

Integrating the Bicycle into the Yosemite Valley Transportation Network

by

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Abstract

Cycling in Yosemite Valley is evaluated as a viable transportation mode within the context of the alternatives described in the 2000 Draft Yosemite Valley Plan/Supplemental Environmental Impact Statement. Free from the obstacles that urban areas face in promoting the bicycle as transportation, Yosemite Valley offers a unique place to promote bicycle use. Traffic congestion occurs during the summer months peak season. During this time, the bicycle represents the quickest, most convenient way for many people to experience the Valley on the park roads and the dedicated Bikeway network portion of the Valley. Distances to locations in the seven mile by one mile Valley are short, allowing short travel times to destinations.

This is the first comprehensive study of bicycle use in Yosemite Valley. In total, 212 completed interviews were collected between September 3, 1999 and September 6, 1999 during peak visitation hours (10:00 a.m. to 4:45 p.m.). Cyclists were interviewed at six points throughout the Valley. Interviews were refused by 50 groups. In all, I find that groups who agreed to be interviewed are not different from groups who declined.

Therefore, I believe my interview sample is representative of late summer cyclists in Yosemite Valley.

This study establishes several important baselines about cyclists during typical busy

summer days, for example, the number of cyclists, the locations they visit, what proportion rent bicycles as compared to bringing their own, the distribution of the size of groups of cyclists, cyclist use of other travel modes and the presence of children among groups of cyclists. Further, additional questions were asked about cycling infrastructure.

Yosemite Valley bicycle riders are experienced Yosemite visitors. Very few bicycle riders were first time visitors to the Valley. These visitors first learned that they could ride in the Valley by seeing bicycles on previous trips or by word of mouth. Valley cyclists were using the bicycle because it was the most convenient way to get around the Valley. In addition, these cyclists used the Valley shuttle bus system at least once during their trip.

Estimates of the total number of cyclists were made. During a typical busy summer day, 618-718 bicycles are in circulation. An estimated additional 168-357 employees commute to work on summer days.

In addition to the interviews, counts of cyclists were made at Curry Village, Camp 6, Mirror Lake, Village Visitor Center, and intersection near the Park Service Administration Building and Swinging Bridge. These counts measure bicycle activity levels during select points in the day.

Introduction and Context

A Group of Cyclists Traveling to Yosemite

To understand how visitors use bicycles in Yosemite, imagine a group taking a journey to Yosemite Valley. A family of four and a good family friend prepares to drive from their home in Berkeley, California to Yosemite Valley. They try to beat the traffic by taking off work and leaving early Friday morning. Since this is their annual July trip to Yosemite and the weather is warm and pleasant, they decide to bring their bikes to ride in the Valley. Despite their many trips to Yosemite, this is the first time they plan to ride bikes there. The parents load both their bikes onto the roof rack of their sport-utility-vehicle. The bike of the 8-year-old daughter is loaded into the back of the vehicle. Their friend doesn't own a bike and will have to rent one. On their last trip to Yosemite Valley, the family saw people riding rented bikes with trailers. They decide they will rent a trailer so their two-year-old daughter, can ride with them.

Once the family arrives in the Valley, they drive to their campsite at North Pines campground. After unloading, setting up their tents and storing the food in bear-proof lockers, they decide to go for a bike ride. Since it is still early, the family rides their bikes over to the Curry Bike Stand where their friend will meet them. The family friend takes the open-air shuttle from the nearby stop at North Pines to Curry Village. Since he

doesn't see any signs for the rental facility, he asks the driver of the bus where to go. The driver drops him off at the main stop in Curry and tells the friend to walk towards the "large green tent." He meets the family at the rental stand and rents a black and red Schwinn single-speed bike that looks like it will fit him. The family finds that the trailers are attached to geared bikes and decide to rent a bike that has the trailer already attached, rather than waiting to have the trailer installed on one of their bikes. For now, they will leave one of their own bikes locked near the rental stand.

Following the direction of the Bike Stand employee, the group decides to ride to Mirror Lake and then follow the loop over to Swinging Bridge. The group rides slowly, enjoying the Valley Bikeway loop, which is free of cars. Once at Mirror Lake, they park their bicycles at the bike rack without locking them. This seems a little strange at first, but bikes rarely are stolen in the Valley and when they rented bikes they didn't even get locks. A short walk takes them to the lake, which is starting to dry up this late in the season.

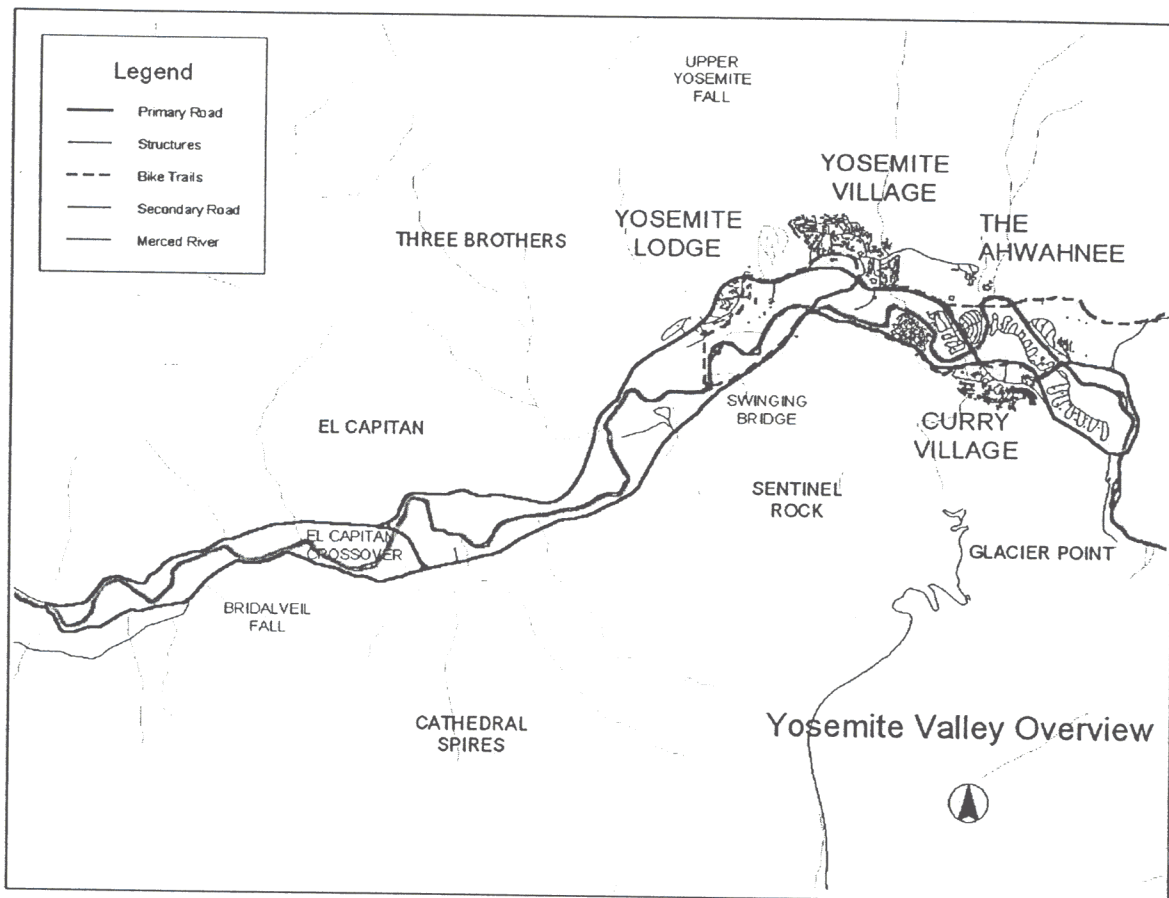
The group continues on the trail enjoying spectacular views of rock formations such as Washington's Column and the Royal Arches, encountering only other cyclists on the trail. When they arrive at Yosemite Village it is teeming with activity, people are riding bikes and many people are walking from the parking lot at Camp 6 to the Village. This

area offers quite a contrast to the solitude of the bike trail from Mirror Lake. Since it is around noon, the group decides to park their bicycles and eat lunch at Degnan's Deli.

After lunch, the group continues their journey west and ends up at Swinging Bridge which crosses the Merced River. Many people are swimming and sunning themselves on the beach. Unsure where the bike trail goes, they cross south over the bridge and head back in the direction of Curry Village. The group returns their bicycles to the Bike Stand and the friend decides to walk back to North Pines while the family rides slowly. On the way back they decide to stop at the Curry Village Store to buy some film and sunscreen. Once back at the campsite for short naps, they decide to attend a ranger campfire program at Housekeeping Camp. Since the weekend traffic is starting to build up, they take the shuttle bus rather than drive for a relaxing evening in the Valley.

How This Family Represents Cycling In the Valley

Our families route can be traced on Map 1. This scenario may be typical of many visitors who come to Yosemite Valley and ride bikes. This story shows how typical bicycling visitors use bicycles and incorporate them as both an activity for recreation and a travel mode.



Map 1: Yosemite Valley Overview

Previous Yosemite Planning Efforts

In April 2000, Yosemite National Park released the *Draft Yosemite Valley Plan/Supplemental Environmental Impact Statement (Draft YVP SEIS)*. This document is the synthesis of previous Yosemite plans including: the *Draft Yosemite Valley Housing Plan/SEIS*, *Draft Yosemite Valley Implementation Plan/SEIS*, and the *Yosemite Lodge*

Comprehensive Design/EA. Together with the *Merced Wild and Scenic River*

Comprehensive Management Plan 2000, these documents detail planned changes which seek to preserve the Valley's natural, cultural and scenic resources as well as provide park visitors the best experience. These plans are based upon a series of laws that established the purpose of Yosemite National Park. On June 30, 1864 President Lincoln signed an act that transferred Yosemite Valley and Mariposa Big Tree Grove to the State of California. This act set aside what would later become Yosemite National Park "for public use, resort and recreation" forever (Olmsted, 1952). Two primary goals were set in the 1864 act:

1. Preserve the resources that contribute to Yosemite's splendor and uniqueness, including exquisite scenic beauty, outstanding wilderness values, and a nearly full diversity of Sierra Nevada environments.
2. Make the varied resources of Yosemite available to people for their enjoyment, education, and recreation, now and in the future (United States Department of the Interior, 2000).

Subsequent legislation included the 1890 act which established Yosemite National Park and the 1916 Organic Act which established the National Park Service. In 1984, the United Nations Education, Scientific, and Cultural Organization's World Heritage Commission designated the park a World Heritage Site.

These acts helped to guide future planning efforts. The Draft YVP SEIS is based on the broad goals set in the draft 1980 General Management Plan. These five goals have governed park planning and development:

1. Reclaim priceless natural beauty
2. Allow natural processes to prevail
3. Promote visitor understanding and enjoyment
4. Markedly reduce traffic congestion
5. Reduce crowding

Despite many draft plans, little has been done to achieve the goals set by the draft 1980 General Management Plan. Infrastructure has remained largely unchanged and Yosemite Valley has continued to grow in popularity. In 1996 visitation reached its peak, with 4 million people visiting Yosemite National Park (United States Department of the Interior, 2000). The trends in recreational visits to the park are shown in Figure 1. With this many visitors to the Valley, vehicle congestion and crowding continue to pose problems that are in conflict with the some of the goals of the park. This congestion and crowding results in a compromised visitor experience and environmental damage.

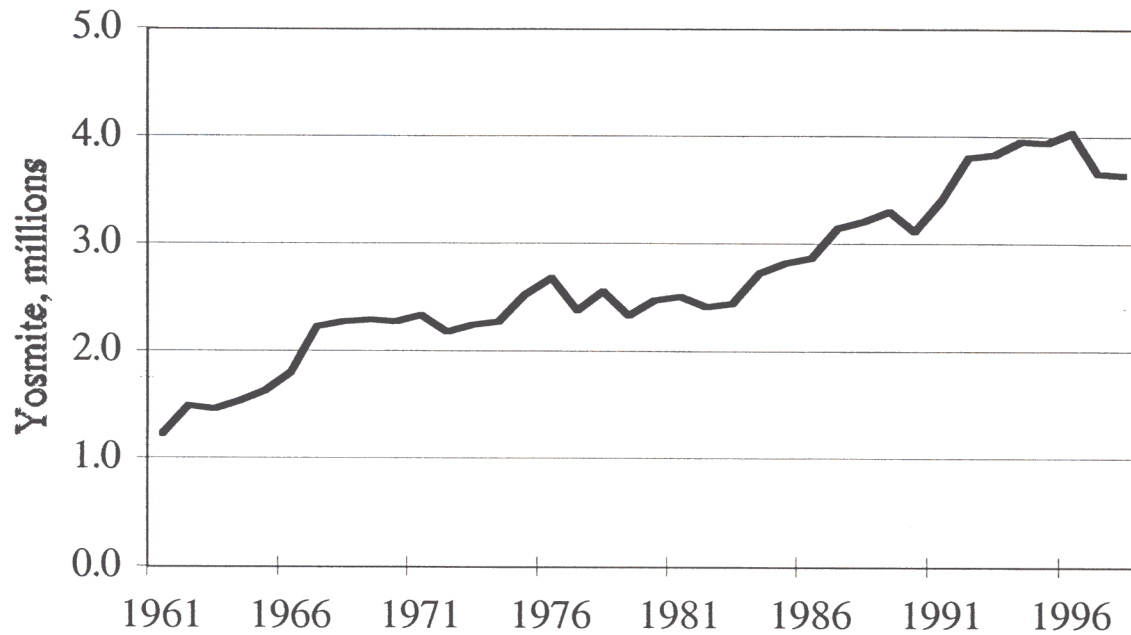


Figure 1: Yosemite Visitation Trends

(<http://www.nps.gov/yose/planning.htm>)

Integrating the Bicycle into the Draft Yosemite Valley Plan

The Draft YVP SEIS seeks to address these problems and to achieve some of the General Management Plan goals. Five alternatives are presented in the YVP including Alternative 1: No Action Alternative. These alternatives seek to “meet resource preservation and visitor experience goals in the Valley, including natural and cultural resource management and restoration, visitor services and recreational opportunities,

transportation, and employee housing” (United States Department of the Interior, V1a pp. 2-3, 2000). Below is a summary of the key points of the action alternatives.

Alternative 2 (Preferred Alternative): Yosemite Village and Out-of-Valley

Parking

Alternative 2, is the Park Service’s preferred alternative. It reduces and consolidates visitor parking in Yosemite Valley into one parking lot in Yosemite Village and adds new parking capacity at three out-of-Valley locations. In this alternative, approximately 180 acres of Yosemite Valley would be restored to their natural condition. Several structures, roads, and visitor use areas would be relocated or removed including:

- Roads through Stoneman and Ahwahnee Meadows.
- Roads through Upper and Lower River Campgrounds.
- North Pine Campground.
- Sugar Pine, Stoneman and Housekeeping Bridges.
- Most parking in the eastern Valley, other than at lodging, campgrounds, and Yosemite Village.
- Commercial trail rides to reduce conflicts between horseback riders and pedestrians.

This alternative also establishes and prescribes a traveler information and traffic management system to manage access and parking. Day visitors would park at out-of-

Valley areas located at Badger Pass, South Landing, and El Portal to supplement Valley parking. These lots would total about 1,570 parking spaces.

New facilities to be constructed include a 550 day visitor parking area at Yosemite Village along with a visitor transit center that would provide orientation for visitors to the Valley. In addition, a new multi-lane traffic check station on Southside Drive near El Capitan crossover would manage access into the east Valley.

Alternative 2 calls for a conversion of Southside Drive from El Capitan crossover to Curry Village to two-way traffic (currently one-way in the eastbound direction).

Northside Drive from El Capitan crossover to Yosemite Lodge would be converted from a one-way road in the westbound direction to a two-way multi-use paved trail for bicycle and pedestrian access.

This alternative calls for the reduction of lodging and camping locations as well as vehicles entering the eastern end of Yosemite Valley. These reductions are as follows:

- Total number of campsites from 475 to 465.
- Lodging units from 1,260 units to 981 units.
- East Valley traffic from 7,200 vehicles to 3,080.
- Employee housing from 1,277 beds to 683 beds.

Shuttle bus service would be expanded from just the eastern end of the Valley to locations throughout the Valley, including Bridalveil Fall. The park system of multi-use

paved trails would be expanded to provide increased opportunity to experience the Valley without the use of private motor vehicles.

Alternative 3: Taft Toe Parking

Alternative 3 consolidates parking for day visitors at the Taft Toe area in mid-Yosemite Valley. This Alternative seeks to restore approximately 200 acres to natural conditions. Several structures, roads and areas would be relocated or removed. All the relocations and removals in Alternative 2 would be made, plus:

- Superintendent's Bridge.
- All day visitor parking in the eastern Valley would be removed to the Taft Toe location (rather than the number of spaces reduced and consolidated in Yosemite Village).

The plan also establishes and prescribes a traveler information and traffic management system to manage access and parking.

A new day visitor parking area in mid-valley at Taft Toe would be constructed that would accommodate 1,622 vehicles. A new visitor and transit center would also be added at Taft Toe that provides orientation for visitors and serves as a hub for all Valley shuttle and regional transit operations. In addition, a new multi-lane traffic check station on Southside Drive near El Capitan crossover would manage access into the eastern Valley. New campsites would be constructed at various locations including 40 sites east of Curry

Village; 13 walk-in sites at Camp 4 (Sunnyside); 45 walk-in sites in the Upper Pines area; and 20 new walk-in sites along Tenaya Creek.

Alternative 3 converts Southside Drive from El Capitan crossover to Curry Village to two-way traffic. Northside Drive from El Capitan crossover to Yosemite Lodge would be converted from a one-way road in the westbound direction, to a two-way multi-use paved trail for bicycle and pedestrian access.

Shuttle bus service would be expanded to Bridalveil Fall to provide access to west Valley locations. The park system of multi-use paved trails would be expanded to provide opportunity to experience the Valley without the use of private vehicles.

This alternative calls for the reduction of lodging and camping locations as well as vehicles entering the east Valley. These reductions are as follows:

- Total number of campsites from 475 to 450.
- Lodging from 1,290 units to 981 units
- Traffic entering the east Valley from 7,200 vehicles to 2,698.
- Employee beds from 1,277 to 689.

Alternative 4: Taft Toe and Out-of-Valley Parking

This alternative would restore approximately 190 acres to their natural conditions. Day visitor parking would be consolidated in the Taft Toe area and in three parking areas outside the Valley. The road, trail, and parking reductions and removals would be the

same as in Alternative 2, except for the two following removals: Superintendent's Bridge and all day visitor parking in the east Valley.

The plan also establishes and prescribes a traveler information and traffic management system to manage access and parking.

Day visitors would park at out-of-Valley areas located at Henness Ridge, Foresta and El Portal. These lots would total about 1,600 spaces.

A new day visitor parking area in mid-valley at Taft Toe would be constructed that would accommodate 550 vehicles. A new visitor and transit center would also be added at Taft Toe that provides orientation for visitors and serves as a hub for all transit operations. In addition, a new multi-lane traffic check station on Southside Drive near El Capitan crossover would manage access into the east Valley. New campsites would be constructed at various locations including 40 sites east of Curry Village; 45 walk-in sites in the Upper Pines area; and 20 new walk-in sites along Tenaya Creek.

Alternative 4 converts Southside Drive from El Capitan crossover to Curry Village to two-way traffic (currently one-way in the eastbound direction). Northside Drive from El Capitan crossover to Yosemite Lodge would be converted from a one-way road in the westbound direction, to a two-way multi-use paved trail for bicycle and pedestrian access.

Shuttle bus service would be expanded to Bridalveil Fall to provide access to west Valley locations. The park system of multi-use paved trails would be expanded to provide opportunity to experience the Valley without the use of private vehicles.

This alternative calls for the reduction of lodging and camping locations as well as vehicles entering the east Valley. These reductions are as follows:

- The total number of campsites from 475 to 441.
- Lodging from 1,260 units to 981 units.
- Traffic entering the east Valley from 7,200 vehicles to about 2,520.
- Employee beds from 1,277 to 689.

Alternative 5: Yosemite Village, Curry Village and Out-of-Valley Parking

Alternative 5 would restore approximately 120 acres to natural conditions. Parking for day visitor visitors would be located at Yosemite Village and Curry Village and at areas outside of Yosemite Valley. Two bridges and parking areas would be removed including:

- Sugar Pine and the Ahwahnee Bridge.
- Parking in east Valley other than lodging, campgrounds, Camp 6 near Yosemite Village and the former Curry Orchard at Curry Village.

The plan also establishes and prescribes a traveler information and traffic management system to manage access and parking. Two day visitor lots located at Yosemite Village and Curry Village would hold a total of 636 vehicles. Remaining parking for day visitors

would be located at out-of-Valley areas in: Henness Ridge, Foresta and El Portal to supplement Valley parking. These lots would total about 1,080 spaces.

New facilities to be constructed include, a visitor transit center at Yosemite Village. In addition, a new multi-lane traffic check station on Southside Drive near El Capitan crossover would manage access into the east Valley. New campsites would be constructed at various locations including 51 sites east of Curry Village; 128 drive-in sites in the area of the former Upper and Lower River Campgrounds; 82 walk-in sites in the Upper Pines area; 10 sites for group camping at Yellow Pine; and 20 new walk-in sites along Tenaya Creek.

Alternative 5 converts one lane of Northside and Southside Drives to a multi-use paved trail from Yosemite Lodge west to Pohono Bridge, and from Pohono Bridge east to Swinging Bridge.

Shuttle bus service would be expanded to Bridalveil Fall to provide access to west Valley locations. The park system of multi-use paved trails would be expanded to provide opportunity to experience the Valley without the use of private vehicles.

This alternative calls for the reduction of lodging and camping locations as well as vehicles entering the east Valley. These reductions are as follows:

- Lodging from 1,260 units to 1145
- Traffic entering the east Valley from 7,200 vehicles to about 4,155.

- Employee housing from 1,277 beds to 752.

Cycling in Yosemite Valley

While the bicycle is mentioned in the draft YVP SEIS as a recreational activity, it is not considered as a means of transportation to provide Valley visitors access to destinations and as an alternative to private vehicles. The bicycle is often overlooked and underrepresented in urban areas as well. The obstacles that cyclists in urban areas face when attempting to use bicycles as a mode of transportation can be overcome in Yosemite Valley. (Cycling in Yosemite National Park is virtually synonymous with cycling in Yosemite Valley. While cycling is possible in other parts of the park, the Valley Bikeway system is almost exclusively where Yosemite visitors ride.) In fact, on a typically busy summer day in the Valley, a bicycle can be the fastest, most convenient way to get around. Motor vehicle traffic congestion occurs more often during the summer months. It is also during the summer months when the weather is warm and pleasant for bicycle riding. The flat terrain of the Valley also makes bicycling easy for many people of varying ability levels. Yosemite Valley also has a dedicated bikeway system that includes 18 miles of trails. Bicycle trails extend from Swinging Bridge in mid-Valley to the eastern end of the Valley. Bicycle trails travel through the developed areas in the Valley and to areas accessible only by pedestrians and bicycles such as Mirror Lake. Distances to locations within the seven mile long by one mile wide Valley are short,

allowing short travel times to destinations. The ease of cycling in the Valley makes the bicycle a viable mode of transportation for summertime park visitors.

In order to view the bicycle as a mode of transportation, baseline information about bicycle use in the Valley needs to be established and evaluated. While many bicycles are often seen in the Valley, these bicycles are looked at solely as a recreational activity.

Characteristics about visitors' bicycles and types of bicycling trips need to be established to determine how the bicycle can go beyond an activity or as a means for moving visitors around the valley. While most of the congestion problems occur during the summer months, baseline information about cyclists during typical busy summer days is one important measure. This type of information includes the number of cyclists, the locations they visit, what proportion rent bicycles as compared to bringing their own, the distribution of the size of groups of cyclists, the presence of children among groups of cyclists, and visitor perceptions about cycling infrastructure.

In addition, understanding the motivations behind the cycling trip is important to determine how cyclists are using their bicycles. Cyclists can be riding simply as a form of recreation in and of itself, or using bicycles primarily as transportation—moving from one point to another, where the destination, not the trip itself, is the objective. Many repeat visitors are aware of the traffic congestion that occurs in the Valley and as a result seek modes other than their own motorized vehicle to travel to destinations in the Valley.

