Characteristics of Summer Weekend Recreational Travel

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•THE recent trend in the use of mathematical models for the distribution of vehicle trips has resulted in a more detailed examination of trip purpose. This is one of the more important refinements developed, because it is evident that trips made for different purposes vary in characteristics.

In two traffic studies made by the Connecticut Highway Department, the Hartford Area Traffic Study (HATS) and the Hartford Metropolitan Transportation Study (HMTS), recognition was given to various trip types. In the application of the gravity model technique of vehicular trip distribution, as developed by Alan M. Voorhees, Connecticut used a four trip purpose model. These trip purposes were work, social, commercial, and non-home base.

Both studies were conducted in an inland area where there are no great recreational facilities to act as traffic generators; therefore, the four-purpose model was adequate. However, future studies by the highway department will involve areas along the shore line, and it will be necessary to consider the effects of recreational travel to and from the shore.

The basic problem confronted in this study was the determination of the characteristics to be developed. First and foremost, it was decided that travel time is important in the consideration of the distribution of travel patterns, and subsequently for its application in the gravity model technique of vehicle trip distribution. Likewise, vehicle occupancy was considered important because it is a basic element of trip production, and persons per vehicle is the conversion factor for relating population to vehicles. The third characteristic is the relationship of trip production to the population density of the origin. A similar relation selected for the fourth characteristic is the effect of car ownership on trip production. Finally, the distribution by hour of vehicles arriving at recreational areas was felt to be of value in estimating the expected time an increased load imposed on a highway system providing access to a recreational facility.

To obtain the necessary information, it was decided that vehicular trips to recreational areas would have to be detected by some type of personal interview. The two types of interviews chosen were the Home Interview Origin and Destination and the Roadside Interview Origin Surveys.

STUDY AREA

The study was conducted in southeastern Connecticut, referred to as the southeast area. This recreational area (Fig. 1) consists of the following 23 towns: Bozrah, Colchester, East Haddam, East Hampton, East Lyme, Franklin, Griswold, Groton, Lebanon, Ledyard, Lisbon, Lyme, Montville, New London, North Stonington, Norwich, Old Lyme, Preston, Salem, Sprague, Stonington, Voluntown, and Waterford. The area also coincides with the Southeast Area Traffic Study being conducted by the Connecticut Highway Department.

Descriptions of the facilities available at the beaches and parks selected for study are as follows:

Ocean Beach Park

Ocean Beach Park is located at the southernmost point of New London and on Long Island Sound. This salt water public beach, operated by the city, has a boardwalk lined

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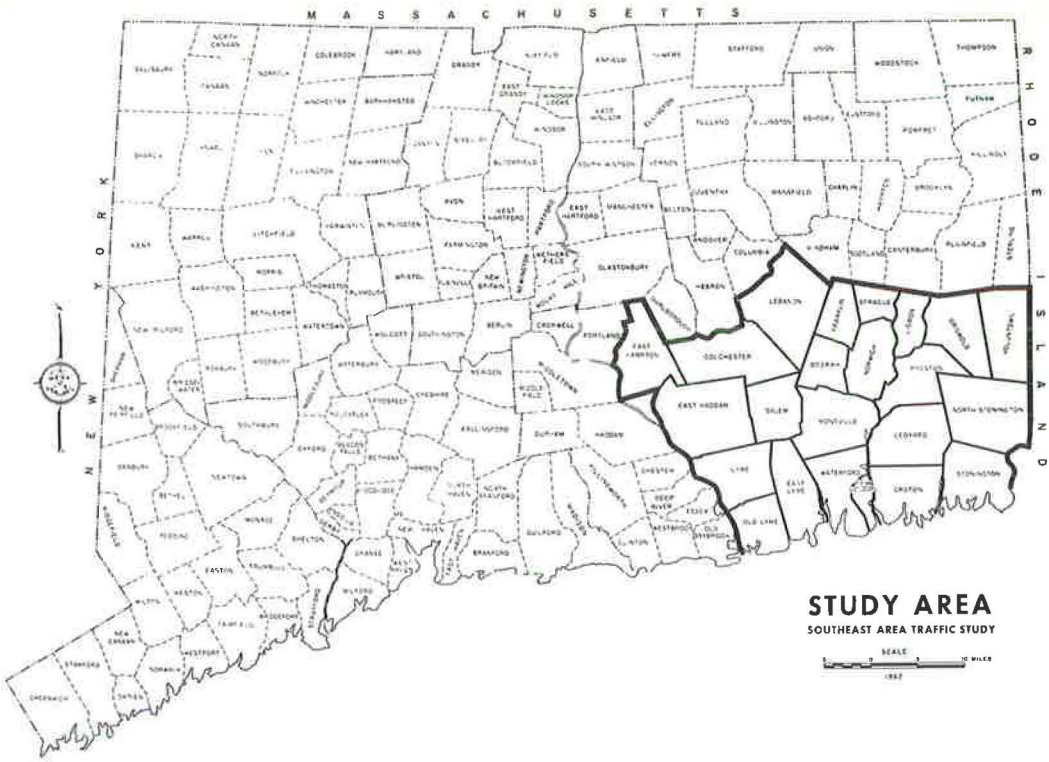


