User Counts on Bicycle Lanes and Multiuse Trails in the United States

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The research presented in this paper was conducted as a supplemental activity to the National Bicycling and Walking Study, with the objective of answering the question, if a facility is built, how many people will use it? The first section of this paper examines temporal patterns in the number of bicycle trips along bicycle lanes and trails. Hourly user counts averaged roughly 100 bicyclists per location for lanes in Gainesville, Fla.; Madison, Wis.; and Phoenix, Ariz.; and a trail in Raleigh, N.C. Trails in Washington, D.C. and Seattle, Wash. attracted twice as many daily users on weekends as on weekdays; at one bicycle lane location in Madison, bicycle volumes on Saturday were half those on weekdays. Counts from trails in Eugene, Oreg.; Washington, D.C.; and Madison were generally three to five times higher during the summer months than in the winter. Since 1987, the average volumes per location along bicycle lanes in Gainesville, paths in New York City, and a trail in Madison have ranged from 400 to 1,200 bicycles per day. In Eugene, the installation of bicycle lanes increased bicycle traffic along the routes by up to 40 percent. This study also reports information on the mix of bicyclists and pedestrians found on multiuse trails. On trails in Florida, Rhode Island, and Washington, D.C., and on one bicycle lane in New York City, bicyclists comprised three-fourths or more of all users. For two bridges in New York City and a trail in California, pedestrians dominated.

With the passage of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), states, metropolitan planning organizations, and localities have more flexibility to plan for and implement facilities and related programs for bicyclists and pedestrians. Planners, engineers, researchers, and bicycling and walking advocates are all interested in answering the question, if a bicycle or pedestrian facility is built, how many people will use it? The research presented in this paper was performed as a supplemental activity for FHWA's National Bicycling and Walking Study, with the objective of gathering information on the number of bicyclists and pedestrians using various facilities.

Most of the bicyclist and pedestrian counts pertained to specific geographical areas. Data on bicycle trips were more readily available, perhaps because bicycle advocacy groups have been more active and are more widespread, or because bicycle counts can be done mechanically and are thus less labor intensive.

This study focuses on bicycle trips that occur on bicycle lanes and multiuse facilities. Bicycle trip counts in mixed street traffic and pedestrian trip counts may be found in a report by Hunter et al. (*1*). The first section of this paper summarizes temporal patterns in bicycle and pedestrian trip counts. Next, information pertaining to the mix of bicyclists and pedestrians on multiuse paths is presented. Possible explanations for the variations in trip counts among facilities are given. Finally, guidelines for data collection are offered.

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TEMPORAL PATTERNS IN TRIP COUNTS

Time of Day

As with automobile trips, the number of bicycling and walking trips varies by time of day. The city of Gainesville, Florida, has records of bicycle counts taken since 1982 (*2*). The number of locations counted has varied from one year to the next. Nine locations were counted from 1989 to 1991, and in 1992 two other locations were added. The locations have a mix of facilities available: designated and undesignated bike lanes, wide curb lanes, and sidewalks.

For 1993, counts were obtained in 15-min intervals between 7 a.m. and 7 p.m. on weekdays, September through December. The total counts for all 11 locations were lowest from 7 to 8 a.m. and from 6 to 7 p.m., and highest from 8 to 9 a.m. and from 5 to 6 p.m. The volumes were actually quite consistent from 8 a.m. to 6 p.m., with about 850 to 950 bicyclists/hr (total of all 11 sites). This pattern probably reflects work and school commuting.

Since the 1970s, Madison, Wisconsin, has been known as a city where bicycling is both popular and an important part of the local transportation system. The 1991 bicycle transportation plan for Madison and Dane County (*3*) reports 159 km (99 mi) of bicycle facilities:

Paths	32 km (20 mi)
Lanes	21 km (13 mi)
Mixed-traffic routes	95 km (59 mi)
Sidewalk routes	11 km (7 mi)

Additional facilities include many rural farm-to-market roads and county trunk highways with paved shoulders, along with two state bicycle trails.

The Madison Department of Transportation has been monitoring bicycle use since the mid-1970s. At the intersection of Mills Street and University Avenue near the heart of the University of Wisconsin campus, continuous bicycle counts are made using loop detectors. Two-way bicycle lanes, both 2.4 m (8 ft) wide, are located on each side of University. University is a one-way street, so one of the bicycle lanes is contraflow. The December 1993 weekday average bicycle volume was 2,309 for a 24-hr period. Peak hourly volume was 131 from 10 to 11 a.m. westbound and 122 from 3 to 4 p.m. eastbound. The lowest average hourly volumes were less than 10 bicycles from 1 to 8 a.m. eastbound and 1 to 7 a.m. westbound (T. Walsh, City of Madison Department of Transportation, unpublished data).

In Raleigh, North Carolina, the Avent Ferry Road Bicycle Path intersects Western Boulevard near the campus of North Carolina State University and Gorman Street a little over 1.6 km (1 mi) south of the campus (*4*). A one-day, 12-hr count revealed that hourly pedestrian usage at Western Boulevard is highest (90–100) between 7 and 9 a.m., falls to around 60–70 during the midday hours,

increases slightly between 2 and 4 p.m., then drops to about 50 or lower after 4 p.m. (Figure 1). Bicycle usage followed a similar pattern, with 50–60 cyclists/hr during peak hours and roughly 30 cyclists/hr during midday. These patterns probably reflect students traveling to and from class at the University. The peak hours for joggers may be those times when students are not in class.

In the morning, most bicyclists are traveling northbound, to campus. Over 40 northbound cyclists per hour were counted between 7 a.m. and 9 a.m. During the afternoon, most bicyclists are traveling southbound, away from campus. About 40 southbound cyclists per hour were counted between 3 p.m. and 5 p.m.

For the designated "Bike-to-Work Day" on Wednesday, February 28, 1990, the City of Phoenix, Arizona, established a temporary bike route (*5*). Orange traffic cones were used to mark off separate bike lanes. A total of 560 unduplicated bicycle trips were recorded that day, approximately 200 more than on an average weekday. Of the 560 trips, 232 occurred between 7 and 9 a.m., 74 between 11 a.m. and 1 p.m., and 254 between 4 and 6 p.m. Of 307 survey respondents, 80 percent were making work trips.

Time of Day Summary

Table 1 shows that hourly user counts averaged roughly 100 per location. Peak-hour volumes were about 1¼ times the average hourly volumes. The peak times tended to correspond with commuter and university schedules.

Weekday, Weekend, and Day-of-Week

In some locations, both a weekday and a weekend count were taken. Recreational users were expected to comprise a higher percentage of weekend users than of weekday users. Where commuting dominates, average daily weekend usage may be lower than average weekday usage. At the Mills and University intersection in Madison, Saturday counts were about half the weekday counts and Sunday counts were slightly over one-fourth of the weekday counts (T. Walsh, City of Madison Department of Transportation, unpublished data). On the other hand, a 1987 survey found 1,700 weekend users per day on a trail near the Kennedy Center in Washington, D.C., but only 860 weekday users per day (*6*).

