THE DEVELOPMENT OF A PREDICTION SYSTEM FOR THE OCCURRENCE
OF LAW VIOLATIONS ON THE OGDEN RANGER DISTRICT,
WEBER COUNTY, CACHE NATIONAL FOREST, UTAH
by
John Henry Harris

A thesis submitted in partial fulfillment
of the requirements for the degree
of
MASTER OF SCIENCE
in
Forest Recreation

Approved:

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ABSTRACT

The Development of a Prediction System for the Occurrence of Law Violations on the Ogden Ranger District, Weber County, Cache National Forest, Utah
by
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Utah State University, 1970

Major Professor: Richard A. Ogle
Department: Forest Science

The primary objective of this study was to develop a prediction system for the occurrence of law violations on the Ogden Ranger District, Weber County, Cache National Forest, Utah, whereby the existing manpower and equipment may be used as effectively as possible.

In an attempt to develop the prediction system, 13 variables were chosen that were felt to be related to the occurrence of law violations. These variables consisted on nine weather variables and four use related variables. Of the original 13 variables, 12 variables were significant. The most significant variables that accounted for the greatest portion of the variability of the occurrence of law violations were directly related to the level of use.

The prediction system developed in this study is not a usable tool for the resource managers of the Ogden Ranger
District because it accounted for little more than chance alone.

(51 pages)
INTRODUCTION

Statement of the general problem

Within a short period of time, the character of public use of outdoor recreation areas has distinctly changed. The public use has changed from the peaceful holiday picnics of yesteryear to mass recreational demands of today.

Every week, campgrounds become migrant communities that range in size from a few families to several thousand people. These campground communities, like other communities, have their distinct problems with law and order. Maintaining law and order in the public outdoor recreation areas is a serious problem facing the outdoor recreation manager today (Campbell, Hendee, and Clark, 1969a).

Crime definitely has no bounds, but it usually occurs wherever people gather together. The following are examples of problems of law enforcement that face various public resource agencies today in our outdoor recreation areas: In the California State Park System, there has been a distinct upsurge in crime. Vandalism exceeded 1850 incidences in only one year (Commission on Peace Officer Standards and Training State of California, 1968). In the National Parks last year, the number of serious crimes rose 67 percent while serious crime in the cities of the United States increased only 18 percent. After
37 years, one concessionaire in Sequoia National Park had to finally place locks on all his cabin doors as theft was so prevalent in the area (Cahn, 1968). From a letter by John T. Koen, Assistant Regional Forester, Recreation and Lands, United States Forest Service, Region Three, the following were the sentiments expressed:

You are correct in your assumptions that lawless behavior at our recreation sites is a serious problem and one that is growing.

... As you would expect, the biggest problem areas are those which lie adjacent to large population centers. Our most common violations at this time are failure of recreationists to pay fees in the posted areas and littering. (Koen, 1969)

One particular United States Forest Service Ranger District that has a law enforcement problem is the Ogden Ranger District. This ranger district is situated adjacent to the urban population center of Ogden, Utah. In a matter of a few minutes, the Ogden recreationist can be on the recreation lands of the Ogden Ranger District and he brings with him a law enforcement problem.

Great efforts by the personnel of the Ogden Ranger District have been made to reduce the law and order problem but the problem is still of a serious nature as the following statistics will indicate:

1. Average yearly vandalism damage from 1965-1967 was $23,300
2. 5421 notices of violation were issued in 1968
3. 266 criminal complaints were filed by the Ogden Ranger district in 1968
4. $4,620 worth of vandalism occurred in 1968 on the district even after intensive law enforcement measures had been enacted (Hronek, 1968)

The resource managers of the Ogden Ranger District realize there is a law enforcement problem and have taken steps to maintain law and order. Recreation guards are on duty to primarily check for proper fee payment in the developed recreation areas, but they also enforce other rules designated in Title Thirty-Six of the Code of Federal Regulations. In carrying out his job, the recreation guard can only patrol so many areas a day. As personnel are limited on the district, each developed recreation area can only be patrolled a certain percentage of each day.

Objectives

The objectives of the study were the following:

1. Develop a prediction system for the occurrence of law violations in developed recreation areas on the Ogden Ranger District whereby the existing manpower and equipment may be used as effectively as possible

2. Test four hypotheses concerning the occurrence of law violations on outdoor recreation areas in the development of the prediction system
   a. Law violations occur more frequently in certain areas as compared to others
b. Law violations occur more frequently on specific days of the week than other days.

c. Law violations occur more frequently at specific hours of the day than other hourly time periods.

d. The occurrence of law violations is associated with specific weather conditions.

Justification

In order to place the importance of an effective patrol system for the Ogden Ranger District in its proper perspective, several opinions and certain operations in use today should be considered.

