***** DRAFT *****

Examining the Uncertainties in Speed-VMT Distributions for Emissions Inventories: South Coast Air Basin

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INTRODUCTION

The California Air Resources Board (CARB) maintains a suite of models, known as EMFAC, to estimate emissions from on-road mobile sources. The executable modules CALIMFAC, EMFAC and BURDEN are embedded in EMFAC, and together estimate vehicle activity weightings and mileages, emissions factors, and the total emissions inventory, respectively (CARB, 1996). The mobile emissions inventory modeling system has been modified over the years (CARB, 1996; CARB, 2000), including efforts both to enhance the emission factors and the total emissions estimation methods, and to provide updated travel activity input data to the model. The current version of model is EMFAC2002 (CARB, 2003).

Speed, VMT and speed-VMT distributions are important for estimating running emission factors in the EMFAC module, and total running emissions in the BURDEN module of EMFAC (CARB, 1996; CARB, 1996; CARB, 2000; CARB, 2003). Changes in speed-VMT distributions, (i.e., percentages of VMT in each speed bin[1]) affect the magnitude of total estimated emissions. Pollutant specific emissions for a given speed bin are estimated by multiplying VMT by the composite emissions factors estimated for that speed bin. Total daily or hourly running exhaust emissions for a given period in a given calendar year (month or season) are calculated by aggregating the emissions estimated for each speed bin.

1.1 Purpose

This report investigates the significance of a recent change in the speed-VMT distributions utilized as defaults in the latest version of EMFAC, EMFAC2002 (CARB, 2003). Previous research has shown that changes in the speed-VMT distributions can have a range of effects on mobile emissions inventories, and subsequently, conformity. For example, when speed VMT-distributions were calculated using *trip-based* flow rates and average speed forecasts, the total estimated emissions (Ito et al., 2001), and weighted speed correction factors (Nanzetta et al., 2000), were substantially different in magnitude from those computed using the traditional *link-based* flow rates and speeds. Others have found that different levels of network, which also change the distributions of VMT with respect to speed, resulted in highly different regional mobile emissions inventories (Sbayti et al., 2002).

This research suggests that changes in EMFAC speed-VMT distributions defaults will almost certainly, and perhaps substantially, impact estimated total emissions.

This report compares the effects of recent changes in speed-VMT distributions in EMFAC2002 to the previously approved EMFAC model, EMFAC7G (CARB, 1996; CARB, 1996). To test the accuracy of EMFAC's default speed-VMT distributions, we also analyze speed-VMT distributions from real-world freeway average speed and flow rate measurements, and compared them to the default distributions. Finally, to explore if the EMFAC speed-VMT distribution defaults represent speeds observed by individual

[1] Data is provide for 13 "speed bins", named for the average speed in each 5 mph incremental set, ranging from 5 mph (the 5 mph speed bin) to 65 mph.

vehicles, we estimated the percentages of time when speeds in a given speed bin are observed using newly collected chase car second-by-second speeds measured on different types of facilities.

2 METHODOLOGY

In EMFAC, mobile emissions inventories can be estimated for the entire state, or for air basins, counties or districts (CARB, 1996; CARB, 2000; CARB, 2003). The focus of this report is the South Coast Air Basin (SCAB), including Orange and parts of the San Bernardino, Riverside and Los Angeles counties.

In the remainder of this section, we discuss the data used in the analysis. These data include default SCAB speed-VMT distributions from EMFAC7G and EMFA2002, as well as freeway speed-VMT distributions calculated using real-world link flow rates and average speeds estimated for the summer of 1997. In addition, distributions of instantaneous speeds on freeways and other facilities, referred as speed fractions, are estimated using recent chase car second-by-second speed measurements, and compared to the trip-based distributions in EMFAC2002.

2.1 SCAB Speed-VMT Distributions: with EMFAC7G Defaults

In EMFAC7G, the percentages of VMT by each speed bin in SCAB can be extracted using the EMFAC source code for each county, by year (from 1990 to 2020), and period of the day (CARB, 1996). We created a new file that included the speed fractions for each of the four counties during select calendar years. EMFAC7G provides default speed-VMT distributions only for passenger cars, except for the year 2020, for which speed-VMT distributions for urban diesel buses are also provided for SCAB counties. We intended to use the 2020 urban diesel bus speed-VMT distribution as the default for our other select calendar years in the model, however, for reasons discussed below, we excluded urban diesel buses from our analysis.

The SCAB speed-VMT distributions for passenger cars and urban diesel buses (using the 2020 distributions) are included among the EMFAC7G defaults for different calendar years (CARB, 1996). These distributions are given, by county, for six different periods of the day: 0a to 6a, 6a to 9a (AM peak), 9a to 12p, 12p to 3p, 3p to 6p (PM peak), 6p to 12a periods (CARB, 1996). In addition to the speed-VMT distributions by county, calendar year and period, two more default files, which include percentages of VMT for each period of the day and total VMT values for each vehicle type, are also provided for different calendar years.

Although urban diesel bus speed-VMT distributions are available as noted earlier, the total VMT for urban diesel buses is zero for all the calendar years represented in the default total VMT file (CARB, 1996)[+]. Given that total VMT value for urban diesel buses

[+] Although daily VMT values for urban diesel buses are zero in the default file, daily VMT values for urban diesel buses are assumed to be equal to the total VMT values provided for medium duty trucks for each calendar year. These daily VMT values for urban buses are allocated to each period of the day by constant distribution factors for all the counties for each year. Moreover, utilizing urban diesel bus speed-VMT

is zero for all the calendar years, we excluded urban diesel buses from our analyses and assumed that the county speed-VMT distributions for passenger cars are the county fleet average speed-VMT distributions.

Utilizing the default information about the distribution of daily county passenger car VMT to each period of the day, and total VMT for each county, we estimated the county passenger car VMT in each period. We then weighted the county percentages of VMT in each speed bin by the share of the county total VMT for SCAB for that period. Aggregating the percentages of VMT by the four counties for each speed bin, we estimated the air basin average speed-VMT distributions of SCAB for 1990, 1994, 2000 and 2010 (defaults were provided for these years) during each period of the day.

2.2 SCAB Speed-VMT Distributions: with EMFAC2002 Defaults

Starting with EMFAC2001, a new user interface for the EMFAC emissions inventory model system enables users to extract travel activity defaults from the executable program (CARB, 2003). For a given air basin, vehicle type speed-VMT distributions for each hour of the day and air basin daily VMT values by vehicle type are available from EMFAC2002 travel activity defaults for each calendar year. We estimated hourly emissions inventories for each calendar year to produce hourly VMT values for each vehicle type as part of the hourly inventory outputs.

To estimate the SCAB fleet average speed-VMT distributions for different hours of the day, first ratios of VMT by vehicle type to total fleet VMT were estimated for different hours of the day. Then, total VMT distributions by vehicle type and vehicle type VMT percentages in each speed bin were combined to calculate the hour-specific SCAB speed-VMT distributions for the total vehicle fleet. We estimated EMFAC2002 hourly fleet average speed-VMT distributions for all the hours of the day for the calendar years 1994, 1997, 2005 and 2010. Distributions for these calendar years were estimated so that EMFAC2002 defaults could be compared to defaults in EMFAC7G which were provided for 1994 and 2010 and to the speed-VMT distributions estimated using real world speeds and flow rates calculated using 1997 South Coast Ozone Study (SCOS) (SCOS1997) data.

2.3 Freeway Speed-VMT Distributions using 1997 SCOS Data

Speed-VMT distributions were also estimated using real-world link flow rates and speeds collected as a part of SCOS1997 (Hicks et al., 1999). Hourly link flow rates and average travel speeds were estimated using volume and occupancy measurements from single-loop detectors on freeway links. The hourly link VMT and speed values were estimated for each available hour and day for the three regions in SCAB, (i.e., North LA, South LA and Orange County). Total daytime VMT for each regions' speed bins were calculated and then combined to estimate the total VMT for all the days for which data were available. The percentages of total VMT in each speed bin for the three regions were combined to estimate the real world freeway speed-VMT distribution for SCAB.

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distributions to estimate the fleet average distributions change the values for the percentages of VMT for each speed bin by less than 0.1%.

2.4 Speed-Fractions from Chase Car Observations

The final data used in this analysis were recently collected chase car information. As part of Caltrans-ARB modeling program (CAMP), instantaneous vehicle operation modes (e.g., speeds and accelerations) were collected for different levels of service in SCAB (Sierra Research, 2003). We estimated the percentage of time in the observation period when speeds were observed for a given speed bin. We used measurements for 18 days in 2000 across different facility types representative of entire trips for estimation.

3 RESULTS

Air basin fleet average percentages of total VMT for each speed bin were estimated using SCAB EMFAC7G and EMFAC2002 defaults using the methods described earlier (CARB, 1996; CARB, 2003). EMFAC7G speed-VMT distributions were estimated for the six periods of the day defined in the model for years 1990, 1994, 2000 and 2010 (defaults were provided for these years in the model). EMFAC2002 fleet average speed-VMT distributions were estimated for every hour for the years 1994, 1997, 2005 and 2010, based on the hourly defaults included in this version.

We then compared the EMFAC2002 distributions for 1994 and 2010 to those from EMFAC7G. EMFAC2002 speed-VMT distributions for 1997 were also estimated to compare to the distributions estimated using SCOS 1997 data.

3.1 Speed-VMT Distributions from EMFAC7G

Our estimated SCAB speed-VMT distributions, using EMFAC7G, for the years 1990, 1994, 2000 and 2010 are show in Figures 1-6. Each figure shows the distribution for one of the six daily time periods defined by the model.

SCAB speed-VMT distributions for a given select year are essentially the same for the two nighttime periods defined in EMFAC7G (i.e., 0a-6a and 6p-0a) (CARB, 1996) (Figures 1 and 6). The highest percentage of VMT is observed in the 60 mph speed bin for all calendar years implying that the highest portion of travel is likely to be freeway-based during the night. The second highest percentage is in the 35 mph speed bin for nighttime. When percentages of VMT in each speed bin are explored across years for the nighttime period, we see that VMT by speed bin changes across years. The highest change can be observed in 35 mph speed bin in which the percentage of VMT decreases gradually from 28% in 1990 to 23% in 2010.

Speed-VMT distributions are the same for the daytime off-peak periods (i.e., 9a-12p and 12p-3p) (Figures 3 and 4). The majority of VMT is assumed to occur in the 45, 50, 55 and 60 mph speed bins for the daytime off-peak periods. Except for the 55 and 60 mph speed bins, percentages of VMT in a given bin change less than 5% for a given pair of years among 1990, 1994, 2000 and 2010. However, percentages of 2000 VMT in the 55 mph and 60 mph speed bins decrease by 5.7% and 7.1% respectively for the year 2010.

There are similarities between the AM (6a-9a) and PM (3p-6p) peak periods (Figures 2 and 5). During the peak periods, 68 to 77% of the regional travel is allocated to the 20 through 45 mph speed bins. When we compare the speed-VMT distributions across the years 1990, 1994, 2000 and 2010, we see that the largest difference in the percentage of VMT in any given speed bin between years is less than 5%.

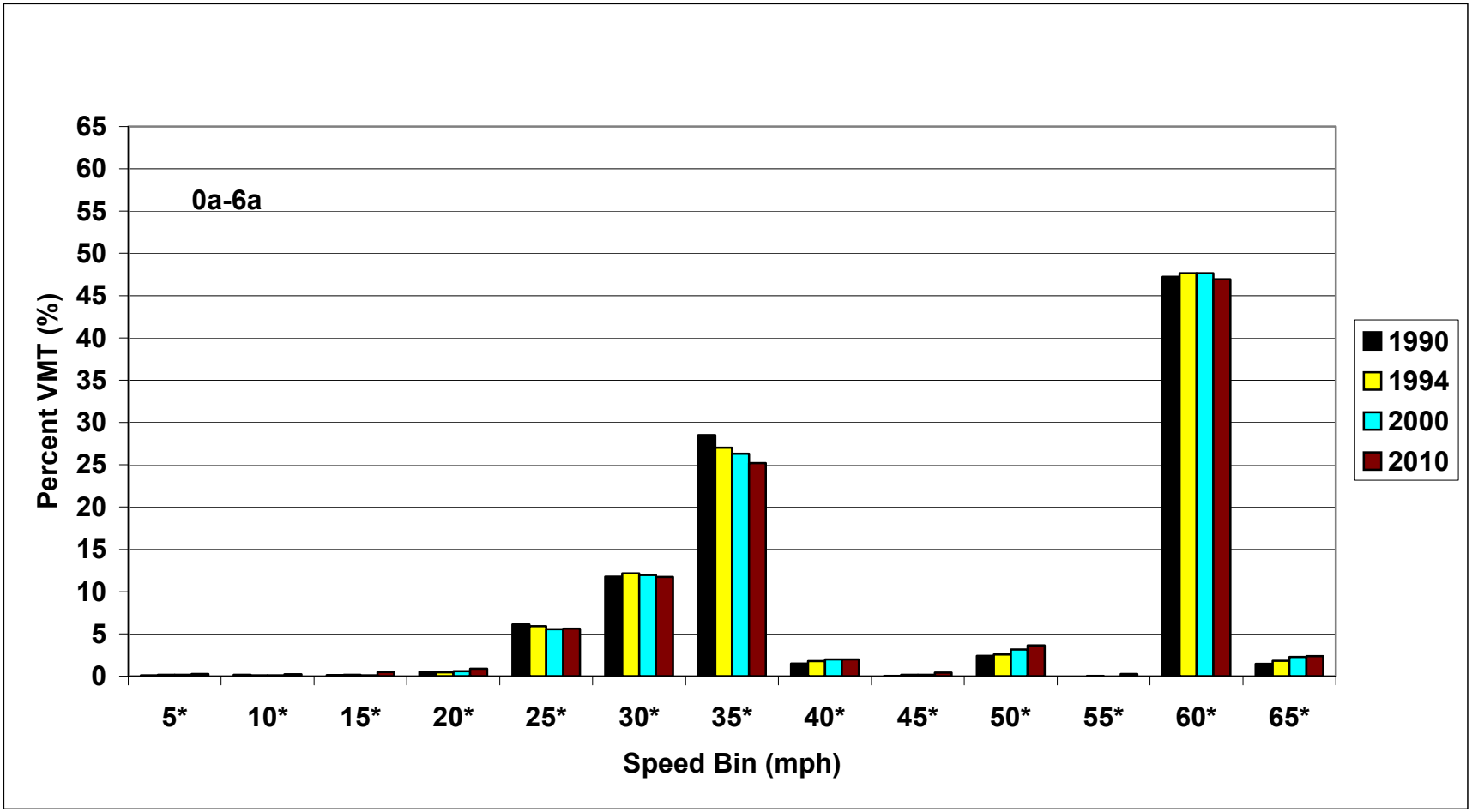

Figure 1. EMFAC7G Estimated Speed-VMT Distribution for 0a-6a (1990, 1994, 2000, 2010)

* 0-7.5 = 5 mph; 7.5-12.5 = 10mph; 12.5-17.5 = 15 mph; 17.5-22.5 = 20 mph; 22.5-27.5 = 25 mph; 27.5-32.5 = 30 mph; 32.5-37.5 = 35 mph; 37.5-42.5 = 40 mph; 42.5-47.5 = 45 mph; 47.5-52.5 = 50 mph; 52.5-57.5 = 55 mph; 57.5-62.5 = 60 mph; 62.5-67.5=65 mph.

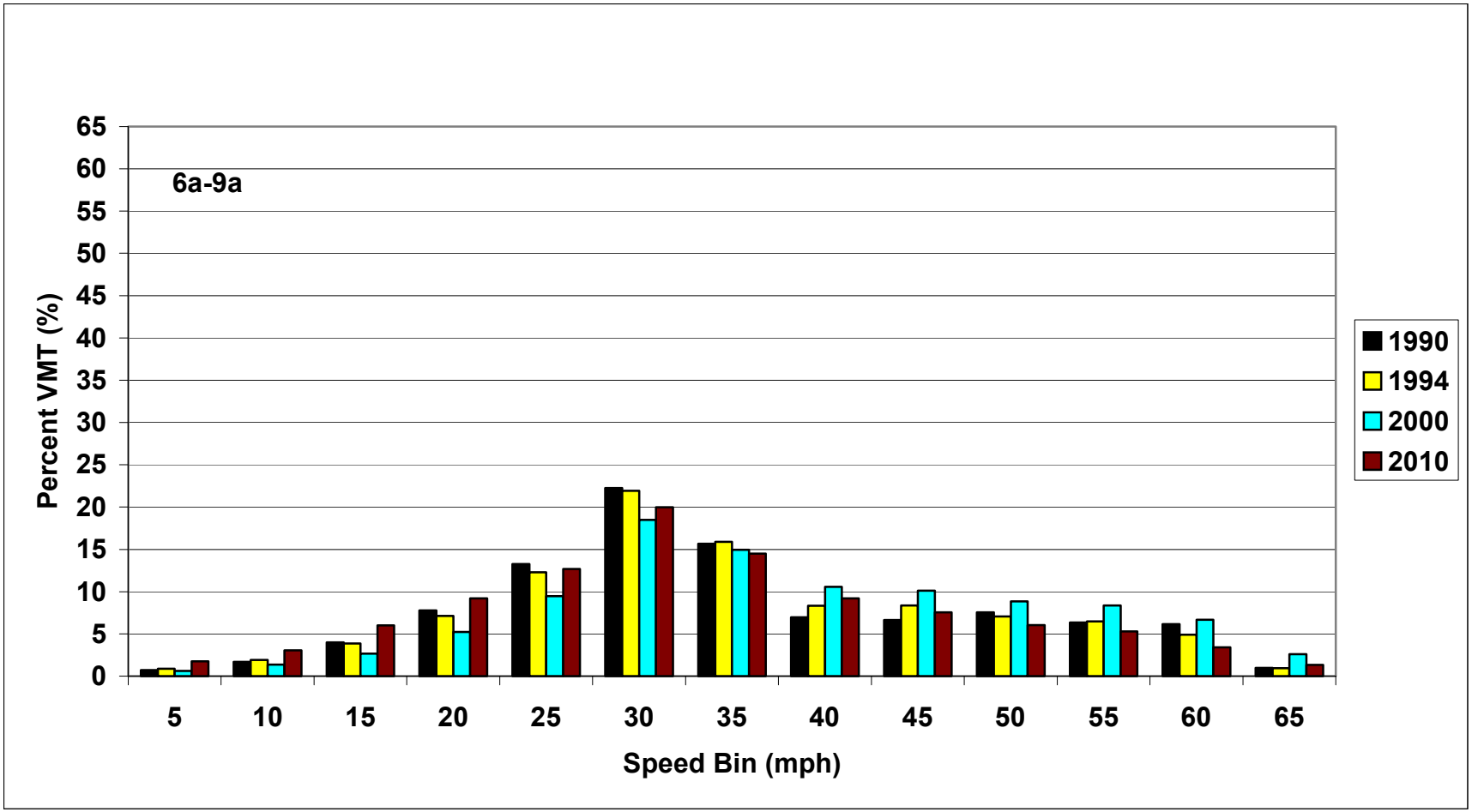

Figure 2. EMFAC7G Estimated Speed-VMT Distribution for 6a-9a (1990, 1994, 2000, 2010)

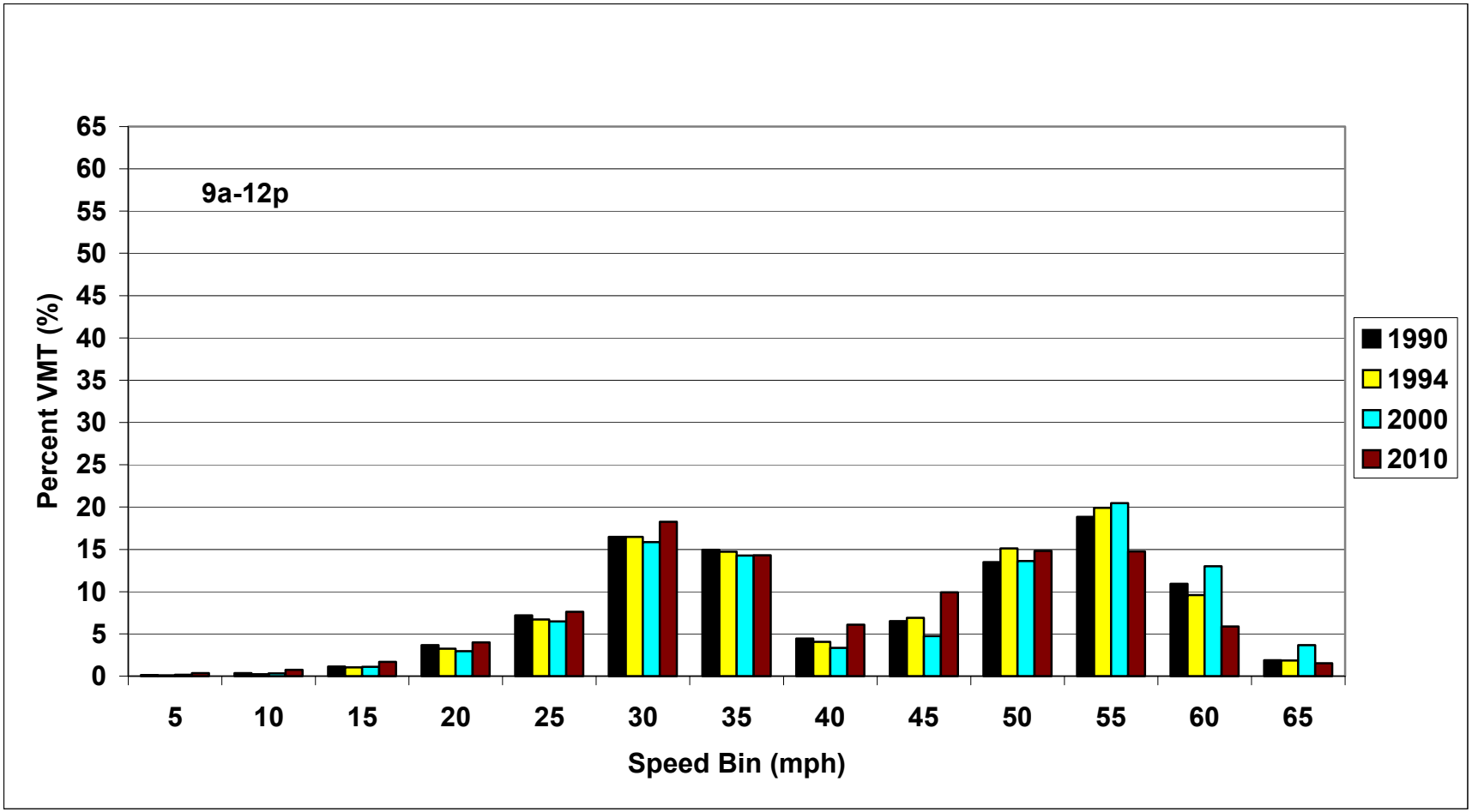

Figure 3. EMFAC7G Estimated Speed-VMT Distribution for 9a-12p (1990, 1994, 2000, 2010)

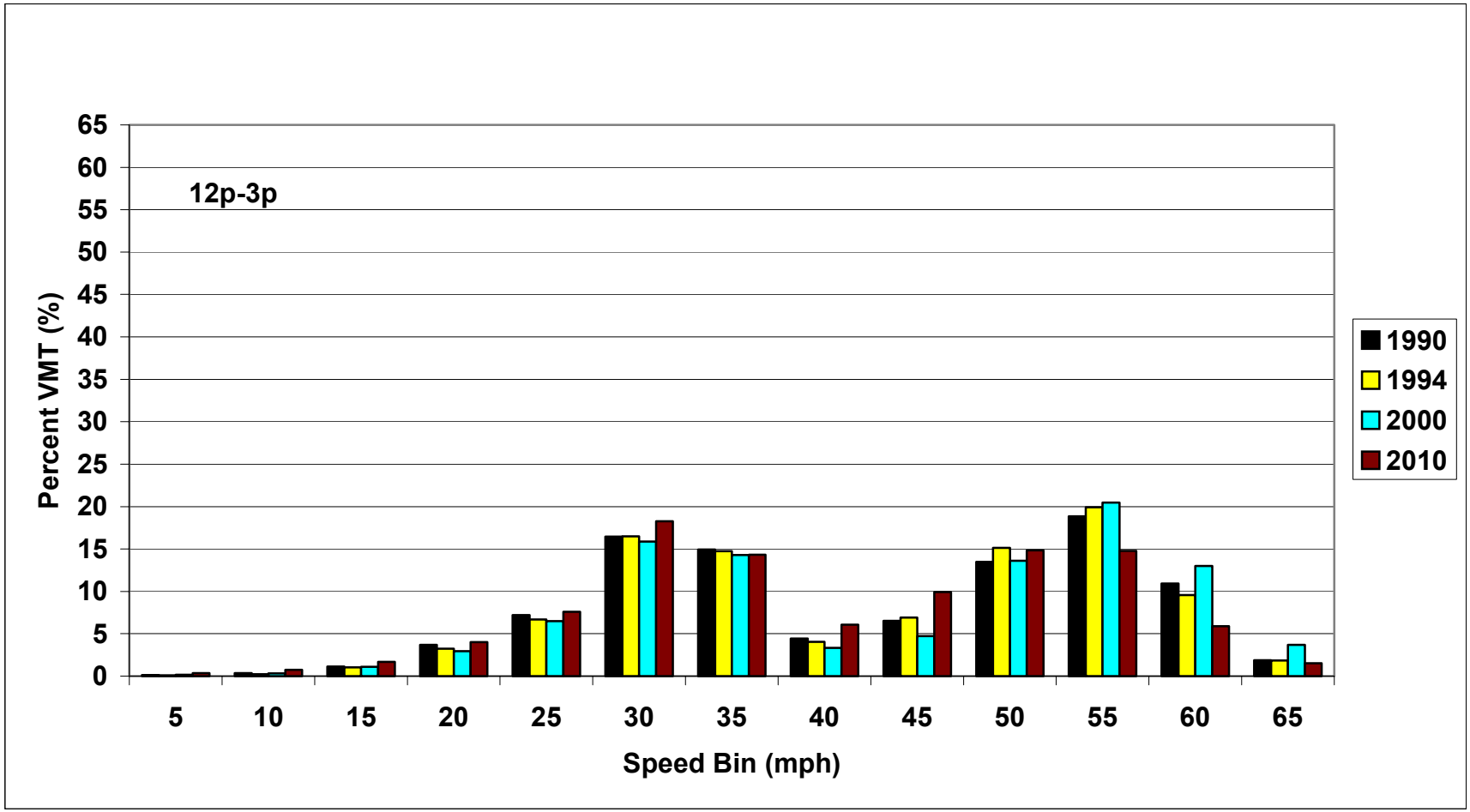

Figure 4. EMFAC7G Estimated Speed-VMT Distribution for 12p-3p (1990, 1994, 2000, 2010)

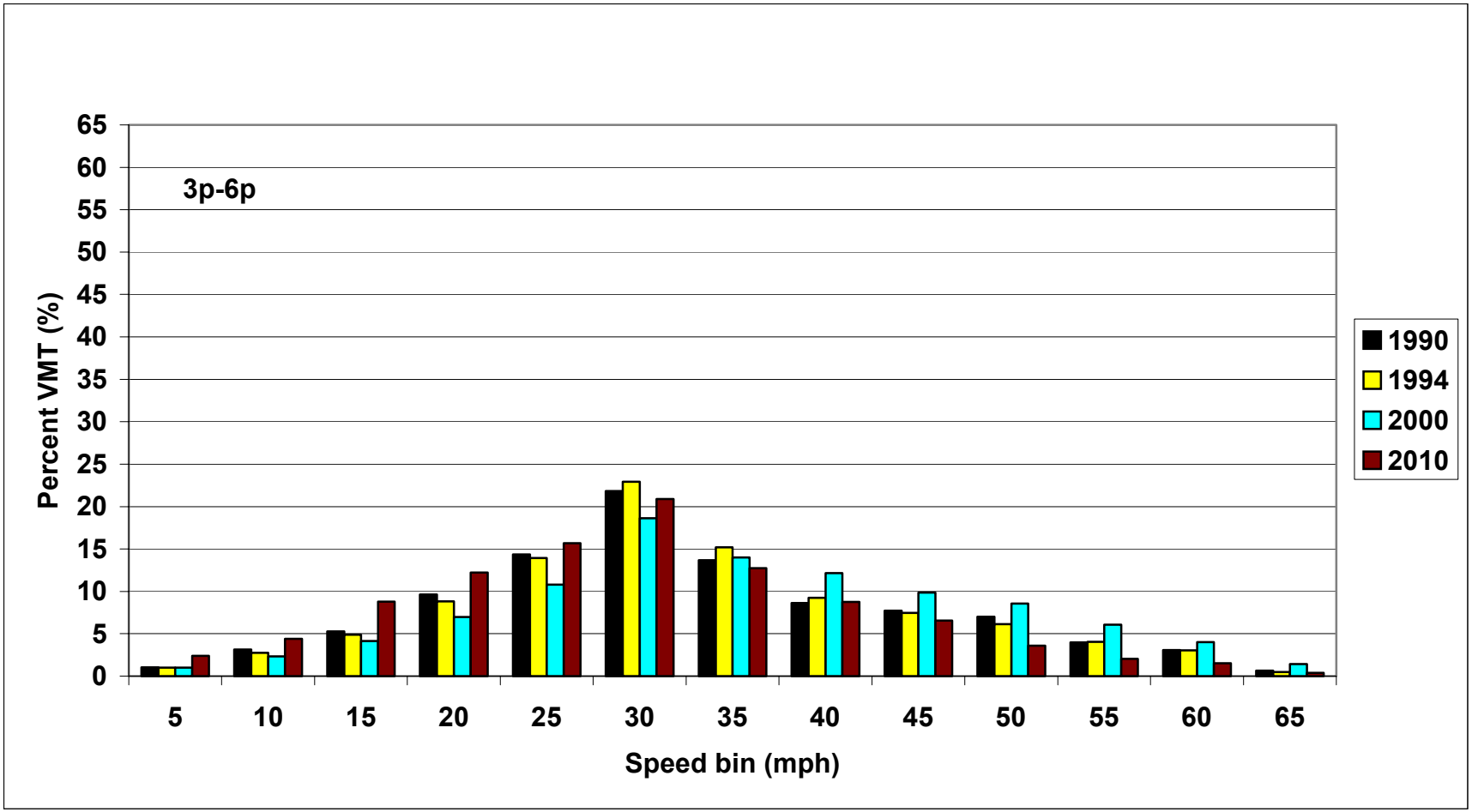

Figure 5. EMFAC7G Estimated Speed-VMT Distribution for 3p-6p (1990, 1994, 2000, 2010)

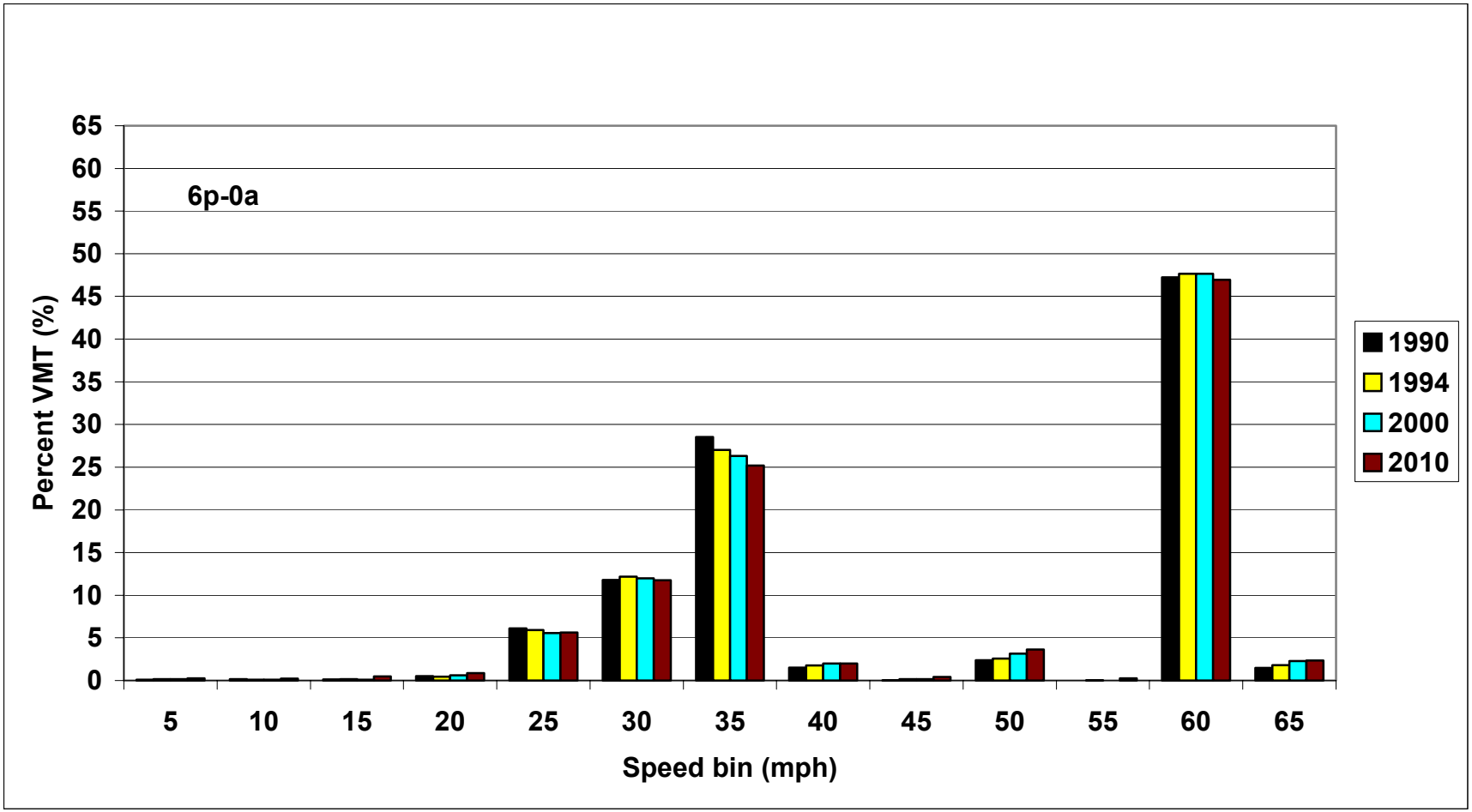

Figure 6. EMFAC7G Estimated Speed-VMT Distribution for 6p-0a (1990, 1994, 2000, 2010, 2020)

3.2 Speed-VMT Distributions from EMFAC2002

Whereas we were only able to estimate speed-VMT distributions using EMFAC7G for specified daily periods, EMFAC2002 allowed us to estimate distributions for each of the 24 daily hours. This is because in EMFAC2002, speed-VMT distributions by vehicle type are provided for each hour of the day (CARB, 2003). To facilitate the comparisons between the two EMFAC versions, we grouped the hourly EMFAC2002 speed-VMT distributions into periods similar to those used in EMFAC7G.

Our estimated SCAB speed-VMT distributions, using EMFAC2002, for the years 1994, 1997, 2005 and 2010 are show in Figures 7-31. Our discussion below groups the figures by select year. Within each year, six individual figures estimate distributions for each EMFAC7G defined daily period, by hour and speed bin.

3.2.1 EMFAC2002: 1994

Figures 7 through 12 show SCAB fleet average speed-VMT distributions for the calendar year 1994 for the six periods of the day.

Except for the hours between 1a and 6a (Figure 7), the hourly fleet average speed-VMT distributions are very similar throughout each period (at most a 2.7 % difference in 30 mph speed bin for 6a-9a) (Figure 8). With respect to the hourly distributions between 1a and 6a, we discovered that the speed-VMT distributions for medium heavy-duty trucks (MHDTs) and motor homes (MHs) are not included, (i.e., percentages of VMT in the speed bins are zero for MHDTs and MHs), for 3a and 4a which results in different speed-VMT distributions for these hours (CARB, 2003). Whether the assumption that MHDTs are not observed at 3a or 4a is correct for a specific calendar year cannot be discussed based on the default information provided in EMFAC2002.

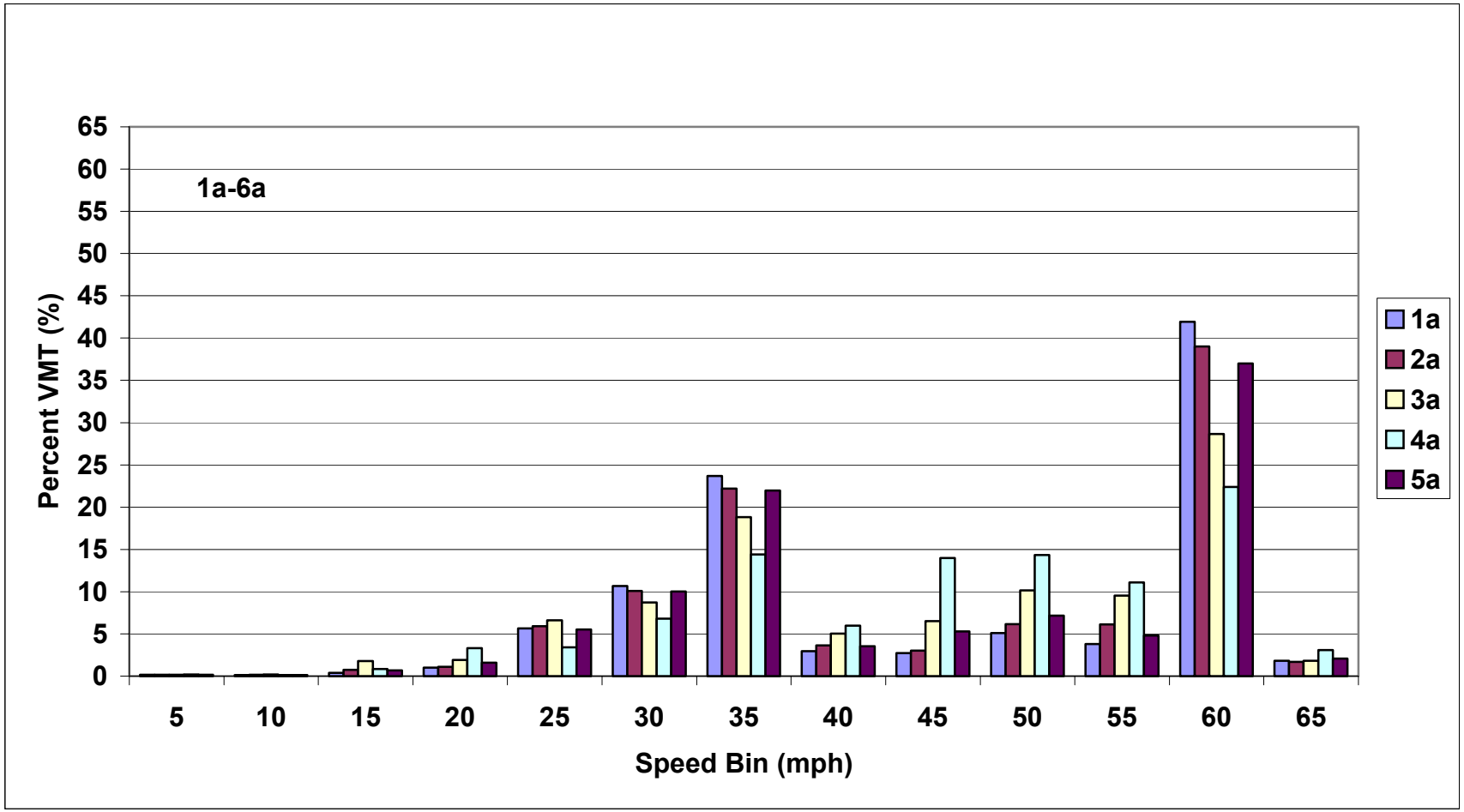

Figure 7. EMFAC2002 Speed-VMT Distributions for 1a, 2a, 3a, 4a, 5a (1994)

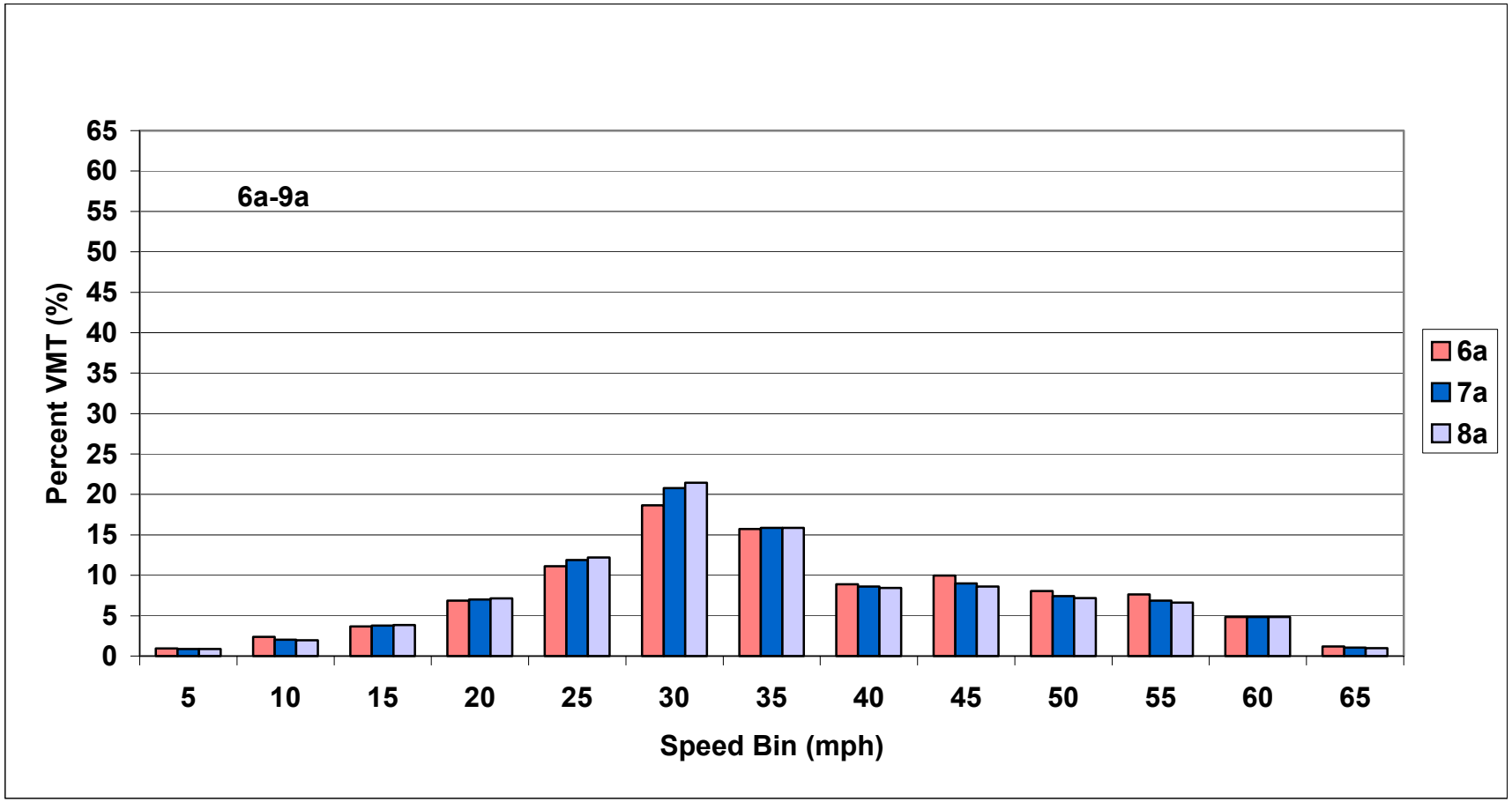

Figure 8. EMFAC2002 Speed-VMT Distributions for 6a, 7a, 8a (1994)

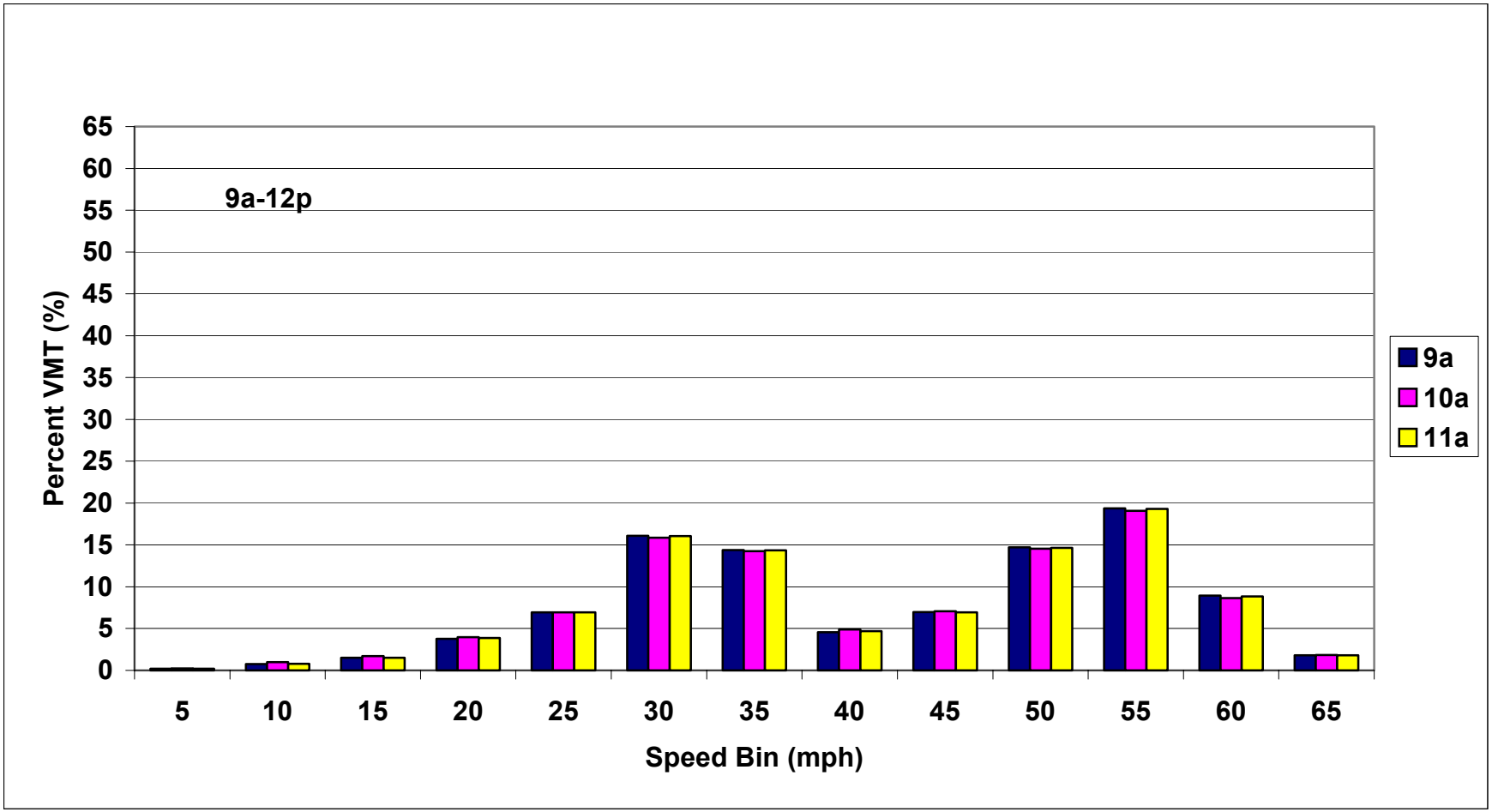

Figure 9. EMFAC2002 Speed-VMT Distributions for 9a, 10a, 11a (1994)

