

Moped Use by Visitors to Hawaii

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The current definition of mopeds and the rules and regulations governing their ownership and operation as enacted by the 1978 Hawaii Legislature are presented. The results of a study that determined the characteristics of an important segment of the local rental market, i.e., visitors to Hawaii, and the attributes of their recreational excursions are also presented. The major findings obtained from an analysis of traffic accidents involving mopeds and reported by the Honolulu Police Department are included.

The 1978 Hawaii Legislature defined the term "moped" and created a new section in the Hawaii Revised Statutes pertaining to special rules governing moped ownership and operation. A conference committee report (1) issued at the time stated that "because of the increased popularity and use of mopeds, regulation and control is necessary in the interest of safety and traffic efficiency."

The committee report claimed that the majority of moped accidents involved rented equipment. For this reason, additional requirements "of maintaining in effect certain minimum amounts of property damage and liability insurance coverage" (1) were placed on moped rental firms.

This paper presents the major findings of a study (2) that

1. Investigated the legislative background of moped use in Hawaii,
2. Examined the trip attributes and the characteristics of visitors to Hawaii who rented mopeds, and
3. Compared the patterns of traffic accidents involving rented and privately owned mopeds.

LEGISLATION

Definitions

The 1977 Hawaii Revised Statutes made no reference to the term "moped." However, a "device propelled by ... motor power of one and one-half horsepower or less upon which any person may ride, having two tandem wheels sixteen inches in diameter or greater" constituted one of three types of devices covered by the generic term "bicycle," which was excluded from the definition of motor vehicle.

A motor-driven cycle, on the other hand, was defined as a motor vehicle and included "every motorcycle, including every motor scooter, with a motor which produces not to exceed five brake horsepower, and every bicycle with motor attached, but excluding such bicycle with motor of one and one-half horsepower or less."

Thus, devices with a motor less than 1.5 hp were defined as bicycles, whereas those with more than 1.5 but less than or equal to 5 hp were defined as motor-driven cycles and were classified as motor vehicles. The former were generally covered by statutes pertaining to bicycles, although there were certain differences between them and other types of bicycles. In such cases, they were referred to as motorized bicycles or bicycles equipped with a motor, but it remained unclear whether these terms also covered motor-driven cycles.

The current definitions set forth by the 1978 Hawaii Legislature provide for a new classification for the moped that is distinct from the bicycle and the motor scooter. The old definition for motor-driven cycle was deleted and a new one for the motor scooter was added. The following definitions are currently in force:

1. Bicycle: "Every device propelled solely by human power upon which any person may ride, having two tandem wheels sixteen inches in diameter or greater, and including any device generally recognized as a bicycle though equipped with two front or two rear wheels."

2. Moped: "A device upon which a person may ride which has two or three wheels in contact with the ground, a motor having a maximum power output capability measured at the motor output shaft, in accordance with the Society of Automotive Engineers standards, of one and one-half horsepower (one thousand, one hundred and 19 watts) or less and, if it is a combustion engine, a maximum displacement of 3.05 cubic inches (fifty cubic centimeters) and which will propel the device, unassisted, on a level surface at a maximum speed no greater than thirty-five miles per hour; and a direct or automatic power drive system which requires no clutch or gear shift operation by the moped driver after the drive system is engaged with the power unit."

3. Motor scooter: "Every motorcycle which produces not more than five horsepower, and excludes a moped."

Licensing Requirement

A provision that was not applicable to the old class of bicycles equipped with a motor was added in 1978; henceforth, a valid driver's license of any category became mandatory. At this time, there exist 10 such categories in Hawaii; the lowest three are driver's licenses for motor scooters, motorcycles and scooters, and cars and trucks 10 000 lb or less gross vehicle weight.

An earlier provision prohibiting any person under 15 years of age from driving a bicycle equipped with a motor was deleted, and the rule amended to refer to mopeds was added.

Liability

Parents or guardians of minors who operate a moped and cause damage through negligence or misconduct are held jointly and severally liable. In addition, rental firms are required to carry minimum liability insurance coverage of \$10 000 per person and \$20 000 per accident.

Use of Bikeways

The basic provisions of the 1977 statutes relating to the use of bikeways were twofold:

1. No motor vehicle can use a bikeway unless it is executing a legal turn or is specifically permitted to do so (e.g., an official vehicle while on official duty); and
2. Vehicles in the vicinity of the bikeway must in some instances yield the right-of-way to bikeway users (e.g., a right-turning vehicle with a bikeway between it and the curb).