As part of the traffic and travel studies conducted in Yosemite National Park during the summer of 1999, the Institute of Transportation Studies at the University of California, Davis conducted a survey of cycling visitors in Yosemite Valley. This survey provides a description of cyclists including demographics, bike trip destinations, perceptions of cycling infrastructure, use of other travel modes, estimates of the total number of cyclists in the Valley, and measures of level of cycling activity in key locations.

There are three types of groups of cyclists in Yosemite Valley according to the ownership of bicycles. Some groups consist solely of people riding bicycles rented from either the Curry Bike Stand and/or the Yosemite Lodge Bike Stand. Some groups consist solely of people riding their own bicycles. And some groups consist of some people riding their own bikes and some riding rented bikes. These distinctions will be shown to be important in terms of prior experience cycling in the Valley and knowledge of cycling in the Valley.

Cyclists were interviewed at six sampling sites: Curry Village, Camp 6/Yosemite Village intersection, Mirror Lake, Valley Visitor Center, Sugarpine Bridge, and Swinging Bridge.

The interviews were conducted on September 3 through September 6, 1999 between the hours of 10:00AM to 5:00PM. The total number of completed interviews was 212. The questionnaire is included as Appendix A of this report.

Throughout this report I will distinguish between bicycle “trips” and the “journey” to Yosemite National Park. The concept of a journey includes the entire trip made from

home to the park and back, and is inclusive of all days spent in the park. A bike trip refers to any specific trip made on a bike. Thus, our respondents were interviewed during a bike trip that was part of their overall journey to the park. Their current journey may include several bike trips. They may have made previous bike trips in the Valley, either on this journey or a prior journey.

This bicycle study offers a unique view of bicycle planning in National Parks. Here the bicycle is examined not only as one mode of recreational trips by visitors' but as an integral part of the Valley transportation system.

Previous Research

Cycling in Urban Areas

Previous research on cyclists has focused upon bicycle commuters in urban areas. Most of the previous survey research has focused on three areas: safety issues in urban areas (accident rates, type of accidents, severity of accidents), infrastructure (bike lanes, bike locking facilities, signage), and the commute trip (trip distance, travel times, routes, frequency and motivation.)

In 1995, a survey of bicycle commuters in the United States as well as Canada was conducted by the University of Washington to obtain information on bicycle commuters such as facilities, bicycle, motivation, safety/accidents, health and household information (Moritz, 1997). This survey was distributed through the Internet and mail. This study attempted to reach as many commuters as possible in all regions of the U.S. in order to provide data on bicycling as a transportation mode.

A similar survey was conducted by University of Kentucky and McMaster University in 1995. Like the University of Washington survey, it dealt with bicycle route information and safety of cyclists on commute routes in Ontario, Canada (Aultman and Hall, 1998). This survey was attached to the handlebars of bicycles in the Ontario area and then sent back to the University.

Other surveys such as the Riverside Bicycle Survey, Technical Memorandum No. 1, have addressed specific issues of a master plan. In this case the three elements included: development of a master bicycle route system, definition of a comprehensive education program, and identification of enforcement requirements (JHK & Associates, 1974).

Interviews of cyclists are rarely conducted due to the many areas in which the survey must be distributed. Bicycle commuters in urban areas must be sampled from a larger and more dispersed population within a larger urban area than Yosemite National Park.

Research has been conducted on bicycle traffic operations and facility design in urban areas. A recent review of research in bicycle traffic science was conducted by the University of Texas at Austin and The Citadel (Taylor and Davis, 1998). This review examined topics in intersection control, capacity and level of service, networks, and roadway design. However, the alternatives presented in the Yosemite Valley Plan are not specific enough to apply these design guidelines.

Other studies in urban areas have identified barriers to cycling and walking trips as viable means for transportation. In a study by the Federal Highway Administration (United States Department of Transportation, 1992), several reasons were identified why the bicycle is not used more extensively as a travel mode. Some of these barriers can be changed by public policies while others are so deeply rooted in the infrastructure of our society, that public policy has little effect. Some of the barriers listed include:

1. Distance, affected by land use history, too far to ride a bike
2. Too dangerous, traffic safety, lack of safe on-street bicycle facilities
3. Convenience, car offers protection from the elements, flexibility and privacy
4. Travel time, car covers great distances quicker
5. Need car for work/other reasons, trip chaining, carry large loads/equipment

(United States Department of Transportation, 1992).

Relationship between Cycling in Urban Areas and in Yosemite Valley

While these barriers are valid reasons for not bicycling in urban areas, many of these barriers do not exist in Yosemite Valley.

Distance Too Far To Ride a Bicycle

The first barrier, distance, is substantially less of a barrier in the Valley. The Valley itself is only seven miles by one mile and distances to developed areas such as those between Yosemite and Curry Villages, and between lodging and camping locations and dining and shopping locations are even shorter. Urban environments encompass larger areas with low-density development that causes destinations to be much farther than many cyclists are willing to travel.

Traffic Safety

Traffic safety is always a concern to any cyclist who shares the roadway with cars. This is a concern in urban areas since cyclists share the majority of roads with automobile traffic. Grade-separated bike lanes, when they exist, are often too narrow. Most of the Valley has dedicated bikeway networks that do not share traffic with automobiles. Many of these trails provide access to areas that motor vehicles cannot reach. However, safety can be a concern on multi-use trails when pedestrians and cyclists share the same path.

Convenience of the Automobile

While in urban areas, the convenience of an automobile may be of importance to time sensitive individuals who value their time after a workday, the majority of the visitors to the Valley are on vacation and are less affected by travel times than in urban areas. They rely less upon a fixed schedule than do people during standard workdays. The other factor of convenience, protection from unfriendly weather, is also reduced in the Valley, since the highest visitation occurs during the summer months when the chance of rain or other adverse weather is small.

Travel Times

Congestion and crowding associated with the peak visitation season also occur during these summer months. While the car may cover distances faster than the bicycle in cities,

current conditions in the Valley require that automobile travel must be linked around loops in the Valley. The two major roadways are one way and if a destination is missed, one must circle the Valley again until the destination is reached. Many two-way paths exist for bicycles and sometimes offer quicker times to locations especially during periods of congestion. Additionally, access to the far eastern end of the Valley by automobile is prohibited and walking, bicycling or shuttle are the only ways to get to locations such as Mirror Lake.

The Need For the Car For Work and Other Reasons

While the need for a private vehicle for work-related purposes might be necessary for commute trips in cities, Yosemite Valley “commute” trips by park visitors are simply to move people from point to point. Some visitors may have a need to carry items which are not easily carried on a bicycle such as firewood, ice and even heavy rock climbing gear for Yosemite’s tall cliffs. However many visitors are concerned with simply moving themselves and members in their party. For these people using the bicycle for travel is appropriate and convenient.

Cycling Research In National Parks

In the National Park Service Transportation Planning Guidebook (United States Department of the Interior, 1998), the bicycle is listed as a method to improve circulation

in parks in addition to safety and trail improvements. Several resources are listed to enhance bicycle use as a transportation alternative including TEA-21 funding and assistance from the FHWA Bicycle and Pedestrian Program. Yet, no studies of bicycle use are cited nor are specific case studies included.

Other national parks and national forests such as the Grand Canyon, Everglades, and the City of Sedona and the Coconino National Forest want to encourage recreational bicycle use in the park and try to improve current infrastructure. In a study entitled “Enhancing Public and Visitor Transportation in the Greater Sedona Area: A Strategic Partnership Between the City of Sedona, Arizona and the Coconino National Forest,” bicycles are cited as means for transportation options but no detailed planning is mentioned (Raphael, 2000).

However, the size of roadways in these areas makes the task of integrating widespread bicycle use difficult. Bicycle use and the accompanying infrastructure must be incorporated into these large road networks. Everglades National Park, for example, has few roads and one of the main corridors is a 38-mile long road from the entrance station to the interpretive facilities located within the park boundaries (National Park Service, 1989). In this context, Everglades National Park has not considered cycling as a viable travel mode (as opposed to recreational activity) for most park visitors.

Despite these attempts, most of the national park planning has focused on the bicycle as a recreational activity. The bicycle trail study in Everglades admits that “No scientific user study is available to provide definitive information about bicycle user groups in Everglades National Park” (National Park Service, 1989). Without any type of study, Everglades identified three groups: touring bicyclers, recreational bicyclers and mountain bicyclers. The distinguishing characteristics of each group are summarized below.

Touring Bicyclers

Group Size and Skills	1-2 cyclists to clubs with 100 or more riders. Wide range of age groups--early teens to 50s or 60s. Experienced riders in good physical condition.
Equipment	Typically expensive, rider-owned, 10-18 speed touring bikes. Riders usually carry rain gear, water, maps, and a repair kit.
Ride Preference	Long rides (20-100 miles/day) on paved surface without frequent interruptions. Speed varies from 10-20 mph depending upon route and weather. Riders normally choose a road shoulder over a separate bike path if the path is crowded with slower riders or pedestrians or if it is not well maintained. The route is normally predetermined.
Objectives	Strenuous exercise, scenery (primarily large scale), and socialization within group.

Recreational Bicyclers

Group Size and Skills	Small groups of unrelated adults or family groups from 2-8 people, including children. Range of experience and physical condition varies from poor to good.
Equipment	Either owned or rented bikes of all types, including one-speed children's BMX-style bikes, 3-10-speed touring bikes, or fat-tire mountain bikes. Many recreational bicyclers are not equipped with rain gear, water, maps, or repair kits.
Ride Preference	Shorter rides (2-10 miles), with intermediate stops or destinations preferred. Separation from motor vehicles and high-speed riders is important for both physical safety and psychological comfort. Going and return rides along the same route may be preferable. Rides are not likely to be preplanned.
Objectives	Moderate exercise, scenery enjoyment (at both large and close-up scale), nature study, and socialization.

Mountain Bicyclers

Group Size and Skills	Usually small groups of 2-6 young adults in good physical condition; off-road experience probably varies among the group.
Equipment	Expensive (\$300-\$900) rider-owned, 12-18 speed, fat-tired city or mountain bikes. Riders usually carry rain gear, water, maps and repair kits.
Ride Preference	Mountain bikers are normally more interested in the challenge than the distance of the ride, and they prefer a variety of terrain. Rides of 10-20 miles are typical, depending on the difficulty of the ride. A destination or loop is usually planned ahead by experienced riders, but spontaneous changes are acceptable.
Objectives	Strenuous exercise and access to more remote locations (destinations are as often related to the challenge of the terrain as to scenic quality, although both are important attributes of the most appealing routes).

(National Park Service, 1989)

All these groups fall under the category of recreation and not commuting or travel per se.

Everglades may not face the same level of congestion as Yosemite, but there still may be

user groups that are using the bicycle for transportation within the park. The case of

Yosemite suggests that at least one other type of cyclist must be added to the typology--

park employees who commute by bicycle, and that the objectives of recreational riders

needs to be expanded.

Bicycling Employees

Group Size and Skills	Employees traveling alone, have detailed knowledge of their commute route. Range of experience and physical condition varies from poor to good.
Equipment	Owned bikes of all types, including mountain bikes, 10-27-speed road bikes, and single speed cruisers. Some riders are equipped with water and repair kits. Riders usually carry backpacks, fanny packs, panniers, or other bags.
Ride Preference	Shorter rides (0.25 –to 4 miles), with an end destination such as a lodging, camping, place of employment or activity area preferred. Separation from motor vehicles and high-speed riders is important for both physical safety and psychological comfort. Routes are preplanned.
Objectives	Most convenient travel mode, shortest travel time, moderate exercise, scenery enjoyment.

While the descriptions of the user groups in Everglades are not unique to the area, Yosemite Valley's groups of recreational bicyclers may differ somewhat from the Everglades description. Cyclists in Yosemite who are riding for recreation may also be riding for transportation. The developed areas in the Valley often share the same multi-use trail that visitors use for recreation. Recreation trips in the Valley may be separate from transportation trips but may also include a trip that would include traveling to a destination as an objective. For example, Valley cyclists may complete a recreational loop on the Valley Bikeway. While returning to their camping location, they may stop at the Village Store to purchase a specific item such as film, thus shifting the emphasis of their bike trip from recreation to transportation. In this situation the recreational cyclist

retains all the objectives listed above but also includes: the most convenient travel mode, shortest travel time, and access to destinations.

While these groups describe park users that may be riding at a given time, a recreation group and a touring group are not mutually exclusive. Riders may change group membership during different trips to the park or perhaps even on the same trip. Bicycling as an activity may encompass several aspects including recreation to cycling as transportation.

Previous Research on More General Samples of Yosemite Visitors

Previous visitor research in Yosemite National Park involving travel has largely been in the form of mail-back surveys handed to exiting park visitors. Two major travel surveys have focused around the Yosemite Area Regional Transportation Strategy (YARTS) conducted by Nelson\Nygaard Consulting Associates and the Yosemite Area Traveller Information (YATI) system conducted by the Institute of Transportation Studies (ITS) at the University of California, Davis (UCD).

Nelson\Nygaard YARTS data collected information from over 7,000 surveys to construct a profile of the typical visitor, not only in the peak season but in the spring and fall “shoulder” seasons as well. In addition, some travel characteristics of visitors were collected including origins and destinations within the park. No data on cycling was collected.

The ITS study was an evaluation of the field operation test (FOT) of intelligent transportation technologies as part of the YATI system. While the evaluation of the YATI components was the primary goal of the study, some visitor characteristics including visitor travel were evaluated. Yet, similar to the Nelson\Nygaard study, bicycle use was not studied.

One of the only studies including bicycle use in Yosemite National Park was conducted by Texas A&M University. Automobile visitors were interviewed as they exited the park. Passengers on charter buses were surveyed using a mail back survey. While the study of bicycle use was not the principal objective, visitors were asked if they had used the bicycle at some point in their trip to Yosemite. During the peak summer months, 15.6 percent of the automobile-based visitors reported that they had used the bicycle at least once during their trip to Yosemite Valley. During the non-summer months the percentage of visitors participating in bicycling remains virtually the same but the percentage of visitors to Yosemite visiting the Valley increases to 96 percent, with 11.9 percent of Valley visitors using the bicycle during their trip. For visitors who arrived in the Valley by a bus the summer bicycling percentage was 1.5 and the non-summer percentage was reported much higher at 13 (Gramann, 1992). However, this study included the bicycling as one activity among dozens of other recreational activities. It did not question the motivations behind bicycle use or identify bicycle ownership patterns. Differences

between the summer and non-summer use of the bicycle were simply reported, not investigated.

Methodology for this Study

Data presented in this study goes a step further than previous bicycle research. Compared to previous research, bicyclists are the focus of this research rather than infrastructure or operations of bicycle traffic. In contrast to previous bicycle research I attempt to answer motivations and behavior of cyclists during their recreational trip to Yosemite Valley.

This study makes use of two primary data sets. First, cyclists were interviewed during a bike trip in Yosemite Valley. Interviews were conducted between September 3, 1999 and September 6, 1999 during peak visitation hours (10:00 a.m. to 4:45 p.m.). Second, counts were made of the number of cyclists at a variety of locations throughout Yosemite Valley. These counts were made during the interval from August 13 to 22, and September 4 to 5, 1999. Counts were not made on all days at all locations.

In situ interviews of cyclists were chosen as the best, most realistic context for the interview subjects—notably, cyclists in Yosemite Valley. The respondents' own current behavior, rather than recalled behavior, becomes their primary response context. Travel surveys based on recall have consistently under-represented cycling (and walking) trips. This is partly due to question construction that biases respondents away from thinking of short trips as being trips at all and sampling frameworks that systematically under-represent less frequent behaviors such as cycling and walking.

Interviews of cyclists were administered at key locations along the popular Yosemite Valley Bikeways. The interviews were conducted during peak bicycling times of 10:00AM to 4:45PM. The response rate varied depending upon location but ranged from 69 percent to 88 percent. The response rate of each location is shown in Appendix B in Table B-2. Cyclists were intercepted during a bike trip. A series of questions was asked about their past, present and future bike trips during this particular journey to Yosemite Valley.

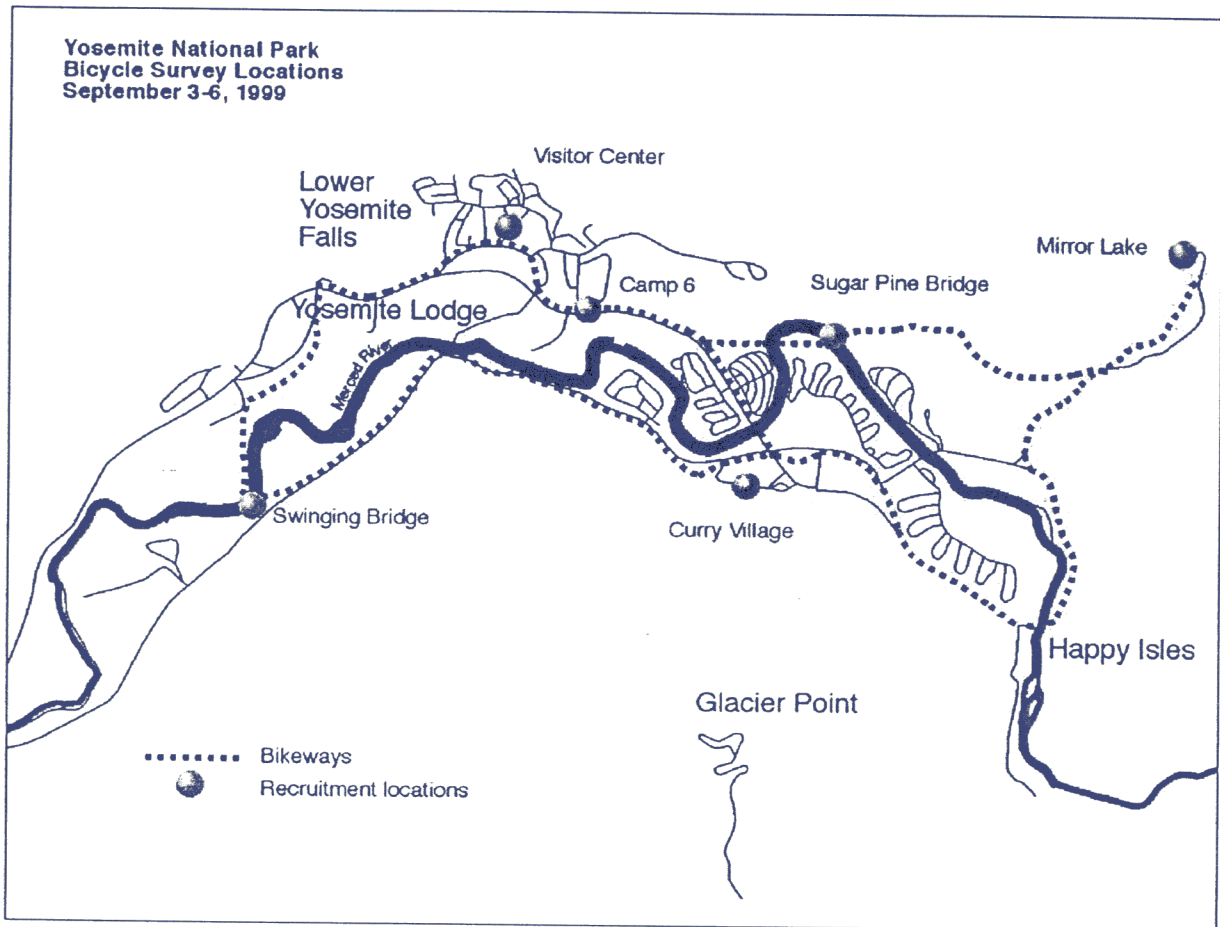
Interviewers used a standard script to recruit cyclists. Traveling cyclists were flagged to a stop by interviewers who were wearing an orange National Park Service Traffic Management Team T-shirt. Visitors were asked if they were willing to participate in a short interview. If they agreed, they were moved over to the side of the path to conduct the interview. Visitors who refused were thanked for their time and waved on. Basic observed data about all cyclists who were approached, including refusals, were recorded. This information included: group size, whether they were riding rental or privately owned bicycles, the presence of children in the group, and basic bicycle equipment and accessories.

Interview and Count Locations

Some recruitment areas had “natural” stopping points. Mirror Lake, for example, has a bike rack to which visitors must secure their bicycles before walking the remainder of the

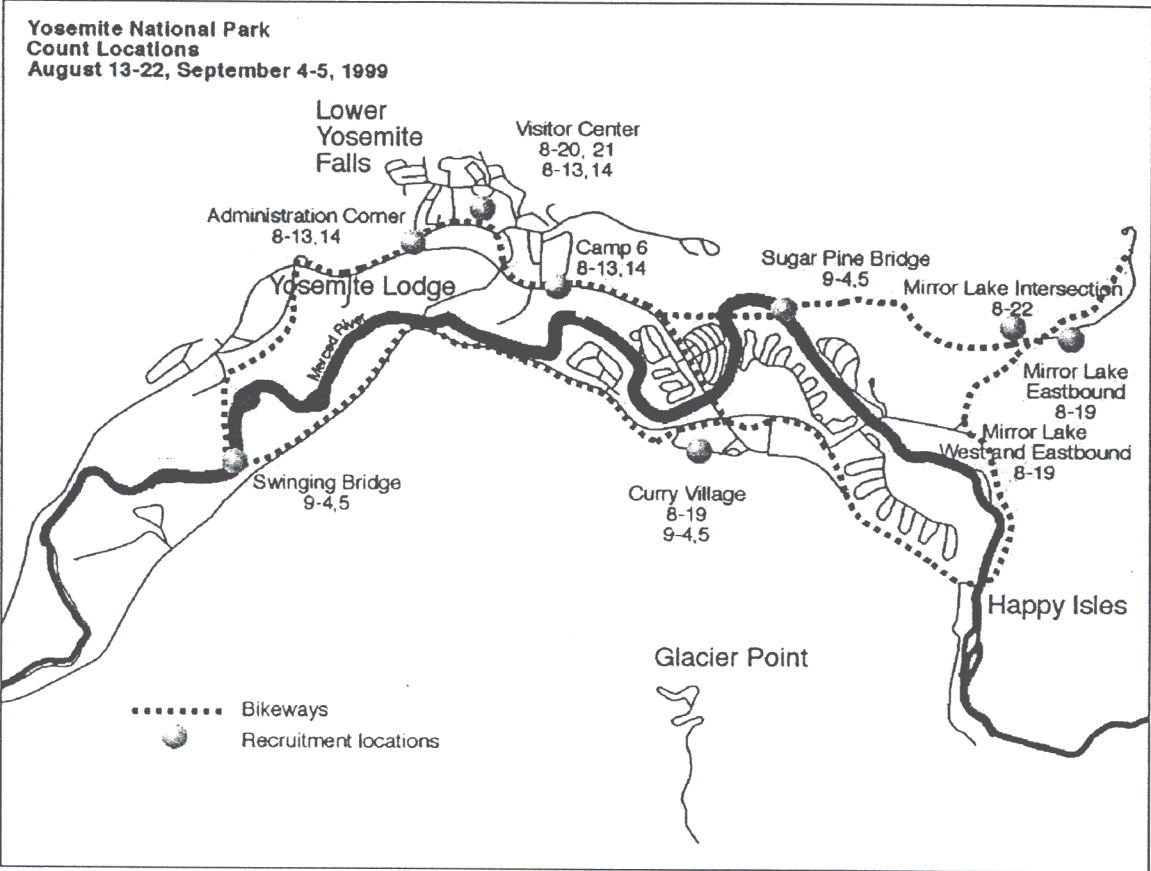
trail to Mirror Lake. Cyclists were intercepted at the bike rack as they dismounted their bicycles. Visitors at Sugar Pine Bridge were recruited as they dismounted their bicycles and walked along the bridge.

Cyclists were recruited at six sampling sites: Curry Village, Camp 6/Yosemite Village intersection, Mirror Lake, Valley Visitor Center, Sugarpine Bridge, and Swinging Bridge. These locations were selected because they represented major destinations in cycling traffic corridors in Yosemite Valley. These locations are shown in Map 2: Bicycle Interview Locations. The specific methodology for each location is shown in Appendix B: Survey Methodology for Locations.



Map 2: Bicycle Interview Locations

Bicycle counts were also made at several locations prior to and during the interview period. These locations correspond to the bicycle recruitment locations or other major points along the route. These locations included Curry Village, Camp 6, Mirror Lake, Valley Visitor Center, an intersection near the Park Service Administration Building, and Swinging Bridge. These locations are shown in Map 3: Bicycle Count Locations.



