TRAVEL BY TRAILS IN PARK AREAS

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This paper is essentially an early conceptual approach to formulate a more comprehensive program for studying and improving trails for park and recreational areas. A review of the growing impact of park and recreation areas is given, and the importance of trails is presented. Recent recreation studies and their theoretical approaches are evaluated, and significant trail problems, such as increase in demand, periodicity, lack of overall planning, and poor design standards, are discussed. The paper also addresses user characteristics, costs, signing, and accidents. Examples of minor administrative and engineering improvements are given that might make for more efficient park use. The paper concludes that many principles applicable in urban transportation planning can be applied to park and recreational trail planning.

•TRAVEL by foot is the oldest means of transportation. Pedestrian movement is a vital part of any urban or rural transportation system because any trip involves a pedestrian movement at the origin or destination or at both. Generally, the pedestrian movement is not the sole purpose of the trip. There is, however, a class of trips where the pedestrian movement itself is the purpose. These trips include walking and hiking and mainly involve recreational pursuits.

This paper will address hiking along trails. Hiking is defined as that activity involving a long walk especially for pleasure or exercise. We will use data supplied mainly by the National Park Service (NPS) and the National Forest Service (NFS) to review, in a macro manner, the state of the art and to make recommendations to improve trail planning. The focus is on low-density foot trails although the principles apply to other types of trails.

PROBLEM

Today people are going to and using parks and other outdoor recreation areas in increasing numbers. NFS of the U.S. Department of Agriculture administers 124 national forests containing about 286,000 miles^2 (740 737 km^2), about 20,000 miles^2 (51 800 km^2) larger than Texas. In 1973, these areas attracted about 188 million visitor days of use (a visitor day is defined as one visitor spending 12 hours of consecutive time in the national forest).

NPS of the U.S. Department of the Interior is the administering agent for about 298 unique geographic areas totaling 47,000 miles^2 (121 730 km^2), about the same size as Mississippi. These areas include a system of 38 national parks, 82 monuments, and 178 other historic and recreational areas. In 1973, these areas attracted nearly 216 million visitors. Table 1 gives previous and projected levels of use for 29 selected national parks and monuments classified by 6 regional areas. Each park region, between 1960 and 1973, shows significant absolute and percentage increases (Table 2). By 1985 and 2000, these parks are expected to attract an average of about 243 and 300 percent more visitors than they did in 1960.

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Table 1. Existing and projected use of selected National Park Service areas.

