6. There was no significant difference between the stationary and the stationary-moving modes.

7. A greater halo effect occurred on the two-lane road than on the four-lane road. This effect extended from 3 to 4 miles upstream to at least 5 miles downstream from a stationary PV on the two-lane road. On the Interstate segment, vehicle speeds were affected, to a lesser extent, from 2 miles upstream to 3 miles downstream from the PV; speeds even increased from 3 to 5 miles downstream as motorists apparently attempted to make up lost ground.

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Evaluation of the Bonneville County, Idaho, DUI Accident Prevention Program

DAVID R. AMICK AND PATRICIA B. MARSHALL

The results of an impact evaluation of the first 15 months of an accident prevention program in Bonneville County, Idaho, are presented. Project Safety is a comprehensive driving under the influence (DUI) program implemented in Bonneville County in October 1979. It provided an integrated systems approach to the drinking-driver problem by the enhancement of treatment, sentencing and parole, and rehabilitation processes. DUI enforcement teams were added to the Bonneville County Sheriff's Office and the Idaho Falls Police Department. A public information component was also developed. Specific personnel were assigned system liaison responsibilities. A before-and-after analysis, which included two comparison locations, used an alcohol proxy measure (nighttime fatal and injury accidents occurring between 8:00 p.m. and 5:00 a.m.) to identify reductions in alcohol-related accidents. There was a reduction of 4.6 alcohol proxy accidents/month (a total of 64) during the study period. Reductions did not occur in comparison counties in the alcohol measure, although the direction of daytime accident trends was similar for all counties studied. State alcohol proxy accidents remained stable during the program period. An estimated $1 million in fatal and injury accident costs was avoided during the program period compared with actual total project costs of $312 471. The $1 million accident cost estimate excludes probable reductions in property-damage-only accidents.

The results of an impact evaluation of the first 15 months of the Bonneville County, Idaho, Project Safety program, implemented October 1, 1979, are presented in this paper. The program was designed to reduce alcohol-related motor-vehicle accidents in the county. The results of this study will contribute to the growing body of literature concerning the design, implementation, and effectiveness of alcohol-related countermeasures. The methodology adopted was designed to determine the following:

1. Has there been a measurable reduction in alcohol-related accidents that can be correlated with the implementation of Project Safety?
2. Is there reasonable evidence to indicate that such reductions can be attributed to Project Safety?
3. What are the cost savings in accident reduction due to Project Safety?

REVIEW OF LITERATURE

Identifying effective methods for preventing alcohol-related motor-vehicle accidents has been a matter of public concern since the U.S. Department of Transportation (DOT) made public evidence that showed that greatly increased crash risk was strongly associated with drinking while driving, even when only moderate drinking was involved (1). Since that time, numerous local and national projects have been implemented in an attempt to curb the drinking-driver problem. Almost all of these efforts were supported with federal funding. The types of countermeasures studied centered primarily on special enforcement campaigns.

The Alcohol Safety Action Projects (ASAPs) funded by DOT and operated during the early 1970s in 35 cities, counties, and states were the largest efforts by far. These programs used a traditional enforcement concept to provide special enforcement directed at the drinking driver and to improve judicial and treatment system capabilities to efficiently process arrested drivers. "The concept in operation represented a major overhaul of the entire enforcement system, and it was therefore of a magnitude and duration that is unique in the history of highway safety" (2, p. 4).

The ASAPs easily demonstrated success in increasing intermediate effectiveness indicators such as driving under the influence (DUI) arrests and agency enforcement levels. Cost-effectiveness was also easily demonstrated through the use of improved management techniques, specialized training, and more accurate devices for testing alcohol concentration. However, "no project reached levels of arrests at which deterrence or a clear reduction in accidents could be traced definitely to the enforcement countermeasure" (2, p. 6).

Moderate successes were reported in reducing the arrest ratio for social drinkers, as opposed to heavy or problem drinkers, through education and treatment components of the ASAPs. Special surveys for a few specific public information projects produced findings that demonstrated a clear relation between exposure to campaign activities and changes in knowledge and attitude. Analysts of the national ASAP program concluded that public information efforts should be significant components of future projects.

Although evaluations conducted at local levels failed to reveal conclusive results concerning the effectiveness of the ASAP concept, a final evaluation conducted by DOT did present enough data and analyses that it could be credibly argued that "some programs including increased certainty of a legal penalty under American law could, in the short run, produce declines in drinking and driving and in associated casualties" (3, p. 84).

Other attempts to measure the effectiveness of enforcement-centered projects have been characterized by methodological weaknesses. Some of the stronger research designs still provide little conclusive evidence because of study weaknesses. In the Stockton, California, Increased DUI Enforcement Program (4), there was a decrease in blood alcohol concentrations and reported collisions during the program period. Yet control-group comparisons yielded ambiguous results and preprogram data were limited. The Fatal Accident Reduction Through Enforcement (FARE) program also reported reduced fatalities in 44 of 47 project locations (5). Again, research results were not completely convincing because of the lack of control sites.

Studies of nonenforcement components of alcohol countermeasures have produced little knowledge about the relation between education, treatment, and probation and alcohol-related accidents. The Tennessee DUI Probation Follow-Up Demonstration Project reported that probation, rehabilitation, or their combination had no significant impact on rearrest or accident rates (6). A study of education programs under the Sacramento, California, Comprehensive Driving Under the Influence of Alcohol Offender Treatment Demonstration Project (7) showed a significant reduction in DUI recidivism due to the education of first-offense drunk drivers. The education programs had no effect on accident involvement.

In general, it is commonly believed that alcohol countermeasures can be expected to produce reductions in alcohol-related accidents if sites are selected that actually have alcohol-related accident problems and if the population of the area is large enough to provide measurable reduction indicators. It is more likely to be successful if the countermeasure is more comprehensive in nature, involving enforcement and public information components as well as treatment, education, and sanctions. Recent findings that only suggest accident reduction are expected to be strengthened by continued, careful project implementation and evaluation.

PROJECT SAFETY

Project Safety provides an integrated systems approach to the drinking and driving problem in Bonneville County through coordination of prevention and education programs, DUI enforcement, sentencing and parole processes, and rehabilitation programs.

Planning for Project Safety began in the spring of 1979 in response to the Idaho Health Systems Agency plan, which called for a reduction in alcohol-related accidents. The plan further called for the initiation of a demonstration project to reduce alcohol-related traffic fatalities.