Map 3: Bicycle Count Locations

Types of Counts

Two types of counts were taken at these locations--neither were traffic volumes or flows, rather they were a representation of the bicycle activity during selected parts of the day.

One style of counts is similar to “traditional” traffic counts in that cyclists were counted as they passed the counter. However, these did not differentiate direction of movement and were taken in 15 minute increments. Thus, these “pseudo-traffic” counts are the

number of bicycles passing a point in any direction every 15 minutes. Other counts I characterize as “level of activity” or LOA counts. These counts record the number of cyclists and pedestrians within a defined area at a moment in time. This area may encompass a patio area such as in the Village Visitor Center or may be a defined section of the bicycle trail. Cyclists may be riding in any direction, or may be parking their bikes. Cyclists need not be traversing the defined area either, they simply need to be in the area at the moment the count is taken. The LOA counts are repeated every 15 minutes.

Hypotheses: Impacts of Experience Level on Bicycling Behavior

In addition to providing basic empirical benchmarks regarding the level of bicycling in Yosemite Valley, I was interested in a broad hypotheses of cyclists’ behavior. As a general principle, I hypothesized that if respondents had prior experience traveling to Yosemite Valley and prior bicycle use in Yosemite Valley, these would affect cyclist behavior in a number of ways. Two specific effects could be hypothesized. First, experienced Valley visitors might be more apt to be cyclists given their knowledge of vehicle congestion and limited parking spaces at popular Valley destinations. Second, people who had previously cycled in Yosemite Valley might be more likely to have brought their own bicycles than to rent. However, since only visitors riding bicycles were surveyed this hypothesis cannot be sufficiently tested without surveys of non-cycling visitors.

Results and Analysis

Describing Cyclists in Yosemite Valley, Including A Comparison of

Interview Subjects to Refusals

I start my description of cyclists in Yosemite Valley by looking at the observed data collected both for groups who were interviewed and groups who declined to be interviewed. I describe cyclists in terms of group size, presence of children, types of bikes and bike equipment. I then compare interviews to refusals to assess whether I think those who agreed to be interviewed are representative of all cyclists. From that point, I focus solely on our interview subjects.

Group size and the presence of children

Cyclists in Yosemite Valley were not likely to make a bicycle trip alone. Only 6 percent of interviews were of cyclists riding alone. The median group size was 3 people, the mean group size was 3.3. As calculated from the data in Table 1, 43 percent of interview groups included children. Children were counted as anyone under 18 years of age. This also included children on their own bikes, or small children being towed in a trailer, or children riding in a children's bicycle seat attached to another rider's bicycle.

Table 1: Presence of children in interview group, number

Children present in the interviewed groups	Completed Interviews	Refusal Interviews
Children not present	118	25
Children present	89	22
Total	207	47

Split Between Private and Rented Bikes

Tourists who want to ride bicycles in Yosemite Valley can either rent bikes from the Yosemite Concessions Services Corporation (YCS) or bring their own. Rental bicycles are easy to distinguish from private bicycles. Rental bicycles were either red and black Schwinn single speed cruisers or multi-gear Schwinn mountain bikes. These bikes all had prominent identification numbers on the top tubes. As shown by the data in Table 2, half of all groups were riding their own bikes; 42 percent were riding rented bikes; and 8 percent of groups included some people riding their own bikes and some riding rented bikes.

Table 2: Private vs. Rented Bicycles

Private or rented bikes	Completed Percent (n=209)	Refusal Percent (n=50)
Private	50	56
Rented	42	38
Some rented, some private	8	6

Visitor Bicycle Type

The type of bicycle the visitor was riding were visually identified by the interviewer.

Cruisers, which were identified by a single gear and 26" wheels, were the most popular bicycle type. 55 percent of groups contained visitors riding bikes of this type. However, the bikes rented by YCS are classified as cruisers and account for many of these bikes.

Mountain bikes followed as the second most popular bicycle (52 percent of groups).

Table 3: Visitors' Bicycle Type

Groups containing this bicycle type	Completed Percent (n=212)	Refused Percent (n=50)
Cruiser	55	62
Mountain bike	52	60
Road bike	10	4
Tandem	1	0

Bicycle Equipment

Information about bicycle equipment on visitors' bicycles was collected through observation. The most frequent piece of equipment was reflectors—30 percent of the visitors' bicycles had reflectors either in the wheels or mounted on other places on the bicycle frame. Bike trailers were another popular item. 11 percent of groups had a bike trailer. While trailers can be used to carry additional gear, in the Valley I observed that many visitors used trailers to carry small children who were too young to ride bikes on their own. The multi-gear mountain bikes that YCS rents are usually equipped to pull children trailers. Racks were on 9 percent of visitors' bicycles. Racks are differentiated from panniers by a flat rack usually mounted over the rear wheel where items can be strapped to the top. Panniers are typically a frame that mounts over the front and rear wheel to carry specially made bags for bicycle touring. Only 2 percent of visitors carried bicycle lights. This may be attributed to the day-time interviews and the fact that YCS does not provide lights for the bikes it rents.

Table 4: Visitors' Bicycle Equipment

Groups with bicycles containing this equipment	Completed Percent (n=212)	Refusal Percent (n=50)
Reflectors	30	46
Trailers	11	22
Racks	9	14
Panniers	1	2
Lights	2	2

Cyclists Wearing Helmets

Helmets are not required to ride in Yosemite Valley. Visitors who rent bicycles can use a helmet included as part of the rental, however adult renters can refuse to take a helmet.

Minors cannot refuse to wear a helmet when they rent bicycles. California State law requires that minors must wear a helmet while riding a bicycle, so there may also be more of a culture of children wearing helmets among visitors from California. The interviewer recorded whether *all* the cyclists in the group were wearing helmets. If only one party member wore a helmet, that group was not recorded as wearing helmets. In only 12 percent of cycling groups were all members observed to be wearing bicycle helmets.

Table 5: Cycling Groups Wearing Helmets

Cycling groups wearing helmets	Completed Percent (n=204)	Refusal Percent (n=40)
Yes	12	4
No	88	96

Comparison of Interviews and Refusals

The median group size for the refusals was 3 people, just as it was for the groups who were interviewed. The mean group size for refusals was 3.2, as compared to 3.3 for groups who were interviewed. A t-test on the difference in the means of the two groups is not statistically significant.

The presence of children was slightly higher in the refusal groups, with 47 percent containing children. However, the difference between interviews and refusals is not statistically significant. A chi-square test performed on the data in Table 3 returns a chi-square value of 0.226. This chi-square value is not significant at either the 95 percent or 90 percent level. I conclude that whether or not a group agreed to be interviewed was independent of whether that group contained children.

The bicycle ownership/rental split appears slightly different for the groups that refused interviews from the completed interviews. 56 percent of all refusal groups were riding

their own bicycles, while 38 percent were riding rented bicycles. Only 6 percent of groups were composed of people riding rented and owned bicycles. Again, these differences are not statistically significant. I conclude that whether or not a group agreed to be interviewed was independent of whether they were riding their own bikes or rented bikes.

The refusal visitors' groups contained slightly more cruiser and mountain bikes, and slightly fewer road bikes, than in the interview groups. If I categorize each group, interviews and refusals by what types of bikes are in each group, I can conduct a chi-square test of whether the distribution of bike types is different between the two. This test returns a non-significant result.

The frequency of various types of bicycle equipment was similar among the refusals to the frequency recorded for completed interviews. Reflectors were the most popular piece of equipment (46 percent), followed by trailers. The percentage of groups with trailers was higher than the completed interview groups. This may be due to the higher percentage of children among refusal groups than the completed interview groups. A summary of the equipment breakdown for both interviews and refusals is shown in Table 4.

The incidence of groups in which all members were wearing helmets was lower in the groups who declined to be interviewed, despite the fact that children were slightly more likely to be present. I observed that in only 4 percent of the refusal groups were all

members wearing helmets. Recall that in 12 percent of interview groups all members were wearing helmets. Still this difference is not clearly significant in a statistical sense. Even with this larger percentage point difference, the chi-square test is ambiguous. The chi-square value (2.769) is associated with a probability that falls between the 5 and 10 percent probability thresholds usually adopted for chi-square tests. I do not have strong hypotheses related to whether or not helmet wearing by all group members would indicate important differences in where people ride, how often they ride, or even whether they are experienced riders. None of these ideas can be tested as I don't have the necessary data for riders who declined to interviewed.

In all though, I find that groups who agreed to be interviewed are not different from groups who declined—at least on those few characteristics that could be recorded by simple observation. Group sizes are similar, the presence of children is similar, ownership vs. rental of the bikes is similar. The type of bike and the occurrence of different types of bike equipment is similar. While there may be slight difference in the likeliness to wear helmets, I conclude that the groups of people who agreed to be interviewed are similar to the groups of people who declined. Therefore, I believe our interview sample is representative of late summer cyclists in Yosemite Valley.

I now leave the comparison of the refusal groups to the completed groups and move to data that was collected only from the completed interviews. For the remainder of this study, I will discuss only data from the completed group interviews.

Experience Visiting Yosemite Valley

Yosemite bicycle riders tend to be experienced Yosemite Valley visitors—only 4% were first time visitors. The median number of previous visits to Yosemite was 7. Recall that this is the largest number of previous trips to the Valley by anyone in the group. Despite the high number of groups of cyclists who had a member who had been to Yosemite Valley previously, only 50% of the groups responded that anyone in their group had previously ridden a bike in Yosemite Valley.

Bicycle Riders: Overnight vs. Day Visitors

Subjects were asked if they were staying overnight in the Yosemite Valley. This did not include lodging or camping locations that are in Yosemite National Park, but outside the Valley. Sixty-one percent of the cyclists groups were staying overnight in the Valley. The remaining 39 percent could have been staying overnight at lodging facilities outside the Valley (but in the park) or in nearby gateway communities such as El Portal. In comparison to the Yosemite visitor data collected by UC Davis in 1996 for the Yosemite Area Traveller Information (YATI) evaluation, the bicyclists interviewed in 1999 were

more likely to stay overnight than the average visitor in 1996. The 1996 data indicates that only 40 percent of visitors who visit the park in a private vehicle (whether owned or rented) stayed at least one night in the park (Kurani, et al. 1997).

The most likely location for cyclists to stay overnight in the Valley was Curry Village - 28 percent of the cyclists who stayed overnight in the Valley stayed in Curry Village. The next most frequent lodging location was Upper Pines Campground (22 percent). Another 22 percent of the overnight guests stayed at hotel accommodations in either Yosemite Lodge or the Ahwahnee. The distribution of the lodging locations in the Valley is shown in Table 6.

Table 6: Lodging Locations of Cyclists who Stayed Overnight in Yosemite Valley

Location	Number	Percent
Curry Village	35	28
Upper Pines	27	22
Housekeeping	18	14
Yosemite Lodge	17	14
Ahwahnee	10	8
Lower Pines	7	6
Camp 4 (Sunnyside)	6	5
Backpacker Camp	1	1
Total	125	100

Lodging and Bike Rental Locations

Data on overnight lodging location and bike rental location are shown in Table 7.

Yosemite Valley overnight guests who rented bicycles tended to rent them at their lodging location or the rental location closest to their camping location. That is, people who stayed at Yosemite Lodge tended to rent from the YCS rental facility near the lodge; those who stayed overnight in Curry Village rented from that facility. A few (3) groups who stayed at the Lodge rented from the Curry Bike Stand. This may be due to the fact that the Curry rental location is more visible than the Lodge location. Taken by itself, this fact may not seem remarkable, but it is consistent with our characterization of information sources. Most people learn about cycling in Yosemite Valley by observing cycling in Yosemite Valley.

Demographics

Household Income

Bicycle riders in Yosemite were asked to indicate their annual household income from all sources. Respondents were either read the income category or were shown the income categories on the interview sheet and asked to point to the most appropriate one. The income distribution is shown in Table 8.

Table 7: Lodging Locations by Rental Locations

Location			
Row percent	Curry Rental	Lodge Rental	Totals
Ahwahnee	5	2	7
	71	29	
Curry Village	19	0	19
	100	0	
Housekeeping	5	1	6
	83	17	
Lower Pines	2	0	2
	100	0	
North Pines	1	0	2
	100	0	
Camp 4	0	2	2
	0	100	
Upper Pines	8	0	8
	100	0	
Yosemite Lodge	3	7	10
	30	70	
Backpacker Camp	1	0	1
	100	0	
Total Number	44	12	56

Cyclists appear to belong to higher income households. In this, they appear to be similar to the general population of visitors to Yosemite. Twenty-nine percent of the visitors belong to households earning more than \$100,000 per year. This is consistent with the YARTS survey data collected in summer 1998 as well as with data collected by ITS-Davis in 1996 (Kurani et al. 1997). In all three studies, the highest income category is the

one most frequently selected by respondents. Nelson/Nygaard Consulting Associates report that 28 percent of Yosemite visitors indicate their household earns \$100,000 or more per year. ITS-Davis reported that 25 percent of park visitors were in this highest income category. While the UCD survey was conducted during the summer months, Nelson/Nygaard reports little seasonal variation in visitor income (Nelson/Nygaard 9-1998).

Table 8: Income Distribution of Valley Cyclists and of General Park Visitor

Samples, percent

Income Levels	Bicycle riders, 1999 n=212	Nelson/Nygaard, 1998¹ n=7430	YATI, 1996² n=1936
Less than \$20,000	7	5	6
\$20,000 - \$39,999	12	14	15
\$40,000 - \$59,999	18	21	20
\$60,000 - \$79,999	20	19	21
\$80,000 - \$99,999	14	14	14
\$100,000 or greater	29	26	25

¹ Nelson/Nygaard, September, 1998

² Kurani et al. 1997

Group Composition

The composition of the group of people traveling together to Yosemite Valley is shown in Figure 2: Composition of Groups Traveling to Yosemite. These data refer to the total group who journeyed together to Yosemite, not just those members of any group that were on the specific bicycle trip during which a group member was interviewed. The single most common group type was immediate family members only—over two-thirds of all groups were made up solely of immediate family. This was followed by groups of friends, then immediate family plus friends, and finally, extended families.

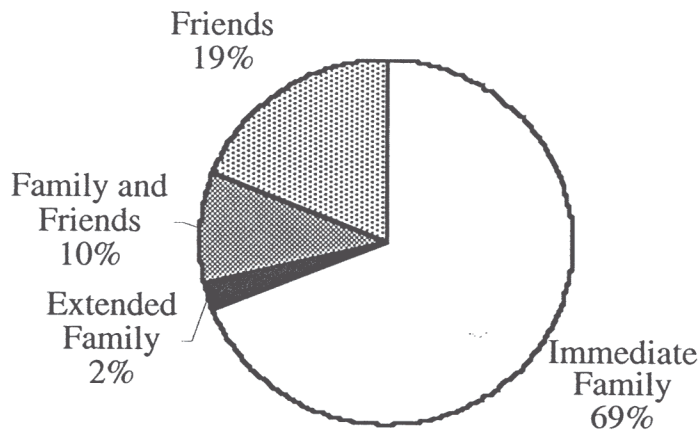


Figure 2: Composition of Groups Traveling to Yosemite

Group Size and Classification

The distribution of group sizes is shown in Table 9. The most common group was composed of 2 people (34 percent). The next most frequent group size was 3 (17 percent). The median group size was 3 and the mean group size was 4.4.

In order to provide a profile of the group composition, I used categories similar to the Nationwide Personal Transportation Survey (NPTS) household definitions. Cycling groups were asked to report the number of people who were traveling with them by age categories. These included people who were not on their current bicycle trip but were traveling with them on their trip to Yosemite. Since I did not ask marital status or retirement status, the categories I provide are not exact matches to the NPTS categories. Adults that were age 65 years or older were assumed to be retired.

Table 9: Group Size

Group Size	Count	Percentage
1	17	8
2	72	34
3	35	17
4	31	14
5	16	8
6	10	5
7	6	2
8	5	2
9	2	1
10+	18	8.5
Total	212	100

The group categories I used are as follows:

- One adult, no child.
- Two or more adults, no children.
- One adult, youngest child under age 5.
- Two or more adults, youngest child under age 5.
- One adult, youngest child age 6 to 15.
- Two or more adults, youngest child age 6 to 15.
- One adult, youngest child age 16 or older.
- Two or more adults, youngest child age 16 or older.
- One adult, retired, no children.
- Two or more adults, retired, no children.

The distribution of group types is shown in Table 10. Overall the most common group type consisted of two or more adults and no other group members—89 groups, or 45

percent of the sample, is composed of such groups. This is consistent with the group size variable showing groups of 2 as the most common group size. The second most prevalent group type consisted of two or more adults with children between the ages of 6 and 15 years old. This type of group accounted for 20 percent of the sample.

Table 10: Household Categories

Household categories	Number Percent
One adult, no child	16 8
Two or more adults, no children	89 45
One adult, child under 6	3 2
Two or more adults, child under 6	35 18
One adult, child 6 to 15	12 6
Two or more adults, child 6 to 15	39 20
One adult, child 16 or older	2 1
Two or more adults, child 16 or older	4 2
Total	200

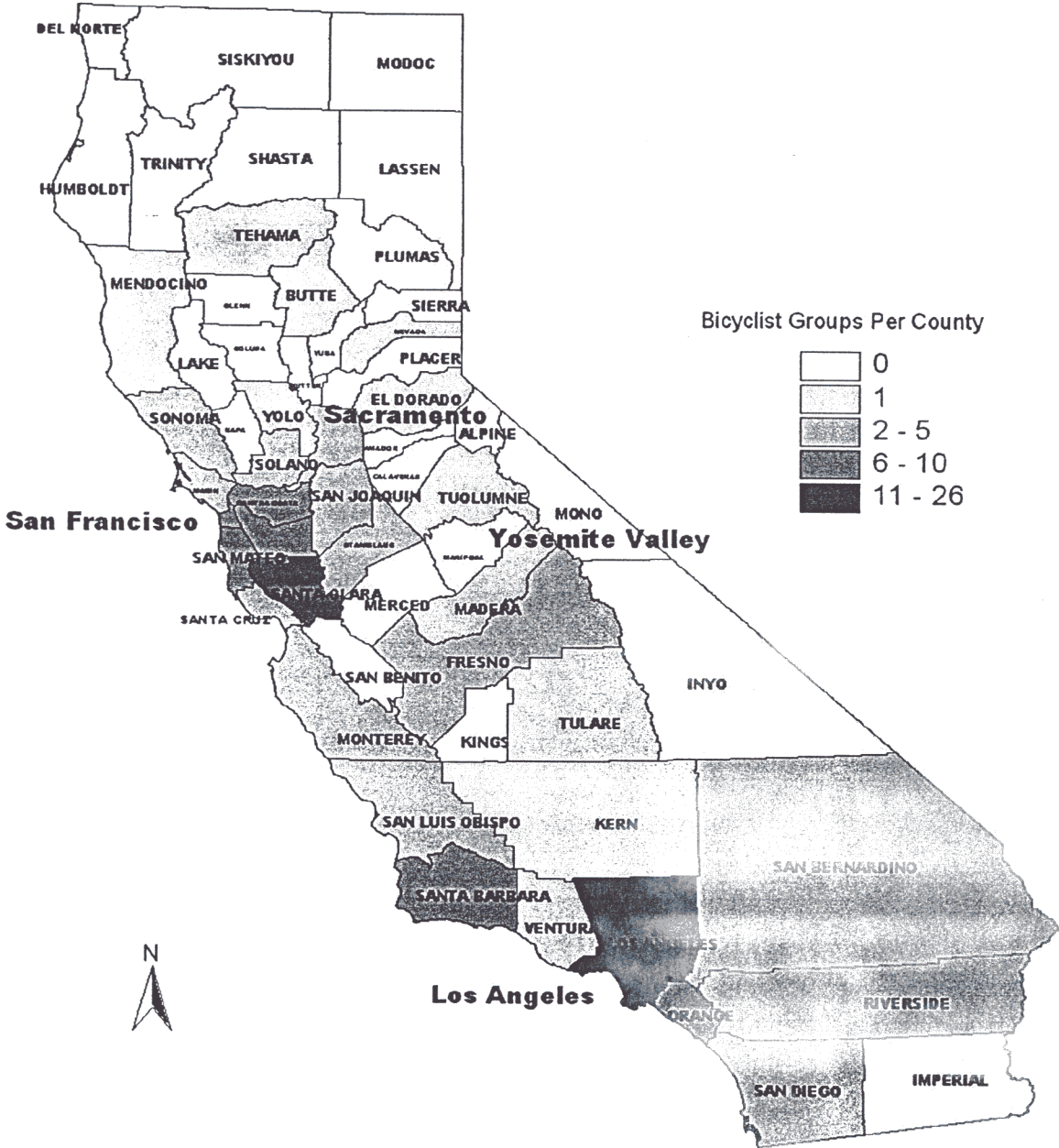
Residence of Bicyclists

Cyclists were asked to identify the country of their residence. If they were residents of the United States, respondents were asked to provide their home zip code. Ninety percent of the Valley bike riders were U.S. residents. This is a higher percentage than measured in year-round samples of all visitors to Yosemite. Seventy-seven percent of year-round visitors in the YARTS data were U.S. residents (Nelson/Nygaard, December 1998).

Among cyclists who were U. S. residents, 86 percent were California residents. This is a much higher geographic concentration than measured for all Yosemite Valley visitors during the summer months by other sources. California visitors constituted only 55 percent of the total visitors in the YARTS data (Nelson/Nygaard 12-1998). The county of residence for California visitors is shown on Map 4: Origins of Yosemite Cyclists. California visitors' residences were concentrated in the San Francisco Bay Area, with a lesser concentration in southern California.

Only 22 groups of international visitors were interviewed. These international visitors constituted 10 percent of the sample of Yosemite Valley bike riders. These visitors represented 12 different countries. The largest number of foreign visitors in the cyclist sample were from Germany and Great Britain. While this is consistent with other studies of all visitors, there are too few foreign visitors in the cyclist sample to make strong conclusions.

Origins of Yosemite Bicyclists



Map 4: Origins of Yosemite Cyclists

Table 11: Country of Valley Cyclists

Country	Count of International Visitors' Groups
Germany	6
Great Britain	3
Israel	2
Netherlands	2
Switzerland	2
Belgium	1
Canada	1
India	1
Japan	1
Malaysia	1
Mexico	1
Singapore	1

Characteristics of the Bicycle Trip

Bicycle Trip Start Locations

The interview sites in the Valley were located along networks of paths and routes that allowed us to intercept bike riders at a variety of different points in their bicycle journeys.

Visitors could have started their bike trip at any number of locations including a bike rental facility, lodging location or the location of their parked vehicle. The single most frequent bike trip origin was the Curry rental location. Thirty-five percent of the cyclists started their bike trip there. In aggregate though, the wide variety of lodging and camping locations were listed as the most common starting location. Nearly half of all bike groups

started their bike trip at their camping or lodging location. Twenty-seven percent of visitors started their bicycle trip from the location where their vehicle was parked. These parking locations were neither lodging/camping locations nor a bicycle rental facility. This shows where the visitor traveled to begin the bicycle trip. These vehicle locations are included in the start locations in Table 12.

Table 12: Bicycle Trip Start Locations

Start Location	Number	Percent
Curry Rental	68	35
Respondent's lodging/camping location	48	24
Lodge Rental	34	17
Curry Village	14	7
Camp 6	6	3
Swinging Bridge	6	3
Yosemite Lodge	5	3
Ahwahnee	2	1
Camp 4 (Sunnyside)	2	1
North Pines	2	1
Sentinel Bridge	2	1
Upper Pines	2	1
Yosemite Village	2	1
Chapel	1	0
Garage	1	0
Housekeeping	1	0
Lower Pines	1	0
Total	197	100

Locations Visited by Bicycle

Since cyclists were either at the beginning, in the middle, or at the end of a bicycle trip when they were interviewed, a series of questions dealing with the past, present and future destinations was asked. Cyclists were asked to report the location or locations of the places they previously had visited, or were planning to visit, during the specific bike

trip during which they were being interviewed. Table 13: Locations Visited by Bicycle, summarizes these locations. The data intentionally exclude known trip start and end locations as “destinations.” Since Curry Village and Yosemite Lodge have bicycle rental facilities and large parking areas, removing the start and lodging/camping locations gives a better estimate of the places most often visited by bicycle. The percentages represent the numbers of people who visited the locations. The percentages sum to more than 100 because groups can visit more than one destination.