Location[a]	Area (miles²)	Existing Use						Projected Use[b]	
		1960	1965	1970	1971	1972	1973	1985	2000
Northwest									
Glacier Bay NM, Alaska	4,381	900	1,800	29,700	25,700	24,700	36,000	61,000	76,000
Mt. Rainier NP, Washington	378	1,538,700	1,643,100	1,925,100	1,742,600	1,682,400	1,528,200	1,971,000	2,420,000
Crater Lake NP, Oregon	250	397,700	480,500	535,000	557,900	594,300	539,500	698,000	857,000
Craters of the Moon NM, Idaho	84	134,300	183,900	223,500	274,600	205,900	190,900	327,000	368,000
Olympic NP, Washington	1,401	1,160,400	2,058,000	2,283,100	1,859,700	3,031,700	2,817,000	4,360,000	5,354,000
Subtotal	6,494	3,232,000	4,367,300	4,996,400	4,460,500	5,539,000	5,111,600	7,417,000	9,075,000
West									
Hawaii Volcanoes NP, Hawaii	468	709,100	573,900	822,300	980,700	1,389,100	1,260,500	1,966,000	2,579,000
Yosemite NP, California	1,190	1,150,400	1,635,400	2,277,200	2,416,400	2,666,600	2,339,400	2,874,000	4,150,000
Death Valley NM, California	2,981	355,900	453,000	580,500	559,500	568,300	606,500	768,000	1,008,000
Sequoia NP, California	604	610,800	877,300	875,700	882,000	869,600	846,300	1,017,000	1,334,000
Pinnacles NP, California	23	72,000	118,000	166,200	169,200	168,900	155,500	226,000	297,000
Subtotal	5,266	2,898,200	3,657,600	4,721,900	5,007,800	5,662,500	5,208,200	6,851,000	9,368,000
Midwest									
Rocky Mountain NP, Colorado	410	1,532,500	1,619,800	2,357,900	2,457,300	2,519,600	2,522,000	3,149,000	4,024,000
Grand Teton NP, Wyoming	485	1,429,900	2,507,000	3,352,500	3,284,500	3,002,200	3,083,300	4,072,000	4,577,000
Pipestone NM, Minnesota	1	155,500	92,100	157,500	156,800	169,700	143,600	293,000	350,000
Yellowstone NP, Wyoming, Montana, Idaho	3,472	1,443,300	2,062,500	2,297,300	2,126,300	2,251,700	2,066,200	2,337,000	2,627,000
Glacier NP, Montana	1,585	724,500	847,100	1,241,600	1,303,100	1,392,200	1,399,000	1,874,000	2,106,000
Subtotal	5,953	5,285,700	7,128,500	9,406,800	9,328,000	9,335,400	9,214,100	11,725,000	13,684,000
Northeast									
Acadia NP, Maine	65	1,638,200	1,733,600	2,776,300	2,455,700	2,645,400	2,776,600	3,555,000	4,351,000
Isle Royale NP, Michigan	843	6,400	9,500	14,400	15,900	16,100	15,700	25,000	30,000
Statue of Liberty NM, New York	1	769,000	1,064,500	1,104,900	1,078,500	1,091,100	1,125,900	1,200,000	1,474,000
Fort McHenry NM, Maryland	1	511,500	628,800	569,100	515,000	504,800	506,800	548,000	673,000
Subtotal	910	2,925,100	3,436,400	4,464,700	4,065,100	4,257,400	4,425,000	5,328,000	6,528,000
Southwest									
Big Bend NP, Texas	1,107	75,900	174,600	172,600	247,400	290,200	341,300	445,000	543,000
Canyonlands NP, Utah	527	—	19,400	33,400	55,400	60,800	62,600	108,000	138,000
Carlsbad Caverns NP, New Mexico	73	537,000	591,000	712,700	791,000	850,100	840,100	1,102,000	1,485,000
Bryce Canyon NP, Utah	56	272,000	366,800	345,900	379,500	426,200	431,000	636,000	813,000
Natural Bridge NM, Utah	12	6,500	19,300	39,900	49,100	58,500	42,700	78,000	100,000
Subtotal	1,775	891,400	1,171,100	1,304,500	1,523,000	1,691,800	1,717,700	2,429,000	3,079,000
Southeast									
Great Smoky Mountains NP, Tennessee	807	4,528,600	5,954,900	6,778,500	7,179,000	8,040,600	9,774,100	13,304,000	16,337,000
Everglades NP, Florida	2,188	579,200	977,600	1,273,500	1,293,500	1,773,300	1,790,700	2,637,000	3,499,000
Shenandoah NP, Virginia	302	1,780,100	2,289,400	2,411,500	2,406,500	2,304,100	2,574,300	2,825,000	3,470,000
Mammoth Cave NP, Kentucky	80	519,100	872,200	1,726,500	1,745,000	1,872,900	1,927,500	2,254,000	2,739,000
Virgin Islands NP, Virgin Islands	23	27,200	57,400	126,600	256,600	281,600	293,600	407,000	540,000
Subtotal	3,400	7,434,200	10,151,500	12,316,600	12,880,600	14,272,500	16,360,200	21,427,000	26,585,000
Total	23,798	22,666,600	29,912,400	37,210,900	37,265,000	40,758,600	42,036,800	55,177,000	68,319,000

Note: 1 mile = 2.6 km². Use values are given in total number of visits per park.

[a]NM = national monument; NP = national park. [b]Does not account for possible fuel shortages that might impact use.

Table 2. Percentages of use higher than 1960 level for selected National Park Service areas.

Location	Existing Use					Projected Use[a]	
	1965	1970	1971	1972	1973	1985	2000
Northwest	135.1	154.6	138.0	171.4	158.2	229.5	208.8
West	126.2	162.9	172.8	195.4	179.7	236.4	323.2
Midwest	134.9	178.0	176.5	176.6	174.3	221.8	258.9
Northeast	117.5	152.6	139.0	145.5	151.3	182.1	223.1
Southwest	131.4	146.3	170.9	189.8	192.7	272.5	345.4
Southeast	136.6	165.7	173.3	192.0	220.1	228.2	357.6
Total	132.0	164.2	164.4	179.8	185.5	243.4	301.4

[a]Does not account for possible fuel shortages that might impact use.

These increases, along with the assumption of approximately fixed natural resources, will present new and serious problems for persons interested in the pursuit of recreation in a low-density environment. There are limits to the amount of use these areas can withstand.

Thedore Roosevelt, in 1912, summarized his views on conservation and the environment aptly with the following remarks:

> In utilizing and conserving the natural resources of the Nation, the one characteristic more essential than any other is foresight. Unfortunately, foresight is not usually characteristic of a young and vigorous people, and it is obviously not a marked characteristic of us in the United States. Yet assuredly it should be the growing nation with a future which takes the long look ahead.

