RECREATIONAL TRIP CHARACTERISTICS AND TRAVEL PATTERNS

Second Phase of the Washington State Recreational Travel Study

Prepared for
Washington State Highway Commission
State Department of Highways
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Federal Highway Administration

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SUMMARY AND CONCLUSIONS

The objectives of this research are two-fold: 1) to identify characteristics of recreational trips, and 2) to identify factors influencing the distribution of recreational trips. Characteristics of recreational trips have been identified on the basis of data collected from different state agencies in the State of Washington.

Seven recreational trip purposes which are characteristic for the State of Washington have been identified in this study: 1) camping trips, 2) hunting trips, 3) fishing trips, 4) visiting beaches and clamming, 5) snow skiing, 6) driving for pleasure and sightseeing, and 7) others.

The analysis has been performed basically for the spatial and temporal distribution of recreational trips. Spatial distribution relates to the location of the recreation opportunities which can clearly be distinct for each of the trip purposes and is further characterized by the trip-length frequency connected with each of these trip purposes. Temporal distribution is related primarily to the seasons within which the activity corresponding to the trip purpose can be pursued.

A further reason for classifying recreational trips into these seven purposes is the difference in travel behavior that can be observed in connection with the trip purposes. For example, hunting, fishing and snow skiing are trips with a distinct destination, and the trip maker tends to select the shortest route to his destination in order to minimize the travel time. Travel to the trip destination is not, therefore, an essential part of the recreation experience. On the other hand, driving for pleasure and sightseeing creates different travel behavior. The trip to

to the recreation site is an essential part of the recreation experience, and the objective is not to minimize the travel time but to optimize the recreation enjoyment.

The identification of factors influencing recreational trip distribution revealed that the attractiveness of a recreation area as perceived by the user is a very significant influencing factor. The analysis further indicated that the travel time between trip-production and trip-attraction zones has a significant influence on the distribution pattern of recreation trips.

Traffic patterns of overnight camping trips to state parks for the years 1969 and 1971 in the State of Washington were successfully simulated with the gravity model by calibrating the model for attractions. This allowed the derivation of a measure for the user's perceived attractiveness of a park. The same gravity model, calibrated in the same manner, successfully simulated 1962/63 and 1970 camper trips to three state parks in Southern California. In both cases, correlation coefficients of 0.90 and higher were derived from observed and calculated trip-length frequency distributions. The correlation coefficient indicates that the functional relationship between travel time and the traffic patterns remains constant over time. However, the actual attractiveness of individual parks changed during the study period, perhaps as a result of changes in activity patterns.

The successful simulation and prediction of overnight camping trips by the gravity model suggests that campers are using the shortest route to their destination. The gravity model's travel time sensitivity rests in the F-factor, which is a function of travel time. This finding is substantiated by the analysis of two campgrounds in the Rancho Cuyamaca Park in Southern California where the northern campground, located closer

to Los Angeles than the southern, showed a higher percentage of Los Angeles origins than the southern campground. Campers traveling to parks within their weekend travel region did not seem to combine major sightseeing with their camping trip, but rather selected the shortest and most direct route in order to maximize their time at the destination.

Finally, the study has revealed a valuable data base for undertaking time sequence studies on camping traffic patterns. Visitors to state parks registered with their place of origin, the number of people in their party, the date of arrival and number of nights spent, and other information pertaining to the equipment used. These records have been collected for a number of years and constitute an excellent origin-destination data base. The particular value of these records, however, is not generally recognized by park agencies, and the records are usually destroyed after they have been audited. An attempt should therefore be made to conserve as many of these records as possible because of their great research potential.

CHAPTER I

INTRODUCTION

In 1969, the Washington State Highway Commission, Department of Highways, embarked on a research effort entitled, "Weekend Recreational Travel." The project was outlined as a three-phase study to accomplish the following purposes:

Phase I - Identification of the problem and development of a conceptual approach

Phase II - Analysis of weekend recreational trip characteristics and travel patterns

Phase III - Development of a prediction model for weekend recreational travel

A report on Phase I entitled, "Weekend Recreational Travel, Development of a Concept", was published in 1970 by the Puget Sound Governmental Conference, Seattle, Washington. Phase II is presented herein, and it is primarily a discussion of recreation trip characteristics and travel patterns.

1. Objectives of the Study

There are two primary objectives of the study: 1) to examine characteristics of recreational trips as they can be identified through quantitative analysis of available data on recreational travel, and 2) to analyze changes in recreational traffic patterns as they occur over time and to draw conclusions as to the significance of different factors influencing the distribution of recreational trips. The characteristics pertain mainly to the temporal and spatial distribution of recreational trips and to the purpose of recreational trips. Analysis of the second objective should provide

insight into the functional relationships of influencing factors and the distribution of trips as well as the stability over time of these relationships.

The data base used to fulfill the two objectives was derived from an existing volume of data collected; only those of significance to weekend recreational trips have been used. Special attention is given to overnight camping trips in the State of Washington and in Southern California.

The need to characterize recreational trips, to define trip purposes, and to determine functional relationships between influencing factors and recreational traffic patterns is well recognized among transportation and recreation planners. The ability to quantitatively relate causes and effects and thereby eventually to predict policy impacts on recreational traffic patterns is a valuable analytical instrument in public and private policy decision-making.

2. The Study Area and Study Methodology

The study area for the determination of recreational trip characteristics was not confined to any particular region, but encompassed the entire State of Washington. For the analysis of recreational travel patterns, two case studies have been performed. One study involved six Washington State parks including Belfair, Penrose Point, Lake Sylvia, Twin Harbors, Lake Wenatchee, and the four urban areas of King, Pierce, Snohomish and Kitsap Counties. The second case study comprised three state parks in Southern California - Rancho Cuyamaca, Palomar Mountain, and Anza-Borrego Desert - as they relate to the three urban areas of San Diego, northern San Diego County and Los Angeles.

In both case studies, the parks presented a variety of recreational attractions ranging from mountain parks and mountain lakes to beach parks and a desert. Several factors contributed to the selection of these parks.

First, there were sufficient data available to observe travel patterns over a period of several years. Such time series data are of importance in order to observe and analyze changes in travel patterns. Over the time period studied, changes occurred in visitation patterns as well as factors that exerted a strong influence on them, most noticeably some significant improvements in the highway network linking the urban areas and the parks. The effect of these highway improvements were analyzed using a before-and-after technique.

The second factor involved the variety of recreational attractions represented by the parks and consequently the variety of recreational activities that can be pursued. Furthermore, the parks have been selected so that parks offering similar activities have experienced different degrees of highway improvements. This will give additional insights into the importance of and role played by the variable factor of accessibility in influencing recreational travel patterns.

The third factor pertained to the geographic location of the study area and the resulting possible bias of the population towards certain types of outdoor recreation attractions and improvements in the highway system. The Southern California case has been selected as a contrast to the State of Washington case.

Data used to identify and characterize trips have been gathered from the Washington State Highway Department, Washington State Parks, State Department of Fishery, State Game Department, and the Interagency Committee for Outdoor Recreation. In the California study, an adequate data base existed only for overnight camping trips from urban areas to San Diego; hence, only those data were analyzed.

Data collected in the 1967 Washington state-wide recreation demand survey provided a basis for determining trip characteristics. The long list of commonly used outdoor recreational activities did not lend itself directly to

the identification of trip characteristics. These activites are aggregated according to their temporal and spatial distribution to determine whether the resulting trip volumes are substantial enough to warrant consideration for transportation planning. Recent observations made by the Washington State Highway Department on the selection of routes when traveling for different recreational purposes have been used to substantiate the findings of the analysis of demand survey and other state recreation data.

The gravity model was used to formulate quantitatively a relationship between travel time and other influencing factors and traffic patterns because it has proved to be a satisfactory simulation technique for urban travel patterns as well as for recreational travel patterns. In this case, the main advantage was a separation of the effect of travel time from all other attraction factors.

The gravity model was applied and calibrated to reproduce the observed trip-length frequency distribution for a base year for both the Washington and Southern California situations. For a second point in time, the same model used for the base year was applied to the four study areas, and the closeness of the calculated and observed trip-length frequency distribution for this later year was determined. A statistical test was made by calculating the correlation coefficient. A high correlation coefficient between the actual and calculated trip-length frequency distribution was indicative of the gravity model's capability to simulate travel patterns and of the significance of the independent variables used in the model.

Much of the discussion will pertain to different seasons of the year. For the purposes of this research, the four seasons have been identified as follows: 1) winter (January, February and March), 2) spring (April, May, and June), 3) summer (July, August and September), and 4) fall (October, November and December).

CHAPTER II

RECREATIONAL TRIP CHARACTERISTICS

1. Spatial Distribution of Outdoor Recreational Attractions

For the purpose of this study, it was necessary to determine the location as well as the magnitude of the outdoor recreation attractions in the State of Washington by using the data collected from various agencies. Included in these data were traffic count information from the Washington State Department of Highways on rural highways and major highways on the fringes of urban areas. Results of this data collection effort are shown in Table 1.

The data were incomplete because a number of important outdoor recreation attractions such as county parks and private recreation sites were not included. Data on these areas could not be obtained within the given time frame. The missing data were of particular importance in areas of large private recreational developments which are found on some of the beaches and in the mountains.

Neglecting private recreation resources catering to winter sport activities caused a severe error in the spatial distribution of outdoor recreation attractions. Therefore, no data on winter sports attractions were included, and it is estimated that approximately 1.7 million visitations or person-trips were missing. All of these trips had their destination in the Cascade Mountains. The person-trips to winter sports attractions accounted for approximately four percent of all person-trips during 1970.

The spatial distribution of visitations was shown by the different agencies on different spatial units, thereby creating four different systems for distributing visitations. For the purpose of this study, all visitation data are shown on the same spatial unit system, the district system of the Washington State Parks. It was selected because it showed the highest

TABLE 1

1970 Visitations to Selected* Outdoor Recreation Attractions in the State of Washington by Recreation Districts in Thousands

District	State Parks	U.S. Forest	National Parks	Marine	Fishing Fresh-water	Clamming	Total	%
1	1,117	268	2,000	368	-	-	3,753	9
2	5,565	268	-	371	44	622	6,870	16
3	3,718	522	1,050	434	13	-	5,737	14
4	4,780	2,258	1,500	337	14	-	8,889	22
5	2,449	616	-	-	37	-	3,102	8
6	711	696	150	-	55	-	1,612	4
7	1,597	3,142	-	-	-	-	4,739	11
8	806	2,577	-	-	-	-	3,383	8
9	1,029	-	750	-	-	-	1,779	4
10	256	-	-	-	-	-	256	5
11	208	-	-	-	-	-	208	5
12	902	-	-	-	-	-	902	2
13	207	327	100	-	-	-	634	-
TOTAL:	23,347	10,674	4,850	1,510	157	622	41,160	100%

*Excludes County and private recreation developments

number of visitations and because it gave a breakdown of the total state into a number of analysis zones.