Today, the patrolling of problem areas where crime is prevalent is thought to be an essential job in law enforcement. In 1958, the San Francisco Police Department thought the patrolling aspect of law enforcement so important that it enacted a special operation called "Operation Saturation." The object of this system was to have the most police at the proper place and at the right time (San Francisco Police Department, 1958). The St. Louis Police Department feels that calls for service are so important that a prediction system has been developed to predict calls for service from the general public (St. Louis Police Department, 1968).

According to Clark, Campbell, and Hendee (1969), in
their studies in state parks, national forest areas, and National Parks, more stringent law enforcement and increased patrols directed at the offenders are often regarded as one of the best ways of controlling vandalism and other deviant actions. The trend to increase the amount of contact between campground rangers and the recreationist should be emphasized.

The following general statement made in a survey concerning the California State Park situation indicates very clearly the importance of a patrol system:

Inability of the park rangers to control disturbances and disorder, or failure to take appropriate enforcement action, encourages disrespect for law and order. Permissiveness by the rangers is interpreted as a license to violate the law. In these matters the capability to enforce the law must be demonstrated before the troublemakers will abide by the law. (Commission on Peace Officer Standards and Training State of California, 1968, p. 43)

The following two summarized comments made by recreationists on the Ogden Ranger District will indicate quite clearly the attitude of the recreationist toward effective patrols in the developed recreation areas:

1. At last, they (the recreationist) were checked for the annual fee permit and others were no longer getting away without paying the recreation fee.

2. The late evening patrol is appreciated as it indicates the concern and interest of the Forest Service in making the campground a safe and peaceful place to visit (Hronek, 1968).
As the above comments have indicated, a patrol system, and particularly an effective patrol system, is a definite necessity today.

Definitions

There are certain words or phrases that need to be defined in this study.

Developed recreation area: All improved observation, boating, camping, and picnic sites that receive concentrated public recreation use.

Law violation: Infringement or breach of the regulations established in Title Thirty-Six of the Code of Federal Regulations.

Weekday: A day in the week and includes the following specific days: Monday, Tuesday, Wednesday, and Thursday except in a holiday situation.

Weekend: A day in the week and includes the following specific days: Friday, Saturday, Sunday, and all holidays occurring in the study period.

Holiday: A day that is set aside by custom for the suspension of normal business procedures. This includes the following specific dates in the study period: May 30, July 4, July 24, and September 1, 1969.

Delimitations of the study

The scope of the study must now be examined. There were certain delimitations that were felt to be necessary in the development of the prediction system. The following
were the specific delimitations of the study:

1. Only the portion of the Ogden Ranger District that was situated in Weber County and only specific developed recreation areas were considered for data collection. The basic reason for choosing this portion of the district as opposed to some other portion was that the district ranger indicated that these areas presented the greatest law enforcement problems to the district staff.

2. Only those law violations that were known to law enforcement agencies were used in the study. Known law violations to enforcement agencies are felt to be the best index of crime today according to several authorities (Shulman, 1966; Sellin and Wolfgang, 1964; and Sutherland and Cressey, 1966).

3. Only those law violations where a definite time of occurrence could be determined were used in the prediction system.

4. The length of time of the study was chosen to be eighteen weeks. This time period covered the presummer season, the summer season, and the postsummer season. This period of time gives the best indication as to the fluctuation of the problem of law enforcement on the Ogden Ranger District.
5. The hours chosen in the prediction system were chosen to coincide with the normal working hours of the recreation personnel on duty every day of the week during the study period. A system that is based on chance hours was thought to be not usable for the district staff due to limitations in both equipment and manpower.

6. The two time periods of A.M. and P.M. were chosen because there were not enough observations for further differentiation to be useful in statistical analysis.

7. The specific weather factors used in the study were carefully chosen after reviewing the literature and consulting with various authorities.
DESCRIPTION OF THE STUDY AREA

The portion of the Ogden Ranger District that is located in Weber County was selected as the study area. The two major areas in Weber County that presented the most serious law enforcement problems were selected for data collection (Figure 1).

The first area consisted of all developed recreation areas located adjacent to the Pineview Reservoir. These sites are situated approximately ten miles east of the metropolitan area of Ogden, Utah. The sites include camping and picnicking areas as well as boat launching facilities. The following are the camping and picnicking areas: Anderson Cove, South Arm, Jefferson Hunt, North Arm, and Bluff. The following are the boat launching facilities: Port Boat Ramp and Marina Boat Ramp (Figure 2).

The second area includes all developed recreation areas located adjacent to State Highway 39 about eighteen miles east of the metropolitan area of Ogden, Utah. This area is designated as the Canyon area because of its canyon location. The Canyon area includes only the following camping and picnicking areas: Magpie, Botts, Hobble, Meadows, Hawthorne, South Fork, and Willows (Figure 3).
Figure 1. The study area (Pineview Reservoir area and Canyon area)
Figure 2. The study area (Pineview Reservoir area)
Figure 3. The study area (Canyon area)
LITERATURE REVIEW

The problem in outdoor recreation areas

Today, the problem of lawless behavior on outdoor recreation sites is serious. Upon examination of the literature, this problem was noted to be quite vast. In order to understand the extent of the problem more clearly, three resource management agencies that have serious problems have been examined (state park systems, United States Forest Service, and the National Park Service).