NPS, partially as a result of vehicle access studies, has suggested and implemented significant changes in the way people have historically been enjoying their parks and recreation areas. For example, buses are now used rather than private vehicles to

take visitors into most of Yosemite National Park's major activity centers (namely, the valley), and public transport systems are also under study for Yellowstone, the Everglades, and Mount McKinley National Parks. The buses now used in Yosemite were mandated because of concern about the growing incompatibility between vehicles and pedestrians and air and noise pollution levels. Parks, however, are seeking to minimize all forms of environmental-ecological damage, and this concern will result in changes in how all of us use these areas in the future.

REASON FOR TRAILS

Trails have historically played an important part in America's development. Today their function is not just for historical purposes but for low-density recreation as well. They have served to open remote areas by allowing mail and commerce to be interchanged. They permit persons to view and obtain access to desert, seashore, marsh, and forest areas close up without damaging existing ecological relationships. Many existing highways and railroad rights-of-way follow previously existing trails formed by the American Indian or by wagons during America's westward push in the 1700s.

Many activities occur on trails, such as hunting, fishing, bicycling, horseback riding, picnicking, sightseeing, nature study, and hiking. As the popularity of recreation areas has generally increased the use of components of these areas has concomitantly increased. NFS data show that trail use has been increasing (1969 to 1973) at an average annual rate of about 6.1 percent; trail use as a percentage of total forest use ranges from about 3.4 to 4.3 percent during this same period. There are about 96,000 miles (154 500 km) of trails in the NFS; however, although classified and used as trails, 67,000 miles (107 826 km) are actually all-purpose roads, 9,000 miles (14 484 km) are walking trails, 15,000 miles (24 140 km) are fire roads, and 5,000 miles (8047 km) are limited-purpose-access roads.

Data from the NPS indicate that trail use is increasing at about 25 percent per year. The specific numbers of people using trails are not available, but a figure of 32,000,000 per year is estimated. Table 3 gives some recent trends in overnight and backcountry use that are probably highly correlated with trail use. Table 4 gives the total supply and type of trails for the United States. NPS has about 9,750 miles (15 691 km) of trails; over 80 percent are more than 25 years old, and another 10 percent are over 10 years old.

One of the few comprehensive transportation system studies made concerning recreational areas was previously described in another publication (4). Trip generation, distribution, modal split, and assignment were forecast from models calibrated from a series of national forest travel surveys. Like other studies (2, 9), however, data were collected primarily from interviews and observations along the major road network leading to the forest. Few studies (3) have been devoted to the analysis of low-density origins and destinations such as those that occur along trails in remote sections of parks and other recreation areas. In addition, these studies were primarily concerned with the private automobile, and the fact is that most parks are still oriented toward serving people close to their vehicles.

Lately, the U.S. Department of the Interior has recognized the seriousness of increasing park use for all its activities and is engaged in an active program to study this and methods of managing existing demand. This has generally been addressed by researching new methods of data collection (10) and by attempting to determine park use motivational characteristics (1, 5, 11). These new statistics, when they are available, should prove useful.

Existing procedures for managing demand along trails in some parks now include

1. Establishing camping duration limits along with campground capacities,
2. Requiring permits for some trails,
3. Restricting trail users such as in Sequoia National Park, and
4. Encouraging reservations for designated camping areas (some parks have tried a computerized reservation system).

TRAIL PLANNING AND DESIGN

Unlike the typical urban transportation planning process that designs transport facilities around criteria of maximum density and volume under constraints of safety and travel time, the objectives of trail planning are quite different, depending on the attributes of its users. Trail planning should recognize explicitly the purpose of the trail and integrate the user with the environment in such a way that this is achieved.

Problems

Major problems currently confronting trail specialists include

1. Methods of determining trail-user characteristics;
2. Facilities required to support trail use;
3. Determination of trail capacity;
4. Ecological and environmental impact of trail use on water, plant, and animal systems;
5. Methods of setting maintenance and staffing standards;
6. Provision of trails for the handicapped; and
7. Methods of calculating trail demand.