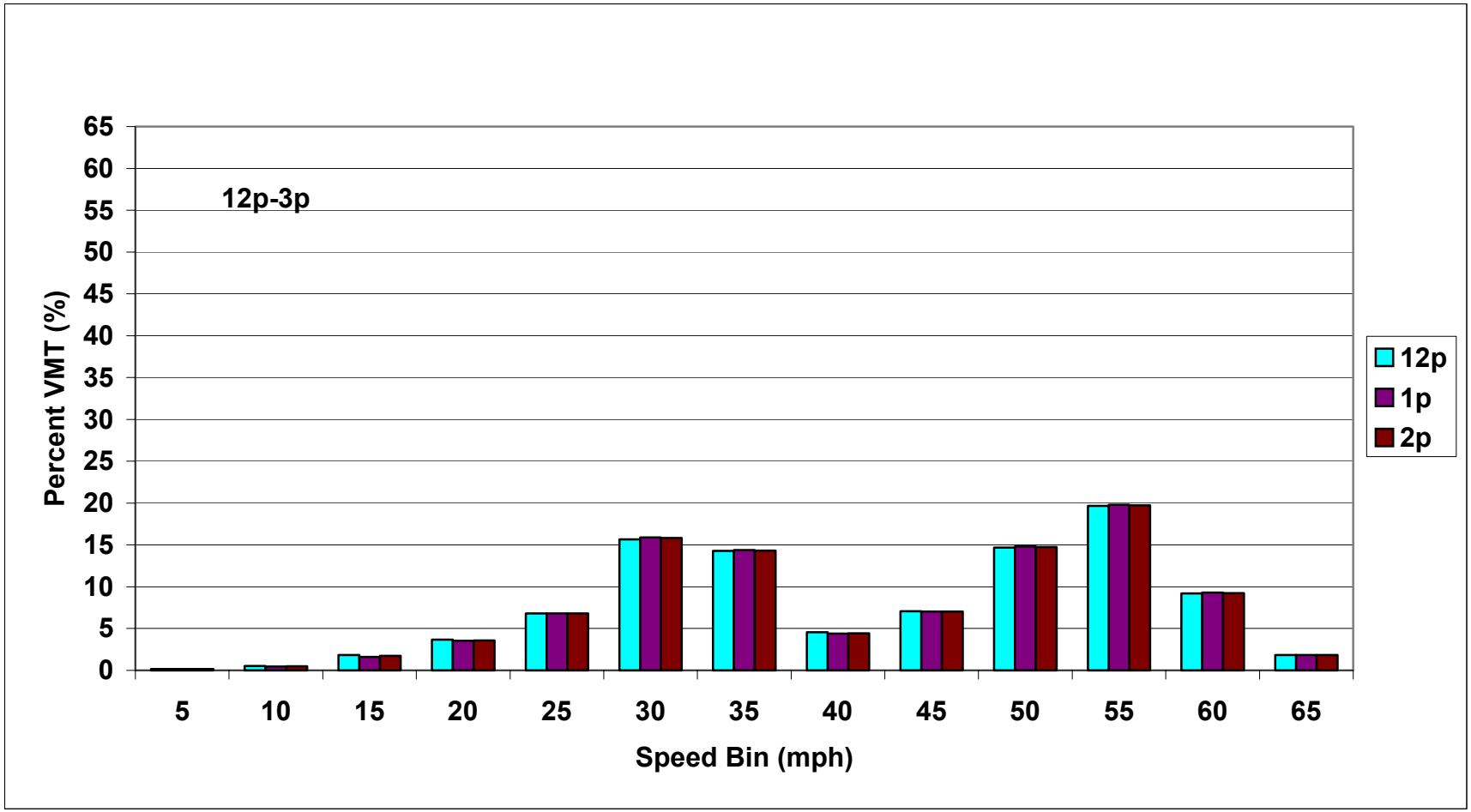

Figure 10. EMFAC2002 Speed-VMT Distributions for 12p, 1p, 2p (1994)

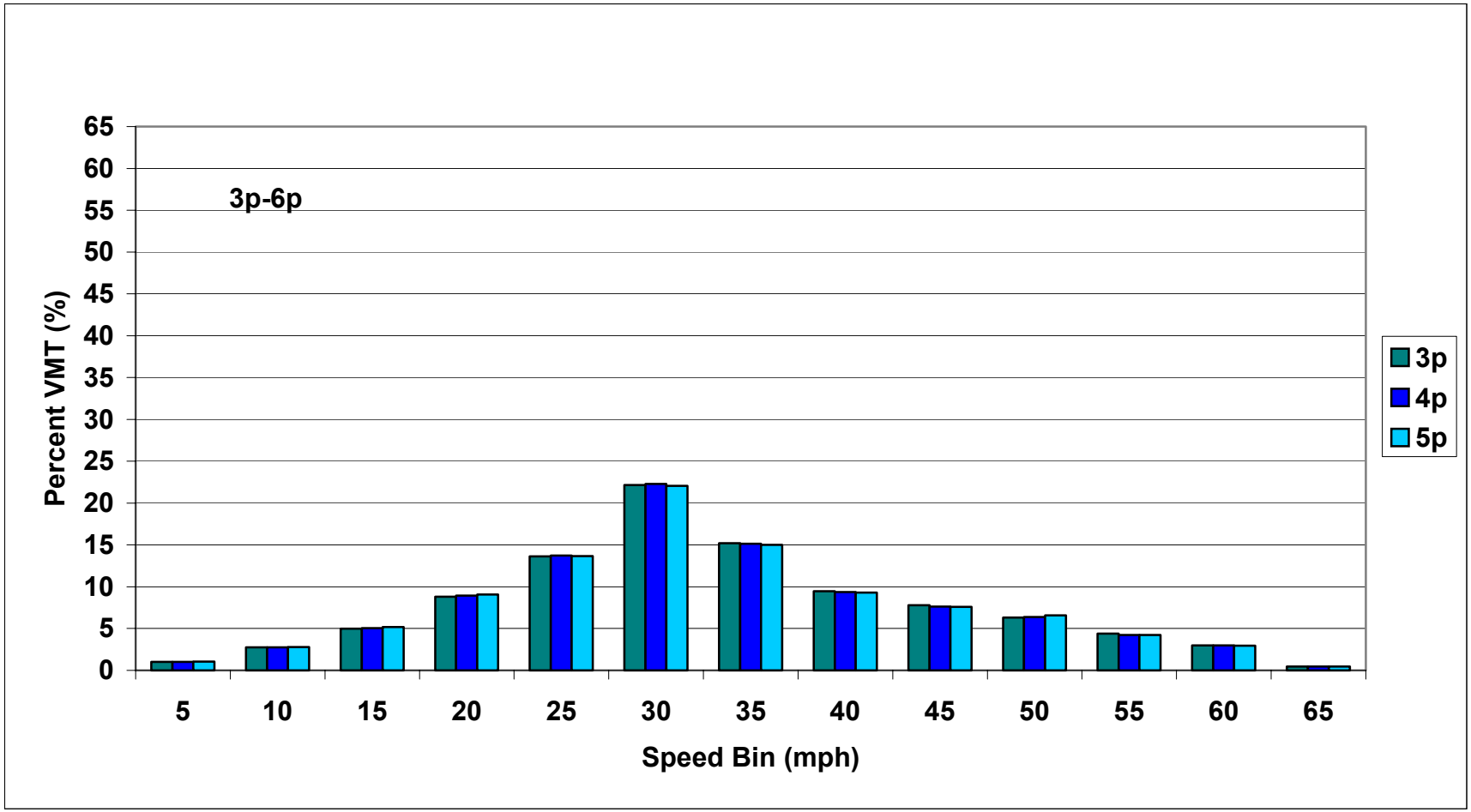

Figure 11. EMFAC2002 Speed-VMT Distributions for 3p, 4p, 5p (1994)

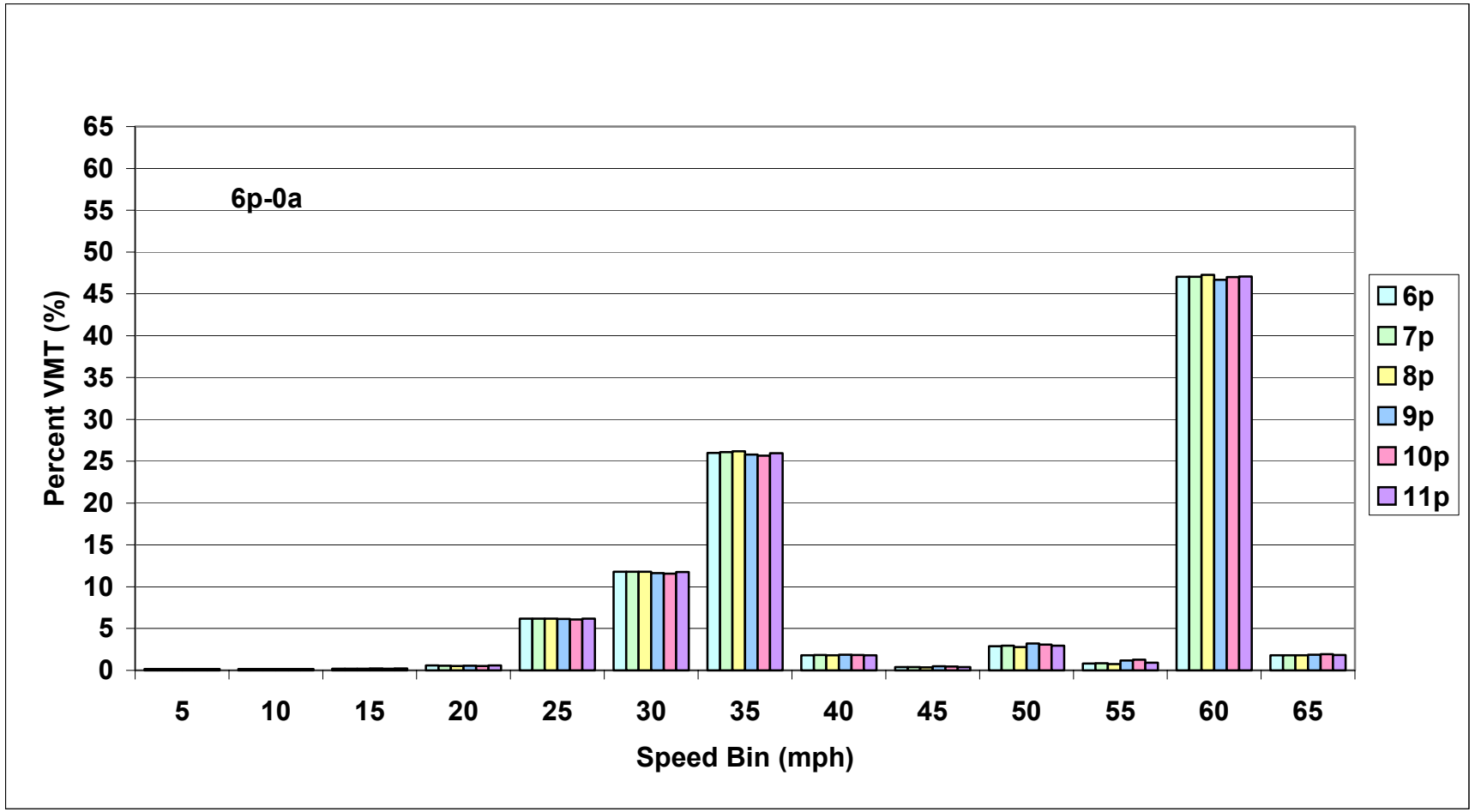

Figure 12. EMFAC2002 Speed-VMT Distributions for 6p, 7p, 8p, 9p, 10p, 11p (1994)

3.2.2 EMFAC2002: 1997

Figures 13 through 18 demonstrate 1997 speed-VMT distributions estimated using EMFAC2002 defaults for the six periods of the day.

The hour hourly fleet average speed-VMT distributions for 1994 and 1997 are essentially the same for a given hour of the day (compare Figures 7-12 for 1994, with Figures 13-18 for 1997). This suggests that although the total hourly VMT values for 1994 and 1997 differ (CARB, 1996), the shares of VMT by vehicle type in each speed bin and the ratios of vehicle type VMT values to the total fleet VMT result in the same fleet average speed-VMT distributions for 1994 and 1997[#]. Except for 3a and 4a, the distributions estimated for the hours between 0a to 6a show somewhat similar characteristics with the distributions estimated for the hours between 6p and 0a (Figures 7, 12, 13 and 18). Similarly, hourly EMFAC2002 distributions estimated for AM peak (6a-9a) and PM peak (3p-6p) show similar but not exactly the same characteristics for 1994 and 1997. Moreover, fleet average speed-VMT distributions estimated for the two daytime off-peak periods. (i.e., hourly periods between 9a and 12p and hourly periods between 12p and 3p) are very similar (Figures 9, 10, 15 and 16).

[#] Total hourly VMT values for the entire fleet and hourly vehicle VMT values by vehicle type are different for 1994 and 1997. However, when the ratios of hourly vehicle type VMT values to the hourly fleet VMT values are combined with the vehicle type speed-VMT distributions for a given hour, the resulting fleet average speed-VMT distributions are the same for 1994 and 1997.

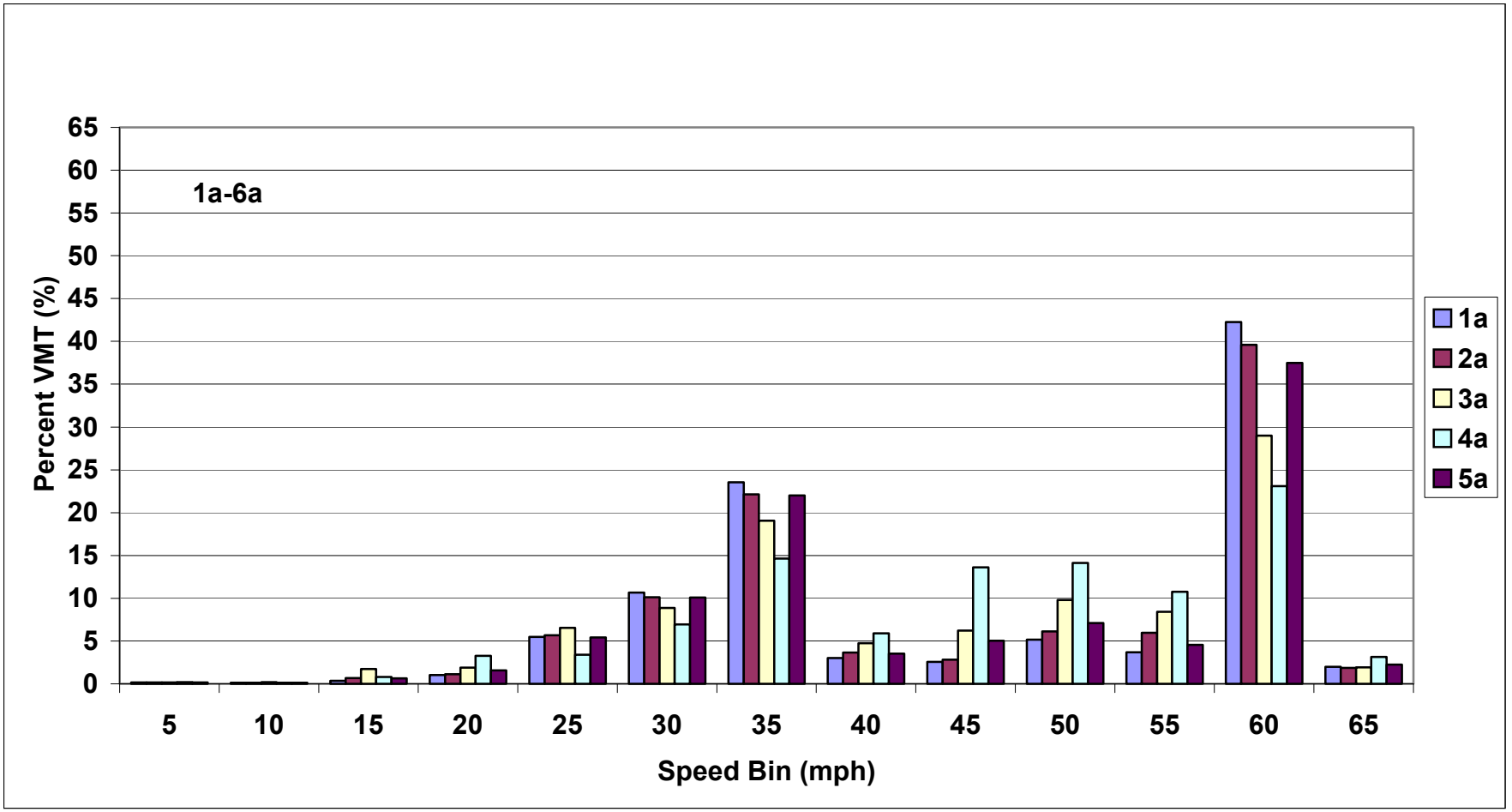

Figure 13. EMFAC2002 Speed-VMT Distributions for 1a, 2a, 3a, 4a, 5a (1997)

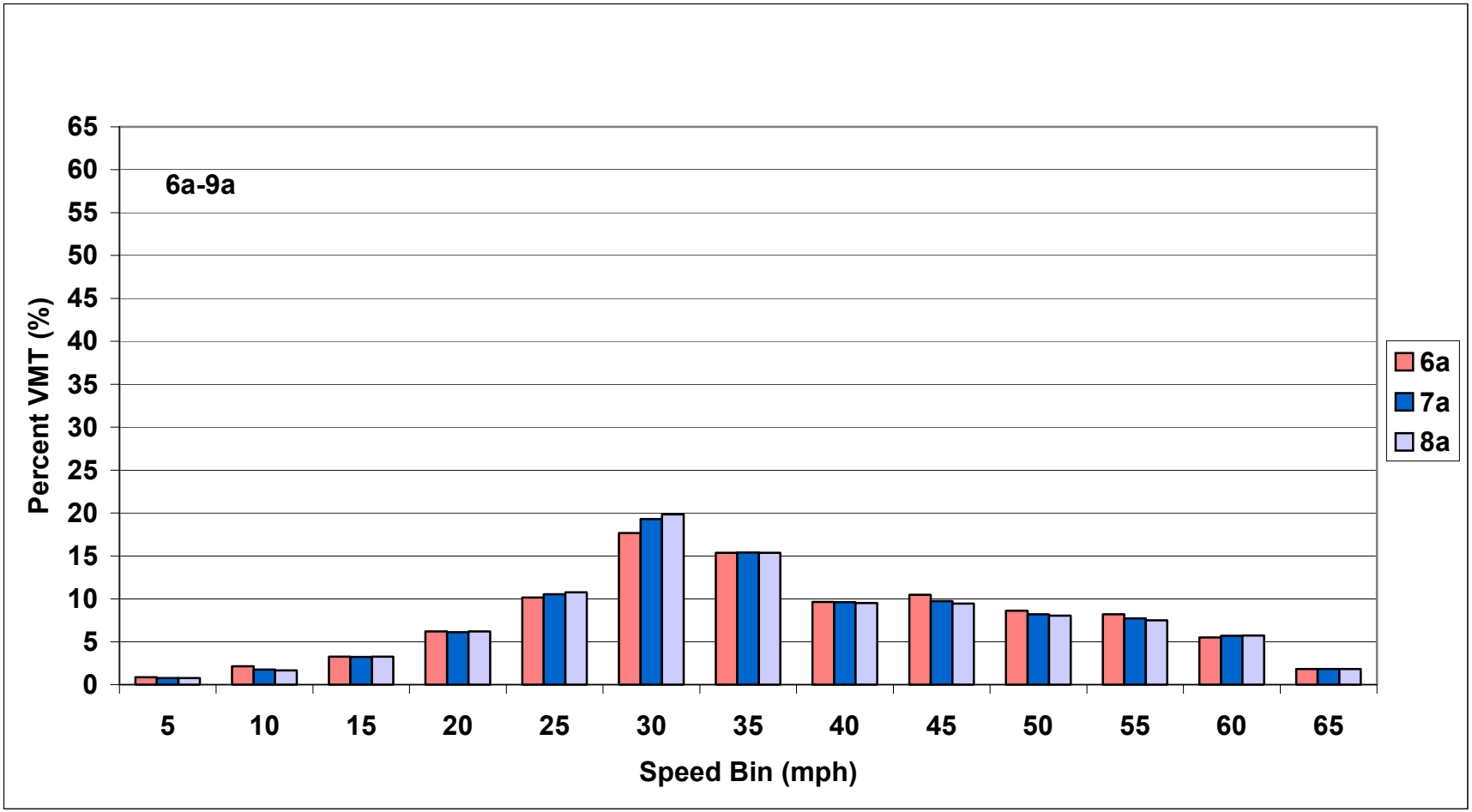

Figure 14. EMFAC2002 Speed-VMT Distributions for 6a, 7a, 8a (1997)

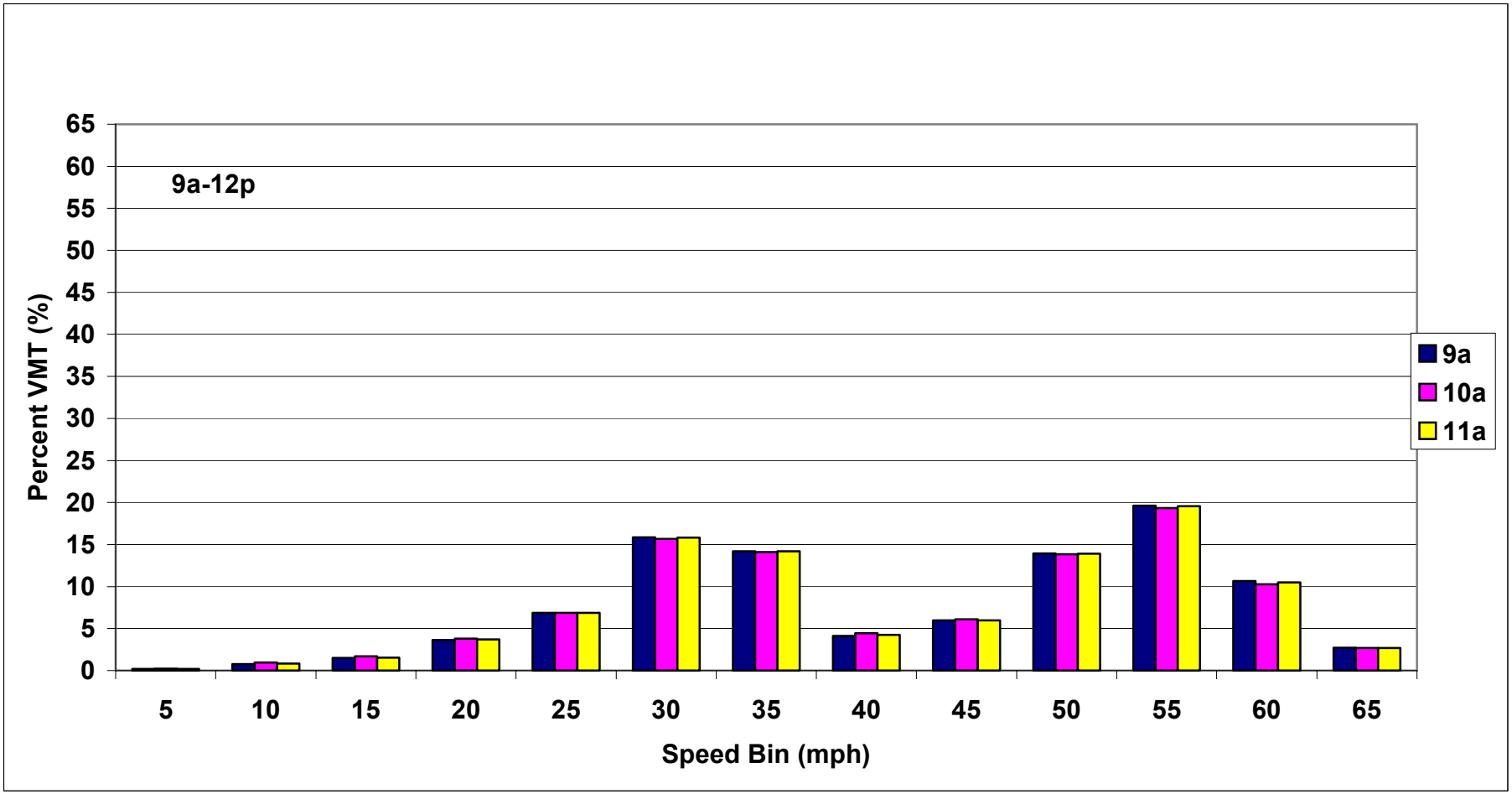

Figure 15. EMFAC2002 Speed-VMT Distributions for 9a, 10a, 11a (1997)

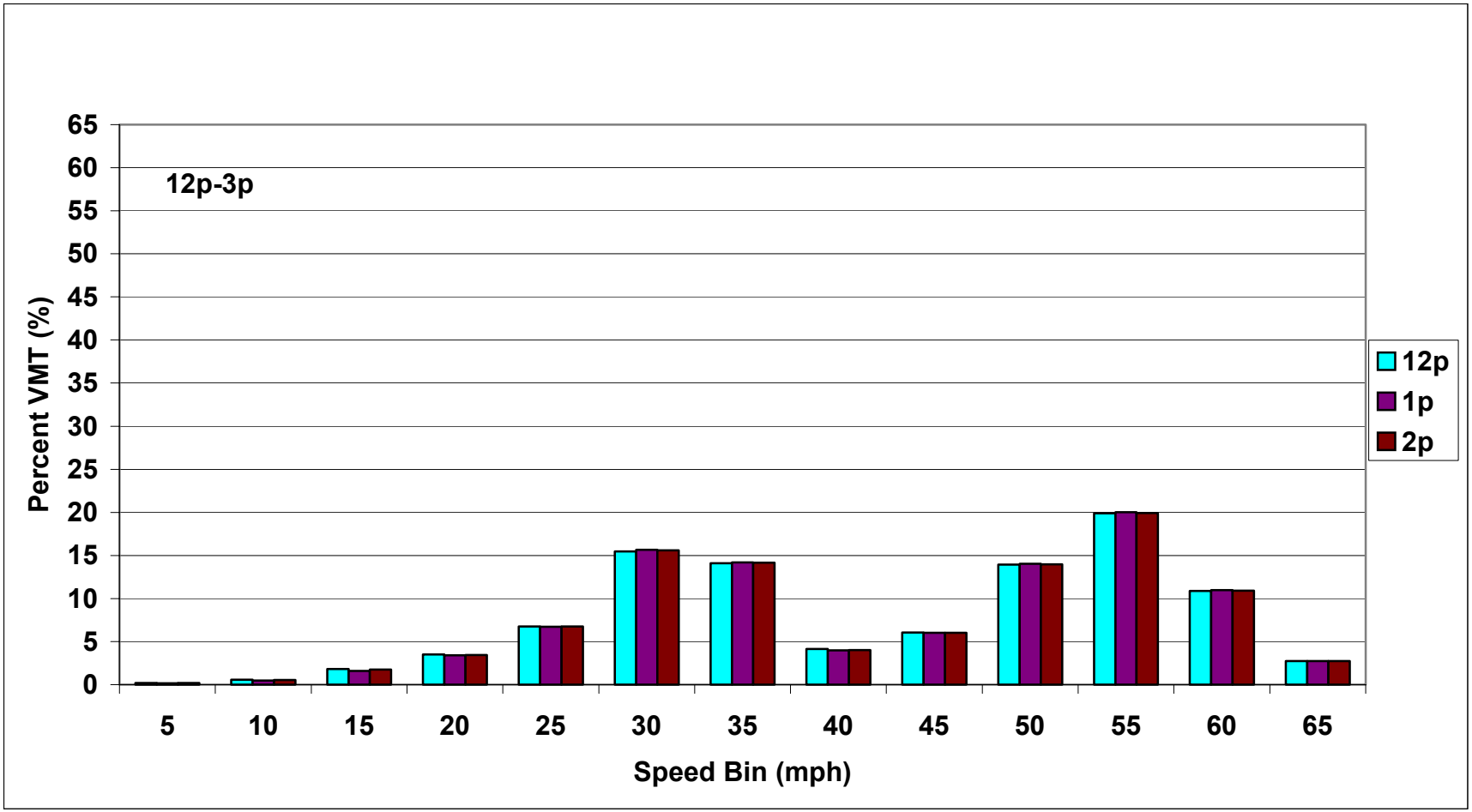

Figure 16. EMFAC2002 Speed-VMT Distributions for 12p, 1p, 2p (1997)

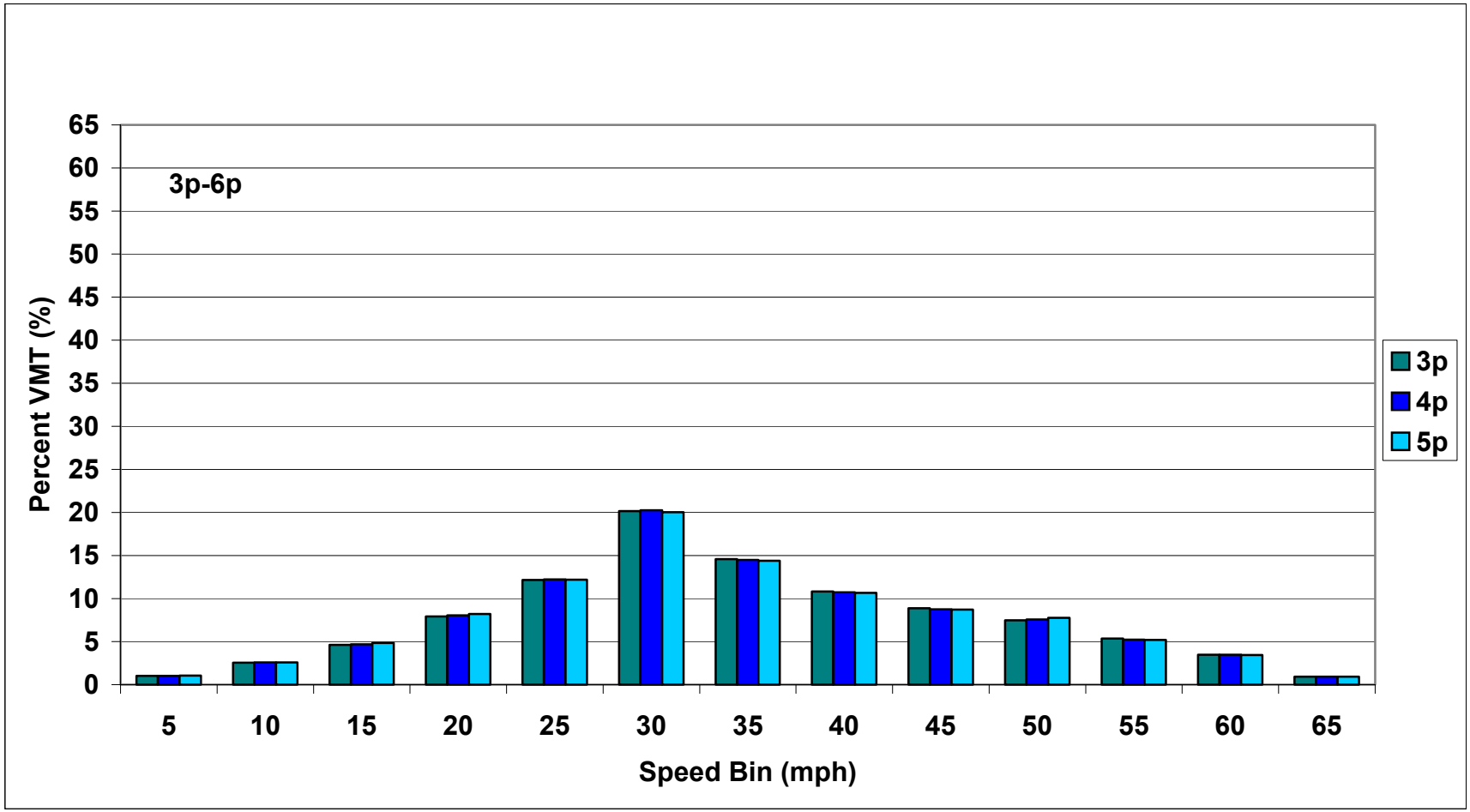

Figure 17. EMFAC2002 Speed-VMT Distributions for 3p, 4p, 5p (1997)

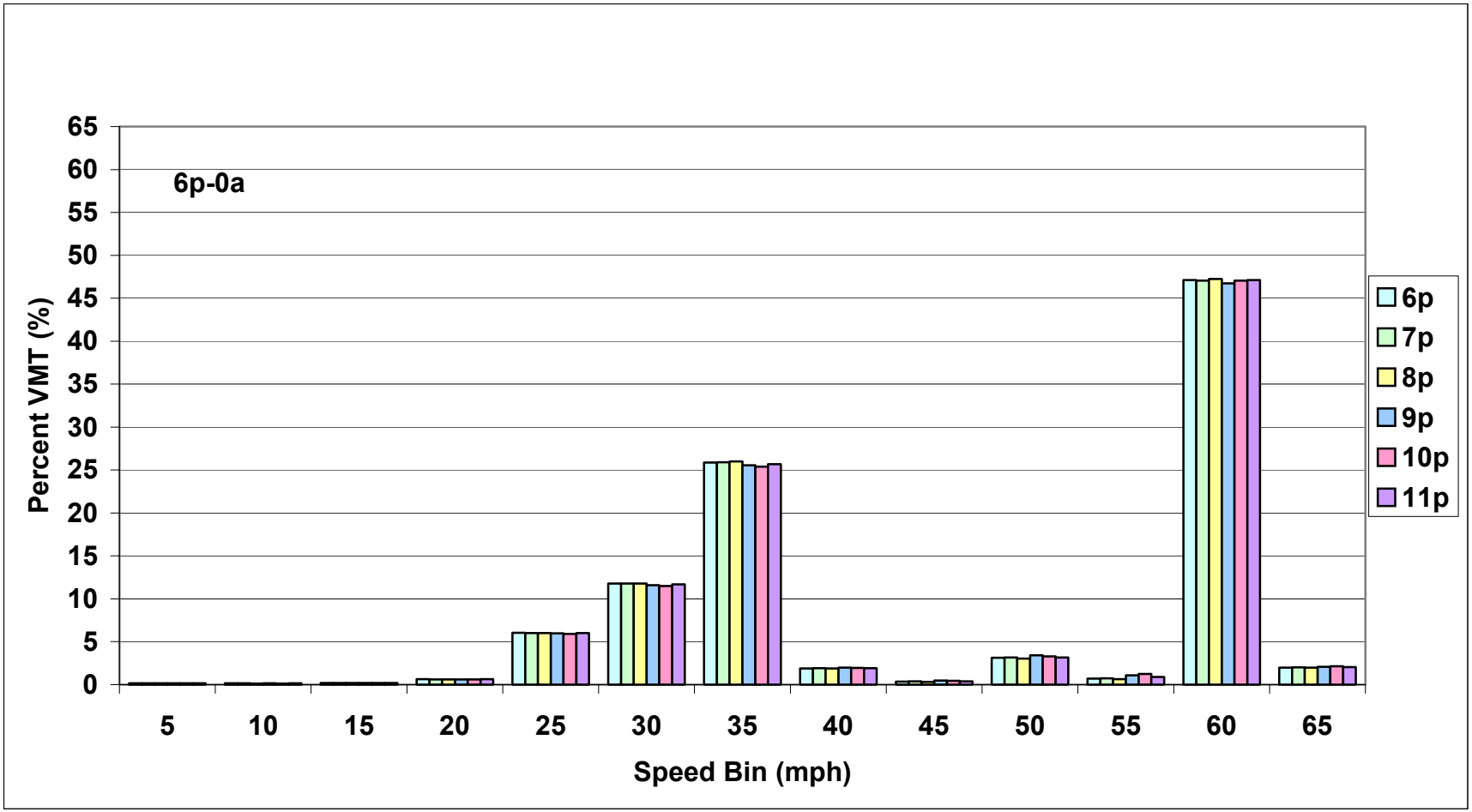

Figure 18. EMFAC2002 Speed-VMT Distributions for 6p, 7p, 8p, 9p, 10p, 11p (1997)

3.2.3 EMFAC2002: 2005

Figures 19 through 24 present speed-VMT distributions for six periods of the day.

Similar to hourly speed-VMT distributions estimated for 1994 and 1997, with the exceptions of hours between 1a and 6a (Figure 19), hourly speed-VMT distributions within a given period are very similar for calendar year 2005 (Figures 20 through 24). The highest difference in the percentage of VMT is estimated for the 25 mph speed bin for AM peak period (the percentage of VMT for 8a is 1.2% higher than the percentage of VMT for 6a) (Figure 20).

Fleet average speed-VMT distributions estimated for 3a and 4a are again different from the distributions estimated for 1a, 2a and 5a because the MHDT and MH speed-VMT distributions are not included in EMFAC2002 for these years. Nighttime speed-VMT distributions for the hourly periods between 6p and 0a exhibit roughly similar distributions to the hourly periods between 0a and 6a (Figures 19 and 24).

As before, the fleet average speed-VMT distributions are the same for the daytime off-peak periods (Figures 21 and 22).

Speed-VMT distributions for AM Peak and PM peak periods are very similar. We estimated a maximum difference of 2%, which was for the 65 mph speed bin. Hourly speed-VMT distributions for AM peak and PM peak periods for 2005 are demonstrated in Figure 25.

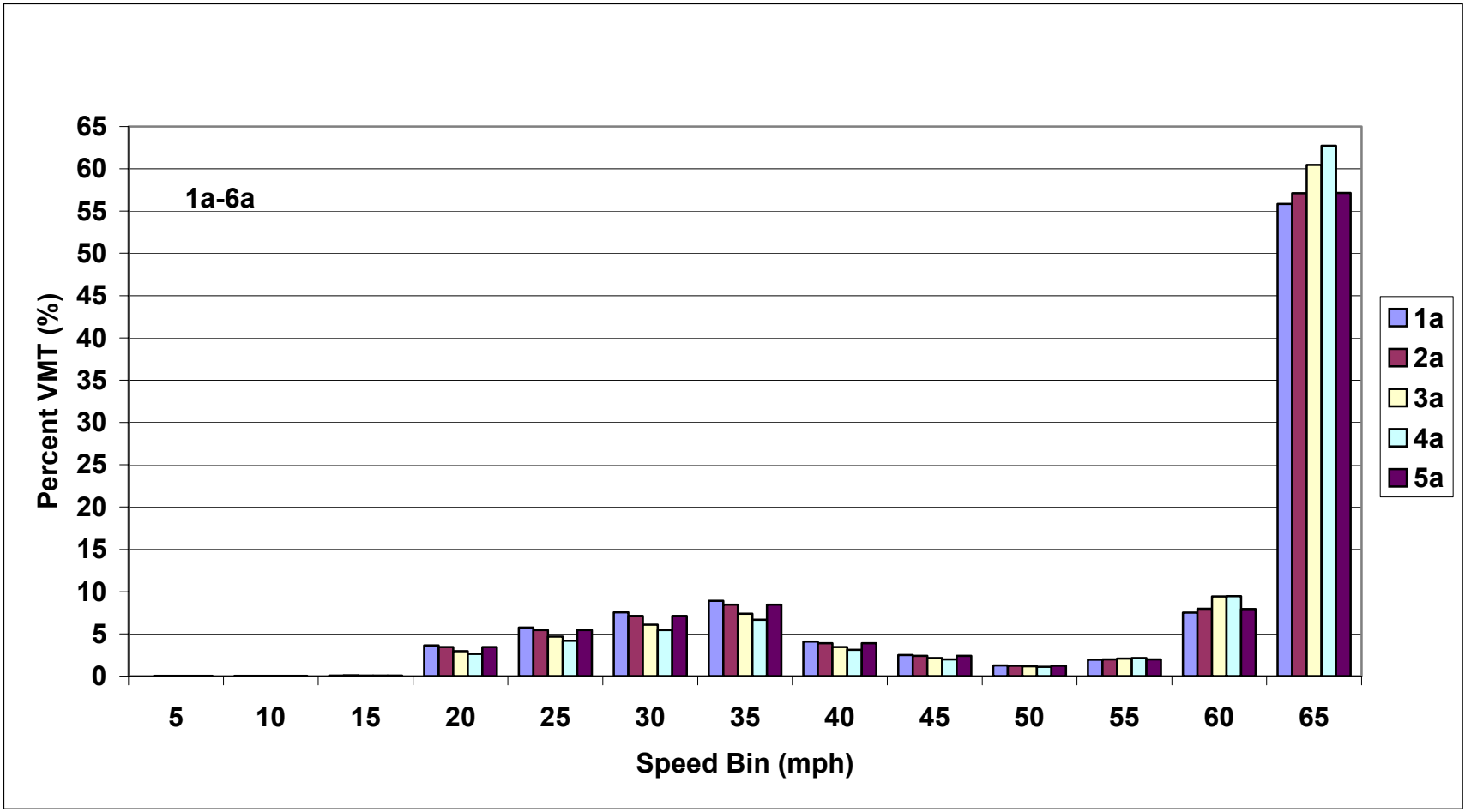

Figure 19. EMFAC2002 Speed-VMT Distributions for 1a, 2a, 3a, 4a, 5a (2005)

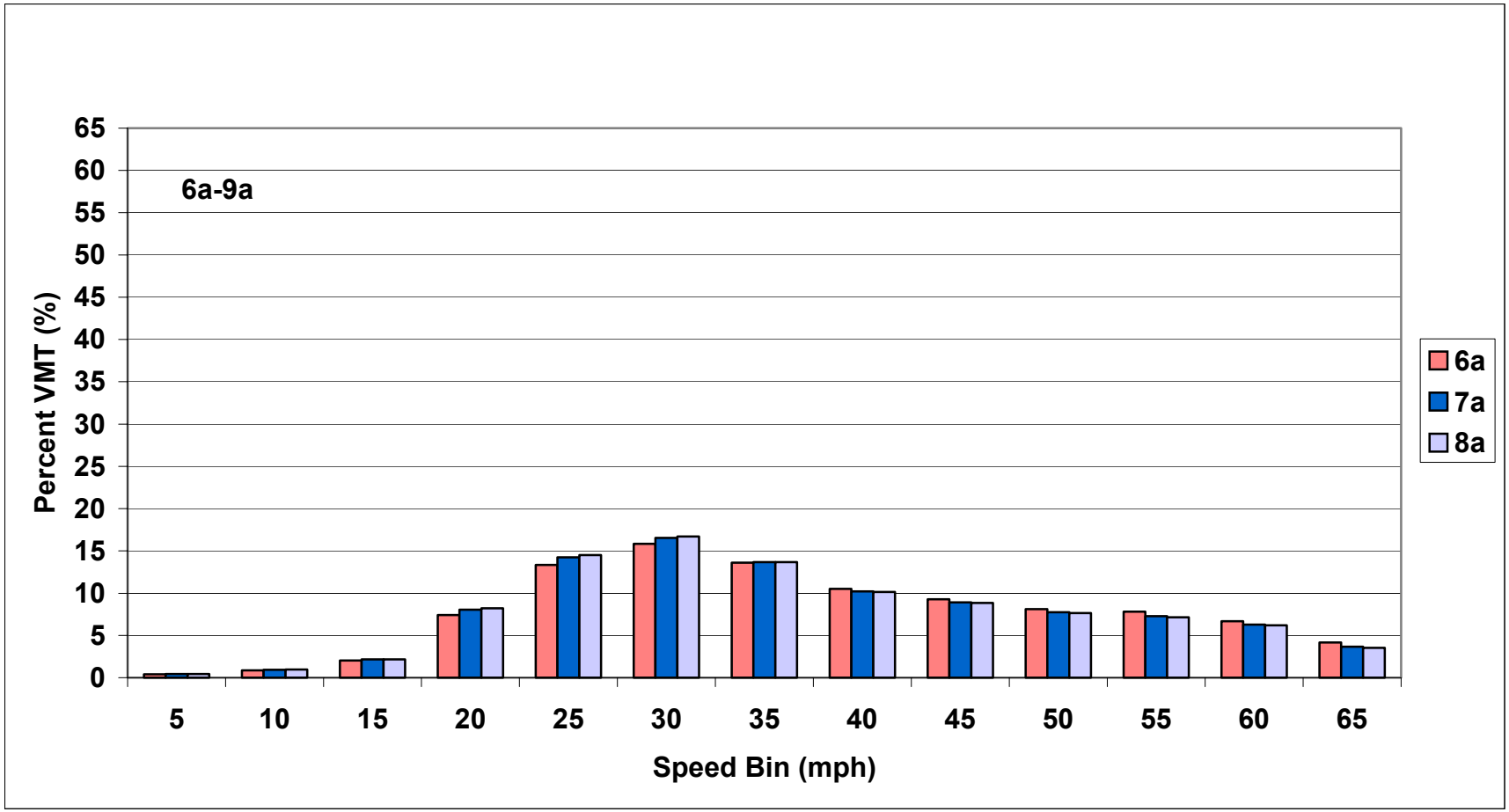

Figure 20. EMFAC2002 Speed-VMT Distributions for 6a, 7a, 8a (2005)

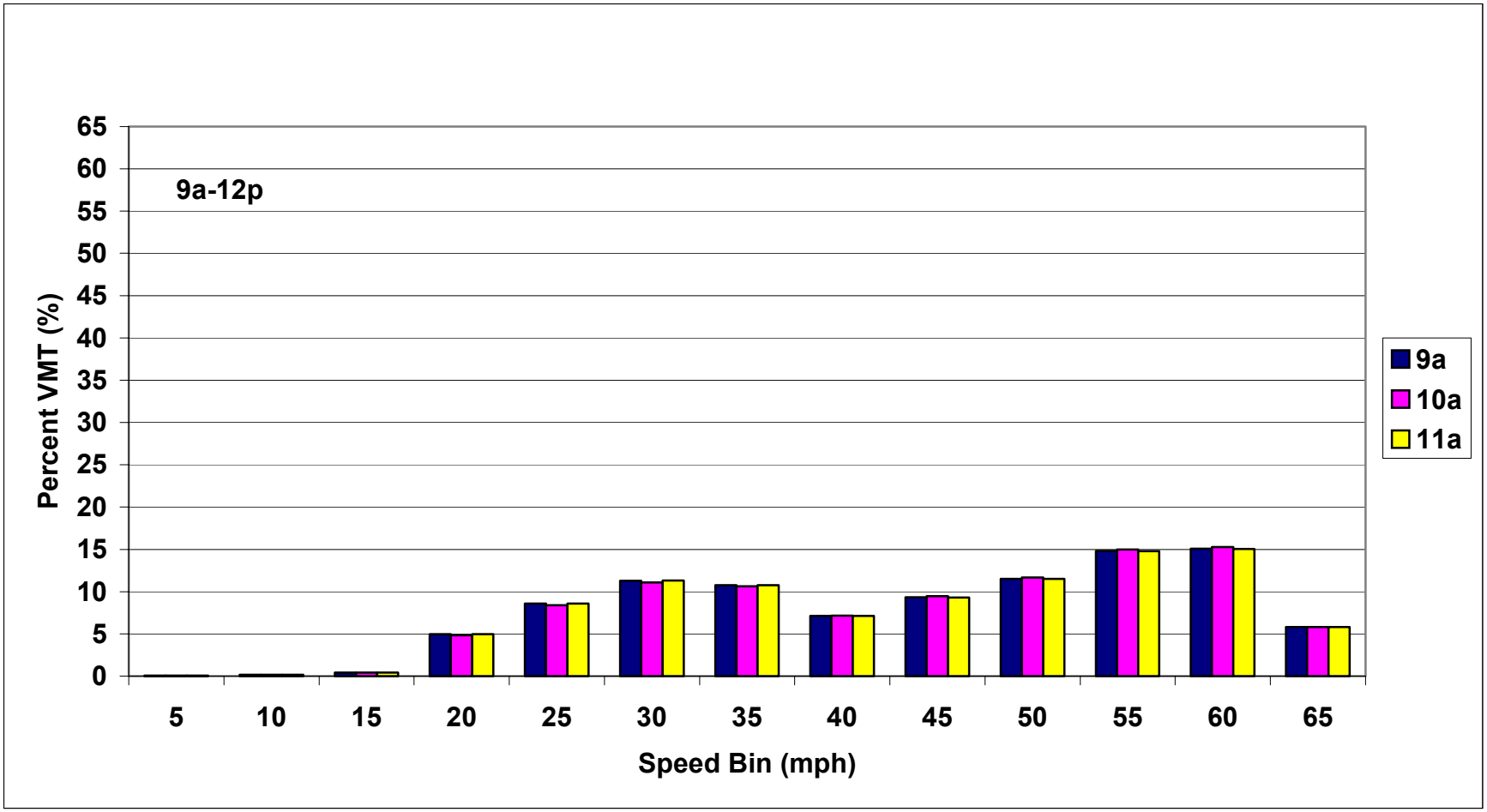

Figure 21. EMFAC2002 Speed-VMT Distributions for 9a, 10a, 11a (2005)