The system consisted of thirteen districts, each made up of one or more counties. Districts 1 and 2 were basically along the Washington coast. Districts 3, 4, 5, and 6 covered the Puget Sound area and the western slopes of the Cascade Mountains. Districts 7 and 8 covered the eastern slopes of the Cascade Mountains, and Districts 9 through 13 covered the eastern plains to the border of Idaho.

The distribution of visitation to the individual districts is shown in Figure 1. The seashore attracts approximately 25 percent of the total visitations; the Puget Sound area and western slopes of the Cascades account for approximately 48 percent of all visitations. Most of the ski/winter sports areas are located on the western slopes of the Cascade Mountains. However, skiing, which accounts for approximately 4 percent of the annual participation, has not been included. The eastern slopes of the Cascades attract about 19 percent of the annual visitations. This clearly indicates that the Cascade Mountains are the major outdoor recreation attraction in the State of Washington, followed by the ocean beaches, including the Olympic Mountain Range and the Puget Sound area. Relative visitation volumes were approximately 20 percent on the beaches, 20 percent in the Puget Sound area, and 50 percent in the Cascade Mountains. The remaining 10 percent were in the eastern plains.

Figure 1 also depicts highways with a 1970 weekend traffic factor greater than 1. This factor was derived by dividing the sum of the average Friday, Saturday and Sunday traffic volume by the average weekday (Monday through Thursday) traffic volume. A factor of 1 or greater than 1 has been used to identify weekend recreational travel routes. Again, not all routes or

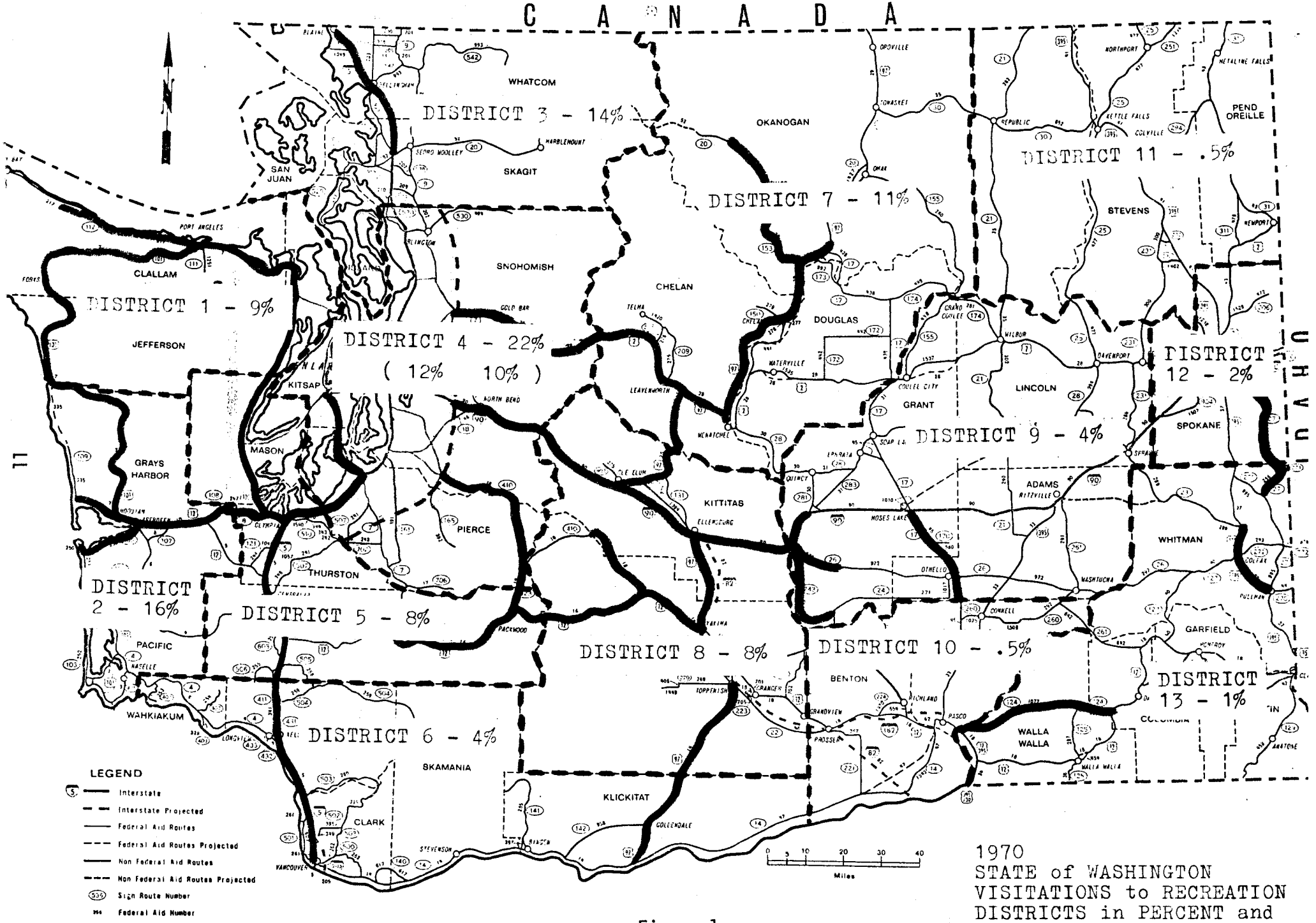


Figure 1

1970
STATE of WASHINGTON
VISITATIONS to RECREATION
DISTRICTS in PERCENT and
WEEKEND RECREATIONAL ROUTES

highways with high weekend traffic patterns were shown because of insufficient traffic count data.

Figure 1 indicates clearly the recreational value of Highway 101 circling around the Olympic Peninsula, Interstate Highway 5 connecting the Puget Sound area with the lower Columbia River and Canada, and the highways crossing the Cascade Mountains. These data reinforced the findings of the visitor distribution which indicated roughly 90 percent of the visitations occurred in the Casecade Ranges and west of these in the Puget Sound area, the Olympic Peninsula, and the beaches. Furthermore, it was of interest to note that all of these areas lay within the weekend travel regions (up to four hours one-way driving time) of the Puget Sound urban areas.

2. Time Distribution of Recreational Trips

A significant characteristic of weekend recreational trips was the particular time of the trip occurrence. Of course, all trips occurred by definition on weekends, that is, between Friday evening and Sunday night or Monday morning. The distribution by day and hour of day was well documented by traffic events. It varied with the type of attraction that could be reached via the route. The monthly distribution of trips was of importance in respect to trip generation and trip distribution because of the difference in attraction power of recreation areas during different seasons and the difference in trip production for the various seasons.

The monthly distribution of visitor volumes is analyzed for State Parks in Figure 2. Distribution of other activities were not included in this figure.

The mean distribution for a number of parks is shown with the minimum and maximum variations marked by envelope curves. This distribution accounted for overnight visitations only, and it is based on overnight registration