Trail-User Characteristics

Trail specialists have already taken interim steps to control the demand for trails; they have done so with little or no information on specific user characteristics, such as age, education, trip length, length of stay, facilities used or desired, origin and destination, and frequency of use. The design of trails should be related to the users; Table 5 (13) gives a summary of one of the few user studies made in a low-density park area. The way an individual reacts on a trail is a function of friction and gravity and other factors. Trails could be improved if more were known about how people walk as a function of grade and surface. Trails, in general, have too long been designed by rules of thumb that, when examined, are unrelated to today's user. Few if any studies have been made correlating the hiker's sense of comfort with the type of trail. Design criteria are needed as well as research concerning the following:

1. Frequency of providing level rest areas on steep trails;
2. Cause of trail accidents such as slippage due to fatigue, weather, and surface;
3. Maximum acceptable grade and trail surface for users;
4. Suggested grades to control erosion;
5. Visual and noise criteria; and
6. Physical layout of trails such as spacing, connectivity, length, width, grade, and surface.

The amount of time hikers spend on trails is important for planning purposes. Walking speeds depend on many factors, as suggested in the table below (1 mile = 1.6 km):

Type of Terrain	Average Time To Cover 1 Mile (min)	Speed (mph)
Along road	15	4.0
Open field, gentle upgrade	25	2.4
Wooded area, gentle upgrade	30	2.0
Mountain area, steep upgrade	40	1.5

Table 3. Type of use of selected National Park Service areas.

Location[a]	Area (mile²)	Overnight Use[b] 1971	1972	1973	Backcountry Use[c] 1972	1973	Total Trail Length (miles)	Hiking Trails	Camping Sites on Trails	Shelters on Trails
Northwest										
Glacier Bay NM, Alaska	4,361	13,100	17,100	18,600	700	1,100	8	3	0	0
Mt. Rainier NP, Washington	378	144,400	141,200	205,100	18,200	24,900	300	75	21	13
Crater Lake NP, Oregon	250	65,300	81,200	92,000	600	1,100	79	14	0	1
Craters of the Moon, NM, Idaho	84	19,000	18,700	17,800	0	0	20	6	0	0
Olympic NP, Washington	1,401	402,500	553,000	566,400	175,200	185,900	586	94	99	76
Subtotal	6,494	644,300	811,200	899,900	194,700	213,000	993	192	120	90
West										
Hawaii Volcanoes NP, Hawaii	468	88,700	93,500	93,600	2,500	2,500	156	22	5	4
Yosemite NP, California	1,190	1,596,300	1,609,400	1,754,300	220,800	318,100	766	141	—[d]	—[d]
Death Valley NP, California	2,981	279,900	255,200	257,900	1,400	—[d]	21	6	0	0
Sequoia NP, California	604	212,100	221,100	235,800	69,100	56,800	809	105	0	0
Pinnacles NP, California	23	47,000	46,200	47,700	—[d]	—[d]	19	7	0	0
Subtotal	5,266	2,224,000	2,225,400	2,389,300	293,800	379,400	1,771	281	5	4
Midwest										
Rocky Mountain NP, Colorado	410	275,600	281,100	301,400	36,100	37,200	320	92	99	0
Grand Teton NP, Wyoming	485	593,200	618,600	559,600	30,400	31,400	200	33	22	0
Pipestone NM, Minnesota	1	—[e]	—[e]	—[e]	—[e]	—[e]	1	1	0	0
Yellowstone NP, Wyoming, Montana, Idaho	3,472	1,345,600	1,464,600	1,141,200	24,900	36,800	990	108	99	0
Glacier NP, Montana	1,583	360,500	357,500	368,700	14,500	27,500	936	177	82	6
Subtotal	5,951	2,574,900	2,721,800	2,370,900	105,900	132,900	2,447	411	302	6
Northeast										
Acadia NP, Maine	65	239,400	224,500	233,500	400	—[d]	123	102	0	0
Isle Royal NP, Michigan	843	75,100	67,700	66,700	8,400	8,200	167	20	99	73
Subtotal	908	314,500	292,200	300,200	8,800	8,200	290	122	99	73
Southwest										
Big Bend NP, Texas	1,107	192,000	215,300	215,100	11,500	13,000	68	31	0	20
Canyonlands NP, Utah	527	25,200	29,600	33,000	11,500	13,400	22	13	0	0
Carlsbad Caverns NP, New Mexico	73	1,400	0	0	0	0	61	11	0	0
Bryce Canyon NP, Utah	56	108,300	119,400	123,800	600	700	62	26	0	0
Natural Bridge NM, Utah	12	6,600	7,700	7,200	—[e]	—[d]	5	8	0	0
Subtotal	1,775	333,500	372,000	379,100	23,600	27,100	218	89	0	20
Southeast										
Great Smoky Mountains NP, Tennessee	807	559,800	626,100	537,900	68,800	82,500	697	186	62	22
Everglades NP, Florida	2,188	131,400	166,600	227,900	8,700	22,800	179	23	20	0
Shenandoah NP, Virginia	302	450,500	446,200	600,500	75,900	120,500	465	171	21	21
Mammoth Cave NP, Kentucky	80	160,500	166,700	186,100	400	700	12	8	0	0
Virgin Islands NP, Virgin Islands	23	90,000	110,600	92,900	—[d]	—[d]	24	22	0	0
Subtotal	3,400	1,392,200	1,516,200	1,645,300	153,800	226,500	1,377	410	103	43
Total	23,794	7,483,400	7,938,800	7,984,100	760,600	987,100	7,096	1,505	629	236