The State of California has a definite problem with law enforcement in the state park system. This problem should be examined in some detail to understand its scope.

In addition to his many tasks in state park management, the California State Park Ranger finds himself confronted with problems that are related to human conduct. These problems are concerned with the direction and the control of people in various situations caused by a lack of conformance to normal patterns of social conduct.

The Legislature of the State of California felt so strongly about law and order that they gave the following general mandate to the Parks Department: The Department shall protect the state park system and preserve the peace therein. The Legislature recognized very clearly that protection responsibilities must not be separated from the other duties of the Parks Department.
The conditions of crime and antisocial behavior in the state parks have been building in frequency and volume over a period of several years. There have been numerous felony offenses of robbery, rape, assault, burglary, and auto theft. Such crimes as theft and vandalism cause great losses. Other types of arrest involve marijuana, dangerous drugs, and other types of narcotics. In some beach areas, nudism and various types of lewd and immoral exhibitions are not uncommon.

Today, the California State Park System is ill equipped and unprepared, both in terms of trained personnel and essential equipment, to cope with the disorder and the problem of crime in the parks today (Commission on Peace Officer Standards and Training State of California, 1968).

Various states have a distinct problem with lawless behavior and a few statements by officials representing these states should be examined.

James E. Webster, Chief, Consultation Education, Park and Recreation Commission, State of Washington has the following to say:

In response to your letter in which you requested if the State of Washington has any problems with law violation in outdoor recreation sites, please let me relate that we do have a problem and it is an ever increasing problem just as crime is ever increasing problem in our society today. (Webster, 1969)

Kessler R. Canon, Administrative Assistant Natural Resources, State of Oregon indicates the following:

Problems of law violations, principally in
vandalism and littering, are on the increase in Oregon, and probably in all areas of the nation. Vandalism is a major problem, and removes from the public many services that might be provided.

I think every recreation manager is faced with an upswing in destructive behavior on the part of a small portion of his users. This is extremely unfortunate, but so far no one has yet found the key to solving the problem. (Canon, 1969)

Charles G. Bolwell, Chief, Division of Enforcement, Department of Natural Resources, State of Rhode Island indicates the problems he has in law enforcement:

Even in the four short years that I have been in natural resource law enforcement there has been a marked increase in lawless activity in our recreation areas.

Our day-use areas are just as bad, sometimes worse. We have trouble with people stealing from cars, teenage drinking, sex perverts, exhibitionists, pot smoking, sniffing glue and anything else you can name. A complete crack-down in these areas has resulted in many arrests and prosecution but I'm sure we'll never eliminate the problem completely .... (Bolwell, 1969)

In the United States Forest Service System, many National Forests have a distinct law enforcement problem. The following specific examples will indicate some of these problems:

The Supervisor of the Wenatchee National Forest estimated that the replacement cost for the damage to public and private property in the area to be over $150,000 annually (Bennett, 1969).

In the Mt. Hood National Forest of Oregon, the United States Forest Service allows people to lease small areas of land and construct summer and winter homes. In those
homes along the Zig Zag River, between June, 1965-June, 1966, 67 percent of the summer homes in the area were vandalized or burglarized (Bennett, 1969).

John S. Sieker, Director, Division of Recreation and Land Use, United States Forest Service, Washington, D.C. indicates his views:

Vandalism and careless litter at National Forest Recreation sites is a serious problem. We can't exactly know how much it costs the Forest Service, but we know it is a sizeable amount and too much. (Bennett, 1969, p. 173)

The National Park Service is the third resource agency that should be examined to indicate the extent of the law enforcement problem in outdoor recreation areas.

The National Park Service in recent years has recorded significant increases in serious crimes against property and persons. This trend exceeds both the increase in visitation and the national increase in crime. Thefts from cars increased 330 percent in one year at Kentucky's Mammoth Caves National Park, and such thefts have become a big problem at many parks. The use of narcotics has caused problems for park rangers at Yosemite, Grand Canyon, and Grand Tetons National Park. Last year, it was indicated that serious crime in the National Parks had increased 67 percent while serious crime had increased only 18 percent in the cities (Cahn, 1968).

Chief Park Ranger, Lyle H. McDowell, Glacier National Park, indicates the following in regards to the problem
Glacier National Park does not have a serious vandalism problem. This is not to imply that vandalism does not occur. At any place where large numbers of people congregate, vandalism to some degree will be found. The seriousness of the problem seems to be inversely proportional to the distance of the park from a large population center and this might account for our good fortune—there are no large population centers nearby. (Bennett, 1969, p. 180)

An examination of serious crimes over the past few years in the nonurban portion of the National Park System would be helpful in seeing the distinct trend in the entire system (Table 1).

