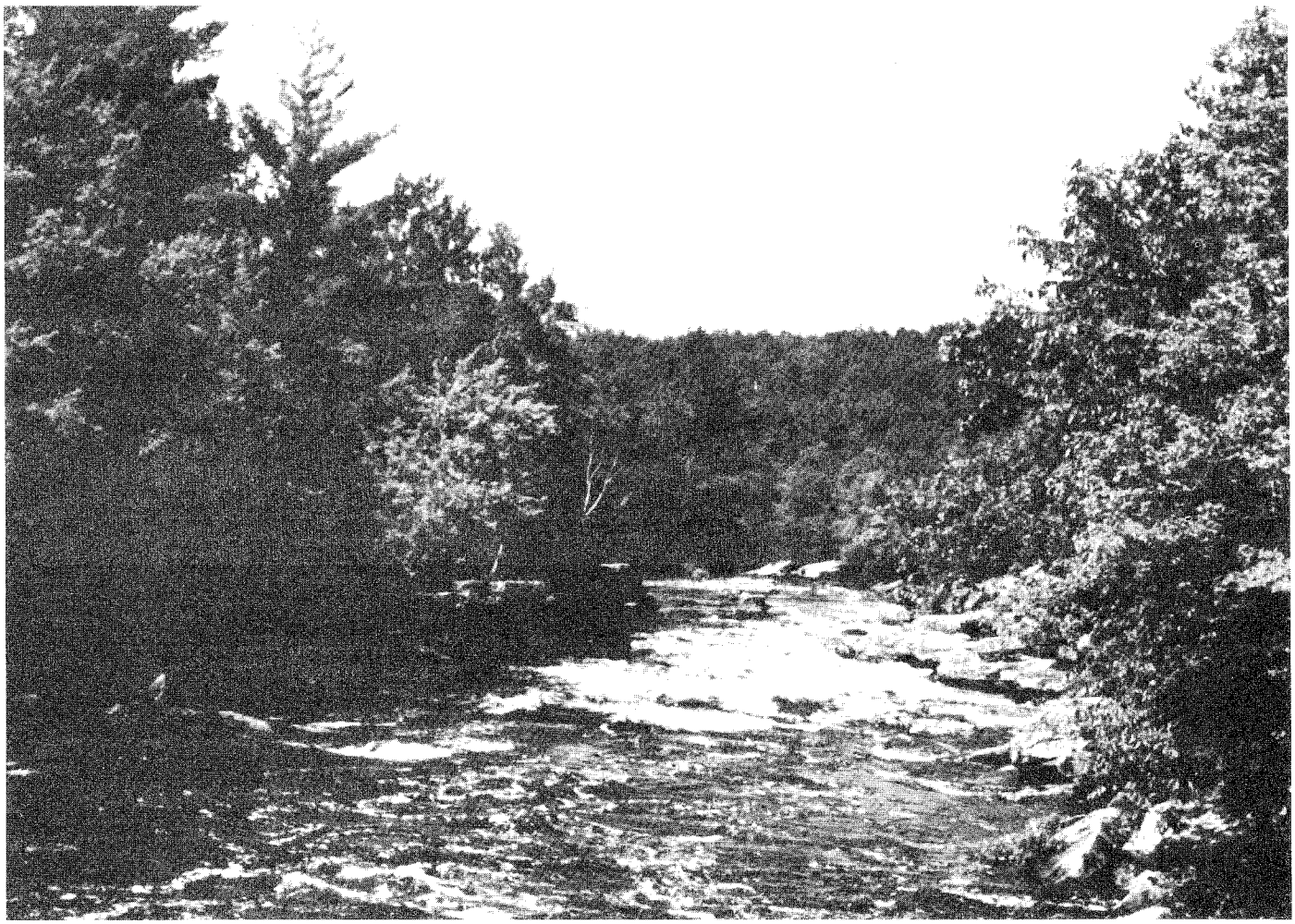
Education completed	KETTLE RIVER USERS								State of Minnesota[1]
	Total users		Pine County		Metro region		Other Minnesota		
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Percent
Elementary	9	2.9	4	6.2	4	2.2	0	.0	19.4
High school	115	37.1	35	53.8	55	30.1	11	31.4	34.5
Some college	54	17.4	13	20.0	35	19.1	4	11.4	12.0
College degree	98	31.6	7	10.7	68	37.2	16	45.7	11.1
Vo-tech	27	8.7	4	6.2	18	9.8	3	8.6	
Missing data	7	2.3	2	3.1	3	1.6	1	2.9	
Totals	310	100.0	65	100.0	183	100.0	35	100.0	

[1]Minnesota data from 1970 census.