Table 13: Locations Visited by Bicycle

Locations Visited by Bicycle	Percentage of Cyclist Groups Visiting this Location by Bike
Yosemite Village and Visitor Center	61
Mirror Lake	58
Happy Isles	46
Yosemite Falls	43
Curry Village	34
Yosemite Lodge	28
Ahwahnee Hotel	23
El Capitan Meadow	17
Lower Pines	13
Housekeeping Camp	12
Upper Pines	11
North Pines	11
Camp 4 (Sunnyside)	6

The location most visited was Yosemite Village and the Valley Visitor Center. Sixty-one percent of the respondents had visited, or were planning to visit, this location by bicycle. As shown by the bicycle counts at the Camp 6 intersection—which leads to the Village and the Valley Visitor Center—some of the highest bicycle activity in the Valley is near the Village and the Valley Visitor Center. Many popular destinations are located in the Village including stores, restaurants, the Ansel Adams Gallery, the Wilderness Center, the Post Office, and others. To the extent this is a very busy location in the Valley, bicyclists are drawn here too.

The next most popular location was Mirror Lake. The Mirror Lake location is a popular location for a few reasons. Many bike trips started at Curry Village (34 percent). The Curry bicycle rental staff recommend to renters that they ride eastward towards Mirror Lake, a location accessible by bicycle and walking.

Happy Isles is the third most likely destination for cyclists to visit. Happy Isles lies on the route between Curry Village and Mirror Lake. In addition to the close proximity to Curry, Mirror Lake is a popular destination for many cyclists in the whole Valley. Happy Isles lies on direct cycling routes from Curry Village.

Other popular destinations included Yosemite Falls, the Ahwahnee Hotel, and Yosemite Lodge. These locations are located along the bicycle network or are easily accessible by

bicycle. Less frequently visited locations such as El Capitan Meadow are not accessible via a dedicated bike route under current conditions.

Cyclists' Perceptions of the Adequacy of the Bike Network

While the bicycle network in Yosemite provides access to most of the eastern end of the Valley floor and offers access to locations not served by other modes, there are areas that the bicycle network does not serve. For example, El Capitan Meadow is a popular visitor destination to view rock climbers and to enjoy the view of the monolith. The meadow is currently only accessible by car or by cycling on the road. Northside Drive extends in this direction and becomes a one way road near the El Capitan vehicle turnouts. To reach El Capitan or any other destination in the westbound direction, cyclists would have to travel on this one-way road. The road has a narrow shoulder and no bicycle lane. Southside Drive towards El Capitan crossover is one-way in the eastbound direction; cyclists traveling to El Capitan or Bridalveil Fall would have to ride against traffic. Further, like Northside Drive, Southside Drive has no striped bike lane. Travel by bicycle in the westbound direction on either Northside or Southside Drive is dangerous and would discourage cyclists from riding to these areas.

I asked visitors if there were enough bicycle paths going to places where they wanted to go to determine if many cyclists were excluded from taking trips to areas such as the west end of the Valley. Most of the survey respondents agreed with the statement that there

were enough bike paths going to places they wanted to go (53 percent); 37 percent disagreed with the statement. Responses are summarized in Table 14. If they disagreed, I asked where they would like to see additional bicycle paths. I summarized the results of this open-ended response in Table 15.

The largest category of places people wished they could access by bicycle was the west end of Yosemite Valley. Locations on the west side of the Valley included El Capitan and Bridalveil Fall. The latter was the second most frequently cited destination to which bicyclists wished to go (14 percent). Some respondents who wished to visit the west area included both El Capitan and Bridalveil Fall as destinations. The category of Bridalveil Fall was a destination that visitors explicitly stated as where they wanted to go. The differentiation between El Capitan and El Capitan Meadow may be between the meadow to the south of Northside Drive and the base of El Capitan. However all these destinations are by far the areas that could see an expansion of the bicycle network such as in the proposed changes in the YVP.

Table 14: Adequacy of Bike Trails

There are enough bike paths going to places I want to go.	Number Percent
Agree	111 53
Disagree	78 37
Don't know	21 10
Total	210

Cyclists who were near the end of their bicycle journey or had completed bicycle trips were more likely than others to know that destinations in the west end of the Valley were not readily accessible to cyclists. Some knew that the bike path network did not extend in this direction, while others had tried to ride to these locations and encountered difficulties with vehicles or lack of bike lanes.

Finally, 10 percent of respondents stated they did not know whether there were bike paths going to the places they wished to visit by bicycle. For some, they didn't know due to lack of information about the bicycle path network; while others had just begun their bicycle journey. Had this group been asked at the end of their bicycle trip, their opinion about the bicycle paths may have been different.

Table 15: Desired Additional Bike Trip Locations

Locations	Number	Percent
West end of Valley	36	72
Bridalveil Fall	7	14
El Capitan	1	2
El Capitan Meadow	1	2
Emerald Pool	1	2
Glacier Point	1	2
Half Dome	1	2
Outside the Valley	1	2
Picnic areas	1	2
Total	50	100

Bicycle Locking Facilities

The other question about bicycle infrastructure dealt with bicycle locking facilities.

Specifically, visitors were asked if they agreed with the following statement, “There are enough places to lock bicycles in Yosemite Valley.” Responses are summarized in Table 16. The majority of the respondents (53 percent) agreed with the statement. But many (27 percent) stated they did not know.

Table 16: Adequacy of Locking Locations

There are enough places to lock bicycles in Yosemite Valley.	Number	Percent
Agree	112	53
Disagree	42	20
Don't know	56	27
Totals	210	100

Neither the Lodge Bike Stand nor the Curry Bike Stand provide locks when renting bicycles. The sales people simply tell the renters to leave their bicycle wherever they want without locking them. Thus for the groups on rental bicycles this question was not applicable. Private bicycles were usually unlocked as well. For residents of urban areas, this may seem quite unusual due to fears of bicycle theft.

The remaining 20 percent disagreed that there were enough places to lock bicycles. These people were asked where they would like to see more places to lock bikes. Responses to this open-ended question are shown in Table 17. Some of the locations cited as having too few places to lock bikes were Curry Village, currently “crowded locations,” and trail heads. Curry Village, one of the most crowded areas in the Valley, does not have many bike racks or other places to lock bicycles. During peak times, bicycles can be seen littering the paths within Curry Village. Since bicycle theft does not appear to be a large problem in Yosemite Valley, I can also interpret this statement to mean there are not

adequate bike stands to store bicycles. Crowded locations may have neither stationary objects to which to lock bicycles nor bicycle parking places. The area around Degnan's Deli is one such location where the existing bicycle rack is often filled to capacity during the lunch hour. Many bikes are "parked" near the bike rack or in the roped off area adjacent to the paths. In crowded locations people may feel less comfortable about leaving a bicycle unattended and unlocked. With many people around, it would be more difficult to spot someone walking away with a bicycle. This fear of theft may also be felt at trail heads. At trail heads, people are gone for longer periods of time while on a day or overnight hike. Visitors may not be comfortable leaving their bicycles for long periods without securing them.

Table 17: Bike Locking Locations

Locations	Count	Percent
Curry Village	6	24
Crowded locations	6	24
Trail heads	5	20
Campsites	2	8
Scenic points	2	8
Degnan's Deli	1	4
Yosemite Village	1	4
Existing racks	1	4
Picnic areas	1	4
Totals	25	100

Comments About Bicycle Use

I also asked visitors if there was anything else that would make it easier for them to ride bikes or more likely to ride a bike in Yosemite Valley. This was an open-ended question.

The results of the responses are summarized in Table 18. Comments generally fell into three categories; comments about the rental bikes, bike paths, and information. In total 37 percent of the responses commented about the bike paths and bicycle network.

Comments about the rental bicycles available at both rental locations accounted for 19 percent of the totals.

Table 18: Comments About Bike Use

Comments	Count	Percent
Maps, directions	26	21
Pedestrian separated paths	18	14
More paths	11	9
Off road trails	10	8
West Trails	10	8
Free bikes	9	7
No cars	8	6
Geared bikes	7	6
Bike lanes	6	5
Better bikes	5	4
Bike repair facilities	5	4
Bike lockers	4	3
Drinking fountains	2	2
Tandem bikes for rent	2	2
Better paths	1	1
Bike rentals at Visitor Center	1	1
Bike trailers for cars	1	1
Valley Visitor Center rentals	1	1
Totals	126	100

The most frequently volunteered suggestion—offered by 21 percent of respondents—was additional and improved maps and directions for the bicycle paths around the Valley.

Many visitors commented that the directions they had for the network were not clear. The only bicycle trail information is a Yosemite Valley Bikeway map that is handed out when visitors rent bicycles. There are no maps located along the routes themselves. Many

survey respondents commented they did not know if off-road (unpaved) trails are permitted for bicycle use in the park.

Many of the responses dealt with facilities such as pedestrian separated trails—14 percent of the responses to this question mentioned the need for such trails. While the bikeway network in Yosemite does not have large enough volumes of cyclists to cause widespread congestion, specific areas of the trail network do share large pedestrian volumes. Areas such as the Camp 6 intersection leading to the Valley Visitor Center have high pedestrian traffic that is shared on the same paths as bicycles. The bike paths in Yosemite are single lanes per direction with a center line delineating each direction. Pedestrians can either share the path with cyclists or walk on the dirt shoulder. Pedestrian separated paths means either a striped area on the same path designated for pedestrians only or a grade separated path with a physical barrier differentiating the bicycle path from the pedestrian path.

How do Visitors Know About Bicycling?

All visitors traveling to Yosemite can receive travel planning information from a variety of sources. These sources help visitors to plan their trip and to schedule activities while they are on their vacation. Since many cyclists were riding private bicycles, they had to have received prior information about cycling in Yosemite Valley (Table 19).

To determine how Valley visitors receive this information, I asked them how they first learned of cycling in Yosemite Valley. This question was phrased so as to encourage them to think about the first time they learned about cycling in Yosemite Valley, not to refer to any sources they may have used for this journey. Specifically, I wanted to know what source of information made them aware that cycling was an activity they could participate in while on a journey to Yosemite.

The largest category of information was simply visitors observing other bike riders during a previous trip and seeing bicycle rentals in the Valley (57 percent). Since nearly everyone interviewed had been to Yosemite at least once before, most of the knowledge about bicycling was based upon previous experience in the park. This previous experience came by the visitors' own experience or the experience of others in their group. The second largest category of information at 19 percent was hearing about bicycle riding from someone else such as friends or family. Some visitors bring their bicycle everywhere with them, and thus brought their bike with them without prior specific knowledge of cycling in the Valley. This group accounted for 12 percent of the sample.

Table 19: Sources of Bicycling Information

Information Sources	Count	Percent
Observation of cyclists	106	57
Word of mouth	37	19
Bring bicycle everywhere	23	12
Advertising	19	10
Bike sources	1	1
Totals	186	100

Other information sources included print media, the Yosemite Guide and travel magazines, internet information, bicycle-specific information sources, and word of mouth. But even combined, these sources are not as commonly cited as direct observation of cyclists in the Valley. Advertising, the Yosemite Guide, and the internet together account for only 10 percent of responses. Similarly, bicycle-specific sources including bicycle magazines and recommendations from bike shops, only account for 1 percent of responses.

Most visitors gained knowledge about cycling by actually being in the Valley or relying upon information provided by another party that had been to the Valley. These two sources accounted for 76 percent of the total means of information about cycling. First hand experience in the Valley proved more important for learning about bike riding as an activity than any other means of information.

Cyclist Characteristics: How experience level affects use.

Do Cyclists with Previous Experience Bring their Own Bikes or Rent?

As we have seen, Yosemite Valley cyclists are experienced Valley visitors. I expect that the experience level of the visitor affects some aspect of their travel behavior in Yosemite Valley. Experienced Valley cyclists who both had prior knowledge of cycling in the Valley and who were cycling in the Valley on this current trip might be expected to use their own bicycles if they judged any hassle associated with bringing their own bikes to be preferable to the cost or hassle of renting. Since such a visitor knew about cycling, bringing private bicycles to the Valley would save them the cost of rentals and allow them to keep the bicycles overnight, giving them more flexibility in their trip (YCS does not allow visitors to keep rental bicycles overnight). While this may be a reasonable assumption, there are reasons why experienced Valley visitors would choose to rent a bicycle.

- Visitors traveling in groups with some members who did not own bikes or did not bring them on this trip.
- Visitors who did not realize they could ride bicycles in the Valley until their current trip.
- Visitors who did not want to travel with their bicycles but enjoyed the convenience of renting the bicycles once in the Valley.

Since 57 percent of the groups reported that they had first heard about cycling in Yosemite by seeing bicyclists and/or seeing rental bicycles, some groups may have gained this information during their current journey to Yosemite. I did not ask respondents if the first time they had heard about cycling was on the current trip, however, many of the cyclists were repeat visitors who had not biked in the Valley prior to this journey. Some of the first time visitors may have observed bicycles during this journey and decided to ride bikes as part of this journey. While these visitors who desired to ride bicycles in Yosemite may have only heard about bicycling once they arrived in the Valley, they most likely did not have their own bicycles. Only 12 percent of the respondents brought their bikes everywhere. These visitors who were first time riders would have to rent bicycles at one of the two Valley rental stands.

Table 20: Ownership by Previous Bicycle Rides, shows the split between bikes that are privately owned and those that are rented, cross-classified by whether cyclists in the group had ridden bikes in Yosemite Valley on a prior journey to the park. Of the people who had ridden a bike in Yosemite Valley during a prior journey to the park, 61 percent were riding privately owned bikes. In contrast, only 39 percent of the respondents who had not biked before in Yosemite were riding privately owned bikes.

The visitors who had not ridden bikes in Yosemite Valley before were most likely to be riding in groups of consisting only of rented bikes (55 percent). The differences between

people who had, and had not, previously ridden bikes in Yosemite Valley are statistically significant. Thus, consistent with my hypothesis, prior experience riding bikes in Yosemite Valley is associated with a higher likelihood to be riding privately owned bikes.

Table 20: Ownership by Previous Bicycle Rides

Ownership of bikes Count Column percent	Ridden before in Yosemite Valley?		Row Total Count
	No	Yes	
All Private	40 39	63 61	103
All Rented	57 55	30 29	87
Some rented, some private	6 6	11 11	17
Total Count	103	104	207

Test	Chi Square	Prob>ChiSq
Likelihood Ratio	15.186	0.0005
Pearson	14.981	0.0006

Reasons for cycling

Visitors were asked the main reason they were riding bikes on this particular bike trip.

Some of the possible answers were exercise/fitness, bike is the most convenient way to get around, bike is the quietest way to get around, to travel to activities around the

Valley, and bike is the cleanest way to get around. “Exercise/fitness” trips were bike trips that were specifically for gaining physical fitness. “Travel to activities around the Valley” referred specifically to commuting to locations or using the bicycle as a means for travel. An example of this would be using the bicycle to go to the Valley Store from a lodging location. The statement “bike is the most convenient way to get around” referred to using the bicycle as a means to access areas of the Valley not accessible by other modes. This could also mean using the bicycle for trip chaining where another mode might have longer travel times. Vehicle congestion in the Valley during peak times makes the bicycle a time saving alternative to the automobile. Responses are summarized in Table 21.

The most frequent reason to ride was using the bicycle as the most convenient way to get around, with 59 percent of the cyclists choosing this category. Second to this was using the bicycle to travel to activities around the Valley (17 percent). Both of these categories are using the bicycle as a travel mode within the Valley. These two factors account for 76 percent of the reasons to ride.

Table 21: Reasons to Ride Bikes

Reason to Ride	Count	Percent
Most convenient way to get around	122	59
To travel to activities	36	17
Exercise/fitness	25	12
Fun	12	6
Quietest mode	5	2
Enjoy scenic views	3	1
Cleanest mode	1	0.04
Least crowds	1	0.04
Unable to walk	1	0.04
Total	206	100

Cyclists' Use of Other Travel Modes

To examine cyclists' use of other modes of travel in the Valley, cyclists were asked if they had used a shuttle bus at least once during the current journey to Yosemite. Sixty percent of the respondents responded that they had used the shuttle bus system at least once. The proportion of cyclists who report using the shuttle is much higher than the proportion measured for all Valley visitors in another study. In the 1996 YATI survey, only 39 percent of Valley visitors reported using the shuttle bus system at least once.

Table 22: Shuttle Use During Current Journey

Shuttle use	Count	Percent
No, have not used a shuttle	83	40
Yes, have used a shuttle	125	60
Total	209	100

Bike riders were also asked if they had used, or planned to use, their own motor vehicle for travel within the Valley. The majority reported that they had not and would not use their motor vehicle for travel within the Valley.

Table 23: Statement for Vehicle Travel

Statement for vehicle travel	Count	Percent
No, did not drive	8	4
No, will not use motor vehicle	119	57
Yes	82	39
Total	209	100

For many Valley bicycle riders, their bikes, the Valley shuttle system, and walking may be complementary modes of travel. That is, the three modes may not directly compete with each other, but may be used in concert to accomplish all travel in Yosemite Valley. Many cyclists clearly feel no great need to use their own motor vehicles once they have arrived in the Valley.

Total Number of Bicycle Riders in Yosemite Valley

From our sample and data on bicycle rentals, the total number of bicyclists in Yosemite Valley on any given day during the summer can be estimated. Since the bicycle activity counts reported earlier were not taken for the whole summer, the only counts of bicycles that are taken on a consistent basis are the YCS Bike Rental data.

The estimates of total cyclists are based on these assumptions and definitions.

- The proportion of rental to privately owned bicycles stays the same for every month of the summer, as well as weekends and weekdays.
- By definition, groups containing both private and rental bicycles, must have at least one rented bicycle and one private bicycle in the group. Recall that among the interviewed groups, 50 percent were riding only private bicycles; 42 percent were riding only rented bicycles; and 8 percent of groups had at least one private and one rental bicycle.

The YCS bike rental data for the month of August for the past few years are shown in Table 24. Based on these data I calculate that an average of 307 bikes were rented by YCS every day during August over the past four years.

Table 24: YCS Total August Bike Rentals

Year	1996	1997	1998	1999	Average
Total August rentals	8,742	9,388	9,267	10,708	9,526

The split for owned versus rented bicycles is for groups, and thus must be converted to individual bikes. Since I do not know the actual split of private and rented bikes in groups containing both, I make two further alternate assumptions which define a lower and upper bound on the actual split. First, it is assumed that there was exactly one rental bicycle in those groups that have both rental and privately owned bikes. Second, it is assumed that there was exactly one private bicycle. In groups containing both private and rental bikes the average group size was 4.8. In both groups containing only private bikes and groups containing only rental bikes, average group size was 3.1. The calculations are shown in Appendix C.

Under the first assumption, the total number of bicycles is estimated to be 718. Under the second assumption, the estimate is 618. This is the estimate of the range of the total number of visitors biking in Yosemite Valley on an August day.

The numbers for the YCS data are the numbers of bicycles rented from both the Yosemite Lodge and Curry Village during their hours of operation (10:00 a.m. to 5:00 p.m. The rental stands are open March through December and usually close at the first

snow of the season). As a result, the estimates for the total number of cyclists in the Valley represent the number of visitors' bicycles in circulation during these hours. This estimate does not include park employees' bicycles, which as will be shown may add another 170 - 350 to the total.

Bicycle Movements in Yosemite Valley

Bicycle activity counts were conducted between August 13, 1999 to September 5, 1999.

Some of the counts were taken during the Labor Day weekend which is a high visitation weekend. These Labor Day counts may affect the reliability of the results when comparing them to typical summer days. Bicyclists were counted at locations throughout the Valley along major points in the bikeway network.

Per the discussion under “Types of Counts” on page 36, these counts represent either pseudo-traffic counts or the level of activity (LOA) at each of the given locations. Since counts were not taken at all locations on the same days nor during the same time of day at all locations, the best comparison of LOA across locations can be made for the period between 12:00PM to 4:00PM.

Identifying Peak Bicycle Activity Counts

Table 25: shows the highest number of cyclists counted at any one location, that is, the peak of the 15-minute counts. The LOA count, that is largest number of cyclists at any one place, at any one point in time, was recorded at Curry Village. 136 cyclists were counted at 4:45PM on September 4. The largest pseudo-traffic count was recorded at the Camp 6 Intersection on August 13. between 12:45 and 1:00PM, 76 cyclists past the counter location.

For most of the locations, the peak period for cycling activity occurred at some point between noon to 1:00PM. In heavy use areas, this corresponds to the lunch hour, where many visitors are on their way to dining locations at Curry Village or Yosemite Village. Some peaks are observed later in the day, close to 4:00PM. These later peaks may be attributed to visitors returning rental bicycles to the Curry Bike Stand and the Lodge Bike Stand. Two peaks from 4:15PM to 5:00PM were observed at Curry Village and the Curry Village Housekeeping Camp intersection. The other late afternoon peak occurred at the Administration Corner from 4:30PM to 4:45PM. This path leads to Yosemite Lodge in the westbound direction. Some of this traffic might be attributed to rental bicycle returns.

Table 25: Average and Peak Bike Counts from 12:00pm to 4:00pm by Location

Location	Date	Count Type	Average "15 minute" counts from 12-4PM	Peak count at this location and date
Administration corner	8/13/1999	p-t	33.50	61
Administration corner	8/14/1999	p-t	35.00	52
Camp 6 Intersection	8/13/1999	p-t	40.25	76
Camp 6 Intersection	8/14/1999	p-t	41.50	58
Curry & Housekeeping	8/19/1999	p-t	22.00	36
Mirror Lake Eastbound	8/19/1999	p-t	8.50	27
Swinging Bridge	9/4/1999	p-t	13.50	31
Swinging Bridge	9/5/1999	p-t	15.25	28
Average of p-t counts			26.19	
Curry Village	9/4/1999	LOA	44.00	136
Mirror Lake E&W	8/19/1999	LOA	15.00	37
Mirror Lake Intersection	8/22/1999	LOA	19.25	53
Village Visitor Center	8/13/1999	LOA	21.00	50
Village Visitor Center	8/14/1999	LOA	40.50	62
Village Visitor Center	8/20/1999	LOA	37.75	64
Village Visitor Center	8/21/1999	LOA	38.50	72
Average of LOA counts			30.86	—

Note: p-t = pseudo-traffic counts; LOA = level of activity counts. See the section "Types of Counts" in the Introduction for description.

1. Counts for Curry Village on 9/5/99 were made only from 10:00AM to 1:00PM.

Moving One Hour Totals

The bicycle counts were made every 15 minutes throughout the data collection period for each location and day. This "15 minute" data shows a high level of variation from count

to count. In order to provide a better picture of trends in the level of activity, a moving one-hour average count is generated from all the counts. The first point of the moving average is calculated by summing the first four 15-minute counts and dividing by four. The second point of the moving average is calculated by dropping the first 15-minute count, adding the next one, and again, dividing by four. Continuing this process, I produce a set of data that always represents the average of an hour of data, but which hour is averaged is indexed by 15 minutes, not one hour.

The calculations of a moving hour average are summarized in Table 26 for the Camp 6 intersection. The 15 minute intervals are numbered consecutively starting at 12:00PM.

The “sum time” corresponds to the periods for which the 15 minute intervals are summed and averaged. For example, in the fourth row, the sum time 1-4 is the sum of the four 15 minute intervals in the 12:00PM to 1:00PM hour. The total for this time period is shown as 240 bikes, the average is then $240 \div 4 = 60$. For the second time period 12:15PM to 1:15PM, the sum of the 15 minute intervals starting at 12:15PM to 1:15PM is represented by the sum time number 2-5.