### Table 1. Summary reports of law enforcement and traffic safety of the National Park Service

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<th>Part I offenses (criminal homicide, robbery, rape, larceny, burglary, auto theft, and aggravated assault)</th>
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<tr>
<td>Year</td>
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<tr>
<td>1966</td>
<td>1542</td>
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<td>1967</td>
<td>2585</td>
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<td>1968</td>
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<td>20,504</td>
</tr>
<tr>
<td>1968</td>
<td>27,756</td>
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A study in the State of Washington ties together the general problems of the three resource agencies previously
mentioned and should now be examined.

Teams of researchers mingled in the selected portions of each of the campgrounds. In each of the observed campgrounds, the general characteristics are as follows: heavy use, well developed facilities, opportunity for water oriented activities, and the presence of resident rangers in the areas. The researchers were looking for the following type of acts in each of the camping areas: nuisance acts, vandalism acts, and legal violations (Clark, Campbell, and Hendee, 1969).

The general findings of the study should be mentioned. Posted somewhere in every campground is a definite list of rules designed to bring law and order to the recreation community. It was found that in every campground violations of these rules persisted (Campbell, Hendee, and Clark, 1969b).

The authors of the study indicated the following general statement concerning the problem of law enforcement: it should be recognized that the campground community, like all communities, contains a definite range of deviant behavior. As the number of campers increases, the problems arising from these behaviors will increase and become much more complicated. The old rule, standards, and management policies will become outgrown and obsolete. Recognition of the problems and specific efforts to cope with the problem are imperative (Campbell, Hendee, and Clark, 1969a).
Findings in the field of criminology

An understanding of a few important factors in the field of criminology are quite essential in the development of a prediction system for the occurrence of law violations.

One must first understand that it is quite difficult to measure the amount and type of crime committed. The following sources indicate the difficulty in measuring crime as well as what is considered to be the best index of crime today:

Crime is by its very nature not very easily measured. It is subject to being concealed and wide areas of criminal behavior fail to be included in crime statistics because of general social resistance toward their reporting to the various law enforcement agencies (Shulman, 1966).

Crimes known to the police are the best index of the number of crimes committed. In any case, the number of crimes known to the police is certainly much less than the number actually committed (Ferracuti, Hernandez, and Wolfgang, 1962).

The most important sources of information about criminal offenses are those agencies that are entrusted with the enforcement of criminal law today. Statistics of the number of offenses known to the police form the best available means of measuring the extent of crime at a specific time, and changes from time to time (Sellin and Wolfgang, 1964).
The efficient use of police manpower has always been a problem, but it has become increasingly serious in the last few years. Crime in the United States is on the increase. The general demand for police services has kept pace with the increase in crime. In the past, such increases have been met by hiring more men and purchasing more equipment. This saturation approach often becomes wasteful and useless. Attention has now become focused on finding more efficient and more effective ways of using the presently available resources of police manpower and material that is available (St. Louis Police Department, 1968).

The theory of patrol beat distribution recognizes the unproven theory that the presence of uniformed patrolmen will prevent or suppress various types of crime. It is physically impossible for the policeman to be everywhere at every moment of the day or the night. The police department, therefore, must attempt to distribute their men at such times and in such ways as to create the impression to the general public that the police may be at any given place at any given time. The methods of providing omnipresent patrol with limited personnel and a limited budget is one of the most trying questions facing the law enforcement administrator today (Bristow, 1969).

In the field of criminology, there are various thoughts as to how police officers should be distributed.
An examination of a few specific sources will give added insight to the distribution problem of police forces.

The officer lessens the opportunity for misconduct by observation and supervision of persons during his routine movement from one part of his beat to another. Special attention to those areas in which incidents calling for police service occur most frequently is often times quite beneficial in the attempt to reduce the amount of crime committed in these areas.

The effectiveness of the patrol in minimizing the belief in the existence of opportunity for misconduct, which is the basic police job, is in direct proportion to the apparent or the observed frequency of the patrol (Wilson, 1963).

By studying the past experiences, the scientist can predict future occurrences. The alert police administrator can also anticipate the distribution of the need for his patrol force on the basis of the past distribution of the problem.

The patrol personnel should be distributed on a proportionate need basis. The time or area which presents a certain percentage of the problem should be assigned that percentage of the personnel available (Walton, 1958a). Proportionate need applies regardless of the number of men distributed. Fifty percent of the available personnel should be assigned to 50 percent of the problem. This holds to different areas as well as to the specific
time of day. It is vitally important that the officer should be in the field during the time and at the location where the crimes do occur (Walton, 1958b).

Since the number of crimes vary according to the degree of the intensity of social interaction among people, it is quite normal to expect distinct fluctuations of offenses by days of the week. Crime not only varies by days of the week but it also varies by hours of the day according to the amount of social interaction (Lunden, 1967).