Note: 1 mile² = 2.6 km². 1 mile = 1.6 km.

[a]NM = national monument; NP = national park.
[b]Passing of 1 night per person.
[c]Use of area at least 0.5 mile (0.8 km) from a paved road and 0.25 mile (0.4 km) from improved facilities.
[d]Not applicable.
[e]No overnight use.

Table 4. U.S. supply trails by type.

Location	Total Trail Length[a]	Trail Type: Hiking	Horseback	Bicycle	Motor	Nature	Handicapped
Northwest	55,646	4,438	3,337	215	2,964	402	37
West	23,122	3,657	2,236	731	466	243	17
Midwest	12,709	3,791	2,507	1,513	5,986	1,418	52
Northeast	16,478	7,844	2,186	1,445	3,555	1,110	54
Southwest	16,823	2,827	1,716	431	816	394	10
Southeast	9,981	3,690	1,694	660	997	1,316	37
Total	134,759	26,247	13,676	4,995	14,784	4,883	207

Note: All values are given in miles. 1 mile = 1.6 km.

[a]Does not equal total type of trails because many that are classified as trails are used for roads, emergency fire lanes, and so on.

Table 5. Results of study on area use of low-density area of Rocky Mountain National Park.

Item	Response (percent)	Item	Response (percent)
State of residence		Family income, dollars	
Colorado	31	<3,000	9
Illinois	8	3,000 to 5,999	8
Michigan	6	6,000 to 8,999	10
Texas	5	9,000 to 11,999	13
Other	50	12,000 to 14,999	13
Age, years		15,000 to 17,999	11
11 to 19	24	18,000 to 29,999	17
20 to 29	50	>30,000	13
30 to 39	11	No response	6
40 to 49	9	Backcountry experience, years	
50 to 59	4	0 to 1	33
60 to 69	1	1 to 2	24
Other	1	2 to 3	10
Level of education		3 to 4	7
Less than high school	9	4 to 5	4
High school	30	5 to 10	10
2-year college	12	Over 10	12
4-year college	26	Previous visits to Rocky Mountain National Park	
Postgraduate	23	0 to 1	49
Occupation		2 to 4	24
Student	45	5 or more	27
Professional	25		
Technician	6		
Other	24		

Travel times for hikers in various situations, based on the table above, can be computed according to the following table:

Situation	Change in Travel Time		
	Increase	Decrease	Percent
Backpacking on trail	X		25
Running on trail		X	50
Walking on gentle downgrade		X	10
Walking on steep downgrade		X	25

Figure 1 shows the duration characteristics of those hikers using trails in national parks; the average trip length is about 2.15 hours.

Design of Trails

The identification and provision of trails are important for recreational use; trail planning and design should be part of a master plan. The steps in planning and laying out trails are similar to the general transportation process: reconnaissance, inventory, plan formulation, alternative development, analysis, and evaluation. Trails designed today should

1. Be long enough for a user to reach some satisfaction level consistent with their speed,
2. Avoid motor crossings,
3. Not use frequent bends or loops because they can create an element of surprise and produce a feeling of remoteness,
4. Use local materials,
5. Use landscaping to separate different trail uses, and
6. Be part of a master plan.

DEMAND FOR TRAILS

Determining the aggregate demand for parks and recreation areas and the specific demand for trails is important. Demand calculation can provide a basis for fiscal and personnel allocation and better management procedures. The tables in this paper have only shown consumption relationships; demand in economic terms is the relationship between price and quantity. Most existing demand methods for trail planning attempt to count the numbers of existing users and extrapolate them according to local population projections and adjust for minor irregularities. The demand for trails, however, may depend on the following internal and external attributes:

1. Condition and capacity of campgrounds,
2. Type of trail,
3. Climate and aesthetic factors,
4. Population of urban area,
5. Distance traveled,
6. Income,
7. Leisure, and
8. Competing trail opportunities.