1970 MONTHLY DISTRIBUTION OF STATE PARK OVERNIGHT VISITORS IN PERCENT

MEAN DISTRIBUTION FOR ALL PARKS

and

MIN/MAX ENVELOPE CURVES

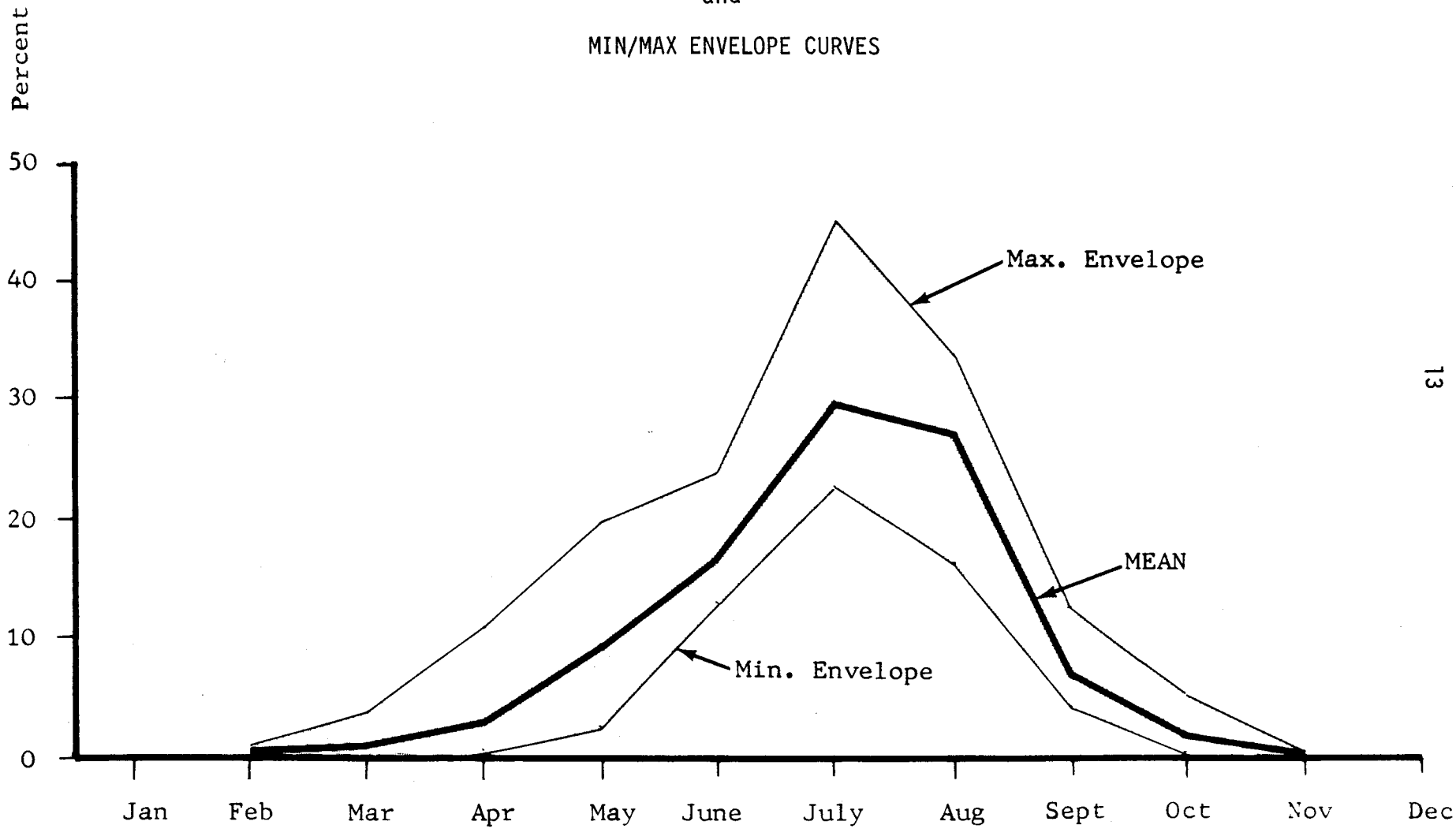


FIGURE 2

1970 CLAM DIGGING ACTIVITIES

MONTHLY DISTRIBUTION OF NUMBER OF DIGGERS IN %

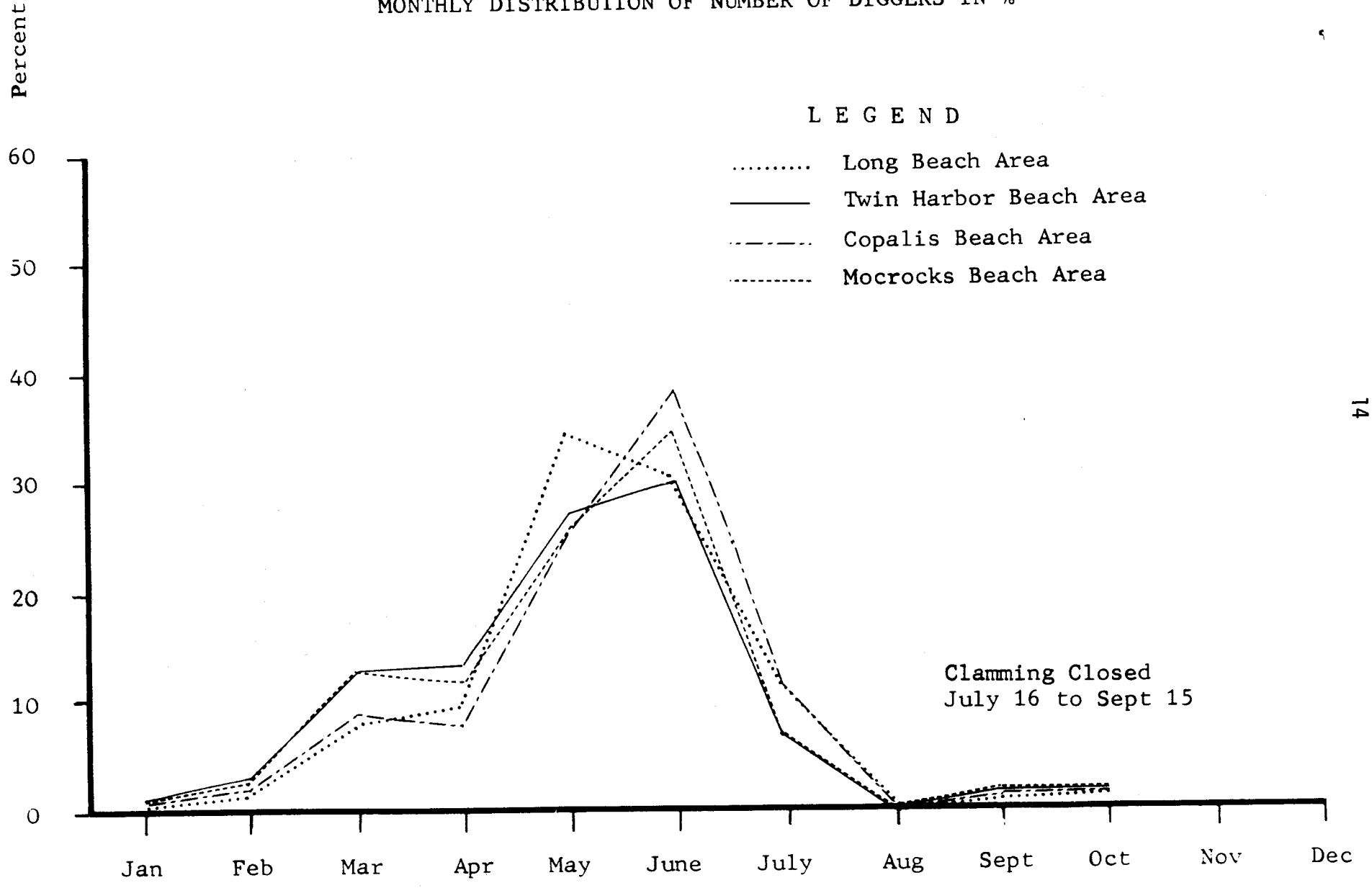


FIGURE 3

receipts for 1970 for several state parks. According to observations from park rangers, however, it can be safely assumed that the monthly distribution of day visitations was very similar to that of overnight visitations.

All state parks showed an increase in visitations during the summer months, while visitation during spring, fall and winter was minimal. There were variations from district to district, however, which are not depicted in Figure 2. Districts 1 through 6, the districts on the beaches and west of the Cascade Mountains, showed their peak during August; Districts 7 through 13, those on the eastern slope of the Cascades and in the eastern plains, showed the visitation peak earlier in the summer. This may be based on climatological facts, namely that the eastern part of the state becomes rather warm as the summer reaches its peak so that people may tend to visit it more during the early part ot the vacation time. Generally, however, there existed a relatively close conformity in the time distribution of state park visitations, namely, that most of the visitations occurred during the summer months, the vacation months, regardless of where the state park was located.

Figure 3 shows the monthly distribution of 1970 clam digging activities on the Washington beaches. A very characteristic curve is seen here with the two highest months, May and June, each accounting for approximately 30 percent of all visitations. During the earlier part of the year, March and April, there were already noticeable clamming activities with approximately 10 percent of the annual volume during each month. Clam digging efforts during July represented approximately 9 percent of the total year; there was no activity in August and very little from September through February. The low July figure and the missing August figure were, to a large extent, the result of closure of the clam season from July 16 to September 15. The time distribution of clam digging activities differed substantially from that of

camping activities, the clamming peak occurring earlier in the year. This difference was caused by the seasonal nature of the related activities.

Figure 4 depicts the time distribution of 1970 fresh-water sport salmon angler trips. Trips to three major areas - Puget Sound, the coast, and the Columbia River - are shown. These three major areas account for over 90 percent of all fresh-water salmon angler activities. The distribution curves show the peaking of trip volumes during September and October with only low to moderate activities during the summer months. The Columbia River area was also characterized by a small peak in April, which is due to a large extent to the fishing season. This curve, similar to the clam-digging curve, differs distinctly from the camping visitation curve.

The 1970 marine sport salmon angler trips are shown in Figure 5. Twelve areas have been considered along the coast and in the Puget Sound area. The mean distribution of visitation was calculated, and the curve showed a clear peaking in August with sizable attendance during the months of June, July and September. It also can be seen that the spring months have higher attendance than those months from October to February. Again, the shape of this curve was determined by the fishing season, and differs from the camping distribution, the clam-digging distribution, and the fresh-water salmon angler distribution.

For other activities, the monthly distribution of visitations was not shown because of a lack of comparable and sufficient data. However, in 1967-68, the Washington Interagency of Outdoor Recreation conducted a telephone survey on recreational demand patterns which listed information by activity and area type and showed participation in these different activities by season.

From this survey, fifteen activities have been determined as outdoor recreation activities in rural areas and at the fringes of urban areas: camping, hunting, fishing, sailing, power boating, other boating, water