Figure 1.

with commercial amusements and concessions. There is also a dance hall which is open only evenings. A paved parking area for approximately 2,000 vehicles is provided, and a small picnic area is available at a considerable distance from the beach. The main route of access to Ocean Beach is Conn. 213, which connects to US 1A in the center of New London.

Rocky Neck State Park

Rocky Neck State Park is a 561 acre site bordering on Long Island Sound in the southwest corner of East Lyme. Operated by the state, it offers salt water bathing, boating, fishing, hiking, shelter, picnicking, and a food concession. A large part of this tract is devoted to camping, but this area is excluded from the beach and picnic facilities. The area is served by a direct connection from the Connecticut Turnpike.

Devil's Hopyard State Park

Devil's Hopyard State Park is an 860 acre recreational area situated in East Haddam, operated by the state. There are no bathing facilities; however, fishing is provided by the Eight Mile River. Hiking trails and picnic areas are also provided. The area is encircled by state routes, but it has no access by a high type roadway.

Hurd State Park

Hurd State Park is a state-operated 698 acre area located in East Hampton on the east bank of Connecticut River. Recreational facilities at this fresh water location are boating, hiking, picnicking, and shelter. Access is provided by Conn. 151.

Hopeville Pond State Park

Hopeville Pond State Park consists of 316 acres and is located in Griswold. It provides fresh water swimming, boating, and fishing, and facilities for hiking and picnicking. Access is provided by an interchange on the nearby Connecticut Turnpike.

HOME INTERVIEW SURVEY

The weekend recreational trip home interview survey was conducted in conjunction with a survey by the Connecticut Highway Department. The department's survey was for weekday travel in the southeast area and was made Tuesday through Saturday.

The sample to be interviewed was selected randomly by towns, with the number in each town based on the percent population of the study area.

The weekend interviews were taken during the months of July and August, and only on Tuesdays. This was because Monday was not an interview day for the weekday trip inventory. However, it was felt that people would remember their recreational trips after a day or two had lapsed. The weekend form was the same as the weekday except for the basic information on the reverse side. It was deemed unnecessary to duplicate this information on the weekend form.

In addition to recreational trips, as many other trips as the interviewee could recall were recorded. This was for possible future use. All trips made between 4:00 PM Friday and 12:00 PM Sunday were considered as being weekend trips.

Advance notice of the survey was publicized by area newspapers, and the households to be interviewed were notified by a letter which appealed for cooperation as citizens.

