AUTOMATIC, TIME-INTERVAL TRAFFIC COUNTS FOR RECREATION AREA MANAGEMENT PLANNING[1]

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Abstract.--Automatic, time-interval recorders were used to count directional vehicular traffic on a multiple entry/exit road network in the Red River Gorge Geological Area, Daniel Boone National Forest. Hourly counts of entering and exiting traffic differed according to recorder location, but an aggregated distribution showed a delayed peak in exiting traffic thought to be typical of recreation areas. The proportions of hourly entering and exiting traffic and weekend and weekday traffic varied among locations. An exceptionally high weekend use was related to occurrence of the autumn color season. Subsequently, there was a general down-trend in weekend use. Implications of traffic data for the allocation of resources to information, interpretation, and enforcement programs in the Red River Gorge area are discussed.

INTRODUCTION

Traffic counts have been used as an indicator variable for recreation use estimation on forest lands and developed recreation sites (James 1971). With few exceptions, axle counts, as opposed to vehicle counts, have been used as the indicator variable in regression models. Typically, recorders are placed on two-way, single-entry roads leading to developed or dispersed recreation areas. Usually, traffic recorders must be hand-read at selected time intervals by field personnel. This paper reports the use of dual-input, time-interval recorders to record hourly and daily variations in traffic flow in forest areas with multiple entry/exit points. These recorders were used in a recreation use estimation study on the Red River Gorge Geological Area on the Daniel Boone National Forest.

Data on time variation in traffic counts have implications for the development of recreation area management plans. Recreation

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planning can be viewed as a production process where management and site resources and human use are managed to produce recreation experiences and ultimately, human benefits (Driver and Brown 1975). It is important to know the total amount and the hourly and daily patterns of recreation use because of their impact on recreation experiences, the resource base, and management loading. Heavy amounts of recreation use can cause displacement of dissatisfied users in both time and space. It can also increase the probability of traffic accidents, forest fires, user conficts, and unacceptable public behavior, as well as resource impacts such as trail and campground deterioration. Information about the distribution of recreation use is important for assigning of personnel and other management resources to road and trail patrols, interpretive activities, maintenance work loads, requests for traffic control, and justification for requests for personnel overtime. All of these are management activities which can contribute directly to enhancing recreational experiences.

METHODS

In the summer of 1979, a recreation use study was inititated in the Red River Gorge Geological Area. The Gorge is a 25,750 acre area located in the Stanton District of the Daniel Boone National Forest. Dual-input traffic recorders were located at six locations along roads near the Gorge boundary (Fig. 1). These locations are Pine Ridge, Koomer Ridge, Tunnel Ridge Road, Nada Tunnel, Road 23, and CCC Camp. At each site, inductive loops were installed to record directional traffic, and recorders were set to print and punch traffic counts at 15-minute intervals during the 4-month study period, August 1 to December 2, 1979. Data were punched onto 8-channel paper tape and translated to computer cards. Data were aggregated into hourly and daily counts and plotted.

RESULTS

Although recorders were installed at six locations, the traffic data for two locations--Koomer Ridge and Tunnel Ridge--were excluded from data analysis. These recorders were located on single-entry roads where vehicles entered and exited the same point. These data have no effect on the total traffic load of the multiple entry/exit road network.

Graphs of the number of vehicles plotted in relation to hour of the day provide information on hourly patterns of vehicular traffic at specific locations in the Gorge area. Pine ridge, located near the Mountain Parkway, appears to be more important as an exit point for vehicular travel (Figure 2). More vehicles are exiting than entering at this point. There are approximately equal amounts of traffic entering and exiting this point until about 2 p.m. when exiting traffic begins to exceed entering traffic. Exiting traffic peaks at 4 p.m. Also characteristic of this point is the high volume of exiting traffic occurring in a narrow time span and a lower volume of entering traffic in a wider time span.

In contrast to Pine Ridge, Nada Tunnel has more entering than exiting traffic (Figure 3). The curve of the entering traffic reaches its summit at 4 p.m. and then declines rapidly. Compared with this curve, the exiting traffic curve climbs at a slower rate. It reaches the highest point about 4 p.m. and then follows a gentle decline until 6 p.m. Thereafter, the curve drops rapidly similar to the entering traffic curve. We suspect that most of the vehicles that depart between 2 and 8 p.m. are day users of the Gorge area.

In comparison with Pine Ridge and Nada Tunnel, CCC Camp has a different traffic pattern. There are about equal amounts of entering and exiting traffic at all hours of the day (Figure 4). These curves depict traffic patterns revealing heavy local use.