1970 FRESHWATER SPORT SALMON ANGLER TRIPS - ACTIVITIES BY MONTH IN %

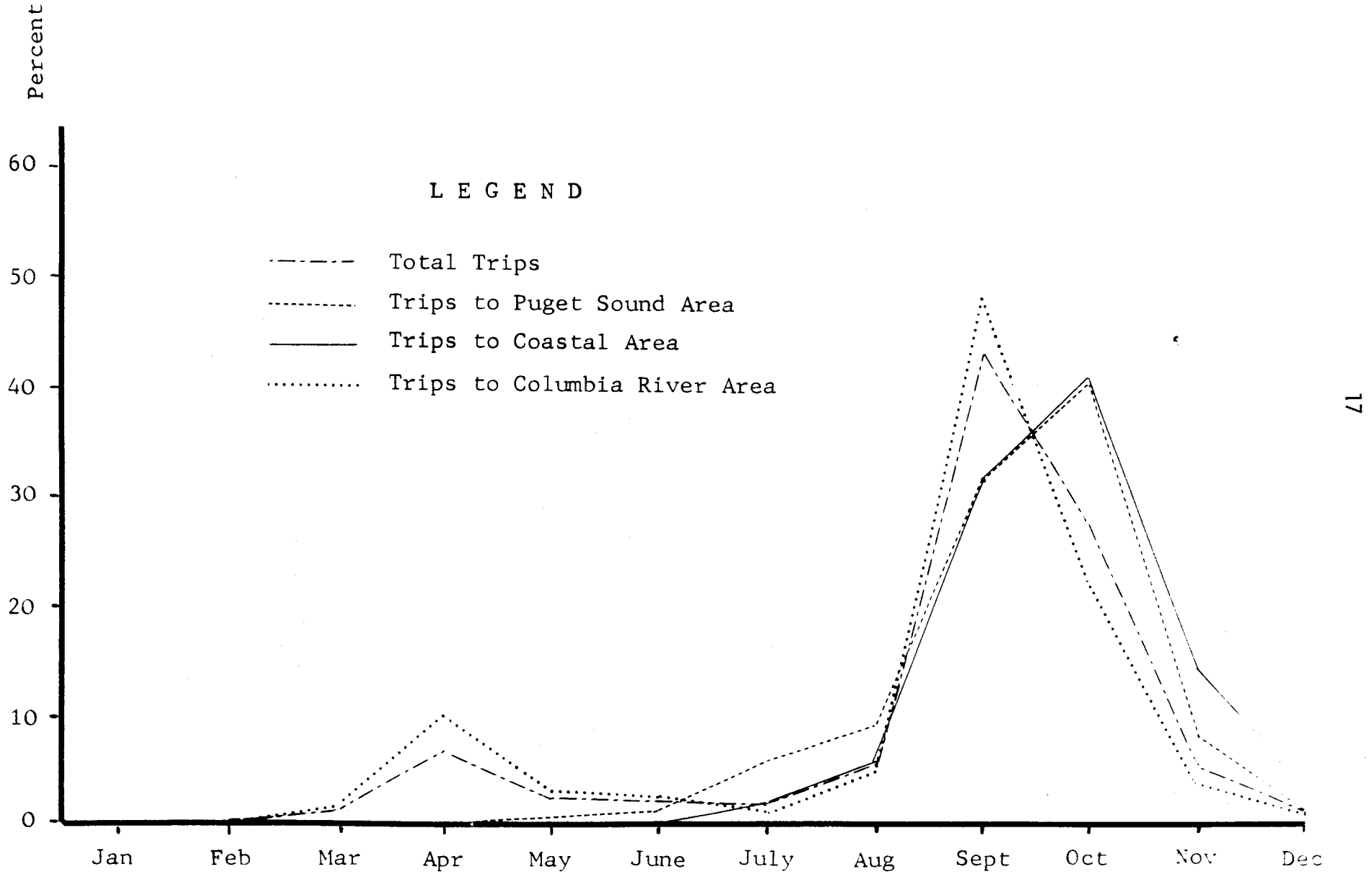


FIGURE 4

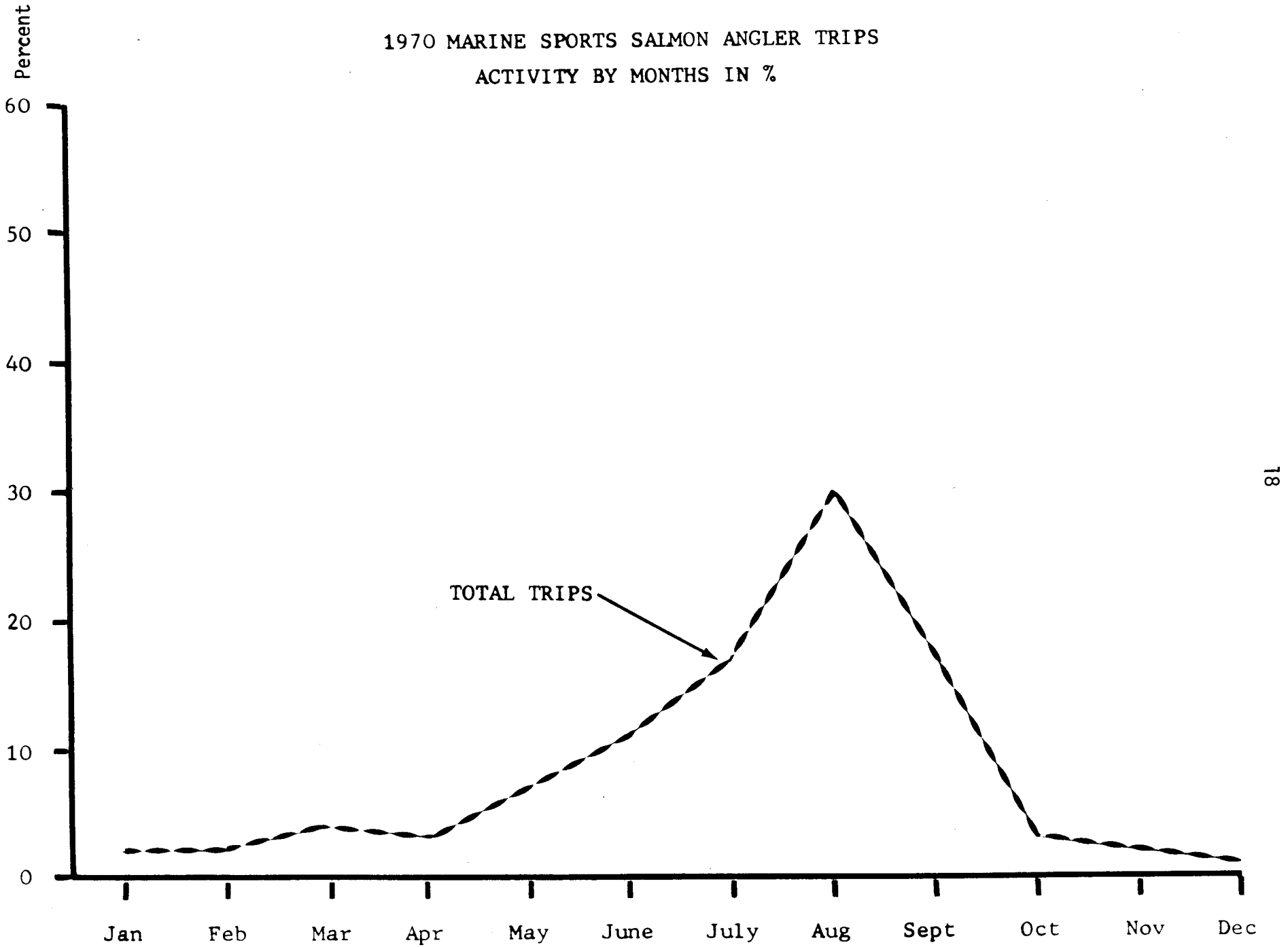

1970 MARINE SPORTS SALMON ANGLER TRIPS
ACTIVITY BY MONTHS IN %
Percent
60
50
40
30
20
10
0
TOTAL TRIPS
Jan
Feb
Mar
Apr
May
June
July
Aug
Sept
Oct
Nov
Dec

FIGURE 5

skiing, visiting beaches, sightseeing, hiking, driving for pleasure, mountain climbing, snow skiing, rock hounding, and clamming. Participation in these activities required trips which have a potential for creating traffic congestion at the fringes of urban areas. These activities accounted for approximately one-third of the total participation reported by the telephone survey. Out of these fifteen activities, eight accounted for about 85 percent of the attendance:

1) Camping - 7 percent
2) Hunting - 3 percent
3) Fishing - 14 percent
4) Visiting beaches and clamming - 14 percent
5) Sightseeing and driving for pleasure - 57 percent
6) Snow skiing - 5 percent

By combining sightseeing and driving for pleasure as well as visiting beaches and clamming, six activities with definite time distributions were derived. The seasonal distribution of these activities is shown in Figure 6. The peak visitation periods for five of the six activities are as follows:

1) Camping - July, August
2) Snow skiing - January, February and March
3) Clamming and visiting beaches - spring and summer months
4) Fishing - summer months

Driving for pleasure and sightseeing had a relatively constant participation for the winter, spring and summer months with a slight drop during the fall. Although hunting, snow skiing and camping accounted for the lowest percentage of visitations, they could not reasonably be combined with any other activity or among themselves to increase their share of the total participation because of the significant difference in the time distribution of their attractions as well as the difference in spatial distribution of their attractions and trip-length frequencies.

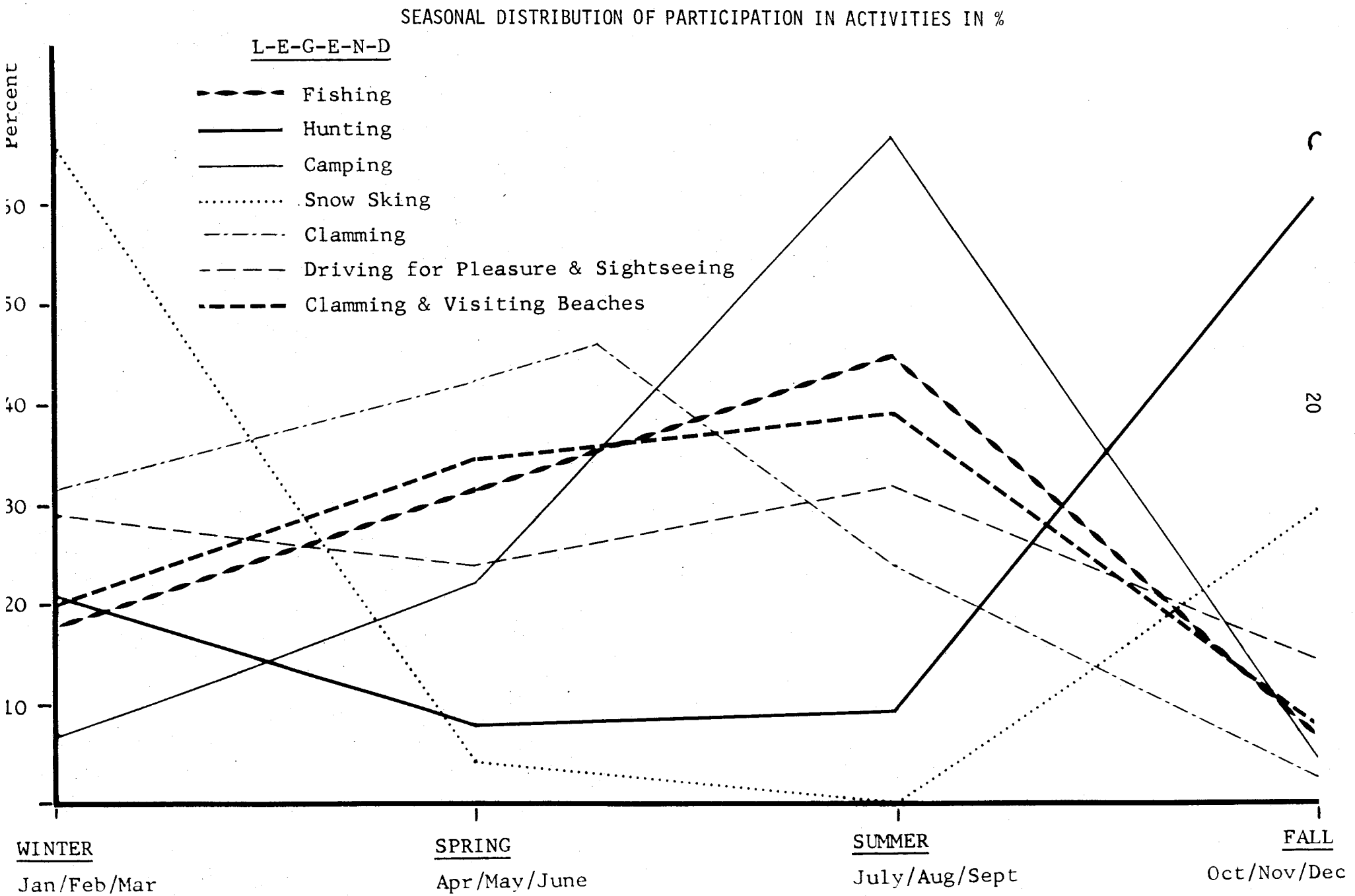

SEASONAL DISTRIBUTION OF PARTICIPATION IN ACTIVITIES IN %
L-E-G-E-N-D
Fishing
Hunting
Camping
Snow Sking
Clamming
Driving for Pleasure & Sightseeing
Clamming & Visiting Beaches
Percent
50
40
30
20
10
WINTER
Jan/Feb/Mar
SPRING
Apr/May/June
SUMMER
July/Aug/Sept
FALL
Oct/Nov/Dec

FIGURE 6

The places where these activities were pursued were well defined because of their spatial characteristics. Fishing took place along the coast, on the shores of Puget Sound, and on the lower part of the streams draining to the Sound and the Pacific Ocean. Hunting activities were found in the mountains and in the range areas on the foothills of the Olympic and Cascade Mountains. Camping was concentrated along the coast, the Puget Sound area and the Cascade Mountains. Snow skiing took place primarily in the Cascade Mountain range with only minor visitations to the Olympic Mountains. Clamming and visiting beaches were confined to the beaches. Driving for pleasure took place on the large number of highways within the state. All of these activities could be identified by a high weekend travel factor which was computed as the ratio of the mean traffic volume for Friday, Saturday and Sunday divided by the mean traffic volume for Monday through Friday.

