APPENDIX G

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MERLIN™ Avian Radar Survey for the Power Company of Wyoming

Graphical Data Report for March – November, 2011

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Notice

This graphical data report was prepared by DeTect, Inc. (DeTect) in the course of performing work for the Power Company of Wyoming, LLC (PCW) under DeTect's contract with PCW. The data and information developed as a result of this study and presented herein are the property of the client and are not to be disclosed to third parties without the express written consent of PCW.

Table of Contents

MERLIN™ Avian Radar Survey
Graphical Data Report for 2011

1 INTRODUCTION

This report presents radar data collected at a PCW's proposed wind energy site during three seasons: Spring 2011 (April 1 – June 30, 2011), Summer 2011 (July 1 – August 15, 2011), and Fall 2011 (August 16 – November 16, 2011), as well as five sites: Site 5 (March 16 – April 23, 2011), Site 2 (April 28 – June 27, 2011), Site 3 (July 1 – August 22, 2011), Site 1 (August 26 – September 20, 2011), and Site 4 (September 24 – November 16, 2011). As can be noted by the date ranges of radar data collected at each site, Spring 2011 includes data from Sites 2 and 5, Summer 2011 includes data from Site 3, and Fall 2011 includes data from Sites 1 and 4.

2 METHODS

2.1 Radar Equipment and Data Collection

2.1.1 MERLIN Avian Radar System

Two MERLIN Avian Radar Systems were used for this radar survey. The first was an XS10200 which ran from March 13 – April 26, 2011. This system used dual marine radar sensors: a 10-kW power, magnetron, X-band frequency (3 cm wavelength), vertical-scanning radar (VSR) sensor, and a 200-W power, solid state, S-band (10 cm wavelength), horizontal surveillance radar (HSR) sensor. The solid state sensor uses a solid state transmitter instead of a magnetron which allows for a more focused transmission and requires less voltage. The second system was another XS10200 unit but with Doppler in the HSR sensor. This system ran from April 27 – May 11, 2011 after which the 10kw X-band sensor was replaced with a 25kw sensor.

The HSR coverage had a radius of 3.0 nautical miles (nm) March 16 – April 23, 2011 and 4.0 nm April 29 – November 16, 2011. The HSR data provided directional information on targets. The VSR coverage had a radius of 2.0 nm and provided both count and altitudinal information on targets (Figure 2.1).

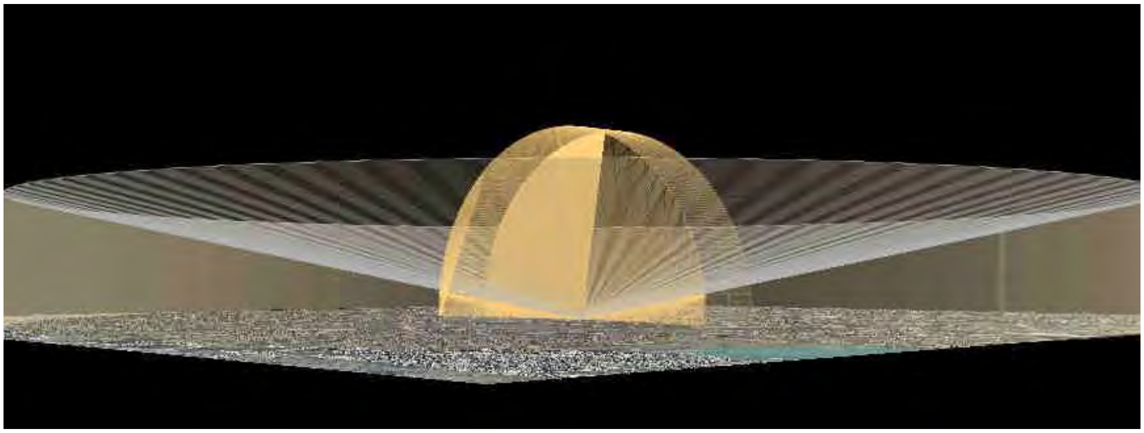

Figure 2-1. Illustration of beam coverage of the horizontal surveillance radar (HSR) and the vertical scanning radar (VSR).

2.1.2 MERLIN Avian Radar Processing Software

The detection and tracking algorithms in the MERLIN software locate plot sequences of biological targets in the raw radar data that fit together into a linear sequence over time as the radar scans (each radar scan updates approximately every 2.5 seconds). When a target meeting the criteria of a bird-like target is tracked for a minimum of three sequential scans or plots, it is identified as a bird target by the radar system, enumerated, and recorded to the system database. A target continues to track as long as it is detected three out of the last four scans or plots. Although the criteria for identifying bird targets has been developed to only track targets that are most likely birds, these are not separable from bats, and targets such as insects or clutter will occasionally be falsely identified and tracked as bird targets. However, the inclusion of non-bird / bat targets was minimized through optimization of the operational settings in the software, visual ground-truthing, and application of custom database queries.