Table 6. Occupations of Kettle River users contacted at access sites in 1977, compared with Minnesota residents.

Occupation category	KETTLE RIVER USERS								State of Minnesota[1]
	Total users		Pine County		Metro region		Other Minnesota		
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number
Percent									
Professional/technical	91	29.4	4	6.2	64	35.0	17	48.6	15.7
Manager/administrator	16	5.2	4	6.2	8	4.8	0	.0	8.6
Sales	2	.6	0	.0	2	1.1	0	.0	7.0
Clerical	12	3.9	2	3.1	9	4.9	1	2.8	17.2
Craftsmen/foremen	35	11.3	10	15.4	19	10.4	2	5.7	12.5
Operatives	5	1.6	3	4.6	1	.5	0	.0	14.4
Laborer/unskilled	22	7.1	8	12.3	7	3.8	4	11.4	9.6
Service	6	1.9	2	3.1	3	1.6	0	.0	13.4
Farmer	3	1.0	3	4.6	0	.0	0	.0	1.5
Homemaker	16	5.2	6	9.2	10	5.5	0	.0	—
Retired	1	.3	0	.0	1	.5	0	.0	—
Students	86	27.7	19	29.2	52	28.4	8	22.8	12.9*
Missing data	15	4.8	4	6.1	7	3.8	3	8.6	
Totals	310	100.0	65	100	183	100.3	35	99.9	

[1]Minnesota data taken from 1970 census. Percentages represent portion of total work force over 16 years of age (1,464,273). Total population of Minnesota is 3,804,971. Census categories did not include homemaker, retired, or student.
*Percentage of total population accounted for by students in grade 9 and above; this figure does not relate to percent of work force.



High water at Hell's Gate Rapids.

APPENDIX E—USE OF AERIAL PHOTOGRAPHY FOR RIVER USE AND BASELINE DATA GATHERING

During the summer of 1976 a cooperative effort was undertaken with the Institute of Agriculture, Forestry and Home Economics Remote Sensing Laboratory to evaluate application of 35mm color aerial photography as a way to obtain baseline information on the Kettle River. The 1976 tests included two flights with fixed wing aircraft. The first flight was on June 19 at 4,260 feet altitude (photo scale 1/9,600) with coverage from Interstate 35 bridge crossing south to the junction of the Kettle with the St. Croix River (distance 32 miles). Photo coverage was one flight line with 15-20 percent endlap. On the second flight (August 25) altitude was reduced to 2,310 feet (scale 1/4,800). Area covered in this northbound (one flight line 15-20 percent endlap) pass was from Highway 48 bridge to Highway 123 bridge at Sandstone (8 miles).

Photography was nearly vertical shooting from a handheld camera position over the plane camera port. This was deemed best due to the sharp bends in the Kettle River and where stereo coverage was not a factor. A Nikon F2 motordriven 135mm lens camera was used with Ektachrome film and x/Wratten 2A haze filter. Output was in the form of color film later made into slides.

It was found that watercraft could be counted even on the small scale, higher altitude photographs, although resolution and detail for identification of people and river features was much improved on the lower altitude flight. An instantaneous count of river users could be made of the river section photographed by the above method.

However, at both altitudes it was possible to miss watercraft under trees or on the banks, as well as miss detail covered by vegetation. River coverage was less at lower altitudes with the loss of some river bank detail. Weather, time of day, and light conditions can be limiting factors in the use of aerial photography for river studies. Good ground control is very important for photo identification.

It appears that river type and use patterns affect the usefulness of aerial photo methods. Unlike the Kettle, large open, heavily used rivers are probably best suited to photographic techniques. On a lightly used river, as the Kettle was in summer 1976, missing one or two craft due to tree covered banks not resolved in the photographs could be critical to use count accuracy. However, with aerial photographs a detailed view of the river is obtained, providing the researcher with a clearer idea of the study area than could be obtained on the ground. Finally, it is possible to obtain valuable unit counts and location information at less cost and effort than by ground surveys.

Sandstone Dam forms a two-mile pool which is heavily used by canoeists, campers, and local boaters.