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Survey Sampling Wilderness Visitors

by Robert C. Lucas and Jerry L. Oltman

Surveys of wilderness visitors can be valuable in meeting the difficult challenges of wilderness management, but improved sampling methods are needed. The methods used in past surveys have serious weaknesses. Mail surveys have overcome many of the shortcomings of personal interviewing, and rates of return for completed questionnaires have been high. However, there has been no adequate source of names and addresses of wilderness visitors from which to draw samples. The unmanned trail registers commonly used provide only names of party leaders, and many groups do not register at all. Furthermore, certain types of visitors are less likely to register than others; thus, the registration list is not only incomplete, but also biased.

A pilot test was made of two new methods for obtaining sample lists of wilderness visitors and a modification of an old method. The most successful method—in which a sign was used to inform visitors that research was in progress and to explain why names and addresses were needed—raised registration rates substantially, especially for hikers, and also produced names of individuals over sixteen years of age in addition to the party leaders. Nonregistrants were personally contacted on the trails. Both registrants and nonregistrants were mailed questionnaires. Over 90 percent of all questionnaires were returned, and analysis revealed significant differences between registrants and nonregistrants. Responses of party leaders also differed from the responses of other party members. Thus, the potential sources of bias in sampling from trail registers do seem important. Improved practices are recommended for many common field situations.

Introduction

Finding out what wilderness visitors are like, what they do, and what they think is important because wilderness policy is controversial and wilderness use is growing rapidly. Furthermore, factual knowledge concerning wilderness users is scarce, and subjective elements that only survey research can identify are critical in the development of management programs. A number of studies have attempted to add to our knowledge of wilderness users (most of these are listed in the references), and more will be needed. However, survey sampling of wilderness visitors involves even more problems than outdoor recreation research in general. Wilderness use is relatively light, highly variable in space and time, and users are mobile and often dispersed in hard-to-reach places. These characteristics are inherent in the purposes for which wilderness exists, but they pose serious challenges to survey sampling.

Several different methods of sampling wilderness visitors have been used in past surveys. Because of the weaknesses of these methods, the investigators

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conducted a pilot test of two new methods and a modification of an old one.

Although this report concerns wilderness users, any studies of dispersed recreation share most of the same features and problems. In fact, some of the same problems crop up in any recreation visitor survey.

Personal Interview Methods

In past surveys, personal interviews have usually been carried out near access points ("waiting" technique) with people beginning or ending trips (or both) and, occasionally, by the interviewer roaming ("roaming" technique) through the wilderness contacting visitors wherever he finds them.

Both waiting at accesses and roaming through the interior have yielded only small samples at high expense. The roaming technique was used for the Outdoor Recreation Resources Review Commission wilderness study (Wildland Research Center 1962) in seven wildernesses and yielded samples large enough for analysis in only three areas. In another study, the roaming technique produced only thirty-one, thirty-three and forty-four completed questionnaires from each of three Montana wildernesses in a summer-long effort, roughly a 0.5 percent sample (Merriam and Ammons).

Waiting for visitors at access points or at fixed points on routes within the wilderness produced larger samples than the roaming technique, but the costs per completed questionnaire were still high. In two studies in the Boundary Waters Canoe Area the waiting technique yielded 118 (Lucas 1964) and 195 completed questionnaires (Taves, Hathaway and Bultena 1960). Both studies required several man-months of effort to produce these modest-sized samples even though this is the most visited of all wildernesses on national forest lands.¹ A current study using this technique in three western wildernesses and in the Boundary Waters Canoe Area averaged about two completed questionnaires per man-day of interviewing.

Sample size cannot be controlled using either the roaming or waiting technique. The primary sampling units are blocks of time assigned to particular portions of the study area. The number of visitors within each primary sampling unit is always unknown or known only very roughly before sampling. Thus, it is not possible to follow the usual sample design steps of (1) selecting the desired level of precision, (2) calculating the sample size needed to achieve it, and (3) obtaining a sample of that size.

The roaming technique cannot yield a definable probability sample because there is an unknown variation in the probability of any person being contacted depending on where the interviewer travels. For example, when the interviewer is deep in the wilderness, the probability of encountering people who make short trips is zero. People who spend time off trails have less probability of being reached than those who keep to the main routes. The roaming technique also is affected by length-of-stay bias (Lucas 1963)—the longer a person stays, the more likely he is to be contacted. This bias, however, can be measured and its effect removed (Lucas and Schweitzer 1965; Wagar and Thalheimer 1968). Finally, contacting people back in the wilderness may be an unwelcome intrusion into the solitude and escape from civilization's demands that some visitors

1. Over 70,000 people were estimated to have visited the area in 1961 (Lucas 1964).

are seeking, although those who have used the technique say they have not sensed resentment.