A May 1990 survey of users of the Burke-Gilman/Sammamish River Trail in Seattle, Washington, provides interesting data (Bill Moritz, University of Washington, unpublished data). Six count stations were used along the 40 km (25 mi) of trail from Seattle to Redmond. At the time of the survey all but 2.4 km (1.5 miles) was a Class I facility. Volunteers worked at stations from 7 a.m. to 7 p.m. on a Saturday and a Tuesday, counting total trail users in each direction by mode of travel and distributing survey cards to willing recipients. About 3,200 cards were returned and analyzed. The weather was moderate and without rain on both survey days. On Saturday, 13,204 bicyclists, 1,153 joggers, 1,367 walkers, and 148 other users were counted. The counts for Tuesday consisted of 4,225 bicyclists, 931 joggers, 992 walkers, and 61 other users. Double counting is present to an unknown extent in these totals. A bicyclist traveling completely from one end to the other and back (total of 80 km [50 mi]) would have been counted 12 times.

Figure 2 plots the number of bicyclists by time of day at the station near the University of Washington (westbound is toward the university). On Saturday, westbound flow peaked at about 190 bicyclists/hr from 2 to 3 p.m., while eastbound traffic was 140 bicyclists/hr from 1 to 3 p.m. and from 4 to 5 p.m. The Tuesday plot shows two peaks: 140 bicyclists/hr westbound from 8 to 9 a.m. and 180 bicyclists/hr eastbound from 5 to 6 p.m.

Eugene, Oregon, is home to the University of Oregon and its 18,000 students. The community has had a bicycle coordinator in place for some time and is considered to be proactive for bicycling. The Eugene City Council adopted the Eugene Bikeways Master Plan in 1975 (*7*). The plan proposed 120 routes covering 242 km (150 mi). By 1981, 113 km (70 mi) of bicycle paths, on-street lanes, and signed routes were in place (*8*).

For one-week periods in 1978, daily variations in bicycle volumes at the Autzen Foot Bridge, the Dapple Way Extension (an on-street pedestrian and bicycle connector through a cul-de-sac), and

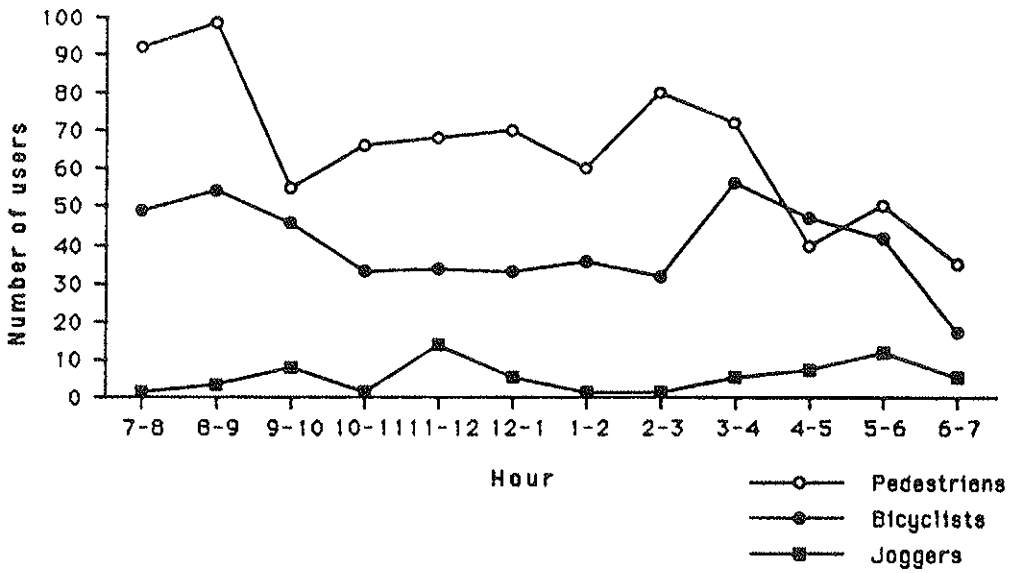


FIGURE 1 Hourly usage, Avent Ferry Road Bicycle Path at Western Boulevard, Raleigh, North Carolina.

TABLE 1 Daily, Peak-Hour, and Average Hourly Bicycle Counts in Four Cities

City	Total Daily Count	Peak Hour Count and Time	Average Hourly Count
Gainesville	10,116 (12 hours, 11 locations)	969 5:00 p.m. - 6:00 p.m. (88 per location)	843 (77 per location)
Madison	2,309 (24 hours, 1 location)	131 westbound 10:00 a.m. - 11:00 a.m. 122 eastbound 3:00 p.m. - 4:00 p.m.	96
Raleigh	787 pedestrians	90 - 100 (pedestrians) 7:00 a.m. - 9:00 a.m.	66 pedestrians
	435 bicyclists	50 - 60 (bicyclists) 8:00 a.m. - 9:00 a.m. and 3:00 p.m. - 4:00 p.m.	36 bicyclists
	115 joggers	10 - 20 (joggers) 11:00 a.m. - 12:00 noon and 5:00 p.m. - 6:00 p.m.	10 joggers
	(12 hours, 1 location)		
Phoenix	560 (6 hours, 1 location)	254 7:00 a.m. - 9:00 a.m.	93

the Ferry Street Bridge in Eugene did not show a consistent pattern (Figure 3) (7). For example, each location had a different peak day. Volumes on the Autzen Foot Bridge and the Ferry Street Bridge showed similar fluctuations by the day of the week. The volumes varied by a factor of two to three through the week. The Autzen Foot Bridge was used by 500 bicycles on Tuesday and 1,500 bicycles on Wednesday. Bicycle volumes varied between 375 and 1,200 per day on the Ferry Street Bridge, and between 150 and 450 per day on Dapple Way Extension.

Weekday, Weekend, and Day-of-Week Summary

In Madison, weekday counts were about double the Saturday counts at the Mills and University intersection. Weekend counts were twice as high as weekday counts in Seattle. The peak days for three locations in Eugene were Sunday, Wednesday, and Thursday.

Seasonal

At two locations along the Washington, D.C. Mount Vernon Trail, Belle Haven and Daingerfield Island, automatic counters found that monthly user volumes vary seasonally (Table 2) (6). The authors who reported these data do not offer explanations for the unusually high counts at Belle Haven in May 1988 or July 1989, nor for the low count at Daingerfield in July 1988.

Data for November 1991 through March 1994 are provided in Table 3 for the University Avenue location in Madison. In both 1992 and 1993, the highest usage occurred in September and October, when students have returned to the university and the weather is still mild. The counts were the lowest during the winter months. Peak-hour volumes are generally 10 to 15 percent of the total.