The Merlin Avian Radar System uses modern, marine-grade radar signal processing technology to collect, process, and store 12-bit digitized radar data from both the VSR and HSR. Target data from both radars is processed in real-time by the MERLIN software at the radar with all data and system parameters recorded to compact, internal system databases for target and track processing, analysis, and reporting.

It must be noted that an individual radar echo does not necessarily represent an individual bird or bat, as individuals moving in and out of the radar beam (e.g. circling) would be "counted" by the radar system multiple times. Similarly, a target that is tracked but drops out of the radar line-of-sight (e.g. drops below a tree or brush line) is recorded as a "new" target once it "reappears" and is tracked again (within the MERLIN system, each target is assigned a unique, 64-digit, identification number which facilitates analysis of extended surveys). Therefore, an individual radar echo is referred to as a biological "target" in this study, and when counted together they represent an index of bird / bat activity or exposure level for any given period of time, and not necessarily a count of individuals.

2.2 Data Analysis

2.2.1 Radar Data

Data was processed using standard and custom database queries developed by DeTect on a SQL server data network in DeTect's Radar Lab located in Panama City, Florida. In order to filter out false tracks in both the horizontal and vertical data (insects, ground clutter, interference, etc.), targets that were only plotted once after they were defined as a target (leaving only one entry in the database) were eliminated from the database. Masks were also applied to areas that exhibited false tracking as indicated by PCW and/or SWCA.

HSR and VSR data were reviewed by PCW and/or SWCA Environmental Consultants staff. Rain and insect events were noted and excluded from both the VSR and HSR data. Database analysis of the filtered radar data was conducted in DeTect's Data Lab in Panama City, Florida. The Data Lab uses Microsoft Windows® based computer systems, networks, and SQL (structured query language) servers for database processing and analysis.

2.2.2 Vertical Radar Data - Target Counts and Altitudes

As targets passed along or through the VSR beam, the altitude of the target was recorded with each scan of the radar. The average altitude of each target AGL was generated and used to derive mean and median target heights, as well as to group targets into one of three categories: below rotor swept zone, in rotor swept zone, or above rotor swept zone. For the purposes of this graphical analysis a rotor swept zone of 0-154.2 m (0-500 ft) AGL was considered.

The VSR data queries were standardized to a 1-km front per hour, generally the industry standard for most migratory and wind energy avian studies and risk analyses. For this report, target passage rates are further defined as the number of targets detected within 0.5 km to either side of the radar, for a total frontal width of 1 km, during a one hour period. Passage rates were standardized using the number of minutes with radar data within a given time period (minus any time with rain) and collated for each dawn (30 minutes before sunrise to 30 minutes after sunrise), day (30 minutes after sunrise to 30 minutes before sunset), dusk (30 minutes before sunset to 30 minutes after sunset), and night (30 minutes after sunset to 30 minutes before sunrise the next day) as well as each season, or time period at each site. The average target passage rates (below, within, and above the rotor swept zone, as well as total), and mean and median target heights, were calculated for dawns, days, dusks, and nights as well as hourly during this survey.

2.2.3 Horizontal Radar Data - Target Directions

The horizontal radar data collected was used to develop information on the movement of targets throughout the project area. As targets were detected on the HSR, their bearings were recorded on each scan of the radar. The average bearing of each target was then generated from all the scans as the target passed through the HSR beam.

The horizontal radar data were queried and the average target directions were generated for each dawn, day, dusk, and night. The overall distribution was also plotted for all dawns, days, dusks, and nights in each season by developing a frequency table of target numbers occurring in 45° increments: eight groups centered on north, northeast, east, southeast, south, southwest, west, and northwest. This provided a directional assessment of the target movements throughout the survey area.

Calculations of mean direction and angular concentration (*r*) for these time periods were calculated using SQL and formulas based on Zar 1999. The value of *r* is a measure of concentration; it has no units and varies from 0 (no concentration, all values very dispersed) to 1.0 (all data concentrated in the same direction), whereas 1-*r* is a measure of angular dispersion (Zar 1999).

3 RESULTS for the Spring 2011 Season

3.1 Level of Effort

The MERLIN Avian Radar System operated at Sites 2 and 5 during the Spring 2011 season (April 1 – June 30, 2011).

Table 3-1. Effort of radar monitoring during the spring 2011 season.