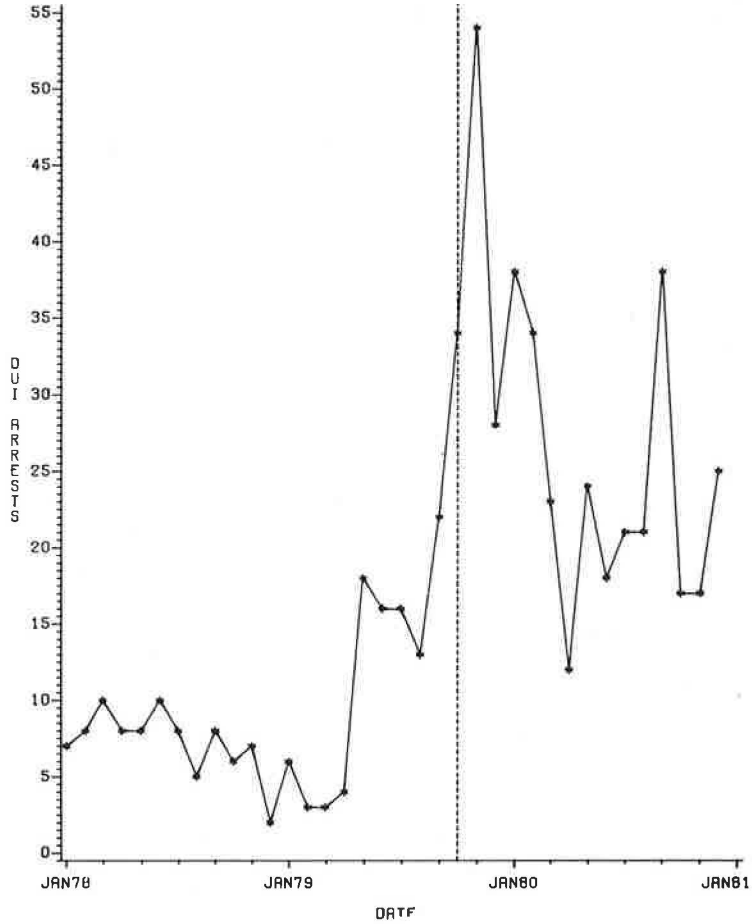
In the 1979 Idaho Highway Safety Plan, by use of an alcohol proxy measure, Bonneville County was ranked number one among all Idaho counties in 1978 alcohol-related accidents. Fortunately, Bonneville County had an alcohol abuse planning group and this group was challenged to seek a solution to the problem. The Combined Alcohol Rehabilitation and Education Services (CARES) policy committee contacted the Idaho Office of Highway Safety, requesting funds to implement a project to reduce alcohol-related accidents.

The resulting project created a new DUI Selective Traffic Enforcement Project (STEP) in both the Idaho Falls Police Department and the Bonneville County Sheriff's Office, a new probation and parole component within the county judicial system, and a new county staff position for a prevention-education specialist who would implement a public information campaign about the project. The program officially began on October 1, 1979.

The county already had well-established services for alcohol education and rehabilitation. However, these needed to be linked with the courts and enforcement in a more purposeful approach in order to control the alcohol traffic safety problem. With the addition of new staff, this was accomplished.

In the enforcement area, a two-man DUI STEP was created in both the Bonneville County Sheriff's Office and the Idaho Falls Police Department. Each STEP team worked shifts and geographic areas that were rated high in alcohol involvement. The patrols worked at night and during the early morning hours. The patrol officers were trained in DUI apprehension. Additional patrol vehicles, a direct breath-testing instrument, and video equipment were purchased for use on the project. Both law-enforcement agencies were located in the same building and were able to use the equipment effectively.

Figure 1. Bonneville County DUI arrests: 1978-1980.



There was a significant increase in DUI arrests for both law-enforcement agencies after initiation of the project. This was the first time either had specifically emphasized DUI detection and arrest. This increase was especially noticeable in the county, which historically had made few DUI arrests. Figures 1-3 show the changes in DUI arrest levels at the beginning of and during the program. It should be noted that much of the discussion about the alcohol problem resulted in increased arrest activity even before the implementation of the program on October 1, 1979, especially in the Bonneville County Sheriff's office.

The number of specialists providing presentence and probation services for DUI offenders was increased from two to five. The DUI specialists provided the link between the enforcement and judicial system and the alcohol-treatment system. Feedback was provided to the court on the status of sentences involving these services. At the beginning of the project, the Alcohol Rehabilitation Association (ARA) provided in-patient and intermediate-care alcohol services. The Idaho Department of Health and Welfare provided outpatient and educational services.

Available records showed that a 50 percent increase in the referral of DUI offenders to treatment occurred during the first 12 months of Project Safety. There were 399 people referred to treatment in the 12 months preceding Project Safety compared with 600 people referred in the first 12 months of the project. An additional 124 people were referred to treatment during the last three months of 1980. This evaluation covers the first 15 months of Project Safety.

The final component was a public information program to educate the public about Project Safety and the problem of drinking and driving in the community. A prevention-education specialist was hired to carry out this task. Activities initiated by this person included daily reports by several local radio stations, profiles of citizens arrested for DUI, a "this could be you" type of program, interviews about Project Safety on local television stations, news releases, booths at community events, and presentations at the junior high and high schools.

During the first six months of the project, the media were supportive and provided considerable coverage. As Project Safety continued, the type of high-exposure media coverage experienced at the beginning of the project was more difficult to obtain. A comparison shows that in the first fiscal project year, FY 1979/80, there was considerably more media activity than in project year FY 1980/81. In FY 1979/80, there were 7 television stories or interviews, 6 newspaper stories, and 10 radio interviews plus daily spot announcements over five AM/FM radio stations; in FY 1980/81, there were 2 television stories and 3 newspaper stories plus weekly spot announcements over 2 radio stations.

METHODOLOGY

Accident Measures

All of the accident data used in this study were retrieved from the central traffic accident data base maintained by the Idaho DOT. All state jurisdictions are required to provide copies of accident re-

Figure 2. Idaho Falls DUI arrests: 1978-1980.