Table 4 shows the average 24-hour weekday automatic bicycle counts on the Law and Brittingham Park paths in Madison from 1988 through 1992 (T. Walsh, City of Madison Department of Transportation, unpublished data). These are off-road facilities on park lands in the central business district that are close to the downtown area and the university campus. Both commuters and recreational cyclists use the paths. The total length of the system is 6.0 km (3.7 mi), and segments are nominally 2.4 to 3.1 m (8 to 10 feet) wide. The counts are quite stable from one year to the next, with use tending to be 5 to 6 times higher from April through October than in winter.

Seasonal Summary

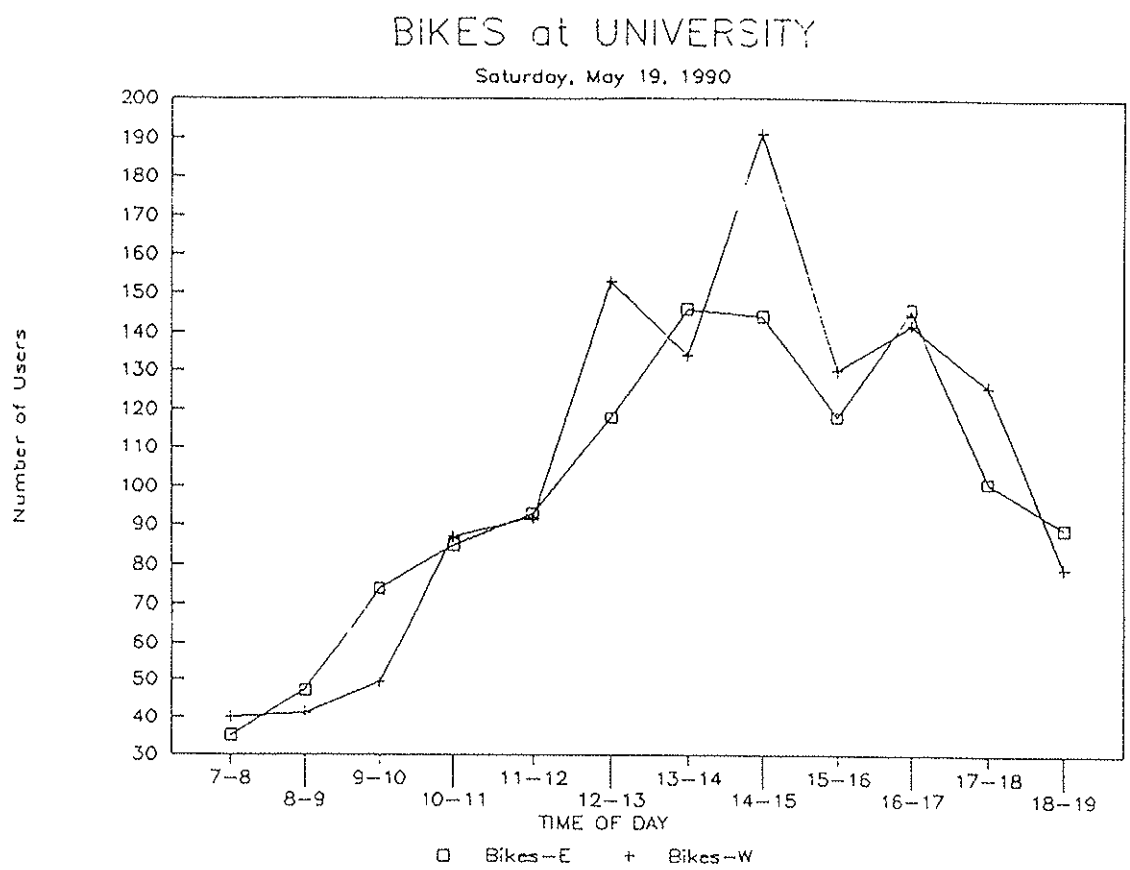
Monthly and seasonal fluctuations in trip counts depend in large part on weather conditions. User volumes were generally highest during the summer and lowest in the winter. For example, daily summer-winter counts averaged 697 versus 138 on paths in Madison between 1988 and 1992. At Daingerfield along the Mount Vernon Trail, the January through March 1988 monthly average was 3,807, increasing to 13,951 for April through September 1988.

Annual Trends

An examination of annual trends in daily counts can reveal changes in long-term travel behavior. Increases in daily counts over time may reflect a higher overall number of trips or modal shifts in favor of bicycling and walking, or both.

A northbound bicycle lane runs along Avenue of the Americas in the Manhattan (New York City) central business district (9). The southbound lane runs along Broadway from Columbus Circle south to 24th Street, then continues south along Fifth Avenue to Washington Square Park North. Since 1982, the Avenue of the Americas bicycle lane has had volumes ranging from 772 to 1,594 for a 12-hr period (Figure 4). Volumes along Broadway–Fifth Avenue ranged from 400 to 954 for a 12-hr period.

As Table 4 shows, the annual average of daily bicycle traffic on Madison's Law and Brittingham Park paths ranged from 414 to 552 bicycles/day (T. Walsh, City of Madison Department of Trans-