Waiting at access points for visitors has its problems, too. This approach is prohibitively expensive at lightly-used entrances, and important differences may be lost by sampling only relatively heavily-used accesses. Also, this technique clearly produces a cluster sample—all the people using the access during the sample period constitute a cluster. A cluster sample almost always produces estimates with larger error terms than a simple random sample of the same size (Kish 1967, section 5.4). The more the people in the clusters tend to be homogeneous, as compared to all visitors to the wilderness, the greater is the loss in precision. However, the cluster sample cuts down costs, especially for travel, and often makes it possible to enlarge samples enough, within the same budget, to gain more than is lost. Cluster sampling can be a logical choice, but the appropriate (and rather complex formulas) for error term calculations must be used. Although many published wilderness surveys are based on cluster samples, none has taken the cluster sample effect into account.

There may also be human relations problems in collecting data at access points. Before the trip, most visitors are anxious to get started, and they cannot describe their activities or reactions to the trip they have not yet taken. After the trip, many people are also in a hurry and are often tired besides. Again, however, experience indicates good cooperation and patience on the part of visitors, and no refusals to answer questions have been reported.

Mail Questionnaire Methods

Past mail surveys have used trail registers as a source of names and addresses and have produced larger samples at lower costs than personal contacts and field interviews. Sample size can be controlled to a degree, although failure of some people to mail back questionnaires introduces some uncertainty about sample size. If desired, certain types of visitors—for example, those using horses—could be sampled at different intensities than others. This is difficult and inefficient using personal contact methods. Lightly-used areas can be sampled at more reasonable cost by using questionnaires than by using personal interviews. Cluster sampling can be avoided altogether. However, if some clustering is still desirable for economic reasons, the degree of clustering can be reduced by taking a larger number of smaller clusters more easily using mail questionnaires than using a personal contact method.

Less accurate recall can be a disadvantage of mail surveys compared to personal contact.² Recall errors also affect personal contacts made after the trip; therefore, the difference is only one of degree due to the greater time lag between the trip and questions in mail surveys.

Nonresponse is generally the major weakness of mail surveys (Robin 1965; Burton and Noad 1968), but it is less of a problem in wilderness surveys than

2. There are other general advantages and disadvantages to mail surveys compared to personal interviews. The mail survey avoids bias due to the interviewer's personality but loses the flexibility of probing answers, for example. The importance of the strong and weak points of each method depends upon the study's objectives. See C. A. Moser (1958, chapter 10) and Sellitz et al. (1967, pp. 238-243).

experience with most other sorts of mail surveys would suggest. Wilderness visitors returned questionnaires at high rates in the nine studies listed below:

	RETURN (PERCENT)	NUMBER OF FOLLOWUPS
Burch and Wenger (1967)	90	2
Wildland Research Center (1962)	89	1
Merriam (1963)	88	1
Lucas (1964)	79	0
Stankey (in progress)	78	2
Sommarstrom (1966)	75	0
Hendee et al. (1968)	71	1
Hendee (1967)	60	0
Lusty (1968)	55	0

The questionnaires used in these studies varied greatly in length and in difficulty of questions, but no study with at least one fellowship mailing had less than a 71 percent return. The refusal rate in household opinion surveys sometimes exceeds the nonresponse rate of the more successful wilderness mail surveys (Kish 1967, pp. 536-543).

The real weakness of the mail survey in wilderness research is the lack of a good mailing list from which visitors can be sampled. Trail registers are the usual source of names and addresses. These are generally boxes with cards or a book for recording information and a sign with directions for registering mounted alongside a trail. This source has two flaws: first, many groups do not register; and second, only one person registers for the entire group.

A study in Oregon showed a registration rate of 74 percent (Wenger and Gregersen 1964). In a Canadian national park, only 35 percent registered (Thorsell 1968, p. 3). A recent study in Montana³ reported a registration rate of 65 percent. A more serious problem is that registration rates vary substantially for different types of visitors; thus, the resulting list is biased. The Oregon study showed that hikers were twice as likely to register as horse travelers, and the study in Montana showed that they were half again as likely to register. Lone individuals were less likely to register than were groups, as were people making short visits compared to those making longer visits. There were other differences, and the bias problem seems serious. There is enough variation in the differences in registration rates between the Montana and Oregon studies to suggest that adjusting for the bias would have to be done on an area-by-area basis. However, the information on registration rates needed to make such adjustments is not generally available and is expensive to acquire.