ROADSIDE O AND D

A survey was conducted at each of the five selected recreational areas. An attempt was made to choose an average weekend, and it was decided to interview on Saturday and Sunday, August 26 and 27, 1961, between the 9:00 AM and 3:00 PM. In addition to the assumption of detecting average trips, it also provided a steady flow of in traffic so that a 100 percent sample resulted at all five areas.

Each of the facilities has a toll booth or booths and controlled vehicular access. The interviewers were stationed at these points and questioned the drivers as they waited in line to enter. Only the origin and number of people in the car were recorded.

Advance notice of this survey was also publicized in area newspapers. "Survey Ahead" signs, as well as warning and stop signs, were placed prior to the interview stations to inform the motorists.

Probably the most limiting factor in summer weekend recreational travel is the weather. Inclement weather would considerably reduce the amount of recreational travel. The only weather problem during the field study period occurred at Rocky Neck State Park on Saturday, August 26, in the morning. There were rather frequent heavy showers in this area. However, at Ocean Beach, 7.5 miles to the east, the weather was excellent. Heavy clouds could be seen over the Rocky Neck area, but there was no other indication of rain. Therefore, it is doubtful that travelers who started out for Rocky Neck earlier in the morning had any knowledge of the precipitation. For this reason, it is being assumed that there is no variation in the visitation to Rocky Neck at that time.

The limitation placed on the roadside O-D surveys is in the number of interviews, rather than sample size, because at all interview locations a 100 percent sample was taken. However, the number of interviews taken at Hopeville Pond, Devil's Hopyard, and Hurd State Park are insignificant compared to Ocean Beach and Rocky Neck and were not included in the travel time factor analysis. Also, car occupancy at these areas was not recorded. Arrival time alone is significant. For the travel time analysis of the trips to the two remaining areas, the entire State was considered, with trips external to the study area being grouped according to an average of travel times.

The home interview survey is limited in its sample size. Even though a 2 percent sample was randomly selected by towns, the number of weekend trips could vary greatly by town. This is because the weekend trips were detected on the following Tuesday.

If a great number of the interviewees were not at home on Tuesday, a call-back was necessary on another day, and then the weekend trips were not recorded. Thus, the sample size is smaller than was originally planned. In this study, only the recreational trips that had a destination listed as playground, beach, or park were used. Commercial recreation was omitted. The home interviews were taken within the study area, but trips external to this area were considered accordingly.

ANALYSIS OF DATA

The data from both the home interview and the roadside survey were coded and put on punch cards for tabulation on a Remington Rand file computer No. 1. The coding was based on the Connecticut 3-digit town number with a 2-digit appendage for zone designation. Thus, each trip has two 5-digit code designations, one for origin and one for destination. Other information was also coded and punched, thereby providing a complete record of all the trip data. With this arrangement the data could be sorted into any order for ease of analyzing.

Upon completing the above phase, it was necessary to develop a system of travel times between zone centroids. This was accomplished by a tree building process based on the Moore minimum path algorithm (1) which determines the shortest path between two centroids, given any number of alternate routes.

The mechanics of tree building is in coding a network of street and highway segments, called links, between intersections and centroids, called nodes. Each link is assigned a distance and speed. This information is stored into the computer memory, and the tree building program then determines the shortest path from each centroid to all others. The centroid to which the shortest paths are determined is called the home node. The final product is a computer tabulation composed of the shortest travel time from the home node to each other node as well as the path or route which must be traced to make the trip in this minimum time. A separate tree is required for each centroid, a total of 110 trees for the study area, including external stations. The externals are centroids located on major routes on the periphery.

Having tabulated the O and D's of the trips and the travel times, the next step in considering trip production based on destination was to develop travel time factors by considering the ratio of actual and theoretical trips. It is assumed that trip production for recreational travel is based on population. For this reason the population of each zone was taken as a percent of the state population. The statewide population was used, because it is reasonable to assume that trips can originate anywhere within the state or beyond.

From this point on, each recreational facility was considered individually. The total number of vehicle trips and person trips were recorded for each zone.

