FINAL REPORT

THREE-WHEELED OFF-ROAD VEHICLE GASOLINE CONSUMPTION IN MINNESOTA

Prepared for:

MINNESOTA DEPARTMENT OF NATURAL RESOURCES
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INTRODUCTION

PURPOSE

The purpose of this study is to determine the level of gasoline consumption by three-wheeled, off-road vehicles in the State of Minnesota. The study results will be used by the Departments of Natural Resources, Revenue and Transportation to determine the level of gasoline tax revenues attributable to the use of these vehicles for recreation and business.

Both a telephone and a mailed survey were used to determine the level of use of these vehicles for this study. An important objective of this study was to distinguish between the total gallons of gasoline consumed by these vehicles in the state and that proportion directly attributable to recreational use.

PERSPECTIVE

The definition of a three-wheeled, off-road vehicle is clearly established by Laws of Minnesota, 1984:

> ...a motorized flotation-tired vehicle of not less than three low pressure tires, but not more than six tires, that is limited in engine displacement of less than 800 cubic centimeters and total dry weight less than 600 pounds.

These vehicles are designed to carry a single rider/driver without provision for passengers.

Specific objectives of the study include:

1. The number of Minnesota households owning one or more vehicle.
2. The average and median number of vehicles owned by households with one or more vehicle.
3. The total number of vehicles in Minnesota
4. The total number of days that each vehicle is used for any purpose.
5. The proportion of these days that are primarily recreational in nature.
6. The amount of gasoline consumed by vehicles in the course of recreational outings.
7. The total annual consumption of gasoline for recreational purposes.
8. Forecast future Minnesota ownership and recreational use of these vehicles.

In order to accomplish these objectives, two surveys were conducted. The first was a general population telephone survey of Minnesota households to determine the number of households with these vehicles. The second was a mailed survey to individuals who had purchased a vehicle within the last eighteen months. The specific methodology and results of these surveys are presented in the remainder of this brief report.

SAMPLING METHODS

Telephone Survey

A general population telephone survey provided the basis for estimating the total number of Minnesota households owning three-wheeled off-road vehicles. The experimental design included a random sample with replacement. That is, a sample of 500 was drawn from all households served by telephones in the state.

The 500 sample size was based on a statistical distribution with a median and mode of one and a mean less than one. Data from industry sources indicated that approximately five percent of all Minnesota households own such a vehicle. Further, industry statistics indicated that the median number of vehicles per household was one. Using these data and assumptions, a sample size of 500 provides an acceptable standard error of the estimate.

Each of the 93 telephone companies operating in the State were contacted to obtain:

- number of operating telephone exchanges,
- assigned 3-digit prefixes to each exchange,
- number of Minnesota residential stations assigned within each exchange, and
- area code.

Business and non-Minnesota households were excluded from this compilation. This method documented 1,409,492 working residential stations in November, 1984 in Minnesota. Known prefixes assigned exclusively to business and governmental listings were excluded from the compilation.

To draw the sample, the working exchanges were listed in a table which included the total number of residences in each exchange and the cumulative total of all exchanges. Using a random start and an equal interval, the exchanges to receive calls were selected. The operating prefix and the last four digits of the telephone number were selected from computer generated random numbers tables.

Working telephone numbers identified by the above method were called at least three times at different hours of the day. Numbers without an answering party were replaced after the third attempt. Business, government offices and non-working numbers were likewise replaced.

This methodology gave each household in Minnesota with telephone service an equal opportunity of being selected. Since exchanges have specific geographical boundaries, the resulting sample was distributed over the State in approximate proportion to the population.

A copy of the questionnaire for the telephone survey is contained in the end pocket.

Mailed Survey

In order to determine the use patterns of the three-wheeled vehicles, a survey was mailed to 1000 individuals who recently purchased a vehicle. The mailed survey permitted detailed questions concerning the number of days that the vehicles were used, the proportion of those days that were for recreational purposes, and the amount of gasoline consumed in the last 12 months.