The person who registers for the group is not a random representative of the group. In family groups, the husband's name usually appears on the register; thus, wives and children are underrepresented in the list. Even in non-family groups, the registrant is likely to be an informal leader who differs from

3. "Wilderness Use Estimation: A Pilot Test of Sampling Procedures on the Mission Mountains Primitive Area in Montana," manuscript by Robert C. Lucas, Hans T. Schreuder, and George A. James to be published as a USDA Forest Service Research Paper.

his companions in experience, attitudes and other factors. If a study's objectives deal with some group action, such as route of travel or length of stay, this group leader problem does not exist. However, sampling only group leaders is a serious drawback if characteristics and attitudes of individuals using wilderness are study objectives.

The nonregistration bias, the group leader bias and nonresponse all seem to favor the more interested, committed wilderness visitor at the expense of the less involved visitor. This threefold compounding could introduce a large cumulative bias in mail surveys. For example, the respondents would represent less than 17 percent of all individuals making visits, if we assume the following: a 75 percent registration rate, an average party size of four, and a 90 percent rate of questionnaire return.

Any registration sampling frame is defined in terms of *visits*. The person who makes several visits is more likely to be sampled than the one-time visitor. Visits may be entirely appropriate units, depending on study objectives. However, visits should not be confused in analysis or reporting with visitors ("visitors" are persons visiting an area during a season, regardless of how many visits they make). Therefore, one must say, for example, that 50 percent of all visits were made by college graduates, not that 50 percent of the visitors were college graduates.

Other Possible Methods

There are four other sampling methods that might be used for wilderness surveys, but each has serious weaknesses. Household surveys of a sample of the general population would be very inefficient because wilderness users are a small proportion of the population (probably about 2 percent for a single year).

Sampling a list of hunting and fishing license holders would have two important disadvantages. First, many wilderness visitors do not fish or hunt and therefore do not have licenses. This weakness is especially accentuated for national park visitors, because hunting is prohibited in almost all national parks. Furthermore, fishing in some parks does not require a license. Second, most license holders do not visit wilderness.

Auto license plate numbers could be recorded at access points and used to develop mailing lists. Length-of-stay bias affects this approach. Furthermore, only the person owning the car (who might not even be in the party) would be reached. Also, visitors entering from nearby campgrounds, resorts or dude ranches do not usually park a car at the takeoff point and would be excluded from the list.

Outfitters could be contacted for names and addresses of their guests, but past studies have indicated that a majority of wilderness visitors do not use an outfitter's services.

It would also be possible, of course, to combine the procedures used in interviewing and mail questionnaire methods in ways that have not been tried. Personal contact could be used to obtain names and addresses for a mail questionnaire. (This was done for nonregistrants.) This approach avoids the trail register's weaknesses and places less of a burden on respondents, but it still suffers from the small sample weakness inherent in the personal interview

method. If a better, less costly way of building a sample list is unavailable, this approach could be a good choice.

It would also be possible to draw a sample from trail registers and then conduct a personal interview in the visitor's home or perhaps by telephone. This would involve all of the weaknesses of the trail register method and be more expensive than the mail questionnaire method. Since wilderness visitors cooperate well with mail questionnaires, this approach probably would be ruled out except for unusual situations, such as long, unstructured interviews or interviews involving the use of photographs or slides.

Methods Tested

The two new methods were tested during 1969 in two national forest wildernesses and in three national parks. Each involved the use of portable, unmanned registration stations. Both types of stations had signs stating that a research study was being conducted and asking for cooperation. The first sign⁴ stated:

**SPECIAL WILDERNESS STUDY
ALL VISITORS MUST⁵ REGISTER
WHEN ENTERING**

To protect and manage wilderness, we need to know more about *you*, the wilderness visitor—what you do and what you think. Write the name and address of each person over 15 in your party on a card from the box and drop it through the slot. Some of you will be picked as sample visitors and mailed a questionnaire. If so, please complete it and send it back.
Thank you. USDA Forest Service Research

This "special sign" station was used during the summer on the Bridger Wilderness, Bridger National Forest in Wyoming and during the fall on the Clearwater National Forest portion of the Selway-Bitterroot Wilderness in Idaho.