On the assumption that the population generates the trips, the theoretical number of trips from any zone would be a proportional number of the total trips based on the zonal percentage of the population. In general terms this can be expressed as

$$\text{Theoretical trips}_{ir} = \sum_{n}^{r} T \times \frac{P_i}{P_s}$$

in which

i = any zone or group;
r = a recreational facility;
$\sum_{n}^{r} T$ = the total number of trips to a recreational area from all zones;
P_i = population of the zone; and
P_s = total population of the state.

The actual number of trips to a recreational area is known from the survey conducted there. The ratio of the actual person trips to the theoretical person trips is then plotted against the travel time in minutes from each zone (2). When the curve of best fit is plotted to the scatter of points, the result will be a travel time factor curve.

This curve is of the form $R = kT^b$, in which R is the ratio of actual and probable trips, k is a constant, and T^b is the travel time to some power. This is the form of the travel time factor in its application to the gravity model.

This method was applied to both Ocean Beach and Rocky Neck so that the resulting curves could be compared and analyzed.

For the characteristics of the relationships between trips per family vs population density and car ownership, it was necessary to determine the population density in families per residential acre, and the car ownership for each zone. Once density and car ownership were established, the number of person trips and the number of vehicle trips per family were plotted.

The determination of car occupancy provided no great problem and was found by dividing the total number of persons entering the facility in the given time by the total number of vehicles entering during the same period, as recorded in the field survey.

The analysis of arrival patterns merely entailed the grouping of arrivals by hour, and plotting the percent of the vehicles arriving at hourly intervals, and also the cumulative percent arrival by comparable hourly intervals.

RESULTS

The data collected in the roadside survey at Ocean Beach and Rocky Neck are to be used in developing travel time factors, car occupancy, and time of arrival.

The 2-day survey at Ocean Beach interviewed 1,257 vehicles. The number of occupants in each car ranged from 1 to 9 persons, and the time of travel varied from a low of 1.0 min, for trips originating within the zone, to 2 hr 10 min for more distant origins. The total number of person trips was 3,329.

For the same survey period at Rocky Neck, 592 vehicles were interviewed. Car occupancy ranged from 1 to 9 persons also, and travel time ranged from a low of 6.0 min to a high of 2 hr 5 min. The high value for the low end of the range is because the zone in which Rocky Neck is located has a population of only 12 people. There is no dense population closer than 6.0 min traveling time. The total number of person trips to this facility during the 2-day weekend was 2,220.

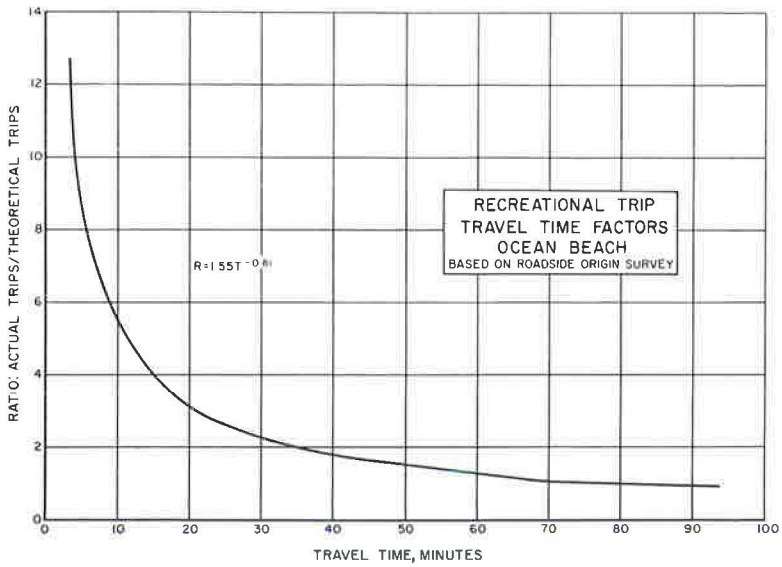
Trips originating outside Connecticut were not included in the analysis. At Rocky Neck there were 70 vehicle trips from the Springfield, Mass., area, and 5 vehicle trips from Rhode Island. At Ocean Beach there were 150 trips from Massachusetts and 176 from Rhode Island. However, 154 of the Rhode Island trips were interviewed Saturday when an industrial firm from Westerly sponsored an outing for its employees.