Regarding the use of bikeways by bicycles, it was required that "whenever a usable path for bicycles has been provided adjacent to or on a roadway ... bicyclists shall use the path and no other portion of the roadway." An exception to this rule allowed counties with a population of at least 100 000 to post certain bikeways to prevent bicycles equipped

with a motor from using them. Of the four counties that make up the state of Hawaii, only one qualifies for this exception.

The 1978 legislation left the above rules intact. However, because of the distinction made between bicycles and mopeds, it was necessary to delete all references to bicycles equipped with a motor and to create a new section entitled Special Rules for Mopeds, which require moped drivers to use bicycle paths and empower the director of the state department of transportation and the counties to restrict or prohibit the use of bicycle paths by mopeds.

Other Rules

Other rules applying to mopeds include the following:

1. Prohibition of driving on sidewalks;
2. Prohibition of passengers;
3. Establishment of a maximum operating speed of 35 mph;
4. Requirement that mopeds be driven in single file; and
5. Requirement that unless performing a legal maneuver or otherwise allowed, mopeds must ride as near to the right side of a roadway as practicable. In the case of one-way roadways with two or more lanes, riding on the left-hand side is also permitted.

VISITOR USE AND ACCIDENT PATTERNS

Visitors to Hawaii constitute a significant segment of the local moped rental market. Because questions relating to rented mopeds played a prominent role in the legislative debate discussed above, a study was conducted to examine the characteristics of these renters and the attributes of their trips. An investigation of the patterns of traffic accidents involving mopeds was also undertaken. The study drew on the following data sources:

1. A user survey,
2. A sample of rental agreements,
3. A volume-count and movement survey,
4. Available moped accident reports, and
5. State of Hawaii Data Book (3).

The first four of these sources are described below.

User Survey

A questionnaire was administered to renters over a period of three weeks in February 1978. The survey was conducted on the premises of a moped rental firm located in the Waikiki district of Honolulu, the major visitor destination in the state. The survey instrument was prepared in both English and Japanese and was structured in four parts as follows:

1. Questions about the users, including age, sex, and place of residence;
2. Questions about their visit to Hawaii, such as the type of travel arrangements and whether they were return visitors;
3. Questions about their use of mopeds, including the duration of rental, size of renting group, places visited, traffic violations, and warnings or citations issued to them, and other questions such as car rental, bus use, and foregone activities; and
4. Two open-ended questions, one asking about problems encountered by the renter and the other seeking suggestions for the improvement of the street system.

Rental Agreements

The agreements between renters and the moped rental firm for an entire month were made available to the researchers. From these contracts, the following data were obtained: number of mopeds per agreement, place of residence of renters, and number and type of road trouble calls.

Volume-Count and Movement Survey

An observer located at a fixed point in the Waikiki district conducted an 8-h volume-count and movement survey. The area visible from the observer's vantage point is shown in Figure 1. Each roadway lane, crosswalk, and sidewalk was uniquely coded as shown, and a number of special locations, such as a hotel parking lot entrance, were also identified. The coding system was used to specify the movement of mopeds within the observation area. The information thus obtained included the number of mopeds in each observed group, the sex of the operator, their movement paths, and the maximum number of mopeds abreast for each group. A convenient method of logging the above information was devised as follows:

$$M/F/Z_1D_1 - \dots - Z_nD_n/S/W,$$

where

- M = number of male drivers in a group;
- F = number of female drivers in a group;
- Z_i = lane, sidewalk, or crosswalk code;
- D_i = direction of movement;
- S = stop location, if any; and
- W = maximum observed number of mopeds.

Thus, an entry of 2/2/3E-4E-6N/H/2 means that a group of four mopeds driven by two males and two females entered the area under observation on Kalakaua Avenue in lane 3 moving east (see Figure 1), changed to lane 4, made a left turn into Liliuokalani, and entered the hotel parking lot. The maximum phalanx width observed was two mopeds.

This complete description of movements facilitated the analysis of the data and also made possible the enumeration of any violations of the rules governing the operation of mopeds.