To obtain an understanding of hourly traffic for the entire gorge area, data were aggregated for Pine Ridge, Nada Tunnel, CCC Camp, and Road 23 and then plotted (Figure 5). There is a more rapid increase in the entering than exiting traffic until about 2 p.m. At that time, the rate of exiting traffic begins to accelerate. Note, again, the delay in the peaking of exiting in relation to entering traffic. While we recognize that some residential traffic is included in this plot, we believe that it is typical for a multiple entry/exit forest area such as the Red River Gorge area.

Figure 6 shows the entering traffic for Pine Ridge and CCC Camp throughout the study period. At Pine Ridge, there was a great deal of difference between weekends and weekdays which suggests heavier recreational traffic entering this point in comparison to local residential traffic. CCC Camp, on the other hand, does not show much variation in weekday to weekend traffic suggesting proportionately more residential/commercial traffic.

Figure 7 shows the incoming and exiting traffic for the aggregate of Pine Ridge, Nada Tunnel, Road 23, and CCC Camp. Note the differences between weekend and weekday traffic. Weekend traffic is much heavier than weekday traffic which is not surprising. Many studies have reported such variations in traffic patterns at recreation use areas--and researchers

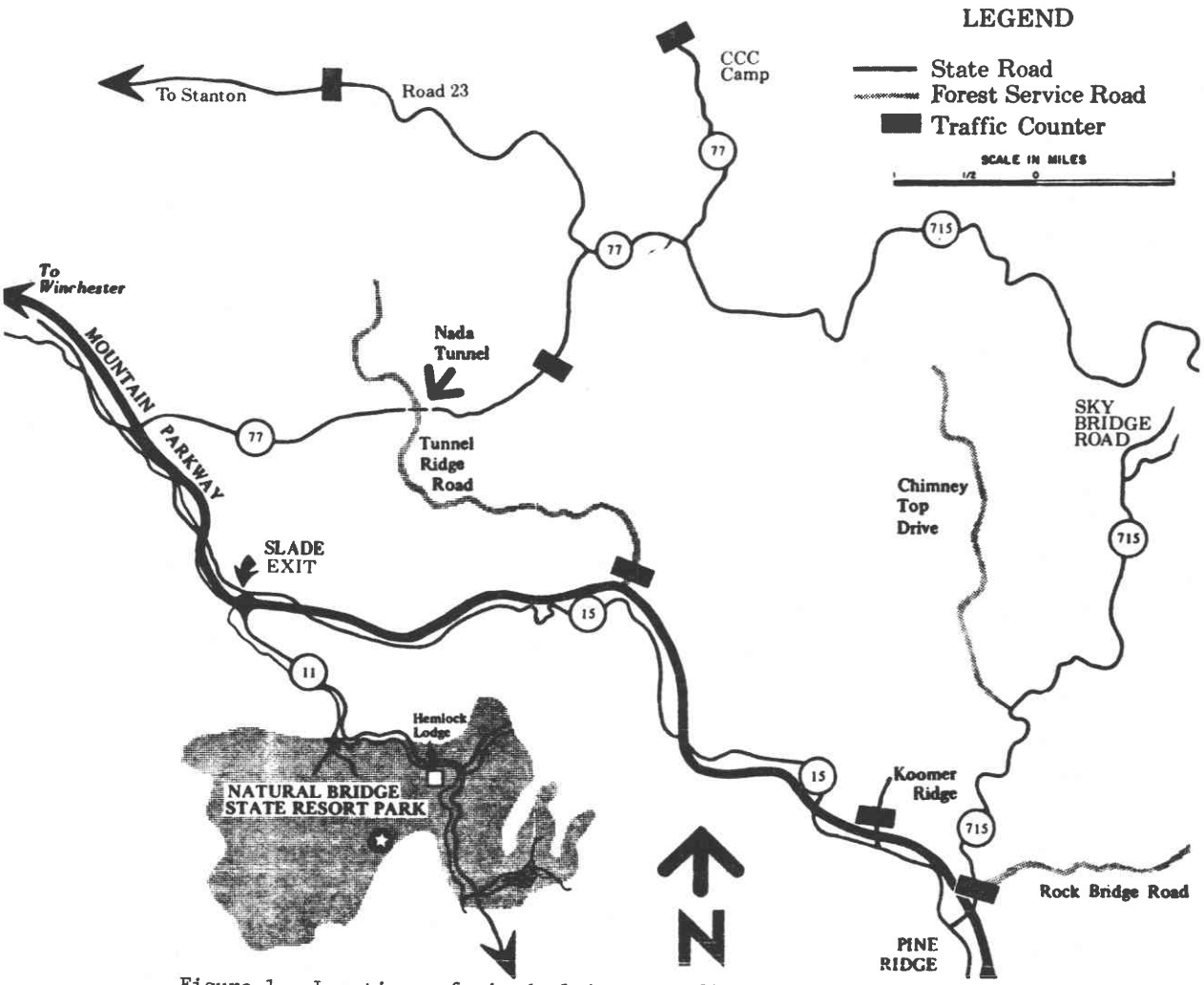

Figure 1. Locations of six dual-imput traffic recorders near Gorge boundary.

have used these data to stratify the sample in recreation use studies.