Radar	Time In Reporting Period	Time radar collected data	Radar downtime	Radar data with rain and/or insects	Useable radar data
Vertical Radar (hrs)	2184	1967.8	216.2	713.6	1254.2
Horizontal Radar (hrs)	2184	1958.9	225.1	90.5	1868.4

3.2 Vertical Radar Data

3.2.1 Target Passage Rates Over Time

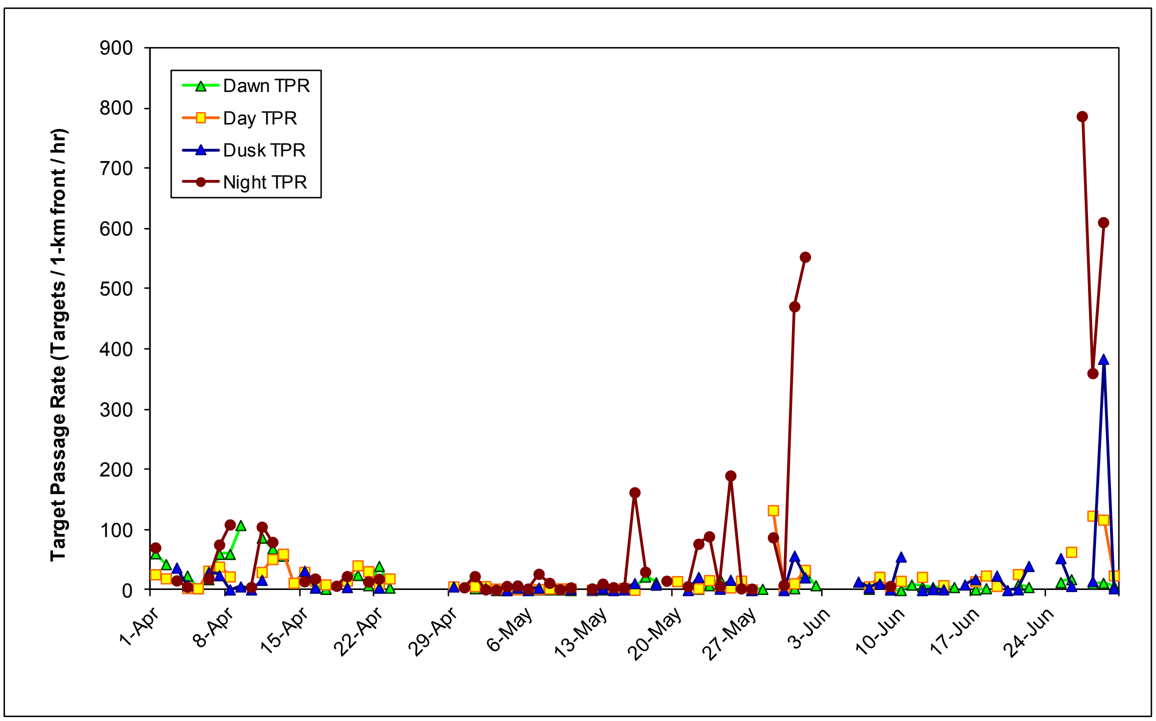

Figure 3-1. Target passage rates during dawns, days, dusks, and nights of the spring 2011 season.