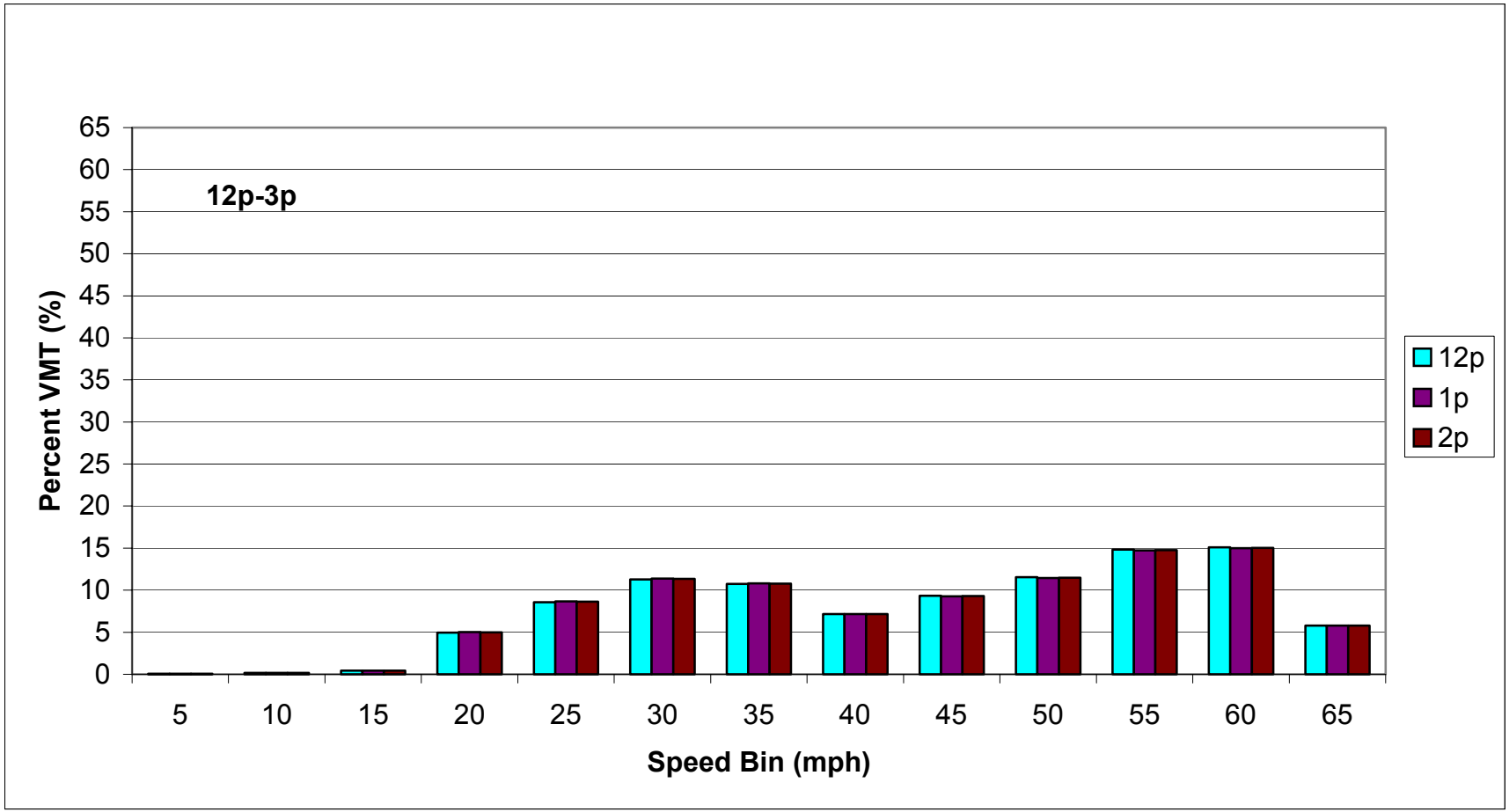

Figure 22. EMFAC2002 Speed-VMT Distributions for 12p, 1p, 2p (2005)

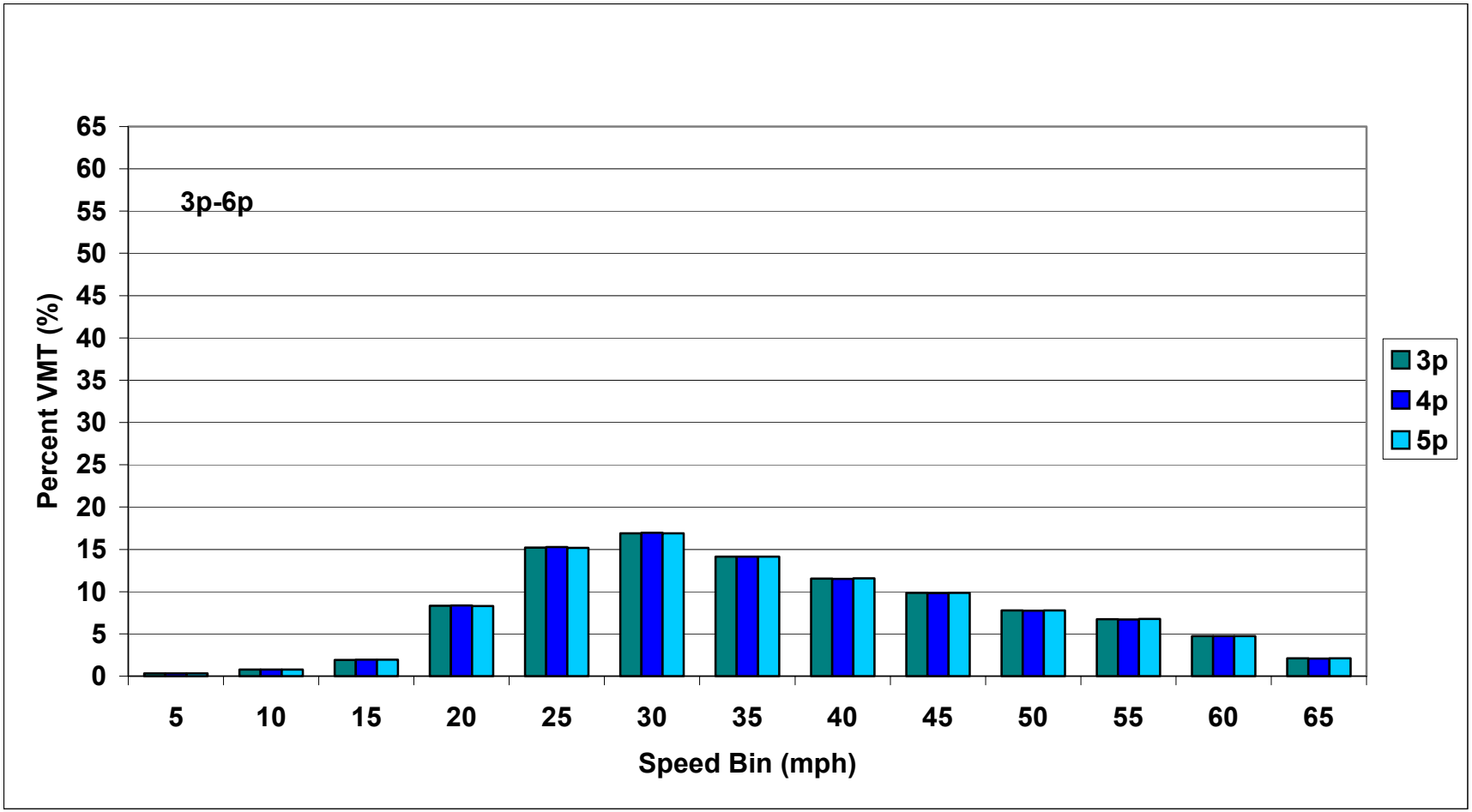

Figure 23. EMFAC2002 Speed-VMT Distributions for 3p, 4p, 5p (2005)

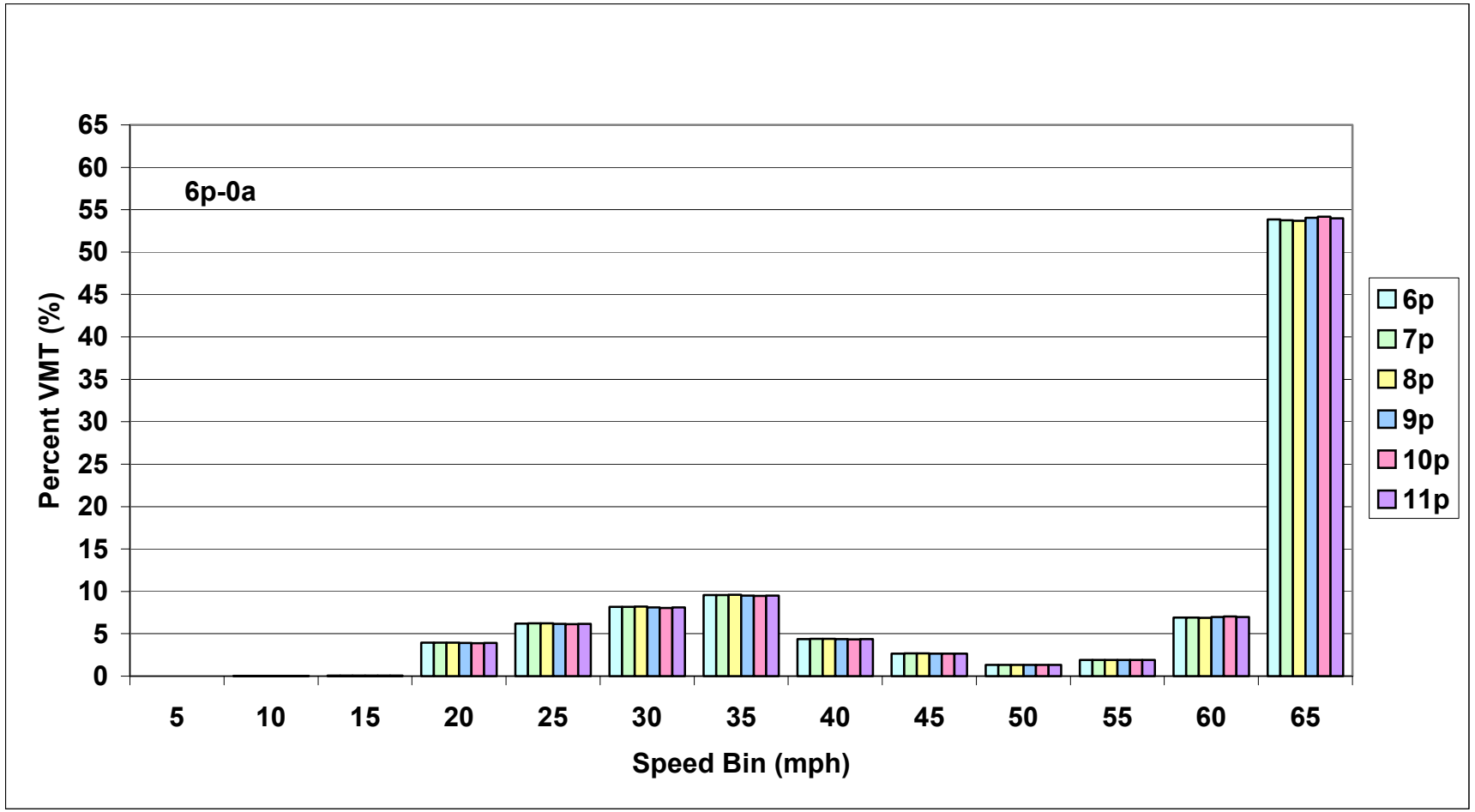

Figure 24. EMFAC2002 Speed-VMT Distributions for 6p, 7p, 8p, 9p, 10p, 11p (6p-00a) (2005)

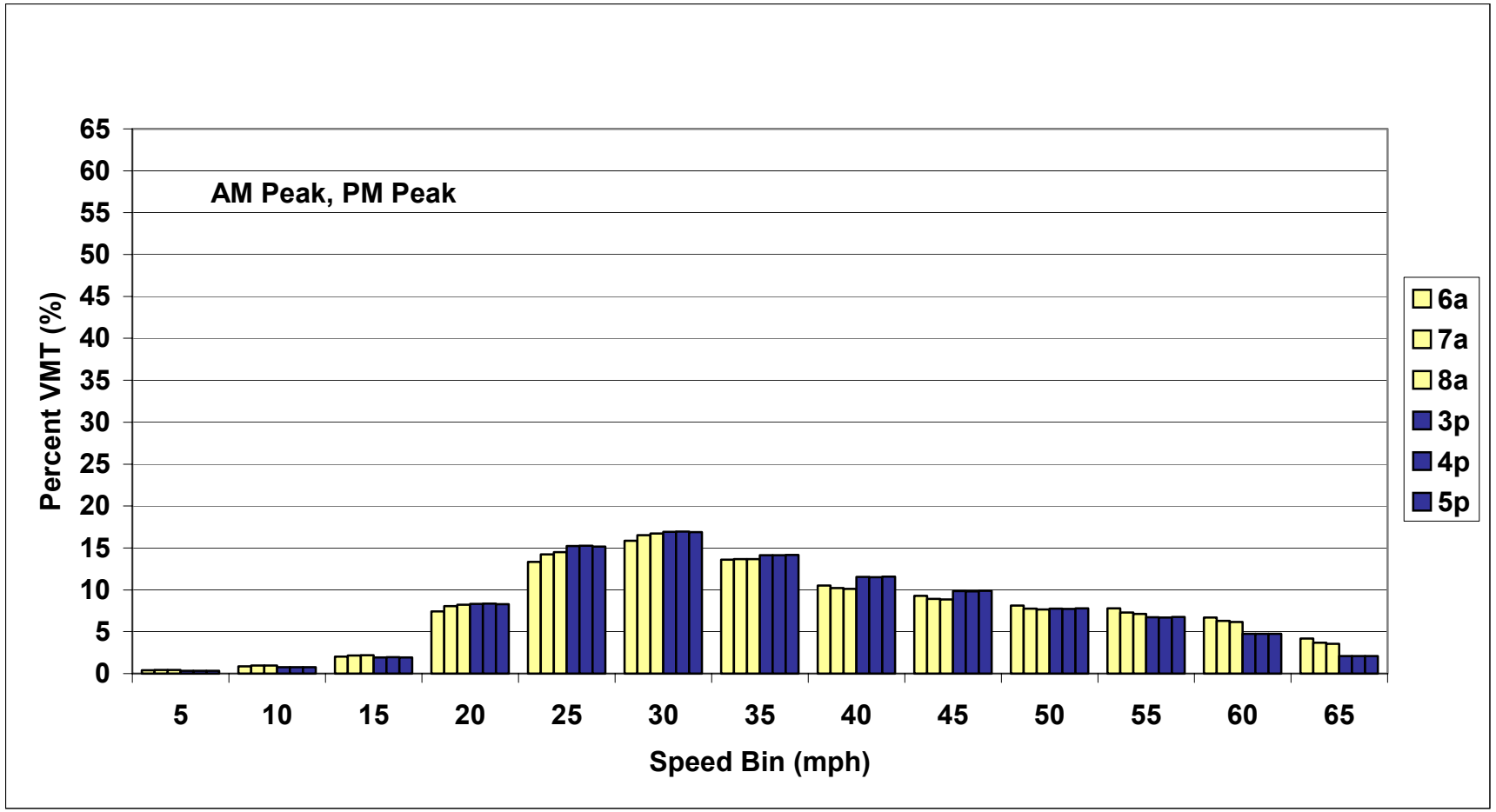

Figure 25. EMFAC2002 Speed-VMT Distributions for AM Peak and PM Peak Periods (2005)

3.2.4 EMFAC2002: 2010

Figures 26 through 31 show the hourly EMFAC2002 speed-VMT distributions for nighttime, AM and PM peak, and daytime off-peak periods for calendar year 2010.

We have shown that the hourly speed-VMT distributions estimated using EMFAC2002 defaults for a given period are pretty similar except for the distributions at 3a and 4a in the nighttime period for which MHDT and MH speed-VMT distributions were not included in the model. Therefore, we can utilize fleet average distributions for any given hour within each period to compare the period-based EMFAC2002 speed-VMT distributions across different years.

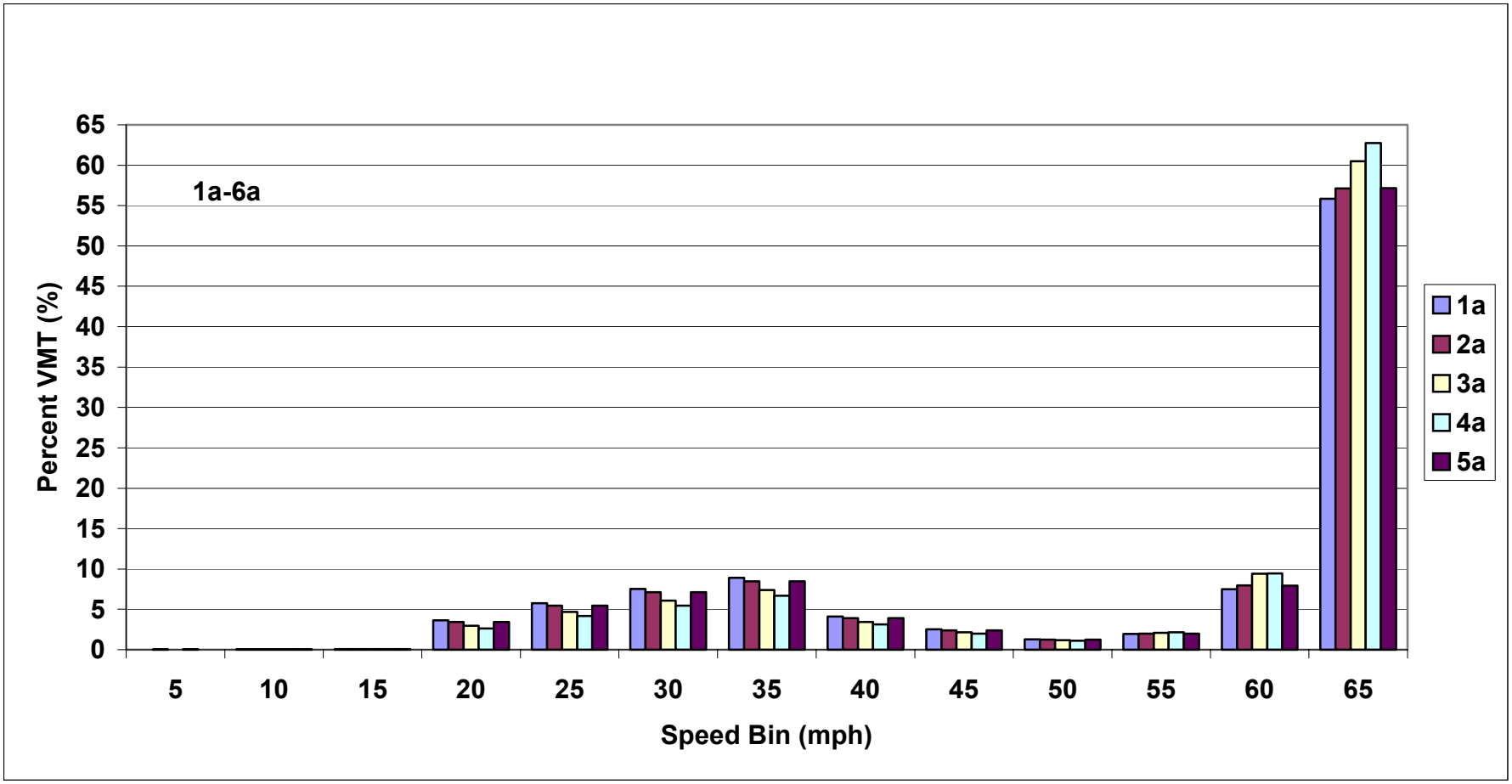

Figure 26. EMFAC2002 Speed-VMT Distributions for 1a, 2a, 3a, 4a, 5a (2010)

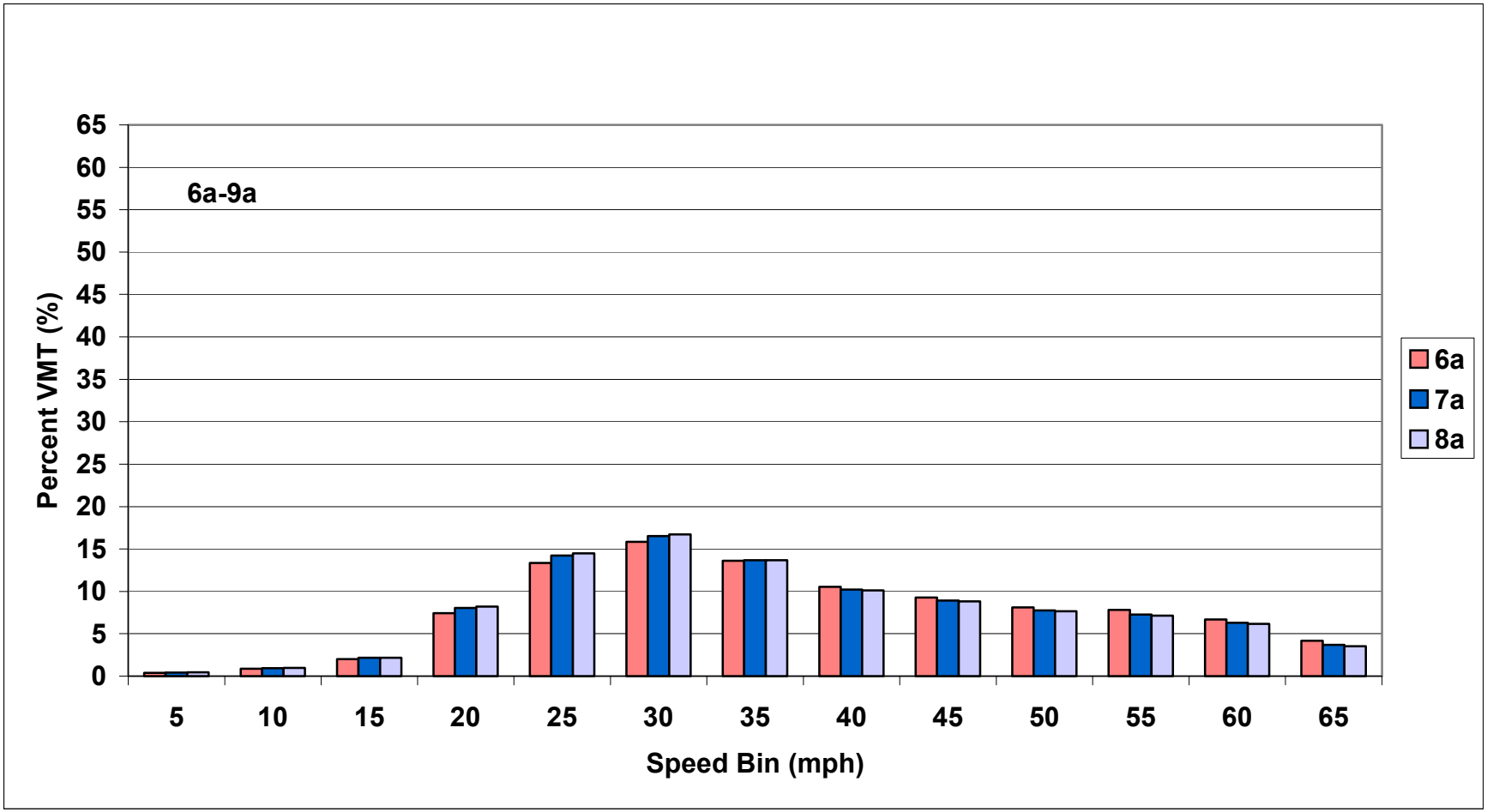

Figure 27. EMFAC2002 Speed-VMT Distributions for 6a, 7a, 8a (2010)

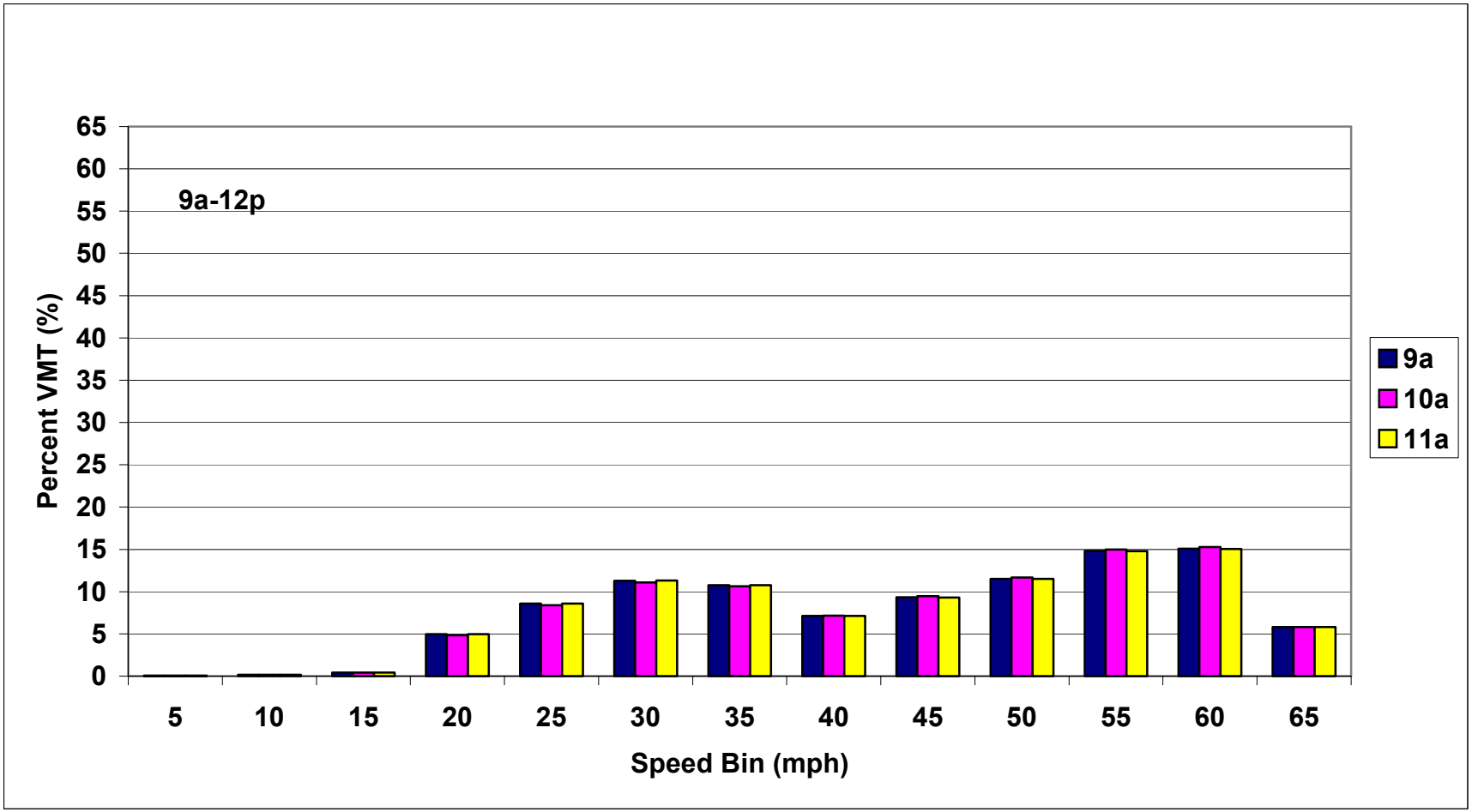

Figure 28. EMFAC2002 Speed-VMT Distributions for 9a, 10a, 11a (2010)

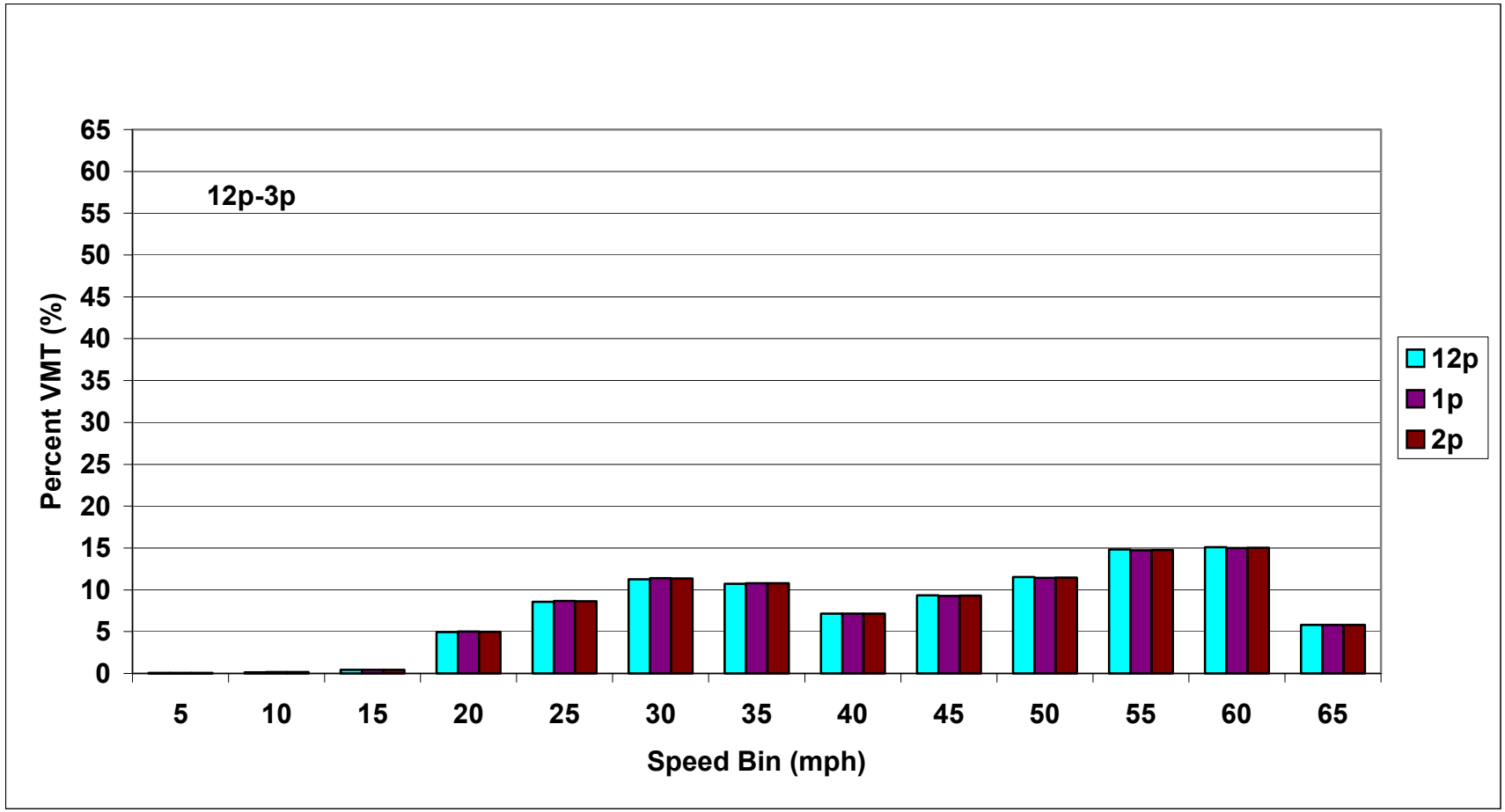

Figure 29. EMFAC2002 Speed-VMT Distributions for 12p, 1p, 2p (2010)

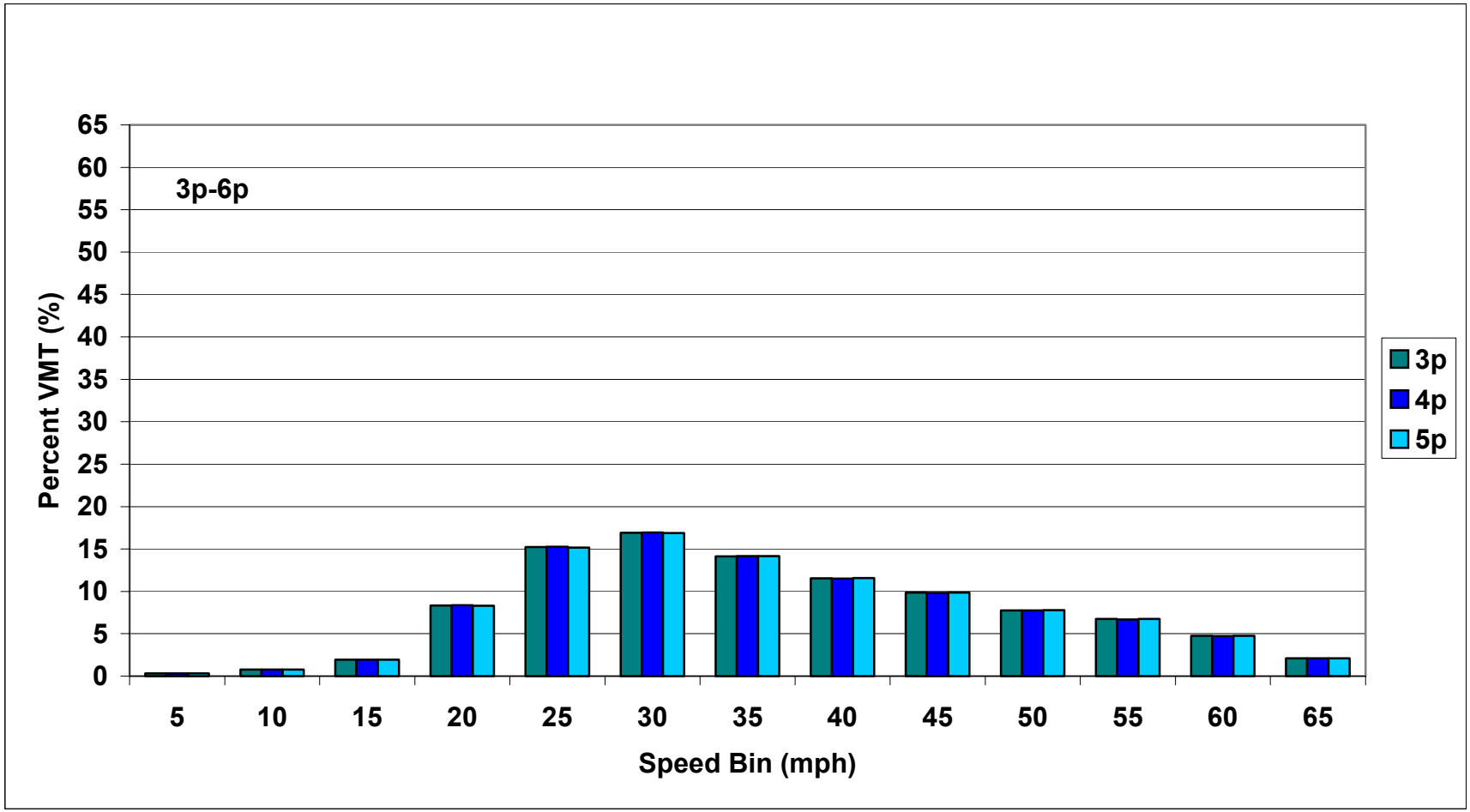

Figure 30. EMFAC2002 Speed-VMT Distributions for 3p, 4p, 5p (2010)

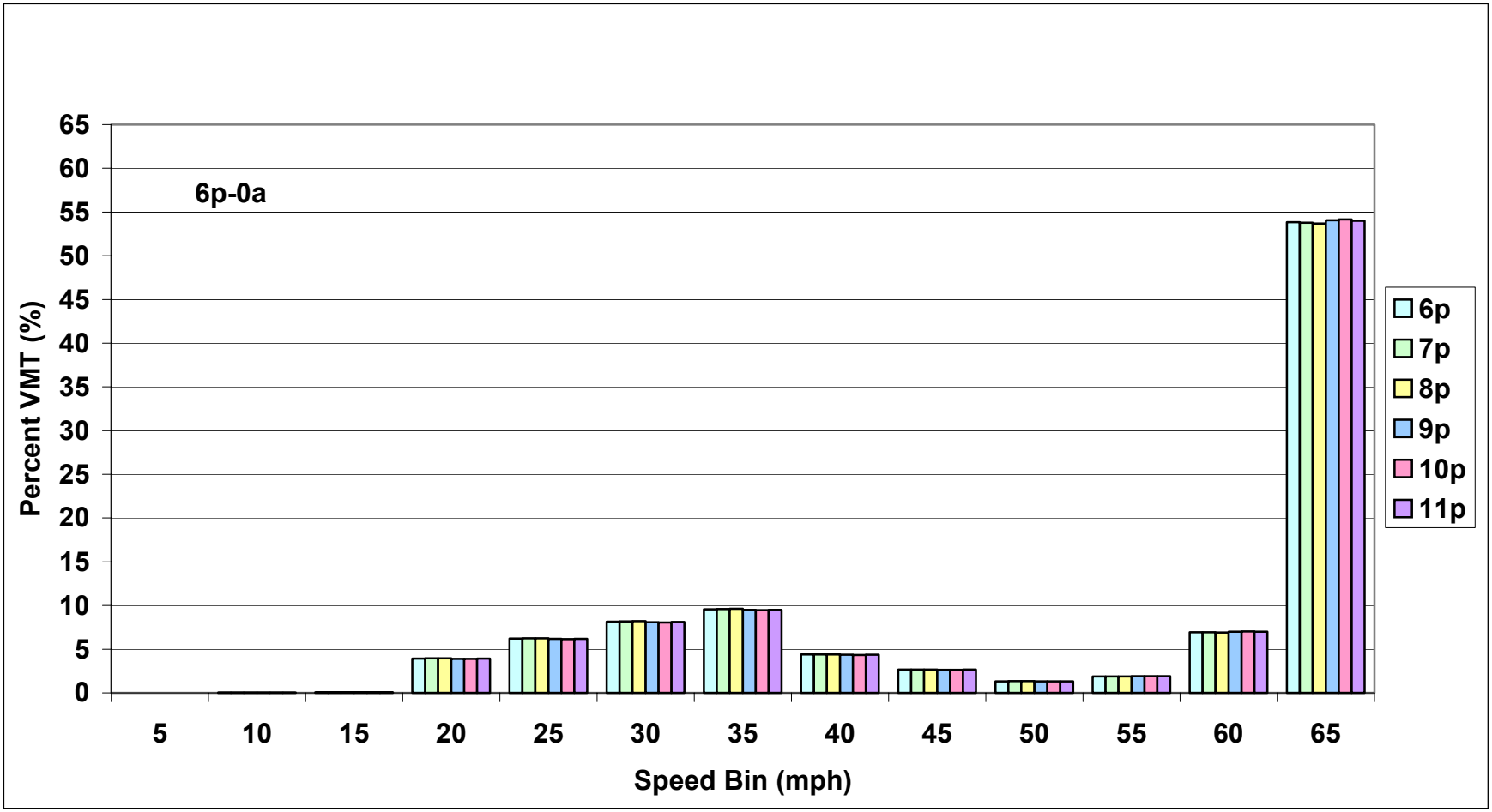

Figure 31. EMFAC2002 Speed-VMT Distributions for 6p, 7p, 8p, 9p, 10p, 11p (2010)

3.2.5 EMFAC2002: A Comparison Across Select Years

We next compared EMFAC2002 speed-VMT distributions for different periods of the day across years. Figure 32 through 35 present speed-VMT distributions for nighttime, AM peak, daytime off-peak and PM peak periods, for 1994, 1997, 2005 and 2010.

Nighttime speed-VMT distributions are very similar for the years 1994 and 1997 and for the years 2005 and 2010 (Figure 32). The percentage of nighttime VMT in the 35 mph speed bin is around 25% for 1994 and 1997 whereas this percentage is around 9% for 2005 and 2010. Similarly, the 47% of VMT in the 60 mph speed bin in 1994 and 1997 reduces to 7% in 2005 and 2010. On the other hand, percentages of VMT in the 65 mph speed bin for 2005 and 2010 are higher (by around 52%) than the percentages for 1994 and 1997.

AM peak distributions for 1994 and 1997 are somewhat different from the distributions for 2005 and 2010 (Figure 33). It is interesting to note that the distributions for 1994 and 1997 are fairly different, while the distributions for 2005 and 2010 are very similar.

Daytime off-peak period speed-VMT distributions are fairly similar for 1994 and 1997, and 2005 and 2010 (Figure 34). Distributions for 1994 and 1997 somewhat differ from the distributions for 2005 and 2010 (by a maximum around 5%). Percentages of VMT for 1994 and 1997 are higher than the percentages for 2005 and 2010 in the 10, 15, 30, 35, 50 and 55 mph speed bins. On the other hand, for 20, 25, 40, 45, 60 and 65 mph speed bins, the VMT shares are higher (maximum around 4%) for 2005 and 2010 when compared to 1994 and 1997.

Differences in EMFAC2002 speed-VMT distributions estimated for 1994, 1997, 2005 and 2010 are similar for AM and PM peak periods (Figures 33 and 35).