The sample was drawn from a list of owners in the State that is maintained by the Specialty Vehicle Institute of America (SVIA) in Costa Mesa, California. Their list comes from the warrantee registrations of the four largest manufacturers. Those four account for approximately 96 percent of all three-wheeled vehicles marketed in the United States. The sample was drawn by the SVIA using the specifications of the Minnesota DNR and the contractor.

Unfortunately, the SVIA list included all vehicles defined by the major manufacturers as off-road. Therefore, the list included the three- and four-wheeled vehicle of interest to this study, as well as two-wheeled vehicles (motorcycles) that cannot be licensed for street use. The staff of the SVIA estimated that approximately 20 percent of the list included owners of these two-wheeled vehicles.

Further, the list includes only those individuals who purchased the vehicle within the last 18 months and is arranged in Zip Code order. Accordingly, the initial selection of approximately 1550 names and addresses was made using a random start and an equal interval. In order to reduce the 1550 names to 1000, a further sample was drawn by the contractor, again using a random start and an equal interval.

Each individual selected received a cover letter, questionnaire, and stamped return envelop. Each letter was individually typed on bond paper and individually signed. The questionnaires were sequentially numbered to assure that respondents were not sent a follow-up letter. Response management was conducted on a computer-based mailing system. Two weeks after the original survey package was mailed, a follow-up letter was sent to individuals who had not yet returned their questionnaire.

Replacements were made for two conditions. The first was for undeliverable survey packages resulting from the individual moving or an inaccurate address. We also replaced surveys which were returned indicating that the household did not own a three-wheeled vehicle. These replacements were made one week and two weeks after the initial survey mailing. The new names were drawn from the remaining addresses nearest to that being replaced by alternating left or right on the list. The reason for using this method was to assure, insofar as possible, that the replacement was also located within the same zip code.

A copy of the questionnaire for the mailed survey is contained in the end pocket.

COMPUTER ANALYSIS

The completed surveys were edited, then coded onto a microcomputer. Those data files were then edited and transmitted to a main-frame computer. The results were analyzed using SPSS as maintained by the University of Minnesota computer Center.

RESPONSE RATES

A total of 500 telephone surveys were completed. In the process of administering the survey, 103 individuals refused to participate. The methodology included calling numbers at random. During administration of the survey, it became apparent that a majority of the refusals were actually businesses that were called. Of the 500 households interviewed, 22 indicated that they owned a three-wheeled vehicle. Four of the 22 owners indicated that they did not use their vehicle for recreation.

The final results of the mailed survey were that 16 surveys were ultimately undeliverable and not replaced, while 49 individuals did not own a three-wheeled vehicle. Additionally, 567 individuals returned a completed questionnaire. Therefore, the effective response rate was 60.6 percent. Four individuals refused to complete the questionnaire.

Figure 1 presents the response rate by day.

In our professional judgement, the effective response rate of 60.6 percent provides a valid estimate of the parameters measured by the survey. Had there been time for a third follow-up, we believe that the response rate would exceed 67 percent.

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PERCENT                                                    Day
0    1    2    3    4    5    6    7    8    9
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-------------------------------------------------------
                                                          331
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Figure 1. Cumulative Response Rate by Day.

RESULTS

QUALIFICATION OF VEHICLES

Throughout both the mailed and the telephone surveys care was extended to assure that respondents were addressing three-wheeled off-road vehicles as defined in the legislation. The respondent was asked to list the number of wheels, engine size, weight and the volume of the gasoline tank. Before coding responses, each vehicle listed was reviewed to assure conformance to the legal definition. Those cases where large vehicles were listed were eliminated from consideration. We are confident that the results of this study do indeed include only qualified vehicles.

VEHICLE OWNERSHIP

The telephone survey provides the estimate of the number of households in Minnesota that own three-wheeled off-road vehicles. As indicated previously, 22 of 500 households contacted owned one of these vehicles. The State Demographers office provided estimates of the number of households in Minnesota for 1983 and 1985. The 1985 estimates included a low and a high estimate.