Now that some basic thoughts as to the distribution of police manpower are known, a brief look at two police organizations should be made.

The St. Louis Police Department has developed a prediction system for calls for service. The basic goal in this system is to determine the number of cars on permanent patrol required to answer all calls for service without delay for specific geographic areas and at specific segments of the day.

The prediction of future calls for service are based on the number of past calls received. The many factors which influence calls for service are thought to be predictable and to change very slowly with time (St. Louis Police Department, 1968).

The San Francisco Police Department felt that a special operation, "Operation Saturation," was needed in
1958 due to a national rise in crime. It was felt that immediate measures must be taken to prevent crime in San Francisco from continuing to follow this national trend.

To ward off this increase in crime, it was decided on forming a special squad of men assigned primarily to attack specific crimes. The entire system centered around the distribution of these men at the right place and at the right time. Those areas where crime was a more serious problem were given more attention than others (San Francisco Police Department, 1958).

Relationship between crime and weather factors

The relationship between crime and weather factors has been debated for many years with no real agreements being reached. Is there a relationship between crime and weather factors or is all the questioning just mere speculation? An examination of various sources will help clarify this relationship.

The Federal Bureau of Investigation felt strongly enough about the relationship between weather and crime that it listed climate, among many other factors, in recent years as one condition which influences the amount of crime in a community (La Roche and Tillery, 1956).

In an examination of murders and political crimes, Lombroso found each to reach a maximum in the hottest months. He investigated political crimes and noted that 836 rebellions occurred between 1791-1880 in the world and
predominated in the hottest months. Ferri, from statistics on sex crimes committed in France between 1827-1869, found that sex offenses occur in the same maximum and minimum frequencies in the same months for all the years studied (Falk, 1952).

Statistical studies show very uniformly that crimes against the person and morals reach a maximum in the summer months. It is very possible that some of the variation in crime is influenced directly by climatic conditions (Sutherland, 1939).

In the late nineteenth, early twentieth century, attempts were made to confirm the relationship between crime and climate. European data by Ferri and Lacassagne supported that warmer climates were associated with higher rates of crime against property. More recent evidence, compiled from 1959 data in the United States, confirms the existence of a marked monthly pattern in the variation of crimes against the person and against property (Bloch and Geis, 1962).

Cohen, in 1941, on a basis of a survey of the literature, an analysis of the Uniform Crime Rates between 1935-1940, and additional information gathered over a century of time and from all over the world, indicated that crime is very definitely a seasonal occurrence (Kaplan, 1961).

A few years ago in Tokyo, Japan, statistics showed
that low pressure days affected people. When the barometer was falling, bus and street car passengers became more forgetful and left more packages and umbrellas on the vehicles than during times of higher barometric pressure (Mills, 1942).

From personal experience, it is known that an increase in humidity in either warm or cold weather may create a feeling of great discomfort. High water vapor pressures at high environmental temperatures are experienced as discomfort because they lessen dissipation of heat by evaporation, thus allowing superficial and deep tissues to be warmer than dry air of the same temperature (Tromp, 1963).

In a study of 18 riots that occurred in the United States in very recent years, certain relationships between riots and the temperature were noted. In most instances, the temperature during the day on which violence first erupted was quite high. This contributed to the size of the crowd on the street, particularly in areas of congested housing.

A breakdown of the 18 riots and the temperature range in which they occurred are as follows:

1. Nine riots occurred when the maximum temperature was 90 F or higher.
2. Eight riots occurred when the maximum temperature was in the 80-90 F range.
3. One riot occurred when the temperature was 79 F (Wicker, 1968).

Certain studies have been done to relate specific types of crime to weather conditions. An examination of a few of the studies will indicate if there really are distinct relationships between specific weather conditions and types of crime.

Dexter (1904) studied the effects of weather on both the crimes of assault and murder in the cities of New York and Denver. In his examination of incidences of assault, he found the following relationships with weather factors:

The assault curve for men is most regular, showing a gradual increase from January, the coldest month, to July, the hottest month, and a decrease for the remainder of the year. In fact, it is very identical with the curve of monthly means for temperature. Except for the very highest temperatures, the number of assaults increases with temperature.

There are other factors that were found to be significant in the number of assault incidents and these include the following: A low barometer reading, indicating low pressure, was found to indicate a greater number of assaults. The mild winds between 6-9 miles per hour were associated with the greatest number of assaults.

In Dexter's (1904) examination of incidences of murder, he found the following relationships with weather:
An increase in temperature indicated an increase in homicidal tendencies up to the peak of 90°F. The greatest number of occurrences of murder occurred on low pressure days as compared to high pressure days. Murders were found to increase with winds from 9 miles per hour up to 17 miles per hour.