Trips originating outside the study area but within the state were grouped according to an average travel time. This was necessary because the tree building process was limited to the southeast area. For groups in the area contained by HATS, the time to an external station from the HATS trees was added to that of the southeast area. Times to population groups in the remaining area were estimated to the external station on the route serving the area.

The home interview survey provides the data to be used in developing the characteristics of trips as related to density and car ownership. The interviews conducted during the months of July and August resulted in 1,319 trips, of which 286 were vehicle trips for recreational purposes of the playground, beach, and park variety. This accounted for 670 person trips. Additional recreation trips of the commercial variety, bowling or golf, for example, were omitted from the analysis.

TRAVEL TIME FACTORS

The ratio of actual and theoretical trips was developed as discussed previously. This was done for both recreational facilities and then plotted against a corresponding travel time. A scatter diagram resulted indicating that a curve of the exponential form would probably be the best fit. The ratios were grouped in 5-min travel time intervals and a regression analysis was performed. To obtain results in the form of an exponential curve, a least squares linear regression in terms of the logarithms of the variables was computed (Figs. 2 and 3).



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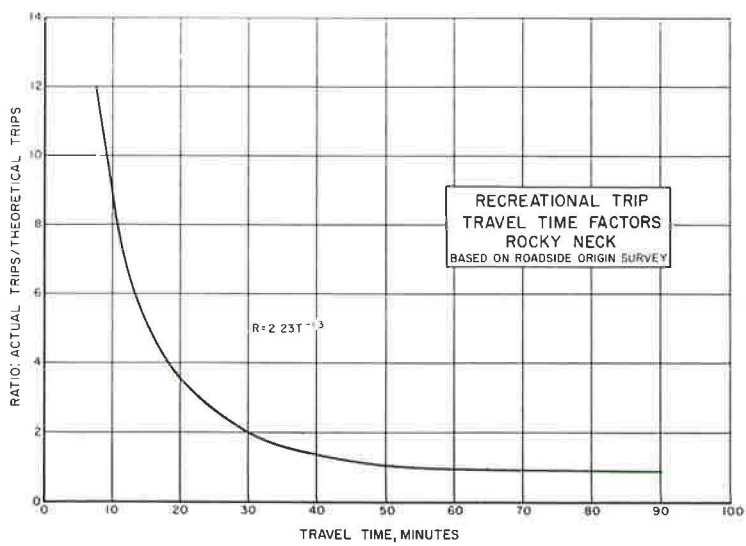


Figure 3.

The equations relating the ratio of actual to theoretical trips and travel time to Ocean Beach and Rocky Neck, respectively, were computed to be $R = 1.55T^{-0.81}$ and $R = 2.23T^{-1.3}$, in which R = actual number of person trips per probable number of person trips, and T = travel time in minutes.

The curves are very close in value except in the range of travel times from 3 to 20 min. This is due mainly to the inherent population distribution of the zones in which the study sites are located. Rocky Neck is situated in a zone that has a 1960 population of 12 people; therefore, there are no travel times less than 6.0 min. This tends to force the curve to the right, thereby increasing the slope. Ocean Beach zone, with a population of 284 people, is much smaller in area, resulting in shorter travel times for the more densely populated surrounding zones.

CAR OCCUPANCY

For the 2-day 12-hr survey period a total of 1,257 vehicles entered Ocean Beach. These vehicles contained 3,329 people. The average car occupancy was 3,329 persons per 1,257 vehicles, 2.7 persons per vehicle.