The second registration station is shown in Figure 1. It had a tape message repeater mounted behind the sign board. The taped message conveyed essentially the same information as the special sign. This method was tested in the Bridger Wilderness only.

The conventional trail registration sign and box were covered with a cloth bag when the portable signs were set up. The existing trail registers were

4. This sign was developed from a suggestion by R. B. Herrington, Intermountain Forest and Range Experiment Station. The second approach, with the tape-recorded message, stems from a suggestion by George H. Stankey, also of the Intermountain Station.

5. The sign used during 1970 in four wildernesses dropped the "MUST." We conclude that the authoritarian tone was unneeded, since the registration rates without it were actually slightly higher than with it.

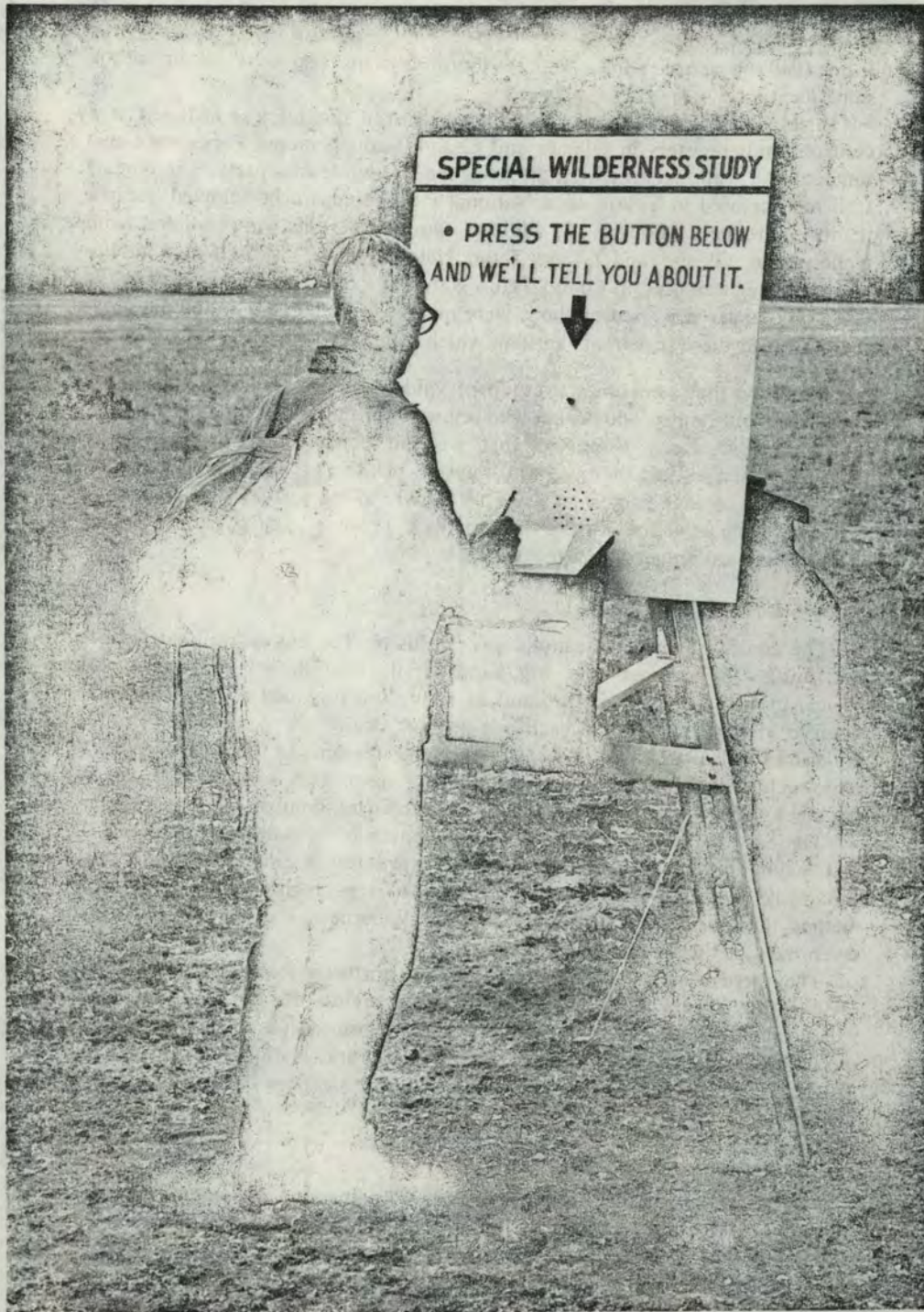


FIGURE.1. A HIKER ENTERING THE BRIDGER WILDERNESS REGISTERS AT THE EXPERIMENTAL MESSAGE REPEATER TRAIL REGISTRATION STATION.

located at the access points, and the portable signs also were set up at the same locations.