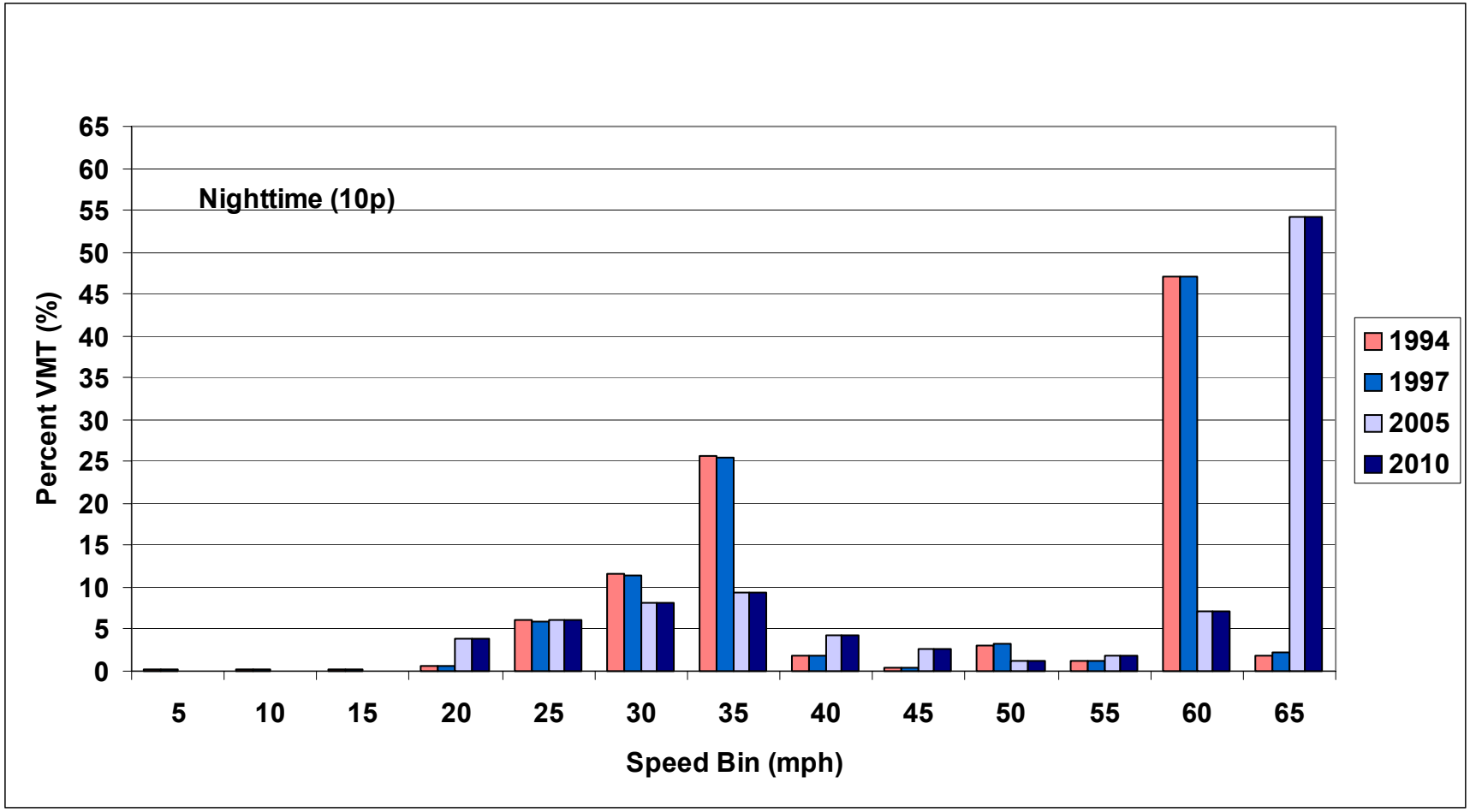

Figure 32. EMFAC2002 Speed-VMT Distributions for Nighttime Period (1994, 1997, 2005 and 2010)

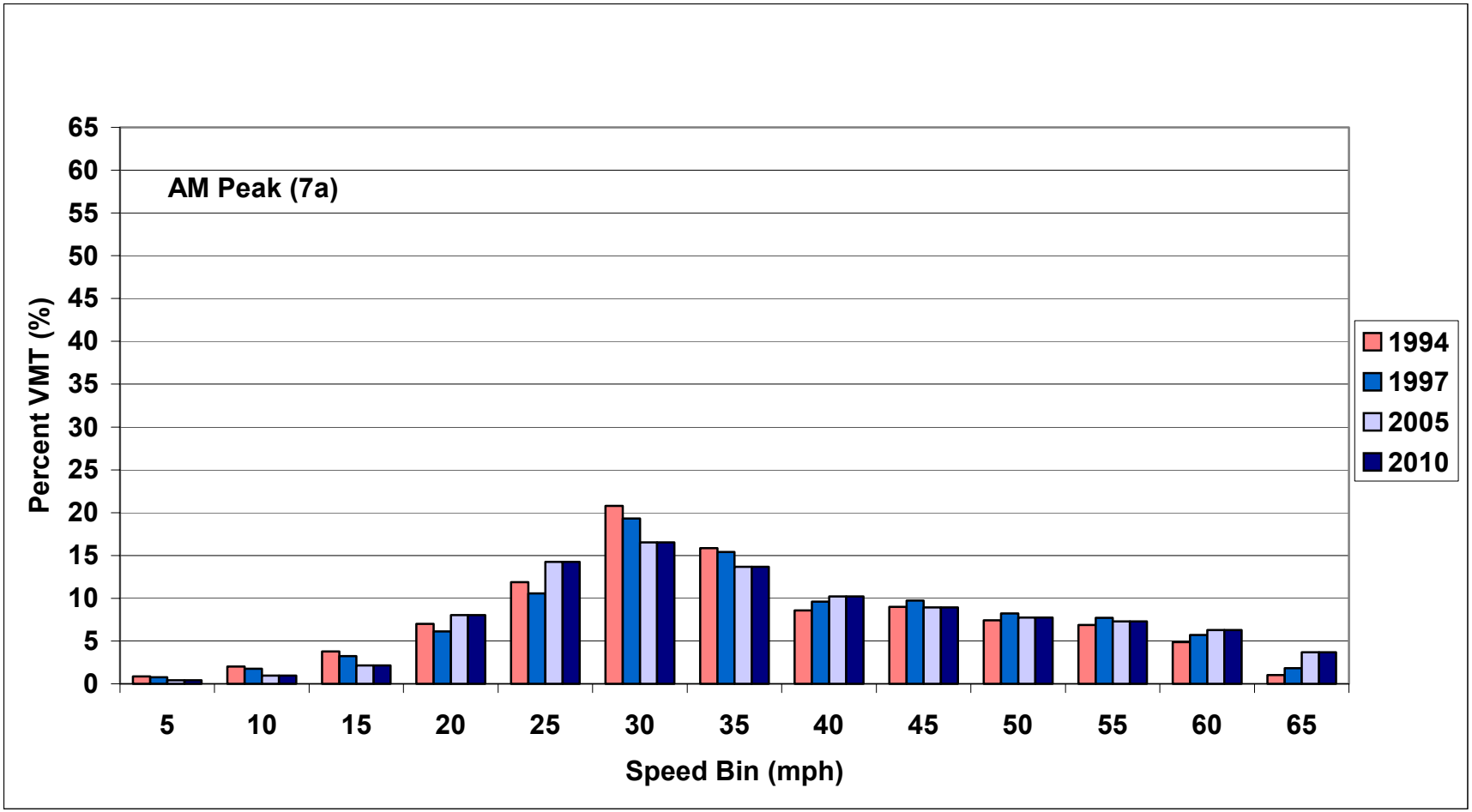

Figure 33. EMFAC2002 Speed-VMT Distributions for AM Peak Period (1994, 1997, 2005 and 2010)

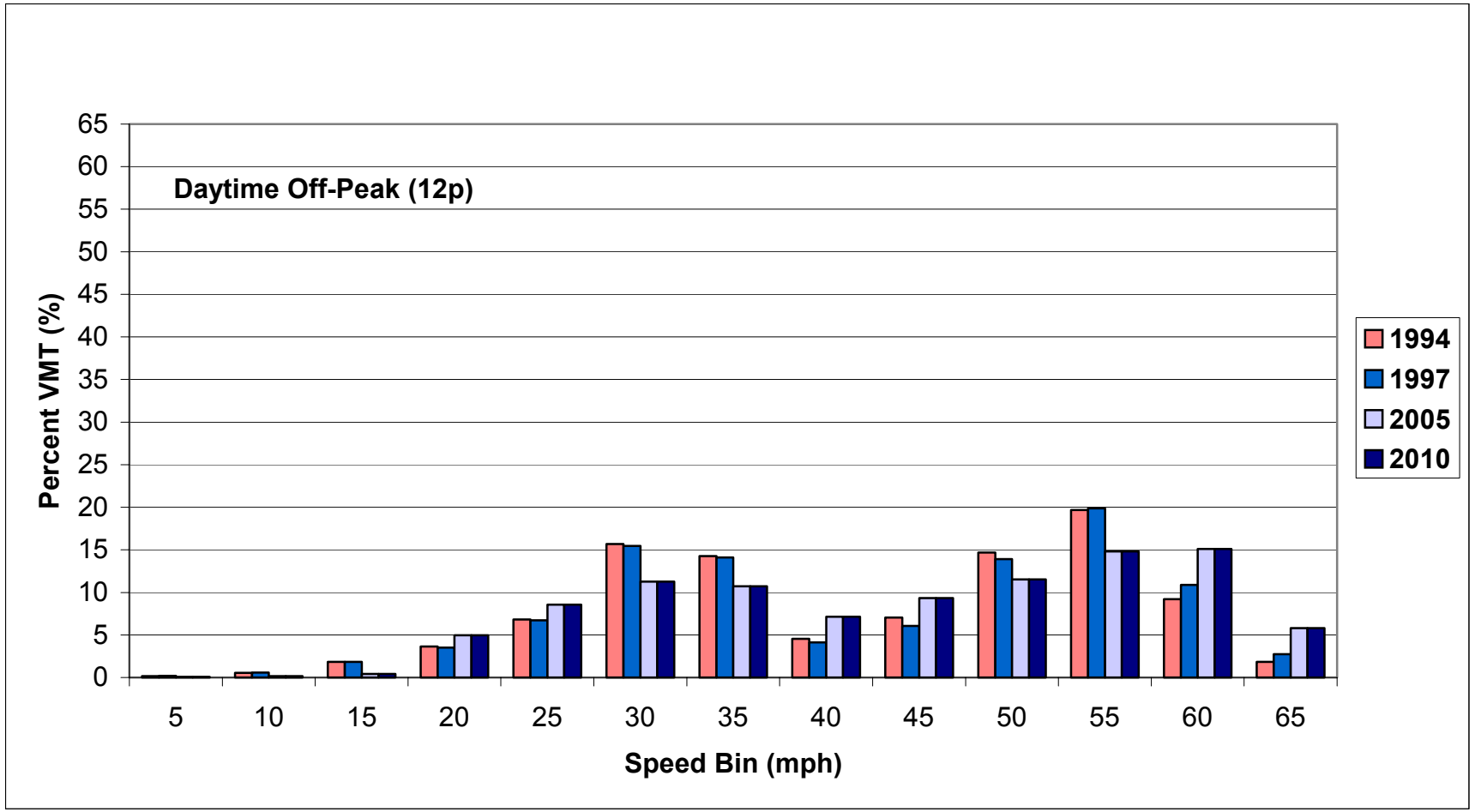

Figure 34. EMFAC2002 Speed-VMT Distributions for Daytime Off-Peak Period (1994, 1997, 2005 and 2010)

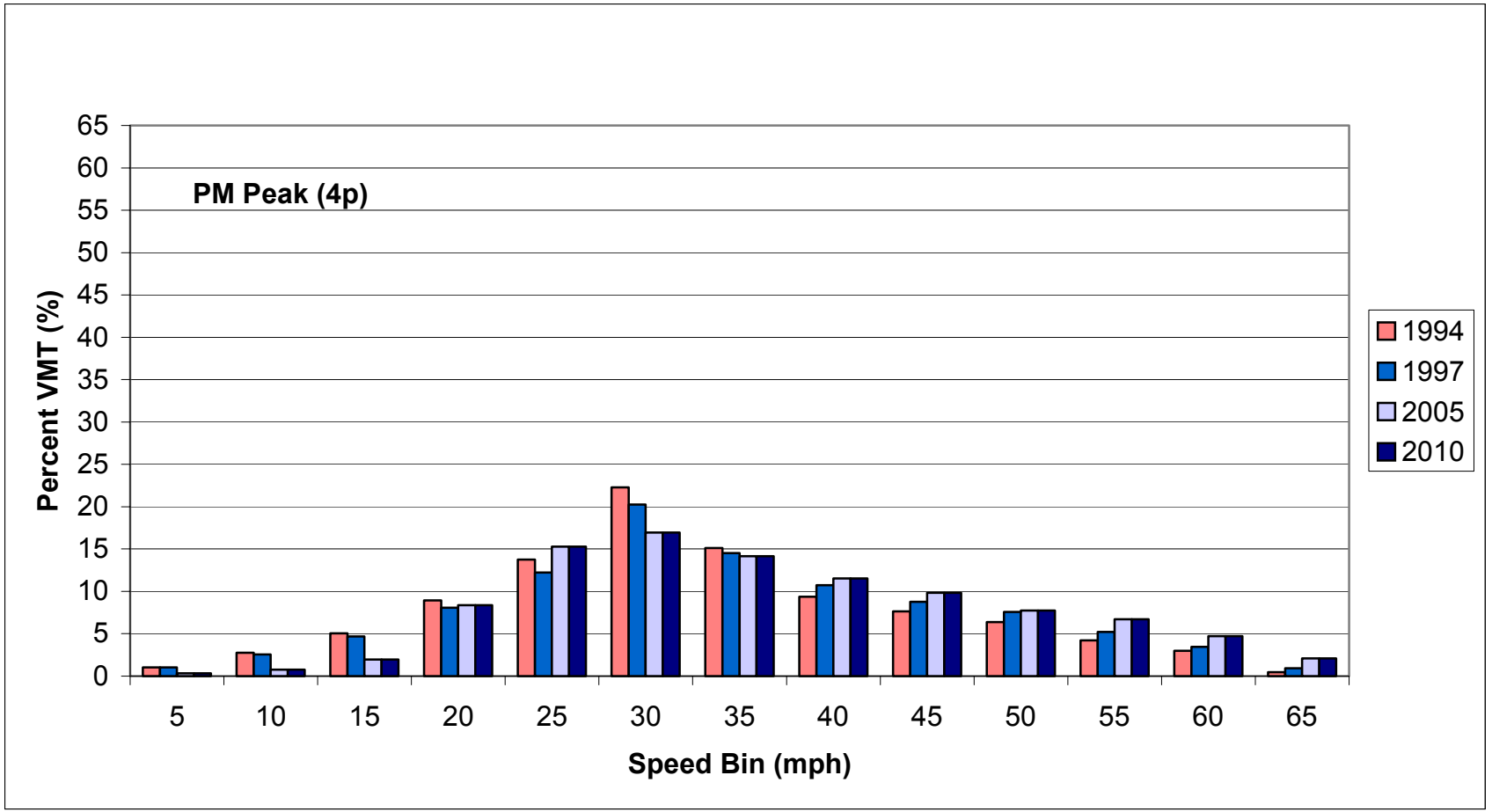

Figure 35. EMFAC2002 Speed-VMT Distributions for PM Peak Period (1994, 1997, 2005 and 2010)

3.3 Comparisons between EMFAC7G and EMFAC2002

We estimated EMFAC7G speed-VMT distributions using the speed-VMT defaults for each period of the day for 1990, 1994, 2000 and 2010 and the EMFAC2002 fleet average speed-VMT default distributions for each hour of the day for 1994, 1997, 2005 and 2010. As might be expected, the distributions from EMFAC7G and EMFAC2002 differ depending on the period for which they are estimated.

In the preceding sections, we showed that within a given period, the hourly EMFAC2002 speed-VMT distributions are the same for most of the hours within that period. In addition, EMFAC2002 speed-VMT distributions for a given period show different characteristics depending on the year.

In this section, we will compare speed-VMT distributions estimated using EMFAC7G and EMFAC2002 defaults for 1994 and 2010 for each period of the day. We will compare the hourly EMFAC2002 distributions to the EMFAC7G speed-VMT default distributions by period.

3.3.1 Comparing EMFAC7G to EMFAC2002: 1994

Figures 36 through 39 present EMFAC7G and EMFAC2002 speed-VMT distributions estimated for nighttime, AM peak, daytime off-peak, and PM peak periods in 1994. For this year, EMFAC7G and EMFAC2002 estimates are similar in every period except the nighttime period.

EMFAC7G and EMFAC2002 speed-VMT distributions somewhat differ for nighttime period for 1994 (Figure 36). The highest difference is estimated for the 60 mph speed bin for which the percentage of EMFAC7G VMT is 5.7% higher than the percentage of EMFAC2002 VMT. The second highest difference is 3.4% for the 35 mph speed bin for which the EMFAC7G VMT is higher.

In contrast, AM peak period distributions estimated by the two models are similar for 1994 (Figure 37). Percentage of EMFAC2002 VMT is 1.1% lower than the percentage of EMFAC7G VMT in the 30 mph speed bin. Differences in the percentages of EMFAC7G and EMFAC2002 VMT percentages are lower in magnitude in the other speed bins.

EMFAC7G and EMFAC2002 speed-VMT distributions are very similar for 1994 for the daytime off-peak periods (Figure 38) and the PM peak period (Figure 39). For the daytime off-peak periods, the highest difference in the percentages of VMT is estimated for the 35 mph speed bin. In this speed bin, the percentage of EMFAC7G VMT is 0.8% lower than the percentage of EMFAC2002 VMT. For the PM peak period, the highest difference in the percentages of VMT is estimated for the 30 mph speed bin as 0.6%.

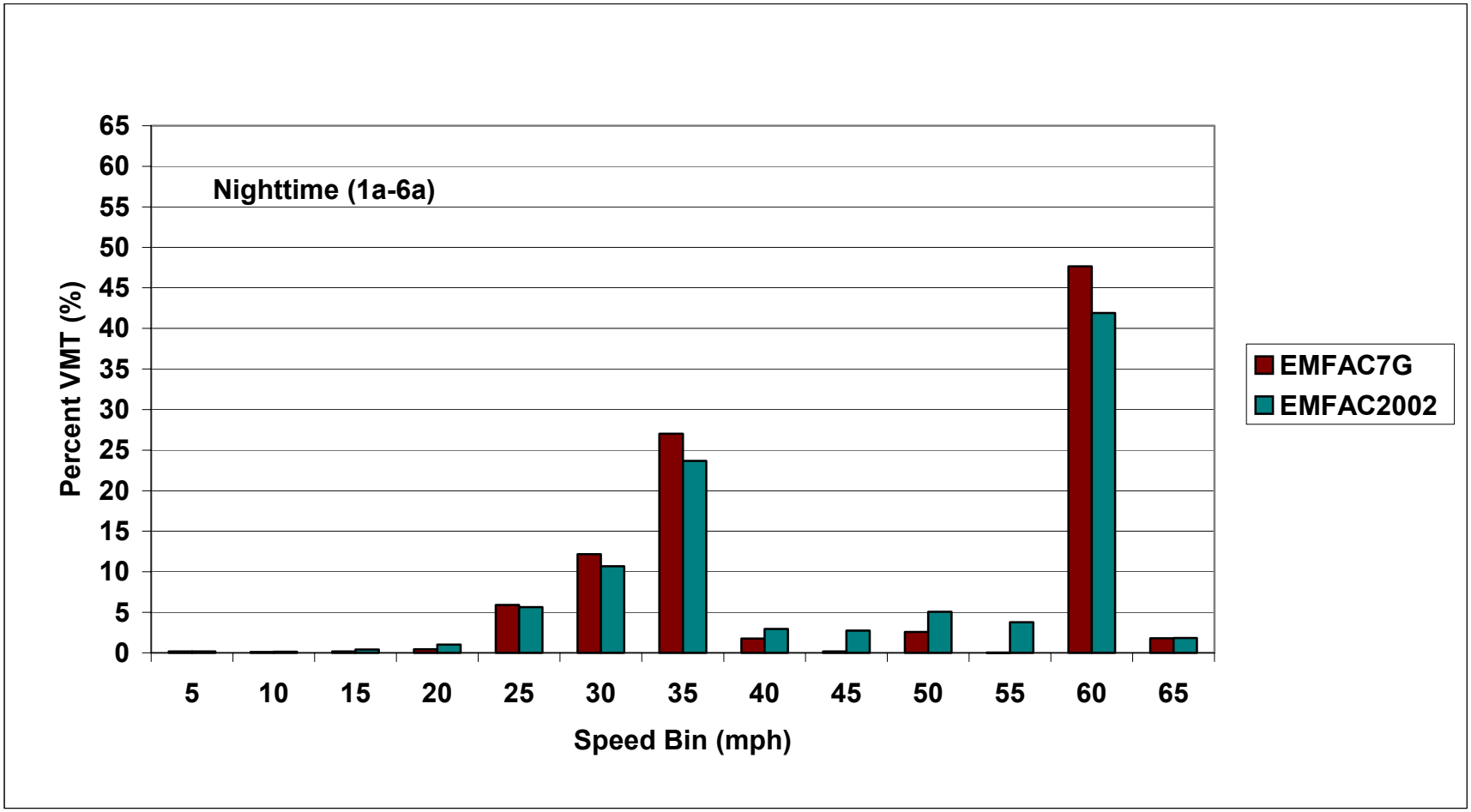

Figure 36. EMFAC7G & EMFAC2002 Speed-VMT Distributions for Nighttime Period (1994)

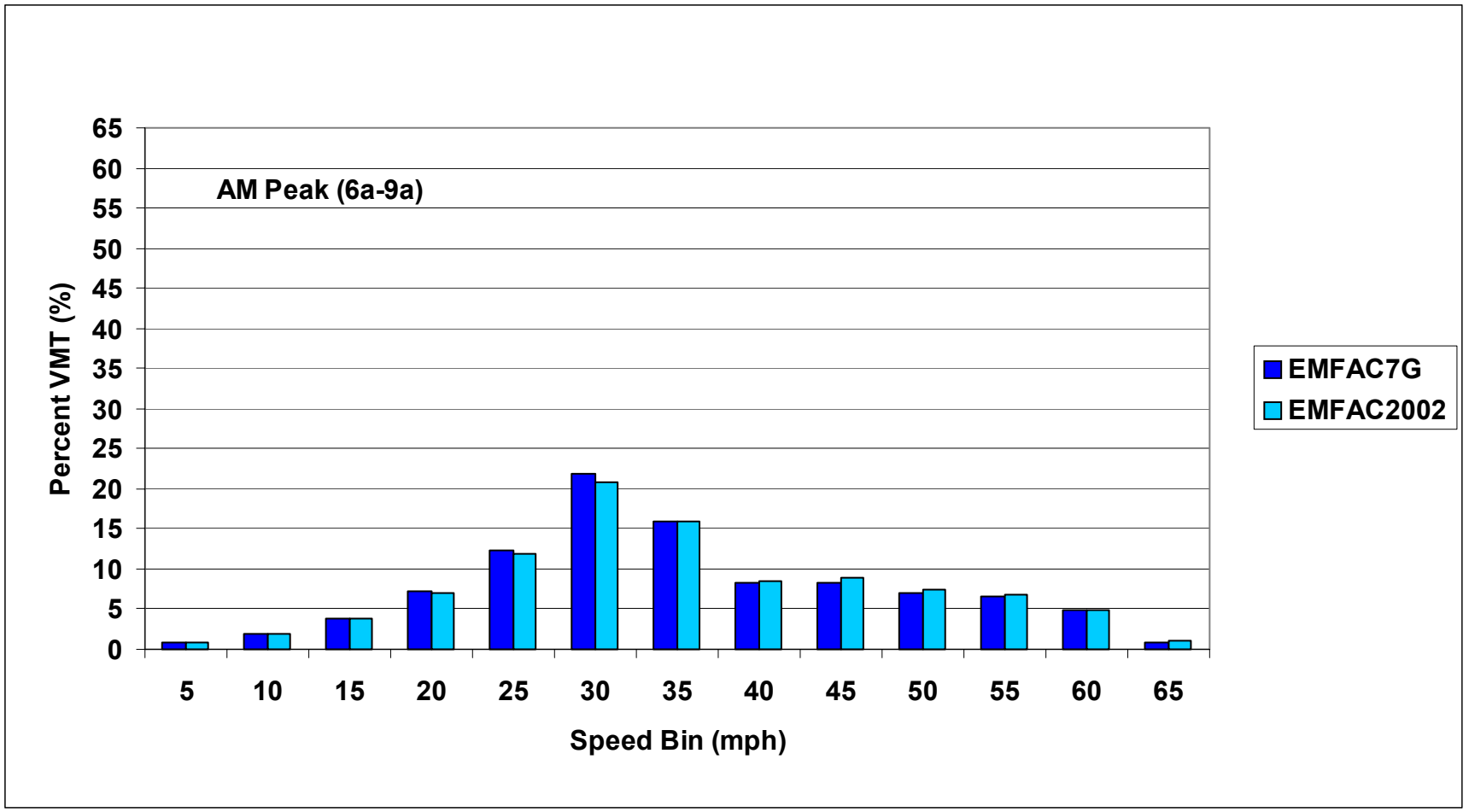

Figure 37. EMFAC7G & EMFAC2002 Speed-VMT Distributions for AM Peak Period (1994)

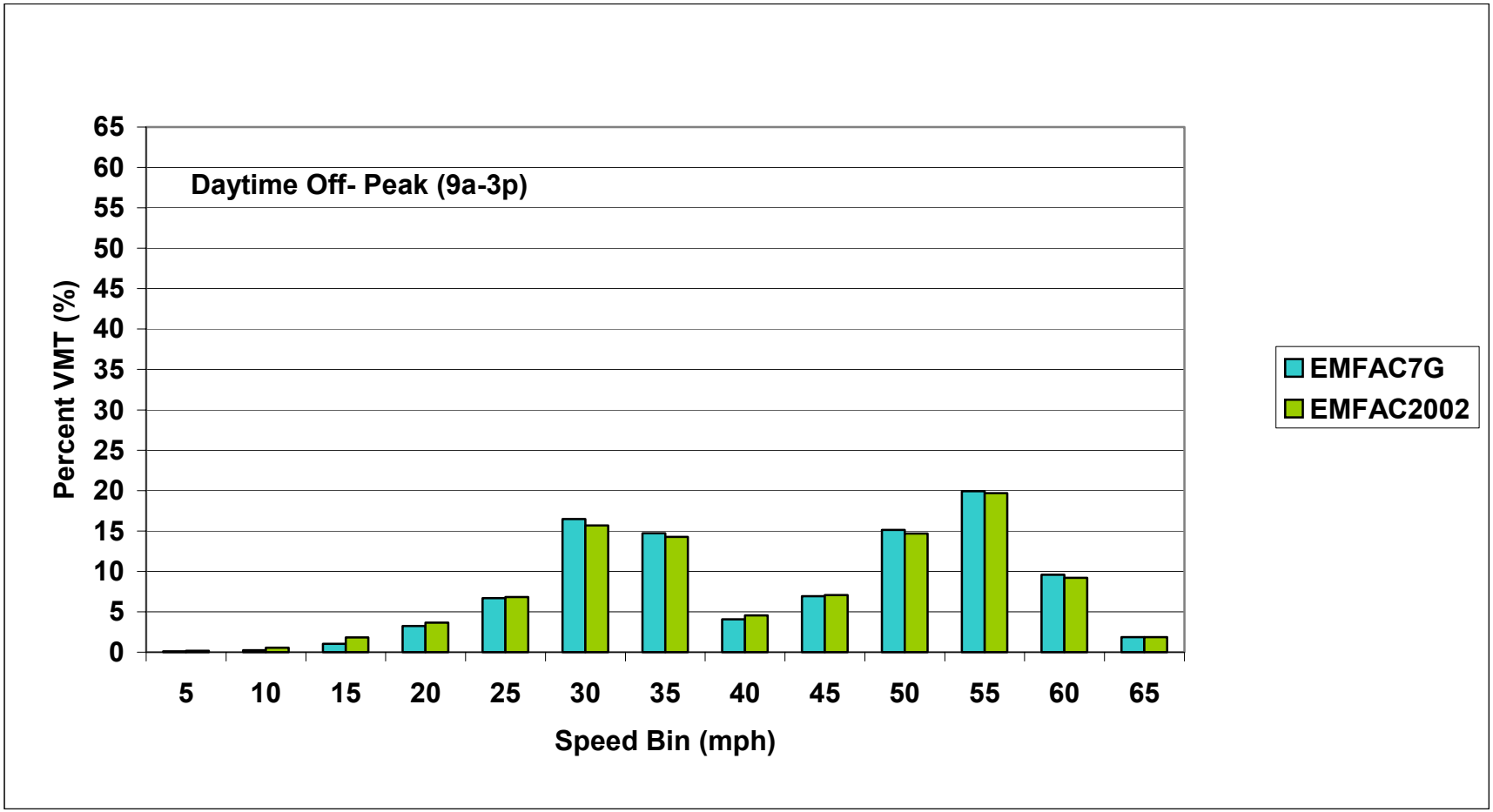

Figure 38. EMFAC7G & EMFAC2002 Speed-VMT Distributions for Daytime Off-Peak Period (1994)

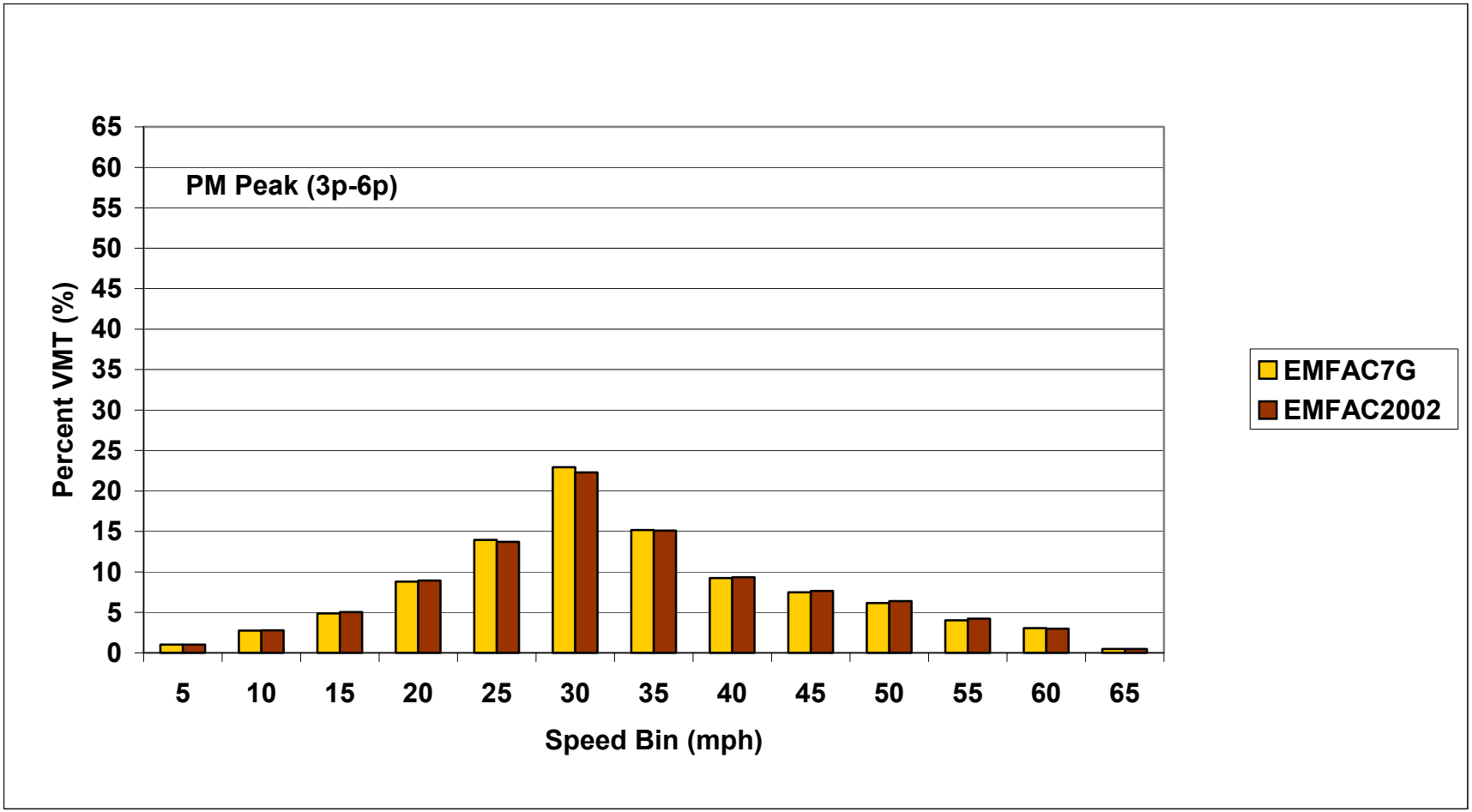

Figure 39. EMFAC7G & EMFAC2002 Speed-VMT Distributions for PM Peak Period (1994)

3.3.2 Comparing EMFAC7G to EMFAC2002: 2010

Figures 40 through 43 present the EMFAC7G and EMFAC2002 speed-VMT distributions for nighttime, AM peak, daytime off-peak and PM peak periods of 2010. The estimates differ in each period, to varying degrees.

EMFAC7G and EMFAC2002 speed-VMT distributions differ substantially during nighttime (Figure 40). Percentages of EMFAC7G VMT are 39.4% higher in the 60 mph and 53.5% lower in the 65 mph speed bin than the percentages of EMFAC2002 VMT in these speed bins. Percentage of VMT is 16.3% higher for EMFAC7G when compared to the percentage for EMFAC2002 in 35 mph speed bin. For the other speed bins, the differences in the percentages of EMFAC7G and EMFAC2002 change between 0.1 and 4.2%.

The difference between EMFAC7G and EMFAC2002 are less for the AM peak period (Figure 41). EMFAC7G percentages are higher (at most 3.8%) in 5, 10, 15, 20, 30 and 35 mph speed bins, on the other hand, EMFAC2002 percentages are higher (at most 2.9%) in 25, 40, 45, 50, 55 60 and 65 mph speed bins.

Daytime off-Peak period speed-VMT distribution defaults for EMFAC7G and EMFAC2002 also differ for the year 2010 (Figure 42). EMFAC7G percentages of VMT are higher for the speed bins 5, 10, 15, 30, 35, 45 and 50 mph. The highest value difference is estimated for the 30 mph speed bin as 6.9%. EMFAC2002 percentages are higher for the 20, 25, 40, 55, 60 and 65 mph speed bins. A 9.2% of difference estimated for the 60 mph speed bin is the highest value difference when EMFAC2002 percentages of VMT are higher than the EMFAC7G percentages.

In the PM peak period, EMFAC7G percentages of VMT are higher for the 30 mph and lower speed bins, but in the speed bins with speeds 35 mph and higher, EMFAC2002 percentages are higher (Figure 43). The largest difference is estimated for the 15 mph speed bin for which the EMFAC7G percentage is 6.8% higher than the EMFAC2002 percentage of VMT. The second highest value is estimated for the 55 mph speed bin for which EMFAC2002 percentage is 4.7% higher than the EMFAC7G percentage.

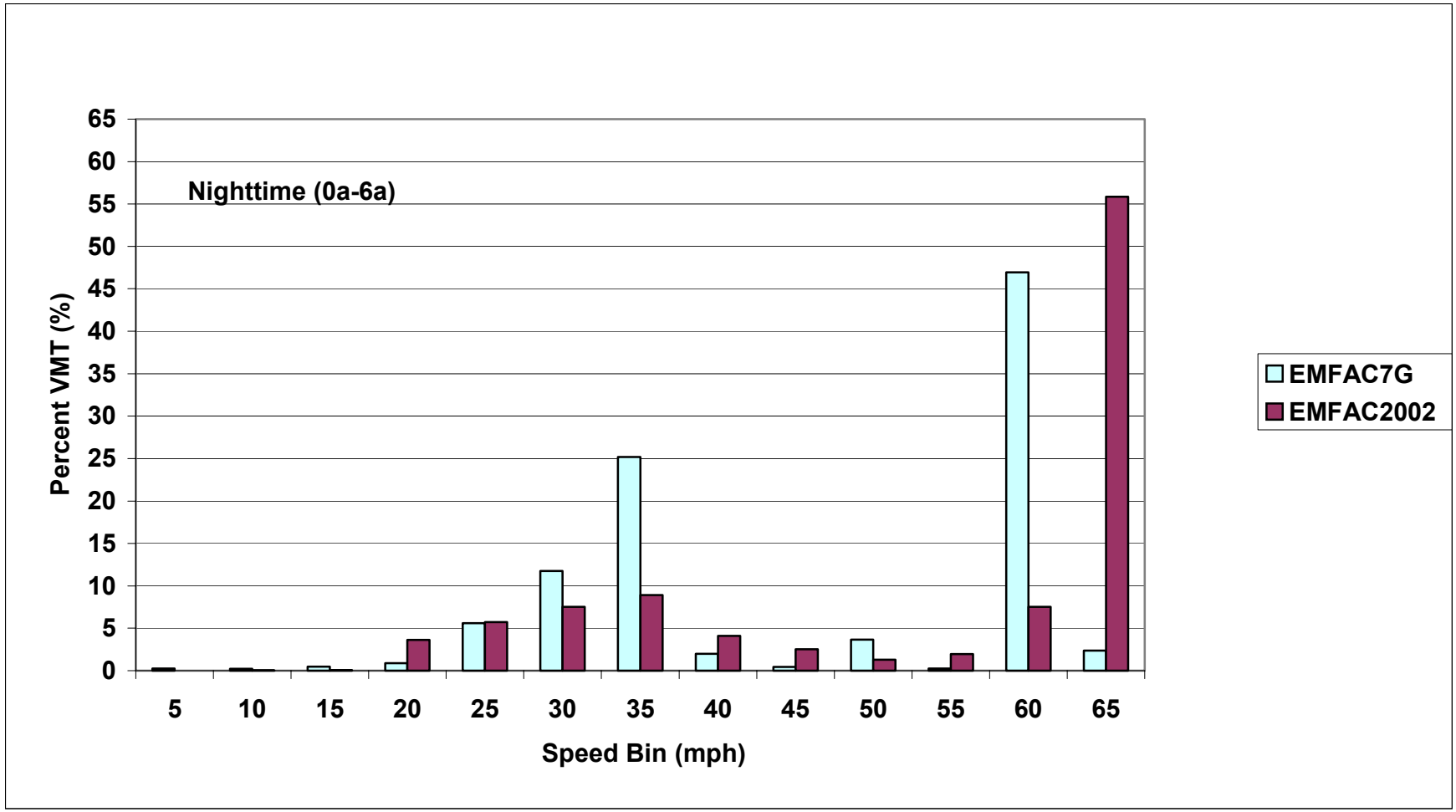

Figure 40. EMFAC7G & EMFAC2002 Speed-VMT Distributions for Nighttime Period (2010)

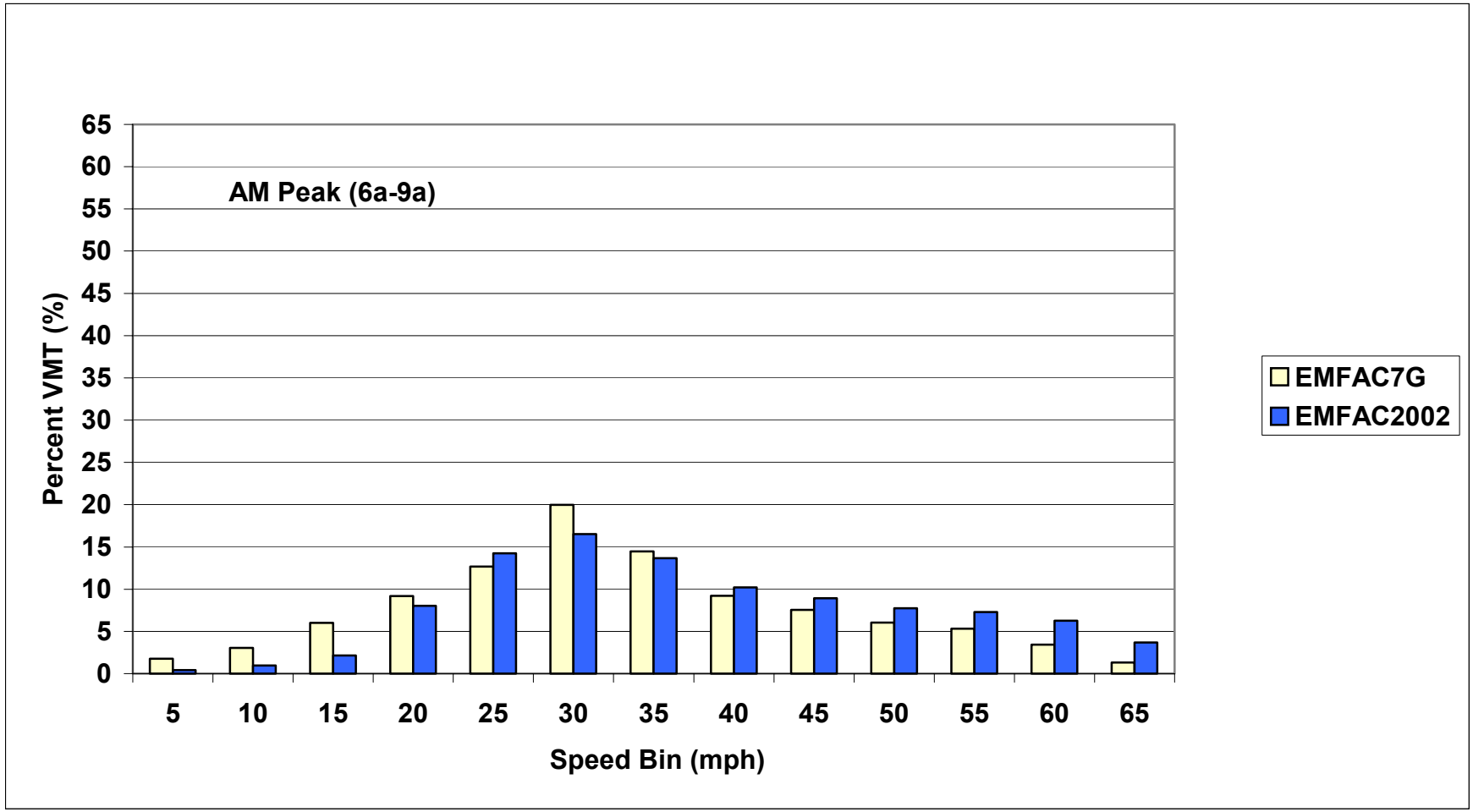

Figure 41. EMFAC7G & EMFAC2002 Speed-VMT Distributions for AM Peak Period (2010)

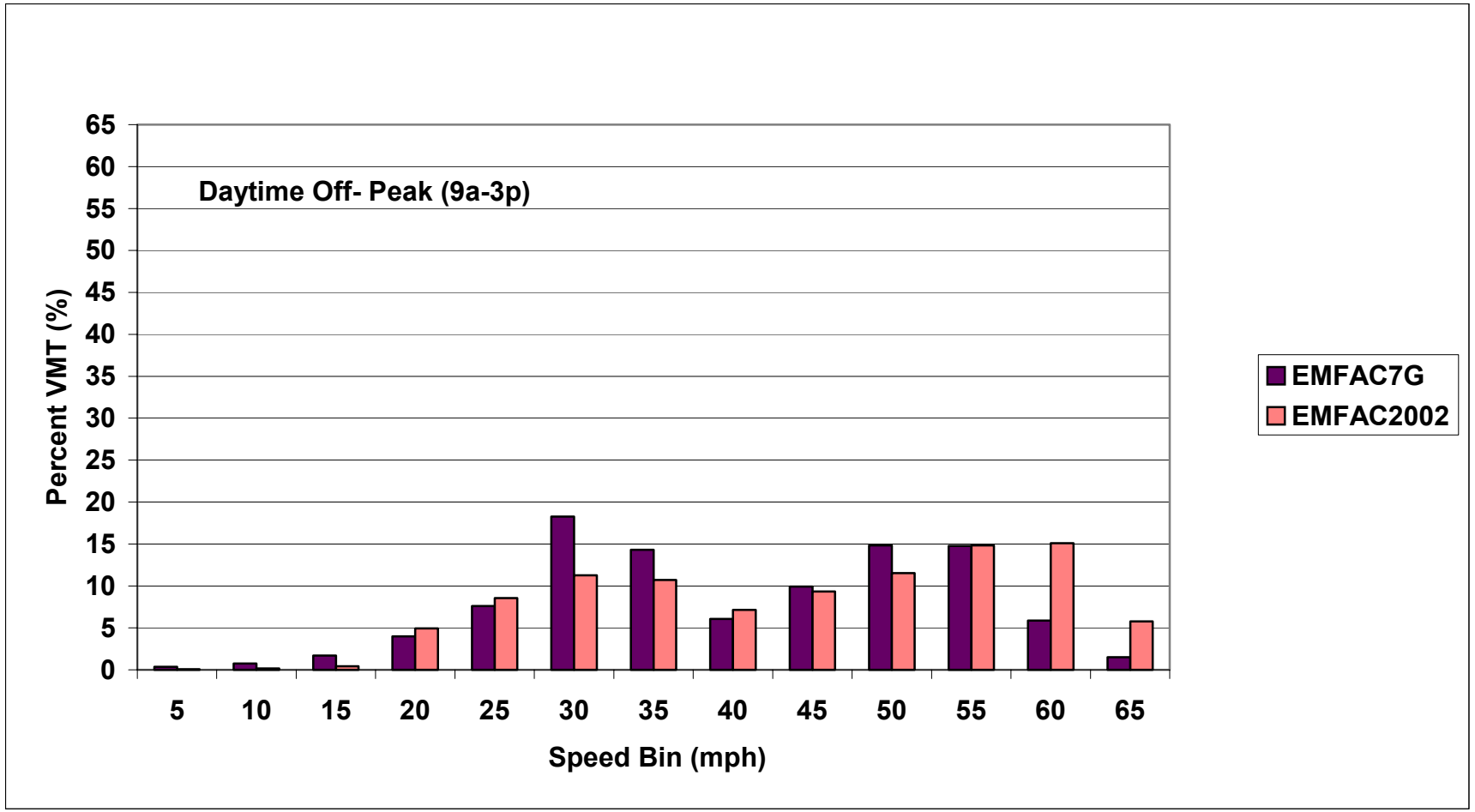

Figure 42. EMFAC7G & EMFAC2002 Speed-VMT Distributions for Daytime Off-Peak Period (2010)

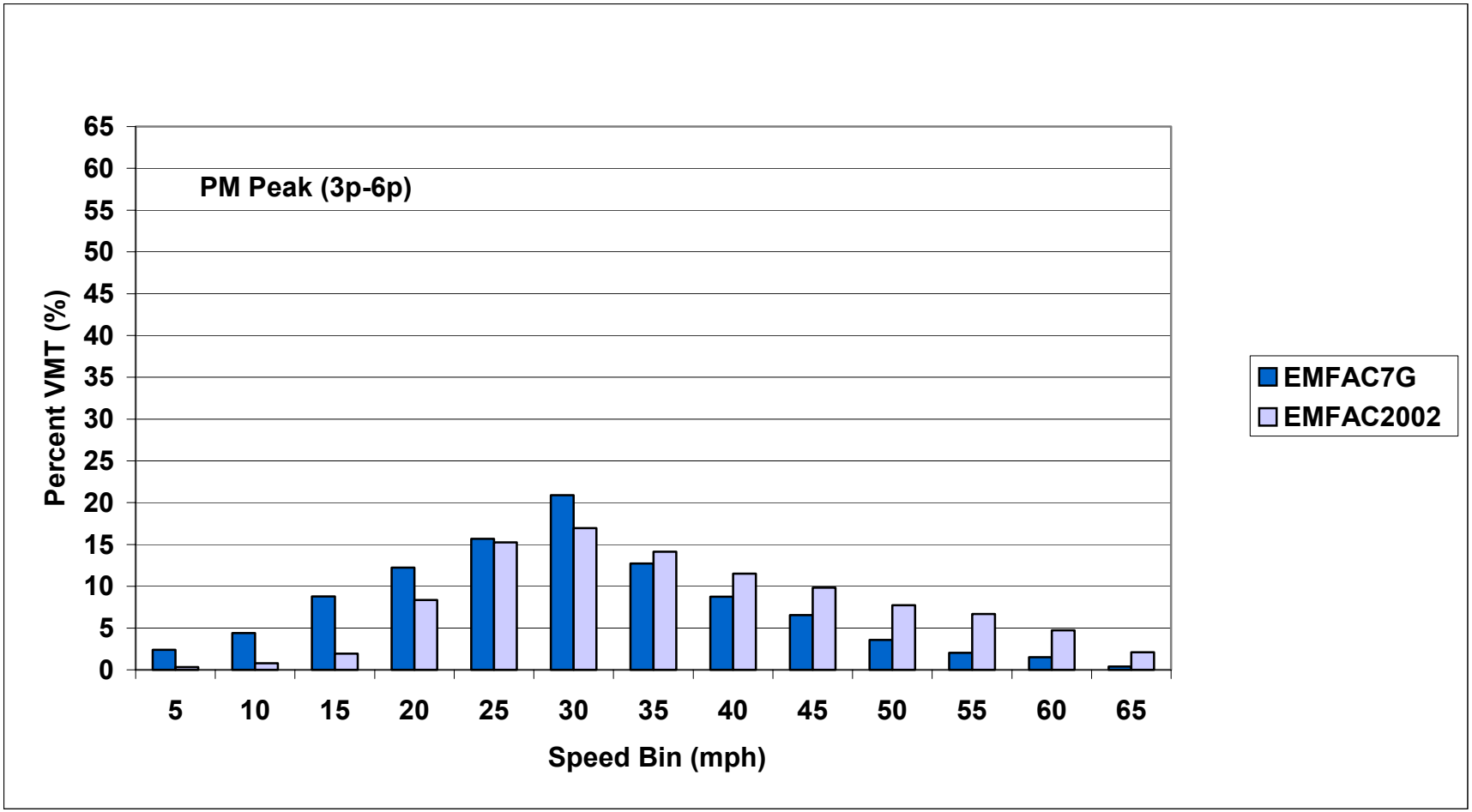

Figure 43. EMFAC7G & EMFAC2002 Speed-VMT Distributions for PM Peak Period (2010)

3.4 Freeway-Only Speed-VMT Distributions from SCOS97 Data

In this section, we present freeway-only speed-VMT distributions from 1997, and compare these real-world distributions to EMFAC2002 estimates for the same year.

The percentages of VMT for each speed bin were calculated for North Los Angeles, South Los Angeles and Orange County using SCOS97 real-world data. Then these three data sets were combined to produce speed-VMT distribution for SCAB. Figure 44 presents the speed-VMT distribution using hourly average speeds and flow rates on Los Angeles Freeway links estimated for the daytime hours (6a through 6p) for the summer for 1997.

To similarly estimate the daytime 1997 speed-VMT distribution for SCAB using EMFAC2002 defaults, we combined the EMFAC2002 distributions for AM peak, daytime off-peak and PM peak periods (6a through 6p) as shown in Figure 45.

Daytime speed-VMT distributions estimated using SCOS97 *freeway-only* data and 1997 EMFAC2002 defaults differ (Figures 44 and 45). Freeway-only daytime percentages of VMT are higher in 40, 45, 50 and 55 mph speed bins (70.5% of total VMT are in these speed bins) (Figure 44). Daytime hours represent both AM and PM peak periods, during which time traffic is likely to be congested, as well as the daytime off-peak period when free flowing traffic conditions are likely to be observed. Therefore, we can say that the percentages of freeway VMT in the speed bins represent both free flowing and congested freeway speeds. However, EMFAC2002 distributions presented in Figure 45 are a combination of *trip-based* speed-VMT distributions, and include congested and uncongested speeds and flow rates for numerous types of facilities, including freeways. For example, a 41.5% of total VMT in 25, 30 and 35 mph speed bins reflects congested and uncongested traffic conditions on arterials. On the other hand, a 40.9% of total VMT in 45, 50, 55, 60 and 65 mph speed bins reflects congested and uncongested traffic conditions on freeways.