Note also that some of the weekend days have considerably larger volumes of traffic. The highest one is a weekend of peak fall color. Another weekend is a holiday, labor day weekend. In Figure 7, there appears to be a downward trend in traffic after the peak fall color weekend. Although there is some variation from weekend to weekend, this variation suggests that traffic levels may be related to local weather. Hendee et. al. (1976) reported that low levels of use were associated with adverse weather.

IMPLICATIONS

This study reports daily and hourly fluctuations in traffic counts in the Red River Gorge area. To make suggestions about the implications for recreation management planning requires three assumptions. First, there are small variations in the proportion of recreational traffic within weekend and weekday strata. To the extent that there is variation, traffic patterns will not be valid indicators of volumes of recreational traffic in the Gorge area. A second assumption is that that proportion of recreation traffic does not vary significantly at each traffic counter location over a short period of time. A third assumption is that accurate directional traffic counts can be made. Our calculations show a traffic count error of 3 percent per site per day. We believe that the major cause of this counting error was not a malfunction of traffic recorders, but rather a double count, one for each direction, resulting from vehicles traveling down the center of the road. A procedure for eliminating directional traffic counting error has been developed (Erickson, in press).

The data presented above have a number of

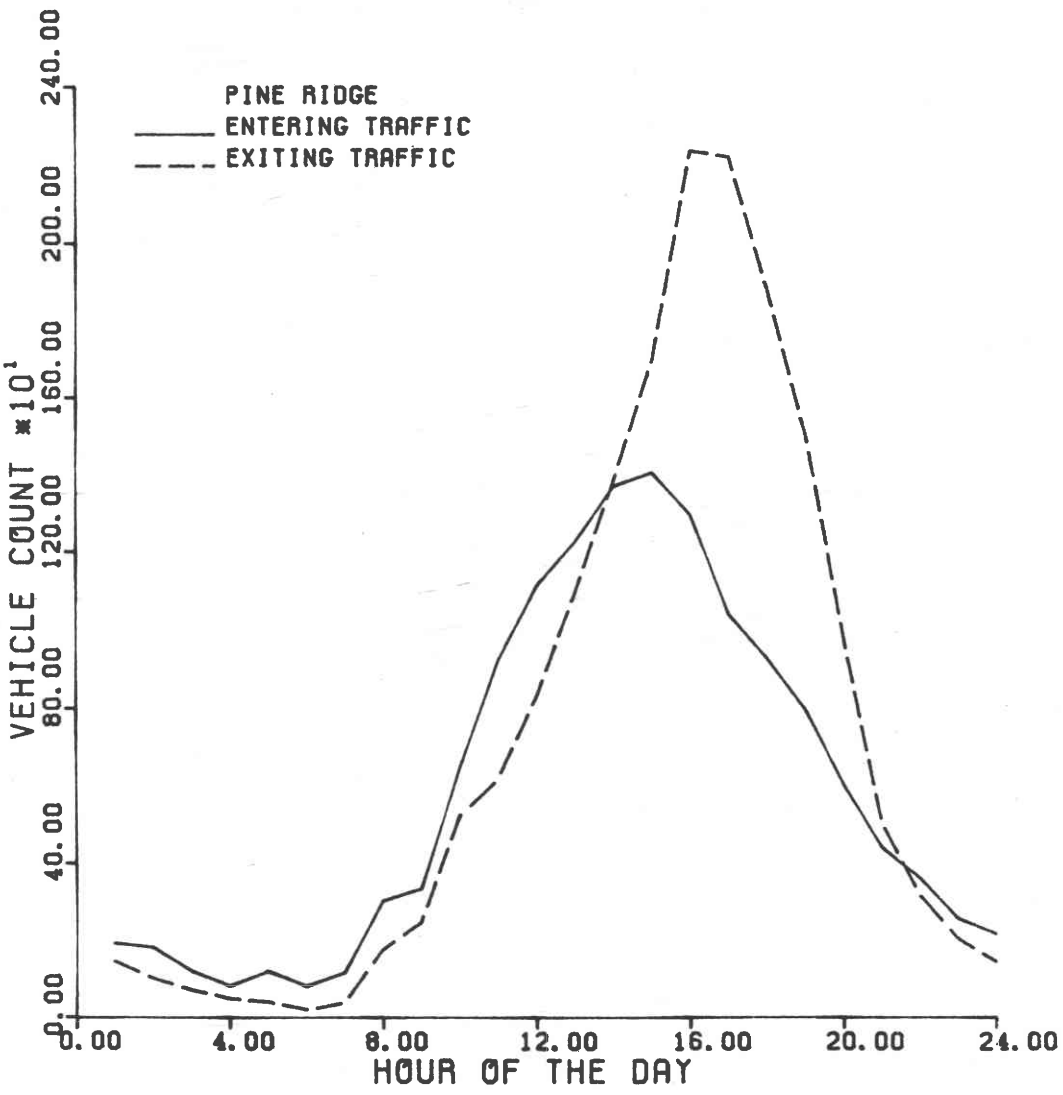

Figure 2.--Hourly entering and exiting vehicular traffic between August 1 and December 2, 1979 at Pine Ridge.

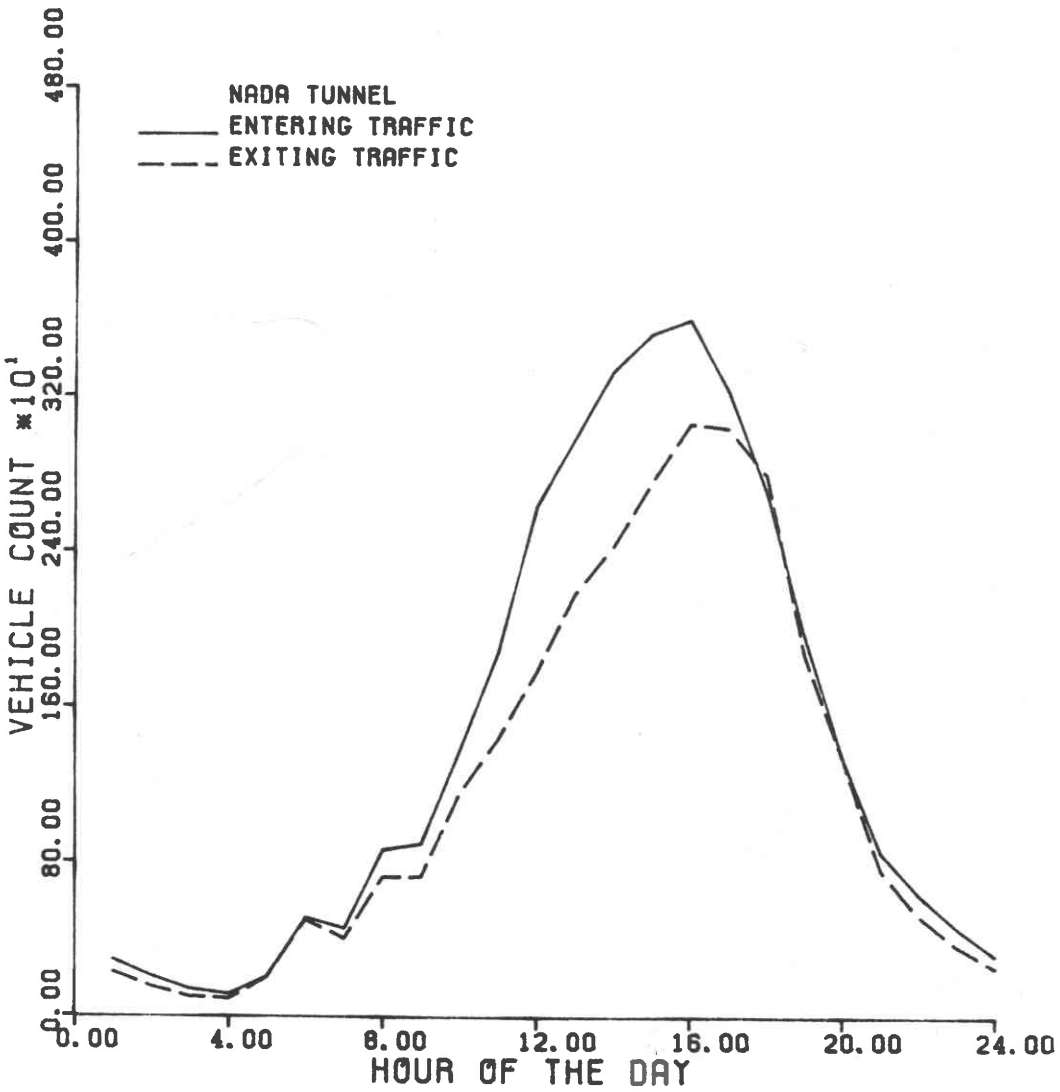

Figure 3.--Hourly entering and exiting vehicular traffic between August 1 and December 2, 1979 at Nada Tunnel.