In the Bridger Wilderness, a conventional trail register was included as a control. Trail registers in Glacier and Grand Teton National Parks were also sampled. All trail registers were the book type, one line to a party. The type of trail register used in Yellowstone National Park could not be sampled because it did not request addresses. In addition campfire permits were sampled from Yellowstone, Glacier and Grand Teton National Parks, as well as a mountaineering register used in Grand Teton National Park. To try to overcome the group leader bias, past methods were modified by including in the questionnaires sent to these registrants an item which stated:

We know that sometimes a group of wilderness visitors have different ideas about things. The person who registers for the group (you) is often different in many ways. So that we can contact some wilderness visitors besides just the ones who register, please give us the names and addresses of each person 16 years old or over in the party. If the address is the same as yours, just use ditto marks (""). Some of these people will receive questionnaires in a few weeks.

Sample Locations

The choice of sample locations was purposive. The busiest trail entrance to the Bridger Wilderness—the Big Sandy trail—was chosen because it was typical in terms of type of use, and its heavy use provided a good chance to observe visitor reaction to each registration device. A peak use period—August 11–31, 1969—was chosen for the same reasons. In the Bridger Wilderness, each of the three registers was tested for seven days, once on each day of the week. The system used each day was chosen randomly.

The Selway-Bitterroot Wilderness was chosen for a fall, hunter-use test. It is a major hunting area, and horses are the ordinary means of travel. A busy trail—Elk Summit—was chosen. The special sign registration method, the method that performed best in the Bridger Wilderness, was tested for the first seven days of the 1969 hunting season.

The three major National Parks in the northern Rockies—Yellowstone, Glacier and Grand Teton—were included to pretest the questionnaire more widely and to determine how many visitors registered on more than one of the two or three types of registers used in each Park. National park personnel provided a sample spread over the season and over locations to roughly approximate randomization.

Field Observations

In the Bridger and Selway-Bitterroot Wildernesses, an observer located himself up the trail where he could be inconspicuous and use binoculars to watch visitor actions at the registration station and where he could intercept those failing to register and ask them for their names and addresses. He checked the trails from early morning to midafternoon each day. This approach worked well in the Bridger Wilderness, but rain and fog reduced visibility so much in the Selway-Bitterroot Wilderness that almost everyone

entering had to be asked for names and addresses which were then compared to registrations. Visitors cooperated well and cheerfully everywhere.

Questionnaire Mailing

Almost all of the registrants and personally-contacted nonregistrants were mailed a 6-page questionnaire,⁶ which was designed to obtain a basic description of themselves, their visit and some fundamental attitudes about the area and its use. A cover letter and a self-addressed, postage paid (franked) return envelope were also enclosed. Up to a maximum of four followup reminders were mailed to nonrespondents at 20-day intervals. Each followup cover letter was different (each progressively shorter), but each stressed the importance of responding. An additional copy of the questionnaire and a return envelope were included each time.

A random sample of "other party members" was selected from the names of companions listed on the questionnaires returned by the visitors sampled from conventional trail registers. To facilitate comparisons, the investigators tried to obtain a sample of "other party members" of about the same size as the sample of original registrants.

Results of the Pilot Test

The "special study" sign produced the highest registration rate by a wide margin during the summer, but this margin was less during the fall (Table 1). However, the major difference in registration rates was between hikers and horsemen, rather than between summer and fall visitors. Summer visitors were predominantly hikers, but most fall visitors, all of whom were hunters, rode horses. Hikers registered readily, but it was difficult to get horsemen to register regardless of the system used. The best success with horsemen was realized with the special sign in the summer, where half of a very small sample registered. During the summer of 1970, 67 percent of the thirty-six horsemen observed registered at special sign stations.