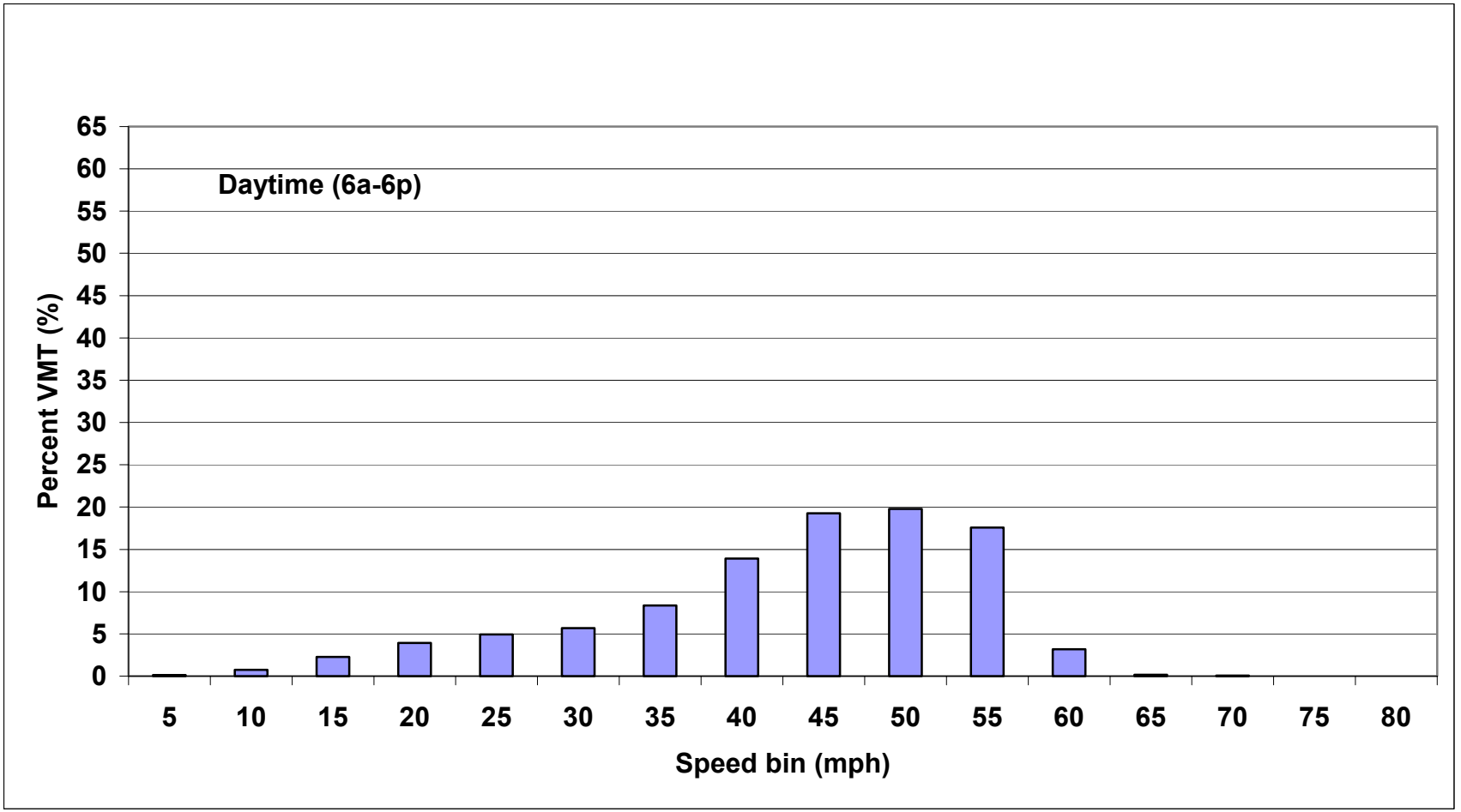

Figure 44. SCOS97 Freeway-only Speed-VMT Distribution for Daytime (1997)

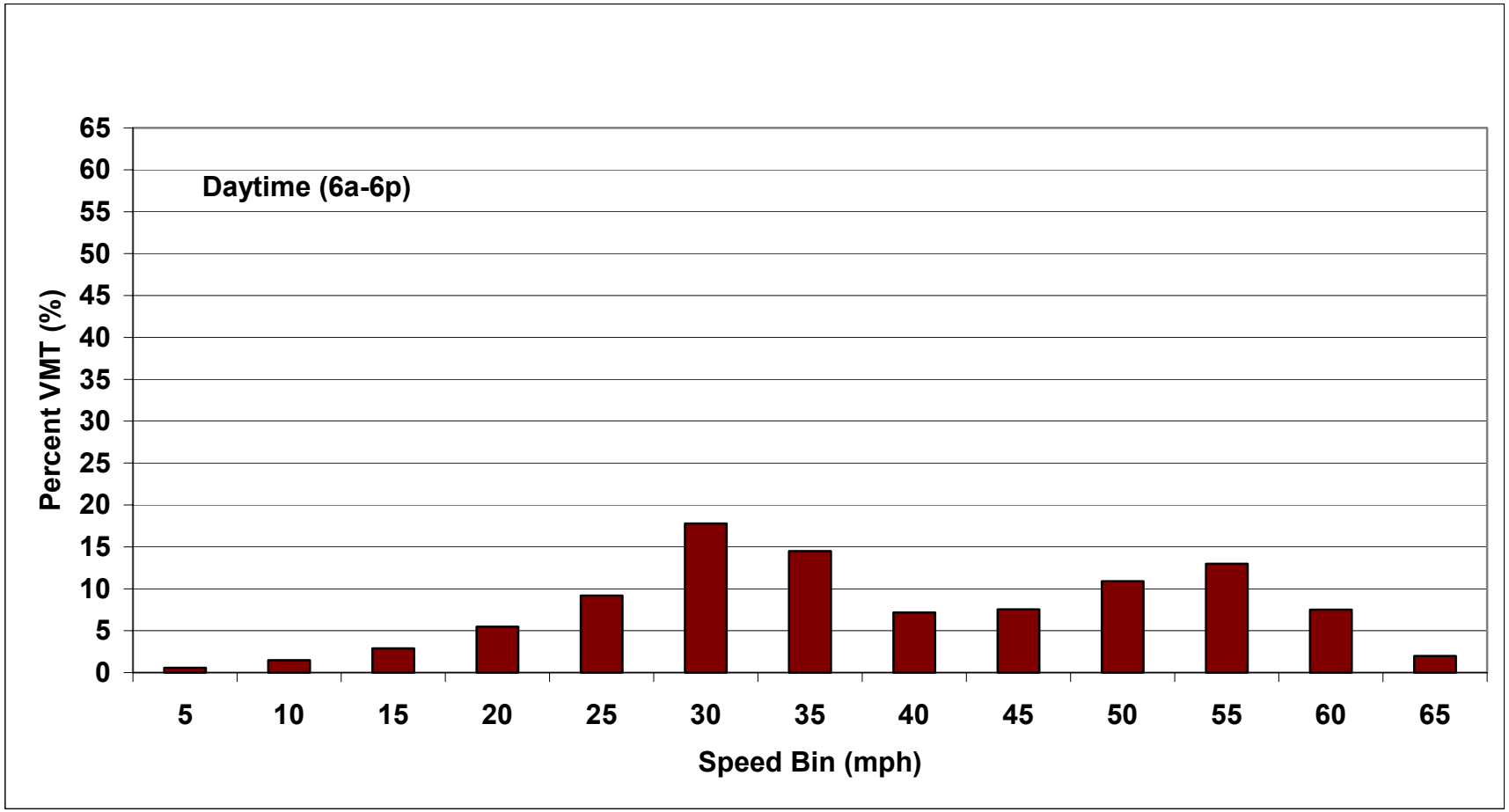

Figure 45. EMFAC2002 Speed-VMT Distribution for Daytime Period (1997)

3.5 Speed Fractions from Chase Car Observations

To explore whether EMFAC-VMT distribution defaults represent speeds observed by individual vehicles, we examined the speed fractions, or the percentage of time speeds in each speed bin were observed, first using trip-based data, and then disaggregating the data by facility type.

3.5.1 Trip-Based Speed Fractions

We began by using trip-based instantaneous speeds measured by chase car vehicles on different facilities of SCAB in 2000 (Sierra Research, 2003). Figures 46 through 59 show the chase car speed fractions for 6a through 7p. Hourly speed fractions show that there is no particular pattern for the trip-based speed fractions for different hours of the day (Figures 46 through 59).

The percentages of speeds for a given hour is at most 18.4% for a given speed bin (percentage observed speeds in the 25 mph speed bin for 7p) (Figure 59). The second highest percentage of speeds is observed in the 5 mph speed bin for 4p and has a value of 14.8% (Figure 56). These low value percentages of speeds in each speed bin show that there is no single speed for which the percentage of observed speeds is very high compared to the other ranges of speed for a given hour of the day (Figures 49 through 56).

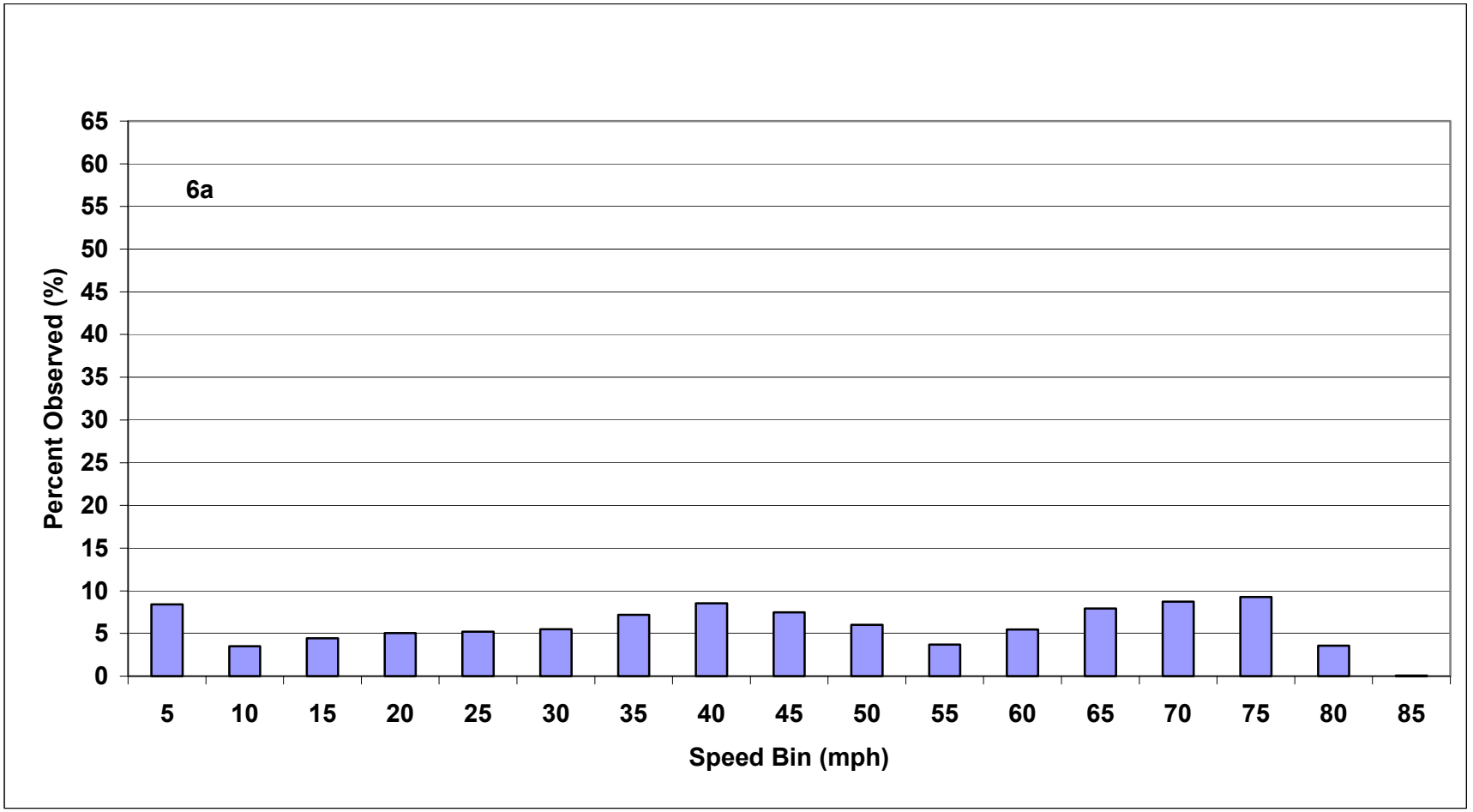

Figure 46. Chase Car Speed Fractions for 6a (2000)

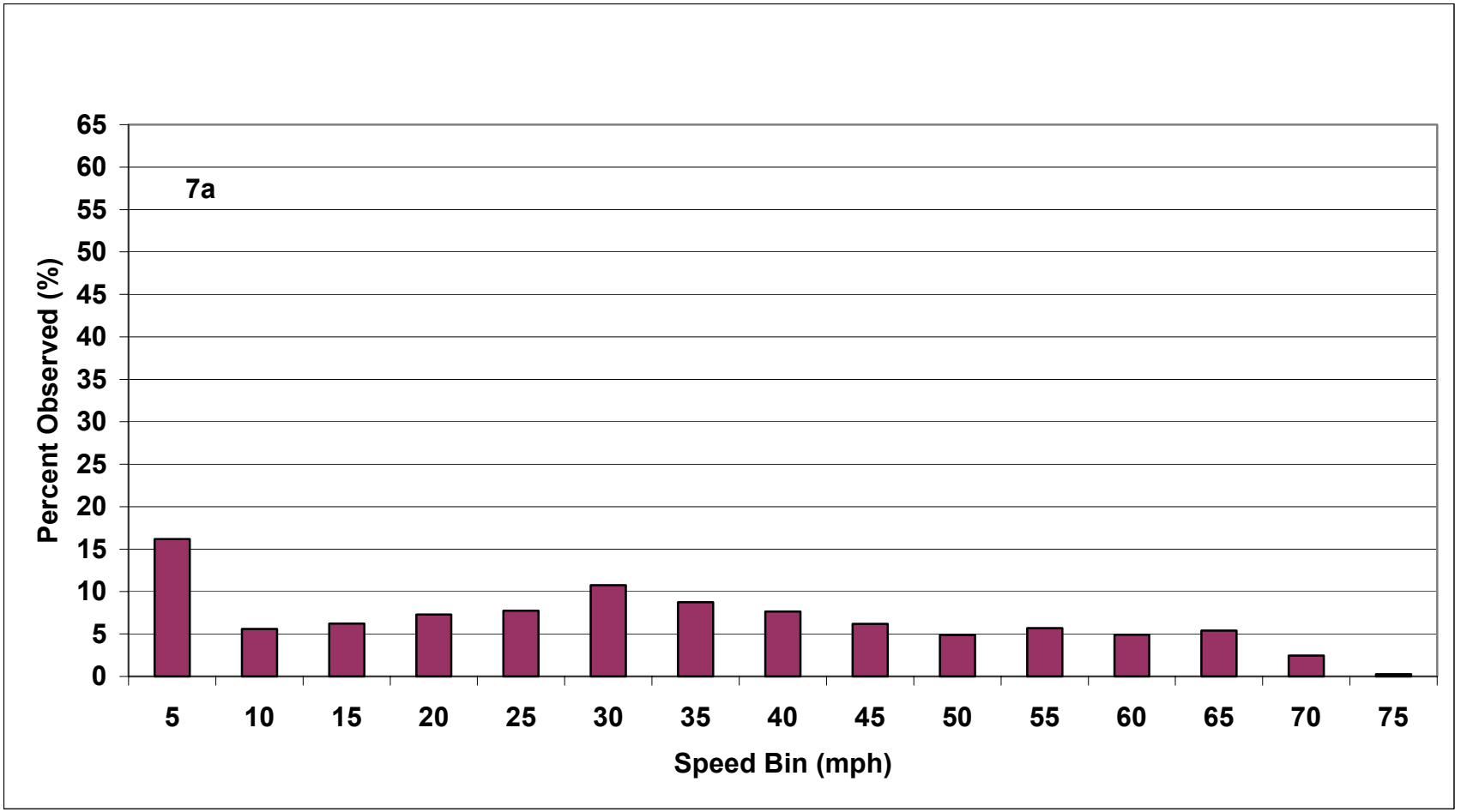

Figure 47. Chase Car Speed Fractions for 7a (2000)

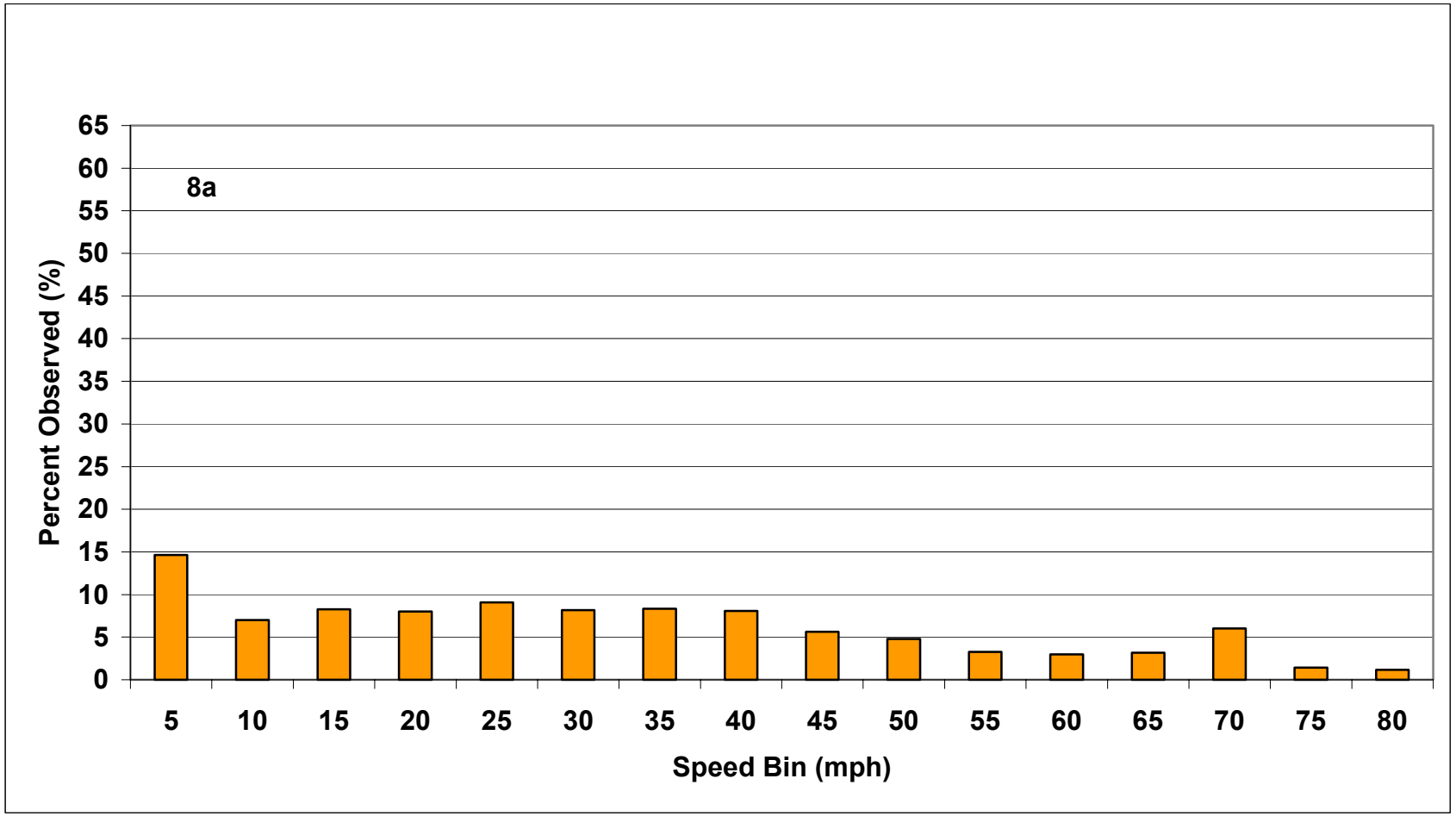

Figure 48. Chase Car Speed Fractions for 8a (2000)

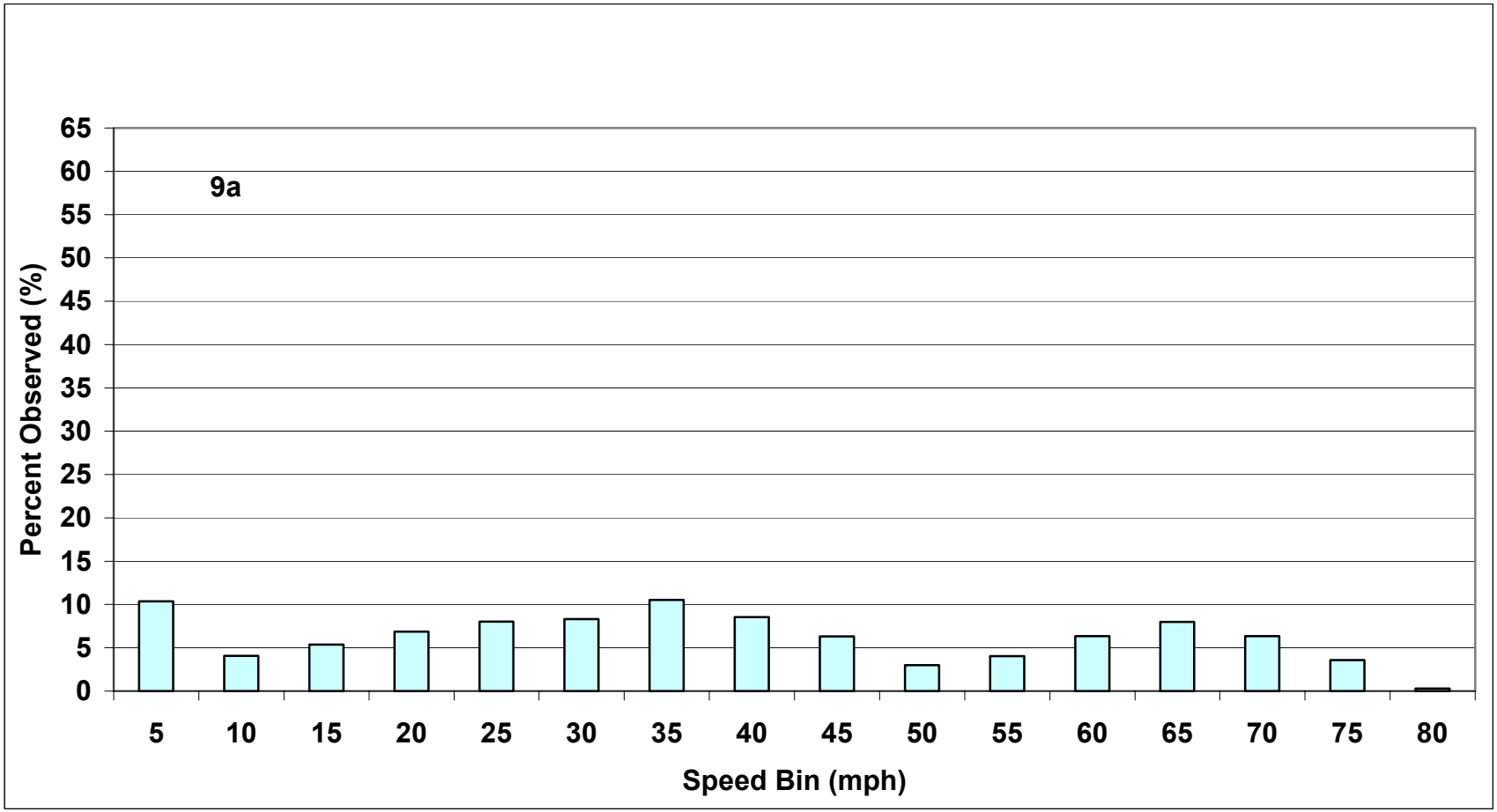

Figure 49. Chase Car Speed Fractions for 9a (2000)

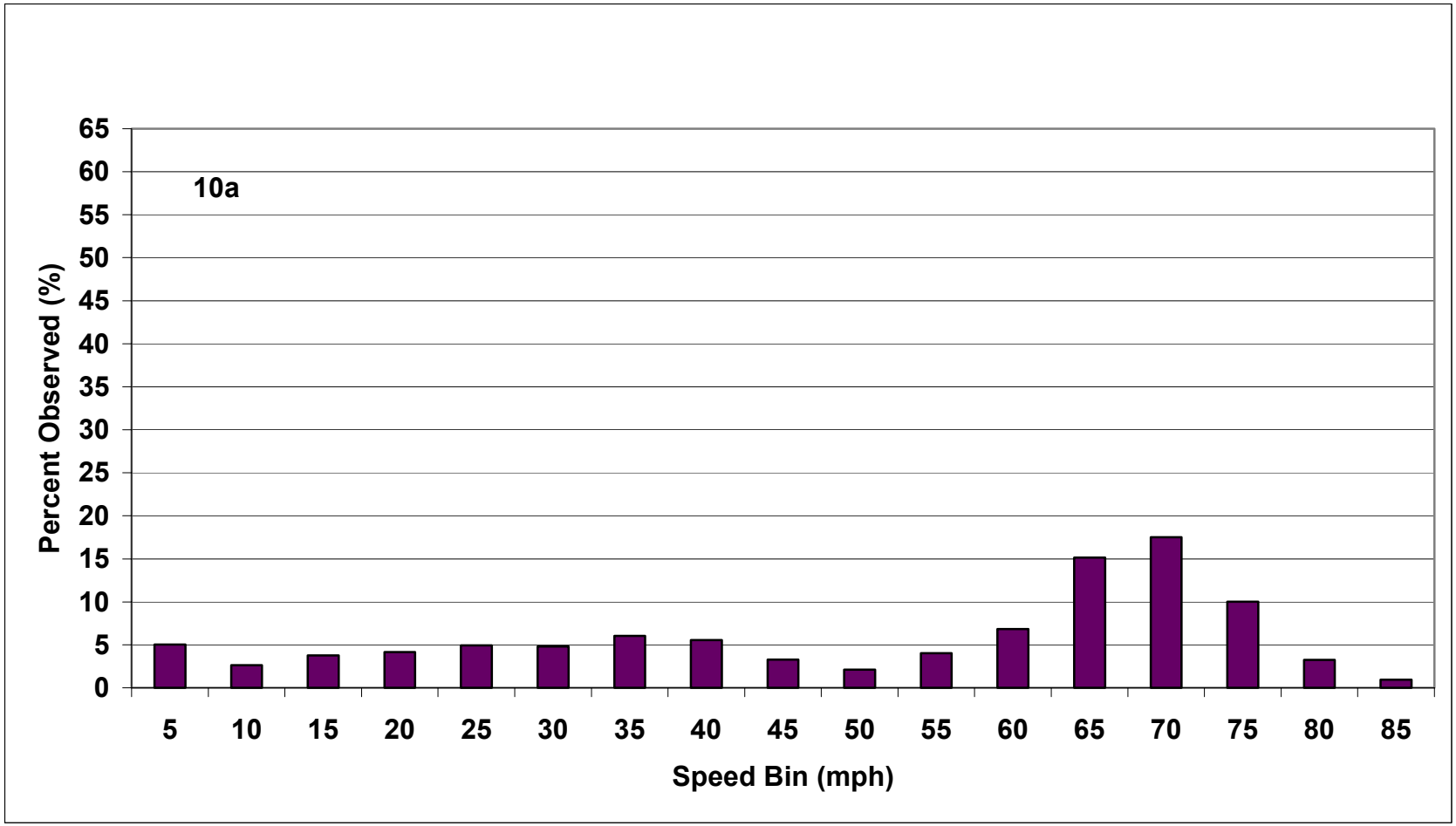

Figure 50. Chase Car Speed Fractions for 10a (2000

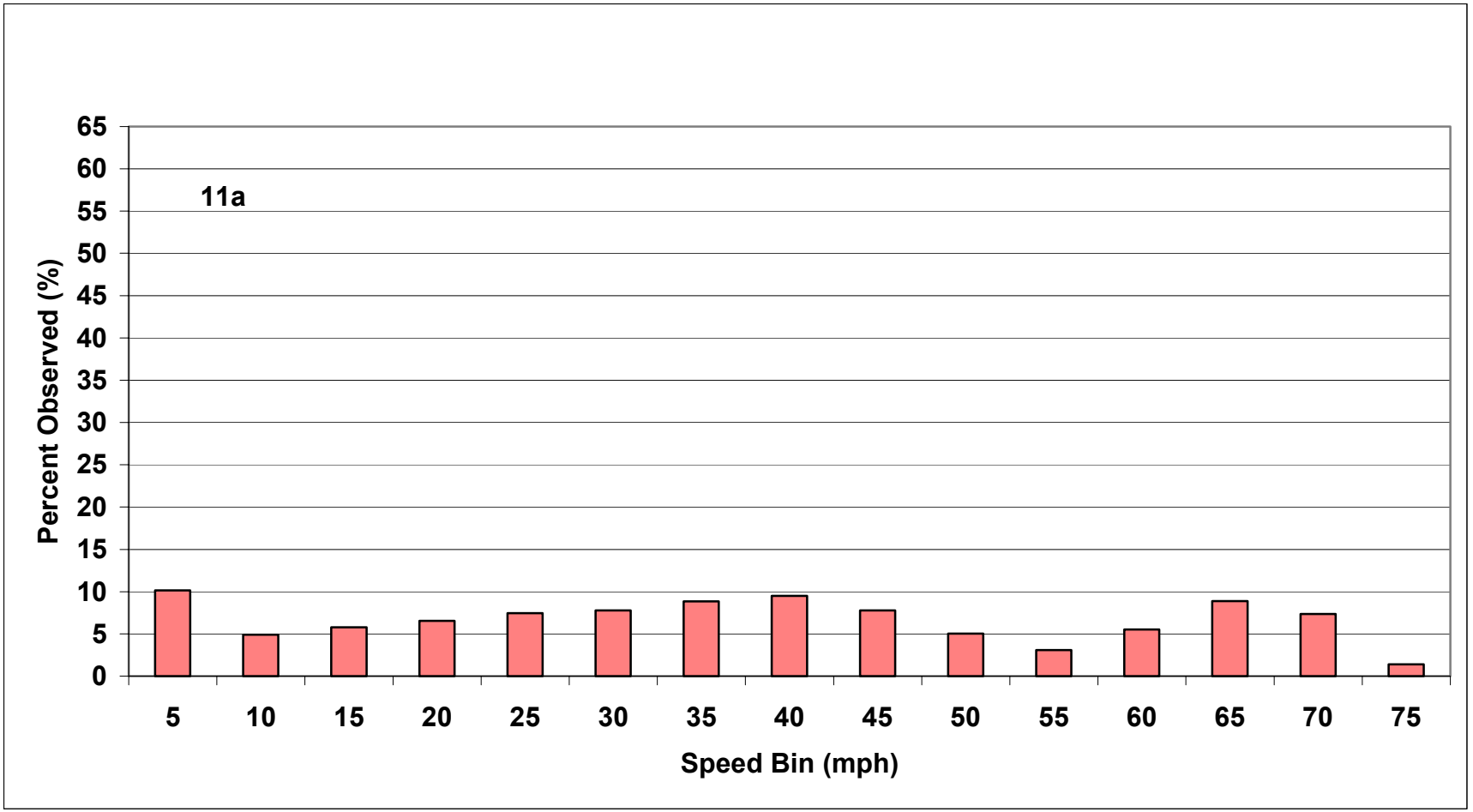

Figure 51. Chase Car Speed Fractions for 11a (2000)

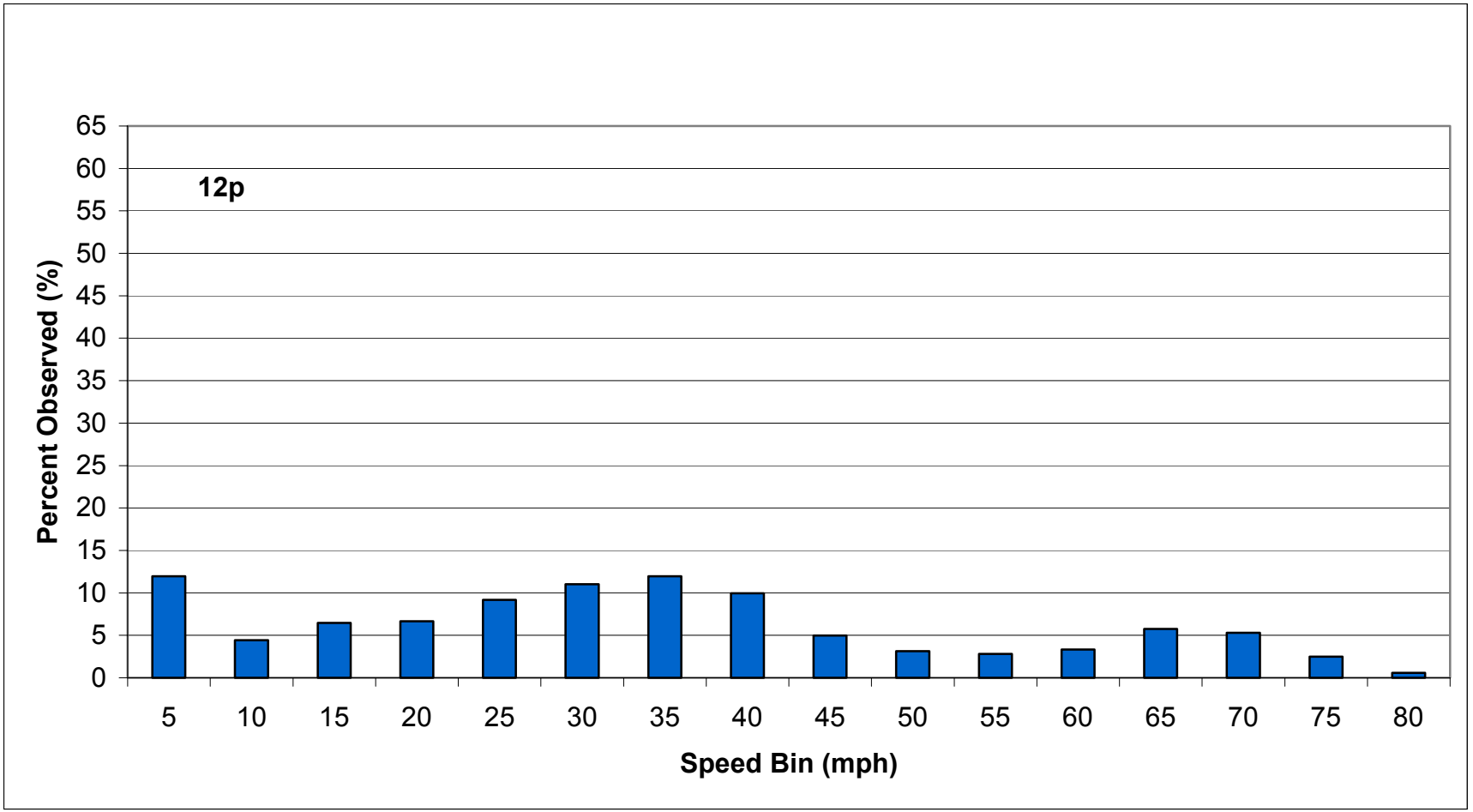

Figure 52. Chase Car Speed Fractions for 12p (2000)

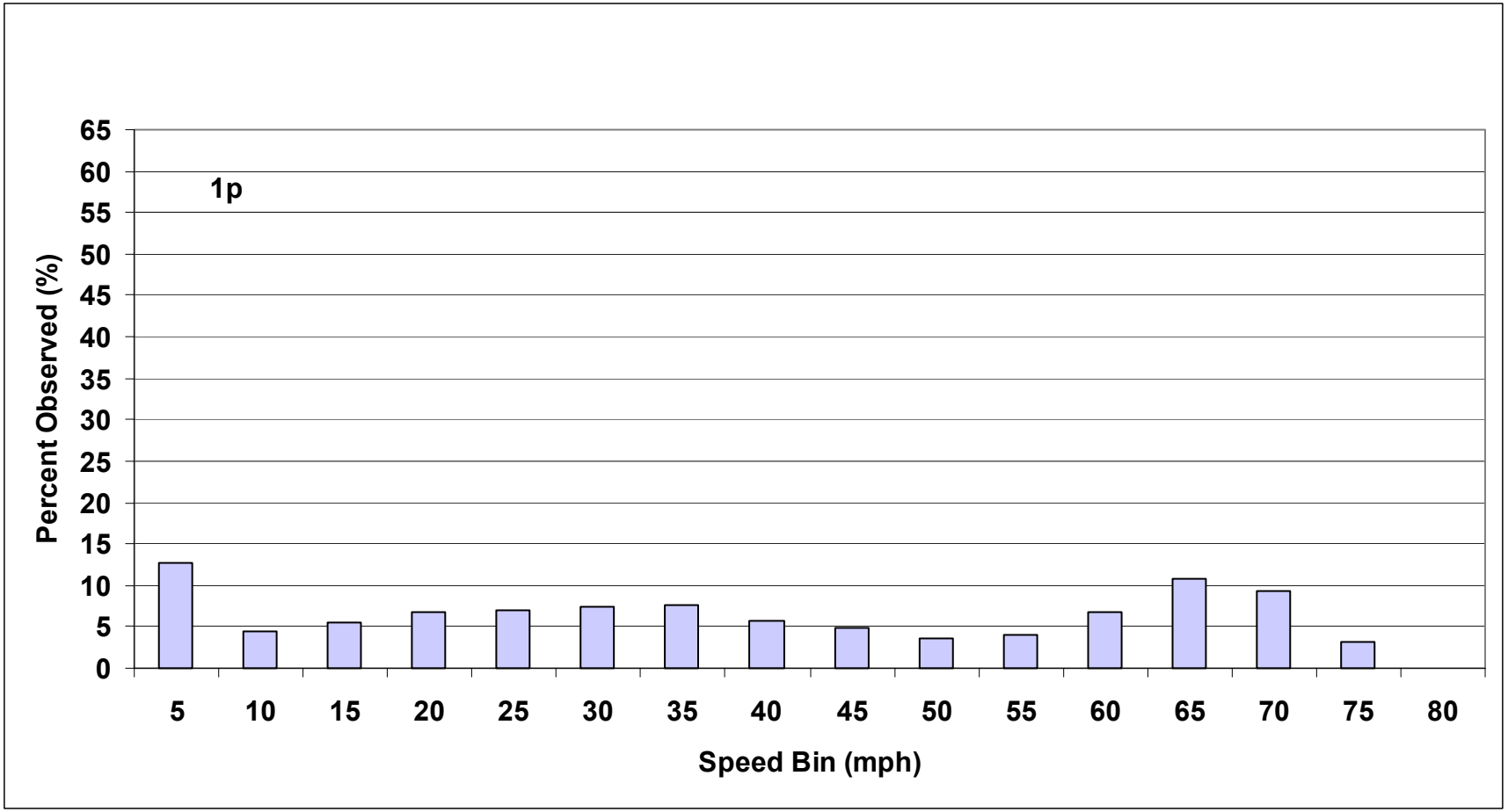

Figure 53. Chase Car Speed Fractions for 1p (2000)

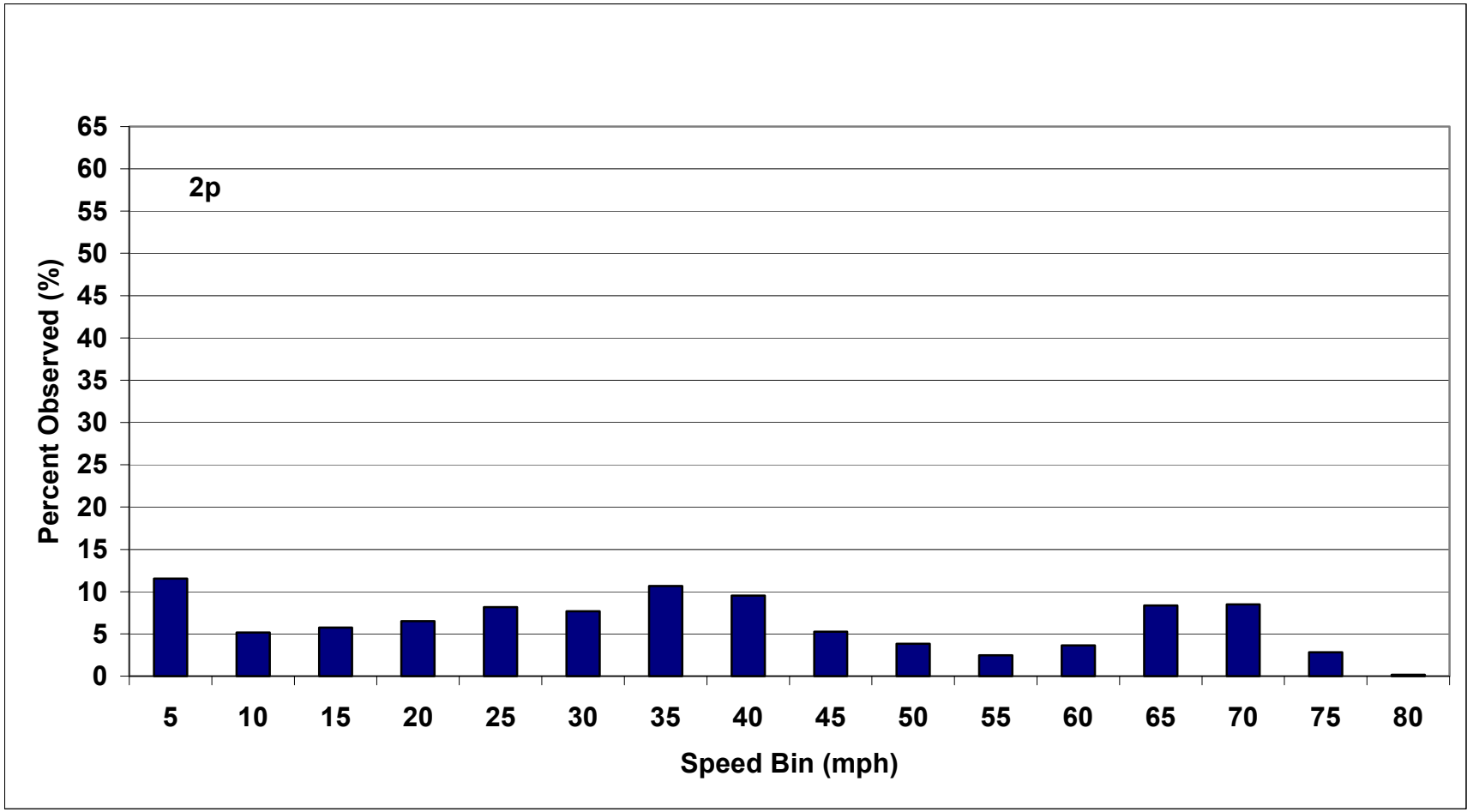

Figure 54. Chase Car Speed Fractions for 2p (2000)

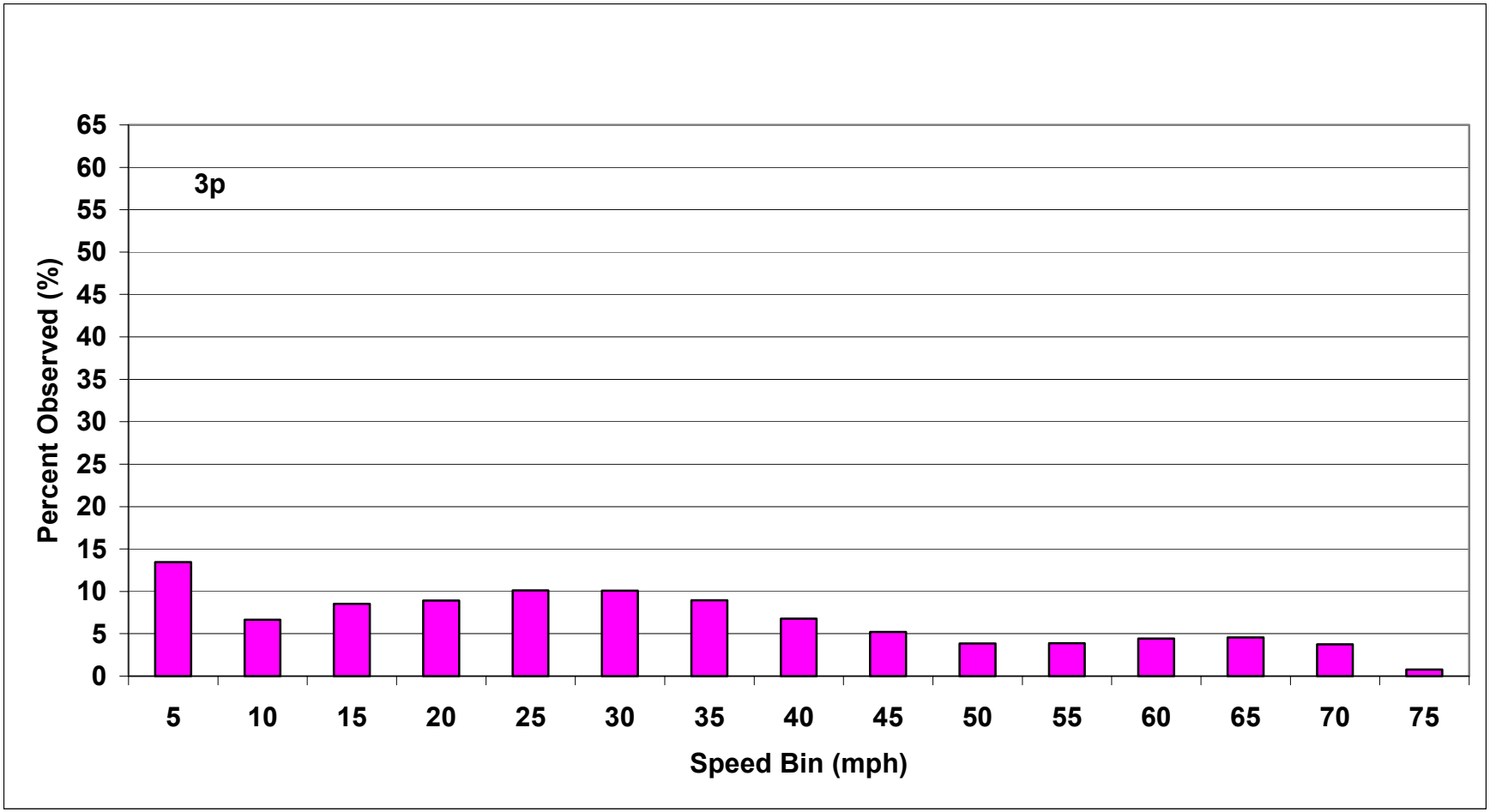

Figure 55. Chase Car Speed Fractions for 3p (2000)