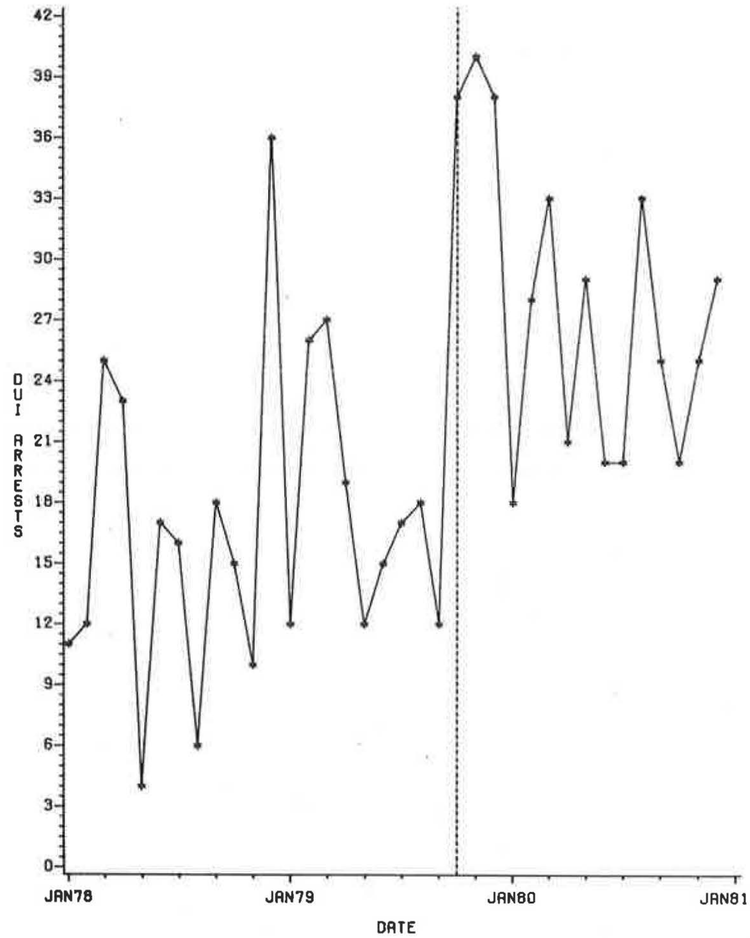
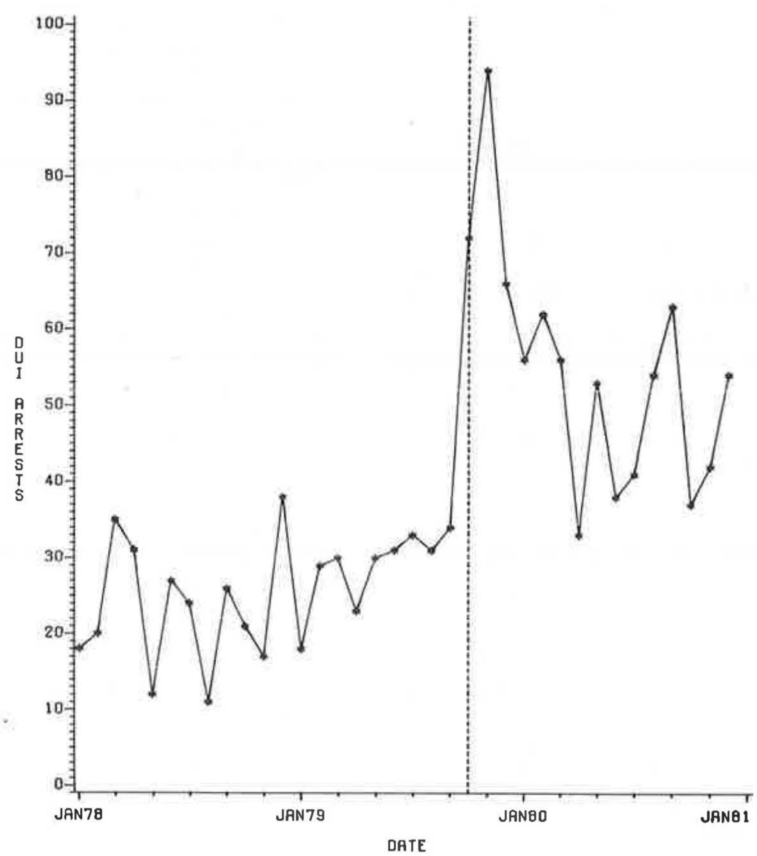


Figure 3. Total Project Safety DUI arrests: 1978-1980.



ports to be entered in this data base. An historical examination of the data used in this study provided no evidence to indicate significant reporting problems for fatal or injury accidents during the period under study.

Several types of data might serve as indicators of alcohol-related accidents. Police accident reports provide information about drivers' alcohol consumption levels when breath tests or blood tests are administered. Although such data are generally reliable, alcohol tests are actually administered rarely. In Idaho in 1980, only 2 percent of all drivers involved in accidents were given an alcohol test.

Another indicator of alcohol involvement is the item "had been drinking" under the category of "driver contributing circumstance" on the accident report form. This item is marked at the discretion of the officer even if a citation is not issued or if a test is not administered. This item is also infrequently checked (8.5 percent of all drivers in 1980). Officers are generally hesitant to indicate alcohol involvement without concrete evidence. A great deal of bias is also introduced because the tendency to mark "had been drinking" varies from officer to officer depending on training, experience, and personal values.

The major weakness of these indicators as effectiveness measures is their dependence on the officer's experience. It is likely that introduction of patrol officers trained in DUI enforcement will cause an upward shift in the frequency of alcohol testing and an increase in the observation of drinking behavior.

An alcohol proxy measure was developed to determine shifts in accidents believed to be alcohol related. The proxy used in this study differs from the alcohol proxy typically used in the NHTSA Fatal Accident Reporting System (FARS)--i.e., nighttime single-vehicle fatal accidents occurring between 8:00 p.m. and 4:00 a.m. (8). The proxy measure used in FARS would not be a feasible indicator of alcohol-related accidents in Idaho because there are only 330 yearly fatalities recorded statewide. Fatal-accident frequencies for counties or cities on a monthly basis are simply too small to be used for trend analysis.

The proxy measure used in this study includes all nighttime fatal and injury accidents occurring between 8:00 p.m. and 5:00 a.m. Accidents occurring on private property are excluded. An analysis of Idaho statewide accidents showed that accidents occurring during these hours normally involved a greater percentage of total drivers being given drinking tests (5.0 percent). Such accidents are also more frequently described by the officer as involving alcohol at some level. In fact, "had been drinking" and "inattention" are the most frequently cited driver contributing circumstances for nighttime accidents. For 23 percent of the drivers, "had been drinking" was noted. "Inattentive driving" was also noted on the accident report for 23 percent (inattentive driving is thought by Idaho traffic safety officials to be frequently related to alcohol).

The alcohol proxy just described is not to be interpreted as the actual number of alcohol-related accidents in any area. Instead, it should be used only as an indicator that is likely to shift if actual alcohol-related accidents are being affected.

A major weakness of the alcohol proxy is that it does not include all alcohol-related accidents because property-damage accidents are excluded due to unreliable reporting. It will therefore be difficult to estimate the complete impact of a DUI program by using the proxy measure.

Design

The evaluation design used here relies on a before-and-after analysis to measure the impact of Project Safety. In addition, two comparison counties in Idaho were selected to provide information about changes in proxy accident trends that occurred during Project Safety but in counties that did not have DUI prevention programs.

It was critical to determine the effect of generally reduced travel and other unmeasured exposure factors on alcohol proxy accidents. It was possible that proxy accidents that occurred at night, even though they were believed to be largely alcohol related, might be seriously affected by the same variables as daytime accidents. If it were found that daytime accident trends were generally not related to alcohol proxy accident trends, it would counter suggestions that accident reductions in the project location were caused by unmeasured exposure variables. Thus, data were also collected in comparison counties and in Bonneville County on daytime fatal and injury accidents (5:00 a.m. to 8:00 p.m.) to suggest overall accident patterns that could have affected proxy accidents differently in each county.

In a further attempt to verify overall accident trends and their relation to proxy accidents, statewide injury accidents were used to help corroborate relations found in the project county and the comparison counties. It was believed that this additional step was needed because comparison sites were not randomly selected before program implementation. Thus, even though similarity between comparison sites and the project county was a serious selection criterion, important differences could have been overlooked by the researchers. Overall statewide data could help suggest normal accident trends.

Comparison Counties and State Data

The researchers attempted to identify counties as similar as possible to Bonneville County. Factors considered significant in selecting sites were population, rural or urban composition, geography, problem size, and existence of DUI prevention programs. The two comparison counties selected were Bannock and Twin Falls.