Table 26: Calculating Moving Total Counts, Camp 6 Intersection, August 13, 1999

Time PM	Time No.	Raw Count	Sum time #	Time Period	Moving Count
12:00-12:15	1	54			
12:15-12:30	2	75			
12:30-12:45	3	35			
12:45-1:00	4	76	1-4	12:00-1:00	240
1:00-1:15	5	45	2-5	12:15-1:15	231
1:15-1:30	6	22	3-6	12:30-1:30	178
1:30-1:45	7	37	4-7	12:45-1:45	180
1:45-2:00	8	27	5-8	1:00-2:00	131
2:00-2:15	9	35	6-9	1:15-2:15	121
2:15-2:30	10	31	7-10	1:30-2:30	130
2:30-2:45	11	42	8-11	1:45-2:45	135
2:45-3:00	12	50	9-12	2:00-3:00	158
3:00-3:15	13	23	10-13	2:15-3:15	146
3:15-3:30	14	45	11-14	2:30-3:30	160
3:30-3:45	15	19	12-15	2:45-3:45	137
3:45-4:00	16	26	13-16	3:00-4:00	113
4:00-4:15	17	25	14-17	3:15-4:15	115
4:15-4:30	18	13	15-18	3:30-4:30	83
4:30-4:45	19	37	16-19	3:45-4:45	101
4:45-5:00	20	22	17-20	4:00-5:00	97

Three different measures of these activity counts are plotted in Figure 3—the 15-minute counts, an average calculated by simply averaging over each clock hour (i.e., from 12:00 to 1:00, 1:00 to 2:00, etc.), and the moving hour average. The moving hour average provides a better picture of the level of activity over the course of time. Thus we can

easily see that while the peak activity does occur during the hour ending at 1:00PM, there is another peak in the half hour ending at 3:15PM.

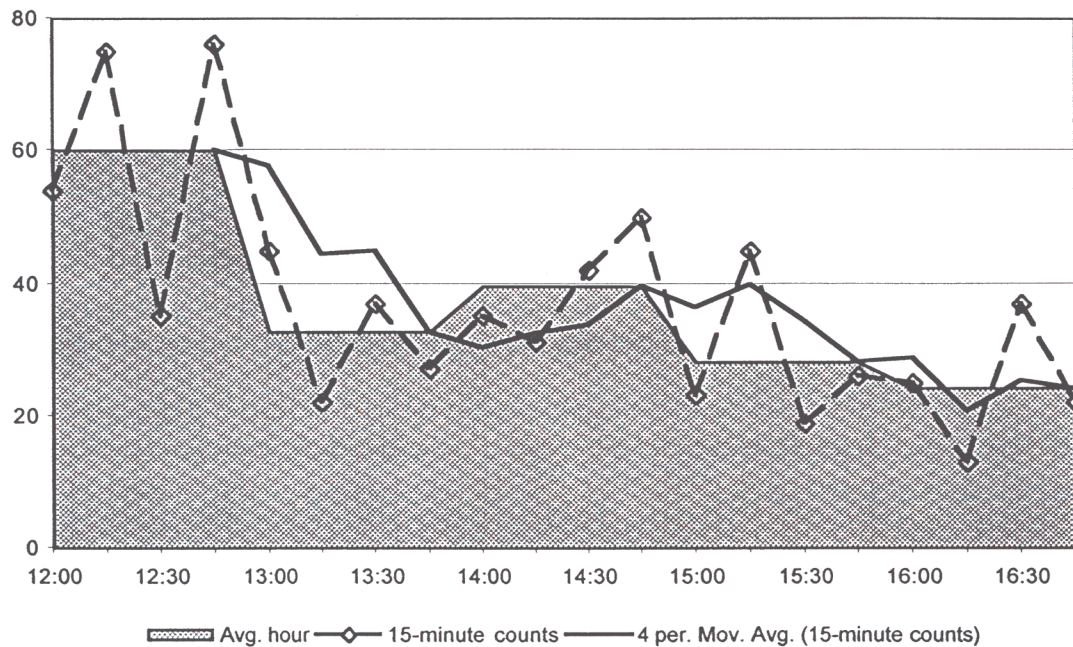


Figure 3: Level of Activity at Camp 6 Intersection, August 13, 1999

The moving average is preferred to the simple hour average for two reasons. First, conceptually, the clock hour would only be meaningful if the majority of people in an area where counts are taken are on their way to activities strictly linked to clock time. That is, if most activities in the vicinity of the Camp 6 intersection could only be accessed at specific times, only then would clock time be most relevant. Second, the moving hour average allows me to more precisely estimate when peaks (and lows) in the

activity counts occur. For example, the moving hour average narrows our measure of the occurrence of the mid-afternoon peak to the half hour ending at 3:15PM, while the simple clock hour averages indicate that the secondary afternoon peak occurs sometime in the hour ending at 3:00PM.

The actual observed maximum and minimum counts can only be observed by looking at the raw 15-minute counts. But as I noted above, these data are so highly variable, it is difficult to make judgements about trends throughout the day.

In the rest of this section, I will show moving one hour totals. (I chose to show averages in Figure 3 simply because it was easier to illustrate the relationship to the 15-minute counts.)

I note it is not possible to obtain the total volume of cyclists in the Valley on any given day with these counts. This data can help to identify busy cycling areas within the Valley and to assess when that congestion occurred on the dates for which counts occurred.

Bicycle Pseudo-Traffic and LOA Counts by Location

This section is organized so that locations where pseudo-traffic counts were made are discussed first, then locations where LOA counts were made. I do so because despite the fact both counts conceptually address the level of bicycling at a location, they measure that activity differently. Further, while I will refer to the sum of four sequential LOA

counts as the “one-hour total” or as the “number of cyclists counted over an hour,” it should be made clear that this total is not derived from continuously counting cyclists for one hour, but rather from summing four instantaneous counts made over the course of one hour. Totals based on continuous counts would certainly be higher.

Administration Corner

Pseudo-traffic counts at the location known as the Administration Building Corner were taken from the south side of the road directly in front of the National Park Service Administration Building. Bicyclists were counted on the multi use path and road in the eastbound direction (traffic going towards the Village) and in the westbound direction (towards Yosemite Falls). Counts were taken on Friday, August 13 and Saturday, August 14. The data are illustrated in Figure 4. (Recall that all count locations are shown on Map 3.) On both days, counting began at 12:00PM and continued until 5:00 PM.

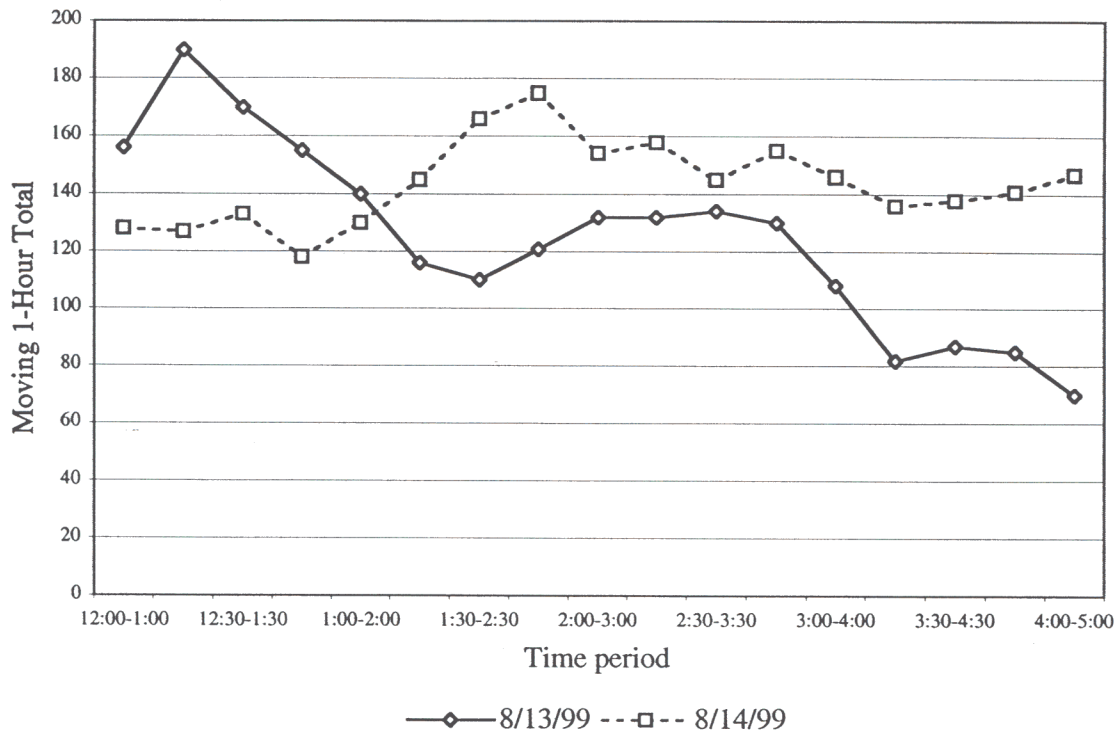


Figure 4: Moving 1-Hour Total, Administration Corner

On Friday, the observed moving hour peak was 190 bicycles per hour. This peak occurred in the hour that ends at 1:15PM. The peak 15-minute count was 61 bicycles. This occurred during the peak moving-hour, between 12:45PM and 1:00PM. Since the counts were not taken prior to 12:00PM it is not possible to see any trends prior to this time, however subsequent counts in nearby locations show peaks near the noon hour. After the peak hour ending at 1:15PM, the activity counts decline to 110 bicycles for the hour ending at 2:30PM. At this point, the counts rise again to a broad peak of about 130 that lasts from the hour ending at 3:00PM until the hour ending at 4:00PM. From this time, the

level of activity generally declines until the counts stop at 5:00PM. During the interval from noon to 4:00PM, the average rate at which bicycles moved past the counter was 134 bicycles per hour.

Counts taken on Saturday, August 14, 1999 were intended to represent a weekend day. Bicycle pseudo-traffic counts remain fairly constant around the noon hour, then climb to a peak of 175 bicycles per hour for the hour ending at 2:45PM. This peak occurs almost an hour and a half later than the 1:15PM peak on the previous day. It would seem likely that Friday peaks occur later in the day than for weekend days such as Saturday. Visitors may arrive in the Valley later on Friday since that day is a weekday and may start activities later in the day. Since many visitors are already in the Valley on Saturday, there might be a peak that occurs earlier in the day, before 12:00PM and the peak that is shown at 2:45PM may in fact, be a second peak of the day.

Later in the afternoon, bicycle traffic remained higher than it had been at the same time on Friday, August 13, 1999. Traffic declined slightly around 4:00PM but climbed again towards 5:00PM. In fact, the peak 15-minute count of 52 bicycles per 15-minutes occurred between 4:30 and 4:45PM. Since the counts ended at 5:00PM, the peak of this late afternoon rise may have occurred even later. However Saturday differs from Friday with this 4:30 and 4:45PM climb in activity. During this time on Friday, the opposite effect is observed, a decline occurs in this time frame. I do not have enough data to speculate why

this effect occurred during August 13 and 14. No additional counts were made at Administration Corner during the study period.

Overall, the number of bicycles at this location did not reach as high a peak on Saturday as it did on Friday, but it was uniformly higher for most of the day on Saturday. The reasons for this uniformity in activity is not clear compared to the peaks in activity on Friday. The average rate that the bicycles passed the counter was slightly higher on Saturday with 140 bicycles per hour. These types of bicycle activity may be compared to pedestrian and shuttle ridership data from the same time period to observe if this activity profile is unique to cyclists or occurs with all activity throughout the Valley.

Camp 6 Intersection

The Camp 6 Intersection is on the same multi-use path as the Administration Corner and provides access in both the westbound or eastbound directions to locations such as Yosemite Falls or Sugar Pine Bridge. The bicycle counts for Camp 6 Intersection were conducted in the same location as the bicycle interviews on different days. Counts were taken at the bicycle path across from Camp 6 and Yosemite Village intersection on both August 13 and 14. However, while counts were made from noon until 5:00 PM on the 13th, there is 15-minute count data only until 4:00 PM on the 14th. The data for both days are illustrated in Figure 5.

On Friday, at the Camp 6 intersection the general trend is similar to the Administration Corner on the same day, showing a peak around the noon hour, a slight increase from 2:45PM to 3:30PM. However this noon hour peak may have occurred much earlier and we may be seeing the decline of this peak after 12:00PM. Differences between the two locations include the following. The number of cyclists passing the counter at the Camp 6 Intersection is higher at every count interval except one than at Administration corner. This results in a higher average count per hour during the interval from noon to 4:00PM. The average was 161 bicycles per hour—higher than at Administration Corner by 30 bicycles per hour. The peak one-hour count occurs fifteen minutes earlier—during the hour ending at 1:00PM. This peak-hour count was 240 bicycles per hour, as compared to 190 at Administration Corner. The peak 15-minute count was also 15 minutes earlier and larger—76 bicycles per 15 minutes during the interval of 12:45 to 1:00PM. The mid-afternoon peak occurred later at the Camp 6 Intersection—during the hour ending at 3:30PM compared to 2:45PM at Administration corner. The count level was much higher at Camp 6 Intersection—150 bicycles per hour, compared to 131. These counts confirm that this is the most heavily trafficked area in the Valley. The Camp 6 intersection is also where the most interviews were conducted—92 interviews over the study period. This area also yielded the most refusals with only a 69 percent response rate.

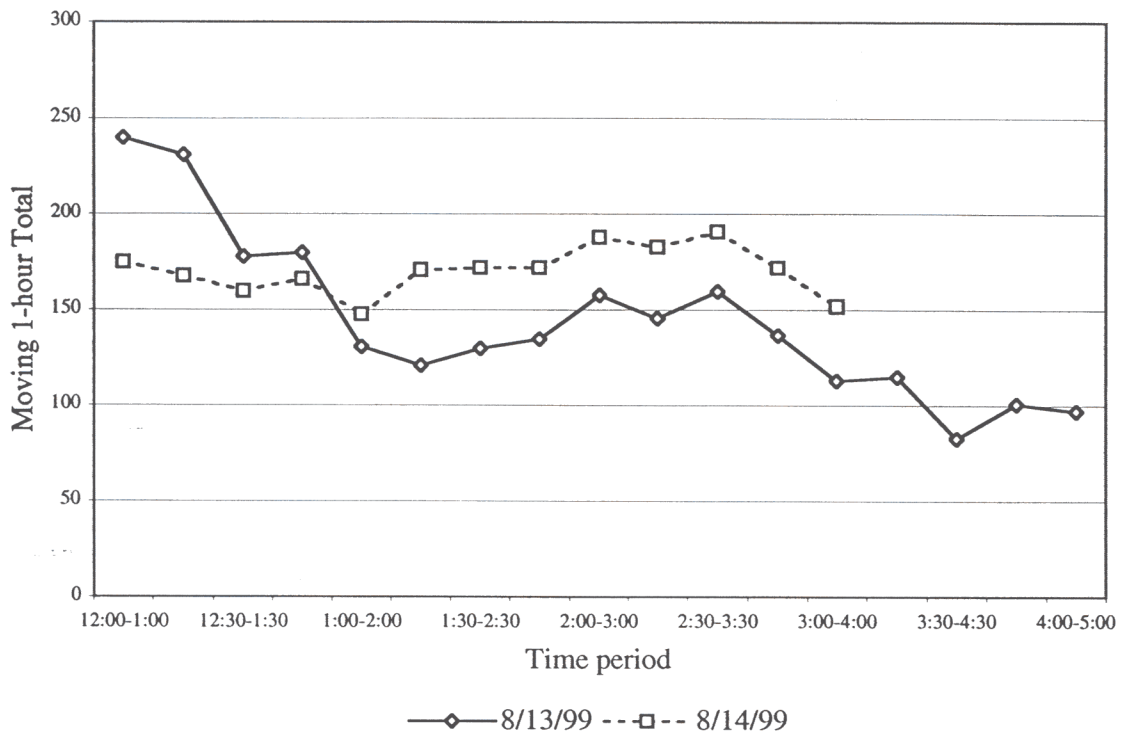


Figure 5: Moving 1 Hour Total, Camp 6 Intersection

The weekend counts (August 14) for Camp 6 Intersection are considerably different from the weekday counts (August 13). Rather than a peak that occurs at noon, there is a generally high and uniform level of bicycles moving past the counter throughout the day similar to the Administration Corner counts. What peak there is occurs between the hour ending at 3:00PM and the hour ending at 3:30P.M. The highest one-hour count during this period is 191 bicycles per hour. After this peak, traffic begins to decline towards the end of the observation period. The activity count stays above 150 cyclists per hour for the

majority of the day, and was equal to 166 bicycles per hour during the interval from noon to 4:00PM.

This trend throughout the day is roughly similar to the trends seen at Administration Corner on the same day. Both locations show uniformly high levels during Saturday. Since the data for Saturday, August 14, ends at 4:00PM, the peak that was observed towards the end of the day is not shown. As we saw for Friday, the trends are similar at the two locations, more cyclists move past the counter at the Camp 6 Intersection than at Administration Corner during every 15-minute interval except one. While both locations are along the same route, the same reasons to explain the Administration Corner activity could be the same at Camp 6. As expected then, the average count per hour was higher—166 compared to 140.

Curry and Housekeeping Camp Intersection

The counts for Curry and Housekeeping Intersection shown in Figure 6 were taken at the 4-way intersection before Stoneman Bridge between Camp Curry and Housekeeping camp on Southside Drive. These counts were only taken once during the study period on Thursday, August 19, 1999. Cyclists were counted in both the east and westbound directions. Counts at this location did not start until after 1:00PM, so any earlier peaks that may have occurred near the noon hour were not observed. That is, I cannot be certain that these counts, like those for September 5 at Swinging Bridge break a “peak near noon”

generalization. I do observe a steady increase throughout the day until counting stopped at 4:45PM. This steady increase might be due to visitors going to Curry Village, Upper and Lower Pines to check into their lodging or camping locations. This data might be referenced against check-in times from NPS or YCS. The peak-hour count was 114 cyclists per hour. The average across the interval of 1:00PM to 4:00PM was 88 bicycles per hour.

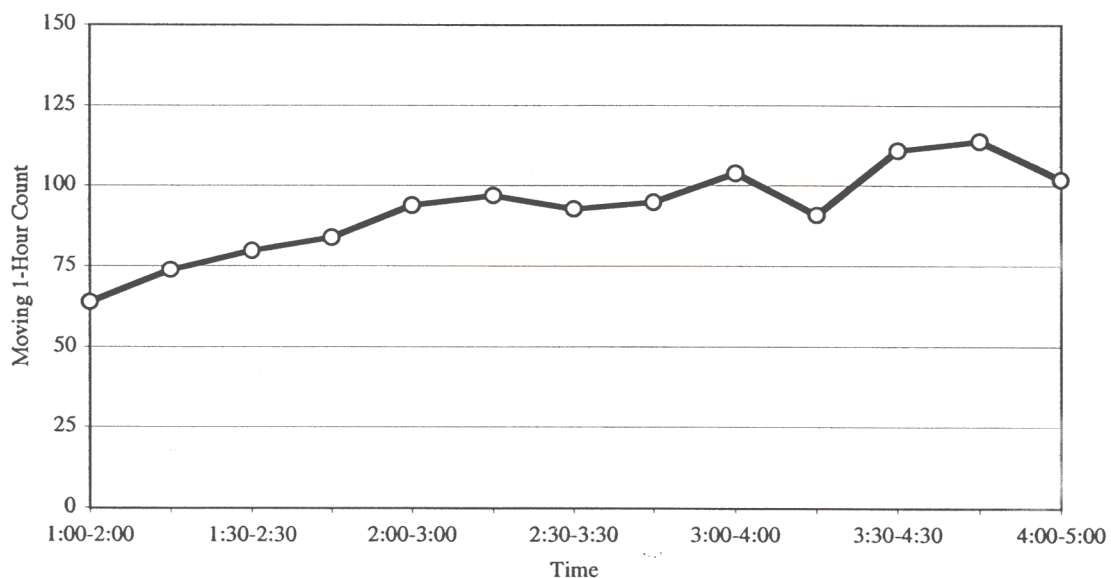


Figure 6: Moving 1-Hour Total, Curry and Housekeeping Intersection, 8-19-1999

Mirror Lake Eastbound (pseudo-traffic counts)

Counts intended to capture the amount of cycling in the Mirror Lake area were made at three different locations on two different days. Further, one of these was a set of pseudo-traffic counts, the other two were LOA counts. I will discuss the pseudo-traffic counts here and return to the LOA counts below.

The counts for Mirror Lake in Figure 7 include only bicycles moving past a counter on the east-west trail leading to Mirror Lake. Counts were intended to represent the number of cyclist going to Mirror Lake on a weekday. Similar to the Curry and Housekeeping Intersection, these counts were made on Thursday, August 19, 1999. These counts are the closest to actual traffic counts as they are only of bicycles moving eastbound on this trail to Mirror Lake. These counts, in fact, represent the total number of cyclists going specifically to Mirror Lake. This however makes them difficult to compare to the other pseudo-traffic counts and even more difficult to compare to the LOA counts since this was the only location with pseudo-traffic counts in one direction only. Additionally, these counts were taken only from 1:00PM to 5:00PM. So that, as was the case with the Curry and Housekeeping counts, I cannot be sure whether the “peak near noon” generalization holds at this location, although in this case it appears likely.

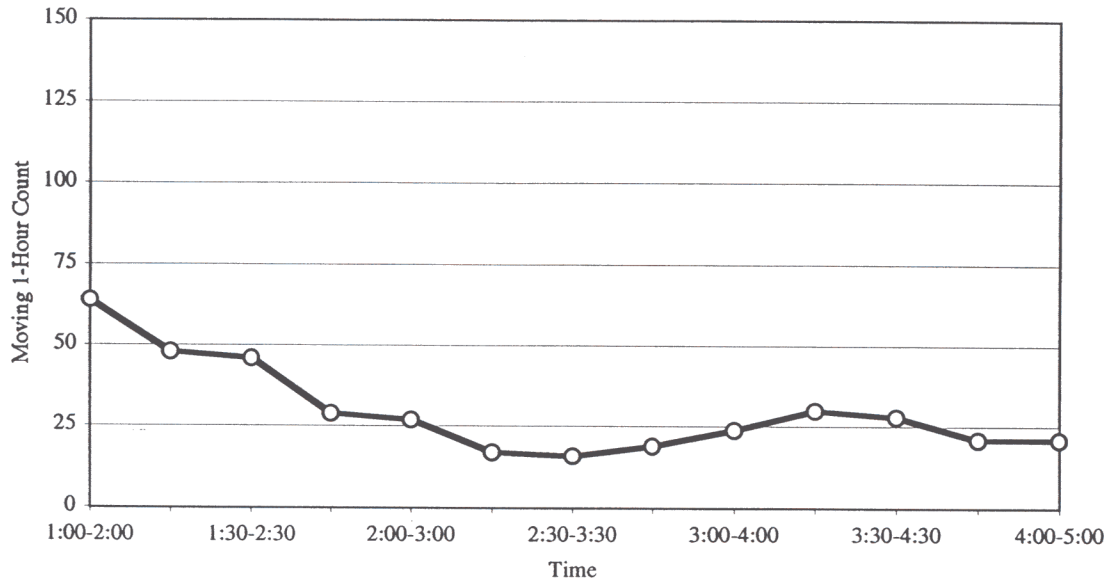


Figure 7: Moving 1-Hour Total, Mirror Lake Eastbound, 8-19-1999

The data starts at its high point in the first hour, which ends at 2:00PM. The peak count was 64 bicycles per hour. The peak 15-minute count, which occurs during this hour, was 27 bicycles. The number of cyclists per hour then declines throughout the afternoon, albeit with a slight rise around 4:00PM. A slight decline occurs after this 4:00PM rise. This might be attributed to bicycle rental returns at Curry Village. Counts after 5:00PM may support this theory. The average across the interval of 1:00PM to 4:00PM was 34 bicycles per hour.

Swinging Bridge

The counts for Swinging Bridge were made on September 4 and 5. These days were the Saturday and Sunday of the Labor Day weekend. The pseudo-traffic count data for both

days are shown Figure 8. On Saturday the 4th, there is a peak of 73 bicycles per hour during the hour ending at 1:15PM, another lesser peak during the middle of the afternoon, and a small increase near 5:00PM. This first peak is the result of the noon hour peak seen in other locations. Swinging Bridge is not only a popular picnic location, but also a popular swimming location. The second, lesser peak occurs during the warmest time of the day which is also the best swimming time. The peak 15-minute count of 31 bicycles per 15 minutes occurs during the peak one-hour count, between 1:00PM and 1:15PM. Bicycles passed the counter at an average rate of 54 bicycles per hour for the period from noon to 4:00PM.