Moped Accident Reports

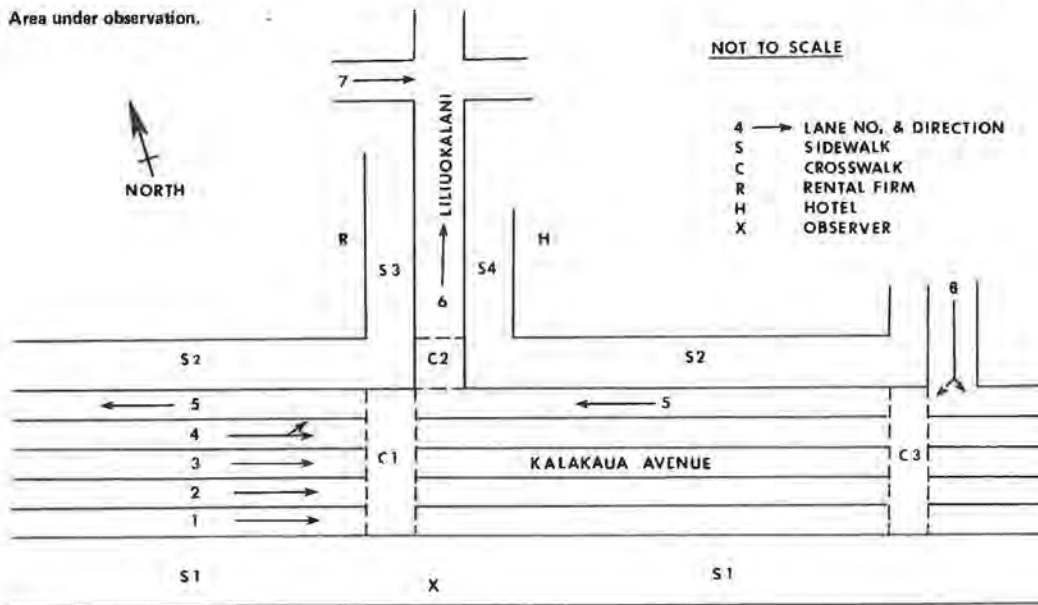
Seventy-one accident reports were obtained from the files of the Honolulu Police Department (HPD) that covered the period from October 1975 to June 1977. Hard copies of the reports are filed by HPD in chronological order and are identified by an accident report number. The contents of these reports are partly computerized by the Hawaii Department of Transportation (HDOT) (4-5), but because the data items in the computer files were limited, it was decided to obtain copies of the actual reports. Normally, because of problems in the definition of terms, this would have entailed many difficulties, especially when we attempted to identify from the computerized files those accidents that involved mopeds. Fortunately, the Motor Vehicle Safety Office of HDOT had compiled a list of moped accident report numbers, dates, and locations. Photocopies of these reports were obtained from HPD at a rate of about 15 reports per week. Data from these reports were coded and analyzed by using the Statistical Package for the Social Sciences (7).

STUDY FINDINGS

User Profiles

The sex profiles of the respondents to the user sur-

Figure 1. Area under observation.



vey and of those observed during the volume-count session are presented below:

Survey	Men (%)	Women (%)
User	64	36
Volume-count	74	26

In both cases, men outnumber women, but there appear to be differences in the proportions corresponding to the two samples. An explanation may be found in the fact that the moped users observed on the street were not drawn exclusively from the rental segment but also included individuals belonging to other categories of moped users. The volume-count proportions are almost identical to those exhibited by University of Hawaii moped users as reported in a paper by Papacostas in this Record.

With regard to age, the user survey revealed an average age of 27 for men and 22 for women; the corresponding medians were 25 and 21, respectively.

Shown below is the distribution by country of residence of the visitors who responded to the user survey. Also shown is the distribution for party heads (excluding Hawaii residents) obtained from the sample of rental agreements and the overall split by country of origin of all visitors to Hawaii as reported by the Hawaii Visitors' Bureau (3).

Sample	Country of Residence (%)			
	United States	Japan	Canada	Other
Use survey	70	9	17	4
Rental agreements	59	7	32	2
Visitors' Bureau (3)	69	14	8	9

A general conclusion can be drawn from this table: a higher proportion of Canadians is found among the moped renters as compared with their representation in the total visitor population. On the other hand, Japanese and other foreign visitors are underrepresented.

The results of the user survey also showed that two-thirds of the renters had never operated a moped before the day on which they were interviewed and that only 17 percent of the renters previously had visited Hawaii compared to the 40 percent return visitors claimed by the Hawaii Visitors' Bureau

(3). Thus, for most renters the use of a moped constituted a novel experience in an unfamiliar setting.

Trip Characteristics

The average duration of moped rentals was estimated to be about 6 h, or a good part of the day's activity. It was also possible to infer from the responses to the questionnaire that about one-third of the renters confined their journeys to the immediate Waikiki district. The majority of the remaining longer excursions involved travel along major arterial streets. Most trips were taken for sight-seeing or joy-riding; only about 10 percent of the respondents indicated that they undertook other recreational activities, such as swimming.