Seasonal variation in suicide rates are mentioned by many observers. Such variations are often times explained by changes in weather conditions. The following weather factors have been mentioned to be associated with suicide: Barometric pressure has been implicated in four different ways in affecting the suicide rate. Rain and precipitation have been mentioned by several authors. Various authors have indicated that mild wind has the greatest effect on suicide attempts as well as on suicide.

It is a commonplace observation that weather does affect how we feel. A sense of gloominess or brightness is often times directly related to weather conditions. Suicide might very well be influenced by specific weather factors although no conclusive evidence is available (Porkorny, Davis, and Harberson, 1963).
METHODS

Records of all known violations that occurred on the developed recreation areas in the Weber County portion of the Ogden Ranger District between May 16, 1969, and September 18, 1969, were collected. The sources of these known violations are as follows:

1. Recreation guards issuing notices in their daily work. The recreation guards were allowed to go about their daily routines without any control by the researcher.

2. A special form provided by the researcher to the recreation guard to indicate violations where the violator was unknown or was not issued a violation notice.

3. Weber County Sheriff.

4. Huntsville Police.

5. Utah Highway Patrol.

From each of these sources of known law violations, the following information was taken:

1. Type of law violation
2. Time of occurrence of the law violation
3. Location of the law violation

After reading various sources, it was felt that certain weather factors were directly associated with law violation occurrences on the Ogden Ranger District. After
reviewing the literature and consulting with various authorities, the following weather factors were chosen to test for their relationship to the occurrence of law violations:

1. Relative humidity
2. Maximum temperature
3. Wind speed
4. Barometric pressure
5. Wind direction
6. Precipitation

The weather information was obtained from the climatological records of the Utah State Climatologist. The climatological data were arranged to coincide with the weekday-weekend distribution for each of the weeks of the study.

The source of each of the weather factors should be noted. The following are the specific steps taken for each of the weather factors:

1. Relative humidity
   Relative humidity was adjusted for the study area and for the city of Ogden, Utah.

2. Maximum temperature
   Maximum temperature was read directly from the recorded data from the Huntsville Monastery for the study area and Ogden Pioneer station for the city of Ogden, Utah.
3. Wind speed
   Wind speed was read directly from the recorded data from the Ogden Airport.

4. Barometric pressure
   Barometric pressure was read directly from the recorded data from the Salt Lake City Airport.

5. Wind direction
   Wind direction was read directly from the recorded data from the Ogden Airport.

6. Precipitation
   Precipitation was read directly from the recorded data from the Huntsville Monastery for the study area and Ogden Pioneer station for the city of Ogden, Utah.

The weather factors taken from the Ogden weather stations were considered in the analysis because it was felt that the Ogden, Utah, weather might affect the amount of use on the developed recreation areas of the Ogden Ranger District.

An analysis of the data collected from the various sources was done by utilizing a computer. Stepwise multiple regression analysis was the statistical technique used in the analysis. The following variables were compared to determine their specific significance in the occurrence of law violations:

1. Week of the study
2. Part of the week
3. Time of day
   a. The study period for each day began at 6:00 A.M. and ended at 12:00 P.M.
   b. There were two periods (A.M. and P.M.) in each day. These broad time periods were necessary because there were not enough observations to further differentiate the time periods.

4. Location
   a. Pineview Reservoir area
   b. Canyon area

5. Weather factors
   a. Relative humidity
   b. Maximum temperature
   c. Wind speed
   d. Barometric pressure
   e. Wind direction
   f. Precipitation
RESULTS AND DISCUSSION

Thirteen variables were examined to see what correlation existed between these variables and the occurrence of law violations. The occurrence of law violations \( V \) was a function of:

- Wind direction \( (X_9) \)
- Precipitation in the study area \( (X_{19}) \)
- Barometric pressure \( (X_{10}) \)
- Precipitation in the city of Ogden, Utah \( (X_{18}) \)
- Wind speed \( (X_8) \)
- Week of the study \( (X_1) \)
- Maximum temperature in the city of Ogden, Utah \( (X_7) \)
- Maximum temperature in the study area \( (X_6) \)
- Relative humidity in the study area \( (X_5) \)
- Relative humidity in the city of Ogden, Utah \( (X_4) \)
- Part of the week \( (X_{15}) \)
- Area \( (X_{16}) \)
- Time of day \( (X_{17}) \)

The formula of this relationship is as follows:

\[
V = f(X_9, X_{19}, X_{10}, X_{18}, X_8, X_1, X_7, X_6, X_5, X_4, X_{15}, X_{16}, X_{17})
\]

Wind direction, as indicated by the F-ratio presented in Table 2, was found to be the only variable not significant at the .10 alpha level. In the final formula this variable was deleted. The following formula expresses
Table 2. Analysis of variance of complete model