Normally, field surveys are taken to establish user origins, mode of travel, length of stay, and demographic characteristics so that demand can be calculated. Historically,

they have been vehicle and park oriented rather than activity oriented and are expensive and time-consuming. Low-cost methods of determining trail demand are necessary. Figures 2, 3, 4, 5, and 6 are scatter diagrams that attempt to show correlation with other easier to obtain variables. Backcountry use was used as a proxy variable for actual trail use. Regression analysis failed to show any statistically significant relationships.

If the demand for park and recreational use were evenly spread throughout the year, there probably would not be the crowding problem that presently exists in some areas. Unfortunately, visits to most park facilities are concentrated in the summer months of June, July, and August, and 61 percent of activities occur between May and September (Figure 7). Naturally, each park has its own particular characteristics that affect use, such as prevailing weather, proximity to major urban centers, and internal scenic attributes. Long holiday weekends may also generate a great deal of park use.

COST OF TRAILS

Hiking trails are currently estimated to cost between $2,000/mile ($1243/km) in typical forest areas and $6,000/mile ($3728/km) in steep, rocky terrain. Trails in very rough terrain have cost more than $10,000/mile ($6214/km), and others have cost $200 or $300/mile ($124 or $186/km). Costs depend on many factors, such as the number and type of bridges, culverts, signs, hand or guard rails, and material and on location and specific labor requirements. Maintenance varies a great deal, depending mainly on how and to what intensity the trail is used and on erosional effects. During 1972 NFS averaged $55/trail mile ($34/km). Of the initial cost per year, 1 to 3 percent can be used as a rough guide (12).

SIGNING

The proper and uniform signing of trails is extremely important. The head of a trail should be identified with a symbol and name (perhaps color coded), mileage for the section indicated, probable walking time, and the level of difficulty (e.g., leisurely, moderate, difficult, and for experienced hikers only). Additional information such as facilities available along the trail would also be beneficial. Along the trail, simple but clearly identified symbols and markers can be used to indicate trail name and important distances. Signing, however, should be standardized at least in recreational areas of similar types.

ACCIDENTS

Visitor accidents in park and recreation areas have generally been increasing. At this time, detailed accident statistics along trails cannot be presented. Most parks, however, report that accidents, particularly falls, occur as a result of hikers leaving the designated trail and getting into terrain that is too steep. Many other accidents, however, occur on trails that are not, or are seldom, maintained. The statistics do show that it is the under-25 age group that is most affected. Most accidents occur in the peak season.

TRAIL DEVELOPMENT

The U.S. Congress, acting in response to new demands on park areas, has passed a number of legislative acts that have set policy for the park and other recreational operating agencies. Passage of the National Trails Systems Act of 1968 recognized the value of trails as a significant form of recreation. It established two types of trails: national scenic trails (NST) and national recreation trails (NRT). NST are

Figure 1. Estimated trip length distribution.

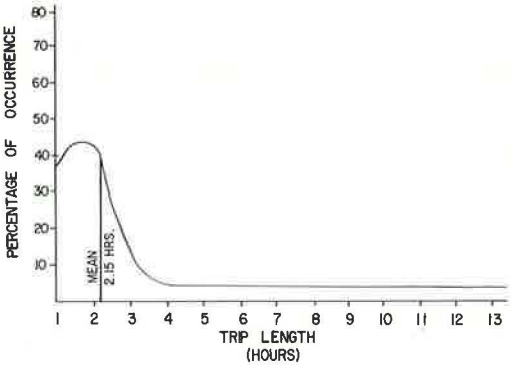


Figure 2. Backcountry versus park use.

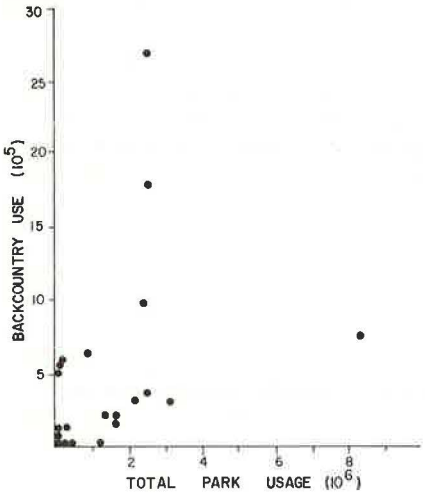


Figure 3. Backcountry use versus park area.