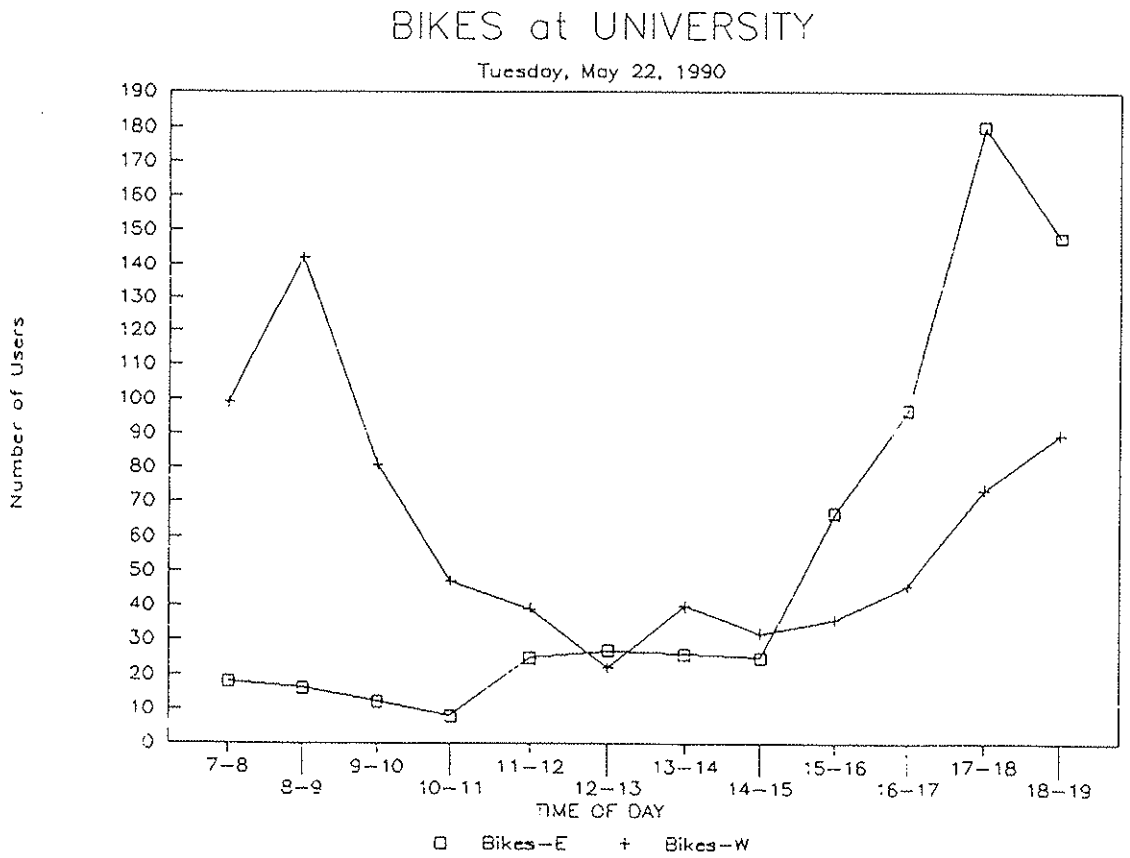


FIGURE 2 Bicyclists by time of day, Burke-Gilman Trail near the University of Washington, Seattle, Washington (Bill Moritz, University of Washington, unpublished data).

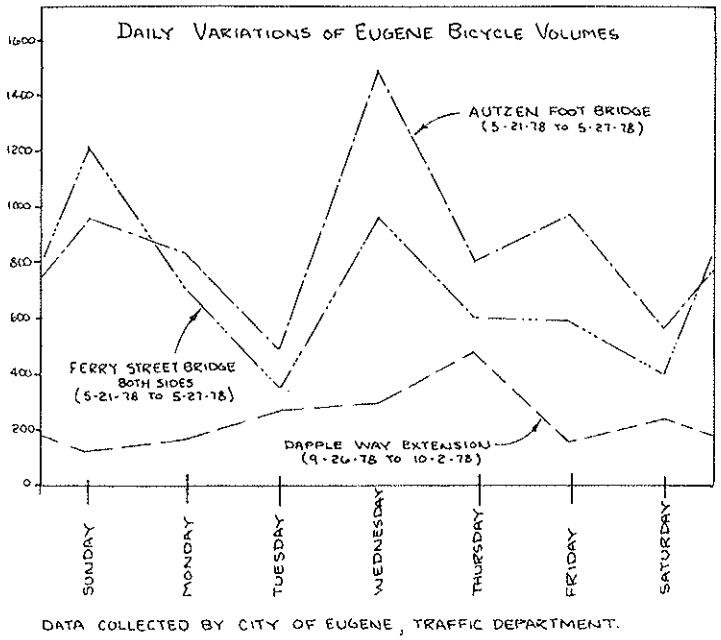


FIGURE 3 Daily variation in bicycle volumes, Eugene, Oregon.

TABLE 2 Monthly User Volumes at Two Locations Along the Mount Vernon Trail, Washington, D.C.

	Location			
	Belle Haven		Daingerfield	
Month	1988	1989	1988	1989
January	779	2,526	927	3,344
February	2,347	4,159	2,791	5,541
March	6,327	10,128	7,703	12,905
April	9,718	6,624	13,435	11,095
May	26,613	13,074	16,386	16,434
June	15,491	14,929	17,723	16,180
July	15,383	43,674	7,262	18,941
August	13,652	13,652	14,859	15,355
September	2,156	10,501	14,043	14,428
October	N/A	9,904	N/A	19,129
November	N/A	N/A	N/A	N/A
December	N/A	N/A	N/A	N/A

N/A = Not available.

portation, unpublished data). The monthly average of daily volumes varied from 41 bicycles/day in January 1991 to 1,243 in June 1992.

Twelve-hour (7 a.m. to 7 p.m.) daily bicycle and pedestrian counts were taken for the bicycle paths along New York City's Brooklyn Bridge, Queensboro Bridge, and Williamsburg Bridge (9). On the Brooklyn Bridge, average daily bicycle counts ranged from a low of 690 in 1989 to a high of 1,633 in 1987. The number of pedestrians was 1,190 per day in 1980 and 2,357 per day in 1987. The peak year for bicycles on the Queensboro Bridge was 1982 (811 bicycles per day counted) and for pedestrians, 1986 (408 pedestrians per day). In 1984, 501 bicycles used the Williamsburg Bridge bicycle path per day. By 1990, that total had declined by one-half, to 248 per day.

Table 5 shows the trend in 12-hr counts in Gainesville, Florida, between 1982 and 1993. Peak volumes occurred between 1984 and 1986. The largest increase over the 11-year period (68.6 percent) occurred at Location 31, which has 1.2-m (4-ft) bicycle lanes. The overall decrease in 1990 may be directly related to five student homicides. Location 28, which has wide curb lanes and sidewalks, and which is near the university, had the steepest decline (23.4 percent).

For all 11 locations (intersections) combined, the total counts increased by 1,128 (12.6 percent) between 1992 and 1993. In general, more bicyclists were observed at four locations near the University of Florida. These four locations accounted for 72 percent of the total, and all have bicycle facilities that feed into the intersec-

TABLE 3 Monthly Bicycle Counts, University Avenue, Madison, Wisconsin

Date	Total	Date	Total
Nov. 1991	3376	Jan. 1993	1148
Dec. 1991	1981	Feb. 1993	2122
Jan. 1992	1328	Mar. 1993	1707
Feb. 1992	2310	Apr. 1993	3634
Mar. 1992	2571	May 1993	3216
Apr. 1992	3466	June 1993	2921
May 1992	3574	July 1993	3418
June 1992	3179	Aug. 1993	2660
July 1992	3420	Sept. 1993	6486
Aug. 1992	2759	Oct. 1993	5895
Sept. 1992	6594	Nov. 1993	4430
Oct. 1992	5927	Dec. 1993	2309
Nov. 1992	3707	Jan. 1994	2343
Dec. 1992	1924	Feb. 1994	1231
		Mar. 1994	2429

[a] Thomas Walsh, City of Madison, Department of Transportation, unpublished data.

tion (Linda Dixon, City of Gainesville Bicycle/Pedestrian Coordinator, unpublished data).

Annual Trend Summary

The average daily bicycle counts per location in each city since 1987 are shown in Table 6. The data do not exhibit a consistent overall trend in any of the cities. Inspection of the most recent 5 years for which data are available shows that average bicycle counts per location dropped by 255 (21.7 percent) in Gainesville, dropped by 22 (4.7 percent) in Madison, and increased by 163 (21.3 percent) for bicycle lanes in New York. Average bicycle traffic on bridges in New York fell by nearly half between 1987 and 1989, then rebounded. Year-to-year fluctuations can result from weather conditions, changes in local employment levels, facility improvements, changes in university enrollment, and any number of other reasons.