Bonneville, Bannock, and Twin Falls Counties are similar in population, as indicated below:

County	Population 1970	Population 1980	Increase (%)
Bonneville	52 457	65 980	26.0
Bannock	52 200	65 421	25.0
Twin Falls	41 807	52 927	27 0

According to 1980 census data (9), all three counties experienced approximately the same percentage growth in population since 1970.

Each of the study counties contains one major population center that is largely surrounded by very small rural communities and open farming country. All three have similar open-farmland geographic characteristics typical of eastern and southern Idaho. Another important common characteristic is that the major population center of each county is bypassed by one major Interstate highway. The accident frequencies for these counties are also similar.

All counties have similar estimates of vehicle miles of travel (VMT), as indicated in the following table (these estimates exclude local roads because knowledge of local-road VMT could affect the direction or magnitude of the percentage change from year to year):

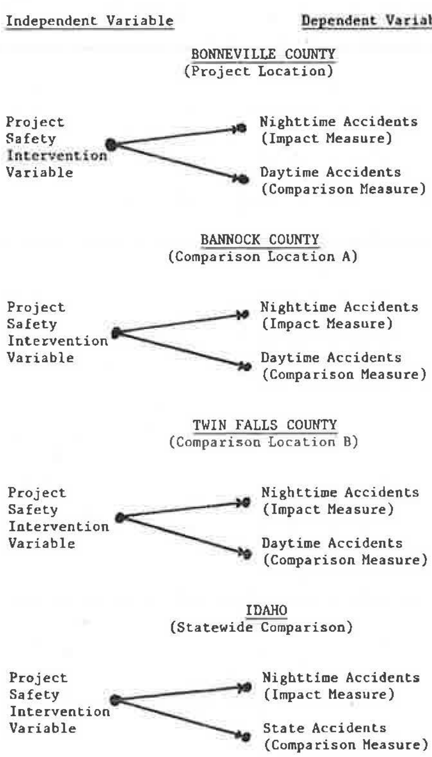
	VMT (000 000s)		
County	1979	1980	Change (%)
Bonneville	317	312	-1.5
Bannock	332	329	-0.9
Twin Falls	212	214	+0.9

There are differences among comparison counties in their abilities to address the problem of the drinking driver. Bannock County has traditionally had an alcohol-treatment program. However, there was no specific concentration on DUI enforcement and officer training in Bannock County, and there was no increase in DUI enforcement personnel levels during the Project Safety program. In fact, DUI arrests in Bannock County were 14 percent less in 1980 than in 1979.

It should be kept in mind that Bonneville County also has traditionally had a treatment program. This evaluation was conducted to measure the impact of an enhanced alcohol accident prevention program. Bannock County can be considered as not having a program of the type evaluated here because it does not have enforcement, public information, and coordination components comparable to those of the Bonneville County program.

The existence of a Bannock County treatment program prompted the inclusion of Twin Falls County, the third comparison group. Twin Falls County does not have a treatment or DUI enforcement program. DUI arrests remained stable from 1979 to 1980 in Twin Falls County. In addition, Twin Falls County does not experience the possible spillover effects of the public information component of Project Safety. Bannock County receives some of the same television and radio information received in Bonneville County. The Twin Falls site was needed to control for alcohol education information released through Project Safety. This precaution was taken even though public information without enforcement has never been shown to have a direct effect on accident occurrence.

Figure 4. Analysis procedure.



Statewide data were collected in two forms: (a) state fatal and injury accidents and (b) nighttime fatal and injury accidents. All counties where active STEPs were in operation were omitted from statewide data. Nighttime hours were defined in the same fashion as project and comparison group data. Figure 4 shows the design approach used in this study.

In all cases, monthly data covered the period from January 1975 to December 1980. The Project Safety intervention was introduced in October 1979.

Analysis Technique

The Box-Jenkins time series approach (10) was used to determine the time series parameters and transfer function estimates for the data. The advantage of using the Box-Jenkins approach is that it allows the researcher to account for and describe characteristics of the data attributable to seasonality or trend or both as well as characteristics of the data that are correlated with individual or multiple independent variables. The time series model for each of the relations to be examined in this study can generally be mathematically depicted as follows:

$$Y_t = W_o I_t + N_t \quad (1)$$

where

- Y_t = monthly alcohol proxy accidents at time period t;
- W_o = impact of Project Safety, i.e., average monthly change in Y_t;
- I_t = Project Safety intervention variable at time period t (when t < 58, I_t = 0; otherwise, I_t = 1);
- N_t = noise series, some function of normal independently distributed error.

The transfer function parameter (W_o) may be interpreted as the average monthly change in accidents during the presence of Project Safety. N_t represents the noise portion of the model for Y_t. N_t contains seasonality, trend, and other time series characteristics of Y_t. The final model will also include reasonable, identifiable delays in program impact that may occur when a program is just beginning.

The t-test statistic was used to determine whether or not W_o was different from zero. Significance was tested at the 95 percent confidence level.

Hypotheses

The following research hypotheses were tested.

1. There will be a significant reduction in nighttime injury accidents in Bonneville County during the time Project Safety is in effect:

$$W_o(1) < 0 \quad (2)$$

where $W_o(1)$ is the average monthly change in nighttime injury accidents in Bonneville County.

2. Reductions in nighttime injury accidents in Bonneville County will be greater than possible reductions in nighttime injury accidents in Bannock County, comparison location A, during the program period:

$$W_o(1) < W_o(2) \quad (3)$$

where $W_o(2)$ is the average monthly change in nighttime accidents in Bannock County during the program period.

Figure 5. Bonneville County alcohol proxy accidents.

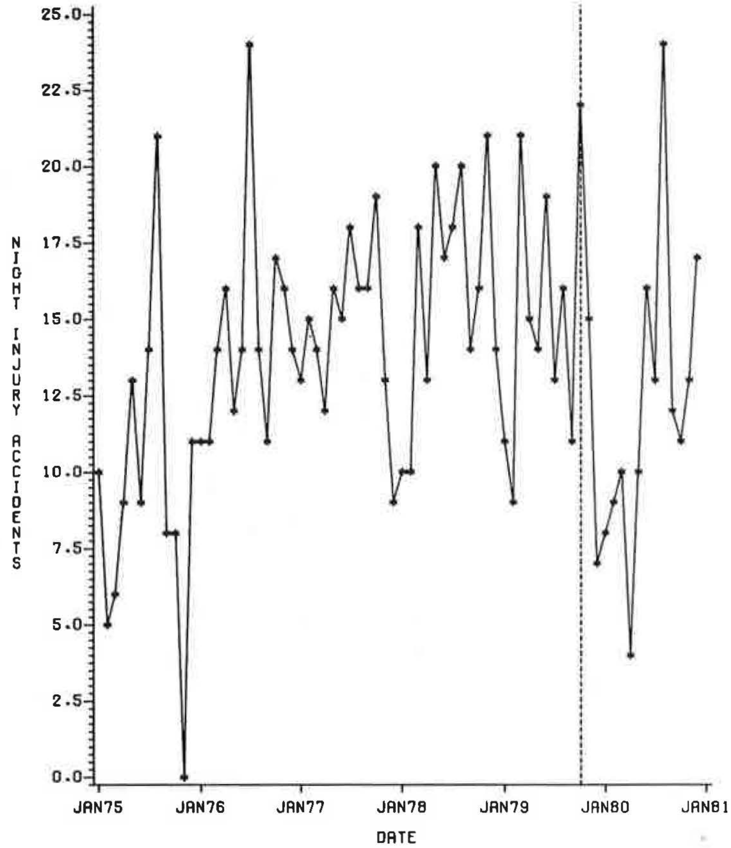


Figure 6. Bannock County alcohol proxy accidents.