3. Arrival Patterns of Campers in Washington State Parks

Overnight campers usually arrive at the park of their choice on Friday night or Saturday morning to begin their weekend stay. This was documented by the high percentage of camper arrivals (36 to 66 percent) during those times at the six Washington state parks. It has been theorized that if a park becomes crowded over the weekend and campers were turned away, more and more campers would come into the park earlier in the week to secure a campspace for the weekend.

Analysis of the arrival dates at the six state parks from 1965 to 1969 indicated a significant increase in camper arrivals on Wednesday and Thursday has taken place in three of the parks (Belfair, Twin Harbors and Lake Wenatchee). This increase was both absolute and relative to the increase of camper arrivals on Friday and Saturday. The other three parks did not show a relative increase of Wednesday and Thursday arrivals, indicating that these

parks were perhpas not yet overcrowded on weekends, or overcrowding was not a dominant factor in influencing arrival patterns.

4. Trip-Length Frequency Distribution of Recreational Trips

The 1970 data for state parks, fishing, clamming, and visits to U.S. Forest sites and national parks have not yet revealed any clues on distance traveled. These travel distances were derived from the 1967-68 statewide telephone survey on the participation in all recreation activities.

Figure 7 depicts the trip-length frequency distribution for the six selected activities already mentioned. This distribution is rather inaccurate and rough because the data do not record actual miles traveled but rather distance classes, as indicated below:

Class 1 - Trips under one mile

Class 2 - Trips of one to two miles

Class 3 - Trips of two to five miles

Class 4 - Trips of five to ten miles

Class 5 - Trips of ten to twenty miles

Class 6 - Trips of twenty to 100 miles

Class 7 - Trips of 100 miles or longer

Because the selected activities were frequently pursued in rural areas, they required travel out of the urban area, and it could be expected that the majority of these trips were between 20 and 100 miles in length. The information contained in Figure 7 confirms this expectation; for all trip purposes, the peak is noticeable for class 6, that is 20 to 100 miles. However, the percentage of trips occurring in this interval and during other intervals differred between the different purposes, thereby allowing characterization of these purposes by trip-length frequency.

TRIP LENGTH FREQUENCY DISTRIBUTION FOR SELECTED ACTIVITIES

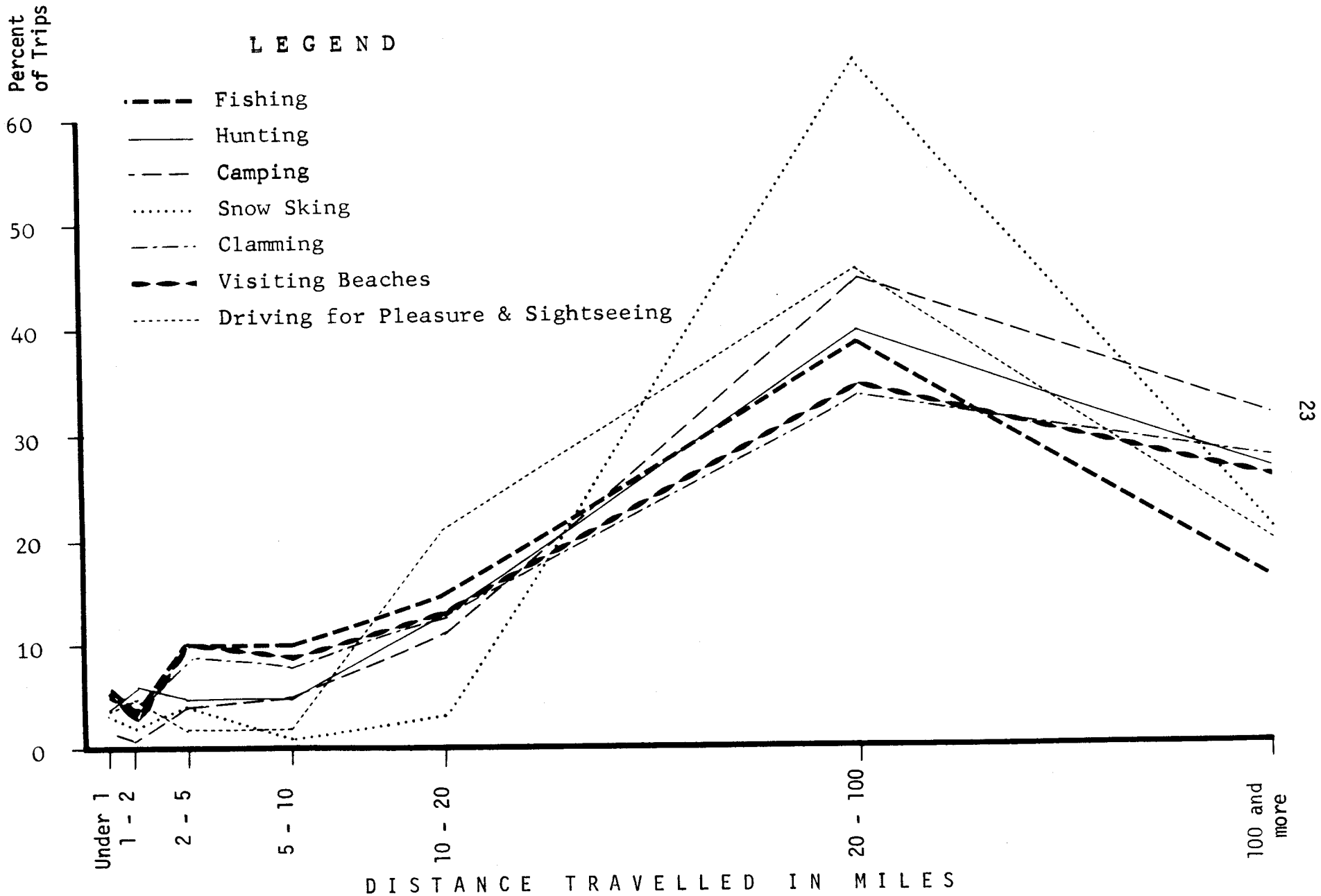


FIGURE 7

5. Number of People in Recreational Trip Party

In several prior studies on recreational travel, it has been found that the party size or vehicle occupancy was between three and four people. This observation was confirmed by the camper visitation data collected for this analysis. Beyond this general observation, certain trends in vehicle occupancy have been observed.

The party size tended to be slightly larger in summer than during the rest of the year. The difference was between 20 and 30 percent and can be observed for all six parks in both time periods, 1969 and 1971. This trend was consistent regardless of the type of park or of the year in which the observation took place. The most probable explanation is that during the summer months, the portion of family recreation trips was relatively large because of school vacations. During spring, fall and winter, family trips made up a smaller portion of the total recreational trip volume.

6. Recreational Trip Purposes

From the previous discussion, six trip purposes have been proposed. A seventh category, "others" included all the activities not particularly mentioned, or approximately 15 percent of all participation in rural outdoor recreation activities. Table 2 depicts the trip volume and percent corresponding to all seven trip purposes, which have been established on the basis of distinct differences in three characteristics: 1) season distribution of trips, 2) spatial distribution of trip attractions which is also inherent in the trip-length frequency distribution, and 3) trip volume.

A last criterion was cited for the creation of these seven trip purposes and dealt with the activity pursued and the consequences it had for the trip itself. Camping, hunting, fishing, visiting beaches, clamming, and snow skiing all had distinct trip destinations at which the activities took place. The traveler was therefore inclined to reach his destination as

TABLE 2

Weekend Recreational Trip Purposes and Corresponding Trip Volumes

	Trip Purpose:	Trip Volume %
1)	Camping	5.4%
2)	Hunting	2.4
3)	Fishing	12.0
4)	Visiting Beaches and Clamming	11.8
5)	Snow Skiing	4.0
6)	Driving for pleasure and sightseeing	49.0
7)	Other	15.4
		100 %

These trip purposes have been selected on the basis of:

1) Geographical distribution of attractions
2) Time distribution of trip occurance
3) Trip length frequency distribution
4) Trip volume distribution
5) Point attraction, linear attraction and combination thereof

quickly as possible. If the prime purposes of the trip was to pursue the activity, the shortest route to the destination would most likely be chosen. Driving for pleasure and sightseeing, which accounted for almost 50 percent of all participations in rural outdoor recreation activities, had no distinct point attraction, but rather a linear attraction; that is, driving itself and the route were the attractions. For these trips there was no shortest route, and the one selected was perhaps determined on the basis of attractions along the route.

A number of trips to point attractions, such as camping, visiting beaches, et cetera, can be conceived as a combination of sightseeing, pleasure driving and a distinct-activity pursuing trip. This complicates the matter of characterizing the individual trip purposes. For the present, trips with such a combination of attractions (point attractions and linear attractions) are not accounted for because sufficient data to analyze this type of trip behavior are not available.

In conclusion, it can be said that the seven trip purposes developed represents a rational selection on the basis of the five criteria used, that is: seasonal distribution of trips, spatial distribution of attractions, trip-length frequency distribution, trip volumes of each purpose, and type of trip attraction, namely point attraction or linear attraction.

CHAPTER III

TRAVEL PATTERNS OF CAMPER TRIPS

1. Analysis of Washington State Park Data

The mathematical formulation and testing of functional relationships between accessibility, attractiveness and travel patterns of a recreation area will be only as good as the data used in the analysis. Numerous sources of recreational travel data and travel-related information are generally available. Different departments and bureaus within the federal government periodically publish statistics revealing information about or related to recreational travel. Similar data can also be obtained from state, regional and local highway and transportation agencies, recreation departments, departments of finance, bureaus of statistics, et cetera.

The data needed for the analysis of travel patterns were very similar to those collected in urban transportation studies and included origin-destination data, information on the trip attraction, data on the trip production, and the accessibility of the recreation area. Origin-destination data revealed the spatial travel patterns and travel behavior of campers as a result of a certain configuration of recreation opportunities, population centers and the transportation system connecting them.

Data on origin-destination was obtained from Washington State Parks and consisted of camper registration forms which revealed the camper's place of residence, the date of arrival, the number of people in his party, and the number of nights spent in the park. Destination of the trip was, of course, the park itself. These records were available for 1967 and 1969 for the six state parks (Belfair, Kopachuck, Lake Sylvia, Lake Wenatchee, Penrose Point and Twin Harbors) and have been used to determine the origin-destination patterns for every park. Washington state parks also provided data on type and

quantity of facilities at the six parks. Data on highway accessibility were provided by the State Highway Department.