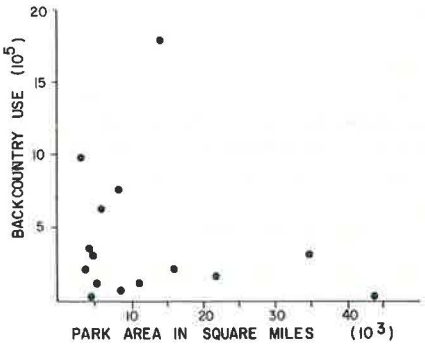


Figure 4. Backcountry use versus trail density.

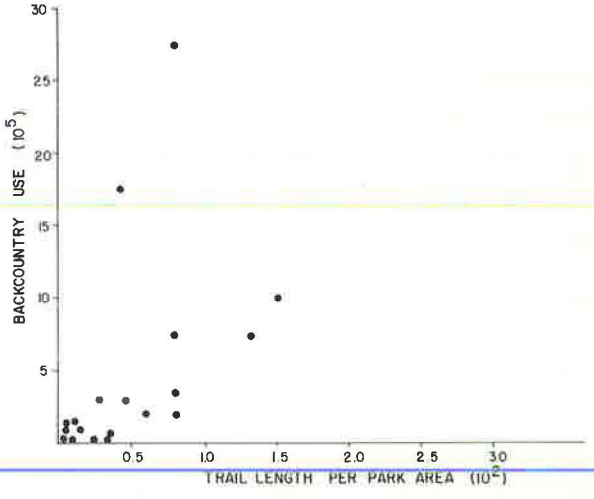


Figure 5. Backcountry use versus overnight use.

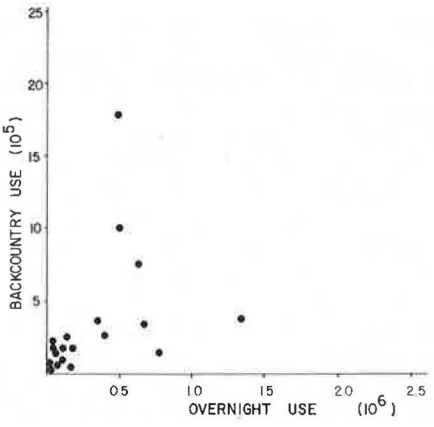


Figure 6. Backcountry use versus trail length.

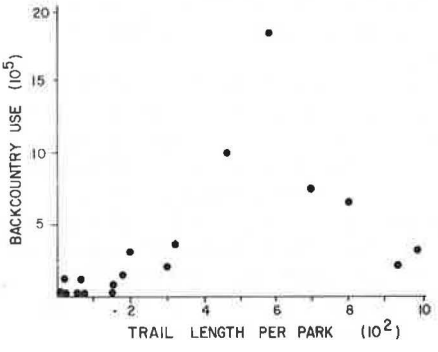


Figure 7. Park use by month, 1972.

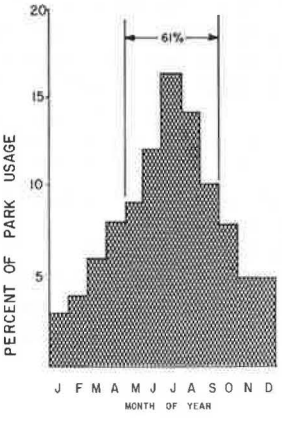
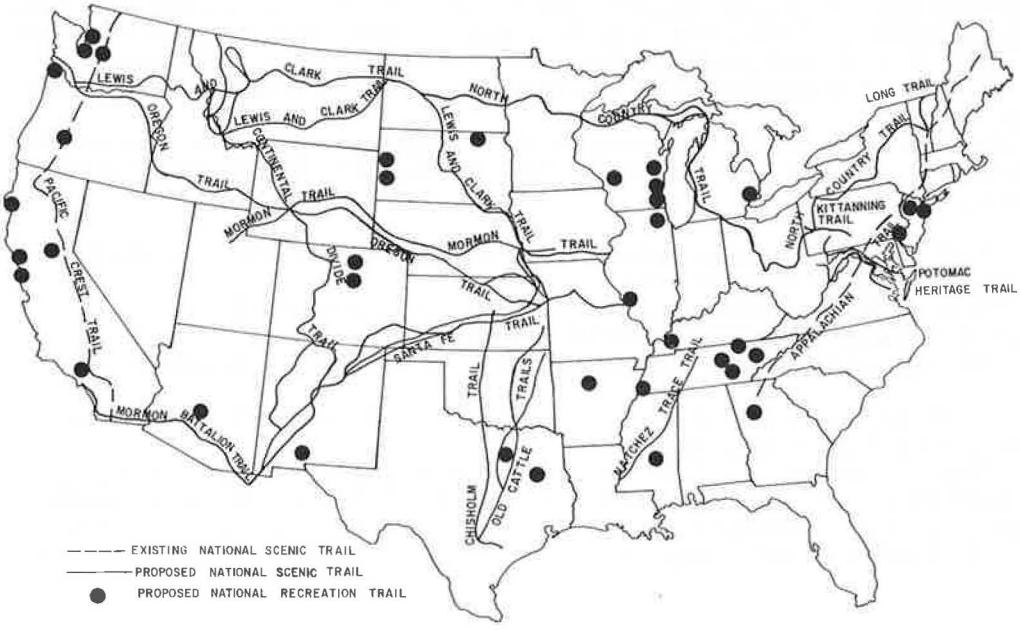