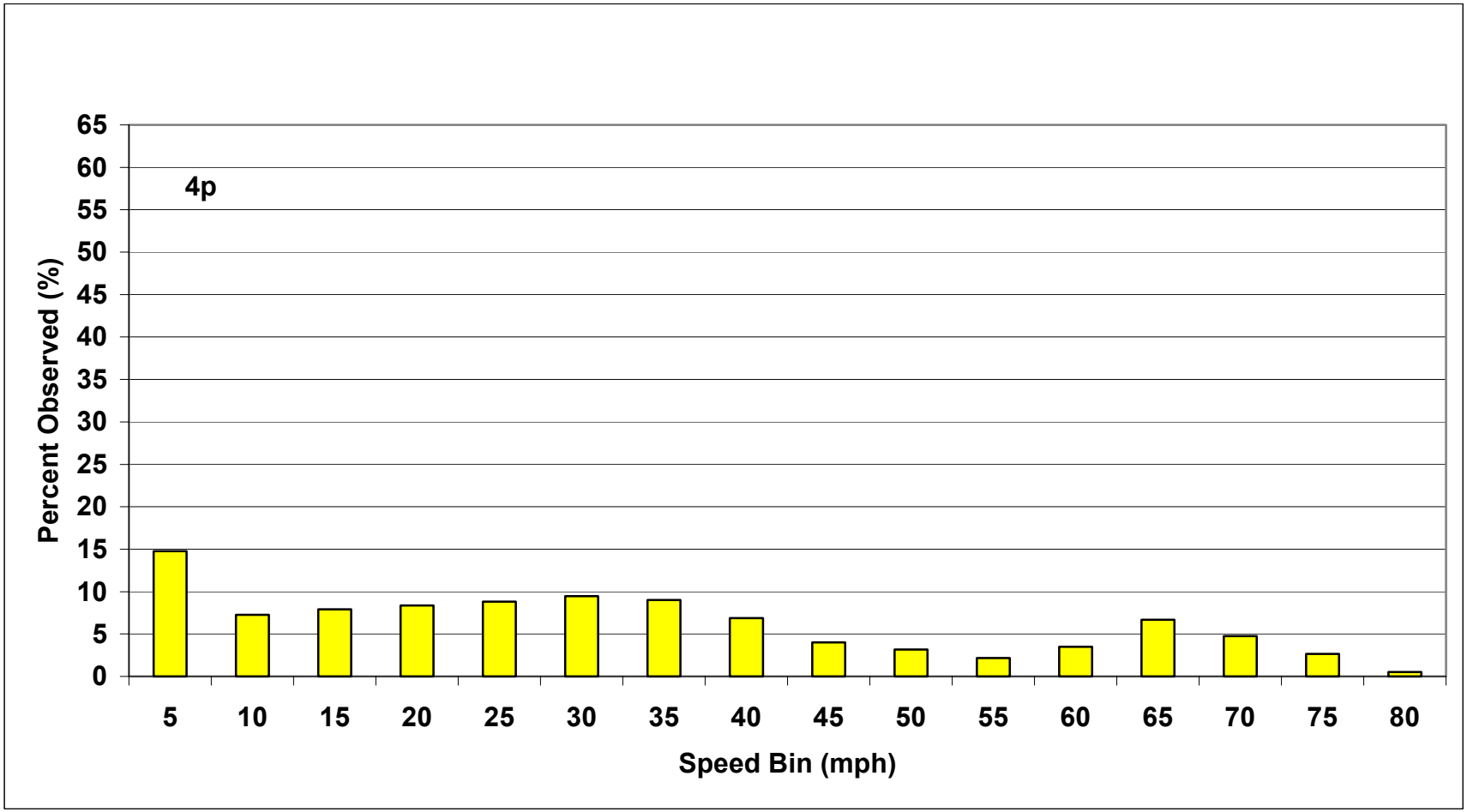

Figure 56. Chase Car Speed Fractions for 4p (2000)

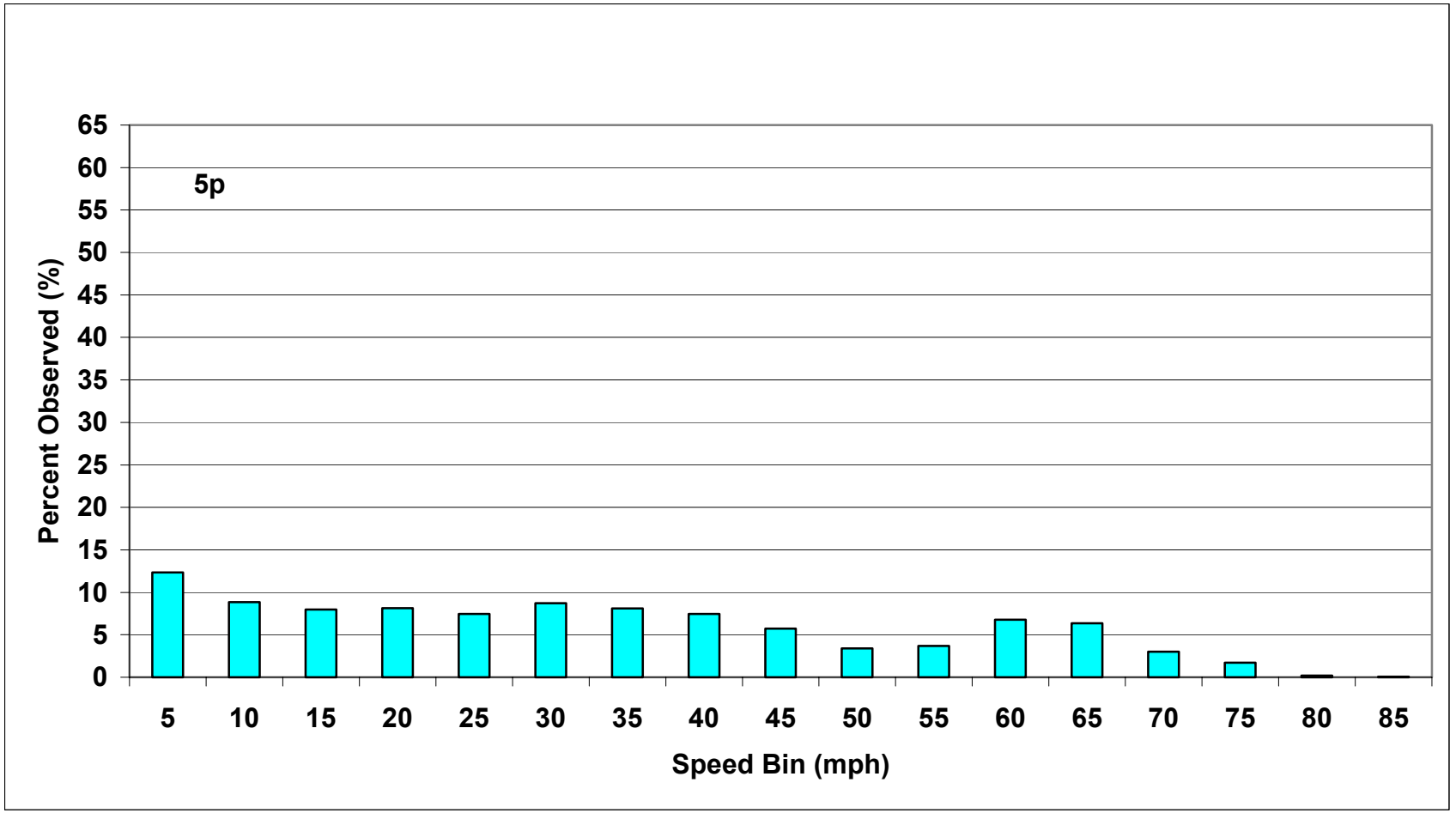

Figure 57. Chase Car Speed Fractions for 5p (2000)

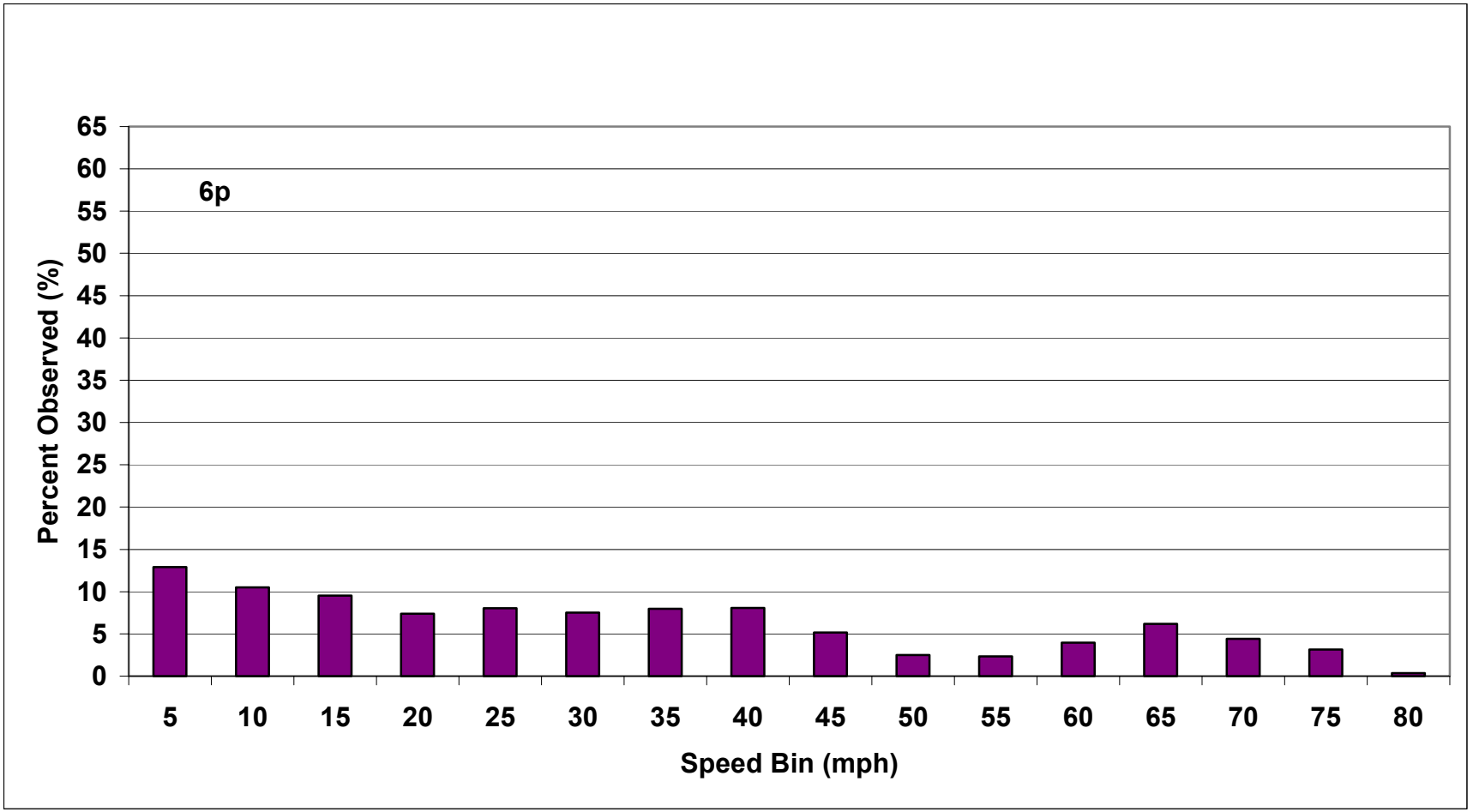

Figure 58. Chase Car Speed Fractions for 6p (2000)

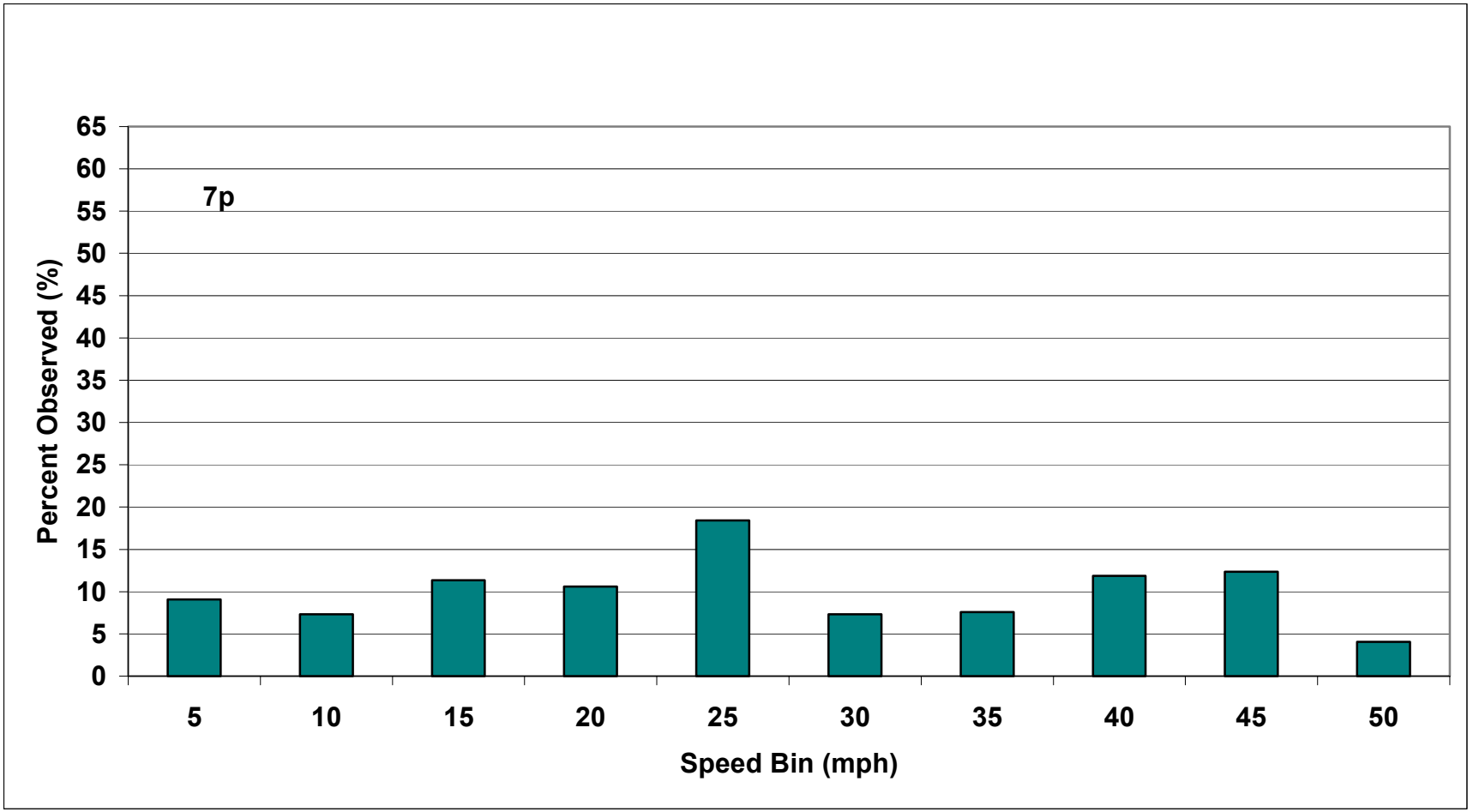

Figure 59. Chase Car Speed Fractions for 7p (2000)

The chase car data we used to estimate hourly speed fractions above were measured on different types of facilities (Sierra Research, 2003). Our next task was to use measured speeds to distinguish the speed fractions by facility type for a given hour. Table 1 presents the facility types for which chase car measurements are available (Sierra Research, 2003).

Table 1. Facility Types

	Facility Type
7	Rural - Major Collector
8	Rural - Minor Collector
9	Rural – Local
11	Urban - Principal Interstate Arterial
12	Urban - Other Freeways & Expressways
14	Urban - Other Principal Arterial
16	Urban - Minor Arterial
17	Urban – Collector
19	Urban – Local

In the following sections, we explore speed fractions for different hourly periods by the facility type. Hourly speed fractions for collectors (7, 8 and 17), local roads (9 and 19), arterials (11, 14 and 16) and freeways/expressways (12) are demonstrated separately for each select hour. We focused our analyses on 6a, 8a, 10 a, 1p, 4p and 6p. It should be noted that not all the facility types defined in Table 1 were observed for a given hour. For example, for 6a, speeds on facility types denoted by 11, 12, 14, 16, 17 and 19 were measured.

3.5.2 Speed Fractions, by Facility, for 6a

Figures 60 through 63 demonstrate speed fractions for collectors (17), local roads (19), arterials (11, 14 and 16) and freeways/expressways (12) for 6a.

For collectors, the percentage of observed speeds is the highest in the 5 mph speed bin with a value of 23.1% (Figure 60). In the other speed bins, the percentages of observed speeds are higher than 15% only for the 40 and 45 mph speed bins.

The observed speeds on urban-local roads are in 30 mph and lower speed bins. The highest percentage of observed speeds is observed in the 5 mph speed bin and is more than one-quarter (26.9%) of the observed speeds on local roads for 6a.

Figure 62 shows the speed fractions for urban-principal interstate (11), urban-other principal (14) and urban-minor (16) arterials. Fraction of speeds in speed bins 65 through 80 is higher for urban principal interstate arterials when compared to the urban-other and urban-minor arterials. For urban-other and urban-minor arterials, the percentages of observed speeds in the 65 through 80 mph speed bins are pretty low, whereas fractions of speeds are higher in the 50 mph and lower speed bins. The largest difference between the urban-other principal and urban-minor arterial percentages is estimated in the 5 mph speed bin. The percentage of observed speeds is 18.1% for urban-other principal arterials whereas the percentage is 24.5% for urban-minor arterials.

For urban-freeways/expressways, the majority of speeds are observed in the 50 through 80 mph speed bins (97.8%) (Figure 63). Moreover, 66.8% of speeds are estimated in the 65 through 75 mph speed bins. On the other hand, there are no speeds observed in the 20 mph and lower speed bins.

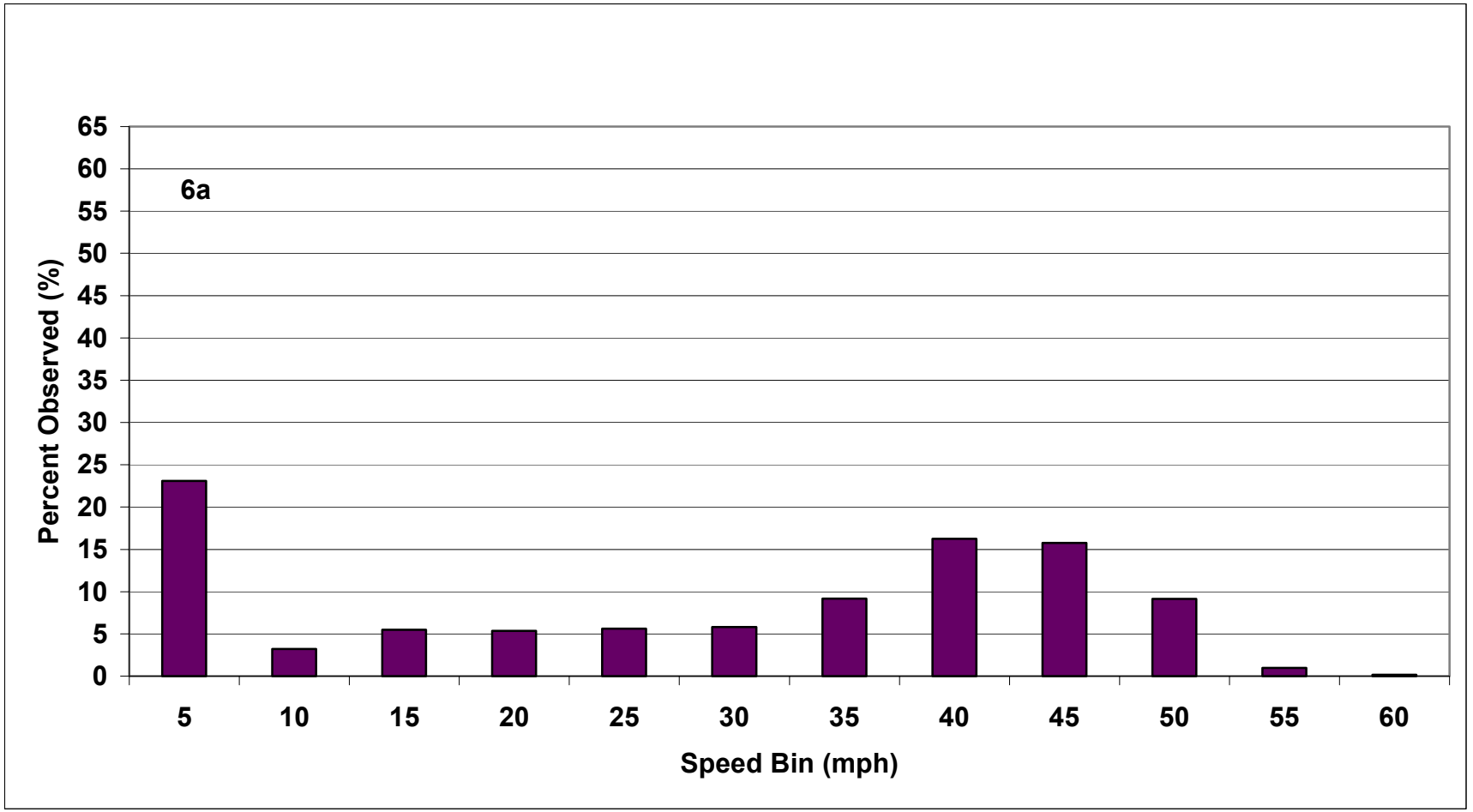

Figure 60. Chase Car Speed Fractions for Urban-Collectors (17) (2000)

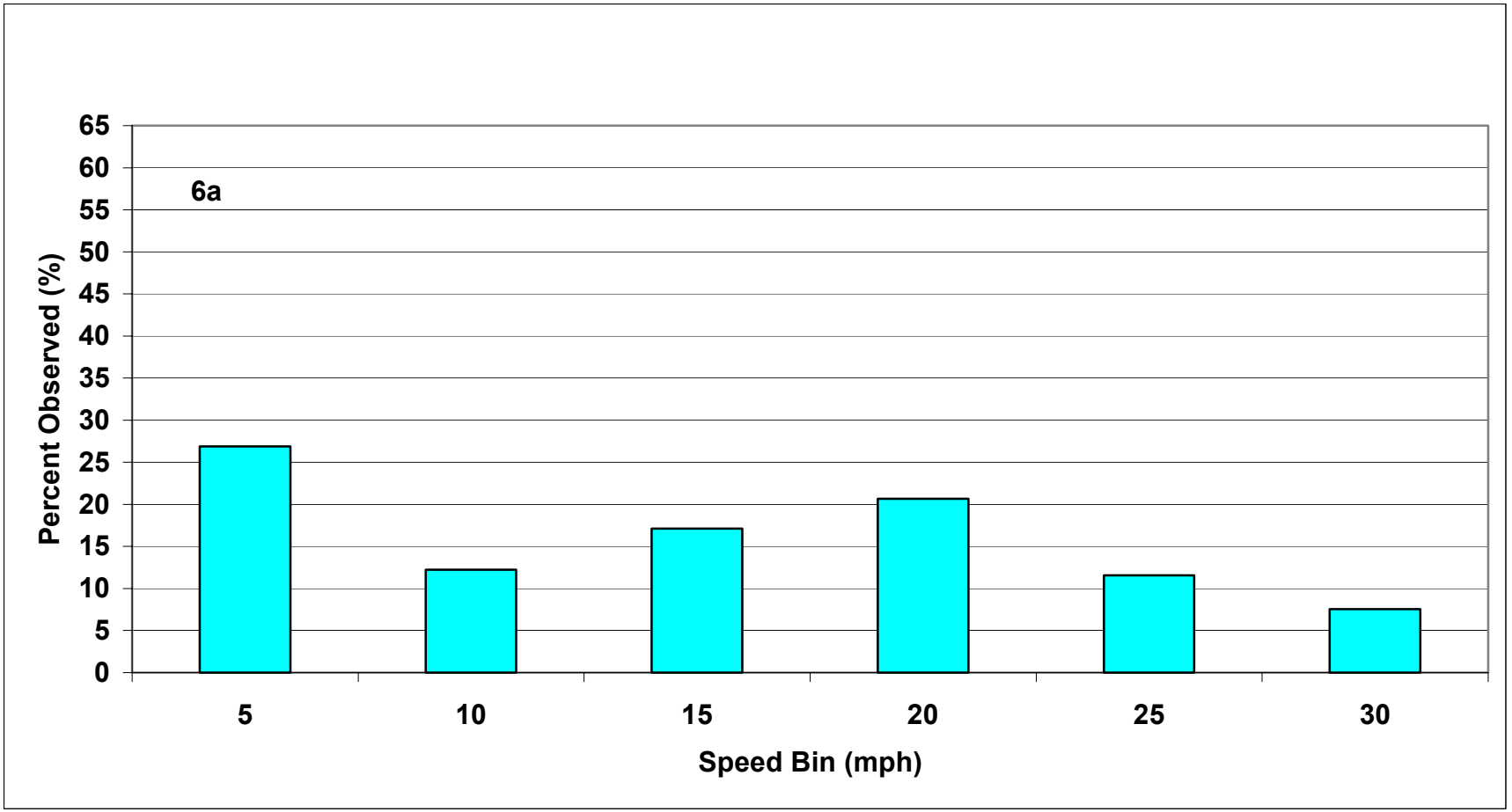

Figure 61. Chase Car Speed Fractions for Urban-Local Roads (19) (2000)

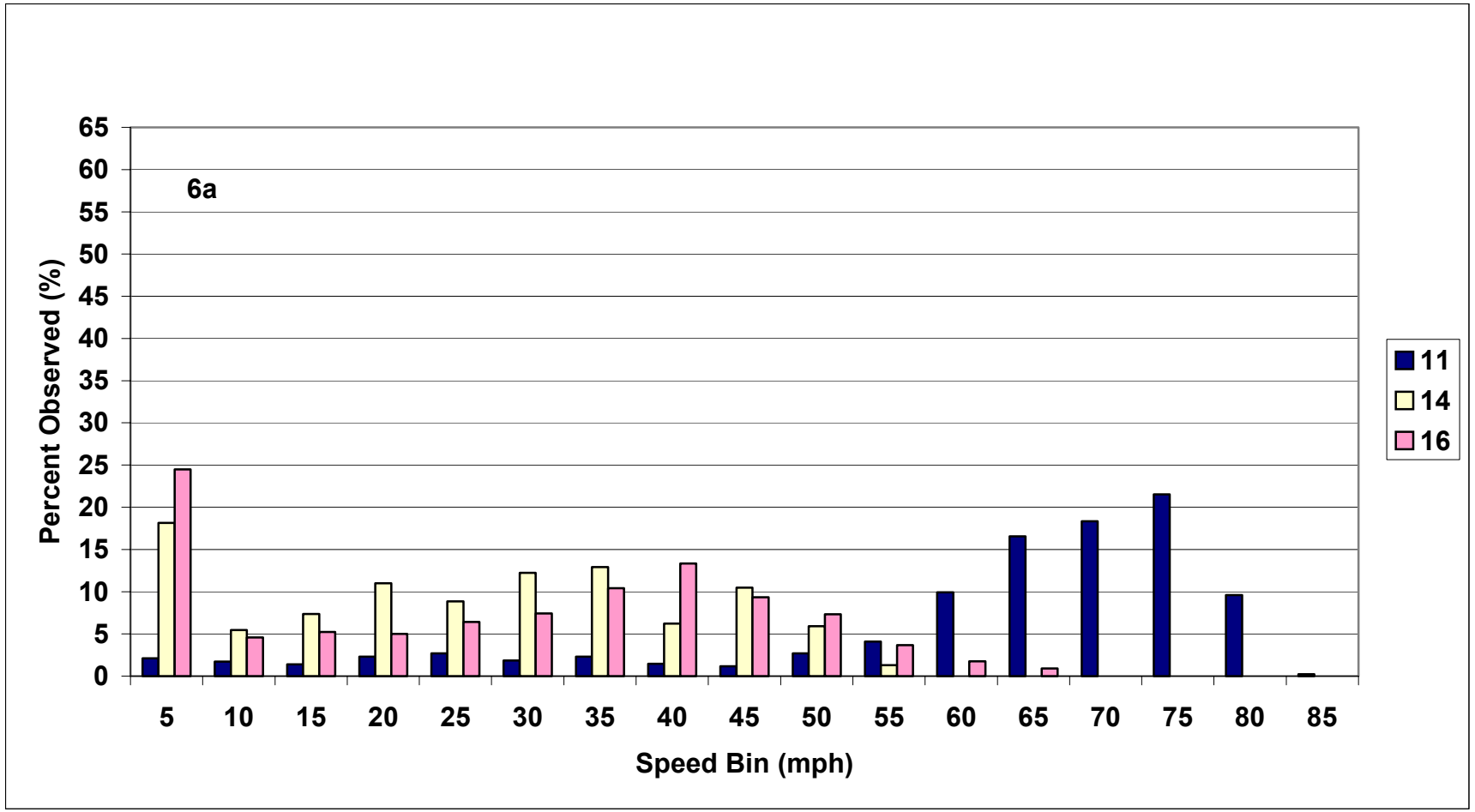

Figure 62. Chase Car Speed Fractions for Urban-Principal Interstate (11), Urban-Other Principal (14) and Urban-Minor (16) Arterials (2000)

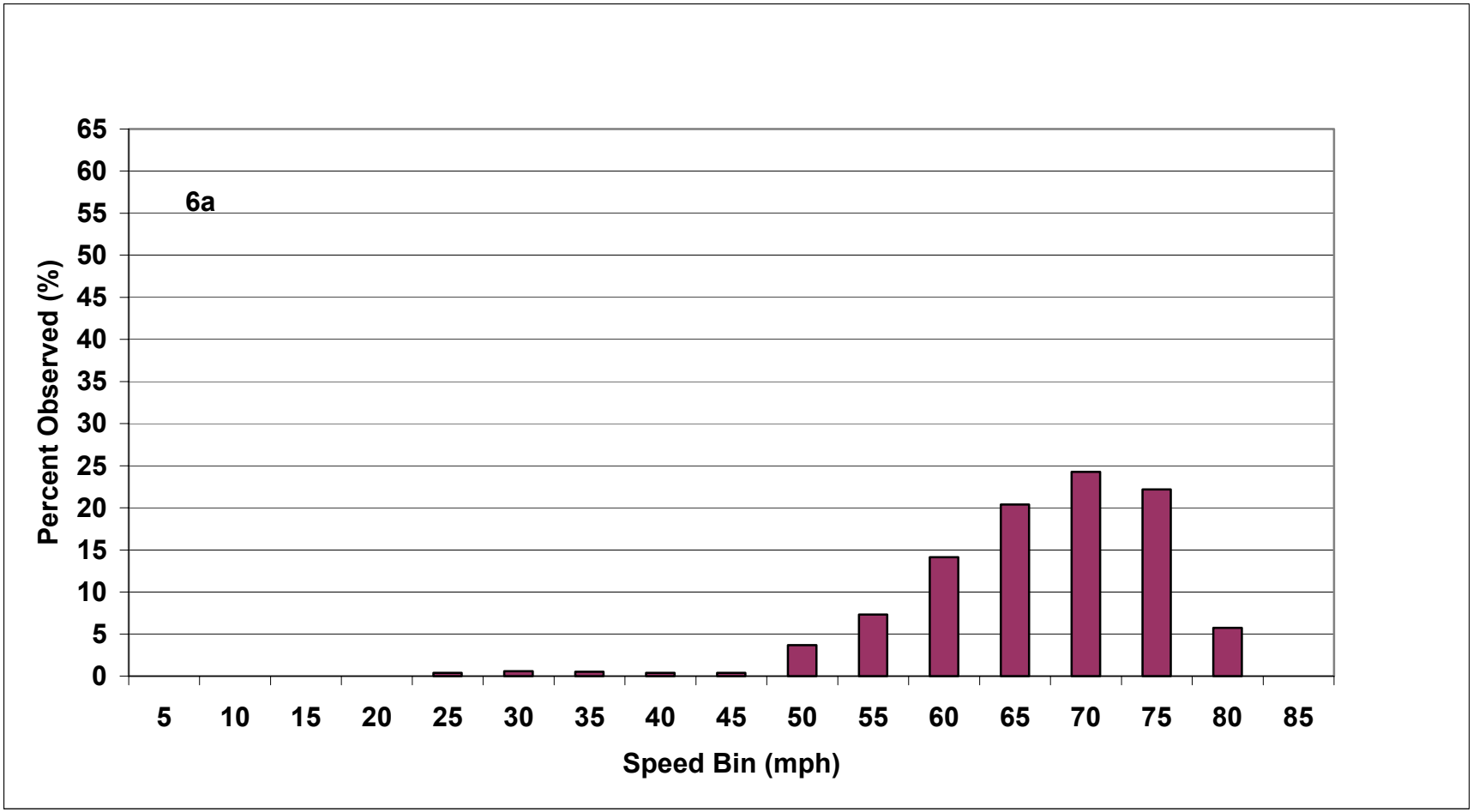

Figure 63. Chase Car Speed Fractions for Urban-Freeways/Expressways (12) (2000)

3.5.3 Speed Fractions, by Facility, for 8a

Figures 64 through 67 show that the speed fractions for 8a estimated for collectors (17), local roads (19), arterials (11, 14, and 16), and freeways/expressways (12) differ.

For urban-collectors, the highest percentage of observed speeds is the 5 mph speed bin, estimated as 28.1% (Figure 64). Percentage of observed speeds in the 10 through 55 mph speed bins change between 3.9 and 10.5%.

Local road speed fractions are somewhat similar to the urban-collectors for 8a (compare Figure 65 to Figure 64). The largest difference between the percentages of observed speed is estimated for the 35 mph speed bin in which the percentage of observed speeds on collectors are 6.5% higher than the percentage of observed speeds on local roads.

Observed speeds fractions on different types of arterials vary significantly in most speed bins (Figure 66). Differences in percentages of urban-principal interstate, urban-other and urban-minor arterials are higher than 10% for the 5 and 40 mph speed bins when we explore the 60 mph and lower speed bins. In the 5 mph speed bin the percentages are 10.5, 43 and 25.5% for urban-principal interstate, urban-other and urban-minor arterials, respectively. The 40 mph speed bin percentages of observed speeds are 0.3, 5.1 and 13.5 % for urban-principal interstate, urban-other and urban-minor arterials, respectively. On the other hand, a 12.2 % of the speeds are observed in the speed bins 65 through 80 mph for urban-principal interstate arterials whereas there are no speeds observed on urban-other and urban-minor arterials in these speed bins.

Observed speed fractions on urban-freeways/expressways change between 0.9% (in the 75 mph speed bin) and 12.8% (in the 25 mph speed bin) (Figure 67). The percentages of observed freeway/expressway speeds are less than 10% in each of the 30 mph through 70 mph speed bins.

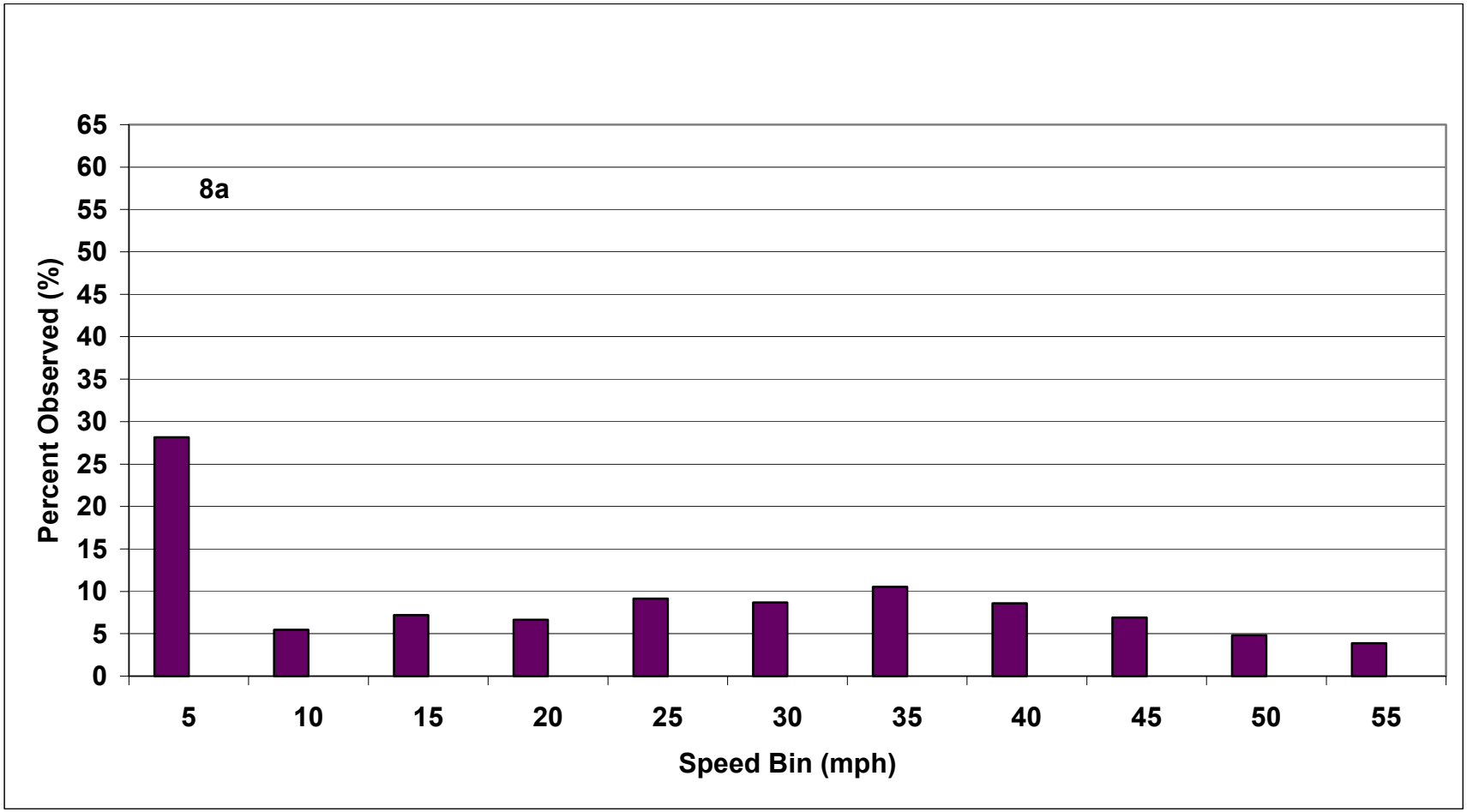

Figure 64. Chase Car Speed Fractions for Urban-Collectors (17) (2000)

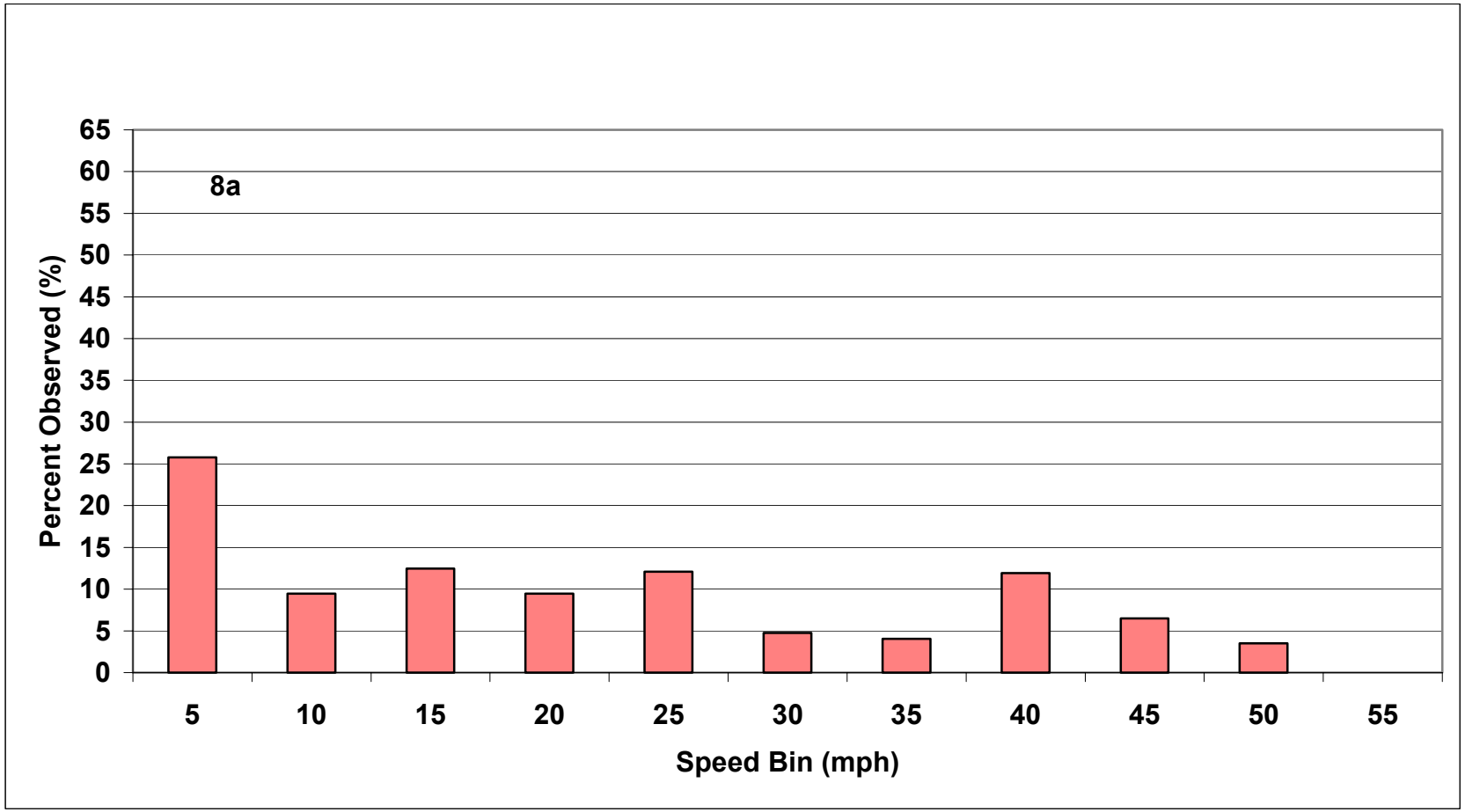

Figure 65. Chase Car Speed Fractions for Urban-Local Roads (19) (2000)

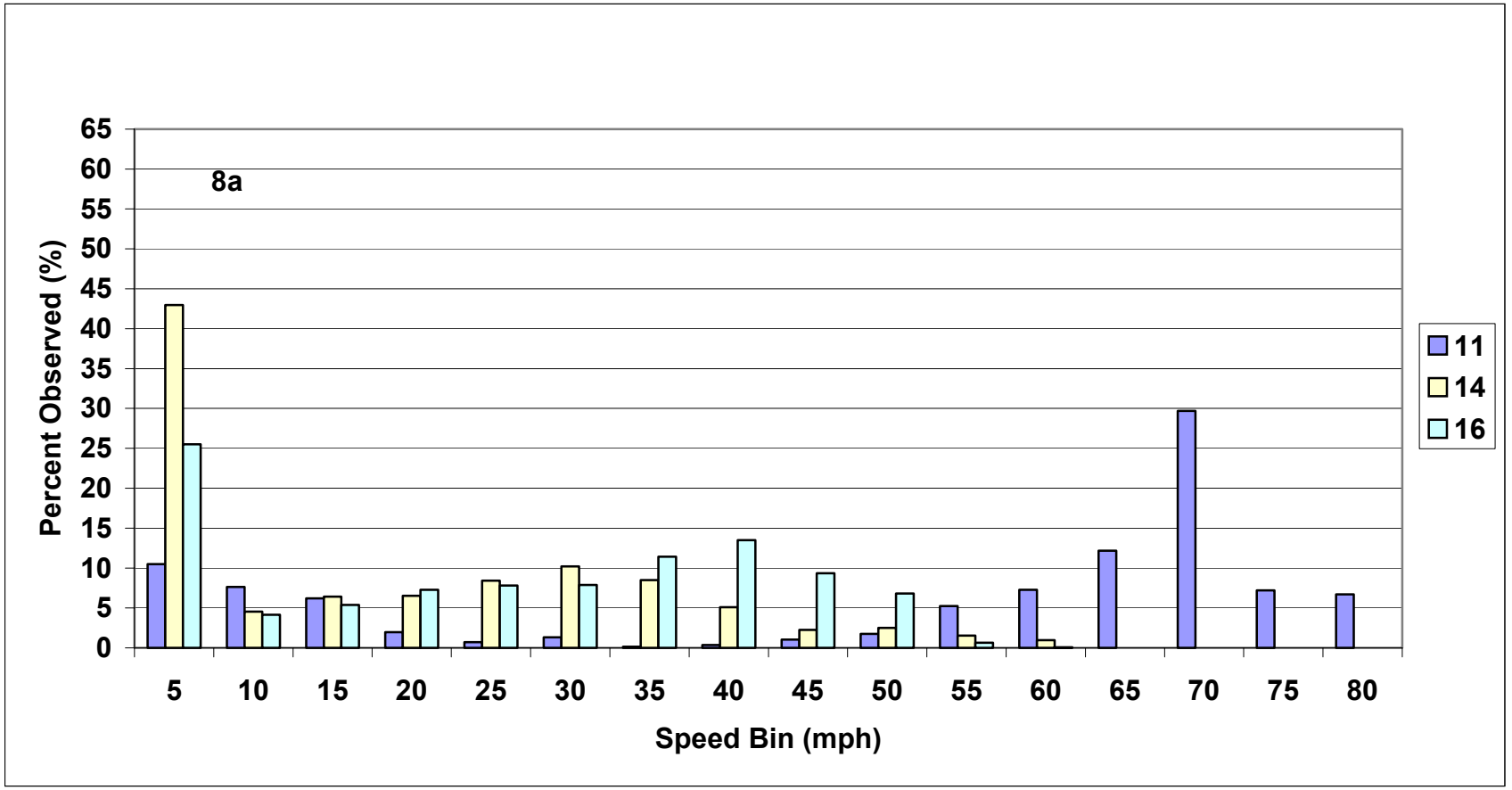

Figure 66. Chase Car Speed Fractions for Urban-Principal Interstate (11), Urban-Other Principal (14) and Urban-Minor (16) Arterials (2000)

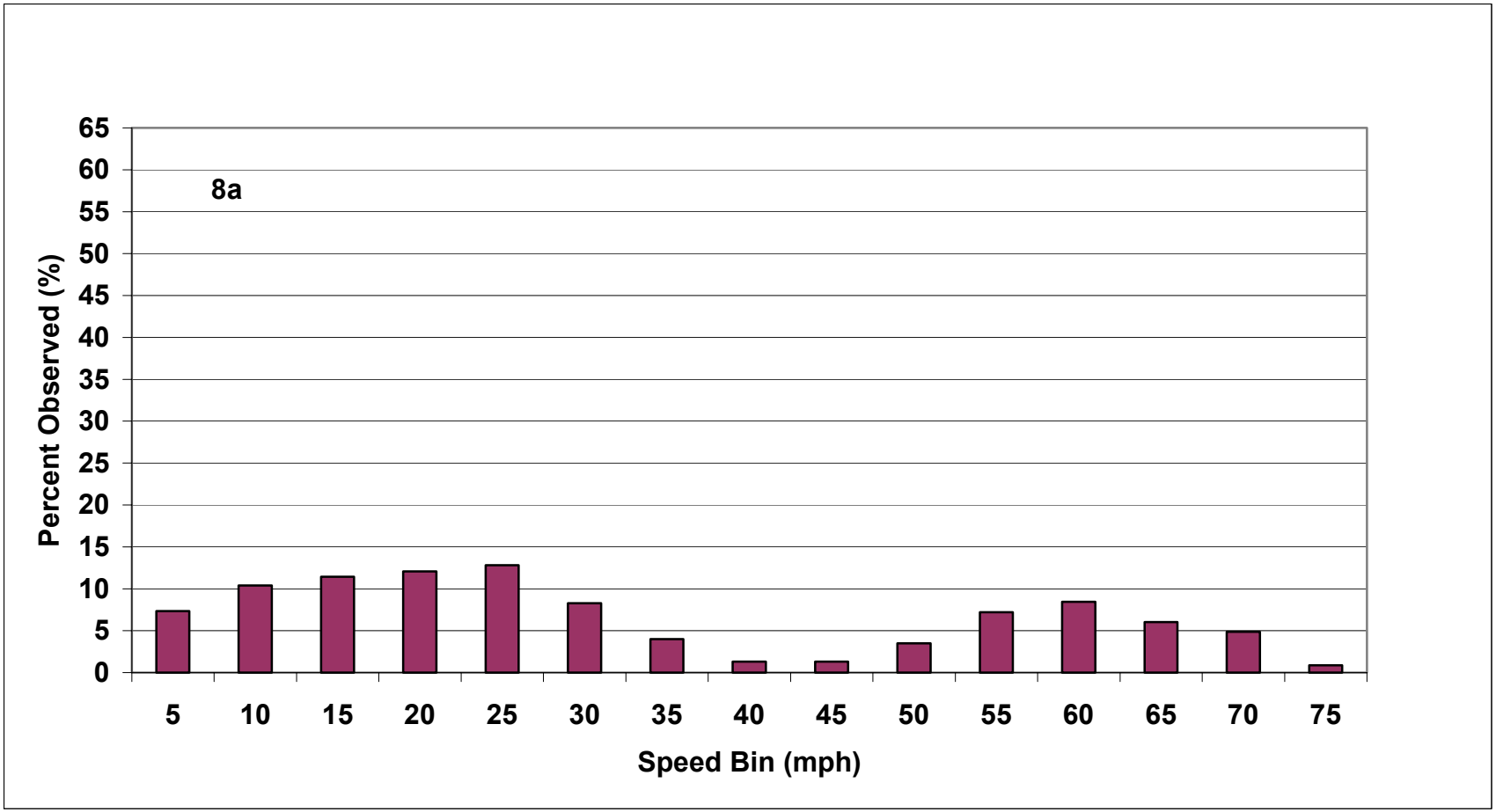

Figure 67. Chase Car Speed Fractions for Urban Freeways/Expressways (12) (2000)

3.5.4 Speed Fractions, by Facility, for 10a

As with 6a and 8a, figures 68 through 71 show that the speed fractions differ for urban-collectors, local roads, arterials and freeways/expressways for 10 a.