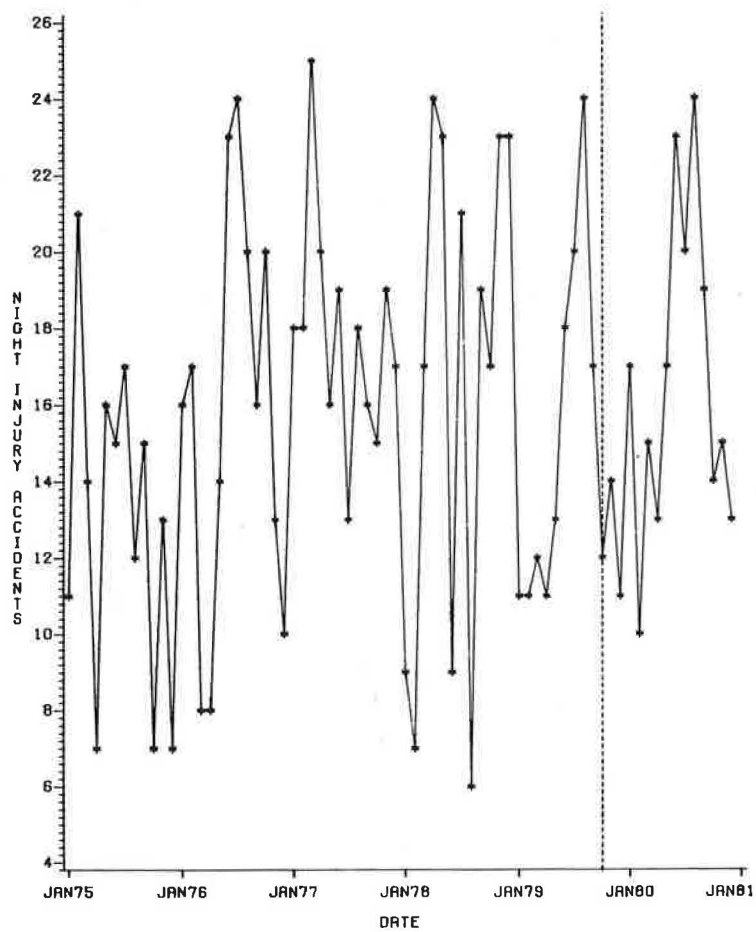


Figure 7. Twin Falls County alcohol proxy accidents.

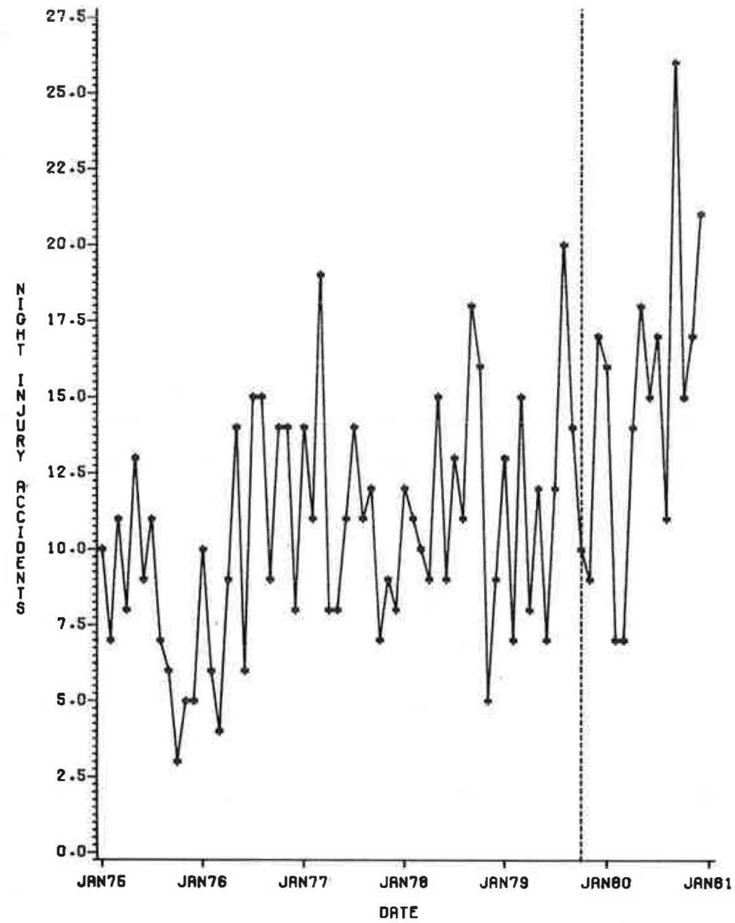


Figure 8. Data sets subjected to time series analysis by use of intervention variable.

STATE ALCOHOL PROXY ACCIDENTS

Transfer function = -0.71
t-statistic = -0.06
Delay time = 1 month
Significance = No
Generalized model:

$$Y_t = -0.71\ I_{t-1} + [1 - 0.63B)(1 - 0.67B^{12})]/[(1 - B)(1 - B^{12})]\ a_t$$

STATE INJURY ACCIDENTS

Transfer function = -18.0
t-statistic = -0.57
Delay time = 1 month
Significance = No
Generalized model:

$$Y_t = -18.0\ I_{t-1} + [(1 - 0.52B)(1 - 0.60B^{12})]/[(1 - B)(1 - B^{12})]\ a_t$$

BONNEVILLE COUNTY DAYTIME ACCIDENTS

Transfer function = -7.8
t-statistic = -3.39
Delay time = 1 month
Significance = Yes
Generalized model:

$$Y_t = -7.8\ I_{t-1} + [(1 - 0.28B^{12})/(1 - B^{12})]\ a_t$$

BANNOCK COUNTY DAYTIME INJURY ACCIDENTS

Transfer function = -6.5
t-statistic = -2.41
Delay time = 1 month
Significance = Yes
Generalized model:

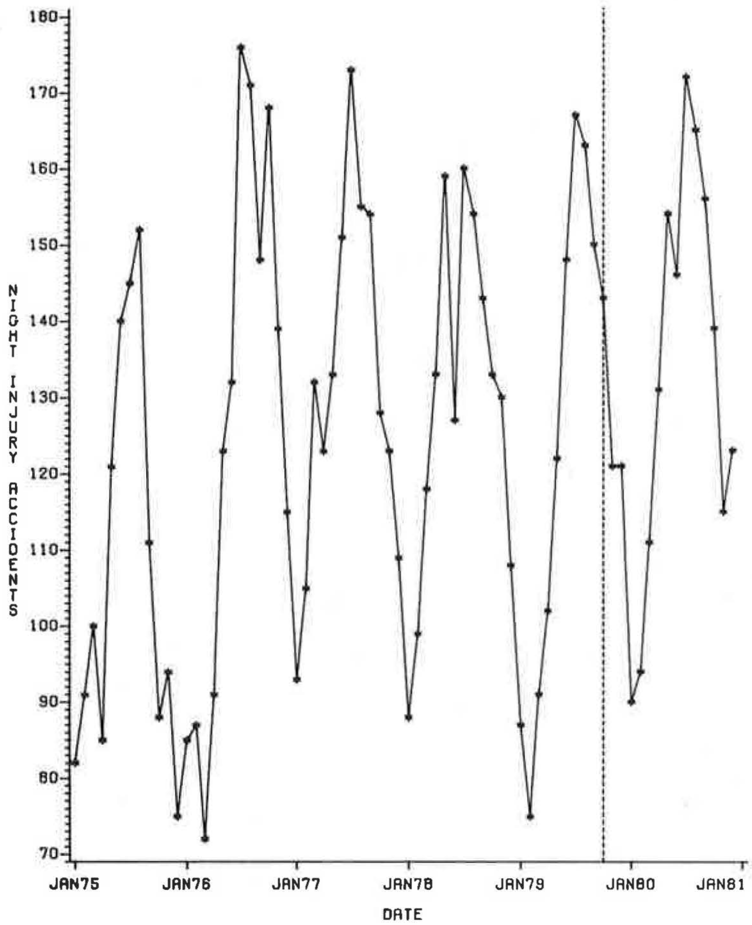
$$Y_t = -6.5\ I_{t-1} + [(1 - 0.60B^{12})/1 - B^{12})]\ a_t$$

TWIN FALLS COUNTY DAYTIME INJURY ACCIDENTS

Transfer function = -6.0
t-statistic = -1.18
Delay time = 1 month
Significance = No
Generalized model:

$$Y_t = -6.0\ I_{t-1} + [(1 - 0.61B)/(1 - B)]\ a_t$$

Figure 9. State alcohol proxy accidents.



3. Reductions in nighttime injury accidents in Bonneville County will be greater than possible reductions in nighttime injury accidents in Twin Falls County, comparison location B, during the program period:

$$W_o(1) < W_o(3) \quad (4)$$

where $W_o(3)$ is the average monthly change in nighttime injury accidents in Twin Falls County during the program period.

The relations between the Project Safety intervention variable and county daytime and statewide measures were examined to help explain relations found between Project Safety and nighttime accidents in the project and comparison locations.

RESULTS

Findings

Figure 5 shows nighttime injury accidents for the project location, Bonneville County. The time series represents monthly accidents that occurred between January 1975 and December 1980. Project Safety was implemented in October 1979.

The mathematical time series (intervention) model for the data is presented below:

$$Y_t = -\overset{(2.2)}{4.6}\, I_{t-1} + \{[(1 - \overset{(0.07)}{0.87}B)(1 - \overset{(0.10)}{0.62}B^{12})]/[(1 - B)(1 - B^{12})]\}\, a_t \quad (5)$$

where

Y_t = monthly nighttime injury accidents in Bonneville County in time period t;

I_t = intervention effect in time period t;

B = back-shift operator;

a_t = white noise component of Y_t after the transfer function (-4.6), moving average (1 - 0.87B), seasonal moving average $(1 - 0.62B^{12})$, regular difference (1 - B), and seasonal difference $(1 - B^{12})$ components have been removed from Y_t; and

$$N_t = \{[(1 - 0.87B)(1 - 0.62B^{12})]/[(1 - B)(1 - B^{12})]\}\, a_t$$

The standard errors for each of the parameter estimates are displayed in parentheses above the estimates. A delay period of one month was identified, as indicated by the term I_{t-1}. All parameter estimates were significant at the $\alpha = 0.05$ level. The t-statistic for the transfer function parameter was -2.09.

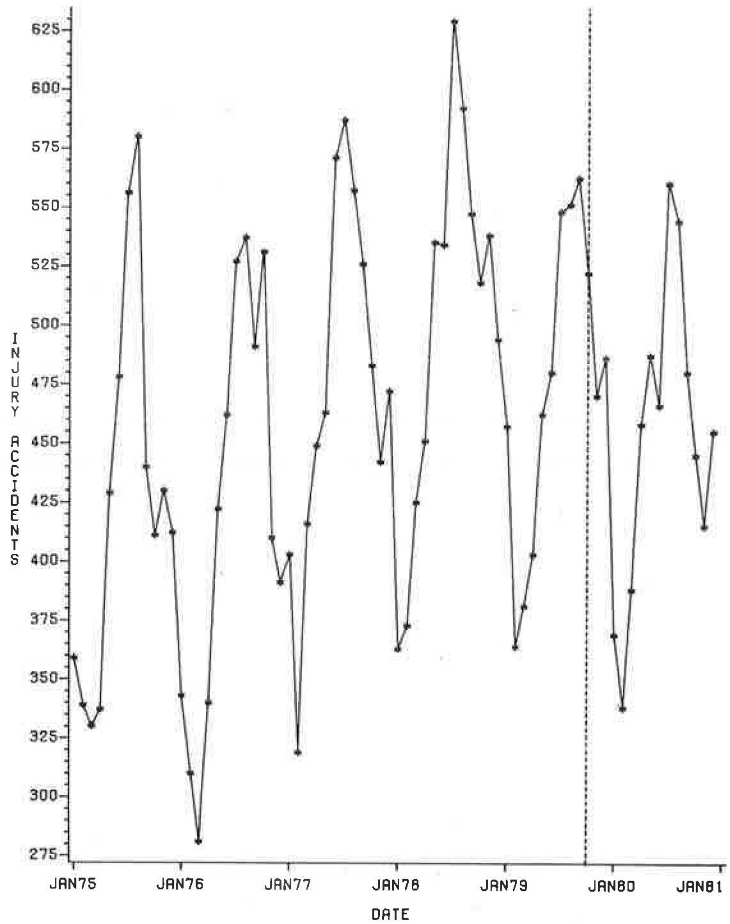
A time series (intervention) model was developed for comparison location A, Bannock County, and comparison location B, Twin Falls County. Figure 6 shows monthly nighttime injury accidents for Bannock County that occurred between January 1975 and December 1980. The Project Safety intervention variable was used in the analyses. A one-month delay period was introduced for all comparison locations to be consistent with the Bonneville County model.

The mathematical time series (intervention) model for Bannock County nighttime injury accidents is as follows:

$$X_t = \overset{(1.79)}{0.64}\, I_t + [(1 - \overset{(0.12)}{0.65}B^{12})/(1 - B^{12})]\, a_t \quad (6)$$

where X_t is monthly nighttime injury accidents in Bannock County in time period t.

Figure 10. State injury accidents.



The seasonal moving average parameter was significant at the α = 0.05 level. The t-statistic (0.36) for the transfer function parameter was not significant.

Figure 7 presents the monthly time series data for Twin Falls County nighttime injury accidents. The mathematical time series (intervention) model for Twin Falls County nighttime injury accidents is presented below:

$$Z_t = \overset{(1.2)}{4.5}\, I_t + N_t \tag{7}$$

where

Z_t = monthly nighttime injury accidents in Twin Falls County in time period t and

$N_t = a_t$.