About half of the respondents said that they would not have visited the same places if a moped had not been available to them. Of the rest, about half cited the city bus system, 20 percent a rented car, 20 percent walking, and 10 percent hitchhiking as the mode they would use in lieu of a moped. Interestingly, about 80 percent of those citing the bus as their alternative mode of travel had actually used the Honolulu bus system before, whereas the same proportion of those who cited other means of travel had not.

One-fourth of the moped renters said that they had either rented a car or were planning to do so sometime during their stay in Hawaii. About 40 percent had no plans to rent a car. The rest were not sure.

When asked to identify any safety problems they encountered, respondents to the user survey cited inadequate bikeway facilities, poorly maintained roadway surfaces, and inconsiderate motorists as the major sources of concern.

Violations and Enforcement

Thirty-five percent of the respondents said that they had ridden on a sidewalk for some portion of their trips; no one indicated receiving either a warning or a citation from the police. This level of tolerance of moped rule violations was also borne out from the volume-count and movement survey, during which no rule breaker received the attention of the police. Ten percent of the observed moped users rode on a sidewalk, 8 percent drove in the wrong

direction of one-way streets, 16 percent of the total sample (or 26 percent of those traveling in groups) rode two or more abreast, and 22 percent of those not executing a left turn were seen in a lane other than the prescribed right-hand lane. However, it should be pointed out that whether strict conformance to the rules governing the operation of mopeds in Hawaii would improve or worsen their safety record is largely an open question and needs careful examination.

Accident Patterns

It should be made clear that the following findings relating to accidents involving mopeds were based on the accident-number method; the researchers were faced with the, unfortunately, all-too-common problem of inadequate exposure data for either moped users as a group or for the various moped user categories.

Because it was claimed during the legislative debate on moped regulation that the majority of moped accidents in Hawaii involve rented devices, the study tried to compare the accident patterns of rented versus privately owned mopeds.

Of the 71 accidents analyzed, only 56 clearly identified the owner of the device involved. Contrary to the aforementioned claim, 43 of these (or 77 percent) involved privately owned and not a rented moped. Moreover, with one exception, chi-square comparisons at the 0.05 level of significance disclosed no differences between the characteristics of accidents involving privately owned mopeds and those with rented mopeds. The only exception was that renters were less likely than owners to be involved in accidents occurring on multilane divided highways.

With respect to accidents, five levels of which (ranging from no injury to fatality) are reported in Hawaii, the majority of the accidents analyzed were of the minor-visible-injury type. There was one fatality. No-injury cases were found to be infrequent, but this may be due to low reporting rates for these accidents.

There was a noticeable lack of head-on collisions and a very small number involving a parked car. The remaining collision patterns were similarly represented; side-swipe and left-turn accidents showed a slight edge over rear-end, right-angle, and right-turn collisions.

Regarding the age of moped drivers, the most vulnerable group, in terms of total accidents, was between the ages of 16 and 20 years.

Finally, it is of interest to note that only one accident report indicated roadway defects at the accident site. If we consider that moped users consistently identify roadway defects as one of their major complaints, this finding may carry the implication that those who do not use mopeds, including members of the police force and perhaps transportation planners, tend to view and evaluate the prevailing roadway conditions from the perspective of the motorist rather than the moped user. If true, this perspective may have as a consequence the unwillingness on the part of planners to consider seriously the investment of funds for the improvement of special facilities used by mopeds.

SUMMARY

The 1978 Hawaii Legislature defined the term "moped" as constituting a new category of devices that are distinct from bicycles and motor vehicles. A limitation of 1.5 hp measured at the motor output shaft and a maximum engine displacement of 50 cc were imposed. Earlier rules pertaining to a now-eliminated

category of bicycles equipped with a motor were updated and consolidated into a special section of the Hawaii Revised Statutes. According to current provisions of the state law, moped drivers must have a valid driver's license and must be at least 15 years old. Parents and guardians are considered to be jointly liable with minors, and moped rental firms are required to carry minimum damage and liability insurance coverage.

Based on a user survey, a volume-count and movement survey conducted in the Waikiki area of Honolulu, and a sample of rental agreements, the study described here determined the characteristics of visitors to Hawaii who rented a moped and the attributes of their moped excursions. The study also analyzed a number of traffic accidents involving mopeds as reported by HPD.