The production of trips usually has been described as a function of socioeconomic characteristics of the population and the recreation opportunities available to this poplulation in the time frame of daily free time, weekends or vacations. However, this study does not attempt to determine the production of recreational trips in the metropolitan areas of King, Pearce, Kitsap, and Snohomish Counties. The determination of trip productions is only possible if the total recreational travel from an urban area is considered rather than just a small portion of recreational trips, as in this analysis. Therefore, the observed number of camper trips from every metropolitan area to the six parks was used here as the actual trip production.

Trip attractions frequently have been described as a function of a recreation area's physical features, that is, the size of the area, number of campsites, picnic tables, et cetera. Another factor determining attractiveness is the type of recreation activities offered at the park. No particular attempt was made in this study to develop a formula for simulating and predicting the attractiveness of a state park, and the observed number of camper trips attracted to a park from the four origin zones was set to be equal to the trip attraction.

The accessibility of the state parks was measured in terms of travel time over the shortest highway route. Travel times for 1971 between the four metropolitan areas and the six state parks have been determined by the State Highway Department. These times have been changed for 1969, based on highway improvements that have taken place between 1969 and 1971. As a basis for changing the travel time, it has been assumed that the addition of every lane-mile, or significant improvement of every lane-mile, equaled a time reduction of 0.10 minutes; this is approximately equal to a five-mile-per-hour increase in

average speed. Table 3 shows the resulting travel times for 1969 and 1971 between the four urban areas and six state parks.

2. Simulation of Trip Distribution for Washing State Parks in 1969

The gravity model was selected as a simulation technique for two reasons: 1) it simulates human spatial behavior, and 2) it distinguished between travel impedences and all other attraction factors, thus making it sensitive to travel time. The model accounts for the competition between different attractions for the trips produced in the urban areas, and it is also easy to hand calculate.

The main disadvantages of the gravity model are its oversimplification in reflecting social behavior and its inaccuracy in predicting trips over a large range of travel time. These two disadvantages were recognized but were not considered to be a severe drawback for the application of the model, because the oversimplification of reflecting social behavior was countered by the fact that only a small portion of total trip making was considered. The inaccuracy of predicting trips over a large range of travel times was offset by the fact that all trips were medium to long range (40 to 180 minutes).

The spatial setup of the recreation system is shown in Figure 8. The gravity model was applied to the spatial setup to simulate trip volumes for the interchanges between every trip-production zone and every trip-attraction zone. The trips to be simulated were those undertaken by overnight visitors. The gravity model used was in the following form:

$$t_{ij} = P_i \frac{A_j F_{ij}}{\Sigma A_x F_{ix}}$$

where t_{ij} = number of overnight visitor trips from production zone i

P_i = total number of overnight visitor trips produced in zone i

A_j = a measure of attractiveness of recreation area j, excluding travel distrance between zones i and j

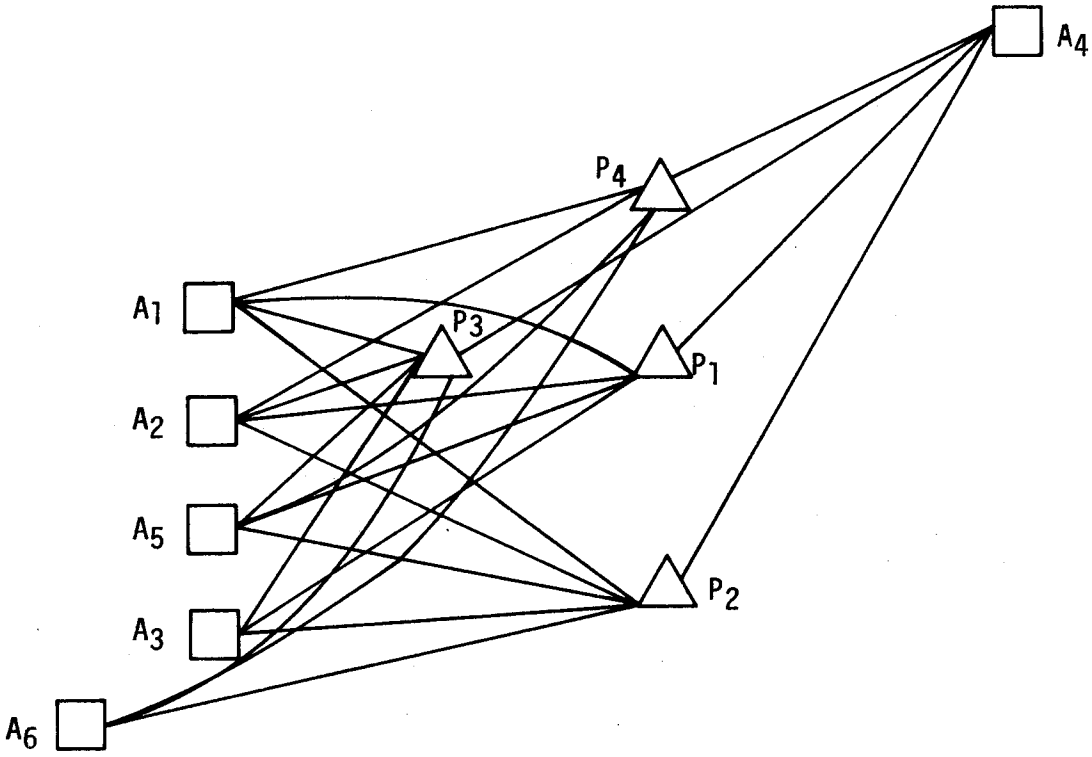
TABLE 3

Travel Times Between Four Metropolitan Areas and Six State Parks

(Values are in Minutes)

From	To	Travel Time 1969	1971
King County	Belfair	85.3	85.3
King County	Kopochuck	78.5	77.7
King County	Lake Sylvia	100.4	99.5
King County	Lake Wenatchee	120.0	119.0
King County	Penrose Point	81.0	80.2
King County	Twin Harbors	134.0	132.8
Pierce County	Belfair	53.7	53.3
Pierce County	Kopochuck	43.3	43.0
Pierce County	Lake Sylvia	70.8	70.3
Pierce County	Lake Wenatchee	146.6	145.1
Pierce County	Penrose Point	45.9	45.5
Pierce County	Twin Harbors	104.3	103.5
Kilsap County	Belfair	24.5	24.5
Kilsap County	Kopochuck	51.9	51.9
Kilsap County	Lake Sylvia	101.0	101.0
Kilsap County	Lake Wenatchee	180.8	179.8
Kilsap County	Penrose Point	41.5	41.5
Kilsap County	Twin Harbors	134.6	134.3
Snohomish County	Belfair	112.7	112.7
Snohomish County	Kopochuck	104.7	103.9
Snohomish County	Lake Sylvia	126.6	125.7
Snohomish County	Lake Wenatchee	101.1	100.5
Snohomish County	Penrose Point	107.2	106.4
Snohomish County	Twin Harbors	160.2	159.0

Spatial Arrangement of Recreation System for
Gravity Model Simulation, State of Washington



Where: P_1=King County Metro. Area
P_2=Pierce County Metro. Area
P_3=Kitsap County Metro. Area
P_4=Snohomish County Metro. Area

A_1=Belfair State Park
A_2=Kopachuck State Park
A_3=Lake Sylvia State Park
A_4=Lake Wenatchee State Park
A_5=Penrose Point State Park
A_6=Twin Harbors State Park

Figure 8

T_{ij} = a measure of travel impedence between production zone i and attraction zone j

The three independent variables of the gravity model were the trip production P, trip attraction A, and the friction factor F. Productions were set equal to the observed total trips made from any of the four metropolitan areas. Attractions were set equal to the observed number of trips attracted to each park. It is recognized here that attractiveness is a function not only of physical features of a park, but also of the user's perception of the park's attractiveness. The importance of the user's perception is demonstrated by the fact that the essential facilities in the six parks have not changed between 1969 and 1971, but the rate of change of total visitation at the different parks has differed considerably.

Because of the incomplete data, only representative sample volumes for production and attraction have been used; these sample volumes are shown in Table 4. The table also displays the trip interchanges between all production and attraction zones and verifies that total productions equal total attractions.

In this analysis, the friction factors were calculated according to the formula:

$$F_{ij} = \frac{1}{d_{ij2}}$$

which assumes that the friction factors are distributed smoothly along a second-degree curve. Trip interchanges that have been calculated using these friction factors and the production and attraction values of Table 4 differed considerably from the observed trip interchange. An attempt to reach closer agreement between calculated and observed trip interchanges through iterative steps in which the friction factors are adjusted have not resulted in considerable improvement. Furthermore, the adjusted friction factors, when

TABLE 4

Trip Productions, Attractions, and Interchanges*, 1969
State of Washington

Attraction	Production	King County P_1	Pierce County P_2	Kilsap County P_3	Snohomish County P_4	Total Attractions
Belfair	A_1	11,634	11,487	7,927	1,064	32,112
Kopochuck	A_2	2,090	2,857	516	99	5,562
Lake Sylvia	A_3	2,982	908	454	227	4,571
Lake Wenatchee	A_4	17,227	1,383	556	180	6,765
Penrose Point	A_5	3,312	2,953	320	5,621	54,513
Twin Harbors	A_6	29,489	14,937	4,466	5,621	54,513
Total Productions		66,734	34,525	14,239	12,758	128,256

*Trip volume represents sample volume only.

plotted against minutes of travel time, did not resemble any curve at all but were indiscriminately distributed.

The failure to produce the observed trip-length frequency distribution by adjusting the F-factor led to a new procedure for calibrating the gravity model. The model was calibrated for the attraction measure A. It was agreed that the adjustment of A accounts for the user's perception of an area's attractiveness. It was further agreed that users from different metropolitan areas probably perceive the attractiveness of a particular recreation area differently; this difference reflects various characteristics of the metropolitan area and its population. Consequently, it can be assumed that an adjustment factor for every trip interchange has to be calculated, except for interchanges between a production zone and attraction zones of similar characteristics, that is mountain peaks, beach parks, et cetera.