The transfer function parameter was found to be significant at the α = 0.05 level (t = 3.75). Seasonal and automobile correlation components in the time series were not significant and therefore were not included in the model.

The sets of data shown in Figure 8 were subjected to the same time series (intervention) analysis as the project and comparison locations by using the Project Safety intervention variable. As with the previous comparison data, a one-month delay time was forced into these models to ensure similar time-period comparison. Graphs of these data sets are shown in Figures 9-13.

Interpretation of Findings

The results indicated a significant reduction in nighttime injury accidents in the project location, Bonneville County, during Project Safety implementation. Significant reductions began occurring in November 1979. The average monthly reduction from the preintervention level was 4.6 accidents/month. An effort was made to rule out the possibility that the above reductions resulted from some factor other than Project Safety by examining similar counties that did not have a comprehensive alcohol program.

Reductions in nighttime injury accidents did not occur in comparison location A, Bannock County, or in comparison location B, Twin Falls County. In fact, changes in accident frequencies in the comparison groups did not resemble reductions in the project location, Bonneville County, in direction or magnitude. Bannock County nighttime injury accidents remained stable during the implementation of Project Safety. Twin Falls County actually experienced a significant increase in nighttime accidents during the project period. The increase in nighttime accidents in Twin Falls County was 4.5 accidents/month.

It was possible that alcohol proxy accidents could have been reduced due to statewide travel and other factors. However, it was found that alcohol proxy accidents did not vary in the same way as daytime injury accidents during the project period. State alcohol proxy accidents remained essentially

Figure 11. Bonneville County daytime injury accidents.

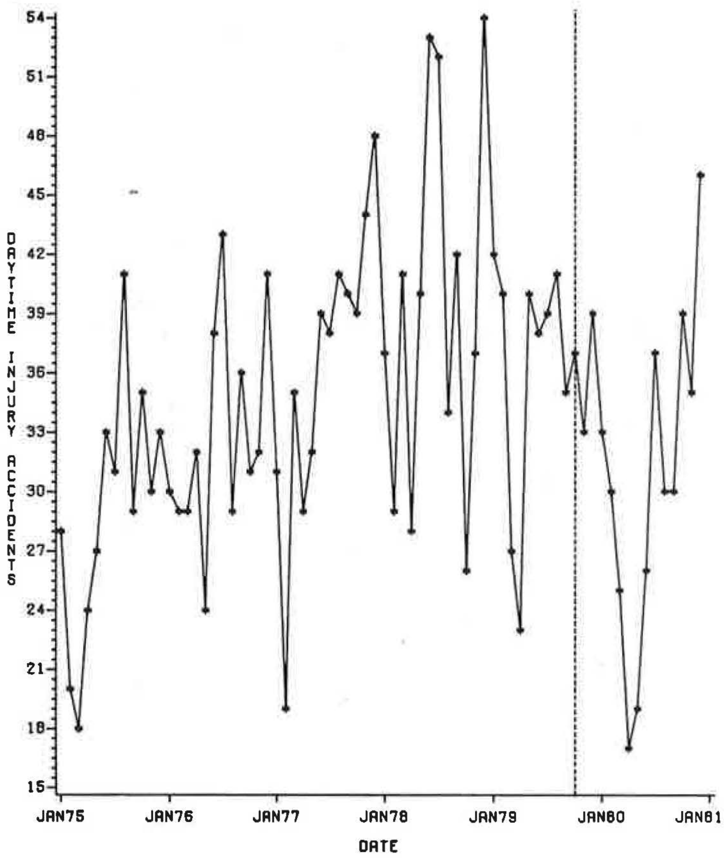


Figure 12. Bannock County daytime injury accidents.

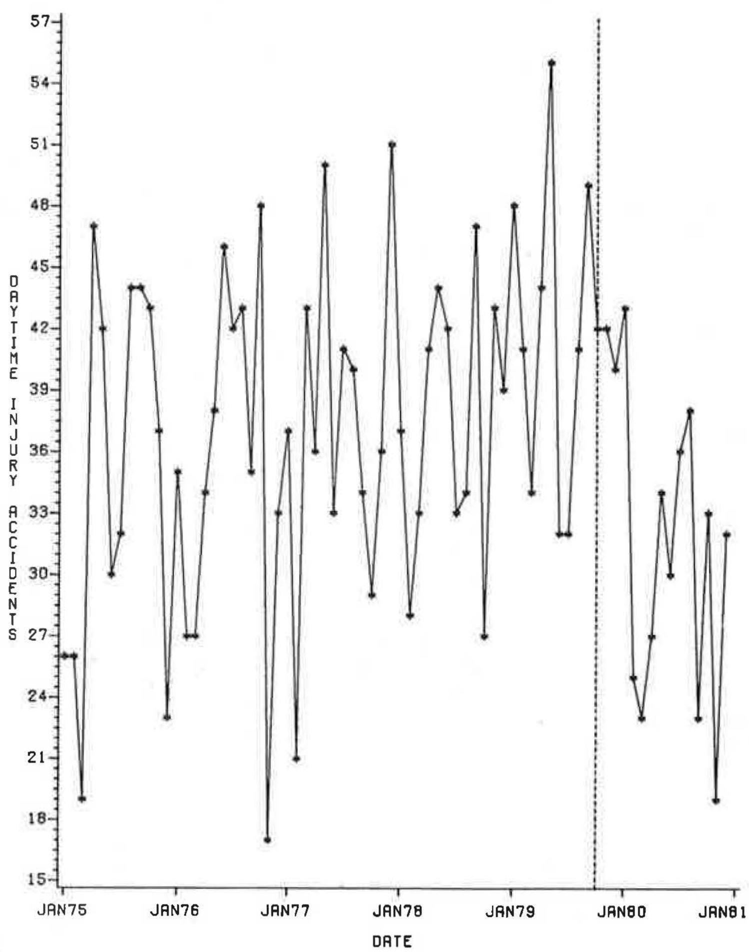
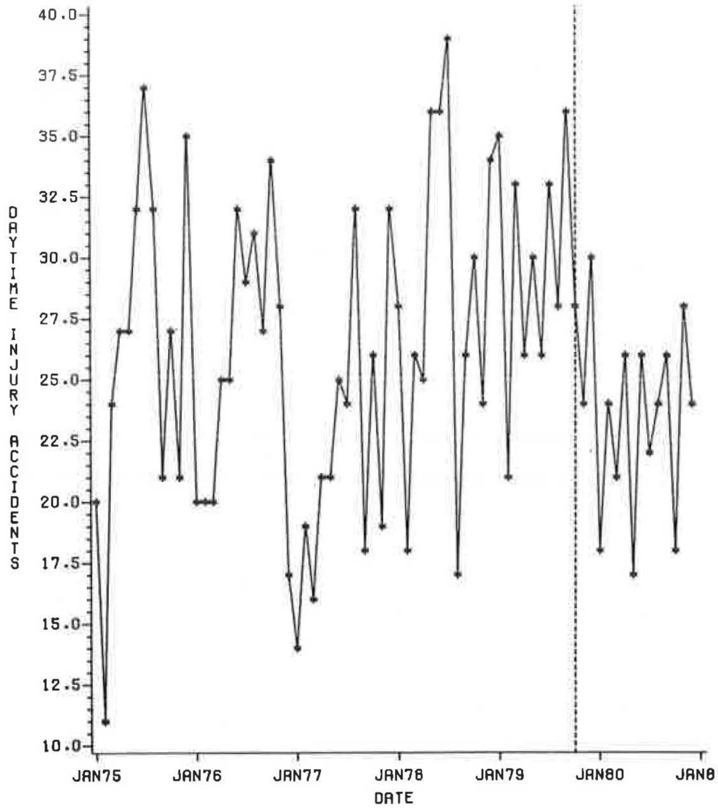


Figure 13. Twin Falls County daytime injury accidents.



stable during the program period. State injury accidents decreased only slightly during the program period.