For the same period, there were 592 vehicles entering Rocky Neck with a total of 2,220 persons. Average car occupancy was 2,220 persons per 592 vehicles, 3.8 persons per vehicle.

Comparison shows a significant difference in car occupancy due to the facilities available at the recreational areas. Rocky Neck is a state park with no commercial amusements and only one food concession. Bathing and picnicking are its biggest attractions and it tends to attract the family type trip, which usually includes children.

Ocean Beach is a city-operated public facility with a boardwalk type layout with commercial amusements as well as bathing facilities and a small picnic area. Observation on the beach and of the vehicles entering showed a high number of the younger set patronizing this area, resulting in a lower average car occupancy.

TRIPS PER FAMILY VS CAR OWNERSHIP

The relationship between the number of trips made per family and car ownership is based on the home interview survey data. Car ownership for the zones was determined by random sampling of the local motor vehicle tax assessment cards for each town, and then locating the selected sample on a zone map. The sample was then expanded to the town car ownership.

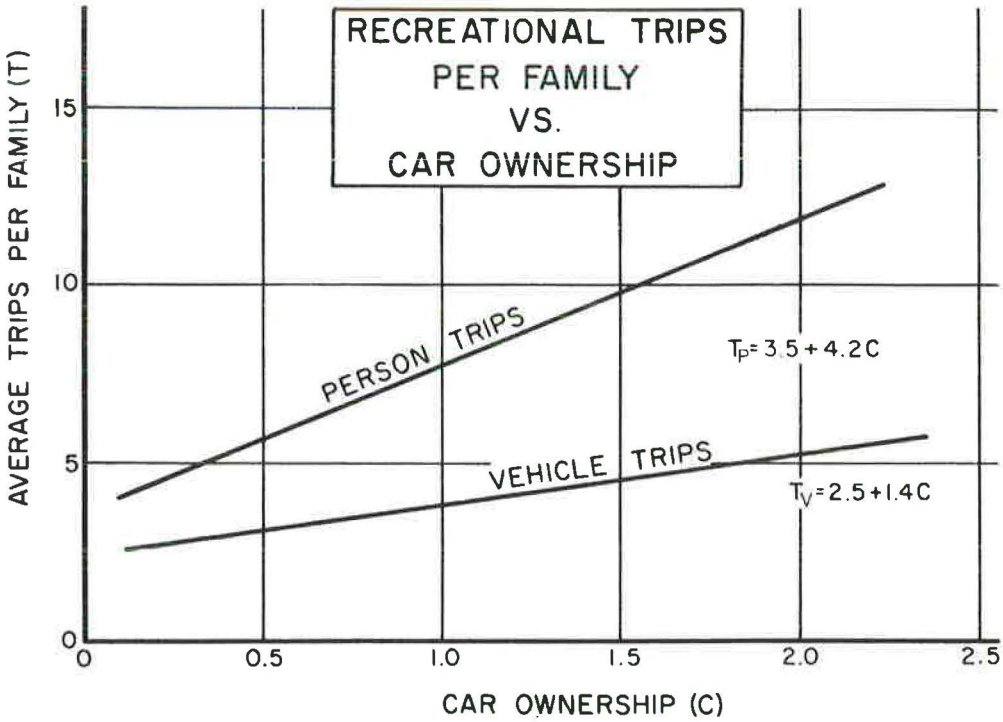
The trips per family in each zone were grouped by similar car ownership and an average value taken. The least squares regression equations relating car ownership to vehicle trips per family and person trips per family, respectively, are $T_v = 2.5 + 1.4C$ and $T_p = 3.5 + 4.2C$, in which T_v = vehicle trips per family, T_p = person trips per family, and C = car ownership by zone (Fig. 4). As car ownership increases, the number of vehicle trips increases, but at a rate less than that of person trips. This shows that larger families have a higher car ownership rate.

TRIPS PER FAMILY VS DENSITY

Again using the data from the home interview survey, the relationship between trips per family and density was developed. As density increases, the number of vehicle trips per family decreases slightly (Fig. 5). Similarly, the number of person trips per family decreases, but at a faster rate.