To test this hypothesis, the six state parks were grouped in the following manner:

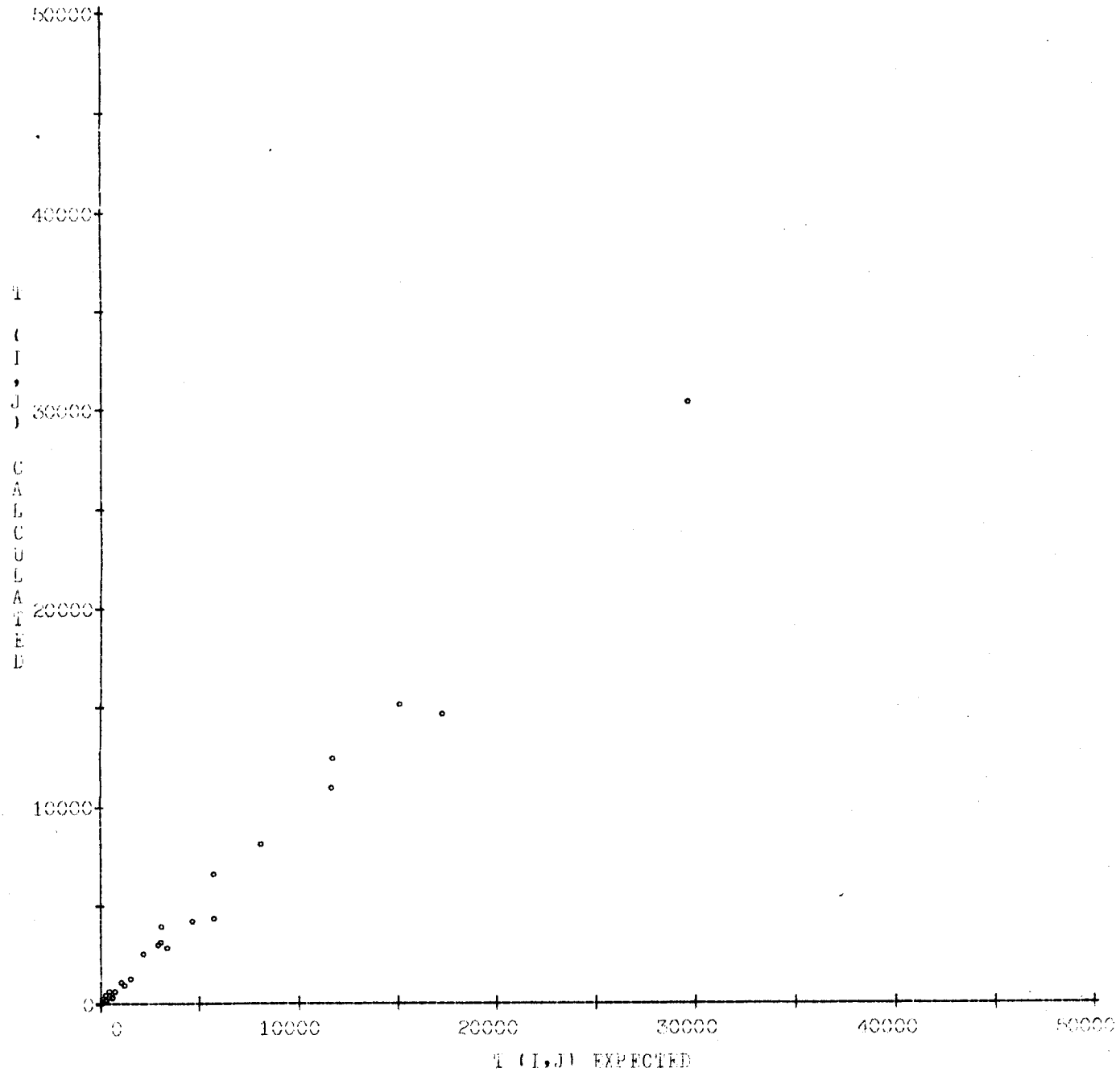
Type 1 - Parks on the Puget Sound, including Belfair, Kopachuck, and Penrose Point

Type 2 - Mountain lakes, including Lake Sylvia and Lake Wenatchee

Type 3 - Ocean beaches, including Twin Harbors

Adjustment factors were calculated with a computer in a calibration process (trial-and-error method) for all trip interchanges between the four production zones and the three types of attractions. The resulting trip-length frequency distribution showed a close agreement with the observed trip-length frequency distribution. A comparison of calculated and actual trips is shown in Figure 9 and indicates again the close agreement of observed and calculated values.

1969 - Observed and Calculated Trips - Model Calibration for A, State of Washington



SYMBOL	NO.PTS.	LEGEND
∘	24	T (I,J) EXPECTED VS. T (I,J) CALCULATED

FIGURE 9

3. Simulation of Trip Distribution of Washington State Parks in 1971

The successful simulation of 1969 camper trip patterns using the gravity model calibrated for attraction has been repeated for 1971. The production and attraction values have been determined in the same manner as for 1969 and are shown in Table 5. For the determination of friction factors, the same procedure as for 1969 has been used.

To calculate 1971 trip interchanges, the attractions for the different parks were multiplied by the adjustment factors as they resulted from the 1969 calibration process. Using these values in the gravity model, trip interchanges for 1971 were calculated. They correspond closely to the observed interchanges (Figure 10) in a comparison of actual and calculated trips.

Thus, the gravity model has proved to be a valid technique for simulating recreational travel behavior. Although the calibration of the model for friction factors did not result in a satisfactory simulation of actual distribution patterns, the actual trip distribution was simulated closely when the model was calibrated for attractions.

4. Analysis of California State Park Data

In order to test whether the gravity model calibrated for attractions could simulate recreational travel patterns in a different geographic area and for different types of recreation attractions, three state parks in Southern California were selected for a case study. Two of the parks, Rancho Cuyamaca and Palomar Mountain, are located in the mountains, while the third one, Anza-Borrego, is a desert park. Three origin areas, Los Angeles, San Diego, and northern San Diego County (in which approximately 90 percent of all users of these parks reside) were selected as production zones.

The data base for this case study was similar to that used for the State of Washington analysis. Origin-destination data in the form of overnight

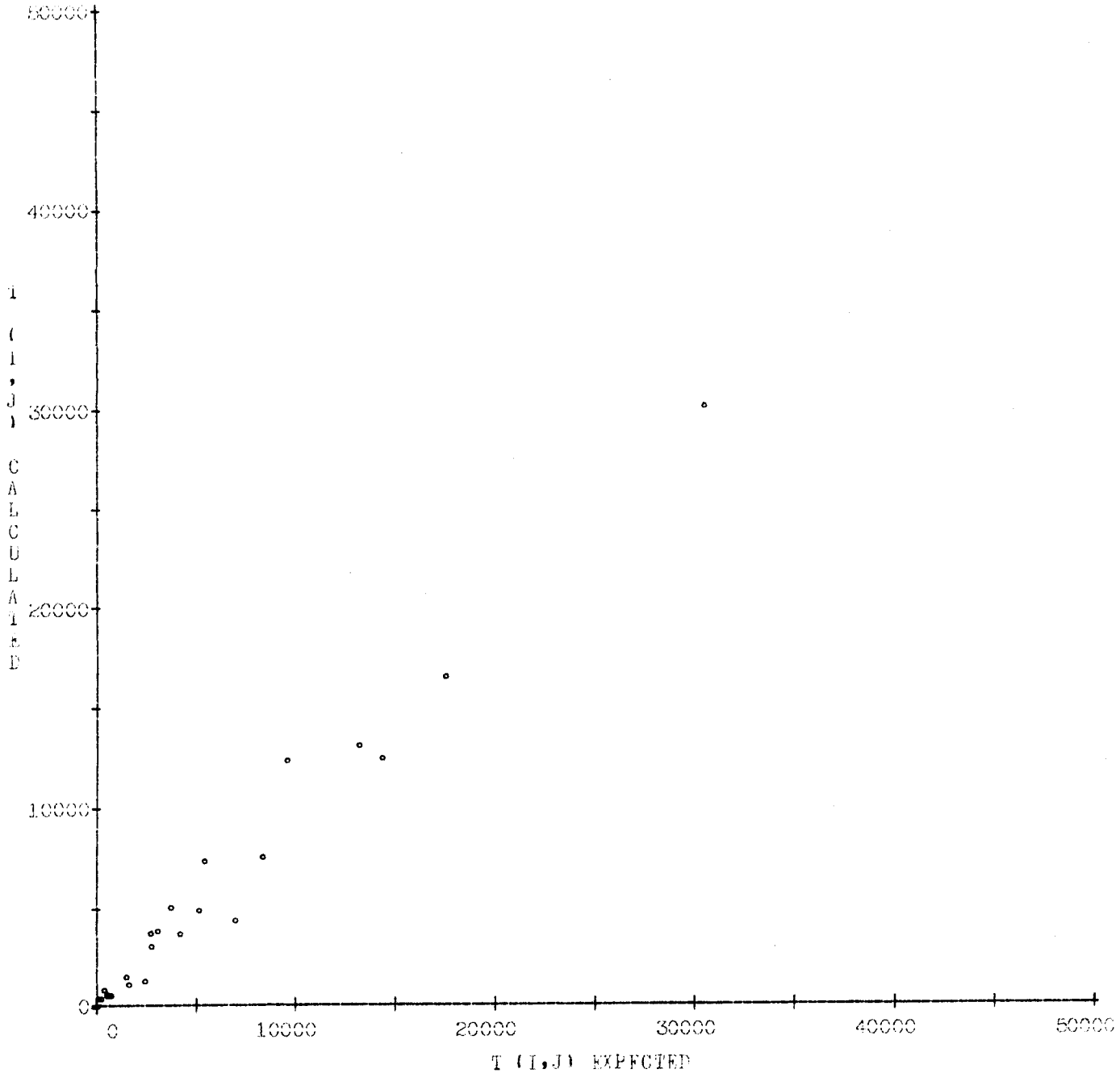
TABLE 5

Trip Productions, Attractions, and Interchanges*, 1971
State of Washington

Productions / Attractions		King County P_1	Pierce County P_2	Kilsap County P_3	Snohomish County P_4	Total Attractions
Belfair	A_1	14,286	9,575	8,273	1,609	33,743
Kopochuck	A_2	3,008	5,038	460	28	8,534
Lake Sylvia	A_3	3,628	1,446	702	245	6,021
Lake Wenatchee	A_4	13,177	2,302	605	6,846	22,930
Penrose Point	A_5	2,715	4,025	501	97	7,338
Twin Harbors	A_6	30,503	17,530	2,626	5,251	55,910
Total Productions		67,317	39,916	13,167	14,076	134,476

*Trip volume represents sample volume only.

1971 - Observed and Calculated Trips - Model Calibration for A, State of Washington



SYMBOL NO.PTS. LEGEND
. 24 T (I,J) EXPECTED VS. T (I,J) CALCULATED

FIGURE 10

camper registrations were collected from state park records. Travel time between the trip-producing areas and the three state parks has been calculated on the basis of travel distance and speeds, as determined by the California Division of Highways.

The data were collected for 1962-63 and 1970. Within this time period, a significant change has taken place in the highway network connecting San Diego and Rancho Cuyamaca, one of the mountain parks, as well as Anza-Borrego, the desert park. A two-lane rural highway was improved to a four-lane freeway, thereby cutting the travel time in half between San Diego and Rancho Cuyamaca.

As in the Washington State analysis, no attempt has been made in this study to calculate trip production or trip attractions as a function of independent variables. The emphasis was on analyzing and simulating trip distribution patterns.