Daytime injury accidents in Bannock County decreased significantly by a monthly average of 6.5 accidents. Twin Falls County also experienced a reduction in daytime injury accidents of 6.0 accidents/month, although this reduction was not significant at the 0.05 level. Bonneville County experienced a significant daytime accident reduction also (an average of 7.8 accidents/month).

Reductions in daytime injury accidents in the study counties do not appear to be reflected to any great degree in state injury accidents. A good deal of research remains to be done to determine the reason for this apparent difference. Other counties included in the state measure used here are generally quite different from the study counties in population, size, and geographic makeup. Decreases in the study counties must have been offset by increases in other counties. No explanation can be offered here.

In general, the study counties did experience reductions in daytime accidents that appear to be unrelated to trends in alcohol proxy accidents. Alcohol proxy accidents may be less likely to be affected by exposure variables because night driving is less likely to include long-distance trips, especially if drinking is involved. The stable or increasing pattern of alcohol proxy accidents statewide and in the comparison counties could be partly explained by a weaker relation to exposure factors.

CONCLUSIONS

The Project Safety DUI prevention program was implemented to reduce alcohol-related traffic accidents in Bonneville County through enhancement of the alcohol-treatment, enforcement, education, and public-information efforts of the county and city governments. The program resulted in substantial increases in DUI enforcement, public-information, and treatment activities. An estimated average reduction of 4.6 nighttime fatal and injury accidents/month occurred during the study period (64 total accidents). Reductions began occurring one month after the start of the program. A comparison with the two other similar counties showed that the above reduction was unique to Bonneville County during the program study period.

Although a monthly reduction of 4.6 fatal and injury nighttime accidents may not appear important, it must be remembered that it makes up a 39 percent average monthly reduction in the alcohol proxy measure in comparison with the appropriate 12 months before Project Safety. Over a 12-month period, it represents 55 accidents. By way of comparison, 55 accidents represents 9 percent of all 1979 injury accidents in Bonneville County (607). This study did not estimate probable reductions in property-damage-only or private-property accidents.

It is estimated that a total of 64 accidents were prevented during the study period. The total cost of the project for that same period amounted to $312 471. The estimated cost of the accidents that were prevented is $1 million. The benefit/cost ratio for Project Safety was approximately 3.2. Given the size of the accident problem in Bonneville County and the scope of the DUI accident prevention program, Project Safety was found to be cost effective.

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Field Study of Rail-Highway Grade-Crossing Crash Sites

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The results of a study undertaken to determine whether an acceptable level of safety has been achieved at the 845 public rail-highway grade crossings in New Mexico are presented. Field studies were conducted at 57 rail-highway grade crossings where one or more accidents had occurred during a 30-month period. With few exceptions, these crossings were found to have adequate design and operational features. Of the sites studied, 35 percent had active traffic-control devices installed after the accident. The project also examined the existing grade-crossing inventory data to determine their accuracy. The study found numerous errors in the inventory file: Principal deficiencies related to highway volumes and advance signs and markings. Evaluation of the data for a limited time period following improvements found an apparently significant reduction in crash experience, which was achieved at a cost of $35 000/accident. The researchers recommend correction of the few deficiencies found in the field study, upgrading of sites that do not meet relevant signing and marking standards, updating of the inventory, and more extensive use of the crossing identification number on accident report forms.

Traffic accidents that occur at the intersection of a rail line and a street or highway are one of the enigmas of highway safety. Available statistics indicate that such accidents are both rare and severe. Their rarity is indicated by the fact that, on an annual basis, at the approximately 220 000 public rail-highway grade crossings in this country there are a total of 11 100 accidents, or an average of 0.05 accident/public crossing/year (1). The severity statistics are also not surprising; the result of several 200-ton locomotives pulling a 5000-ton string of freight cars and striking a 1.5-ton car or pickup is not difficult to predict. What is perhaps surprising is that such a collision does not always result in a fatality. National data indicate that 11 percent of the collisions between trains and highway vehicles result in fatalities and that many of the remainder produce occupant injuries. Although they account for less than 0.1 percent of nationwide traffic accidents, collisions with trains result in approximately 2 percent of the highway fatalities.

In one sense, the grade crossing is just like any other highway intersection where two flows of traffic intersect. However, the generally low train volumes create a situation in which the approaching driver knows that a train may be at the crossing but does not expect one to be there while he or she is actually at the crossing. In an attempt to improve safety at these locations, a variety of static and active traffic control devices can be used to warn approaching motorists and to regulate vehicle traffic when a train is near the crossing. Flashing lights or gates are preferred treatments, but they are expensive, and limited funds for improvement restrict the number of locations that can be treated with these devices.

Through mechanisms with varying degrees of formality, safety improvements at rail-highway grade crossings must compete for funding with a variety of other highway programs that range from spot improvements to new construction. Numerous studies have documented the highly favorable measures of cost-effectiveness for some of these other types of remedial actions. However, once the most hazardous grade crossings have been improved, it is difficult to show a comparable level of cost-effectiveness for the remaining crossings. In fact, it is valid to inquire whether a point of diminishing returns has been reached in grade-crossing safety (2). The objective of this study was to determine whether New Mexico and the three principal railroads that operate within it have, through their previous improvement programs, reached the maximum practical level of safety at rail-highway grade crossings.

Although New Mexico is the fifth largest state in land area, it has only 1960 miles of Class I and Class II rail line, barely 1 percent of the mileage in the entire country. The state has 845 public rail-highway crossings, approximately 0.4 percent of the nationwide total. Accident statistics based on police reports for the 1961-1980 period show that the state averaged 32.5 train-involved accidents/year. Annual fatal and injury accidents averaged 4 and 10, respectively. Although there was a small annual increase in accident experience during this period, the increase is apparently less than the growth of either rail or highway volumes. A 1979 tabulation of grade-crossing accidents and incidents reported to FRA by the railroads shows that New Mexico had 0.24 percent of the nationwide accidents, 0.96 percent of the fatalities, and 0.37 percent of the injuries. Although it is risky to draw strong conclusions from this data base, it appears that the state has fewer but more severe accidents than might be expected in view of its relative share in the number of crossings.

In a typical year, less than 4 percent of New Mexico's public grade crossings have an accident.