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>D.F.</th>
<th>MS</th>
<th>F ratio</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>648</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wind direction</td>
<td>1</td>
<td>203.98</td>
<td>0.88</td>
<td></td>
</tr>
<tr>
<td>Precipitation in study area</td>
<td>1</td>
<td>780.96</td>
<td>3.37</td>
<td>.10</td>
</tr>
<tr>
<td>Barometric pressure</td>
<td>1</td>
<td>954.93</td>
<td>4.12</td>
<td>.05</td>
</tr>
<tr>
<td>Precipitation in the city of Ogden, Utah</td>
<td>1</td>
<td>1713.46</td>
<td>7.38</td>
<td>.01</td>
</tr>
<tr>
<td>Wind speed</td>
<td>1</td>
<td>2967.83</td>
<td>17.79</td>
<td>.0005</td>
</tr>
<tr>
<td>Week of the study</td>
<td>1</td>
<td>7305.66</td>
<td>31.48</td>
<td>.0005</td>
</tr>
<tr>
<td>Maximum temperature in the city of Ogden, Utah</td>
<td>1</td>
<td>6142.48</td>
<td>26.47</td>
<td>.0005</td>
</tr>
<tr>
<td>Maximum temperature in study area</td>
<td>1</td>
<td>9254.16</td>
<td>39.88</td>
<td>.0005</td>
</tr>
<tr>
<td>Relative humidity in study area</td>
<td>1</td>
<td>13703.08</td>
<td>69.05</td>
<td>.0005</td>
</tr>
<tr>
<td>Relative humidity in the city of Ogden, Utah</td>
<td>1</td>
<td>13374.87</td>
<td>57.64</td>
<td>.0005</td>
</tr>
<tr>
<td>Part of the week</td>
<td>1</td>
<td>12930.78</td>
<td>55.72</td>
<td>.0005</td>
</tr>
<tr>
<td>Area</td>
<td>1</td>
<td>44487.08</td>
<td>191.71</td>
<td>.0005</td>
</tr>
<tr>
<td>Time of day</td>
<td>1</td>
<td>92531.87</td>
<td>398.76</td>
<td>.0005</td>
</tr>
<tr>
<td>Error</td>
<td>635</td>
<td>232.05</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$R^2 = .587$
the relationship between the occurrence of law violations (V) and the remaining independent variables:

\[ V = f(x_{19}, x_{10}, x_{18}, x_8, x_1, x_7, x_6, x_5, x_4, x_{15}, x_{16}, x_{17}) \]

The regression coefficients for each of the independent variables is presented in Table 3.

In the original objectives of the study, it was stated that four hypotheses would be tested in the development of the prediction system. The hypotheses consisted of the following: (1) law violations occur more frequently in certain areas as compared to others (Pineview Reservoir area vs Canyon area), (2) law violations occur more frequently on specific days of the week than other days, (3) law violations occur more frequently at specific hours of the day than other hourly time periods, and (4) the occurrence of law violations is associated with specific weather conditions. The F-ratios in Table 2, except for the variable wind direction, substantiate each of the four hypotheses at the specific alpha levels listed in the table.

By the use of multiple regression analysis on the 13 variables presented in Table 4, the mathematical computation establishes an \( R^2 \) of .587.

The following variables, presented in their order of deletion, contributed very little in explaining the variability in the occurrence of law violations as indicated
Table 3. Regression coefficients for independent variables

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>Regression coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind direction</td>
<td>0.0174</td>
</tr>
<tr>
<td>Precipitation in study area</td>
<td>1.7616</td>
</tr>
<tr>
<td>Barometric pressure</td>
<td>-1.8460</td>
</tr>
<tr>
<td>Precipitation in the city of Ogden, Utah</td>
<td>-2.6519</td>
</tr>
<tr>
<td>Wind speed</td>
<td>1.5272</td>
</tr>
<tr>
<td>Week of the study</td>
<td>-0.7815</td>
</tr>
<tr>
<td>Maximum temperature in the city of Ogden, Utah</td>
<td>-4.2805</td>
</tr>
<tr>
<td>Maximum temperature in study area</td>
<td>5.2226</td>
</tr>
<tr>
<td>Relative humidity in study area</td>
<td>7.5001</td>
</tr>
<tr>
<td>Relative humidity in the city of Ogden, Utah</td>
<td>-9.3459</td>
</tr>
<tr>
<td>Part of the week</td>
<td>5.6058</td>
</tr>
<tr>
<td>Area</td>
<td>8.2859</td>
</tr>
<tr>
<td>Time of day</td>
<td>-12.6762</td>
</tr>
</tbody>
</table>
Table 4. Stepwise regression summary