5. Simulation of Trip Distribution, California State Parks in 1962-63 and 1970

The gravity model was applied to the three-origin/three-destination system using production, attractions, and travel times as shown in Tables 6 and 7. Friction factors were calculated on the basis of travel times using the same formula as in the Washington study.

Calibrating the gravity model for F-factors using 1962/63 data revealed a significant discrepancy between the observed trip-length frequency distribution and the calculated trip-length frequency distribution. Correspondingly, F-factors calculated for close agreement of observed and actual trip-length frequency distributions were distributed indiscriminately in the friction factor/travel time graph and did not resemble any curve.

By using the same approach as was used in the State of Washington analysis (the calibration of the gravity model for attractions), satisfactory

TABLE 6

Trip Productions, Attractions, and Interchanges, 1962/63, Southern California

Production / Attraction		Los Angeles P_1	San Diego P_2	Norther San Diego County P_3	Total
Palomar Mountain	A_1	9,496	7,273	1,818	18,587
Rancho Cuyamaca	A_2	12,687	54,478	2,985	70,150
Anza-Borrego Desert	A_3	23,186	22,621	3,391	49,198
Total Productions		45,369	84,372	8,194	137,395

TABLE 7

Trip Productions, Attractions, and Interchanges, 1970, Southern California

Productions / Attractions		Los Angeles P_1	San Diego P_2	Northern San Diego County P_3	Total Attractions
Palomar Mountain	A_1	9,386	7,942	3,851	21,179
Rancho Cuyamaca	A_2	23,628	59,070	4,544	87,242
Anza-Borrego Desert	A_3	88,234	54,705	10,588	153,527
Total Productions		121,248	121,717	18,983	261,948

results were produced for 1962/63. The calibration effort resulted in a close approximation of observed and calculated trip-length frequency distributions. Applying the attraction adjustment factors as calculated for 1962/63 to 1970 data, the gravity model produced a close approximation of observed and calculated trip interchanges. The close agreement of observed and calculated trip interchanges for 1962/63 and 1970 is shown in Figure 11.

6. Comparison of Trip Distributions for Washington and California State Parks

For both the Washington State analysis and the Southern California case, the gravity model was used effectively to simulate and predict the spatial distribution of overnight camping trips to different types of parks. In both cases, the model was calibrated for attractions, revealing an attraction adjustment factor that essentially represents the users' perception for the attractiveness of certain types of parks.

Because an adjustment factor was applied to each trip interchange between a metropolitan area and every type of recreation area, this factor reflects the locational and social characteristics of the production zones as well as the attraction zones. This indicates that people living in different urban areas perceive the attractiveness of the same recreation area differently. It further shows that people living in a certain metropolitan area have a perception for different types of recreation areas independent of physical facilities and amenities offered at these areas. The simulation achieved with this calibration technique in both the State of Washington and in Southern California was an encouraging indication of the general applicability of this method. Therefore, it appears desirable to test further this procedure by enlarging the number of trip production and attraction zones.

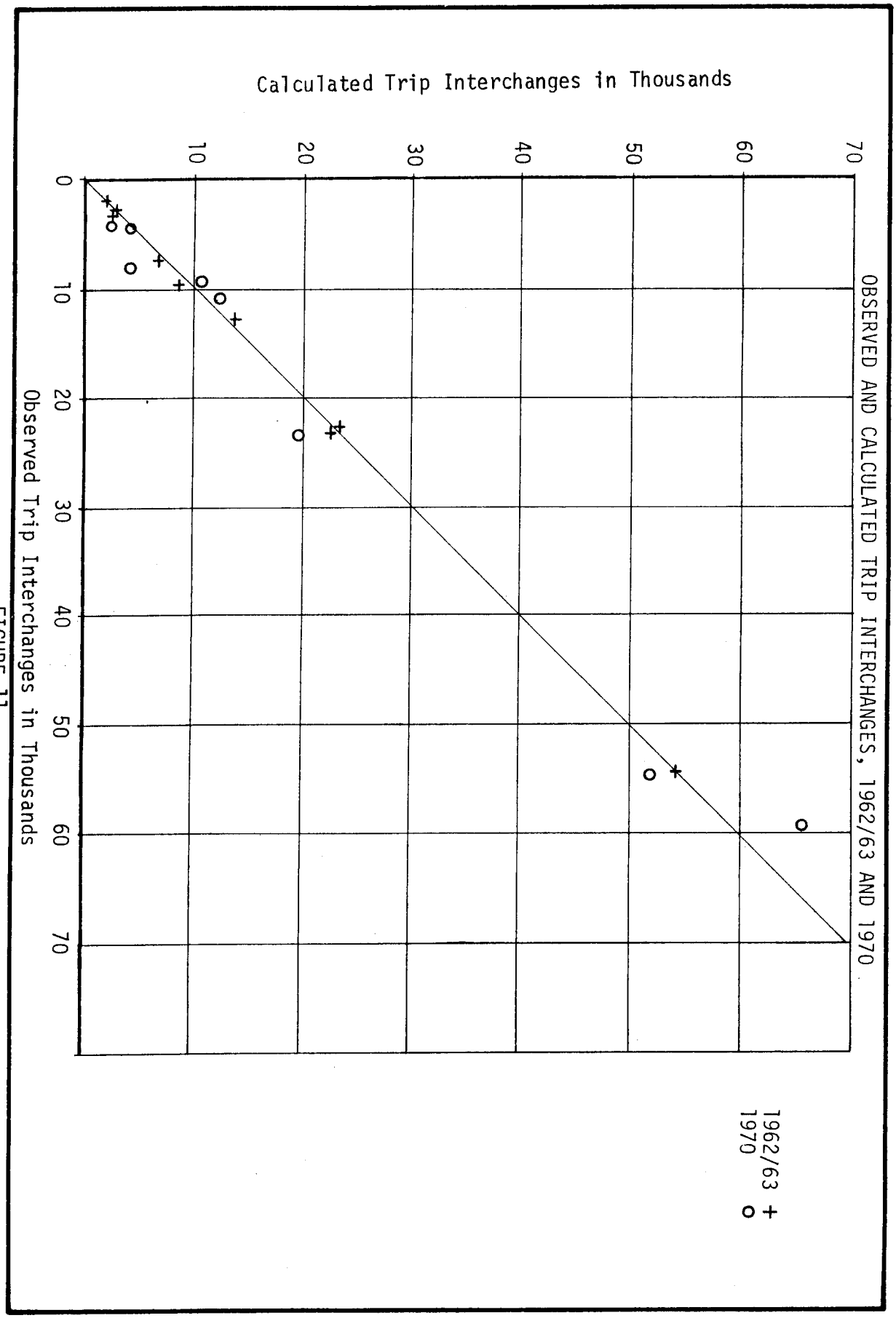

OBSERVED AND CALCULATED TRIP INTERCHANGES, 1962/63 AND 1970
Calculated Trip Interchanges in Thousands
Observed Trip Interchanges in Thousands
0
10
20
30
40
50
60
70
1962/63 +
1970 o

FIGURE 11

CHAPTER IV

TOWARD A PREDICTION MODEL FOR RECREATIONAL TRIPS

The foregoing analysis has dealt only with camping trips. This trip type constitutes only a small segment of all recreational trips, and recreational trips are only a part of the total weekend travel volume which includes non-recreational trips as well. In order to arrive at a general weekend travel model, all trip types, both recreational and non-recreational, need to be considered. A recreational traffic model is desirable and useful in areas with predominant recreational traffic on weekends, and it obviously needs to incorporate all types of recreational travel.

It is possible that, because of a significant difference in the characteristics of the various recreational trips, not all trip types can be simulated successfully with the procedures developed for camping trips. This pertains, in particular, to sightseeing trips and combinations of sightseeing and destination trips. It is, therefore, conceivable that several distribution models need to be developed to simulate the distribution of all recreational trips.

It has been shown that the distribution of trips is only a part of the total recreation travel model. An essential part of such a model is the calculation and prediction of trip productions and trip attractions or the number of total trips produced in urban areas and trips attracted to a recreation area. This analysis has shown that some of the more common approaches to calculate productions and attractions cannot be considered adequate in the prediction of such values.

1. The Trip-Generation Model

Most previous attempts by researchers to calculate and predict the production of recreational trips (that is, the demand for recreation) have seen

the demand as a function of socioeconomic characteristics of the population and the availability of recreational opportunities. Consequently, participation rates have been developed for different activities which are assumed to remain constant over time. The participation rate concept has been questioned recently, and this analysis has also pointed out some of the concept's shortcomings, even though only a small spectrum out of the total recreation trip making has been analyzed, and no attempt has been made to predict productions and attractions.

The question that needs to be asked is whether the total recreational trip production for any urban area remains constant over time in respect to socioeconomic variables of the population. Total recreational trips produced is an aggregate measure of all activities, disregarding participation in the individual activities. Data required for such an analysis do not exist as yet but are desparately needed to further the knowledge in this area.

The total number of trips attracted to a particular recreation area has commonly been calculated as a function of physical attributes of the recreation area itself. This analysis has clearly shown that this method is not satisfactory for predicting attracted trips. A significant variable in the attraction equation is the attractiveness as perceived by the user. Unless this perceived attractiveness can be quantified and predicted, any attempt to predict attracted trips to recreation areas will be a questionable undertaking. Because of the nature of the perceived attractiveness, some researchers feel that it is not possible to predict recreation trips at all. The importance of this item suggests that further research on the perception of attractiveness of recreation areas should receive a high priority in recreational travel research.

2. Decision and Simulation Models

The travel models discussed so far and, in particular, the distribution model that has been used to simulate camper travel patterns in the State of Washington and in Southern California, are basically techniques that simulate actual conditions. They thereby contribute to further understanding of the traffic behavior of recreationers. The policy maker is faced with the task that extends beyond the understanding of causes and effects of recreational travel. He is faced with developing policies that lead to certain recreational travel and recreational-area use patterns.

The trip distribution and general models discussed in this analysis are not adequate tools for this policy decision-making process. In order to simulate a desired pattern of future use with these models, a large number of trial-and-error runs of the models must be made. In each run, the independent variables need to be changed. In order to correct this deficiency, it is suggested that the application of mathematical programing techniques and optimizing techniques be investigated. It is expected that the use of mathemathical programing in conjunction with the gravity model and the common trip-generation models will allow for a greater decision-making potential on the part of the policy maker.

Furthermore, optimization techniques incorporate holding capacities of recreation areas as well as carrying capacities of highways and other transportation facilities and can thereby be of valuable service to the decision maker.

Consequently, it can be seen that the gravity model is a useful tool in simulating and predicting recreational travel patterns. All variables, including the adjustment factors, have been identified and determined. The model is not the best, however, for deriving policies of how to obtain patterns of future use.