Before-and-After Studies

Before-and-after studies are intended to reveal the net change in the number of bicycling and walking trips along a facility before and after the facility was installed.

In the late 1970s in Davis, California, bicycle counts were taken along Anderson Road, Sycamore Lane, and Oak Avenue a few weeks before and one week after a bicycle lane was painted onto Anderson Road (*10*). The 3-hr (7:30 to 8:30 a.m. and 3:30 to 5:30 p.m.) ridership increased by 103 on Anderson Road (7 percent), by 103 on Sycamore Lane (12 percent), and by 95 on Oak Avenue (14 percent). The percent increase in bicycle traffic on Anderson Road with the bicycle lane was less than that on the other two routes, but along Anderson Road, the number of riders 25 years and older increased by 87 percent, from 255 to 477. Interviews with 108 cyclists living near the University of California, Davis, revealed that 45 percent of the cyclists who had previously used other routes switched to Anderson Road.

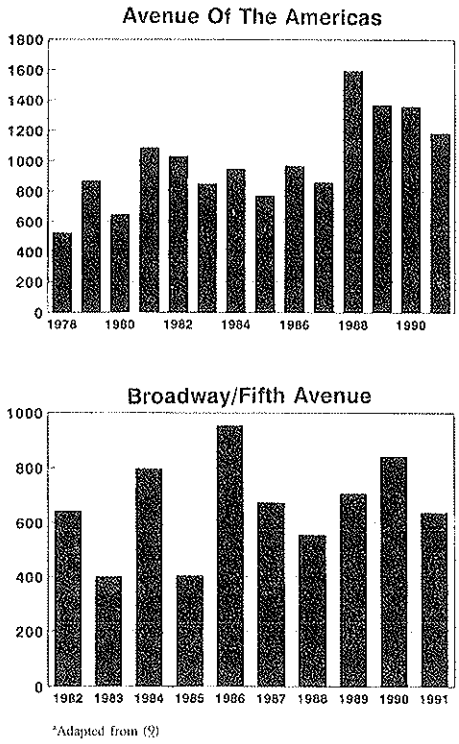
In Eugene, Oregon, bicycle lanes were installed along six streets in August 1993 (City of Eugene Public Works—Transportation Division, unpublished data). "Before" counts were taken in August, shortly before the lanes were installed, for a 7-hr peak count distributed among morning, midday, and afternoon peaks, and totaled 1,309. The volumes ranged from 148 on 18th Avenue to 438 on 13th Avenue. "After" counts taken 1 year later totalled 1,628, for an overall increase of 24 percent. The counts increased

TABLE 4 Average 24-hr Weekday Bicycle Traffic by Month, Law and Brittingham Park Paths, Madison, Wisconsin

(Average of three automatic recording stations)

Months	1988	1989	1990	1991	1992	5-year Average
January	42	89	119	41	107	80
February	118	67	143	127	71	105
March	208	90	238	178	225	188
April	367	474	192	408	355	359
May	840	551	536	1083	601	722
June	1063	1096	785	1160	1243	1069
July	942	672	766	1152	702	847
August	778	747	924	959	678	817
September	581	546	830	763	560	656
October	335	369	524	399	409	407
November	207	176	231	217	253	217
December	91	93	90	142	101	103
Ann Total	5572	4970	5378	6629	5305	5571
Ann Avg	464	414	448	552	442	464
Apr-Oct	701	637	651	846	650	697
Winter	133	103	164	141	151	138

[a] Thomas Walsh, City of Madison, Department of Transportation, unpublished data.



[a]Adapted from (9)

FIGURE 4 Volumes along two bicycle lanes, New York City.

by 32 percent, to 196, on 18th Avenue and by 20 percent, to 527, on 13th Avenue.

The Greenway Bridge in Eugene, spans the Willamette River and connects existing bicycle paths on either side of the river. One-day surveys were conducted, studying 735 bicyclists using the Greenway Bridge and two other bridges in May 1978 and 535 bicyclists in April 1978. According to these surveys, work trips accounted for about 30 to 40 percent of all weekday trips, and another 15 to 20 percent of weekday trips were school trips (*11*). About half of the bicyclists surveyed crossing the Greenway Bridge would not have made their trips if the bridge had not been built. The survey findings suggest that the Greenway Bridge eliminated about 500 automobile trips per week. Summer weekday counts on the Greenway Bridge exceeded 1,100 bicycles per day in 1982, and weekend counts surpassed 2,000 (*8*).

Phoenix, Arizona, has been actively encouraging the use of bicycles for commuting through implementation of facilities, adding bicycle racks to all city buses, and providing showers and lockers at selected city buildings. The bicycle network totals 483 km (300 mi) and includes separate paths, on-street bike routes (signed only), striped bicycle lanes, and wide sidewalks (*12*). There are more than 161 km (100 mi) of on-street bicycle lanes. More than 1127 km (700 mi) of various facilities will eventually be included in the network.

Baseline bicycle usage volumes and riding characteristics data were obtained on nine bike lanes throughout the city in November and December of 1991 (*5*). Trained observers gathered the information for 7 hours (7:00 to 9:00 a.m., 11:00 a.m. to 1:00 p.m., and 3:00 to 6:00 p.m.) at each of the nine locations. The times selected

TABLE 5 Bicycle Volumes, Gainesville, Florida, 1982–1993

No.	Intersection	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
13	NW 34th Street and NW 39th Avenue	93	105	130	162	111	84	129	157	156	176	187	143
15	S. Main Street and SW 2nd Avenue	804	N/A	669	630	529	560	518	566	581	667	668	529
22	SW 34th Street and SW 20th Avenue	795	1,312	1,251	1,053	893	626	731	812	957	732	675	631
23	SW 13th Street and SW 16th Avenue	760	1,478	1,824	2,026	1,231	1,369	1,384	1,564	897	1,621	1,493	785
25	SW 34th Street and SW 2nd Avenue	594	N/A	1,066	1,296	853	867	760	868	767	929	697	819
28	W 13th Street and W. University Avenue	2,085	N/A	2,479	3,188	2,873	2,327	1,944	2,462	1,886	2,112	1,504	2,290
31	SW 23rd Terrace and Archer Road	956	N/A	1,268	1,368	1,191	732	1,034	1,121	1,121	1,144	1,134	1,612
32	NW 34th Street and NW 8th Avenue	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	297	410
37	W 17th Street and W University Avenue	N/A	3,714	3,139	3,365	3,646	2,876	2,484	2,768	2,305	2,281	1,508	2,594
40	E 9th Street and E University Avenue	N/A	N/A	247	225	247	165	224	259	225	314	224	233
54	NW 23rd Avenue and 83rd Street	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	601	70
	TOTAL	6,087[a]	6,609[a]	12,073	13,313	11,574	9,606	9,208	10,577	8,895	9,976	8,988	10,116

[a] Figure includes data for locations where available.

N/A = Counts were not taken at this location for this year.