The superiority of the special sign, at least for hikers, seems obvious in Table 1. This conclusion is supported by the results of a variance analysis of weighted means⁷ of registration rates transformed to arcsins, which suggests that the rate for the special sign is higher than either that for the message repeater or that for the conventional register (.05 significance level). The difference was not established between the message repeater and the conventional register.

The registration rate for the conventional trail register in the Bridger Wilderness was actually lower than that observed in the Oregon study of wilderness

6. Two very large parties from outdoor clubs were randomly subsampled with a sampling fraction of 1/3. A few nonregistrants were observed, but could not be contacted. Additional sample names were taken from the Bridger conventional trail register from the period before the test. For these reasons, the "numbers exposed" in Table 1 do not equal the "number delivered" in Table 2, even after accounting for undelivered questionnaires returned by the the Post Office. Mailings were usually made from one to three months after the trip.

7. The analysis was an adaptation of a method for one-way classification with unequal replication, from Steele and Torrie (1960, pp. 116-117). Only the Bridger results were analyzed, because only there were the three methods compared.

TABLE 1
VISITOR RESPONSE TO THREE TYPES OF WILDERNESS TRAIL REGISTERS

WILDERNESS (SEASON)	TYPE OF TRAIL REGISTER	TYPE OF VISITOR	INDIVID- UALS EXPOSED ^a	PERCENT EXPOSED WHO REGIS- TERED	PERCENT EXPOSED WHO GAVE USABLE ADDRESS	PERCENT RETURNED BY P.O.
Bridger (summer)	Special sign	All visitors	109	92	92	1
		Hikers	103	94	94	
		Horsemen	6	50	50	
	Message repeater	All visitors	65	54	54	2
		Hikers	43	70	70	
		Horsemen	22	23	23	
	Conventional	All visitors	34	65	53	5
		Hikers	30	70	60	
		Horsemen	4	25	0	
Selway-Bitterroot (fall)	Special sign	All visitors	44	27	23	0
		Hikers	11	73	73	
		Horsemen	33	12	9	

^aConventional register figures are for groups, not individuals.

registration (Wenger and Gregersen 1964) and the same as that observed in the Montana study.⁸ Thus to hypothesize that a very high registration rate for the special sign might merely reflect unusually cooperative visitors appears unsupported.

The poor performance of the message repeater was a surprise. It was expected that it would produce the highest response. Almost all parties pressed the button and the message played flawlessly, but almost half the people did not register. The speculation is that fascination with the device distracted people from the message. Many people peered around behind the sign, curious about how it worked. When contacted afterwards on the trail, a few indicated that they thought recorded messages were inappropriate in the wilderness setting. The message was recorded by a professional radio announcer, and with hindsight, it is suspected that it may have sounded too smooth and "canned." There seems to be little reason to experiment further with recorded messages for sampling visitors in wilderness studies, however, since the special sign is more effective and obviously cheaper, simpler and more reliable.

Quality of Addresses

About 20 percent of the names and addresses on the conventional trail register in the Bridger Wilderness were not usable (incomplete or illegible), and 5 percent of those that looked usable were returned by the Post Office as undeliverable. The same problems were encountered in sampling from the names and addresses taken from the national park registers.

In contrast, almost all registration cards from the special sign and message repeater registration stations could be used, and less than 2 percent of the questionnaires were returned by the Post Office as undeliverable. The non-registrants contacted on the trail all gave usable addresses, and none of these questionnaires was returned as undeliverable.

8. Unpublished study by Lucas, Schreuder and James cited previously.

Addresses of "Other Party Members"

About 63 percent of the respondents sampled on conventional registers gave names and addresses for all of their companions sixteen or over, as requested in the questionnaire. (The age of sixteen was chosen only because it was felt that this age came close to guaranteeing ability to handle a written questionnaire, not because of any denial of the importance of younger visitors.) Names and addresses were given for 66 percent of the total number of individuals sixteen or over that were reported by the respondents. These addresses proved to be of fairly high quality; 94 percent appeared usable, and only 1 percent of these could not be delivered by the Post Office.

Questionnaire Response

Visitors responded extremely well to the mailed questionnaire; overall, 91 percent of the questionnaires were returned by the cut-off date which was set at twenty days after the last mailing (Table 2).