All the speeds on rural-minor collectors are observed in the 45 mph and lower speed bins (Figure 68). The highest percentage of observed speeds is in the 35 mph speed bin (26.1%). On the other hand, speeds observed on rural-major collectors are in the 60 mph and lower speed bins and speeds observed on urban-collectors are in the 55 mph or lower speed bins. Higher proportion of rural-minor collector speeds are observed in the 35 and 40 mph speed bins, on the other hand, percentages of speeds observed on rural-major collectors are higher in the 55 and 60 mph speed bins.

Speeds are observed in the 30 mph and lower speed bins on urban-local roads (Figure 69). Moreover, 74.2% of observed speeds are in the 25 mph and lower speed bins.

The percentage of observed speeds observed in the 65 mph and higher speed bins are high for urban-principal interstate arterials (Figure 70). Only 18.5% of observed speeds are in the 60 mph and lower speed bins on urban-principal interstate arterials whereas all the speeds are observed in the 55 mph and lower speed bins and in the 50 mph and lower speed bins on urban-other and urban-minor arterials, respectively.

Higher speeds are observed on urban-freeways/expressways as compared to the speeds observed on other types of facilities for 10a (compare Figure 71 with Figures 68-70). There are no speeds observed in the 30 mph and lower speed bins, on the other hand, 85.1% of urban-freeway/expressway observed speeds are in the 60 mph and higher speed bins.

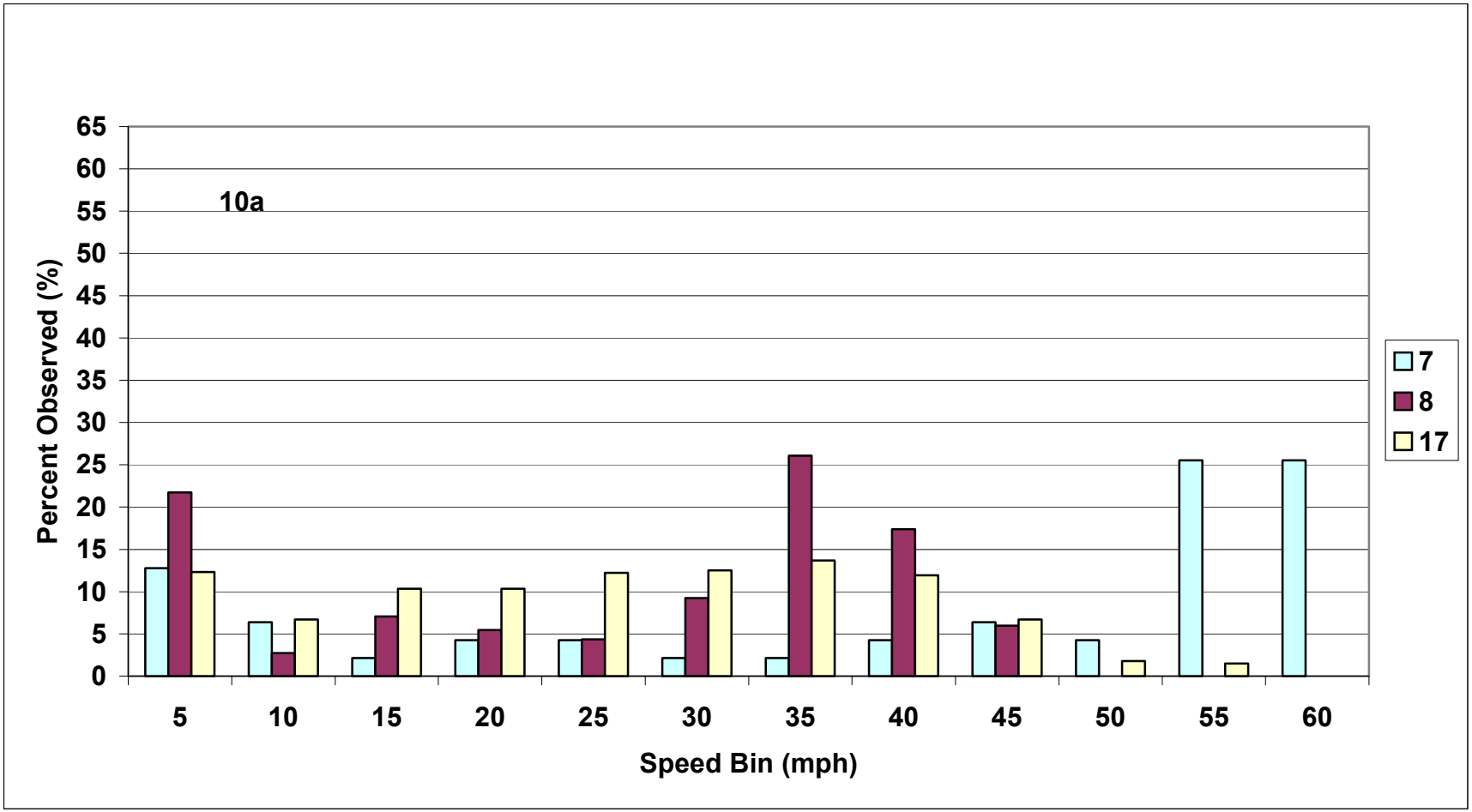

Figure 68. Chase Car Speed Fractions for Rural-Major (7) and Rural-Minor (8) and Urban- (17) Collectors (2000)

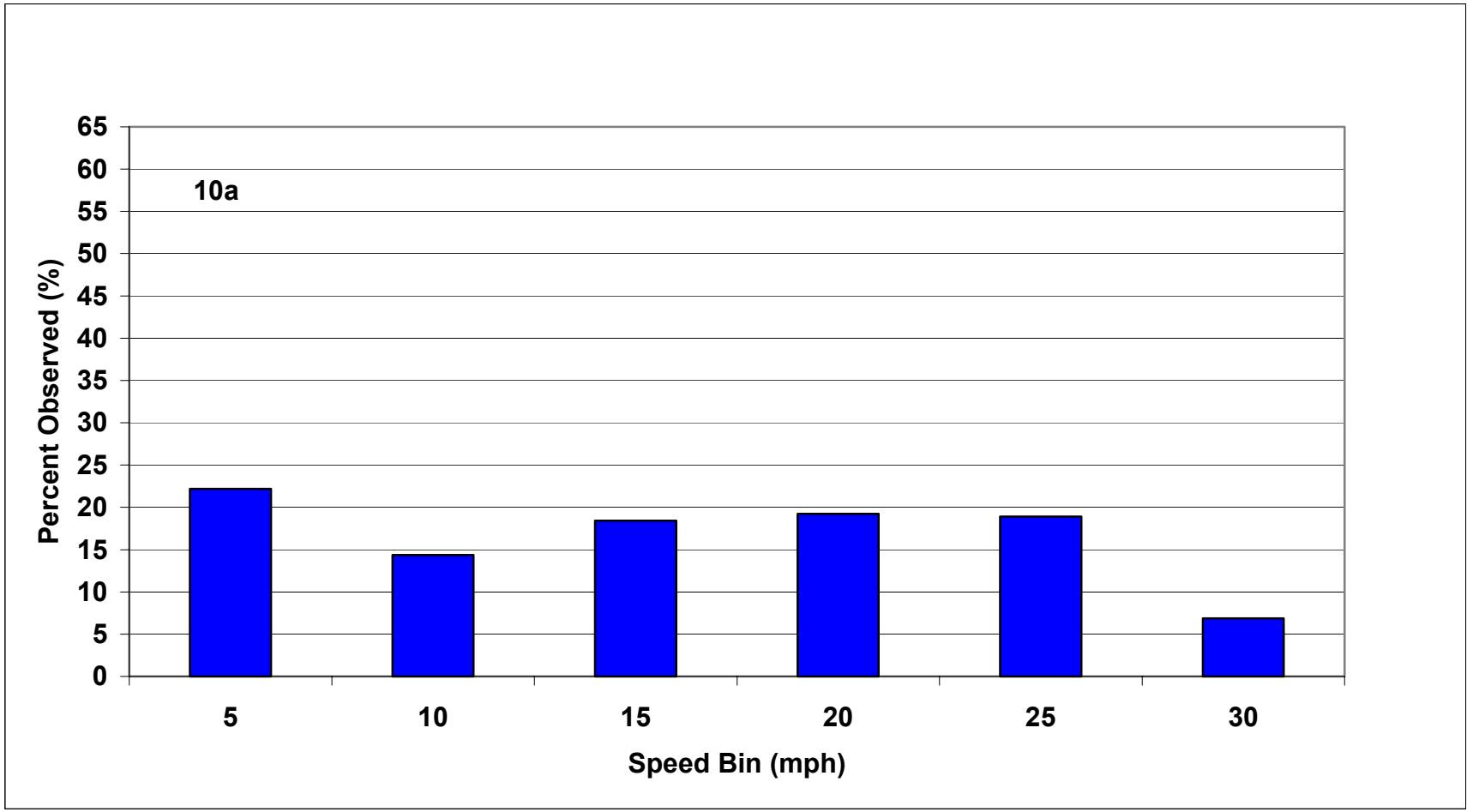

Figure 69. Chase Car Speed Fractions for Urban-Local Roads (19) (2000)

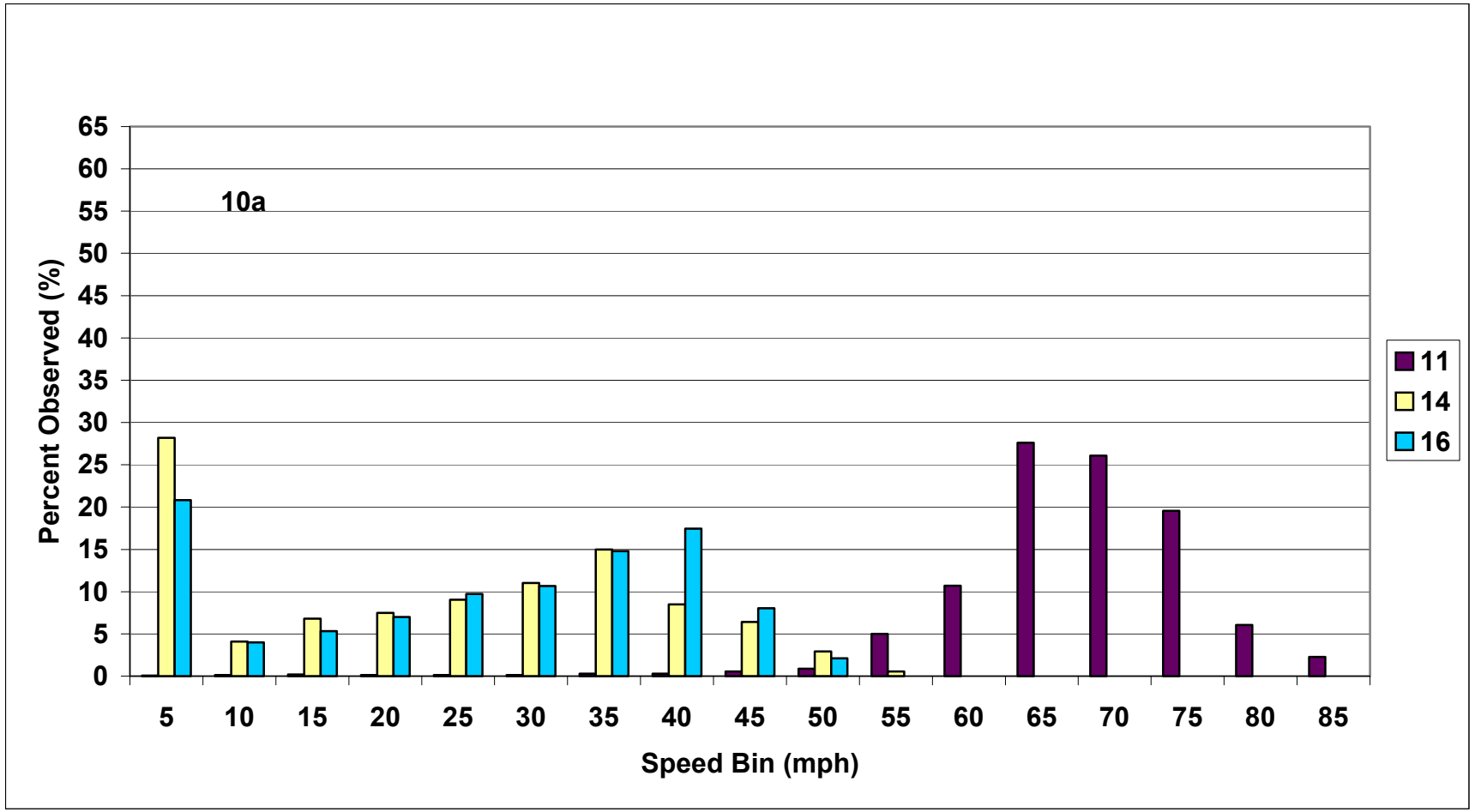

Figure 70. Chase Car Speed Fractions for Urban-Principal Interstate (11), Urban-Other Principal (14) and Urban-Minor (16) Arterials (2000)

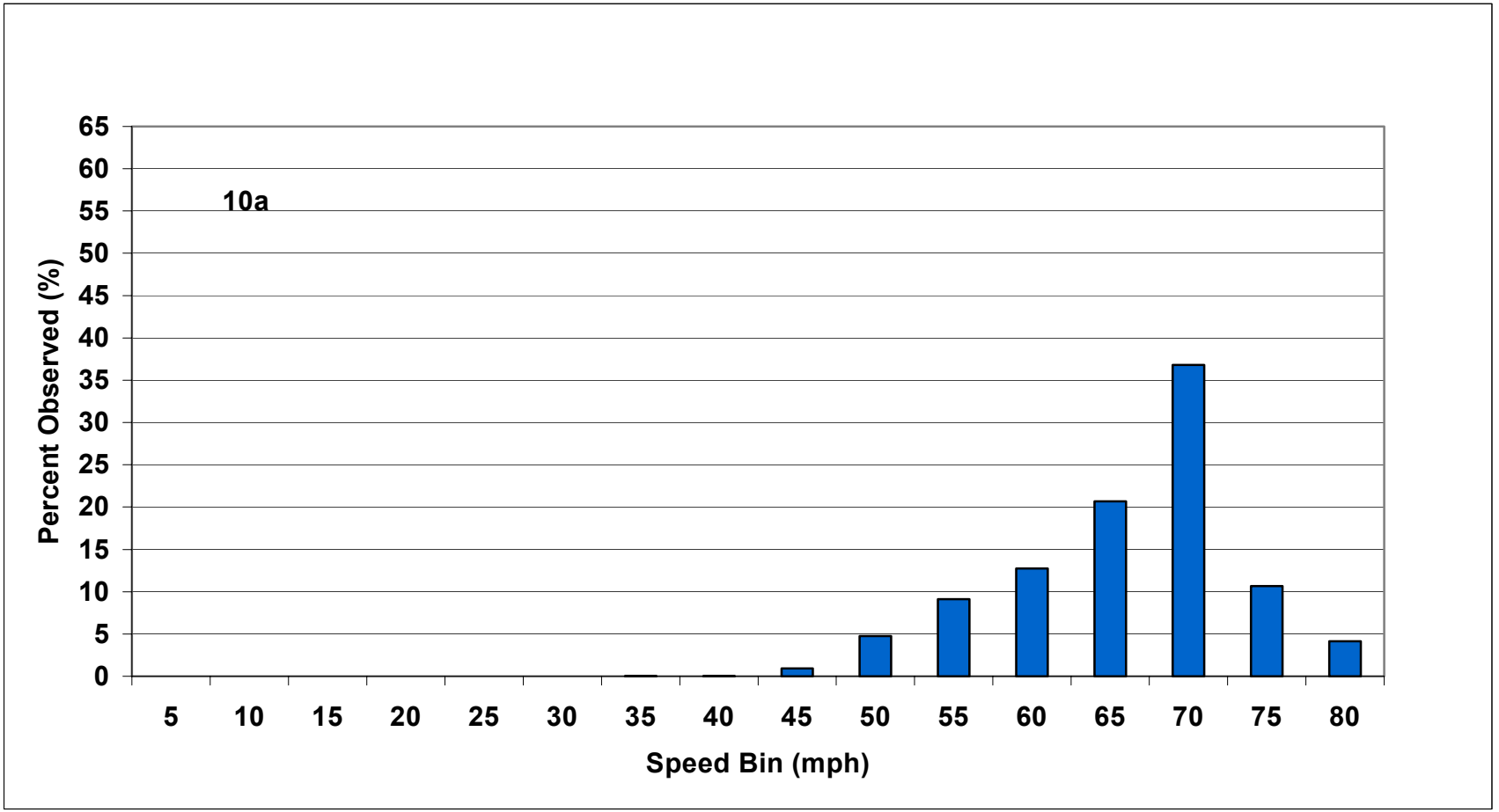

Figure 71. Chase Car Speed Fractions for Urban-Freeways/Expressways (12) (2000)

3.5.5 Speed Fractions, by Facility, for 1p, 4p, and 6p

Speed fractions are given for 1p in Figures 72 through 75, for 4p in Figures 76 through 79, and for 6p in Figures 80 through 83.

The speed fractions, similar to those for 6a, 8a and 10a (Figures 60 through 71), differ for across facilities for 1p, 4p and 6p, respectively (Figures 72-83). Also similar to the facility type fractions for 6a, 8a and 10a, speed fractions for a given facility type differ across the hours (i.e., across 1p, 4p and 6p).

For all the hours we explored, although speed fractions by facility type differ across hours, and speeds fractions for a given hour differ across facilities, the range of speeds observed for a given facility type are somewhat similar.

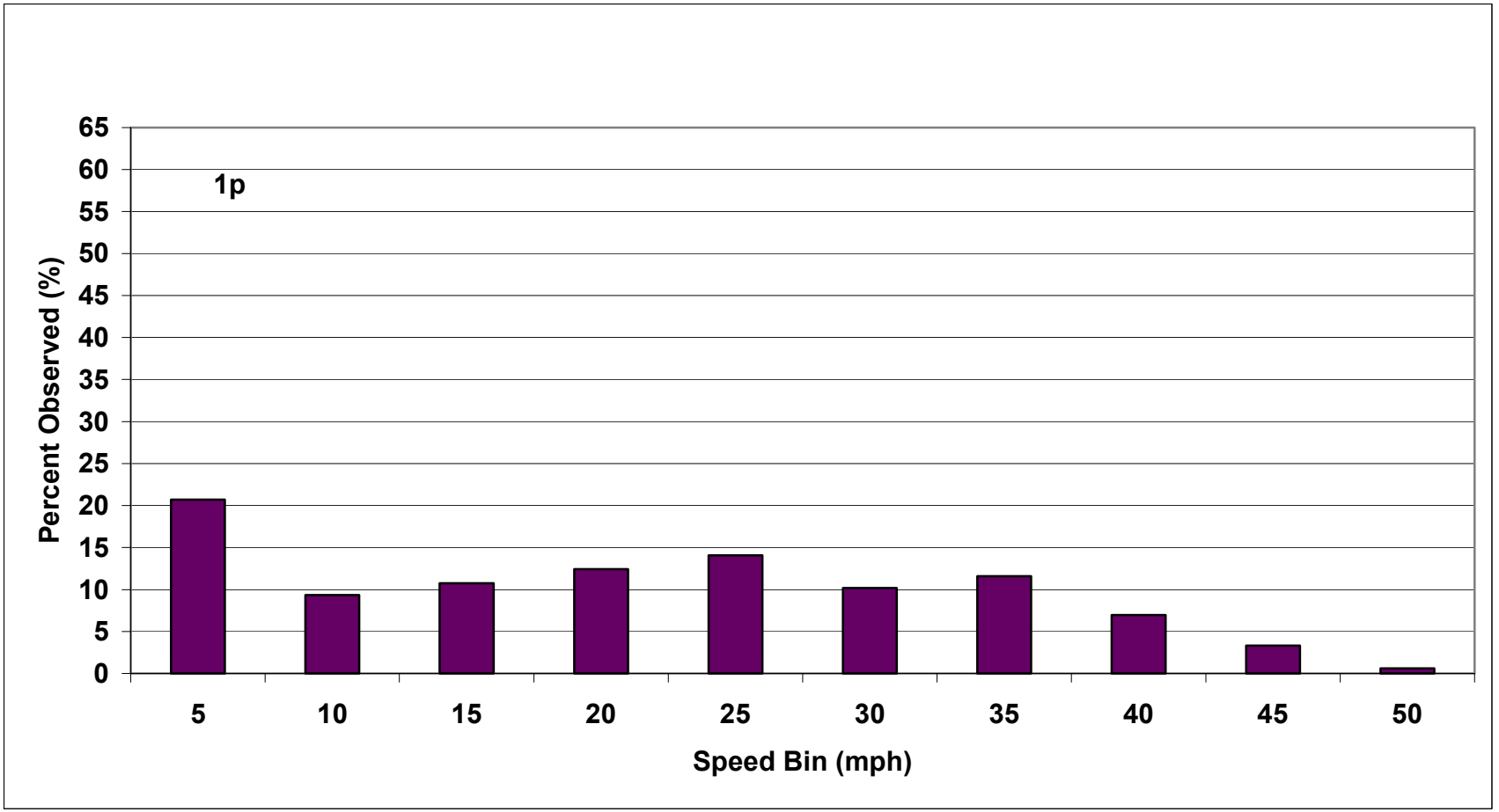

Figure 72. Chase Car Speed Fractions for Urban-Collectors (17) (2000)

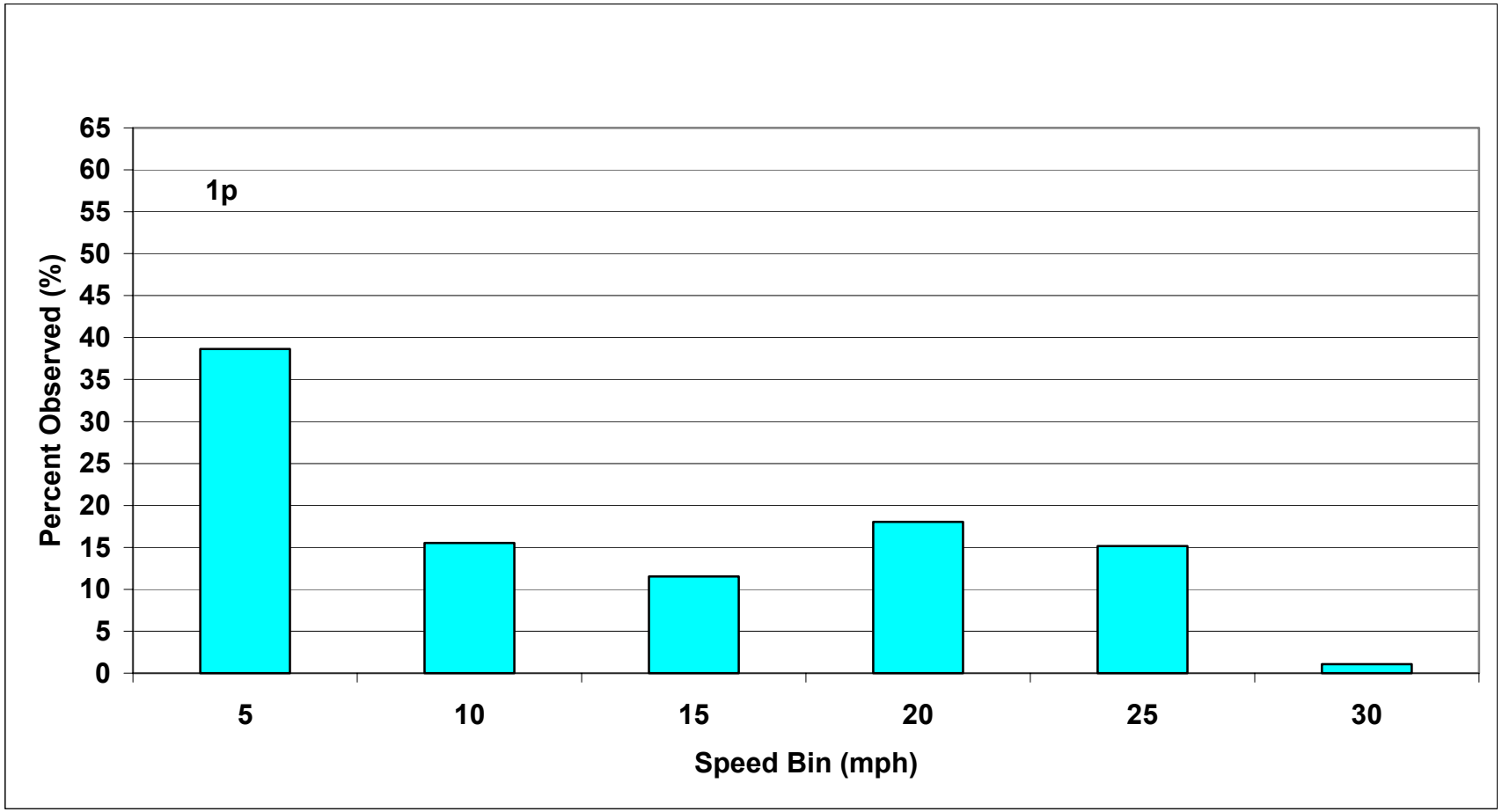

Figure 73. Chase Car Speed Fractions for Urban-Local Roads (19) (2000)

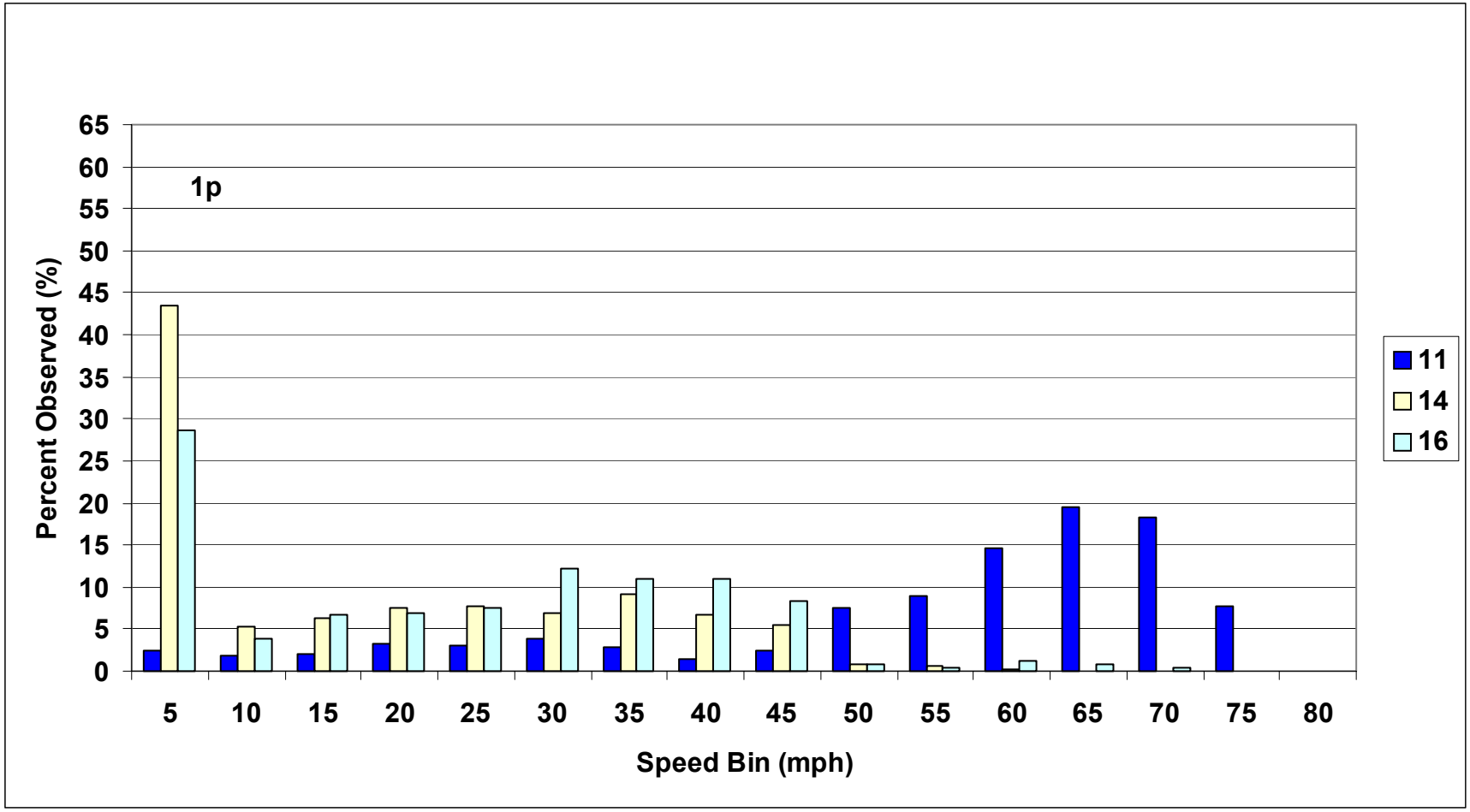

Figure 74. Chase Car Speed Fractions for Urban-Principal Interstate (11), Urban-Other Principal (14) and Urban-Minor (16) Arterials (2000)

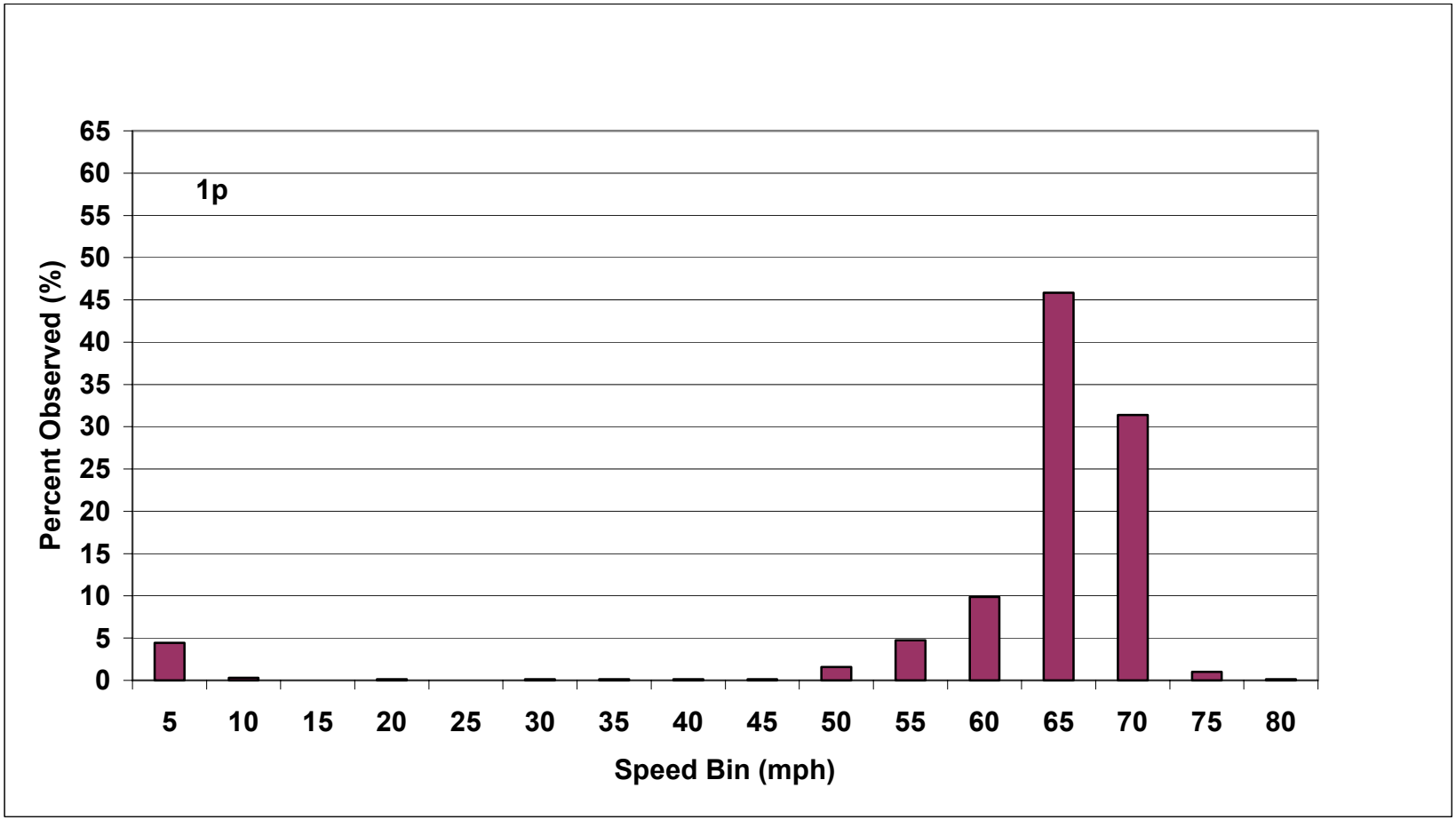

Figure 75. Chase Car Speed Fractions for Urban-Freeways/Expressways (12) (2000)

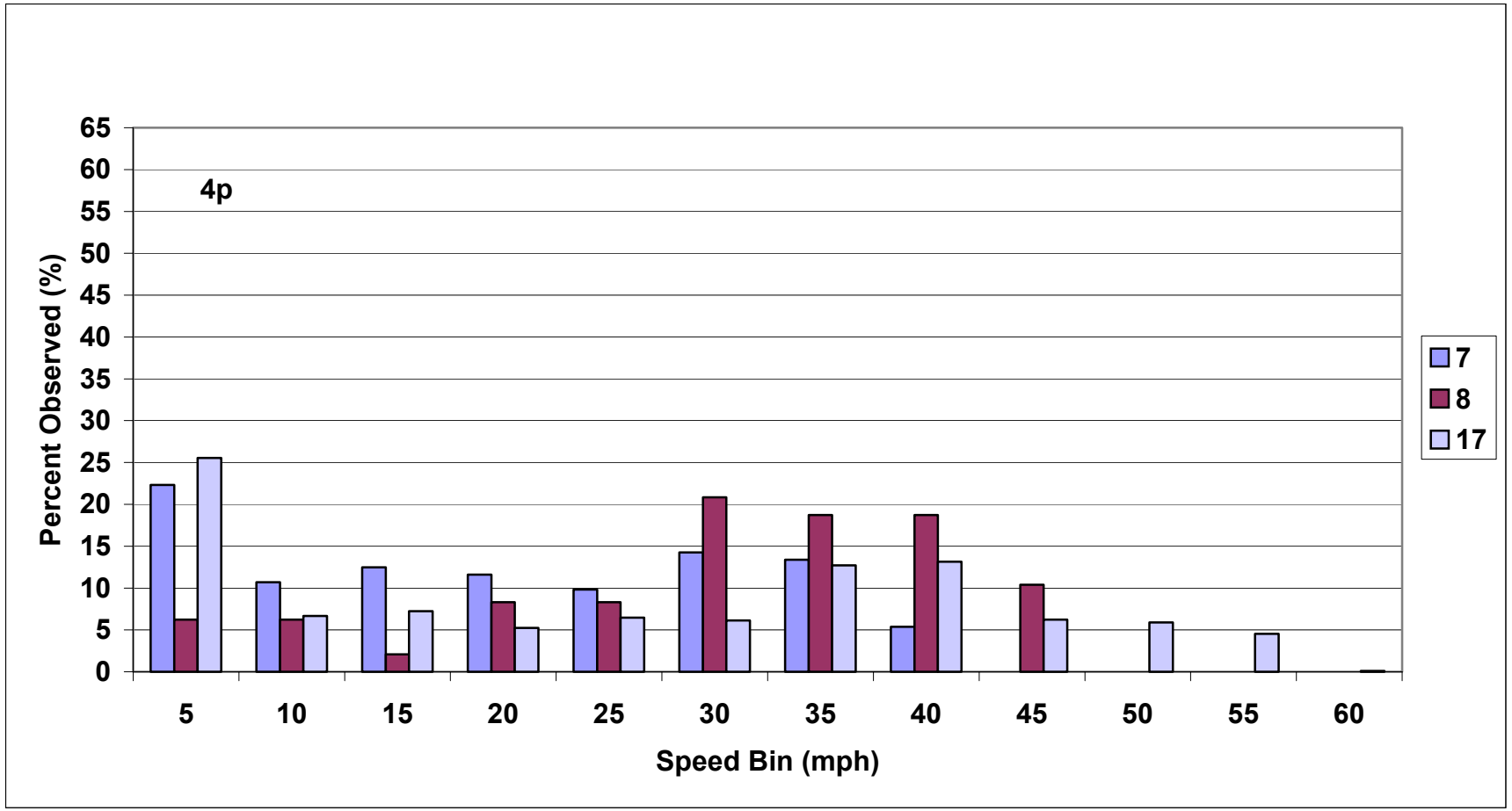

Figure 76. Chase Car Speed Fractions for Rural-Major (7) and Rural-Minor (8) and Urban- (17) Collectors (2000)

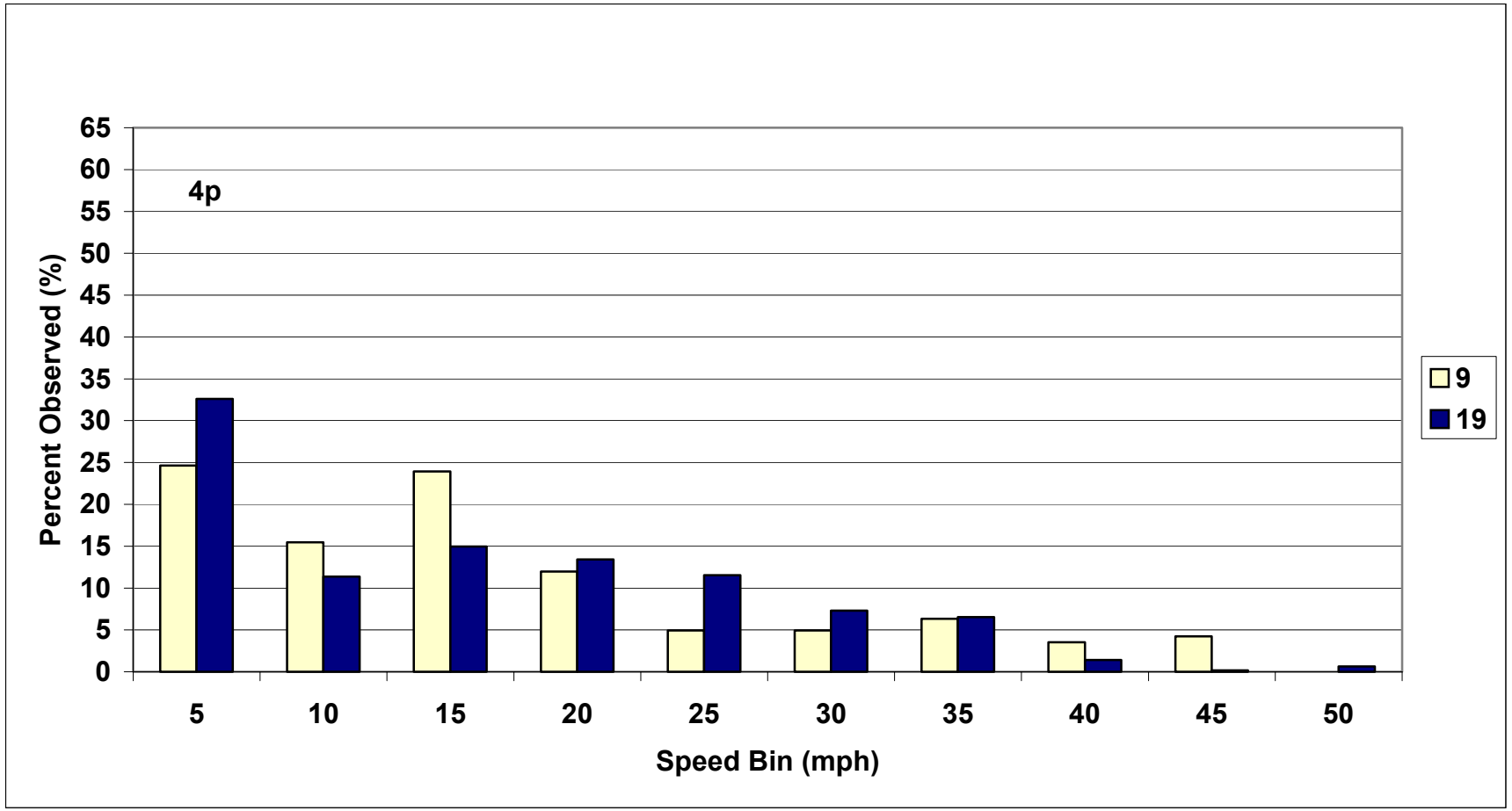

Figure 77. Chase Car Speed Fractions for Rural-Local (9) and Urban-Local (19) Roads (2000)

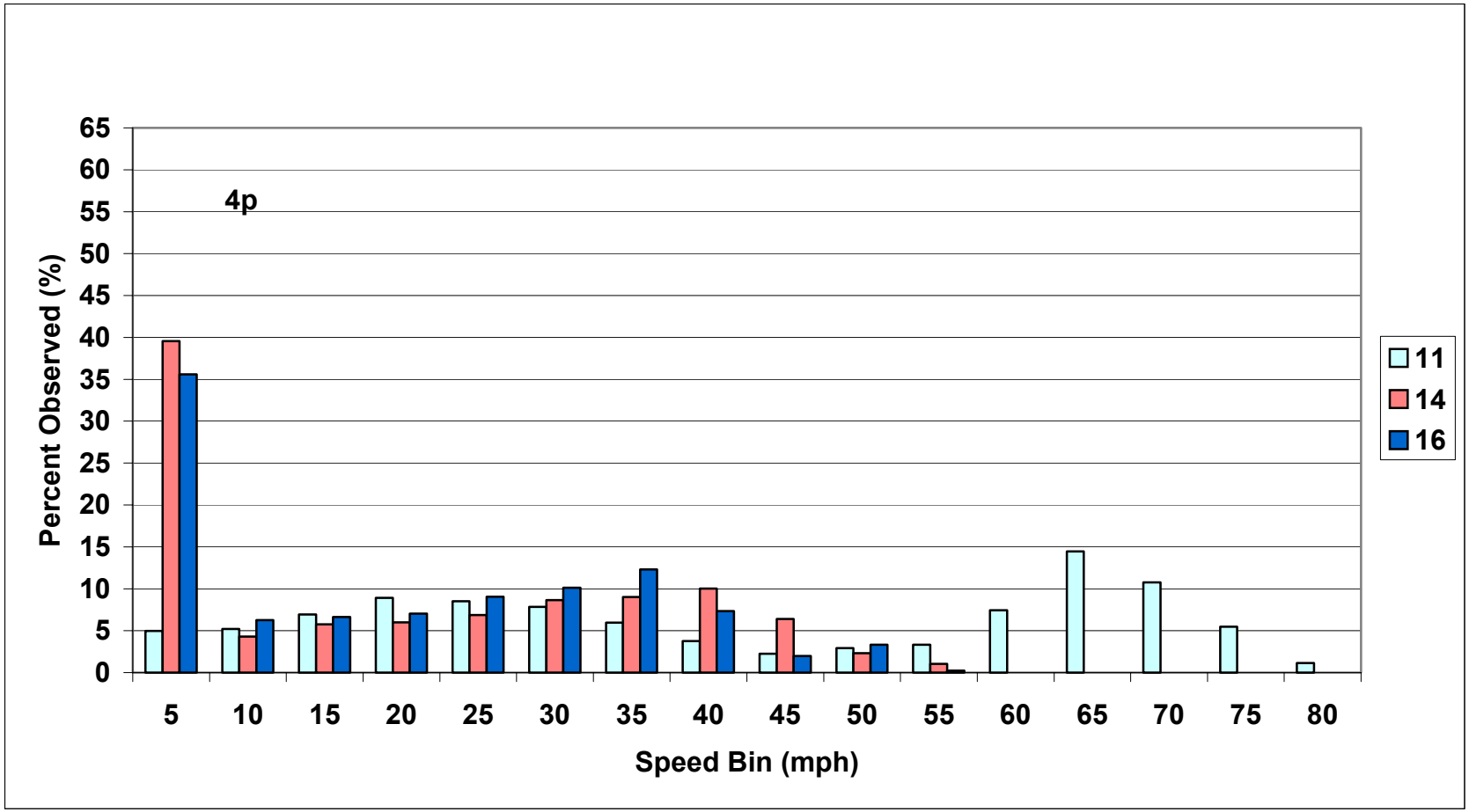

Figure 78. Chase Car Speed Fractions for Urban-Principal Interstate (11), Urban-Other Principal (14) and Urban-Minor (16) Arterials (2000)