Note: It should be noted that 1990 counts were taken during and immediately following the five student homicides in the Fall of 1990. During this tense period in Gainesville, students were advised to travel in groups and avoid after dark travel. This may explain the decrease in bicycle volume observed in the Fall of 1990. Incidentally, the decrease in bicycle volume is noticed primarily at locations adjacent to the University of Florida campus and not other locations in Gainesville.

[b] Linda Dixon, City of Gainesville bicycle/pedestrian coordinator, unpublished data.

TABLE 6 Average Daily Bicycle Counts per Location, 1987–1993

Year	Gainesville	Madison	New York	New York -- bicycles on bridges
1987	1067	N/A	767	812
1988	1023	464	1074	533
1989	1175	414	1038	451
1990	988	448	1102	517
1991	1108	552	930	893
1992	817	442	N/A	N/A
1993	920	N/A	N/A	N/A

NOTE: N/A = Not applicable.

targeted commuting bicyclists. Two locations had traffic signals that could be actuated by bicyclists through special push buttons.

Bike to Work Week was held February 24–28, 1992, and two special group rides were arranged for the Tuesday of that week. Data were collected at five of the original nine sites during morning and afternoon commute times (total of 5 hr). Data collection was matched to the same day of the week as the baseline observations obtained earlier, except for the location (23rd Avenue) at which an organized group ride was held.

Comparative results are shown in Table 7. Observations were made on weekdays and in good weather conditions. Overall, 480 bicyclists were observed in November and December, or about eight bicycles/hr. The highest use was 16.7 bicycles/hr. (Lafayette Boulevard) during the late afternoon commute time. In general,

TABLE 7 Summary of Bicycle Observations in Phoenix, Arizona

		November - December 1991				February 1992		
		Bikes per Hour						
Location	Traffic Control	Number Observed	7-9 am	11am-1pm	3-6 pm	Number Observed	7-9 am	3-6 pm
23rd Ave at Camelback Rd	Traffic Signal	86	10.5	11.0	14.3	100	24.5	17.0
Encanto Blvd at 7th Ave	Traffic Signal	34	4.0	1.5	7.7	30	4.5	7.0
7th St at Broadway Rd	Traffic Signal	47	5.0	2.5	10.7	38	5.0	9.3
Washington St at 28th St	Traffic Signal	47	7.0	3.5	8.7	36	5.5	8.3
Campbell Ave and 28th St	Traffic Signal	60	10.0	4.0	10.7	79	15.5	16.0
Encanto Blvd and 39th Ave	Stop Sign	58	6.0	3.0	13.3	N/A	N/A	N/A
Lafayette Blvd at Arcadia	Stop Sign	90	16.0	4.0	16.7	N/A	N/A	N/A
Sweetwater at 28th St	Stop Sign	29	3.5	2.0	6.0	N/A	N/A	N/A
3rd Ave at Encanto Blvd (One Way)	None	29	3.0	3.0	5.3	N/A	N/A	N/A
Total		480	7.2	3.9	10.4	283	11.0	11.5

N/A -- Not available.

volumes were highest in late afternoon (10.4 bicycles/hr), followed by early morning (7.2 bicycles/hr) and then midday (3.9 bicycles/hr), but this would be expected, because bicycle commuters were being targeted.

In February, a total of 283 bicyclists were observed, or about 11 bicycles/hr. The number of cyclists per hour actually declined for Washington Street at 28th Street. An increase of about 50 percent during the morning and afternoon peak hours was seen on Campbell Avenue. The hourly flow during the morning commute on 23rd Avenue (where an organized group ride was held) more than doubled, from 10.5 to 24.5 bicycles/hr.

Before and After Summary

In Eugene, bicycle counts increased 24 percent overall following the installation of bicycle lanes. Morning peak counts were about 50 percent higher during a Bike to Work Week in Phoenix. Counts increased between 7 and 14 percent at three locations in Davis, and bicyclists 25 years and older were particularly attracted to one of the locations.

THE MIX OF BICYCLISTS AND PEDESTRIANS ON MULTIUSE PATHS

Many facilities are built to serve multiple users, such as bicyclists, walkers, and joggers. These multiuse trails and paths are usually completely segregated from motor vehicle traffic. As these trails often traverse parks, greenways, or other wooded settings, many cyclists and pedestrians use the trails for recreational purposes. Other trails are used by individuals commuting to and from work or school. This section presents trip counts for multiuse trails and paths. Information regarding the mix of bicyclists and pedestrians is given when available.

Bicyclists and pedestrians were manually counted at five intersections spread along a 23.5-km (14-mi) bike path built in 1990 between Providence and Bristol, Rhode Island (*13*). Counts were taken on weekdays from 5 to 7 p.m. and weekends from 9 to 11 a.m. The counts were adjusted to estimate the average daily bicycle traffic. The data showed an average modal split of 80 percent bicycles and 20 percent pedestrians.

Several sources of counts on trails in and near Washington, D.C. are quoted in a report compiled by the Denver Service Center (*6*). In August 1983, an 11.5-hr Sunday count found 1,048 users along a section of the Mount Vernon Trail south of Alexandria. Fifty-five percent of the total were cyclists, with runners or joggers and walkers accounting for the remainder. An 11.5-hr Monday count found 788 users and nearly the same distribution of cyclists, runners, and walkers.

A 1985 study counted 820 users per day on the Mount Vernon Trail at the Memorial Bridge but only 400 users per day at the 14th Street Bridge. The mix of users varies by location along the trail. At the Memorial Bridge, 50 percent of the users were cyclists and 60 to 65 percent were commuters. Nearly 80 percent of the users at the 14th Street Bridge were cyclists; 75 to 80 percent were commuters. At both locations, adult males comprised 80 percent of the users.

In August 1993, the Oregon Department of Transportation set up two interview stations to interview users of the I-205 bicycle path in Portland [Michael M. Ronkin, Bicycle/Pedestrian Program Manager, Oregon Department of Transportation regarding I-205 bike path survey, Dec. 7, 1993]. One station was operated for 10 hours on one day only; the other station was operated for 10 hours on each of two days. Bicyclists comprised 598 (64 percent) of the 932 users who passed the interview stations and 217 (77 percent) of the 281 users who completed a questionnaire. Of the bicyclists who completed a questionnaire, 38 percent listed travel as a trip purpose, 67 percent listed recreation, and 86 percent cited exercise. The average bicyclist rode 2.5 times per week for 19 km (12 mi) on the path.

A weekend count conducted on a 6.4-km (4-mi) bicycle-pedestrian path in Brooklyn New York City) in September 1989 from 7 a.m. to 7 p.m. revealed 1,200 cyclists and 1,100 pedestrians (J. Benfatti, New York City Department of Transportation, unpublished data). When the Central Park drives are closed to motor vehicles during the summer, 1,300 bicyclists use the drives between 10 a.m. and 3 p.m. Another 1,100 cyclists use the drives between 7 p.m. and 10 p.m.