The counts for Sunday, September 5 at Swinging Bridge are the first to clearly break the general pattern of a peak near the noon hour. Rather than a distinct peak near noon, the bicycle activity counts show a generally upward trend all day. The peak hour is the hour ending at 4:45, during which 91 bicycles passed the counter. This peak differs from that of the previous day where a small increase was noted, rather than a sharp peak. This Sunday peak may be attributed to visitors returning bicycles to the Yosemite Lodge Bike Stand. This is also one of the few locations where the peak 15-minute count did not occur during the peak hour. The peak 15-minute count (28 bicycles per 15 minutes) was recorded between 11:15 and 11:30AM. The counts for Sunday are generally higher than the Saturday counts. The afternoon average is 61 bicycles per hour, compared to 54 on

Saturday. In this last sense, the number of bicycles passing the counter at Swinging Bridge mimics the trends in the pseudo-traffic counts at the Administration Corner, Camp 6 Intersection, and the LOA counts at the Village Visitor Center. This pattern is one in which one day has distinct noon and mid-afternoon peaks, and the next day has uniformly high activity. The difference between Swinging Bridge and other locations is that both days at Swinging Bridge are weekend days, not a Friday and a Saturday. However, because of the Monday holiday, a one-day shift from the typical Friday-Saturday pattern would not be surprising.

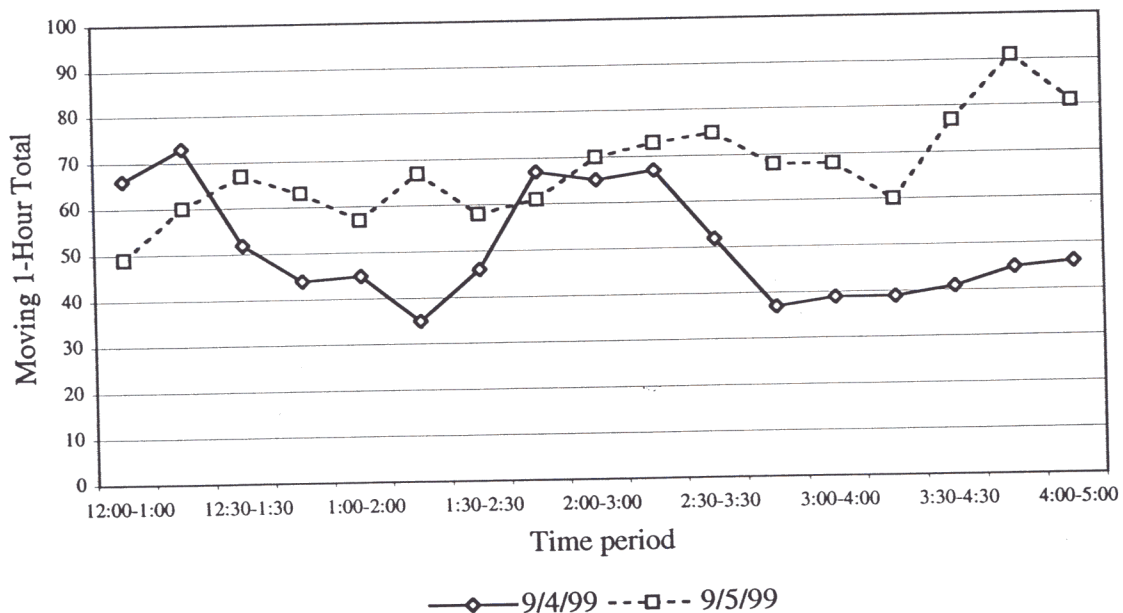


Figure 8: Moving 1-Hour Total, Swinging Bridge, 9-4-1999 and 9-5-99

Village Visitor Center

I now move on to those locations with LOA counts. Bicycle LOA counts were made at the Village Visitor Center during two different two-day periods—August 13 and 14, and August 20 and 21. All the cyclists within sight of the counter, either on the path or the patio area in front of the Village Visitor Center was counted. The bicycle activity counts for the area in front of the Village Visitor Center on August 13 and 14 are illustrated in Figure 9; the data for August 20 and 21 are shown in Figure 10.

The Village Visitor Center path is much smaller than at the other locations and it is less of a thoroughfare. The specific places cyclists can most easily access along this path are the Village Visitor Center, The Ansel Adams Gallery, the Wilderness Center, and the Post Office.

The LOA counts at this location on Friday, August 13 show slightly different trends in cycling activity than indicated by the pseudo-traffic counts at the Administration Corner and Camp 6 Intersection on the same day. While the peak number of cyclists in the area in front of the Village Visitor Center is recorded in the hour ending at 1:30PM, there is no mid-afternoon peak. It is likely that cyclists in front of the Visitor Center were either en route to or returning from the Visitor Center. It is possible that many cyclists go to the Visitor Center area for lunch and to get information on activities and plan the rest of their day based on information received at the Visitor Center. The Village Visitor Center was

the most popular location visited by cyclists during their journey. A total of 188 cyclists were recorded during the four counts taken during the peak hour. The peak 15-minute count of 50 cyclists was recorded during this hour. Activity counts steadily decline after the peak such that from about 3:00PM the counts are steady at a level of 25 to 30 bicycles at each count. The average number of bicyclists counted every 15 minutes during the interval of noon to 4:00PM was 88.

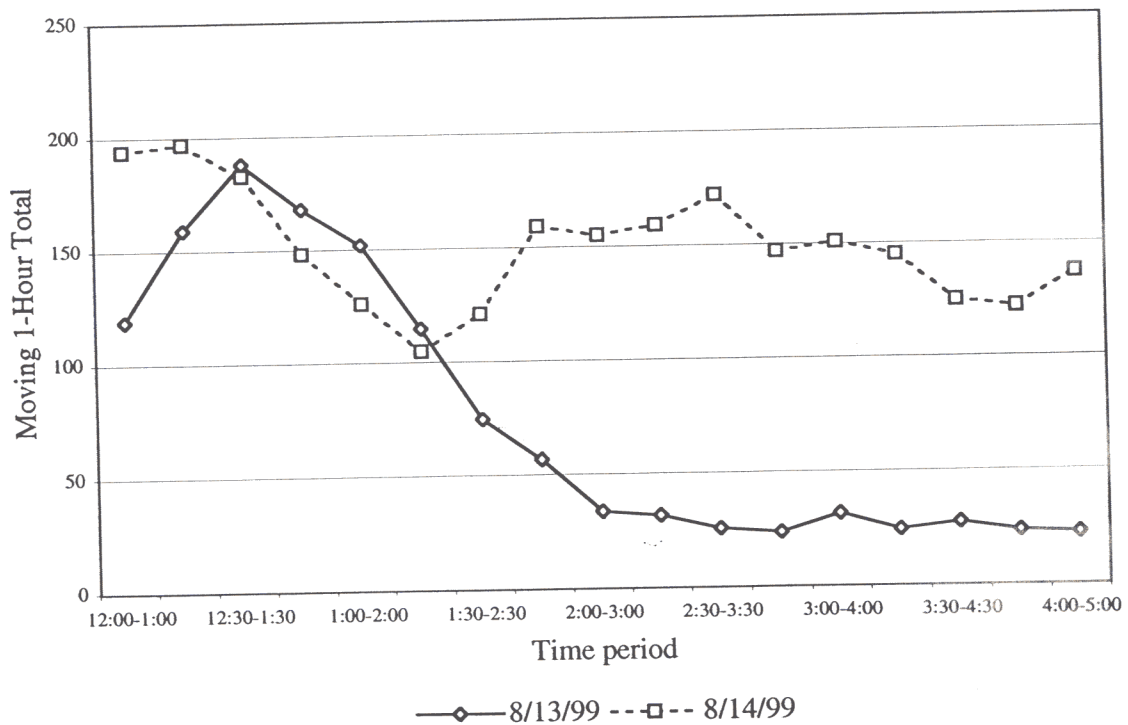


Figure 9: Moving 1-Hour Total, Village Visitor Center, 8-13-1999 and 8-14-99

The August 14 LOA counts for the Village Visitor Center show a peak count of nearly 215 in the hour ending at 1:15PM. Counts then decline sharply (to about half the peak level). The low point occurs during the hour ending at 2:15PM. Then activity rises to a broad afternoon peak. Bicycle activity counts stay between 150 and 170 from the hour ending at 2:45PM to the hour ending at 4:15PM. Except for the early afternoon decrease in activity, the overall pattern is similar to that seen at Administration Corner and the Camp 6 Intersection in that the counts made on Saturday tend to show a generally high, sustained level of activity as compared to Friday with a slight peak to the hour ending at 5:00PM. Since both locations are within close proximity, the patterns for both should be similar. The peak count is higher on Saturday (197 bicycles counted across four occasions in one hour compared to 188), as is the hourly average across the interval of noon to 4:00pm (162 compared to 88).

The counts for the Village Visitor Center on Friday, August 20 (Figure 10) are different from the counts one week earlier at the same location. There is a peak near noon, but the peak on the 20th is not pronounced compared to activity throughout the rest of the afternoon. This peak may not be as pronounced in part because the peak 15 minute count of 64 cyclists, recorded during the interval of 11:45AM to noon, does not occur during the peak hour. The peak hour count of 172 occurs during the hour ending at 1:00PM. Though there is a less distinctive noon peak, bicycle activity in the vicinity of the Village Visitor

Center on Friday, August 20 is generally higher than on the previous Friday. Different from previous Fridays, a slight increase is observed in the hour ending at 4:00PM. Since these are consecutive weeks, such dramatic differences are difficult to explain with only two weekends of data. The average of the counts made from noon to 4:00PM on the 20th is 151, compared to 88 on the 13th.

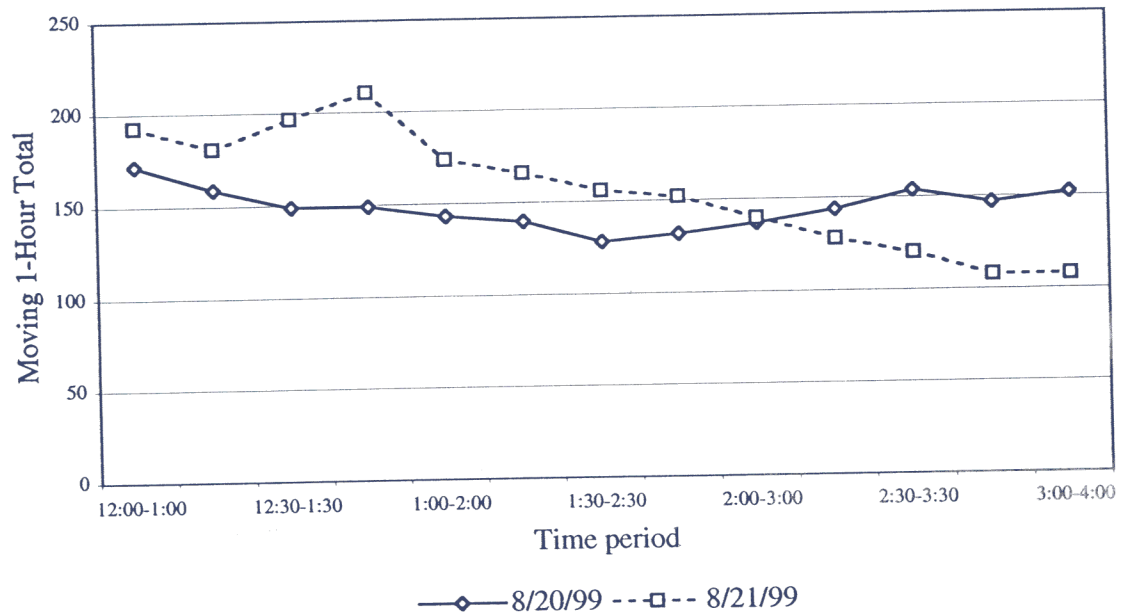


Figure 10: Moving 1-Hour Total, Village Visitor Center, 8-20-1999 and 8-21-99

The counts for Saturday, August, 21 are also dissimilar to those from the previous Saturday. The peak hour on the 21st occurred during the hour ending at 1:45PM (211 cyclists) after which activity steadily declined until counting stopped at 3:45PM. That is,

on the 21st, the number of cyclists in the area in front of the Village Visitor Center was peaking at about the same time the count was decreasing from a noon peak on the 14th. After the early afternoon peak on the 21st, cyclist activity declined throughout the rest of the afternoon, showing no signs of the broad mid-afternoon peak seen the previous Saturday. Also of note the typical Saturday peak towards the end of the day was not observed. In fact, the count decreased and was lower than the Friday counts towards the end of the day. The average LOA was slightly lower on the 20th than on the 14th (154 compared to 166). The highest single 15-minute count at the Village Visitor Center—72 cyclists—was recorded on this day in the interval from 12:45 to 1:00PM.

Mirror Lake Intersection and East and Westbound (LOA counts)

The bicycle activity counts intended to represent weekend activity at the Mirror Lake Intersection were taken on Sunday, August 22. Counts were taken at the intersection of the paths leading eastbound to Mirror Lake, westbound to Sugar Pine Bridge, north-east to Mirror Lake, and south to Curry Village. This location is a popular destination for bicyclists and pedestrians. In addition to representing the number of cyclists going to or returning from Mirror Lake, these counts show activity of cyclists in the east end of the Valley. The moving hour counts are illustrated in Figure 11. There is a broad peak in the bicycle activity counts—at about 140 cyclists—during the time from the hour ending at 1:15PM to the hour ending at 1:45PM. After this, bicycle activity steadily declines

throughout the afternoon. This decline may be due to cyclists heading to the west areas of the Valley to return to lodging and camping locations or to return rental bicycles. In the two Bike Stand locations, we can see peaks occurring towards the 4:00PM hour.

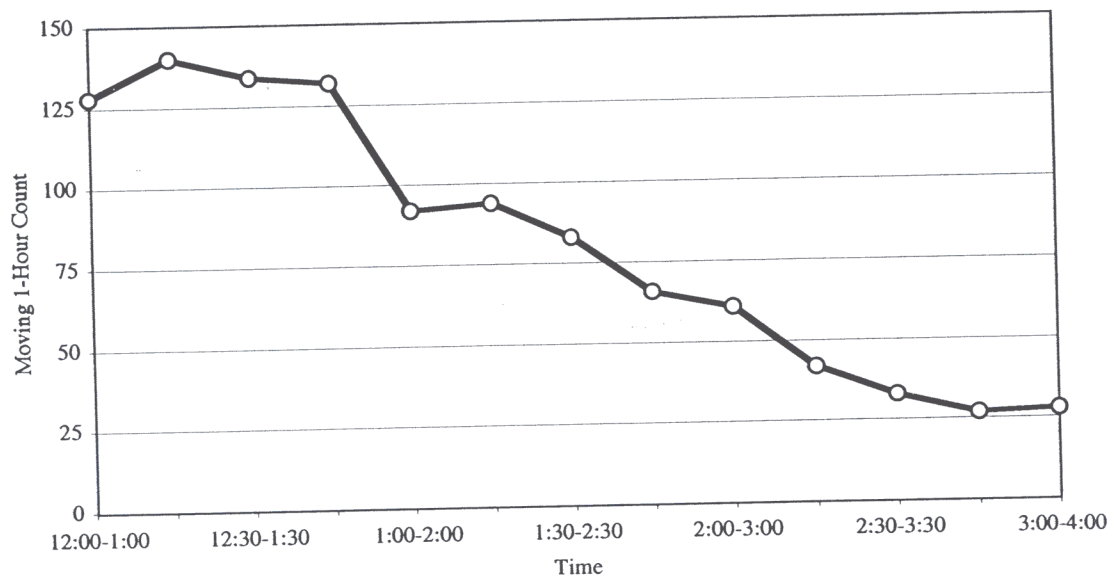


Figure 11: Moving 1-Hour Total, Mirror Lake Intersection, 8-22-1999

The peak 15-minute count of 53 cyclists was recorded during the interval of 12:45 to 1:00PM. This is during the peak hour. The average number of cyclists counted per hour during the interval of noon to 4:00PM was 77.

The activity counts shown in Figure 12 are of cyclists on the east-west pedestrian/bike trail leading to Mirror Lake. Though these counts were made near the same location as

the counts shown in above in Figure 11, the data are not comparable. The data in Figure 12 include cyclists moving in both directions (and possibly even some who were not moving at all) and are counts of all cyclists within a defined viewing area at one time, not the number moving past a point.

The counts show a moving 1-hour peak of 121 during the hour ending at 2:45PM. The peak 15-minute count of 37 cyclists occurs at the end of this hour too. Since counts at this location did not start until 1:00PM, a higher peak might have occurred much earlier, as seen at most other locations. Factors that may account for this later peak might include cyclists returning from popular lunch locations such as Curry Village and Yosemite Village where peaks occurred almost an hour earlier. From the mid-afternoon peak, activity decreases throughout the day, but with a small increase in the hour ending at 4:15PM. Across the shortened afternoon interval of 1:00PM (rather than noon) to 4:00PM, the average hourly total was 60 cyclists.

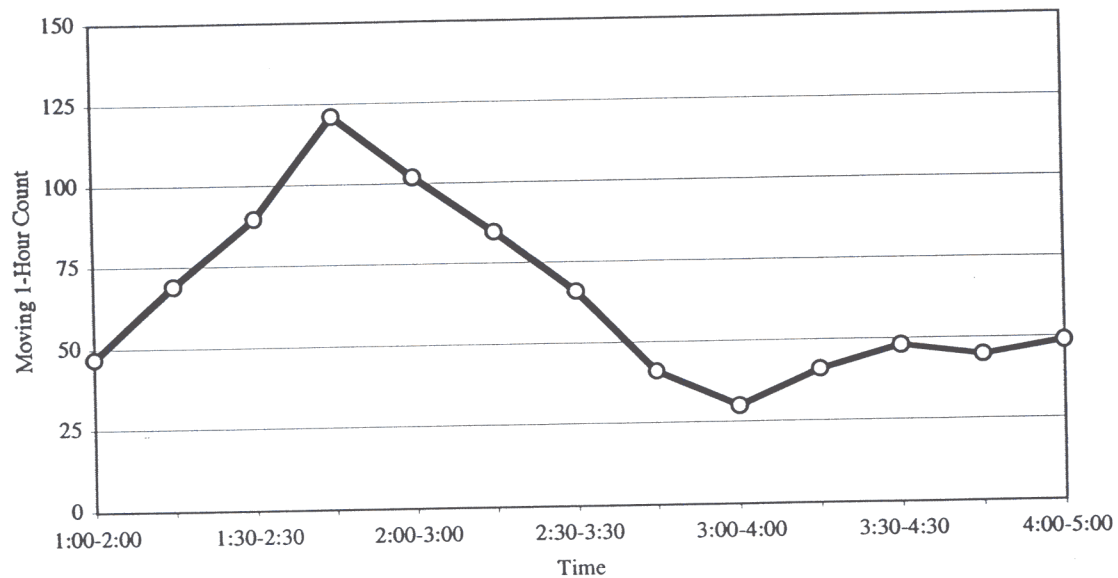


Figure 12: Moving 1-Hour Total, Mirror Lake East and Westbound, 8-19-1999

Curry Village

The LOA counts at Curry Village were taken in front of the Curry Bike Stand. Counts included cyclists on both the north-south route, as well as bike riders in the parking lot in front of the bicycle rental stand. These data are illustrated in Figure 13. Similar to other areas, a large peak occurs near noon, in this case, during the hour ending at 1:15PM. The total of the four counts in this hour was 256 cyclists. A mid-afternoon moving 1-hour peak of about 210 was recorded during the hour ending at 3:00PM. There is another peak, nearly as large as the mid-day peak, at the end of the count period. This later peak may be due to visitors returning rental bikes at this time since the Curry Bike Stand closes at 5:00PM and bicycles cannot be kept overnight. In fact the single largest 15-minute LOA

count was recorded here at the end of the day. This count, equal to 136, is larger than any other single count anywhere by a factor of nearly 2. The next largest 1-hour total was 72, recorded at the Village Visitor Center on Saturday, August 21. This location was also the busiest, on average, throughout the afternoon period. The one-hour average was 176 cyclists in the area around the bike rental stand or on the north-south trail near the stand throughout the period from noon to 4:00PM.

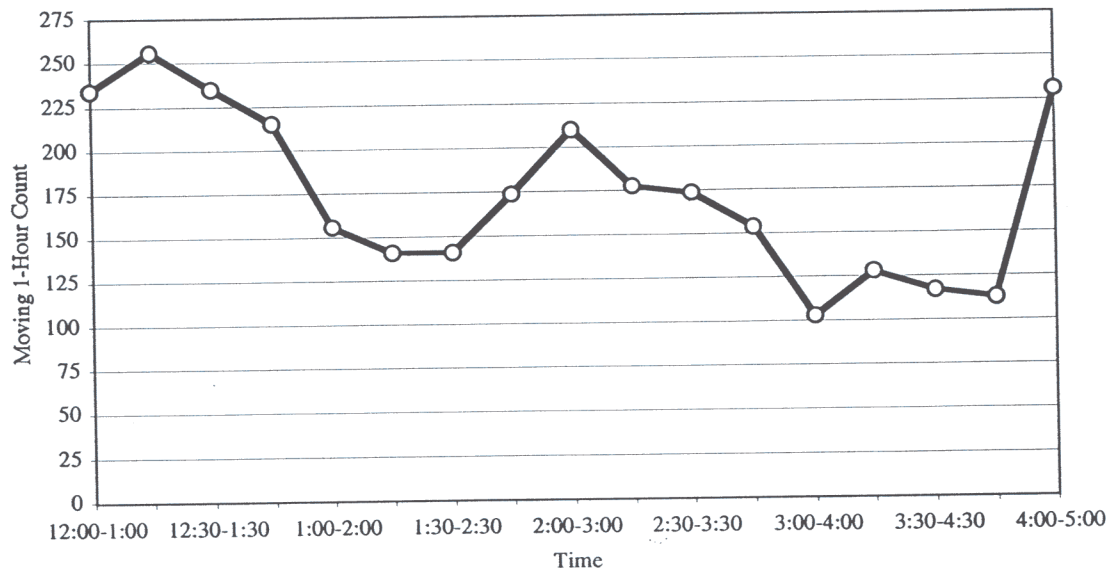


Figure 13: Moving 1-Hour Total, Curry Village, 9-4-1999

Conclusions

Yosemite bicycle riders are experienced Yosemite Valley visitors. Personal experience from previous visits or experience of other Valley visitors provides valuable knowledge that is useful in planning activities and travel while in Yosemite Valley. Despite the many different means for advertising bicycles in the Valley, such as print media including the Yosemite Guide, the majority of visitors learn about bicycling in the Valley through direct observation of cyclists during a journey to Yosemite National Park.

Cyclists are more likely than not to be staying overnight in Yosemite Valley. Their income distribution is skewed toward the high end but matches that of other general samples of visitors to Yosemite National Park.

Cycling in the Valley is typically not a solitary activity—only 6 percent of interview subjects were cycling alone. Median group size was 3; mean group size was 3.4. The most common group consisted of two adults cycling together (45 percent), but nearly as many groups consisted of two adults and children of varying ages (40 percent). These groups are typically composed only of immediate family.

Cyclist Travel Modes

Many groups of cycling visitors parked their motor vehicles once in the Valley and did not use it for travel in the Valley, instead relying upon other modes for travel. For many

Valley bicycle riders, their bikes, the Valley shuttle system, and walking may be complementary modes of travel. That is, the three modes may not directly compete with each other, but may be used in concert to accomplish all travel in Yosemite Valley. Many cyclists clearly feel no great need to use their own motor vehicles once they have arrived in the Valley. In fact 57 percent of cyclists stated they had neither used nor planned to use their own motor vehicle for travel within the Valley.

The Unique Nature of the Valley Makes Cycling a Viable Travel Mode

The obstacles that cyclists in urban areas face when attempting to use bicycles as a mode of transportation can be overcome in Yosemite Valley. In fact, on a typically busy summer day in the Valley, a bicycle can be the fastest, most convenient way to get around. Motor vehicle traffic congestion occurs more often during the summer months. It is also during the summer months when the weather is warm and pleasant for bicycle riding. The flat terrain of the Valley also makes bicycling easy for many people of varying ability levels. Yosemite Valley also has a dedicated bikeway system that covers a large portion of the Valley. Distances to locations within the seven mile long by one mile wide Valley are short, allowing short travel times to destinations.

The ease of cycling in the Valley makes the bicycle a viable mode of transportation for summertime park visitors. Rather than view the bicycle as being purely a recreational activity, the bicycle could be observed as being an integral part of the Valley

transportation system, providing a complement to the shuttle bus system. This use of cycling as transportation in the Valley may be unique to Yosemite National Park.