The telephone survey indicated that 4.2 percent of the households in Minnesota own a three-wheeled off-road vehicle. In 1983 there were an estimated 1,508,382 households in Minnesota. The 1985 projected number of households is 1,595,800 (low) and 1,634,400 (high). By interpolating for 1984, the estimated number of households with these vehicles is 68,292 (low) and 69,141 (high). The standard error is 0.0092.

AVERAGE AND MEDIAN OWNERSHIP

The estimate of the average and median ownership in Minnesota is available from the results of the mailed survey. Table 1 presents the number of vehicles owned for each household.

TABLE 1
Number of Vehicles Owned

Number	Frequency	Percent	Cumulative Percent
1	417	73.5	73.5
2	119	21.0	94.5
3	23	4.1	98.6
4	7	1.2	99.8
6	1	0.2	100.0
Total	567		

Table 1 indicates that the average number of vehicles owned by household with one or more vehicles is 1.34 and the median number is one. The standard error is 0.027.

TOTAL NUMBER OF VEHICLES IN MINNESOTA

The number of households with one or more vehicles and the average number of vehicles per household have already been calculated. By combining these estimates, the total number of vehicles in Minnesota can be derived. For these calculations, we will use both the low and high estimate of households in Minnesota as interpolated from the State Demographer's projections.

The low estimate of households with one or more vehicle is 68,292. With 1.34 vehicles per household and a standard error of 0.027, there is an estimated 91,511 plus or minus 2470 vehicles in the state. The high estimate of households provides an estimated 92,649 plus or minus 2501 vehicles.

The difference between the high and low estimates of households as provided by the State Demographer is 1,138 vehicles. For simplicity of further computations, we believe that it is logical to take a middle point between these two values. Therefore, our estimate of the number of vehicles in the state is equal to 92,000 plus or minus 2,484 (89,516 to 94,484).

NUMBER OF DAYS USED

The mailed survey also permits us to estimate total use of these vehicles. The questionnaire (Appendix A) contained two sets of questions on the number of days used. The first question asked the respondent the number of days that the vehicle was used in the last 12 months. The second question asked the respondent to break that use down by quarters. As expected, some respondents provided estimates that were not consistent.

Table 2 presents the number of days that the vehicles are used as derived from the two different questions. The table also separates those individuals who have owned the vehicle for less than one year from those that have owned their vehicle for more than one year. As expected, new owners have a higher mean number of days that the vehicle is used.

It is clear that keeping first-year owners separated is necessary to derive the most accurate estimate of use and gasoline consumption.

Note that the estimated total use of the vehicles is lower for the seasonal question. The requirement of using a twelve-month recall period is an inherent difficulty in this survey. The alternative, using a weekly or monthly recall period, requires conducting the survey over a one year period. That was not possible. Further, some respondents refused to provide the seasonal estimate. The seasonal use for 44 of the vehicles was not provided. This compares with 29 that provided not estimate for the annual question.

TABLE 2
Annual and Seasonal Estimates of Total Use
(Days)

Estimate Source	Mean	Standard Error
Annual question		
Owned <12 months	119.58	12.96
Owned >12 months	86.91	4.58
Weighted mean	99.36	7.77
Seasonal question		
Owned <12 months	106.47	11.55
Owned >12 months	79.86	4.49
Weighted mean	90.00	7.18

For further computations, we believe it is reasonable to use both of these weighted means, rounded to the nearest whole number (99 and 90 days). It is imperative to recall that this estimate applies only to vehicles that are used wholly or partially for recreation. Those vehicles that are used only for business or farm purposes are not included in these computations.

NUMBER OF DAYS USED FOR RECREATION

After providing the estimate of the total number of days that each vehicle was used, the respondent was asked to estimate the number of those days that were primarily recreational in nature. Again, it is important to recall that the following estimates apply only to those vehicles that are used at least partially for recreation.

Two estimates of the number of days used for recreation are available from the survey; annual and seasonal use were separately listed. Table 3 shows the annual and seasonal estimates of recreational use, as well as the proportion of total use that is primarily recreational in nature.