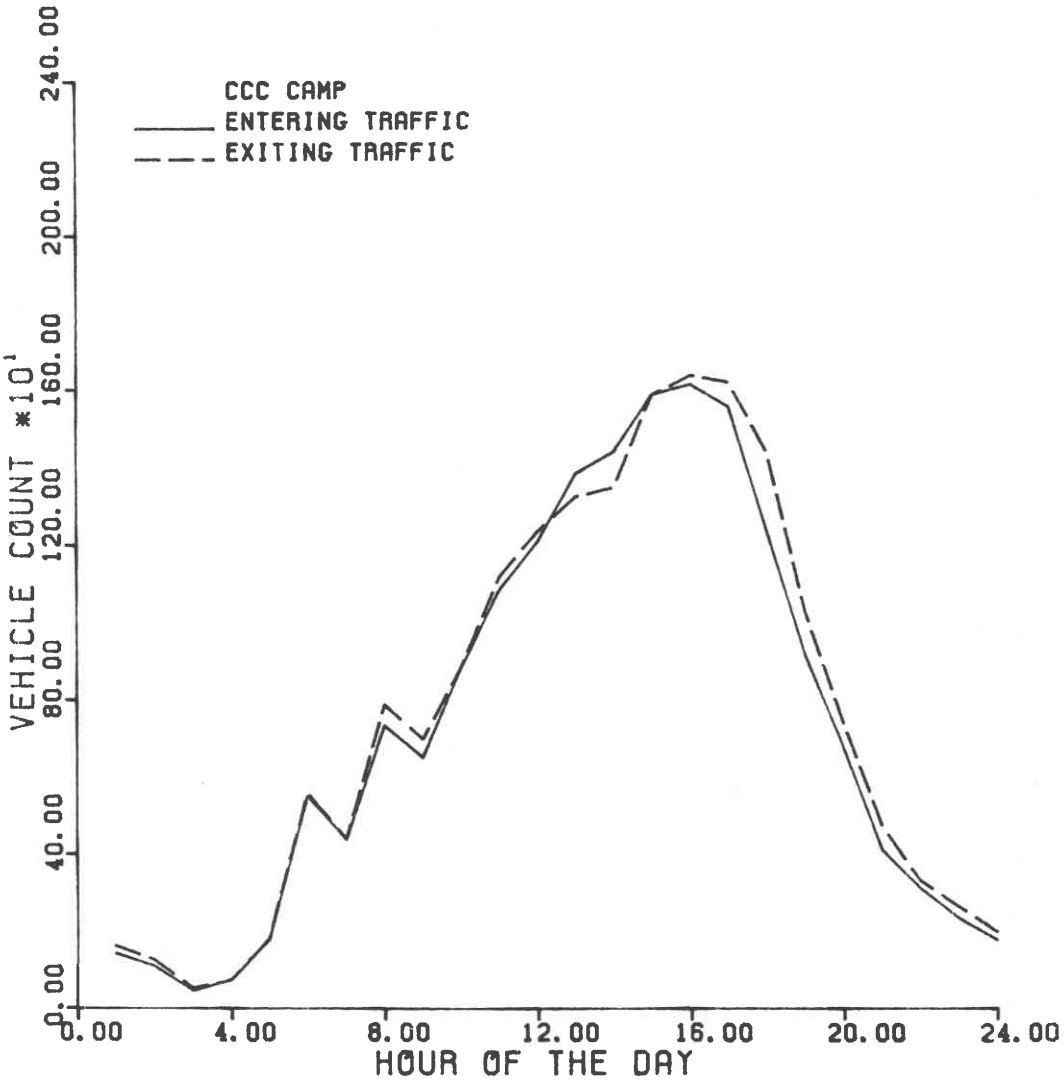

Figure 4.--Hourly entering and exiting vehicular traffic between August 1 and December 2, 1979 at CCC Camp.