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>$R^2$</th>
<th>Percent of explained variability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind direction</td>
<td>.587</td>
<td>0.1</td>
</tr>
<tr>
<td>Precipitation in study area</td>
<td>.586</td>
<td>0.2</td>
</tr>
<tr>
<td>Barometric pressure</td>
<td>.584</td>
<td>0.1</td>
</tr>
<tr>
<td>Precipitation in the city of Ogden, Utah</td>
<td>.583</td>
<td>0.4</td>
</tr>
<tr>
<td>Wind speed</td>
<td>.579</td>
<td>0.4</td>
</tr>
<tr>
<td>Week of the study</td>
<td>.575</td>
<td>1.9</td>
</tr>
<tr>
<td>Maximum temperature in the city of Ogden, Utah</td>
<td>.556</td>
<td>2.9</td>
</tr>
<tr>
<td>Maximum temperature in study area</td>
<td>.527</td>
<td>0.9</td>
</tr>
<tr>
<td>Relative humidity in study area</td>
<td>.518</td>
<td>2.2</td>
</tr>
<tr>
<td>Relative humidity in the city of Ogden, Utah</td>
<td>.496</td>
<td>1.9</td>
</tr>
<tr>
<td>Part of the week</td>
<td>.477</td>
<td>9.4</td>
</tr>
<tr>
<td>Area</td>
<td>.383</td>
<td>12.5</td>
</tr>
<tr>
<td>Time of day</td>
<td>.258</td>
<td>25.8</td>
</tr>
</tbody>
</table>
by the values presented in Table 4: precipitation in the study area; barometric pressure; precipitation in the city of Ogden, Utah; wind speed; week of the study; maximum temperature in the city of Ogden, Utah; maximum temperature in the study area; relative humidity in the study area; and the relative humidity in the city of Ogden, Utah.

The weather factors, as noted in the deletion process, contribute little in the explanation of the variability of the occurrence of law violations. A combined $R^2$ value of .091, derived by the addition of the percent of explained variability for all the weather variables, indicated that these variables only explained 9.1 percent of the variability of the occurrence of law violations.

Although the analysis is correct as to the effect of the weather variables, the possible impact of some weather factors, particularly the two precipitation variables, might be greatly reduced because of a timing factor. The precipitation, both in the city of Ogden, Utah, and on site, occurred primarily in thundershowers which took place in the late afternoon. By this time of day, the greatest number of violations had already occurred. Thus, if there was any relationship between precipitation and the occurrence of law violations, this relationship might go undetected because of a data collection problem.

It is appropriate to emphasize the most significant contributors to the percent of explained variability in
the occurrence of law violations. The following three variables explained 47.7 percent of the variability in the occurrence of law violations: part of the week, area, and time of day.

It should be mentioned that each of these three most significant variables is directly correlated with the level of use. Since the level of use and the occurrence of law violations are directly related, these variables would be expected to be quite significant in the prediction model.
SUMMARY AND CONCLUSIONS

The primary objective of this study was to develop a prediction system for the occurrence of law violations on the Ogden Ranger District, Weber County, Cache National Forest whereby the existing manpower and equipment may be used as effectively as possible.

In an attempt to develop the prediction system, 13 variables were chosen that were felt to be related to the occurrence of law violations. These variables consisted of nine weather variables and four use related variables. Of the original 13 variables, 12 variables were significant at least to the .10 alpha level. The most significant variables that accounted for the greatest portion of the variability of the occurrence of law violations were directly related to the level of use. The entire model accounted for 58.7 percent of the variability of the occurrence of law violations during the study period.

The prediction system developed during this study is not a usable tool for the resource managers of the Ogden Ranger District for the following reason: The entire model accounted for only 58.7 percent of the variability of the occurrence of law violations on the study area. As there are only two areas where men and equipment may be distributed, the prediction system accounted for little more than chance alone.
SUGGESTIONS

It is felt by the researcher that one primary modification in the methods of this study, if feasible, would make it possible to develop a usable predictive tool for the resource managers of the Ogden Ranger District, or perhaps any other resource manager who has a law enforcement problem. This change would be to record the time a recreation guard stays in a certain area. This would mean that the recreation guard would keep a daily diary of where he was and for how long a period of time he was in this location. This would give the researcher an accurate sample of the total known violations with timing indicated. This change would, in all probability, help the researcher in filling up the needed cells for further divisions of the broad time periods established in this study. The ideal data collection procedures, although highly impractical to the resource manager, would be to control the movement of the recreation guards in a systematic manner in order to obtain the truest picture possible of the total number of occurrences of law violations.

These suggestions are felt by the researcher to be the ones that would help to evolve a prediction system for any resource manager that would be an index to guide him in redistributing his manpower in the areas where they
are most needed on a systematic basis rather than by chance or vague hunch.


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St. Louis Police Department. 1968. Allocation of Patrol Manpower Resources in the St. Louis Police Department Volume I. St. Louis, Missouri. 96 p.


VITA

John Henry Harris

Candidate for the Degree of

Master of Science

Thesis: The Development of a Prediction System for the Occurrence of Law Violations on the Ogden Ranger District, Weber County, Cache National Forest, Utah

Major Field: Forest Recreation

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