GASOLINE CONSUMPTION

The survey instrument also asked respondents to estimate both annual and seasonal use of gasoline for each vehicle. Again, the estimates of use vary, but not as much as the total days and recreation days of use. Table 4 presents both the total gallons used per vehicle and the average of the total used per vehicle.

TABLE 3
Annual and Seasonal Estimates of Recreational Use
(Days)

Estimate Source	Mean	Standard Error
Annual question		
Owned <12 months	91.91	10.22
Owned >12 months	65.10	3.73
Weighted mean	75.32	6.20
Seasonal question		
Owned <12 months	79.64	9.31
Owned >12 months	62.38	3.79
Weighted mean	68.96	5.89
Proportion		
Annual question		
Owned <12 months	93.24	13.87
Owned >12 months	81.92	1.86
Weighted mean	86.23	6.44
Seasonal question		
Owned <12 months	79.54	2.22
Owned >12 months	80.67	1.62
Weighted mean	80.24	1.85

TABLE 4
Annual and Seasonal Estimates of Gasoline Consumption
(Gallons)

Estimate Source	Mean	Standard Error
Total Consumption:		
Annual question		
Owned <12 months	60.53	9.45
Owned >12 months	30.10	2.23
Weighted mean	41.70	4.98
Seasonal question		
Owned <12 months	53.49	7.17
Owned >12 months	29.15	2.28
Weighted mean	38.43	4.14
Average Consumption Per Day:		
Annual question		
Owned <12 months	0.67	0.07
Owned >12 months	0.50	0.03
Weighted mean	0.56	0.04
Seasonal question		
Owned <12 months	0.73	0.08
Owned >12 months	0.49	0.03
Weighted mean	0.58	0.05

Note that the average total consumption is equal to the total consumption divided by the total days used. These computations were performed by the computer for each separate case.

The next step is to derive the proportion of these gasoline consumption estimates that are for recreational use only. This is done by multiplying each estimate of gasoline consumption by the proportion of recreational use. The results are shown in Table 5.

The table shows that there is a difference of 6 gallons per year per vehicle for the two different estimates. As a result, we feel that these two sets of questions provide reasonable, albeit different, estimates of gasoline consumption. When these values are interpreted within the overall context of the limitations imposed by the timing of the study, in our professional judgement they do provide an acceptable degree of accuracy.

TABLE 5
Annual and Seasonal Estimates of Gasoline Consumption
For Recreational Use
(Gallons)

Estimate Source	Mean	Standard Error
Annual question		
Owned <12 months	56.44	23.27
Owned >12 months	24.66	4.09
Weighted mean	36.77	11.40
Seasonal question		
Owned <12 months	42.54	9.39
Owned >12 months	23.51	3.89
Weighted mean	30.76	5.99

TOTAL GASOLINE CONSUMPTION FOR RECREATION

Total gasoline consumption for recreation is derived in a two-step process. First, the number of vehicles in the state are multiplied by the percent that are used at least partially for recreation. Second, the number of vehicles used for recreation are multiplied by the average annual consumption of gasoline for recreational purposes.

The mailed survey indicated that 17.8 percent of all vehicle owners use it for business or farm use only. Accordingly, of the 92,000 households that own a three-wheeled off-road vehicle, only 75,624 are used for recreational purposes.

Given previous calculations that indicated gasoline consumption for all purposes was between 31 and 37 gallons/vehicle/year, the total gasoline consump-

tion for recreational purpose are shown in Table 6. Note that the computations of gasoline consumption are based only on those vehicles that are used at least partially for recreation.

Accordingly, in our professional judgement, the total number of gallons of gasoline that is consumed for recreational purposes by three-wheeled off-road vehicles is equal to 2,553,500 gallons annually.

TABLE 6
Gasoline Consumption for Recreational Use
(Gallons)

Estimate Source	Average Gasoline Consumption	Number of Vehicles	Recreation Consumption
Annual question	36.77	75,624	2,780,695
Seasonal question	30.76	75,624	2,326,194

SEASONAL USE

Finally, the survey documented that there is a marked seasonal pattern to recreational use of three-wheeled vehicles. Table 7 presents the seasonal pattern. Summer and fall are the most heavily used seasons.