Through the years, more pedestrians than bicyclists have used the Brooklyn Bridge bicycle path. In 1991, the daily averages were 1,183 bicyclists and 1,688 pedestrians. On the other hand, every year bicyclists outnumbered pedestrians on the Queensboro Bridge, by 602 to 140 (a factor of 4.3) in 1991. Pedestrian counts for the Williamsburg Bridge were done only in 1987 and 1989. In 1987, there were more bicyclists (368 versus 262 pedestrians), but in 1989, pedestrians dominated (467 versus 248 bicyclists).

A sample of three diverse rail-trails from across the U.S. was studied during 1990 and 1991 (*14*). Eight years old at that time, the 42-km (26-mi), crushed limestone surfaced Heritage Trail traverses rural farmland in eastern Iowa. This trail was estimated to have 135,000 visits annually: 65 percent bicycling, 29 percent walking, and 6 percent other. The 2-year old, 26-km (16-mi) paved St. Marks Trail, which parallels State Road 363, begins on the outskirts of Tallahassee, Florida, and passes through small communities and forests toward the Gulf of Mexico. An estimated 170,000 people used this trail annually: 81 percent bicycling, 9 percent walking, and 10 percent other. The 14 year-old Lafayette/Moraga Trail is a 12.2-km (7.6-mi) paved trail 25 miles east of San Francisco, California, which travels almost exclusively through developed suburban areas. This trail had an estimated 400,000 annual visits: 20 percent bicycling, 63 percent walking, and 17 percent other.

The Pinellas Trail is a popular facility on the west coast of Florida connecting Clearwater with Largo and St. Petersburg. At present about 53 km (33 mi) of trail are open; 77 km (47 mi) are planned to be built in the next few years. The asphalt-paved trail is nominally 4.6 m (15 ft) wide: 3.1 m (10 ft) for bicycles and in-line skaters, and 1.5 m (5 ft) for pedestrians. An 11.5-hr (6:30 a.m. to 6:00 p.m.) survey of users was conducted on Tuesday, November 9, 1993, by the Pinellas County Department of Planning (K. Medwick, Pinellas County Department of Planning, unpublished data). Eight locations near traffic generators such as schools, shopping centers, recreation areas, and medical centers were used as survey sites along the 37 km (23 mi) of trail in use at the time of the survey. Volunteers handed out a brief, self-administered questionnaire to trail users. To protect against double counting, users were asked if they had already filled out a survey. The survey produced 967 responses, and participation was thought to be good. The weather on the survey day was good, although a predicted 60-percent chance of showers may have lowered actual trail use.

While the bicyclist versus pedestrian mix was unavailable, other survey results indicated the following points.

- Use varied little by time of day;
- 63 percent of the users were male;
- 64 percent were adults aged 25 to 65;
- 40 percent lived less than 0.4 km (.25 mi) from the trail, and 35 percent lived more than 1.6 km (1 mi) from the trail;
- 55 percent usually traveled less than 8.1 km (5 mi) each way on the trail, and 45 percent more than 8.1 km (5 mi);
- 88 percent used the trail at least twice a week, and 45 percent at least 5 days per week;
- 67 percent used the trail for recreation, exercise, and so forth, and 33 percent for transportation to work, school, stores, and so forth;
- 60 percent of commuters used the trail 5 days per week, and 87 percent at least 2 days per week;
- 51 percent used a bicycle to get to the trail, while 27 percent walked, 20 percent used a car, and 2 percent some other means; and
- The distance from trail to destination was less than 0.4 km (.25 mi) for 29 percent of users, and more than 1.6 km (1 mi) for 41 percent of users.

Multiuse Path Mix of Users Summary:

Information pertaining to multiuse trails is summarized in Table 8. Average combined bicycle and pedestrian volumes ranged from 25 to 240 users/hr. On most facilities, bicyclists dominated by as much as 81 percent versus 19 percent pedestrians. Pedestrians outnumbered bicyclists on three facilities.

DISCUSSION OF RESULTS

The bicycle and pedestrian counts reported in this paper vary widely from one location to another and even on the same facility (Table 9). Comparisons between cities are difficult, given variations in the time periods counted. For instance, the counts in Davis were taken during one hour in the morning and two hours in the afternoon. Without information as to how counts vary throughout the day, a 12-hour or 24-hour estimate of usage cannot be obtained. In other cities, daily counts were taken over longer periods, such as 6, 12, or 24 hours. Some cities counted on only one or two selected days. The

TABLE 8 User Mix on Multiuse Trails

	Total Users Per Day	Average Per Hour	Percent Bicyclists	Percent Walkers/Joggers
Providence - Bristol, RI				
East Bay Bike Path	200-475[1]	N/A[2]	80	20
Washington, DC				
Mt. Vernon Trail south of	1,048 (11.5 hrs, Sunday)	91	55	45
Alexandria	788 (11.5 hrs, Monday)	69	55	45
Memorial Bridge	820	N/A	50	50
14th Street Bridge	400	N/A	78	22
Portland, OR				
I-205	932 (30 hrs)	31	64	36
New York, NY				
Brooklyn, bicycle/ped path	1,200 cyclists (12 hrs)	100	52	48
	1,100 pedestrians (12 hrs)	92		
Brooklyn Bridge, 1991	1,183 cyclists (12 hrs)	99	41	59
	1,688 pedestrians (12 hrs)	141		
Queensboro Bridge, 1991	602 cyclists (12 hrs)	50	81	19
	140 pedestrians (12 hrs)	12		
Williamsburg Bridge, 1989	248 cyclists (12 hrs)	21	35	65
	467 pedestrians (12 hrs)	39		
Iowa				
Heritage Trail	135,000/year[3]	25[4]	65	35
Florida				
St. Marks Trail	170,000/year[3]	31[4]	81	19
Pinellas Trail	967 (11.5 hrs)	84	N/A	N/A
California				
Lafayette/Moraga Trail	400,000/year[3]	73[4]	20	80

NOTES:

[1] Estimated average daily bicycle traffic based on 2-hour counts.
[2] N/A = Not available.
[3] Estimated based on surveys administered over a 12-month period, two days per week, representing 15 hours per day.
[4] 15 hours/day.