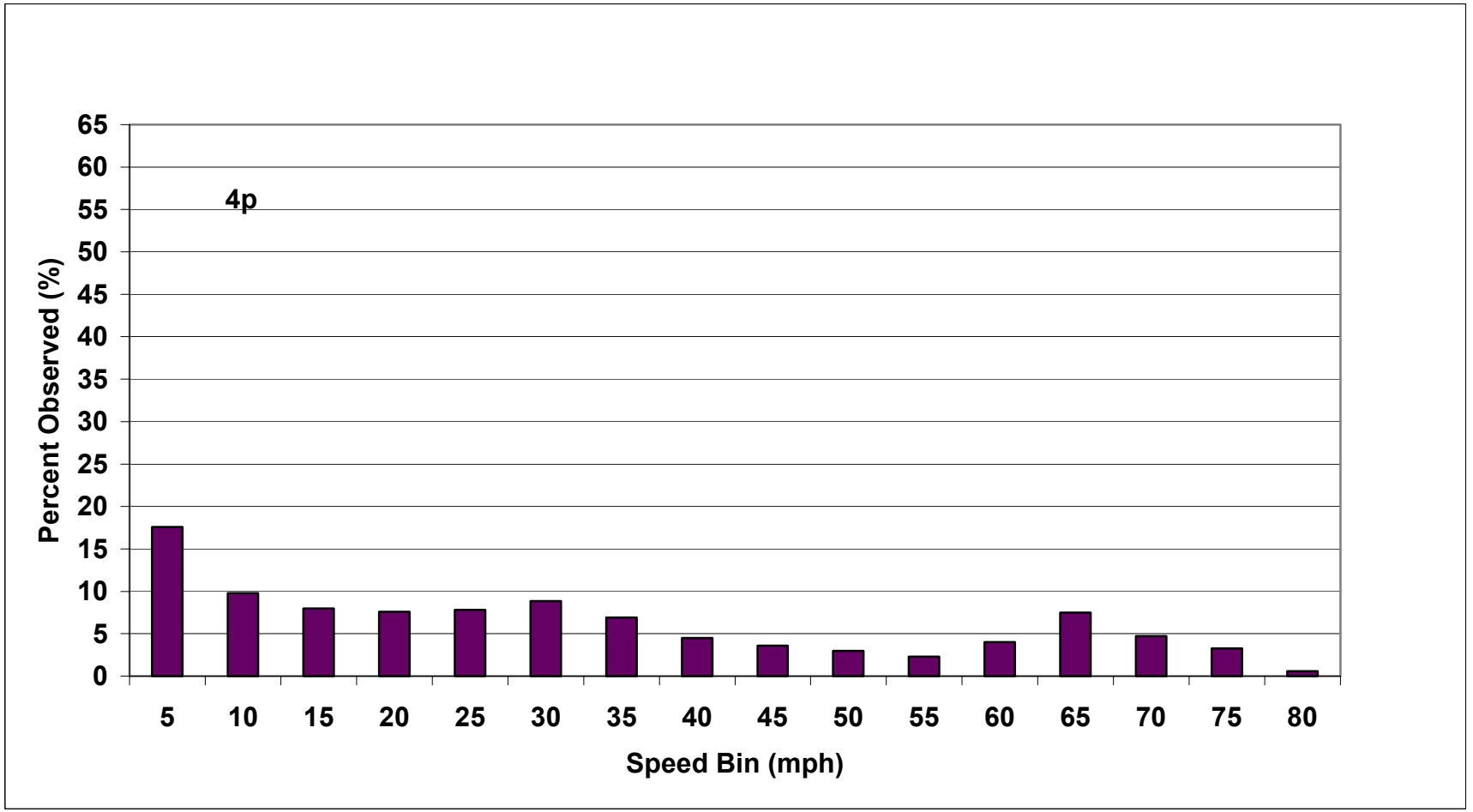

Figure 79. Chase Car Speed Fractions for Urban-Freeways/Expressways (12) (2000)

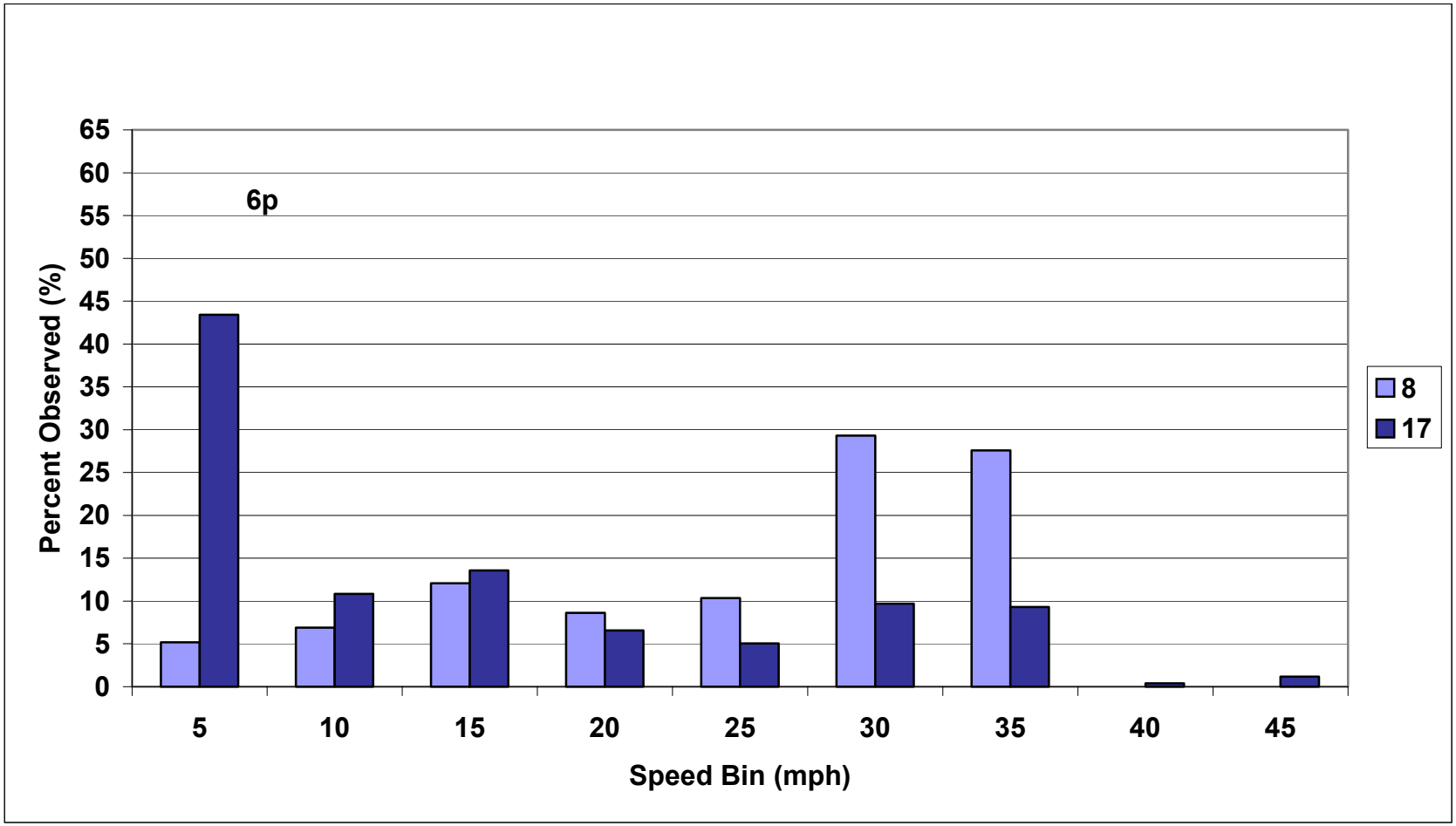

Figure 80. Chase Car Speed Fractions for Rural-Major (7) and Rural-Minor (8) and Urban- (17) Collectors (2000)

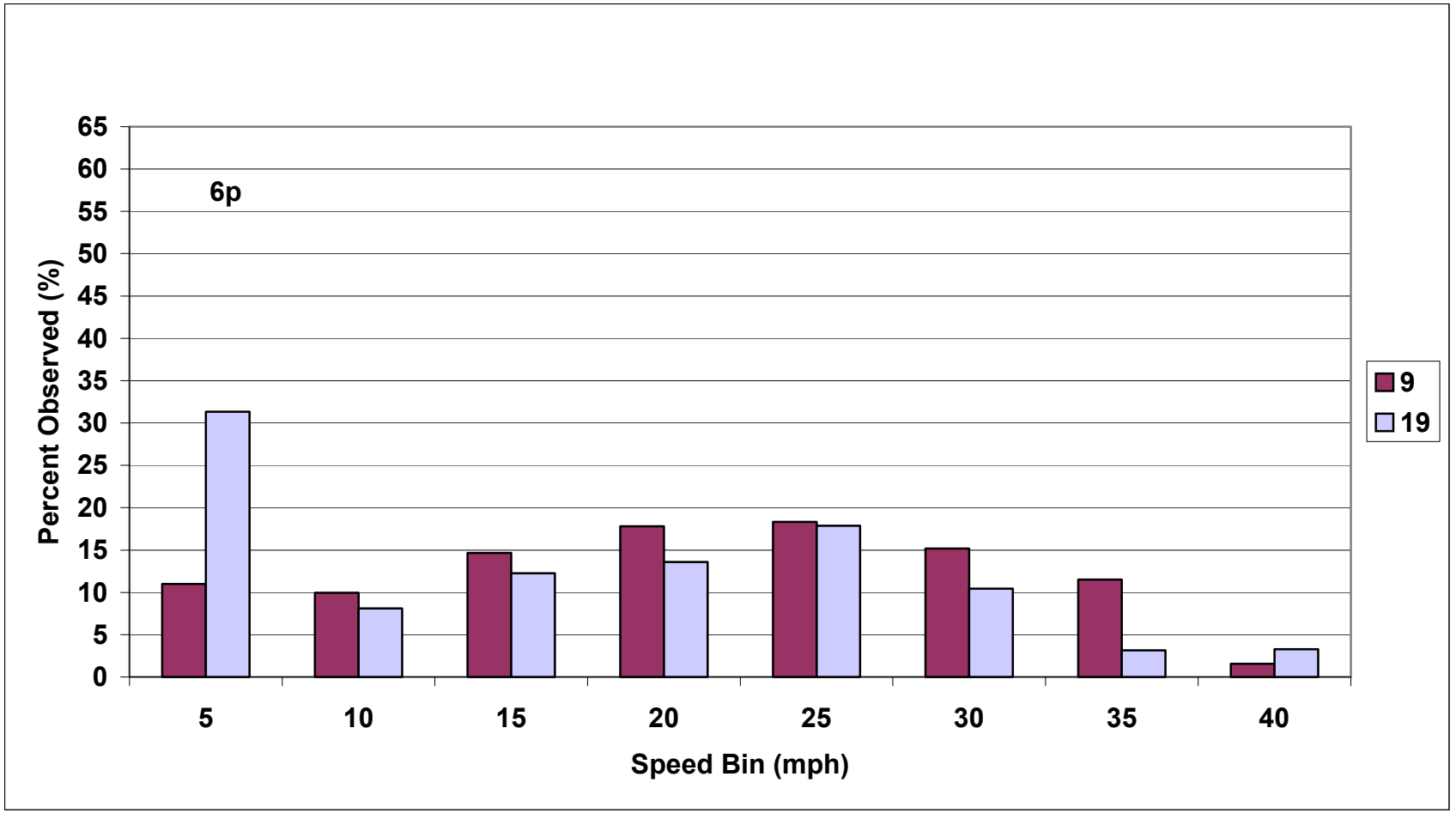

Figure 81. Chase Car Speed Fractions for Rural-Local (9) and Urban-Local (19) Roads (2000)

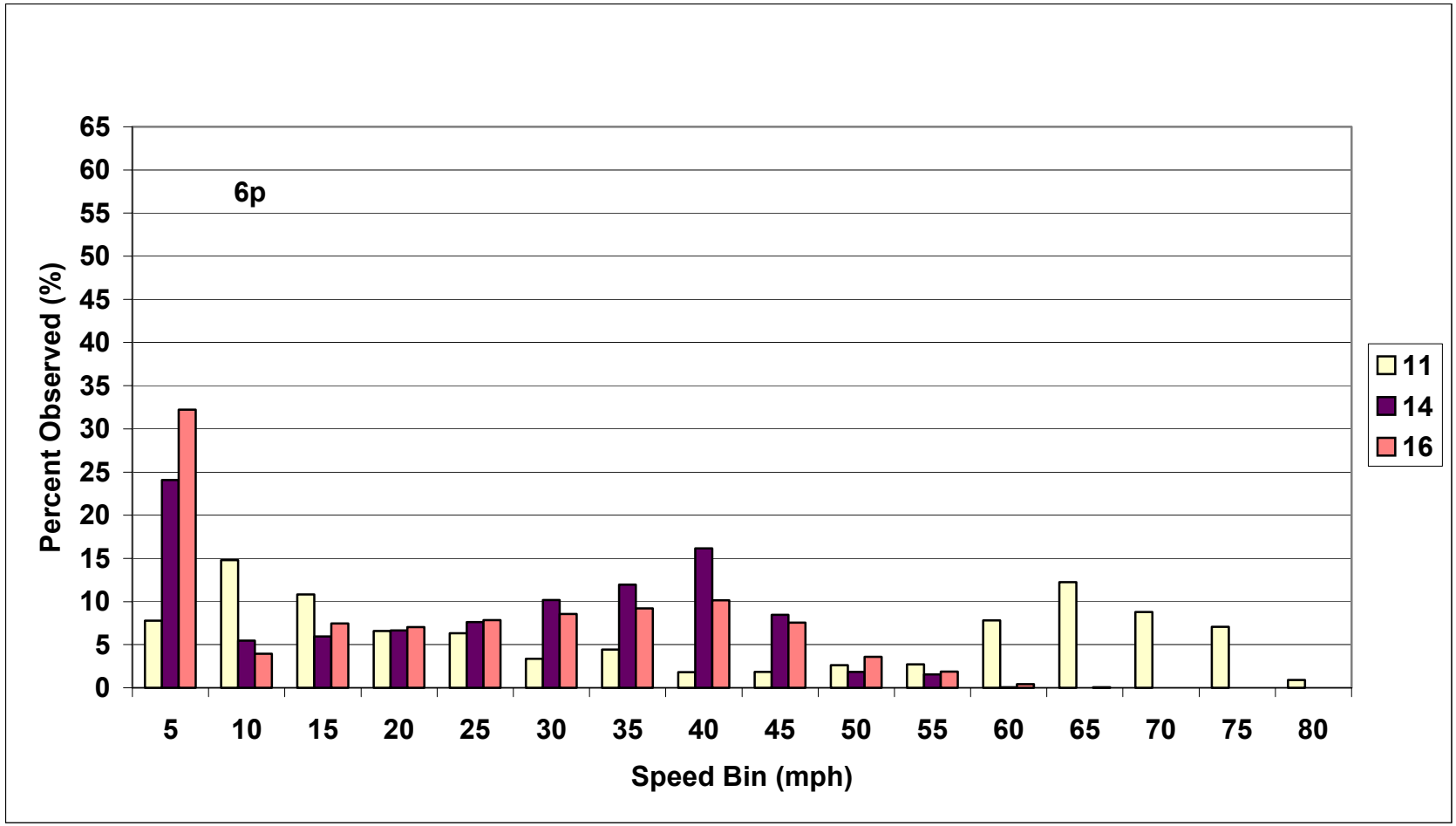

Figure 82. Chase Car Speed Fractions for Urban-Principal Interstate (11), Urban-Other Principal (14) and Urban-Minor (16) Arterials (2000)

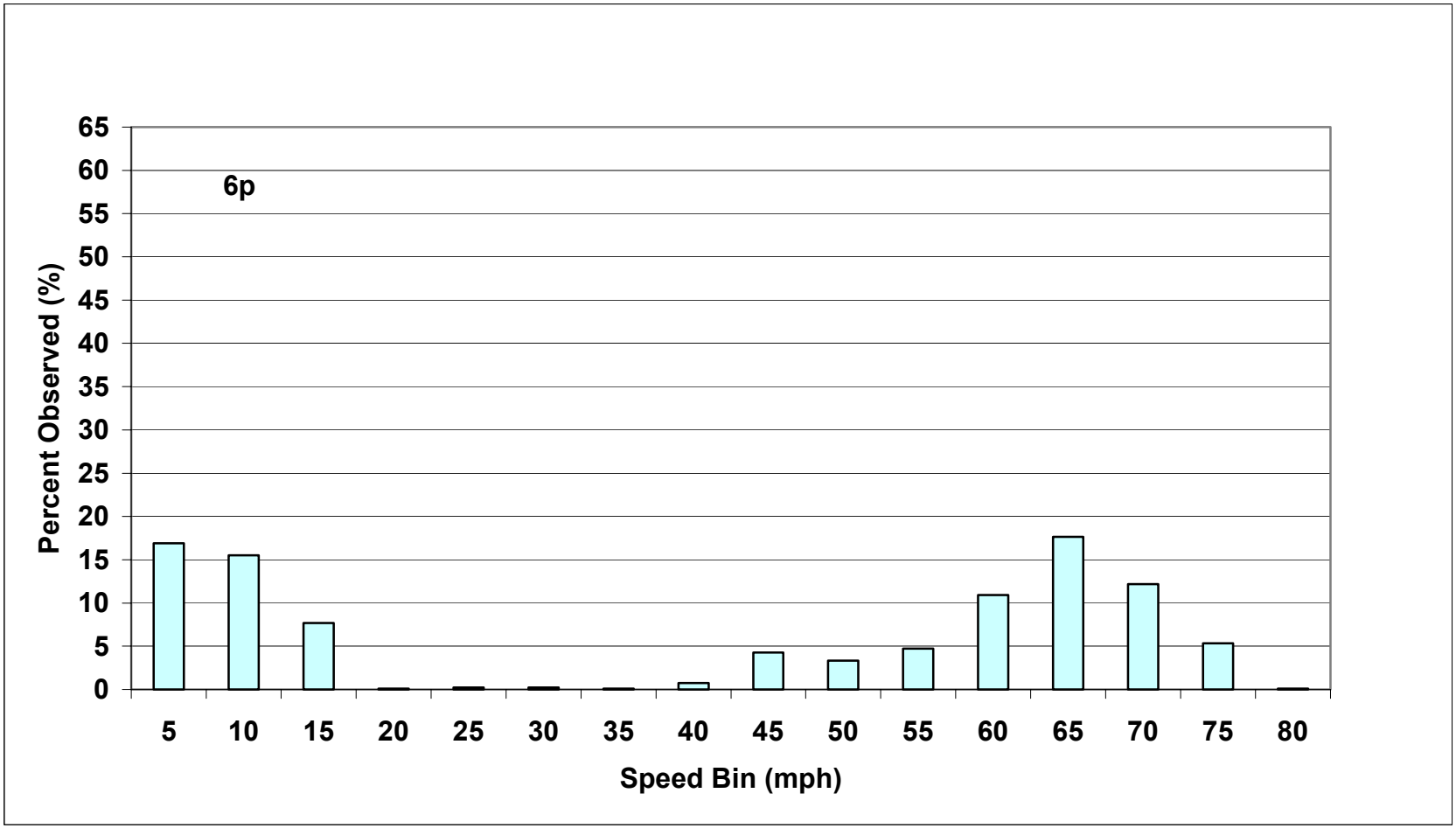

Figure 83. Chase Car Speed Fractions for Urban-Freeways/Expressways (12) (2000)

3.5.6 Speed Fractions, by Facility, Across the Hours

In the prior sections, we presented speeds on urban-principal interstate arterials, urban-freeways/expressways, urban other principal arterials, urban minor arterials, urban-collectors and urban-local roads by hour (i.e., for 6a, 8a, 10a, 1p, 4p and 6p). We now examine the data by facility type, across the hours.

Figures 84 through 88 illustrate speed fractions by each of the facility types, for all of the hours. The analysis shows that for a given facility type, hourly speed fractions are mostly different. For example, in Figure 84, observed speeds are in the 0 through 85 mph speed bins for 6a and 10a and in the 0 through 80 mph speed bins for 8a, 1p, 4p and 6p.

The ranges of observed speeds on urban-freeways/expressways are somewhat different for the hourly periods (Figure 85). The speeds are observed in the 25 through 80 mph, 0 through 75 mph, 35 through 80 mph for 6a, 8a and 10a, on the other hand, in the 0 through 80 mph for 1p, 4p and 6p.

Different from most of the other facility types, speeds on urban-other principal arterials are somewhat similar across the hours (Figure 86). The speeds are observed in the 0 through 55 mph speed bins for 6a, 10a and 4p, and in the 0 through 60 mph speed bins for 8a, 1p and 6p.

On urban-minor arterials, speeds are observed in the 0 through 65, 60, 50, 70, 55 and 60 mph speed bins for 6a, 8a, 10a, 1p, 4p and 6p, respectively (Figure 87). However, it should be noted that the percentage of observed speeds in the 60 mph and higher speed bins is 2.5% at most (for 1p) for all the hours we have focused on.

As with the majority of the facility types, the speed fractions for urban-collectors differ for the hours we explored (Figure 88). The observed speeds are in the 0 through 60 mph speed bins for 6a and 4p, 0 through 55 mph speed bins for 8a and 10a, 0 through 50 mph speed bins for 1p, and finally 0 through 45 mph speed bins for 6p.

Speeds on urban-local roads are observed in the 0 through 30, 50, 30, 30, 50 and 40 mph speed bins for 6a, 8a, 10a, 1p, 4p and 6p, respectively (Figure 89). Although the ranges of observed speeds differ for different hours, we can say that the speeds are lower on urban-local roads than the speeds on the other types of facilities. Similarly, as might be expected, higher speeds are observed on urban-freeways/expressways.

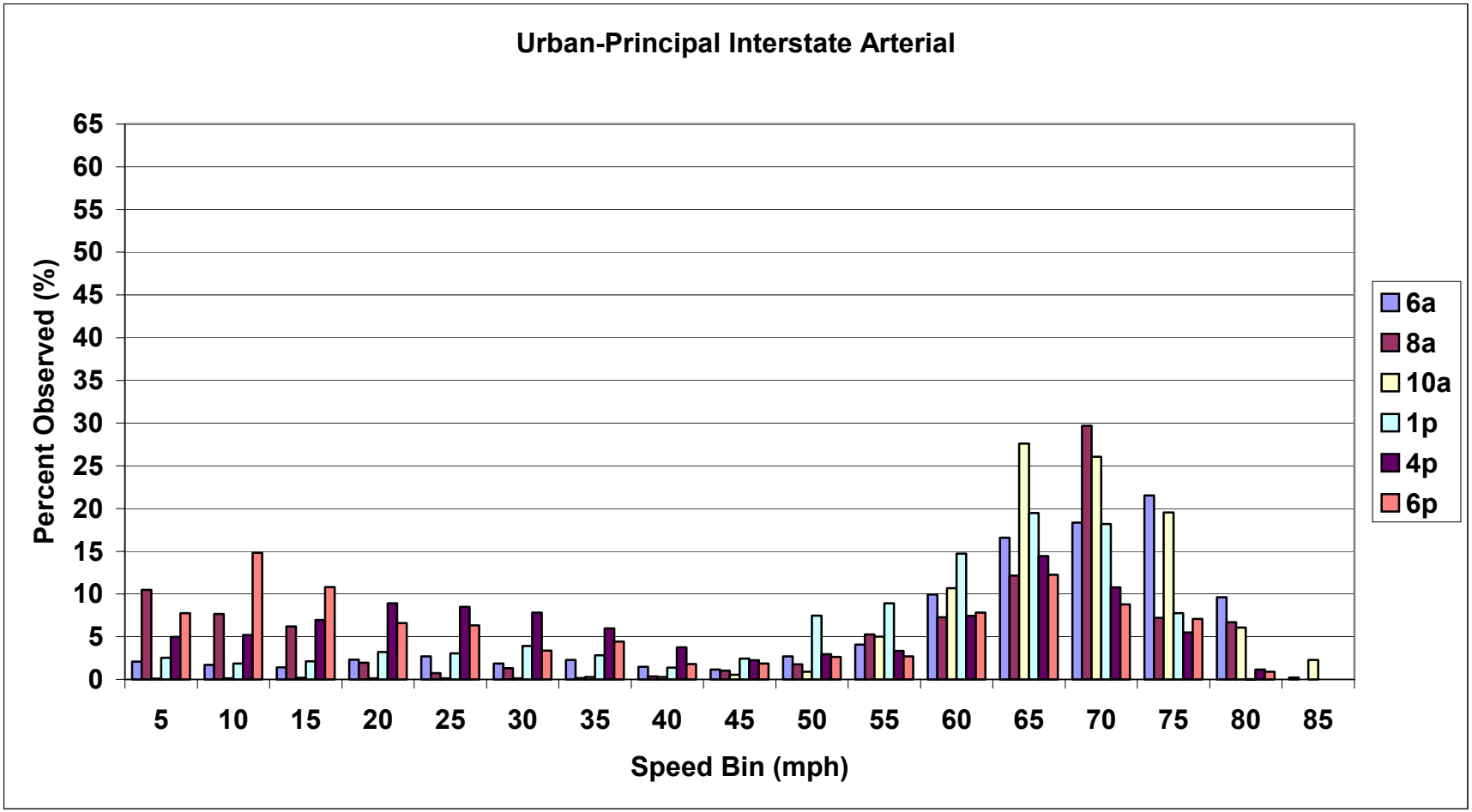

Figure 84. Chase Car Speed Fractions for Urban-Principal Interstate Arterials (11) (2000)

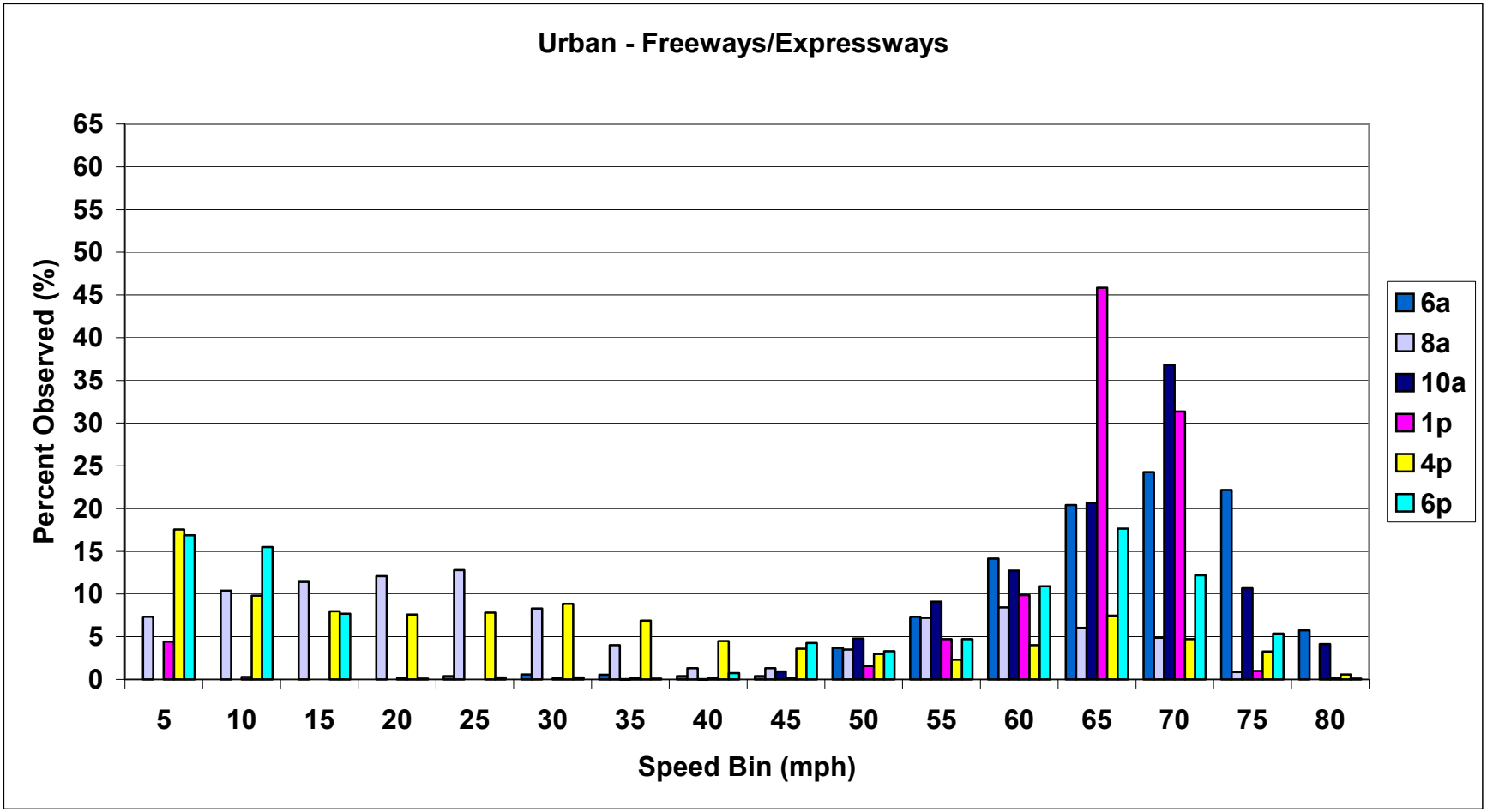

Figure 85. Chase Car Speed Fractions for Urban-Freeways/Expressways (12) (2000)

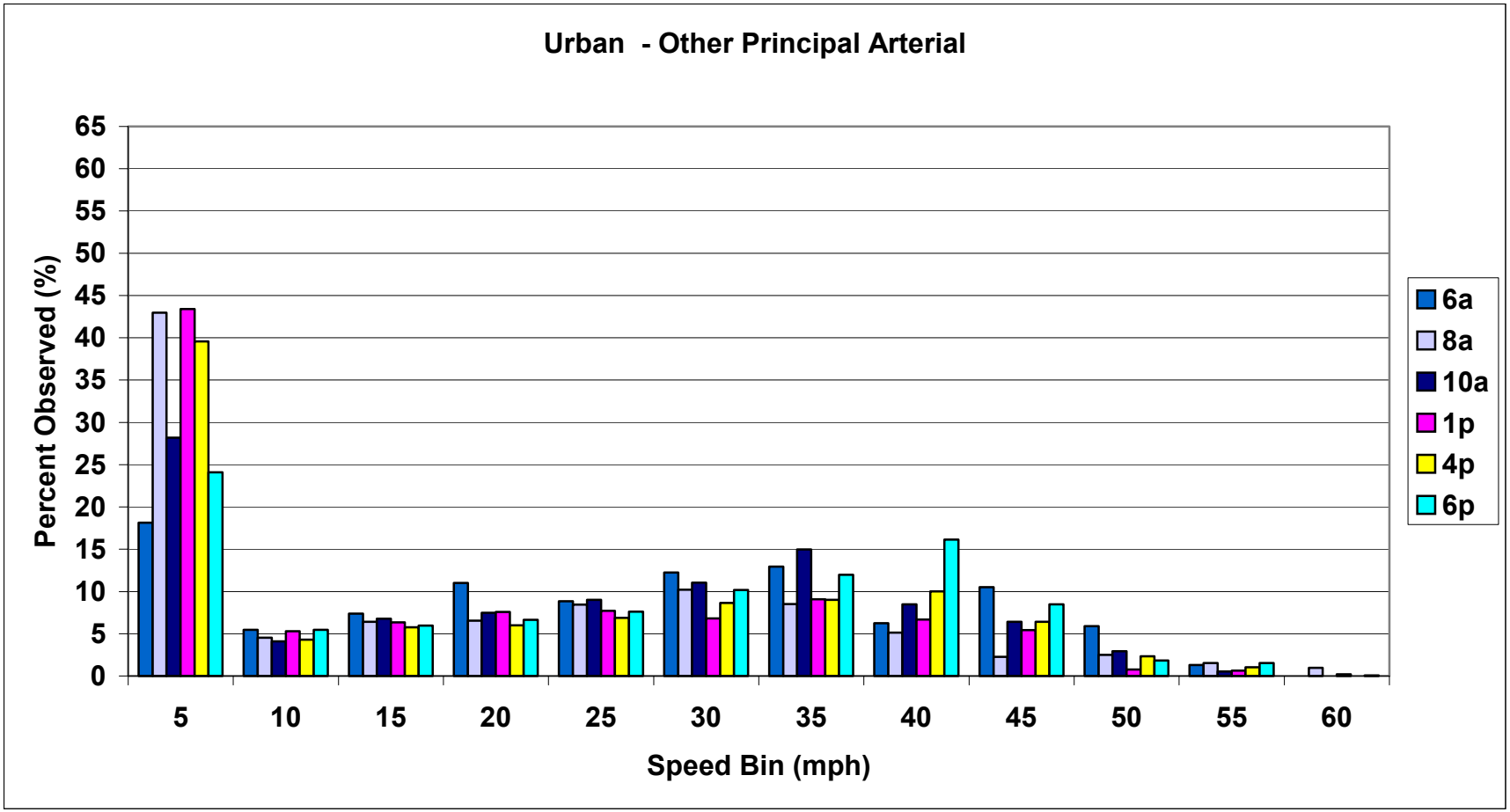

Figure 86. Chase Car Speed Fractions for Urban-Other Principal Arterials (14) (2000)

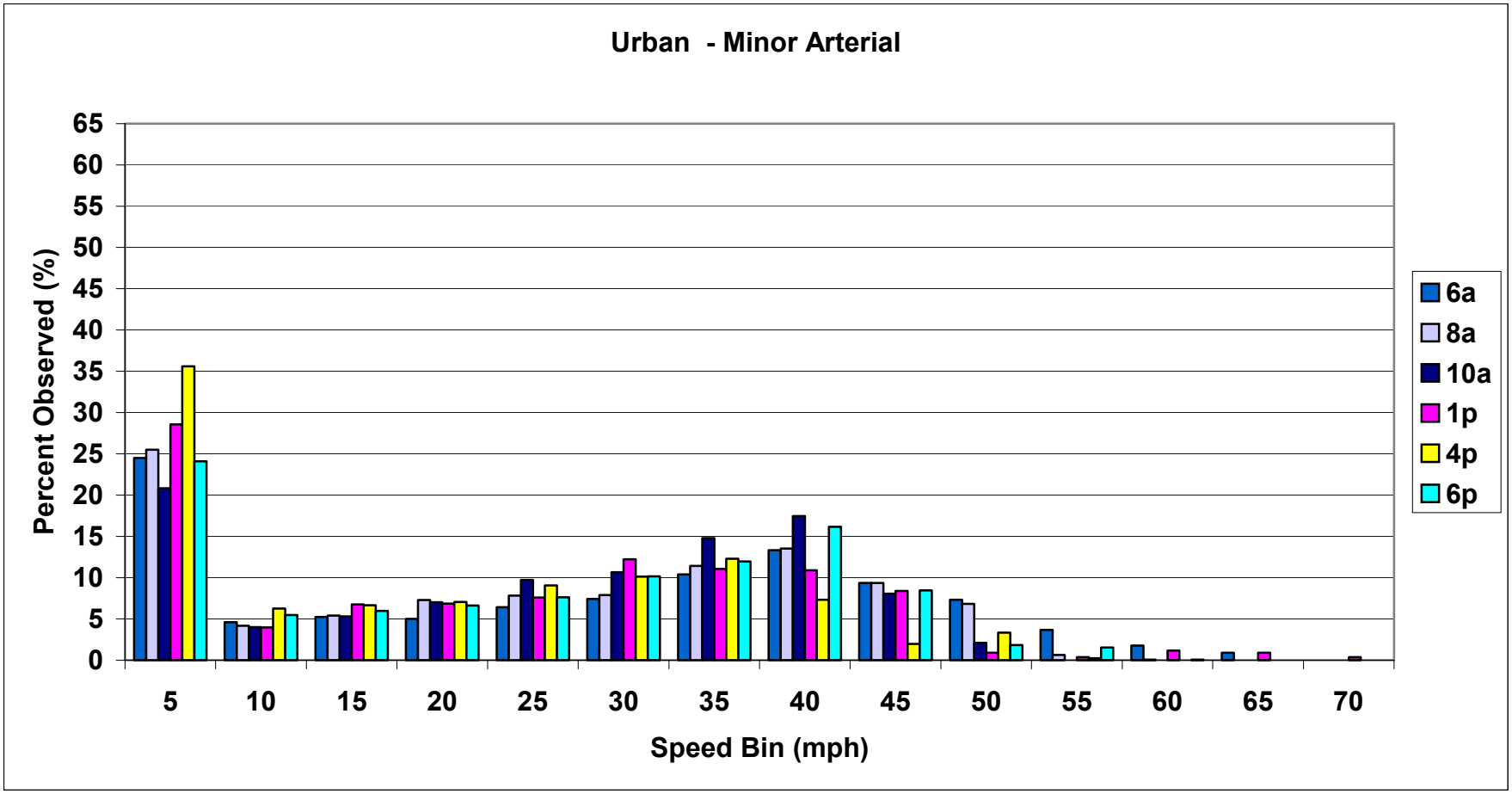

Figure 87. Chase Car Speed Fractions for Urban-Minor Arterials (16) (2000)

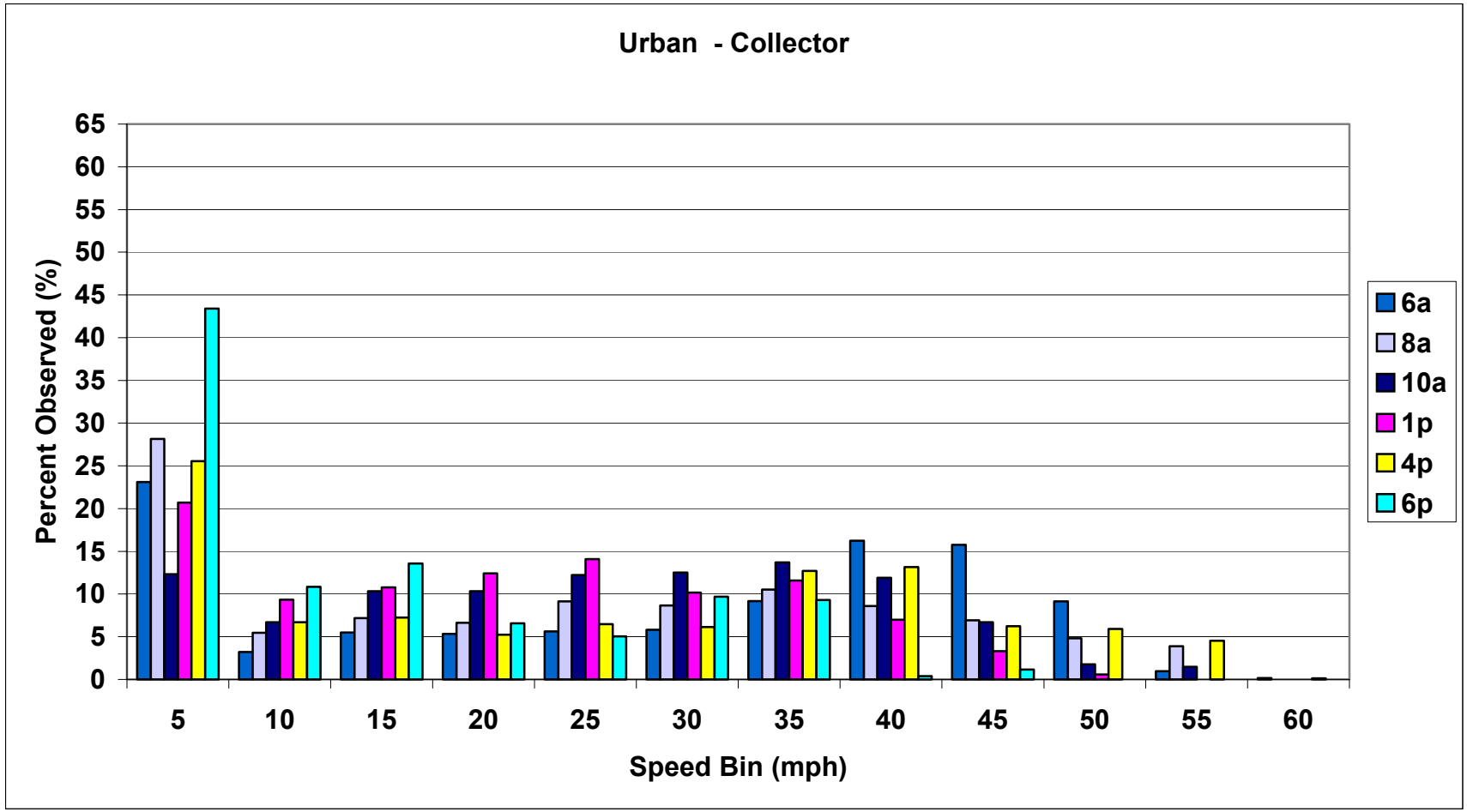

Figure 88. Chase Car Speed Fraction for Urban-Collectors (17) (2000)

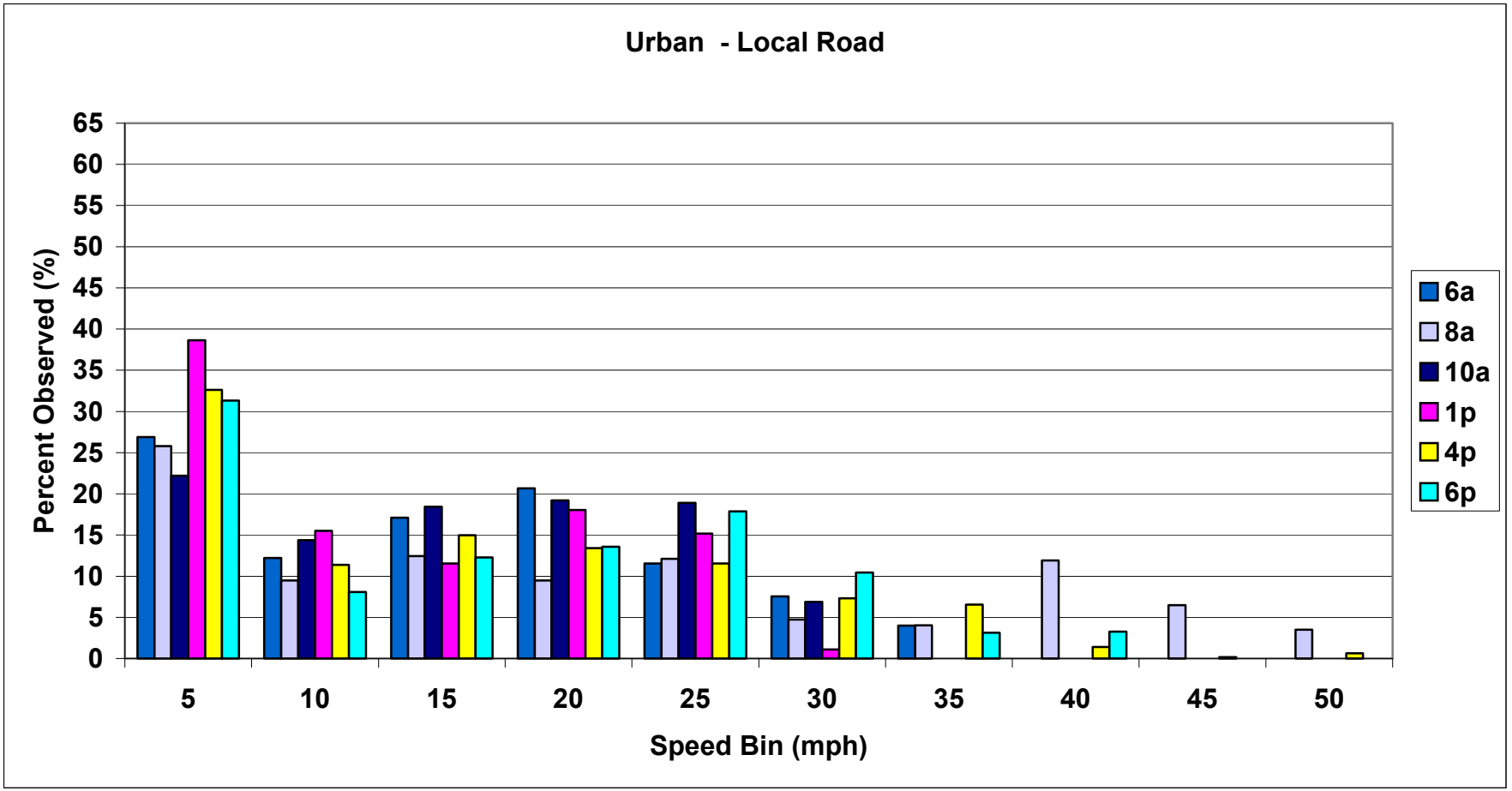

Figure 89. Chase Car Speed Fractions for Urban-Local Roads (19) (2000)

4 CONCLUSION

This report investigates whether a recent change in the speed-VMT distributions used as defaults in EMFAC2002 will impact estimated total emissions. Our research suggests that the change will almost certainly, and perhaps substantially, have such an impact.

Our examination, using the South Coast Air Basin as an example, included three main areas: 1) a comparison of EMFAC7G and EMFAC2002 estimates of speed-VMT distributions; 2) a comparison of EMFAC 2002 speed-VMT distribution estimates with real world data, as provided by SCOS97; and 3) an exploration of speed fractions estimated using chase car second-by-second speeds.

4.1 EMFAC7G Speed-VMT Distributions

Although daily county-specific speed-VMT distribution defaults are included separately for six daily periods in EMFAC7G (CARB, 1996), four different speed-VMT distributions are apparent. They are nighttime, AM peak, daytime off-peak, and PM peak periods. To arrive at these four periods, we grouped the two nighttime periods (6p to 0a and 0 a to 6a), as well as the two daytime off-peak periods (9a to 12 p and 12p to 3p). In addition, we found that speed-VMT distributions are similar across the years 1990, 1994, 2000 and 2010 (for which the defaults were provided in the model).

4.2 EMFAC2002 Speed-VMT Distributions

EMFAC2002 speed-VMT distributions defaults are available for each hour of the day for each county, district, air basin or the state (CARB, 2003). As discussed earlier, except for the distributions provided for 3a and 4a during nighttime, hourly distributions are similar during the six periods defined in EMFAC7G for the years 1994, 1997, 2005 and 2010. In addition, for a given period of the day, EMFAC2002 speed-VMT distributions are very similar for 1994 and 1997, and very similar for 2005 and 2010. Distributions for 1994 and 1997 are somewhat similar to the distributions for 2005 and 2010 for all the periods except for the nighttime period. The 1994 and 1997 nighttime distributions are very different from the 2005 and 2010 nighttime distributions especially in the 60 and 65 mph speed bins.

4.3 EMFAC7G and EMFAC2002 Compared

EMFAC7G and EMFAC2002 speed-VMT distributions are somewhat similar for nighttime, AM Peak, daytime off-peak and PM peak periods for 1994. However, speed-VMT distributions from the two versions of the model differ for 2010 especially for nighttime (EMFAC 2002 defaults are available for every year, however, 1994 and 2010 are two of the years that the defaults were provided for EMFAC7G). Combining the findings about the EMFAC2002 speed-VMT distributions across years, and comparisons of EMFAC7G and EMFAC2002 distributions for 1994 and 2010, shows that the new EMFAC2002 speed-VMT distribution provided for 2010 (CARB, 2002) is very different from the EMFAC2002 1994 distribution. Moreover, given that EMFAC7G and EMFAC2002 distributions are very similar for 1994, distributions very similar to the ones provided for EMFAC7G are still utilized in EMFAC2002 for this year. Implications

of using EMFAC2002 distributions similar to the ones provided for EMFAC7G for 1994 (or other years for which old distributions are used) should be analyzed.

4.4 EMFAC2002 and SCOS97 Real World Data Compared

EMFAC2002 daytime (6a-6p) average speed-VMT default distribution for 1997 and speed-VMT distribution estimated using 1997 SCOS real world data differ. The difference is expected because the defaults in EMFAC2002 are estimated using travel demand model flow rate and speed forecasts representative of travel on different types of facilities (CARB, 2003), whereas SCOS97 data uses speeds and flow rates estimated only for freeway links (Hicks et al., 1999).

4.5 Speed Fraction Data

As a part of this study, we also estimated hourly speed fractions using chase car instantaneous speed measurements in 2000 (Sierra Research, 2003). Although the ranges of speeds for a given facility type show similarities, there is no typical facility type speed fraction pattern for the hours we explored.

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