Everglades National Park may be the only other site of a study involving bicycle use in national parks (National Park Service, 1989). That report concentrated on recreational bicycle trips and their accompanying infrastructure, yet made little mention of visitors using the bicycle as transportation to lodging, camping and activities within the park. It is here in Yosemite where the recreational visitor goes beyond the standard definition of cycling for exercise, enjoyment, nature study and socialization, and exemplifies a broader definition.

Bicycling trips in Yosemite may be both for recreation and for transportation. In addition to all the trip objectives of the recreational visitor, the Yosemite Valley cyclists' objectives include: the most convenient travel mode, shortest travel time and access to destinations.

An additional group of cyclists that accounts for a large number of trips, are the NPS, YCS and park partners who work in Yosemite Valley. Many employees live and work in the Valley and use the bicycle as a mode to travel to work. These employees have the same objectives as the recreational visitor and also enjoy the benefits of commuting by a bicycle. In the same way that cycling in Yosemite Valley is a unique transportation experience for visitors, the Valley may be one of the few places in the National Park

System where such a large percentage of employees commute by bicycle. No mention of employee cyclists were made in the Everglade study, this may be due to the large distances in the park that needs to be traversed or a simple oversight in their planning process.

The Total Number of Cyclists On a Typical Summer Day

I estimate that there are between 618 and 718 visitors on bicycles in circulation on a typical day in August. This estimate is not, strictly speaking, a count of all the people who have, or will ride, a bike during their journey to the park.

This estimate also omits employees. Not only does the bicycle provide a means of transportation for the park visitor but also for park employees who work in Yosemite Valley. Of the total number of employees who live and work in Yosemite Valley, 33 percent ride bicycles to work at least sometimes and 15 percent only ride bicycles to work (Kurani, et al. 2000). In the summertime there can be nearly 1,086 YCS, NPS and park partners working in the Valley. This can be an additional 170 to 360 employee bicycle trips on any given summer day. This percentage of bicycle commuters is far larger than for bicycle transportation in urban areas, and thus cycling can be encouraged as a commute alternative.

Estimating Levels of Cycling Activity

The counts of cyclists in the Valley during the study period, while not “true” traffic counts, give a quantitative measure to observed heavy activity periods. Despite the differences in the types of counts, this gives the first measure of the level of cycling activity throughout Valley locations. Counts of bicyclist activity reveal several similar trends at a variety of locations and dates. Of the sixteen sets of counts, 10 show a distinct peak at, or shortly after, noon. Half of the counts show a second, typically smaller peak, in the mid-afternoon. However, only 6 of the count location/dates show both the noon and mid-afternoon peak. These increases in activity may be due to cyclists seeking lunch—either as a sole destination, or as a series of stops in a longer bike tour. The mid-afternoon peak typically occurs between the hour ending at 2:45PM and the hour ending at 3:30PM. The latest peak was recorded at the Curry Village site at 5:00PM. This most likely corresponds to renters returning their bikes to the rental stand located near the count location.

Two of the sets of counts which did not show distinct noon-hour or mid-afternoon peaks were taken on the same Saturday at locations along the same bike path—Camp 6 Intersection and the Administration Building intersection. These locations show uniformly high counts through out the count period (noon to 4:00PM at one location, noon to 5:00PM at the other). Both sets of counts are higher on Saturday than on Friday, with

the exception of the noon hour peak on Friday. In these cases, the uniformity of the Saturday counts may be attributed to decreasing travel into the Valley after the noon hour. Cyclists may already be in the Valley arriving the previous night and therefore are circulating around the Valley at a more even rate. The peaks in the Friday activity could reflect visitors arriving at different points in the day and therefore starting their bicycle trip later. Also, in most cases the counts for Saturday were higher than on Friday. It may very well be that this volume of activity does not clearly show peaks because most of the day is already at a “peak” volume. This high volume may be limiting additional bicycle trips either by infrastructure constraints or by the perception of crowding. This data might be compared to counters of vehicle traffic arriving in the Valley. In addition, pedestrian activity as compared to bicycle activity might seek to address if these peaks are unique to bicycle circulation or are indicative of all the activity within the Valley.

The LOA and the pseudo-traffic counts offer a starting point to measure cyclist activity throughout the Valley, the counts can be improved upon to offer a more realistic and complete view of traffic volumes.

Recommendations for Further Research

Regarding cyclists themselves, it may be of interest, to the concessioner in particular, to know the incidence of repeat bike rentals across several different journeys to Yosemite Valley. That is, our data would indicate that once people (at least residents of California)

learn about cycling in the Valley, they are likely to bring their own bikes on subsequent journeys rather than rent once they arrive.

Supplementing Pseudo-Traffic and LOA Counts with Traditional Traffic Counts

While the bicycle counts give us a measure of the LOA at various locations throughout the Valley, many of the counts were taken only once or twice per location. These counts may not be representative of the LOA for typically busy summer days. In addition, while the counts were conducted at locations of observed high bicycle activity, activity in other areas was not counted. Additional locations should include: the Ahwahnee Bridge, the path south of Southside Drive past the Chapel and any extension to mid-Valley or the west end. Counts should be repeated for more days, and need to be taken during consistent time periods across locations and days. Further, the time frame for counts needs to be extended to before noon and after 5PM. These traffic counts should also be directional.

Some of the weekday counts occurred on a Friday. Fridays may not give an accurate representation of weekday travel behavior. Some vacation trips may begin on a Friday so visitors can enjoy three consecutive days for the weekend. To accurately observe weekday counts, Tuesday through Thursday days may be more appropriate. In addition

some of the counts were taken during the Labor Day weekend which is typically a high visitation weekend.

Traffic volumes of bicycles could be best measured by stationary traffic counters at areas along the bicycle network. These counters could measure actual traffic flow count (rather than the pseudo-traffic or LOA counts) as well as weekend and weekday counts splits. In addition, volumes of bicycles could be measured throughout the year, not just during the peak months of travel. Traffic volume could be measured in the eastbound, westbound, north and southbound directions along bicycle paths. These counts would give an accurate picture of bicycle volumes throughout Yosemite Valley. Infrastructure improvements, suggestions for routes, and other cycling related actions may well hinge on not simply how many cyclists are in an area, but on whether most are headed in one direction or the other.

Comprehensive Study of Travel Behavior-Travel Diaries

We know that Valley cyclists had a higher shuttle ridership than the general population of Valley visitors. In addition, 57 percent of cyclists interviewed said they did not use or plan to use their motor vehicle for travel within the park. Despite these statistics, it is difficult to determine if Valley cyclists are using the bicycle as a replacement of another mode to travel to activities and locations within the Valley. Fifty-nine percent of Valley visitors reported that the bicycle was the most convenient way to get around the Valley.

Yet, in the interview it was difficult to distinguish between recreation trips and trips to accomplish non-recreation purposes.

While I interviewed visitors on bicycles, I did not survey park visitors that were not riding bikes. Longer, more detailed interviews or surveys might be possible if alternative sampling frames were considered. In particular, travel diaries of Valley visitors would give a clearer picture of the actual travel patterns and incorporate the bicycle as a mode of travel in relation to the other modes that the visitor uses while in the Valley. Detailed information such as the purpose, location and duration of the trip could be taken from the diaries. Information on trip chaining by bicycles could determine how the bicycle is used in relation to other modes of travel. Alternative sampling frames could also address visitors who were not riding bicycles, to ascertain reasons why some people are not cycling and what, if anything could be done to encourage them.

Factors to Increase Cycling in Yosemite Valley

As we have seen, many cyclists are riding on the bikeway network in Yosemite Valley during typical busy summer days. It is estimated, based on the number of visitors to the Valley during the summer, that 4 percent of visitors may be riding bicycles at one time. These cyclists have either rented bicycles from the two Valley rental locations or have brought their own bicycles to ride in Yosemite. Most visitors gained knowledge about cycling by actually being in the Valley or relying upon information provided by another

party that had been to the Valley. These two sources accounted for 76 percent of the total means of information about cycling. First hand experience in the Valley proved more important for learning about bike riding as an activity than any other means of information.

Much can be done to encourage cycling in the Valley. Currently the park does not take a pro-active role to promote such a simple and low-cost transportation mode and recreation activity as cycling. Many visitors could simply be unaware that cycling is an activity or means for transportation until they actually arrive in the Valley. There are several ways in which the park could encourage cycling in the Valley. Basic information about cycling in the Valley needs to be provided to park visitors both during and before their trip. Bicycle facilities including bike paths in the Valley could be improved. Bicycle equipment including the rental bicycles and accessories could be changed to make the bicycles usable to travel to activities. Each of these recommendations are discussed further in the section below.

Providing Information about Cycling in the Valley

Internet Information

Information about cycling in Yosemite is virtually non-existent. Other than simply listing bicycling as an activity in literature provided by YNP and YCS to visitors as they enter

the park and a few posters showing bicycle riders, specific information about cycling is not easily seen. Simple information about renting bicycles in Yosemite such as types of bicycles, bicycling routes (terrain, length of routes, times to complete routes), rates of bicycle rentals, reservations, hours of operations and locations of rental facilities are not listed on the Yosemite National Park or YCS web site or in the Yosemite Guide. There are several web sites that can be utilized by the park to provide information about bicycling in the Valley. The Yosemite National Park web site (<http://www.nps.gov/yose>), the Yosemite Concessions Services web site (<http://www.yosemitepark.com>), the Yosemite Area Traveller Information (<http://www.yosemite.com>) and the Yosemite Association (<http://www.yosemite.org>) could provide the above listed information as well as reciprocal links to each other's sites.

In addition to web information, printed media in park publications (including the Yosemite Guide, which is handed to visitors as they enter through the park entrances) should include specific information about cycling. Information in the form of signs and other printed flyers should be available to visitors at the new visitor/transit center and the traffic check station on Southside drive as proposed in Alternative 2 of the Draft Yosemite Valley Plan (See Alternative 2 in the "Introduction and Context").

Maps and Directions in the Valley

Printed information in the valley should be expanded to include maps and directions posted along the Yosemite Valley Bikeway. When park visitors were asked what things could be added to improve their bicycle trip or make it more likely to cycle in the valley, 21 percent responded that they wanted maps and directions for bicycling routes.

Currently, the park provides little to no information about bicycling paths and trails on the Valley bikeway system. Fundamental elements of any bikeway such as signage denoting bike paths, all-weather bikeway maps on the trail, and directions to the bicycle network from camping and lodging locations are absent from the Valley. These improvements are infrastructure elements that can be added for little cost and minimal environmental impact.

Directions and signs to the two Valley bike rental locations are also lacking. There are no signs to the Yosemite Lodge Bike Stand anywhere in the Valley, even within Yosemite Lodge. The Bike Stand is inconspicuously located among the buildings in Yosemite Lodge. It is not clear that bikes can be rented from this location unless you walk inside the rental facility.

The Curry Bike Stand, on the other hand, is far more visible than the Lodge Bike Stand.

The Curry location is much larger and easily seen by its distinctive green tent. Still, there

are no signs advertising this facility to visitors traveling towards Curry Village on Southside drive or to visitors staying in the Curry tent cabins.

Yosemite Valley overnight guests who rented bicycles tended to rent them at their lodging location or the rental location closest to their camping location. That is, people who stayed at Yosemite Lodge tended to rent from the YCS rental facility near the lodge; those who stay overnight in Curry Village rent from that facility. A few (3) groups who stayed at the Lodge rented from the Curry Bike Stand. While these few groups may not be a large enough sample to draw firm conclusions, it could suggest that the Curry rental location is more visible than the Lodge location. Taken by itself, this fact may not seem remarkable, but it is consistent with our characterization of information sources.

In addition to providing information about cycling as a recreational activity, this information could be used to inform and educate current and potential park visitors that cycling in the Valley is the quickest and easiest way to travel to lodging, camping locations and activities. Encouraging travel by bicycle could help to reduce vehicle miles traveled by visitors' vehicles in the Valley.

Additional Bicycle Trails

A factor that is of concern in urban environments is the multi-use trails on which there is both pedestrian and bicycle traffic. Conflicts can arise from this mix of traffic when there is a large speed differential between bicycles and pedestrians on the same path. On busy

multiple use trails, cyclists often feel hampered by pedestrians and must slow down considerably to safely pass them. Pedestrians can sometimes be intimidated by cyclists passing from behind and in an effort to move out of the way can inadvertently move into the path of cyclists.

Yosemite Valley is no different. Despite the many miles of bicycle trails that often see little traffic, heavy use areas such as the Camp 6/Yosemite Village intersection can be a safety concern. The paths that both bicyclists and pedestrians use are designated multi-use, allowing mixed traffic on many parts of the trails. These trails lack signage or striping to distinguish the pedestrian path from the bicycle path. The path leading from Camp 6 to the Visitor Center is very crowded with pedestrian and bicycle traffic that often results in pedestrians moving out of the way on the dirt shoulder to avoid bicyclists. There is no clear direction for either the cyclists or the pedestrian to move. Among cyclists interviewed for this study, the second most frequently cited factor, next to maps and directions, that would improve their cycling trip, was pedestrian separated paths.

Separating bicycle and pedestrian could be accomplished in a number of ways: a physical separation such as grade separated path or striping of lanes for cyclists and walkers or hikers. Lanes can be striped on the right side of the path in both the east and the westbound directions. Pedestrians can walk in this striped area while cyclists can ride to their left. An alternative striping scheme can be to put a lane in the middle of the path for

pedestrians in both directions while cyclists pass to either side of them. This separation of traffic would only need to be implemented in busy areas such as the path from Camp 6 to the Visitors Center and the path leading from Curry Village to Mirror Lake.

Access to the West Areas of the Valley

In addition to improving the actual bike trails, the park could greatly improve bicycle access by providing trails to popular areas currently accessible only by car. When cycling visitors were asked where they would like to see more bicycle trails, 72 percent of the respondents offering suggestions indicated that they would like to see trails access locations in the western end of the Valley, such as El Capitan Meadow, a popular area to view rock climbers and enjoy the view of El Capitan. Alternative 2 seeks to address this trail issue by converting Northside Drive, from El Capitan crossover to Yosemite Lodge, from a motor vehicle road to a multi-use paved trail for pedestrians and bicycles. This would give visitors an opportunity to visit the western end of the Valley and expand the trails to include more car-free areas.

In addition to this western end of the Valley, an additional 14 percent of the respondents offering suggestions said they would like to see trails extend all the way to Bridalveil Fall. Currently Bridalveil Fall is accessible by car along Southside Drive or the Valley Loop Trail which is for hikers and horses only. Shuttle service does not currently extend to this location. There is no prohibition against bike riding around the current

Northside/Southside Drive loop to access Bridalveil Fall. However, in the western end of the Valley, both these roads are narrow and twisting, affording drivers short sight lines. Neither road has wide shoulders, leaving cyclists no where to ride but in the traffic lane.

Cycling and The Draft YVP SEIS

In the following section I will primarily address Alternative 2, the preferred alternative in the Draft Yosemite Valley Plan Supplemental Environmental Impact Statement using insights from the bicycle study. Based on actions listed in this alternative, I will make recommendations about improving cycling as both a recreational and transportation mode.

Although three other action alternatives are listed in the YVP SEIS, Alternative 2 contains elements that are common to all the action alternatives. All the four alternatives deal with day visitor parking in either out-of-Valley locations, parking areas in the Valley or, have a combination of both. In addition, all the action alternatives convert all or a portion of Northside drive into a multi-use paved path. The differences in the locations or size of the parking lots and trails are slight, however the concepts from my recommendations can be applied despite the variances among the actions.

Alternative 2 of the draft YNP SEIS calls for a new multi-use paved trail adjacent to Southside Drive from Swinging Bridge as far as El Capitan crossover. Yet, this new multi-use trail does not extend to Bridalveil Fall, which lies only a short distance away.

To provide access to Bridalveil Fall by bicycle, the new multi-use trail to El Capitan Meadow could be extended from El Capitan crossover to the Bridalveil Fall parking area. This would provide a safe route free from conflicts with vehicles traveling to the west areas.

Providing for Bicycling by Day Visitors

While day visitors account for 39 percent of cycling visitors, this percentage could increase with the aforementioned bicycle information. Currently the majority of day visitors who cycle use the large day visitor parking lots such as Curry Village to park their vehicle. Those who park here and rent bicycles, rent them at the Curry Bike Stand.. The two most likely locations from which day visitors start their bike trips are the Curry Rental area (31 percent) and Lodge Rental (28 percent).

A summary of the Valley locations where visitors start their bicycle trip, separately tabulated by overnights and day visitors, is shown in Table 27: Bicycle Trip Start Locations by Day Users and Overnights. While many park visitors, whether overnight day visitors, rent from these locations, the parking lots near both rental locations are currently being utilized for day visitor parking. While the Camp 6 parking lot was designed for day visitor parking in an experimental trial in the summer of 1999, only 5 interviewed cyclist groups started their bike trip there. Since bicycle rentals are not available there, these visitors probably brought their own bicycles with them to ride in the

Valley. During the summer 1999 experiment, there was no specific information about renting bicycles available to visitors in the Camp 6 parking lot..

Table 27: Bicycle Trip Start Locations by Day Users and Overnights

Count Column Percent	Day Users	Overnights	Row Total
Curry Rental	22	43	65
	31	36	
Lodge Rental	20	13	33
	28	11	
Curry Village	7	7	14
	8	6	
Swinging Bridge	6	0	6
	8	0	
Camp 6	5	0	5
	7	0	
Yosemite Lodge	3	2	5
	4	2	
Yosemite Village	2	0	2
	3	0	
Sentinel Bridge	2	0	2
	3	0	
Lodging/Camping Parking Areas	3	55	58
	4	46	
Garage	1	0	1
	1	0	
Chapel	1	0	1
	1	0	
Total	72	120	192

Bicycles at the Visitor and Transit Center

Alternative 2 of the draft YNP SEIS calls for day visitor parking to be consolidated at Yosemite Village, with parking at other camping/lodging locations to be limited to overnight guests only. This parking area would work in conjunction with a visitor and transit center that would provide orientation for visitors as well as a hub for transit operations. Under this Alternative, bicycle rentals would also be available in this location. Since day visitor parking would be removed from Curry Village and the Lodge, this new bike rental facility would be necessary in order to encourage and facilitate cycling among day visitors (who currently park at Curry and the Lodge from renting bicycles). This new bicycle rental facility should be highly visible and information about it should be provided through the various sources of traveler information available to visitors. Rather than think of the rental facility as separate from the transit hub located in the Village area, the bicycle rental facility should be incorporated into the hub to help move visitors to destinations in the Valley.

Accommodating Cycling Visitors in Out-Of-Valley Lots

In addition to renting bicycles to the day visitors who will be parking in the new 550-vehicle lot, consideration must be taken to accommodate the visitors who will be parking at out-of-Valley lots and who wish to cycle in Yosemite Valley. Under Alternative 2, these visitors will be shuttled to the Valley from lots located at Badger Pass, South

Landing and El Portal. Once brought to the Valley transit center, additional shuttles will transport day and overnight visitors throughout the Valley.

As discussed above, bicycles should be integrated into the transit hub in the Valley, to provide an easy transition from shuttle bus to bicycle for those who wish to transfer.

The problem of people who park in an out-of-Valley parking lot and who want to bring their own bicycles to the Valley may be more complex. Visitors who bring their own bicycles to the Valley and park their vehicles at one of the out-of-Valley lots will need to transport their bicycles into the Valley. Alternative 2 suggests that shuttle buses will be outfitted to accommodate recreational equipment such as bicycles. However, the draft YNP SEIS does not specifically mention transportation for bicycles on out-of-Valley shuttles. The type of bike racks commonly seen on urban buses typically hold only 2 to 4 bicycles. In the Valley the average size of a group on a bike trip was 3.4 people. Using these standard racks, only one average size group with their own bikes would be able to board a bus; other cycling groups would have to wait for the next bus. Since the distances from the out-of-Valley lots are too far to ride on a bicycle and the terrain too difficult for most Valley visitors, many bicycles would need to be transported along with visitors to the Valley. For cyclists who want to bring their own bicycles to the Valley, a cargo van or flat-bed truck would be necessary to accommodate all the visitors' bicycles so groups may travel together.

Bicycle Facilities for Sales and Service

While the rental facilities repair and maintain the bicycles they rent, there is little provision for repairing visitors' own bicycles. Neither the Curry Bike Stand and the Lodge Bike Stand do not offer any service to visitors for minor repairs such as fixing flat tires and repairing broken chains. The bike stands do not stock many spare bicycle parts. It would be of great benefit to park visitors who ride their own bicycles in Yosemite to have a facility to bring their bicycles for minor service. Visitors might be encouraged to bring their bicycles if they knew that there was a facility that performed minor repairs as well as stocked and sold replacement parts such as tubes, tires, chains, water-bottles and bicycle helmets.

The number of rock climbers remains small compared to the many participants in other activities in the Valley, yet a mountain shop exists that caters to, and stocks many items necessary for, climbing the high granite walls in the Valley. Many climbers are aware that they are able to purchase equipment in the Valley and see the existence of the mountain shop as support of their activity. Bicycling should be no different. In addition to providing a service to cyclists, bicycle facilities would show that the park encourages and supports visitors who wish bring their bikes to the Valley.

Accessories for Cycling as Transportation

While the bicycles rented in the Valley seemed adequate to many visitors, providing simple accessories on the rental bicycles would help to encourage cycling as a transportation mode in the Valley, as well as enhancing recreation opportunities. The single-speed bicycles that can be rented are very simple bicycles with no additional accessories. Providing baskets mounted on the handlebars or saddle-bags would allow the rental bicycles to transport more equipment, luggage, food, and other gear to lodging and camping locations. Simple errands can be accomplished by providing a place to store purchased items on the bicycle. The same accessories would make it easier for cyclists to carry food, water, sweaters, and other items for longer tours of the Valley.

Not many cyclists ride at night. This may be due to perceived safety issues with park roads or simply because rental bicycles cannot be kept overnight. Barriers to riding bicycles at night in urban areas are reduced in the Valley i.e. traffic safety, crime and colder nighttime temperatures. Alternative 2 will evaluate extended rental hours and periods such as multi-day rentals. Multi-day rentals will allow visitors to keep bicycles overnight. Lights and reflectors on these rental bicycles will increase safety for cyclists riding at night. If Alternative 2 is implemented, bicycles might be the preferred mode of nighttime travel after shuttle buses have stopped operating.

Information provided to Yosemite Valley cyclists both in the park and outside the park can greatly increase visitors' awareness of cycling as an activity and travel mode.

Improvements in trails including, separating pedestrian traffic from cycling traffic will improve safety and the overall bike riding experience. Access to the western end of Yosemite Valley by bicycle is desired by many cyclists.

Integrating the bicycle into the alternatives proposed by the Draft Yosemite Valley Plan SEIS will help to provide additional transportation choices for the Valley visitor. The bicycle, often neglected in transportation plans in urban areas, is be a clean, quiet, and convenient way to see Yosemite Valley.

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Appendix A Bike Rider Interview Form



Introduction: “Hi, my name is _____. I am conducting a survey for the University of California, Merced to better understand bicycle use in Yosemite Valley. Can you spend a few minutes to answer a few questions about bicycling during your visit here? I need one person to volunteer to be interviewed.”

If YES, “Thank you” (continue with survey)

If NO, “Thank you and enjoy the rest of your visit.”

Observed data

Record observed data for all groups that are approached for an interview, even if interview is refused. Interview begins with question 7.

Interview Location: _____

Interview start time (day, Hour:minute AM/PM) _____

- **Number of people in group.** _____
- **Children present.** ₀ No ₁ Yes
- **Rental or private bikes.**
 - ₁ Rented
 - ₂ Private (owned or borrowed)
 - ₃ Some rented, some private
- **Type of bikes. (Check all that apply.)**
 - ₁ Road bike
 - ₂ Mountain bike
 - ₃ Cruiser (single gear)
 - ₄ Tandem

- **Helmets for all riders?**

- ₀ No
₁ Yes

- **Equipment on one or more bikes. (Check all that apply.)**

- ₁ Racks ₄ Lights
₂ Panniers ₅ Trailer
₃ Reflectors ₆ Other: _____

Lodging

- **Are you staying overnight in Yosemite Valley during this trip to Yosemite National Park?**

- ₀ No (Skip to question 10. For question 10, number of nights = 0.)
₁ Yes (Continue with question 8.)