TABLE 9 Summary of Bicycle Counts

Location	Type of Facility	Time Period	Range of Counts
Clearwater-Largo-St. Petersburg, FL	Pinellas Trail	11/9/93 6:30 a.m. - 6:00 p.m.	967 total
		weekday	2,000 - 3,000 users 33% use trail to go to work, school, shopping
Davis, CA	On-street bicycle lane	Weekdays, 1974: 7:30 am - 8:30 am 3:30 pm - 5:30 pm	 255/ 3 hours before 477/ 3 hours after
Eugene, OR	Bicycle path	Summer weekday, 1978 Summer weekend, 1978	1,100/day 2,000/day
	Bicycle lanes	Weekday, 1978	100-3,000/day
	Bicycle path	1974-1977	100-400/day
	Bicycle paths	1977, 1978; Tues, Thu,Sat: 2,6, or 10.5 hours	
	Bicycle routes	5/21/78 - 5/27/78 at 2 locations	< 200 - > 1,400/day
	Bicycle lane & path	9/26/78 - 10/2/78 One week, 12 N to 11 p.m.	450/day lane 567/day path
Gainesville, FL	Urban intersections connected to bike lanes, wide curb lanes, sidewalks	1993: 7 a.m. - 7 p.m.	70-2,594/day
Madison, WI	Bike paths	1988-1992, weekday, 24 hours	41/day (1/91) - 1,243/day (6/92)
	Urban intersection	December 1993, 24 hours	2,309/day (weekday) 1,193/day (Sat), 647/day (Sun)
	Urban street	1991-1994	1,148/day (1/93) - 6,594/day (9/92)
New York, NY	Urban streets	Summer	113 - 1,069/day
	Class I bicycle path	weekday, 1991 7 a.m. - 7 p.m.	602 - 1,183/day
	Class III bicycle lane		673 - 1,186/day

(continued on next page)

values thus obtained may not be representative of an average day during the year. Weekend counts tend to include a higher proportion of recreational users than weekday counts. Weekend totals may be higher, as in Eugene and Seattle, or lower, as in Madison, depending on the relative numbers of recreational users and commuters. Summer counts are higher than winter counts because of favorable weather conditions, as is evident in Madison and Washington, D.C.

It was beyond the scope of this research to investigate other possible explanations such as local land use patterns (which generate and attract trips) for variations in the counts among cities. With the variations in time periods, it is difficult to determine whether cities with high population densities (such as New York) or college towns (Davis, Eugene, Madison, and Gainesville) have higher volumes of bicyclists and pedestrians than other cities. A case study executed as part of the National Bicycling and Walking Study (*15*) found higher rates or modal splits for bicycle commuting in college towns compared to other cities, perhaps because college towns were characterized by shorter commuting distances and higher ratios of bicycle lane mileage to arterial mileage than other cities. Daily university class schedules are reflected by the hourly variations in counts on the Avent Ferry Road Bicycle Path in Raleigh. Counts along University Avenue in Madison were higher even in November than in the warmer months of June through August, because school was in session.

Other factors that are likely to increase bicycle and walking trips are the availability of a connected bicycle lane or path network and the presence of light-to-moderate levels of motor vehicle traffic. Bicycle and pedestrian volumes may vary because of promotional activities (such as Bike to Work Week in Phoenix) or special situations (fear following the homicides of students at the University of Florida). Local terrain and the physical condition of facilities can also affect individuals' choices of whether to walk or bicycle at all and their decisions to use a facility.

TABLE 9 (*continued*)

Location	Type of Facility	Time Period	Range of Counts
Phoenix, AZ	Temporary bike lanes	Wed, 2/28/90: 7-9 am, 11-1 pm, 4-6 pm	560/ 6 hours
	Bike lanes at intersections	Weekdays, Nov and Dec: 7-9 am, 11-1 pm, 3-6 pm	29-90/ 7 hours
	Bike lanes at intersections	2/24 - 2/28: 7-9 am, 3-6 pm	30-100/ 5 hours
Portland, OR	Bicycle path	Two days in August, 1993: 10 hours/day	598
Providence, RI	Bicycle path	1991: Weekdays 5 pm - 7 pm Weekends 9 am - 11 am	Estimated from counts 225-475/day
Raleigh, NC	Bicycle path	September 14, 1988, 7 am - 7 pm	1,331/day
Seattle, WA	Burke-Gilman Trail	Sat 5/19/90 & Tues 5/22/90: 7 am - 7 pm	Bicyclists: 13,204 (Sat) 4,225 (Tues) Pedestrians: 2,520 (Sat) 1,923 (Tues)
Washington, DC	Mt. Vernon Trail	Aug. 1983: Sun - 11 hours	1,048 total
		Mon - 11 hours	788 total
		1985	820 total (Memorial Bridge) 400 total (14th Street Bridge) (60-65% commuters)
		Monthly 1988-1989	Belle Haven 779 (1/88) - 43,674 (7/89) Daingerfield 927 (1/88) - 19,129 (10/89) (75-80% commuters)

CONCLUDING REMARKS

The counts in a number of cities suggest that bicycle lanes and bicycle paths can reach volumes of 1,000 to 2,000 users per day, at least when weather conditions permit (Table 9). While planners in other cities may use these figures as a crude estimate of bicycle travel, they must be aware that counts obtained in one city may not generalize to other cities because of the conditions and limitations under which the counts were made.

No studies were found that related bicyclist and pedestrian trip generation to a comprehensive range of land uses. However, Brownell (*16*) estimated bicycle usage of a proposed 23.3-km (14.5-mile) bicycle facility between Providence and Bristol, which has since been built. He relied on the trip generation equations that estimated the total number of bicycle trips generated by each analysis zone in the facility's area of influence as a function of employment, school enrollment, and population.

If a local modal split is known or can be estimated, it can be applied to trip generation rates given in ITE's *Trip Generation Manual* (*17*) to estimate the number of bicycle and pedestrian trips that a particular land use would generate. Thus, the number of trips generated by a proposed trail can be estimated according to the existing building types and floor space. Sometime after the trail is in place, the estimates should be compared with actual counts to evaluate and refine this modal split approach and other methodologies that rely upon equations.

Ideally, it would be possible to estimate trips directly from some combination of building type, floor space, population, bicycle ownership rates, and information from surveys asking people whether they would switch to a proposed facility or where they would have biked and walked had the facility not been built. To achieve this ideal, a national data base would be needed to provide the data for deriving equations that could be used to estimate trips.

An ideal trip-counting approach might involve counting the number of bicyclists and pedestrians using an existing facility or street that serves as an important route before a new facility is installed, and then counting the number of users on both the existing and new facilities after installation. The inclusion of a control site will pro-

vide an indication of whether overall bicycle and pedestrian trip-making is changing. When staff and funding are available, trips should be counted at various locations for at least 10 to 12 hours per day, with days scattered throughout the year. Observers could note the gender and approximate age of users and distribute surveys to ask users about trip purposes and distances traveled. If only the number of users is desired, automatic counters could provide continuous counts.

The National Bicycling and Walking Study (*18*) discusses the benefits associated with increased levels of bicycling and walking. Surveys show that more people would bike and walk if there were more safe, attractive, convenient, and well-maintained facilities, such as sidewalks, trails, bike lockers, and so forth. Information about how many bicyclists and pedestrians are likely to use a proposed facility gives an indication of its benefits, and thus, whether it is worth the investment. Transportation planners would have a sense of the role of bicycling and walking in the overall transportation scene. Traditionally, planners and other officials have given little, if any, consideration to nonmotorized modes of transportation. Given the requirements of ISTEA and the Clean Air Act Amendments, bicycling and walking may become more key components of the American transportation system.

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