Figure 8. Proposed and existing hiking trails.



nonmotorized trails whose major function is to provide hiking access to noteworthy scenic, historic, national, or cultural features. Representative of this type are the Appalachian and the Pacific Crest Trails (Figure 8); the others are still under study. Both of these are continuous trails, about 2,000 and 2,350 miles (3219 and 3782 km) respectively. NRT can be designated by the Department of the Interior or the Department of Agriculture (without legislative approval but with the consent of the local jurisdictions) to serve any one of several purposes: nature-interpretative tours, walking, horse-mule riding, four-wheel-drive vehicles or snowmobiles, or personal car. These trails are specifically legislated to be located near urban centers.

Other trails under consideration for addition to the NST include the Continental Divide Trail [3,100 miles (4989 km)]; Potomac Heritage Trail [825 miles (1327 km)]; Old Cattle Trails [800 miles (1287 km)]; Lewis and Clark Trail [2,000 miles (3219 km)]; Natchez-Trace Trail [600 miles (966 km)]; North Country Trail [3,200 miles (5150 km)]; Kittanning Trail [200 miles (322 km)]; Oregon Trail [2,000 miles (3219 km)]; Santa Fe Trail [800 miles (1287 km)]; and Mormon Trail [800 miles (1287 km)]. Others are being investigated.

Congressional legislation also provides for financial assistance to states for trail planning. As a result, many states are in the process of establishing systems of scenic trails. In addition, the Federal Highway Administration has authorized the use of federal funds for trails in urban areas as long as they are part of the Interstate or primary road system and in the highway right-of-way.

Most trail planning now done on the federal level is directed by the National Forest and National Park Services, and some is being done by the U.S. Corps of Engineers; no centralized agency, however, deals with trails, and states are only now entering this area actively. Little initiative is taken by the U.S. government, and it does not usually address specific problems until private interest groups place enough pressure on it. Although there are two primary sources of funds for trails, the Highway Trust Fund and the Land and Water Conservation Fund, these must compete with other projects sponsored from these monies. Other significant legislation affecting trails also includes the National Environmental Policy Act of 1969, the Water Quality Act of 1965, the Wilderness Act of 1964, and the Historic Preservation Act of 1935.

CONCLUSIONS

Many of the principles applicable in urban transportation planning can be applied to park and recreational trail planning. As in any plan, goals and objectives need to be established and clearly stated, and the plan must be analyzed and evaluated with meaningful measures of effectiveness. New data collection techniques are currently available, such as aerial photography, to decrease overall costs, but the field survey will probably continue to generate the most useful data, especially in light of disaggregate behavioral trends.

Trail planning and design can be expensive, but improvements can be made simply by applying minor administrative and low-cost engineering techniques including the following:

1. Better and more uniform signing, especially at the head of a trail or along roads, may distribute hikers more efficiently.
2. Dead-end trails should be connected with other trails to form loops.
3. Use of one-way trails should be encouraged.
4. Park managers should try to separate users by type and trip purpose on certain trails.
5. Trails without an adequate and safe surface or grade should be improved and maintained or closed to the public.
6. Maps and descriptions of hiking trails should be prepared and be more readily available; maps showing trails and other facilities should be frequently updated with suitable map scales [preferably 1 in. = 2,000 ft (1 cm = 610 m)] so that they can be followed without frequently placed signs or indications; and information including trail

description, mileages, and trail cross sections or profiles, suggested hiking season, and other pertinent local information should be easily obtained.

7. Trails should be planned, designed, and constructed as part of an overall master plan.
8. Trails can be constructed in highway, railroad, canal, and river rights-of-way as well as on land fills. This often negates land-purchasing costs.

Various techniques can be used to allocate or physically assign trail users to obtain more efficient use. These techniques include pricing (time of year or by facility type), metering (permit use only or licensing for certain park facilities), general information system (advisement and diversion), and new construction (shelters, additional trails, and the improvement of trails).

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