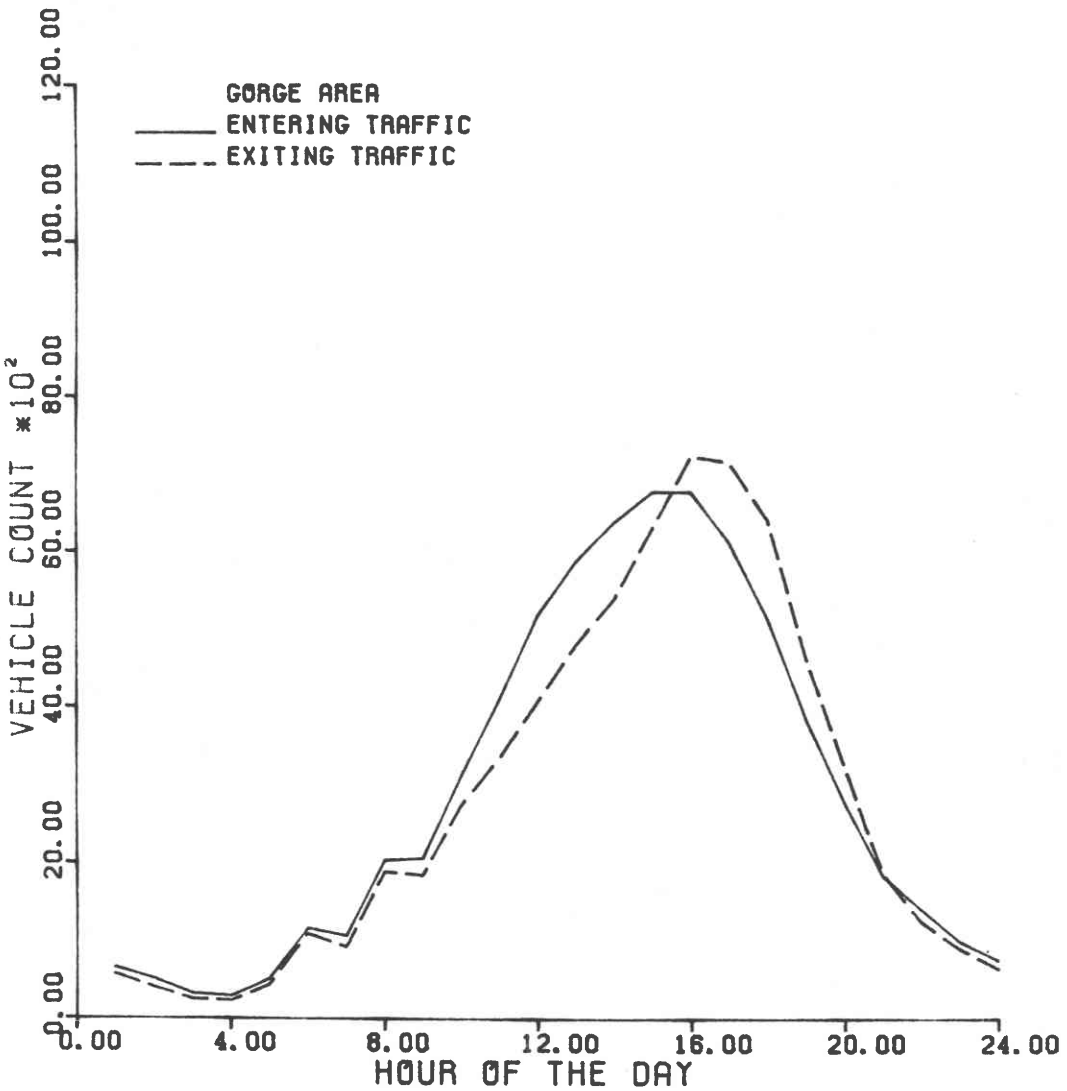

Figure 5.--Aggregated hourly entering and exiting vehicular traffic between August 1 and December 2, 1979 for four locations in the Red River Gorge Area.