- **Where are you staying overnight in Yosemite Valley? (See Yosemite Valley map.)**

Location: _____

- **In what type of lodging facility are you staying while in Yosemite Valley?**

- ₁ Campground, with or without a tent ₂ Tent cabin
₃ Lodge/hotel room ₄ RV, trailer, or camper

- **When this trip to Yosemite National Park is over, how many days and nights will you have spent in Yosemite Valley during this trip?**

Days _____ Nights _____ ₉₉ Don't know

Travel to, and in, Yosemite Valley and Yosemite National Park

• How did you travel to Yosemite Valley?

₁ transit bus (VIA)

₂ charter or tour bus

₃ train and bus (Amtrak and VIA)

₄ rented motor vehicle

₅ personal motor vehicle

₆ other: _____

• Including this trip, what is the largest number of times that anyone in your group has visited Yosemite Valley?

Visited Yosemite Valley _____ times.

Bicycle Use

• Has any one in this group ridden a bike in Yosemite Valley before this trip?

₀ No.

₁ Yes

• How did you first hear about bike riding in Yosemite Valley? (Check all that apply.)

₁ I heard from friends or family

₂ I read about it in travel magazines

₃ I heard from a bike shop

₄ I read about it in bike magazines

₅ From information off the internet

₆ I saw bike rentals in Yosemite Valley

₇ Saw others ride bikes here during a previous trip

₈ The Yosemite Guide

₉ I bring my bike everywhere.

₁₀ Other: _____

• **What is the main reason you ride bicycles in Yosemite Valley? (Check one only.)**

- | | |
|--|--|
| <input type="checkbox"/> 1 For exercise/fitness | <input type="checkbox"/> 2 To travel to activities around the Valley |
| <input type="checkbox"/> 3 Bike is most convenient way to get around | <input type="checkbox"/> 4 Bike is cleanest way to get around |
| <input type="checkbox"/> 5 Bike is quietest way to get around | <input type="checkbox"/> 6 Other: _____ |

• **Where did you start this bike trip?**

- | | |
|---|---|
| <input type="checkbox"/> 1 Our lodging/camping location | <input type="checkbox"/> 5 Other: _____ |
| <input type="checkbox"/> 2 Bike rental facility at Curry Village | |
| <input type="checkbox"/> 3 Bike rental facility at Yosemite Lodge | |
| <input type="checkbox"/> 4 From where our vehicle is parked. | |
| If vehicle, where is your vehicle parked? _____ | |

• **Where all are you going during this bike trip? (Check all the places they are going or have been on this trip. Show Yosemite Valley map. Probe for more than one destination.)**

- | | |
|--|---|
| <input type="checkbox"/> 1 Yosemite Village and Visitor Center | <input type="checkbox"/> 2 Yosemite Falls |
| <input type="checkbox"/> 3 Happy Isles | <input type="checkbox"/> 4 Upper Pines Campground |
| <input type="checkbox"/> 5 Curry Village | <input type="checkbox"/> 6 The Ahwahnee |
| <input type="checkbox"/> 7 Yosemite Lodge | <input type="checkbox"/> 8 El Capitan Meadow |
| <input type="checkbox"/> 9 Lower Pines Campground | <input type="checkbox"/> 10 Mirror Lake |
| <input type="checkbox"/> 11 Sunnyside campground | <input type="checkbox"/> 12 North Pines |
| <input type="checkbox"/> 13 Housekeeping Camp | <input type="checkbox"/> 14 Other: _____ |

- **What are all the places in Yosemite Valley you have been already on your bikes during this entire trip to Yosemite National Park (not including the bike trip you are now taking)? (Show Yosemite Valley map.)**

- | | |
|---|--|
| <input type="checkbox"/> ₁ Yosemite Village and Visitor Center | <input type="checkbox"/> ₂ Yosemite Falls |
| <input type="checkbox"/> ₃ Happy Isles | <input type="checkbox"/> ₄ Upper Pines Campground |
| <input type="checkbox"/> ₅ Curry Village | <input type="checkbox"/> ₆ The Ahwahnee |
| <input type="checkbox"/> ₇ Yosemite Lodge | <input type="checkbox"/> ₈ El Capitan Meadow |
| <input type="checkbox"/> ₉ Lower Pines Campground | <input type="checkbox"/> ₁₀ Mirror Lake |
| <input type="checkbox"/> ₁₁ Sunnyside campground | <input type="checkbox"/> ₁₂ North Pines |
| <input type="checkbox"/> ₁₃ Housekeeping Camp | <input type="checkbox"/> ₁₄ Other: |
| <input type="checkbox"/> ₁₅ No other bike trips | |
-

- **What are all the places in Yosemite Valley you may still go on your bicycle during your entire visit (not including the trip you are now taking)? (Show Yosemite Valley map.)**

- | | |
|---|--|
| <input type="checkbox"/> ₁ Yosemite Village and Visitor Center | <input type="checkbox"/> ₂ Yosemite Falls |
| <input type="checkbox"/> ₃ Happy Isles | <input type="checkbox"/> ₄ Upper Pines Campground |
| <input type="checkbox"/> ₅ Curry Village | <input type="checkbox"/> ₆ The Ahwahnee |
| <input type="checkbox"/> ₇ Yosemite Lodge | <input type="checkbox"/> ₈ El Capitan Meadow |
| <input type="checkbox"/> ₉ Lower Pines Campground | <input type="checkbox"/> ₁₀ Mirror Lake |
| <input type="checkbox"/> ₁₁ Sunnyside campground | <input type="checkbox"/> ₁₂ North Pines |
| <input type="checkbox"/> ₁₃ Housekeeping Camp | <input type="checkbox"/> ₁₄ Other: |
| <input type="checkbox"/> ₁₅ No other bike trips planned | |
-

- **We are interested in your opinions about bicycle facilities in Yosemite Valley. Please tell us whether you disagree or agree with the following statements.**

There are enough places to lock bicycles in Yosemite Valley. Disagree Agree Don't know

If you DISAGREE, where would you like to see more places to lock bicycles?

There are bike paths going to places I want to ride in Yosemite Valley. Disagree Agree Don't know

If you DISAGREE, what places would you like bike paths to go to?

- **Is there anything that would make you more likely to ride a bike, or would make it easier for you to use you bike for more trips, in Yosemite Valley?**

- **During this trip to Yosemite Valley, have you used, or will you use, the shuttle buses in the Valley?**

₀ No, I haven't used them yet, and I won't be using them.

₁ Yes, I have ridden a shuttle already, or plan to do so.

- **During this trip to Yosemite Valley, have you used, or will you use your own motor vehicle to travel within the Valley?**

₀ No, I will not use my own motor vehicle to get anywhere in the Valley.

₉ No, I did not drive a vehicle to Yosemite Valley.

₁ Yes.

Who rides bicycles in Yosemite Valley?

READ: The following questions will be used for statistical purposes only, for example, to tell us whether the people who answer this questionnaire are similar to other groups of visitors to Yosemite National Park. Your responses are anonymous and confidential.

Are you, or is anyone in your group, an employee of Yosemite National Park or Yosemite Concession Services?

₀ No

₁ Yes

In what country do you live? _____

If in the U.S.A, What is your home Zip Code? _____

Who's traveling with you on this trip? (select all that apply)

Immediate family members

Friends

Relatives

Others: _____

Including yourself, how many people of each age group are traveling with you? (Include entire group, not just those on the bike trip. Enter ZERO for zero values, do not leave blank.)

Younger than 5 years _____

16 to 19 year _____

30 to 39 _____

50 to 59 _____

5 to 15 years _____

20 to 29 _____

40 to 49 _____

60 to 64 _____

65 years or older _____

What is your household's annual gross income from all sources?

If income is not in \$US, ask for income in native currency. Indicate currency and amount below.

Currency: _____ Amount: _____

₁ Less than \$20,000

₂ \$20,000 - 39,999

₃ \$40,000 - 59,999

₄ \$60,000 - 79,999

₅ \$80,000 - 99,999

₆ \$100,000 or greater

₈ decline to answer

Thank You Again for Your Time.

Do you have any comments you would like to add? (Record below.)

Appendix B: Survey Methodology for Locations

Counts were conducted at various locations to determine the level of activity for each of these locations. Since interviews were conducted rather than a mail survey, I wanted to capture the maximum number of cycling groups within the given timeframe. The counts of these locations as well as the interview procedure for each location are described in the following section.

Bicycle activity counts were made every 15 minutes. Since these counts were conducted for different lengths of time at different locations, the best comparison across locations of total bicycle activity is average of the counts across the 12:00pm to 4:00pm. time frame. These data are shown Table B-1. These counts can be used to measure bicycle activity at the given locations.

Curry Village

The counts at Curry Village were intended to capture visitors renting bicycles from the Curry Bike Stand. Counts taken near the bicycle rental facility show this location to be the busiest area in the bicycle network. Across the period 12:00 p.m. to 4:00 p.m. on September 4, 1999 an average of 44 cyclists were counted during each 15 minute interval. An interviewer was stationed outside the bike rental area to intercept riders either leaving the rental area or returning their rental bikes. On subsequent days, the

interviewer changed locations at Curry Village to a location closer to both the motor vehicle parking lot and the path to the Curry Store.

Table B-1: Average Bike Activity Counts from 12:00PM – 4:00PM by Location

Location	Date	Average of counts taken every 15 minutes from 12-4PM	Peak count at this location and date
Curry Village	9/4/1999	44.00	136
Camp6 Intersection	8/13/1999	40.25	76
Valley Visitor Center	8/21/1999	38.50	72
Valley Visitor Center	8/20/1999	37.75	64
Valley Visitor Center	8/14/1999	40.50	62
Administration corner	8/13/1999	33.5	61
Camp6 Intersection	8/14/1999	41.50	58
Mirror Lake Intersection	8/22/1999	19.25	53
Administration corner	8/14/1999	35.00	52
Valley Visitor Center	8/13/1999	21.00	50
Mirror Lake E&W	8/19/1999	15.00	37
Curry&Housekeeping	8/19/1999	22.00	36
Swinging Bridge	9/4/1999	13.5	31
Swinging Bridge	9/5/1999	15.25	28
Mirror Lake Eastbound	8/19/1999	9.50	27
Total 12-4 avg.		28.43	

Camp 6

Camp 6/Village intersection is one of the most heavily trafficked areas in the Valley. The motor vehicle traffic from the Camp 6 day use parking lot as well as the Village area

make the intersection heavily congested during peak times. High bicycle traffic made this area a good recruitment location.

During the weekend of August 14, 1999, the 12:00PM to 4:00PM counts averaged 40.25 one day, and 41.50 the next. These average counts are second only to those near the bike rental facility at Curry Village. Yet, these counts differ from the Curry Village counts in that traffic at this intersection was heavy in both the eastbound and westbound directions. In addition to heavy bicycle traffic, large numbers of pedestrians travel from the Camp 6 lot to Yosemite Village and the Valley Visitor Center. This path also serves bicycle traffic to and from the east end of the Valley including destinations such as Mirror Lake, the Ahwahnee Hotel, and Curry Village. Westbound, cyclists travel through this intersection on their way from Yosemite Falls, the Valley Visitor Center, and Yosemite Village. Because of the high level of cyclist traffic, I positioned two interviewers at this location.

This heavy traffic, coupled with a lack of a shoulder for interviewees to pull out of the flow of traffic, contributed to the lowest response rate of any location. Interviewers also noted that the Camp 6 area contained major destinations including activities that were time dependent (activities at the Valley Visitor Center), and dining locations where potential subjects were interrupted while on their way to a meal. Despite the presence of

stop signs for both the east and westbound direction at the Camp 6 intersection, stopping cyclists was also difficult.

Refusal rates for all interview locations are shown in Table B-2. Of the cyclists approached at Camp 6, 69 percent agreed to be interviewed. The next lowest participation rate was at the Valley Visitor Center, where 80 percent of those approached agreed to be interviewed.

Sugar Pine Bridge

While seemingly ideal, Sugar Pine Bridge proved to also be a problematical location to conduct interviews. Sugar Pine Bridge is located at the east end of the Valley on the bike and pedestrian path between Yosemite Village and Mirror Lake. The only means of access to the bridge is either by bicycle or walking. The interviewer was stationed on the westbound side of the path. Cyclists who stopped on the bridge to enjoy the view were approached for interviews. These interviewees were very cooperative and friendly as they had already stopped on the bridge and did not have to dismount their bicycles for the sole purpose of the interview.

Table B-2: Refusals by Locations

Location Row Percent	Total Attempted Interviews	% Completed
Curry Village	41 ¹	100
Sugar Pine Bridge	8	88
Mirror Lake	43	86
Swinging Bridge	66	85
Valley Visitor Center	10	80
Camp 6	92	69
Overall	260	85

1. All interviewers were instructed to record refusals to the survey. It appears that the interviewer stationed at Curry Village for the duration of the study did not record the refusals.

However, only a few interviews were conducted at this location because the majority of the cyclists in the westbound direction traveled through the Camp 6 intersection where they had already encountered an interviewer. Some refusals at Camp 6 were due to the fact that visitors had just completed an interview at the Sugar Pine Bridge location. It was decided to discontinue interviews at Sugar Pine Bridge due to the low volume of cyclists and increase the interviews at Camp 6 for the remainder of the study period. The interviewer stationed at this location was later moved to Camp 6 to assist the other interviewer.

Valley Visitor Center

The area near the Valley Visitor Center was believed to be an important recruitment location. This area contains four sets of bike racks to accommodate numerous cyclists. The bicyclist activity count on August 14, 1999 week averaged 40.50. But this was nearly double that of the day before. As the 14th was a Saturday, it could be that an influx of day use visitors on the weekend accounts for the tremendous increase over the counts from Friday the 13th. Counts at this location included all visitors moving in the eastbound and westbound direction as well as those within the entire quadrangle area in front of the Valley Visitor Center.

Interviews were conducted at the bike racks. However, low traffic in this area during the interview period in early September resulted in low numbers of completed interviews.

Interviewers moved from the bike racks to the bike path further south of the Valley Visitor Center. This second location proved problematic too. It was difficult to intercept bicyclists as there was no place for cyclists to stop out of the flow of traffic, nor was there any reason, such as an intersection or stop sign, for cyclists to be stopping or slowing. As a result of all these issues, only 10 interviews were conducted at the Valley Visitor Center. The interviewers at this location later moved to the Camp 6 intersection.

Mirror Lake

Mirror Lake can be accessed by two modes, bicycle and walking. At the east end of the Valley, the bicycle is the best mode to travel by. At the top of the hill towards Mirror Lake, a bicycle rack is provided to visitors so they may park their bicycles and continue their journey to the lake by foot. It was at this bicycle rack that the interviews were conducted. This “natural” stopping point proved to be a very successful location for the interviews, resulting in one of the highest response rates of 86 percent. Bicycle activity here was comparable to Swinging Bridge, averaging 15 cyclists for August 19, 1999 from 12:00 p.m. to 4:00 p.m.

Swinging Bridge

Swinging Bridge is an important area in the bicycle path network. It is at the western end of the dedicated cyclist/pedestrian path. There is a beach and picnic area near the bridge. Somewhat secluded from motor vehicle traffic, Swinging Bridge is a popular location for cyclists and pedestrians. Still, during the study period, the average of bicyclist traffic counts ranged only from 13.5 to 15.25 per 15-minute period.

In the summer, the picnic area at the south end of the bridge is a popular destination away from crowded locations farther east in the Valley. A small motor vehicle parking area with restrooms and picnic tables enables visitors to access the area by car. At the north

end of the bridge, a small beach area gives visitors a location to swim and sunbathe. From the north, a bicycle path that leads to the Yosemite Lodge is the only means to get to the bridge.

The response rate at Swinging Bridge was 85 percent. This area had the second highest amount of attempted interviews--66 contacts were made during the interview period. An interviewer was required for both the southbound and northbound direction. Initially, one interviewer was stationed at this location. But as happened initially at Camp 6, a significant number of potential interviews were missed while the interviewer was engaged in an interview.

Cyclists were interviewed while they were stopped on the bridge to enjoy the view or intercepted at the bottom of the bridge. A short turn in the bike path just before the bridge at the north end provided the ideal location to stop cyclists. Groups of cyclists were traveling slowly as they approached the bridge in the southbound direction and were flagged to a stop. Cyclists were also intercepted as they parked their bicycles at the north end of the bridge in the small beach area. Large shoulders along the path in both the northbound and southbound direction also provided a good location to pull groups over and out of traffic. Since many groups were either stopped at the bridge or traveling slowly, cooperation was high among groups.

Interview Subjects

One person was asked to represent the group that was cycling together. For questions dealing with number of previous visits or bike experience, spokespersons would state their own experience level, and ask other group members. The highest level of experience was recorded. In some questions, where multiple responses were accepted, group members other than the spokesperson would voice their responses. The interviewer recorded these responses as well as those of the spokesperson.

Excluding Park Employees

Employees of the National Park Service, Yosemite Concessions Service, or any park partners were not stopped for interviews. Park employees were excluded for two reasons. Park employees' travel behavior, including bicycle travel, was recorded by a more detailed mail survey of park employees conducted during August and September, 1999³. Employees have detailed knowledge of the Park and use bicycles differently than park visitors. Park employees may use their bicycle for travel within the Park to such locations as employment centers, rather than for a recreational use such as a park visitor would do. To distinguish Park employees from visitors, the trained interviewers visually screened

³ The results of this study are summarized in, Kurani et al. 2000.

oncoming cyclists. Several visual clues made Park employees distinguishable from other visitors. Employees usually traveled alone compared to park visitors who traveled in groups. Some employees were easily identified through either a NPS uniform or YCS uniform.

Appendix C: Calculations for the total number of bicycles

The ownership split for bicycles was tabulated on a per-group basis. The group percentage needed to be converted to the total counts. Since we did not know the split of private and rented bikes in groups containing both, two equations were generated. In Equation 1, it was assumed that there was exactly one rental bicycle in groups with both private and rental bikes. In Equation 2 it was assumed that there was exactly one private bicycle in such groups. The true number lies between these two ranges. In groups containing both private and rental bikes the average group size was 4.8.

Year	1996	1997	1998	1999	Average
Total August rentals	8,742	9,388	9,267	10,708	9,526

Since we only have YCS bike rental data from 1996 onward, it was difficult to estimate a trend in the total number of bike rentals. An August average was generated for the 4 years of data. This average is 9,526. For the monthly totals this number was divided by the number of days in August (31). The average daily number of rented bicycles $9,526/31 = 307$.

Equation 1: Mixed groups have exactly one rental bike

$$\begin{aligned}
 \text{A. } & \{[(\# \text{private groups} / \# \text{all groups}) * (\text{average private group size})] + \\
 & [(\# \text{rental groups} / \# \text{all groups}) * (\text{average rental group size})] + \\
 & [(\# \text{mixed groups} / \# \text{all groups}) * (1 \text{ rental bike} + (\text{average mixed group size} - 1))]\} * \\
 & \# \text{all groups} = \\
 & \text{Total number of bikes.}
 \end{aligned}$$

Substituting the known ratios of group types, i.e., the first term on each line, and the known average group sizes, gives the following:

$$\begin{aligned}
 & [(0.50) * (3.1 \text{ private bikes}) + (0.42) * (3.1 \text{ rented bikes}) + (0.08) * (1 \text{ rented bike} + 3.8 \\
 & \text{private bikes})] * \# \text{ all groups} = \text{total \# of bikes}
 \end{aligned}$$

Now, the ratio of the proportion of cyclist groups with all rental bikes to the proportion of groups with both private and rental bikes is:

$$\text{B. } 0.42/0.08 = 5.25$$

And using our estimate of 307 rented bikes per day from above yields:

$$\begin{aligned}
 \text{C. } 307 = \text{Total \# of rental bikes} = \\
 & \text{number of rental bikes in groups containing only rental bikes} + \\
 & \text{number of rental bikes in groups containing both private and rental bikes.}
 \end{aligned}$$

$$307 = (\# \text{rental groups} * (\# \text{ rental bikes/ rental group})) +$$

$$(\# \text{mixed groups} * (\# \text{ rental bikes per mixed group}))$$

From B.,

$$\# \text{ rental groups} = 5.25 (\# \text{mixed groups})$$

Substituting this into C, and recalling that by the assumption which defines this case the number of rental bikes per mixed group is 1:

$$307 = 5.25 (3.1) [\# \text{mixed groups}] + [1 \text{ rental bike in mixed groups}] * [\# \text{mixed groups}],$$

$$\# \text{mixed groups} = 307/17.28 = 17.77$$

Substituting back into B gives:

$$\# \text{ rental groups} = 17.77*(5.25) =$$

93.29 groups of cyclists riding only rented bikes.

Now, the ratio of the proportion of private groups to the proportion of rented groups is =
(0.5/0.42)

Thus, the total number of private groups =

$$(0.5/0.42)*(93.29) = 111.06 \text{ private groups of cyclists}$$

Now the total number of private bikes is the number of private bikes in private groups plus the number of private bikes in mixed groups.

111.06 private groups * Average group size (3.1) =

344 private bikes in private groups

Average number of private bikes in mixed groups (4.8 total bikes – 1 rented bike)*17.77

mixed groups =

67 private bikes in mixed groups

Now summing,

Total number of cyclists ≈ total number of bicycles =

344 privately owned bicycles in private groups +

67 privately owned bicycles in mixed groups +

307 rented bicycles =

718 bicycles

Note that in both this case and the next, we ignore the slight differences between the number of cyclists and the number of bicycles caused by tandem bicycles and children riding in either a child's seat attached to an adults' bike or a trailer.

Equation 2 :Mixed groups have exactly one private bike

$$\begin{aligned}
 \text{A. } & \left[\left(\frac{\# \text{private groups}}{\# \text{all groups}} \right) \times (\text{average private group size}) \right] + \\
 & \left[\left(\frac{\# \text{rental groups}}{\# \text{all groups}} \right) \times (\text{average rental group size}) \right] + \\
 & \left[\left(\frac{\# \text{mixed groups}}{\# \text{all groups}} \right) \times (1 \text{ private bike} + (3.8 \text{ rented bikes})) \right] \times \\
 & \# \text{all groups} = \\
 & \text{Total number of bikes.}
 \end{aligned}$$

Substituting the known ratios of group types, i.e., the first term on each line, and the known average group sizes, gives the following:

$$\begin{aligned}
 & [(0.50) \times (3.1 \text{ private bikes}) + (0.42) \times (3.1 \text{ rented bikes}) + (0.08) \times (1 \text{ private bike} + 3.8 \\
 & \text{rental bikes})] \times \# \text{ all groups} = \text{total \# of bikes}
 \end{aligned}$$

Now, the ratio of the proportion of cyclist groups with all rental bikes to the proportion of groups with both private and rental bikes is:

$$\text{B. } 0.42/0.08 = 5.25$$

And using our estimate of 307 rented bikes per day from above yields:

$$\begin{aligned}
 \text{C. } 307 &= \text{Total \# of rental bikes} = \\
 & \text{number of rented bikes in groups containing only rented bikes} + \\
 & \text{number of rented bikes in groups containing both private and rental bikes.}
 \end{aligned}$$

$$307 = (\# \text{rented groups} * (\# \text{ rented bikes/ rented group})) +$$

$$(\# \text{mixed groups} * (\# \text{ rented bikes per mixed group}))$$

From B.,

$$\# \text{ rented groups} = 5.25 (\# \text{mixed groups})$$

Substituting this into C, and recalling that by the assumption which defines this case the number of rented bikes per mixed group is 3.8:

$$307 = 5.25 (3.1) [\# \text{mixed groups}] + [3.8 \text{ rented bikes in mixed groups}] * [\# \text{mixed groups}],$$

$$\# \text{mixed groups} = 307/20.08 = 15.29$$

Substituting back into B gives:

$$\# \text{ rental groups} = 15.29 * (5.25) =$$

80.27 groups of cyclists riding only rented bikes.

Now, the ratio of the proportion of private groups to the proportion of rental groups is =
(0.5/0.42)

Thus, the total number of private groups =

$$(0.5/0.42) * (80.29) = 95.56 \text{ private groups of cyclists}$$

Now the total number of rented bikes is the number of rented bikes in rented groups plus the number of rented bikes in mixed groups.

95.56 private groups * Average group size (3.1) =

296 private bikes in private groups

Average number of private bikes in mixed groups (1 private bike)*15.29 mixed groups =

15 private bikes in mixed groups

Now summing,

Total number of cyclists \approx total number of bicycles =

296 private bicycles in private groups +

15 private bicycles in mixed groups +

307 rented bicycles =

618 bicycles