Almost all questionnaires were completely filled out, suggesting no serious recall problems. "Don't remember" was provided as a possible answer wherever appropriate, but it was rarely used and usually accounted for less than 1 percent of the answers, except for questions about expenses, where "don't remember" rose to around 10 percent of the total. There was every

TABLE 2

RATE OF RETURN OF MAILED QUESTIONNAIRES

TYPE OF REGISTRATION USED	SOURCE OF NAMES AND ADDRESS	NUMBER DELIVERED*	PERCENT RETURNED
1) Special sign trail register	Self-registration	107	98
	Non-registrants personally contacted	39	87
2) Message repeater trail register	Self-registration	35	94
	Non-registrants personally contacted	15	93
3) Conventional trail register	Self-registration	118	96
	Non-registrants personally contacted	23	96
4) Campfire permits (National Parks)	Self-registration	141	89
5) Mountaineering register	Self-registration	24	96
6) Types 3, 4, and 5 above	Listing by group registrant ("Other party members")	206	85 ^b
7) Grand total		707	91

*Questionnaires returned by the Post Office as undeliverable are omitted. See Table 1 for percent of undeliverable questionnaires.
^bOnly two follow-up mailings were made for "Other party members" compared to four for all other visitors.

indication of thoughtful, conscientious answers. Additional, volunteered comments were common, and 6 percent of the questionnaires had some sort of unsolicited approving remarks, such as, "Thank you for giving me this chance to express my ideas." Only two questionnaires had any critical or resentful remarks, and even one of these had been filled out fairly completely.

All types of registration produced high rates of returns. It was hypothesized that those people who were informed of the study and led to expect a questionnaire would be more likely to fill it out and return it than would people who received no advance notice. The evidence on this point is mixed. The visitors who registered on the conventional trail register did not know a questionnaire was coming, but 96 percent of them returned the questionnaires. On the other hand, the national park visitors sampled from campfire permits, all of whom also received questionnaires with no advance notice, had slightly lower rates of return than forewarned national forest visitors. The effect appears small if it exists at all.

It was also hypothesized that nonregistrants exposed to either of the two systems that announced a research study was being conducted would have a lower rate of return than registrants, since these people had rejected a chance to receive a questionnaire. In a sense, they declined to volunteer and then were drafted, but nevertheless the nonregistrants exposed to the message repeater had about the same rate of return as registrants, and the difference for those visitors exposed to the special sign was not great.

Nonregistrants as a Source of Bias

Nonregistrants' answers to many questions differed significantly (at the .05 level as tested by chi-square) from the answers given by registrants. For example, nonregistrants did significantly more fishing, less mountain climbing and less swimming than did registrants. They were less likely to be members of national wilderness-oriented clubs. They were two to three times more likely to be farmers, business proprietors, clerks or "blue collar" workers, and they were less than half as likely to be professional people or students than were registrants. Nonregistrants had completed much less school, were less likely to be married, were older, made fewer wilderness trips during 1969 and were less satisfied with their visit. In short, the nonregistrants did not fit the descriptions of wilderness users in previous studies, and omitting them from a sample seems very undesirable.

Responses of "Other Party Members"

Although the technique of asking the person who registered for his group on a conventional trail register to provide names and addresses of his companions worked only moderately well, these companions had a high questionnaire return rate. Only two followups were sent to the sample of companions, but an 85 percent response rate was still achieved. This is about the same as the response from the first two of the four followup mailings made

9. A systematic observation schedule was used to record if the people stopped, took time to apparently read the sign or push the recorder button, took out a registration card, etc. Almost everyone apparently read the sign and played the recording.

to the original sample. There was almost no variation between areas in response rates for the other party members.

Unfortunately, this way of reaching other party members suffers from a compounding of nonresponse. Some registrants do not return questionnaires, others omit some of their companions' names and some companions do not respond. As a result, probably close to half of the "other party member" population would not be represented.

Furthermore, the results indicate the group leader registrants did differ from their companions. Statistically significant differences were found for most social and economic variables—age, sex, occupation, family relationship, length of vacation and years of education. The underrepresentation of wives was pronounced. Wives made up only 4 percent of the family group registrants, although they accounted for 25 percent of all family group visitors sixteen or over. Most activity data differed, but usually only between the .25 and .10 level of statistical significance. On the other hand, the attitude questions asked showed no significant differences. The attitude questions concerned satisfaction, reaction to numbers of other visitors met, opinion of the area's condition (littering and wear and tear), opinion of the level of development, personal importance of wilderness, reasons for taking the trip and conservation club membership.