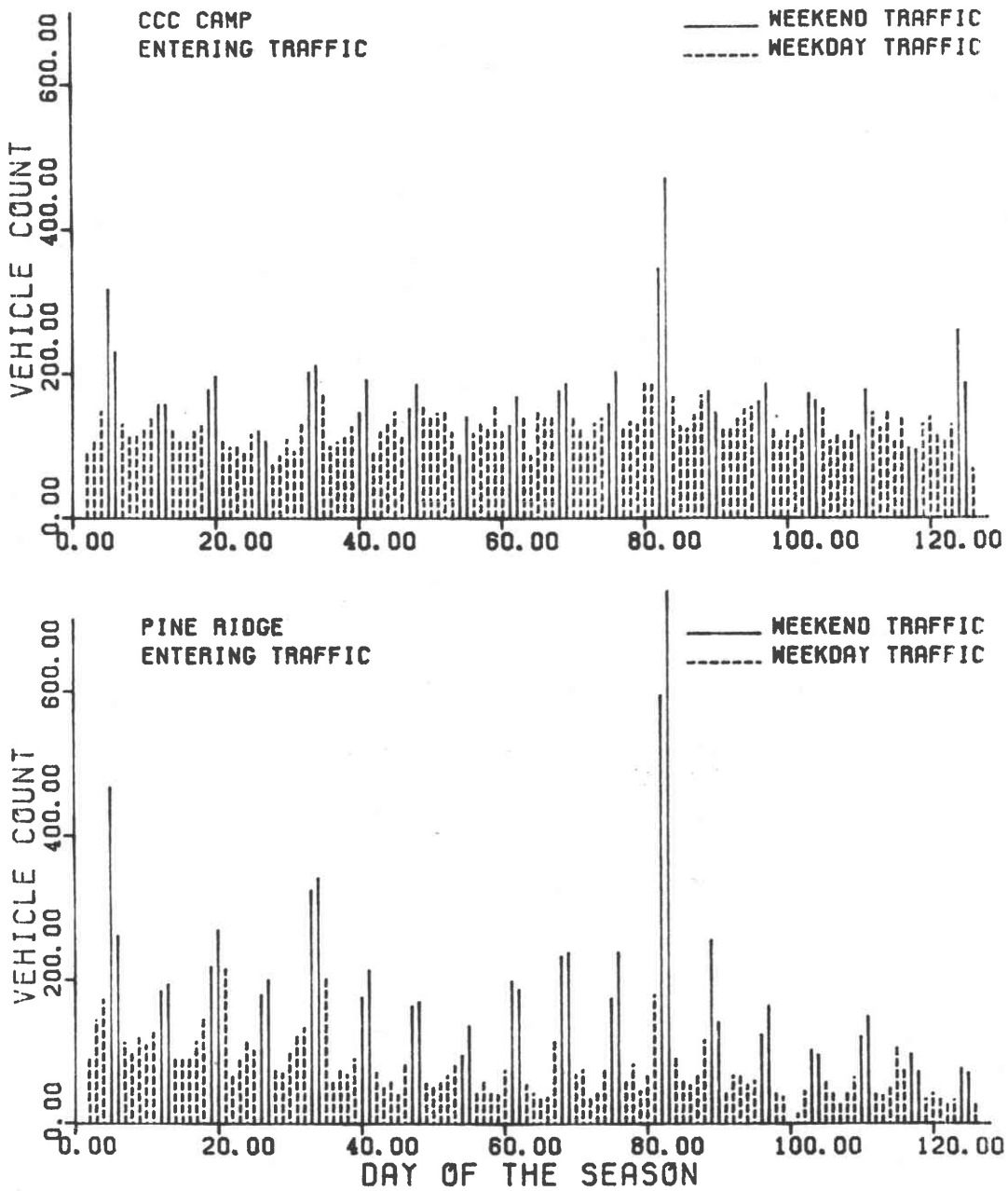

Figure 6.--Daily distribution of entering vehicular traffic between August 1 and December 2, 1979 at two Red River Gorge entry points.