The majority of the renters surveyed were found to be visitors from the rest of the United States. Canadians were more likely, whereas Japanese and other foreign visitors were less likely, to rent a moped as compared with their proportions in the overall visitor population. Male renters outnumbered females and were somewhat older.

The average duration per rental was about 6 h. Almost all excursions were made exclusively for sight-seeing and joy-riding. Approximately 10 percent of the trips involved another recreational activity such as swimming. About one-third of the renters confined their trips to the immediate Waikiki area.

Approximately 25 percent of the renters indicated that they either had rented a car or were planning to do so during their stay in Hawaii. About 40 percent said they had no such plans and the rest were not sure.

The renters identified as major problem areas the need for more and better bikeways, the need for better maintenance of roadways, and inconsiderate motorists.

Based on total accidents, the study showed that a legislative finding that the majority of moped accidents in Hawaii involve rented devices was not accurate. With a single exception, no significant differences were found in the accident patterns of renters versus owners of mopeds. The majority of the reported accidents involved minor visible injuries and there was one fatality. The most vulnerable age bracket was between 16 and 20 years.

Traffic violations by moped users are generally tolerated by the police, but the safety implications of this are unknown at this time.

Finally, a significant difference in the perception of roadway conditions was found between moped users and police officers who completed the accident reports. Hence, a better awareness of special problems encountered by moped users is needed.

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Motorcycle Trade Press Exposure Study

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To determine nationwide motorcycle rider characteristics, training, protective gear use, and riding patterns, the Motorcycle Safety Foundation conducted a questionnaire survey in cooperation with the motorcycle trade press. Seven motorcycle magazines ran the full-page questionnaire in their January 1981 issue: American Motorcyclist, Biker, Cycle, Cycle Guide, Cycle World, Road Rider, and Touring Bike. In addition, a New England motorcycle club newsletter reprinted the form. A total of 16 339 forms were returned and analyzed. These national exposure data replicate the findings from an earlier observational exposure study by Hurt in such areas as motorcycle brand, engine size, motorcycle and helmet color, and respondent's sex and education.

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RIDING PATTERNS

Mileage Last Month

The questionnaire appeared in the January 1981 issue of the trade press magazines. It appears that the magazines were received in December, because many respondents noted that their answers were for November. Therefore, half the responses for "last month" probably represent November and half December.

Twenty-six percent of the respondents said they had ridden zero miles; only 8 percent claimed more than 1000 miles. The mean was 410 miles and the median was 200 miles. The highest mileage claimed was 8500 and only 55 respondents claimed more than 3000 miles. The data from the question about distance ridden last month are as follows:

No. of Miles	Percent of Respondents	No. of Miles	Percent of Respondents
0	26.1	701-800	3.9
1-100	10.9	801-900	1.5
101-200	15.2	901-1000	5.8
201-300	8.5	1001-2000	6.7
301-400	6.2	2001-3000	0.8

No. of Miles	Percent of Respondents	No. of Miles	Percent of Respondents
401-500	8.3	3001-4000	0.2
501-600	3.7	4001-5000	0.05
601-700	2.1	5000+	0.07

Annual Mileage

Less than 1 percent of the respondents stated that they had not ridden last year, and 26 percent claimed 10 000 miles or more. The average number of miles ridden was 7110; the median was 6000 miles. The highest mileage reported was 85 000, although only 60 respondents claimed more than 30 000 miles (85 000 miles at an average of 50 mph is 1700 h--there are only 8760 h in a year). Mileage last year is summarized below (zero-mileage responses excluded):

No. of Miles	Percent of Respondents	No. of Miles	Percent of Respondents
0	0.9	6001-7000	6.5
1-1000	5.5	7001-8000	7.1
1001-2000	10.3	8001-9000	4.1
2001-3000	10.0	9001-10 000	7.1
3001-4000	9.9	10 001-20 000	16.9
4001-5000	10.4	20 001-30 000	1.9
5001-6000	9.0	30 001+	0.4

By Manufacturer

The number of miles that respondents reported riding last year by manufacturer differed substantially only for BMW. As the table below shows, BMW owners reported an average of 2500 miles more than that reported by owners of the Harley-Davidson:

Avg No. of Miles	Manufacturer
9940	BMW
7440	Harley-Davidson
7090	Honda
7070	Suzuki
6490	Yamaha
6410	Kawasaki

By Engine Size

The number of miles last year reported for various sizes of bikes increased with larger engine sizes. Motorcycles with engines less than 400 cc traveled only about 3000 miles last year compared with those