Conclusions and Recommendations

The major disadvantages of past mail survey techniques used to study wilderness visitors are incomplete coverage of the sampling frame by registration lists and bias in these lists. Both disadvantages can be reduced. Coverage can apparently be increased in most cases by explaining to visitors why their names and addresses are needed. The field test described in the paper suggests that a portable registration station with a brief explanatory sign can inform visitors and increase coverage. It is also possible to eliminate the bias towards party leaders by asking all individuals over some minimum age to register. If the study's objectives are best served by sampling group leaders, the sign wording could be modified to obtain only leader registrations, while retaining the advantages of higher registration rates and less bias.

The costs of the special registration system are much lower than direct, personal contact with visitors, and costs could be reduced further by use of a cluster sample design in which registration stations would be used only for sample trails and blocks of time. Registrants could then be subsampled, using a probability-proportional-to-size (PPS) design to reduce variation in sample cluster sizes (Kish 1967, chapter 7). A cluster design would reduce the precision of estimates for a given sample size and increase the complexity of some statistical computations, but it could cut field costs or enlarge the sample enough to make it the best choice.

The weakness of the mail survey method is that although nonregistration was reduced, it was not eliminated (especially for horsemen). For hikers, the tested system works well; 94 percent of summer hikers cooperated. This reduces to a minor problem bias resulting from not sampling hiker non-registrants, despite the fact that the results indicate numerous significant differences between the responses of nonregistrants and registrants. The fall

hiker registration rate (73 percent) is lower than the summer hiker rate (94 percent), but it is far better than the response to conventional trail registers by fall hikers.¹⁰ This rate probably is satisfactory. The fall rate is far less precisely estimated because it was based upon a much smaller sample. However, if the amount of nonregistration seems unacceptably large, or if a scientist suspects the registration rate in his study may fall lower than it did in this test, then registration rates should be spot checked by an observer located up the trail. A sample of nonregistrants should be obtained during the spot checks. Questionnaires completed by the nonregistrants then could be weighted and combined with registrants, or at least used to estimate the nature of bias in the registrant data.

The horseman nonregistration problem is more serious. Spot checking registrations would yield a sample of nonregistered horsemen. However, if no more than half the horsemen registered, precise estimates probably would not be obtained at sampling intensities that would be feasible. Three ways of dealing with the horseman problem seem possible:

1. The registration stations could be redesigned to make it possible to register from horseback. We are planning to test such a design. Locating the registration station at the horse unloading ramp also might increase effectiveness.

2. Greater efforts could be made to inform outfitters of the study and to solicit their cooperation. The dismal showing with fall horsemen in this study was attributed largely to the complete noncooperation or misunderstanding of one outfitter.

3. If it is possible to identify access points where horse use exceeds some proportion of all use (perhaps 10 or 20 percent), these locations could be treated as a separate stratum to be sampled by personal contact to obtain a sampling list. Horsemen cooperated well both in supplying addresses when contacted on the trail and in completing mail questionnaires.

The costs of personal contact might be reduced if visitors in horse-use areas could be checked on key access roads that serve a number of trailheads. The checkpoint could be similar to a game checking station. Filter questions could screen out nonrecreational drivers and visitors who had not been in the study area. To equalize probabilities for all wilderness visitors, only people leaving the area (not just going back into town, etc.) should be asked for their names and addresses. Brief roadside interviews were used in one wilderness study (Lucas 1964) and in two studies of extensive recreational use of non-wilderness areas (Cushwa and McGinnes 1963; James and Henley 1968). Motorists cooperated well, but the interviews had to be brief. The mail questionnaire gets around this limitation.

The technique of asking the individual who registers to supply a list of his companions' names and addresses as part of the questionnaire was only partially successful. We hesitate to recommend using it, although it would be very easy and inexpensive anywhere that the conventional group registration rate was high enough. It certainly is an improvement over completely ignoring

10. The fall registration rate in the unpublished study by Lucas, Schreuder and James (cited before) was only 41 percent, and 85 percent of fall visits in the study area were by hikers.

everyone except party leaders. Future mandatory registration systems could be valuable research tools in this connection.

The high rate of return of the questionnaires was so consistent and widespread that we feel confident that nonresponse can be cut down to acceptable levels through followup reminders, at least for questionnaires of moderate length and difficulty.¹¹ The high educational levels and interest of most wilderness visitors are assets that give mail surveys great advantages in studying these recreationists.

11. For helpful suggestions, see Robin (1965).

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