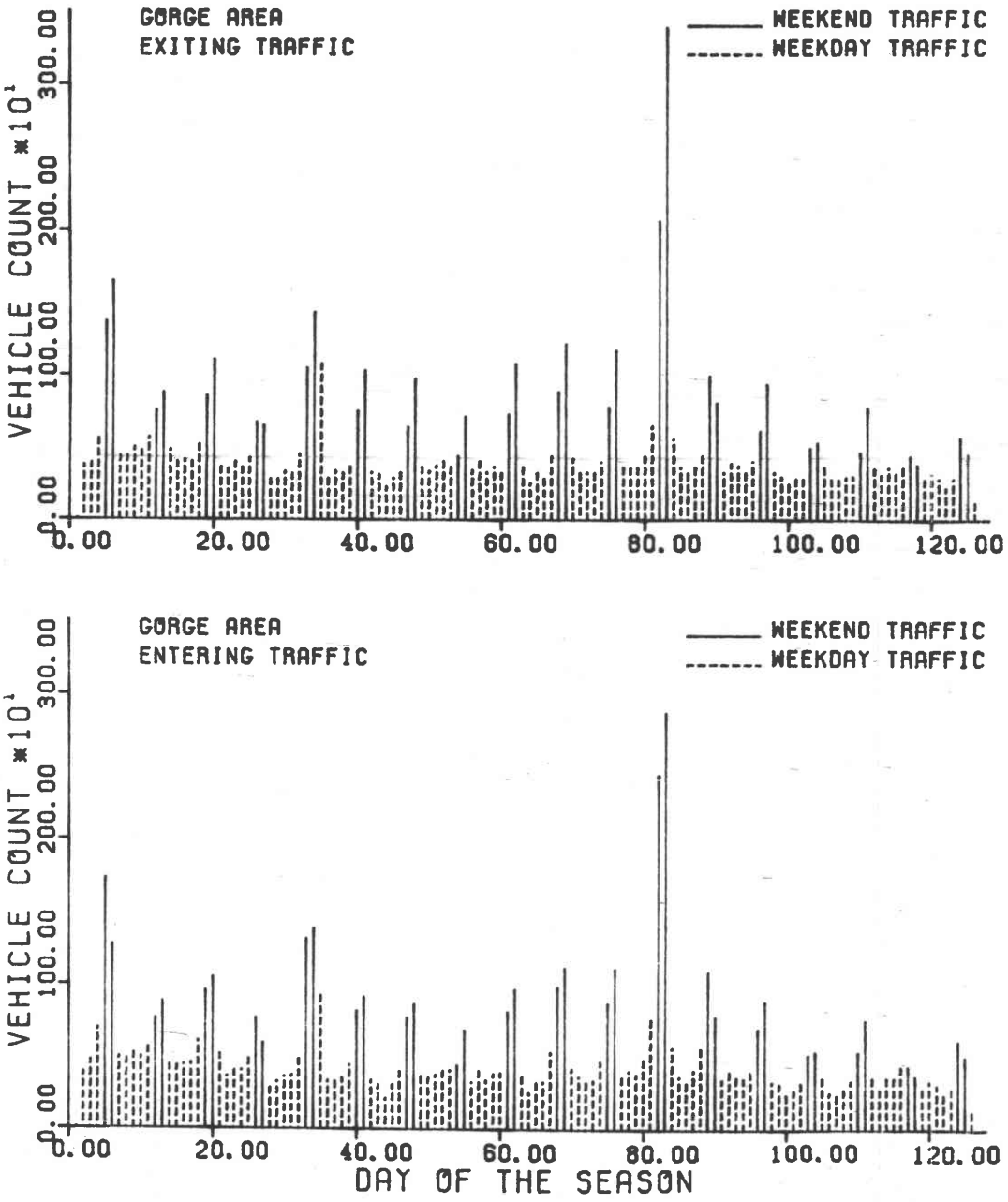

Figure 7.--Aggregated daily entering and exiting vehicular traffic between August 1 and December 2, 1979, for four locations in the Red River Gorge Area.

implications for recreation management planning. Our data suggest that certain roads are used more heavily as entry points into the Gorge area, e.g., Nada Tunnel, while others are used more heavily as exit points, e.g., Pine Ridge. Based on comments received during the study period, people are not knowledgeable about the kinds of recreational opportunities in the Gorge area, and are not informed about the geological significance of it. Given the heavier entering traffic at Nada Tunnel, it would be effective to locate information/interpretive media at this location. On weekends, it may be desirable to locate staff to both control traffic at the Tunnel and to hand out a brochure for a self-guided auto tour (Sharpe, 1976) or for stimulating use dispersal away from crowded sites. Nada Tunnel is a single vehicle passage through the mountain. As a result, traffic is slowed down considerably, particularly on weekends.

Pine Ridge had more exiting than entering traffic. At this point, it may be appropriate to locate a departure sign. In addition, it also might be desirable to locate a deposit box where people could place their suggestions for improving the area.

The greatest need for road or trail patrols would appear to be from 10 a.m. to 4 p.m. since most of the traffic is either entering or exiting from the Gorge area. After 4 p.m., entering and exiting traffic decreases at a rapid rate. This would appear to be an appropriate time to contact campers to see if they have problems. This might also be an appropriate time to conduct an interpretive program.

Many of the vandalistic acts that occur in forest areas occur at night, and traffic counts may be an indicator of these acts--even recorders are subject to tampering. Examination of traffic records for days and nights when vandalism has occurred may help identify most likely times of occurrence and from where those committing the vandalistic acts may have entered the system.

From a management planning standpoint, it is necessary to have a firm rationale for allocating management personnel and other resources. Obviously traffic in the Gorge area is higher on weekends, suggesting that more personnel should be allocated to these days. But among weekends, use is highly variable and the specific number of personnel needed must be decided on the basis of expected visitor load. An examination of vehicular loading for one year should be useful for determining personnel needs for specific weekends and other periods for several succeeding years. For weekends that are known to have high use levels, such as holidays or weekends at the peak of the fall color season, additional temporary personnel might be hired or reassigned to assist in visitor management including interpretation and enforcement.

Traffic counts such as recorded during 1979 for the Red River Gorge Area should have use for area management planning for a few years after the study period. Perhaps equally important, however, are insights that might be gained by 3- to 4-year repeat measures of traffic periodicity and patterns. Noticeable changes in either hourly or daily pattern of use could indicate evolving changes in these patterns or in the type of users. Forest recreation management is greatly in need of such indicators of change so that evolution of use patterns can be detected rapidly.

In summary, hourly, daily and seasonal traffic flow records seem to be useful management and program scheduling tools. There is much we do not know about interpreting traffic flows, but further research and management application should teach us a great deal.

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