It is evident that the low density areas generate more person trips per family than the high density areas. However, this is justified when it is considered that the lower density areas have a higher car ownership.

The equations of the regression lines computed for vehicle trips per family and person trips per family, respectively, are $T_v = 4.4 - 0.10D$ and $T = 11.8 - 0.71D$, in which T_v = family vehicle trips, T_p = average family person trips, and D = density in families per residential acre.



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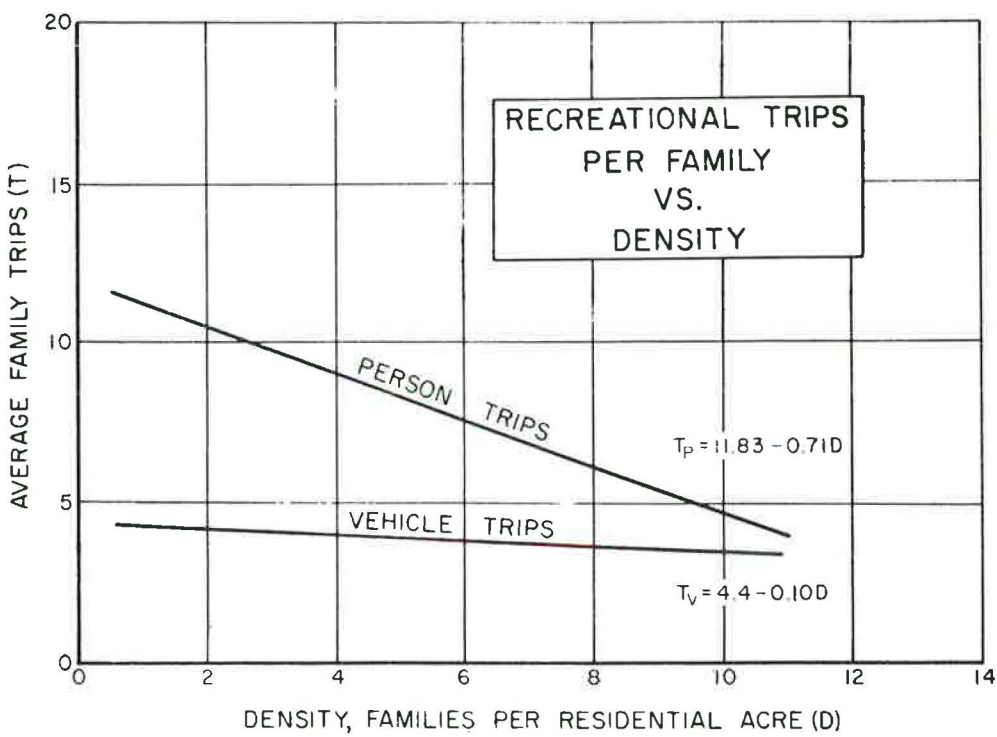

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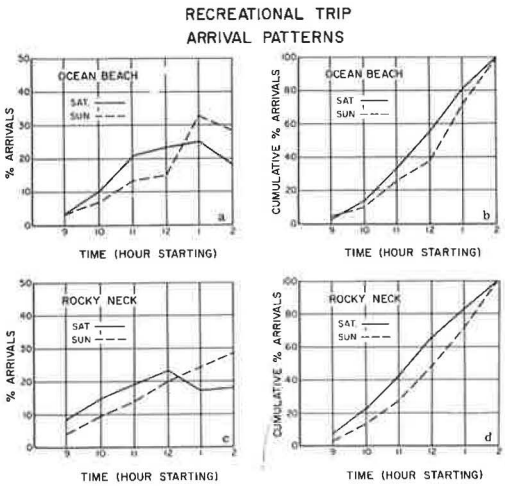