TABLE 7
Seasonal Use of Three-Wheeled Vehicles
(Days)

Season	Owned <12 months	Owned >12 months	Weighted Average
Total Use			
Winter	7.71	15.59	12.59
Spring	12.79	18.32	16.21
Summer	19.72	24.41	22.62
Fall	15.16	19.27	17.70
Recreational Use			
Winter	6.24	13.39	10.66
Spring	9.03	14.39	11.73
Summer	15.50	19.48	17.96
Fall	11.42	15.12	13.71

FORECASTED MINNESOTA OWNERSHIP AND RECREATIONAL USE

During the course of this study, we searched the literature and contacted knowledgeable researchers concerning trends in the ownership of three-wheeled off-road vehicles. We were unable to find a significant amount of literature beyond that already researched by the DNR and contained in their report "Off-Road Vehicle Use in Minnesota". Accordingly, there is very little information on which projections can be based.

The most useful data available came from the SVIA, which provided historical trends of sales in Minnesota. The percent growth (or decrease) in sales is shown in Table 7.

TABLE 8
Rate of Increase in the Wholesale Shipments
To Dealers in Minnesota

Period	Percent Growth
1980 - 1981	+84.5
1981 - 1982	+19.6
1982 - 1983	+36.2
1983 - 1984	-13.0

The table indicates that sales are falling off. The SVIA attributes this to the normal product sales growth curve. That is, as the market becomes saturated, sales decline. The decrease of 13 percent, as shown in Table 7, is attributed to the market nearing its saturation point. The SVIA stated that Minnesota experienced a more rapid increase in sales than most other states in the United States. Accordingly, national sales trends would not provide as accurate an estimate as Minnesota trends.

Consequently, we are left with little more than the 13 percent decline for 1984 and qualitative judgements based on the results of the survey, review of previous studies and the previously cited DNR study. It seems reasonable, then to use the 13 percent decline in shipments and population growth as the basis for projecting recreational use of vehicles through 1987.

Consequently, assuming that shipments will continue to decline by 13 percent per year, there will be a projected 129,200 vehicles in the state by the end of 1987. When this is adjusted for the projected change in population,as supplied by the State Demographer's office, the projected number of vehicles increase to 130,200 by 1987. It is reasonable to take population growth into account since the increase represents additional market potential. When this is reduced to account for exclusive business and farm use, the total number of vehicles used for recreation in 1987 is projected to be 107,000.

Of the 107,000 vehicles projected to be used in 1987, only 8.2 percent of them will be held by new owners (12 months or less). Approximately 91.8 (98,100 vehicles) will have been owned for more than one year. Table 9 presents the effect that the shifting ownership pattern will have on the weighted mean of gasoline consumption. Note that the table is similar to Table 5, but with a different percentage of new and old owners.

TABLE 9
Annual and Seasonal Estimates of Gasoline Consumption
For Recreational Use in 1987
(Gallons)

Estimate Source	Mean	Percent	Standard Error
Annual question			
Owned <12 months	56.44	8.2	23.27
Owned >12 months	24.66	91.8	4.09
Weighted mean	27.28		11.40
Seasonal question			
Owned <12 months	42.54	8.2	9.39
Owned >12 months	23.51	91.8	3.89
Weighted mean	25.08		5.99

The result is that the weighted average gasoline consumption decreases when a larger percent of the vehicles have been owned for more than one year. The pattern of recreational, business and farm use can logically be held constant over the next three years. Thus, the 25.1 and 27.3 gallons consumed per vehicle for recreation yields a total estimated recreational use consumption for 1987 of between 2.7 and 2.9 million gallons. In our professional judgement, the most probable gasoline consumption for 1987 will be 2.8 million gallons.

We believe that this estimate is realistic given the rapid expansion of the market for these vehicles within the last five years. It is apparent from industry records that there still is substantial market potential in the state, even though shipments and sales are slowing.