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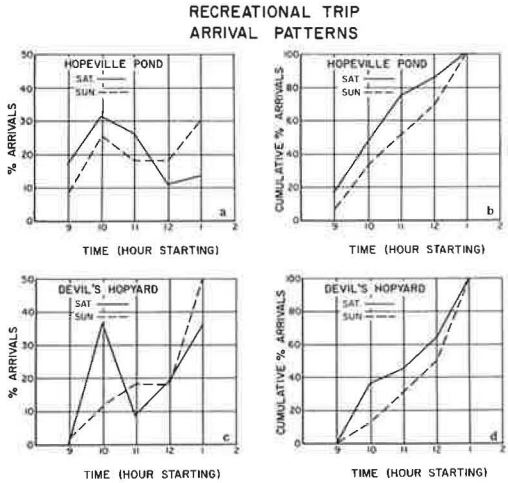

Figure 7.

TIME OF ARRIVAL

In the analysis of the arrival characteristics of recreational trips, Hopeville Pond State Park and Devil's Hopyard State Park were considered in addition to Rocky Neck and Ocean Beach. Figures 6 and 7 show the arrivals at each recreational area by percent arrivals and percent cumulative arrivals vs time.

Figure 6a shows the difference between Saturday and Sunday at Ocean Beach. The Saturday peak occurs between 1:00 and 2:00 PM, and declining thereafter. On Sunday, the peak is again from 1:00 to 2:00 PM, however, the increase is much higher, going from 15 percent to 33 percent from 12:00 Noon to 1:00 PM. The low morning volume is most likely due to the church attendance before the recreational trip.

Figure 6c shows a similar relationship at Rocky Neck. The difference is that on Saturday the peak is at the 12:00 Noon to 1:00 PM hour and then drops off, followed by a slight rise. This may be due to the late afternoon picnic or cookout. For Sunday there is a steady increase in volume which indicates the family groups possibly starting out early for an all day affair.

Figure 7a, showing the arrivals at Hopeville Pond, indicates the strong attraction for the picnic type recreation trip, even though fishing, bathing and boating are available. The Saturday curve shows the early morning arrival, thereafter declining and picking up again slightly for the afternoon. The Sunday curve shows the definite noon and evening feast outdoors.

Figure 7c portrays the arrival curves for Devil's Hopyard. There were no arrivals from 9:00 to 10:00 AM; however, there is a strong resemblance to the Saturday curve of Figure 7a. Sunday shows an increase in the early hours and then levels off at noon. There follows a rapid increase to the peak hour between 1:00 and 2:00 PM.

The survey period ended at 2:00 PM, therefore, the hour beginning at 1:00 PM was the last at which a count was taken.

CONCLUSION

The travel time factor curves developed for Ocean Beach and Rocky Neck illustrate that the facilities available at recreation areas do not strongly influence travel considerations. This is especially true of the trips greater than 25 min in length. Any travel less than this time could very well be influenced by the proximity of two recreational areas competing for visitation. It is logical to assume that people living within minutes of a beach hesitate to travel a much longer time to visit another recreational area.

Based on the similarity of the travel time curves, it is concluded that the grouping of data collected at both survey sites would result in a curve capable of providing time factors for use in the mathematical model. Applied to the model, the factors would adequately assist in the distribution of vehicular traffic to recreational areas.

The values derived for car occupancy do differ according to the facilities available at a recreational area. This varying characteristic can be utilized in estimating vehicle trips which are usually based on population. Car occupancy is the factor by which person trips are converted to vehicle trips and vice versa.

The characteristics of family trips as related to density and car ownership follow the trend of other trip types. That is, as density increases car ownership decreases and less trips are made. However, for purposes of this study, only weekend trips were considered, and for this reason the frequency would be less than weekday trips of other types.

As illustrated in the arrival curves, the time depends somewhat on the facility visited. Areas offering family activity show a definite trend of arriving in time to eat lunch or for a late afternoon cookout.

On Sundays the religious trip influences the arrivals and causes a peak near noon.

REFERENCES

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