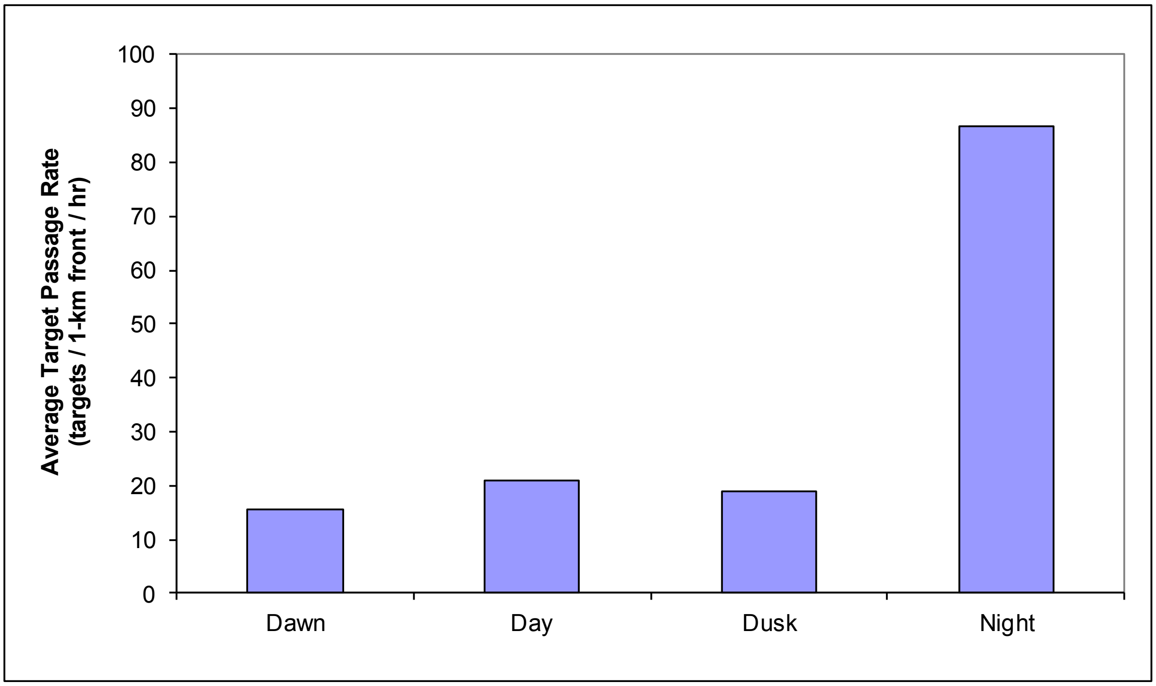

Figure 3-2. Average target passage rates for dawns, days, dusks, and nights of the spring 2011 season.

Table 3-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for four biological periods during the spring 2011 season.

	Dawn	Day	Dusk	Night
Average	15.6	20.8	18.8	86.7
Standard Deviation	22.7	28.3	53.8	173.8
Median	5.5	12.0	4.6	15.0
Minimum	0.0	0.4	0.0	0.6
Maximum	108.0	132.6	384.0	787.0
Range	108.0	132.3	384.0	786.4

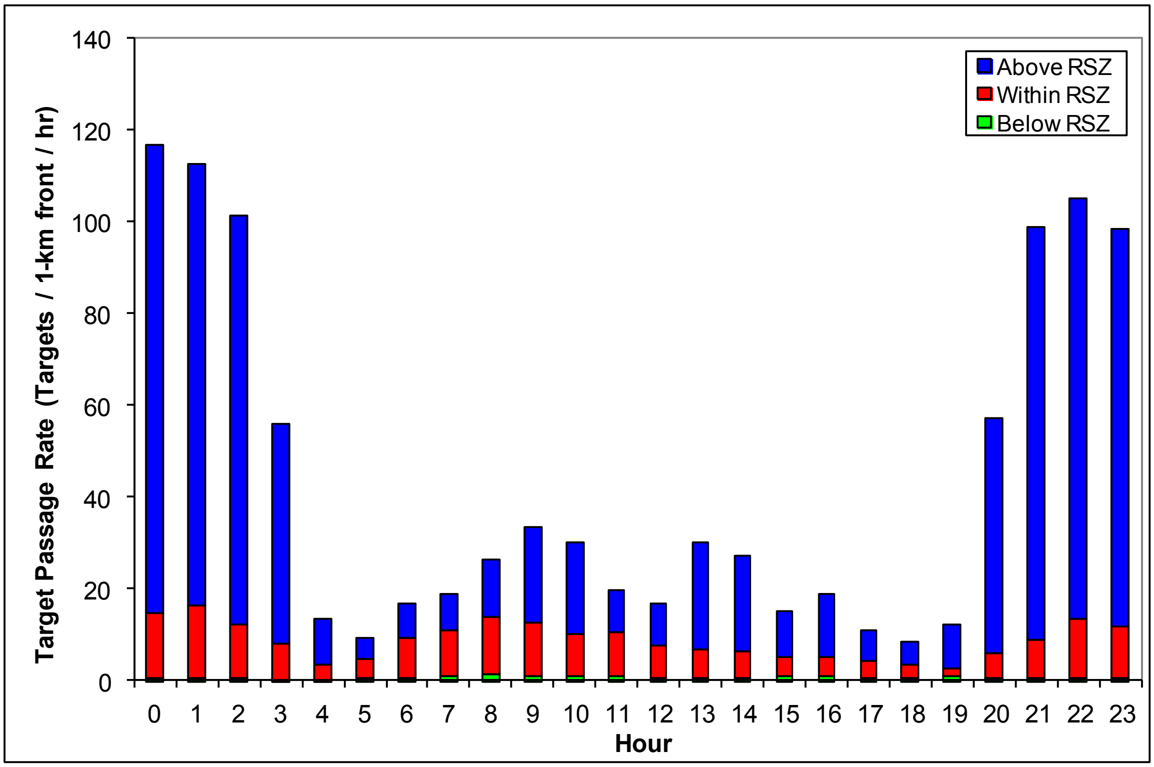

Figure 3-3. Hourly activity (average target passage rates) during the spring 2011 season.

3.2.2 Altitudinal Distribution of Targets

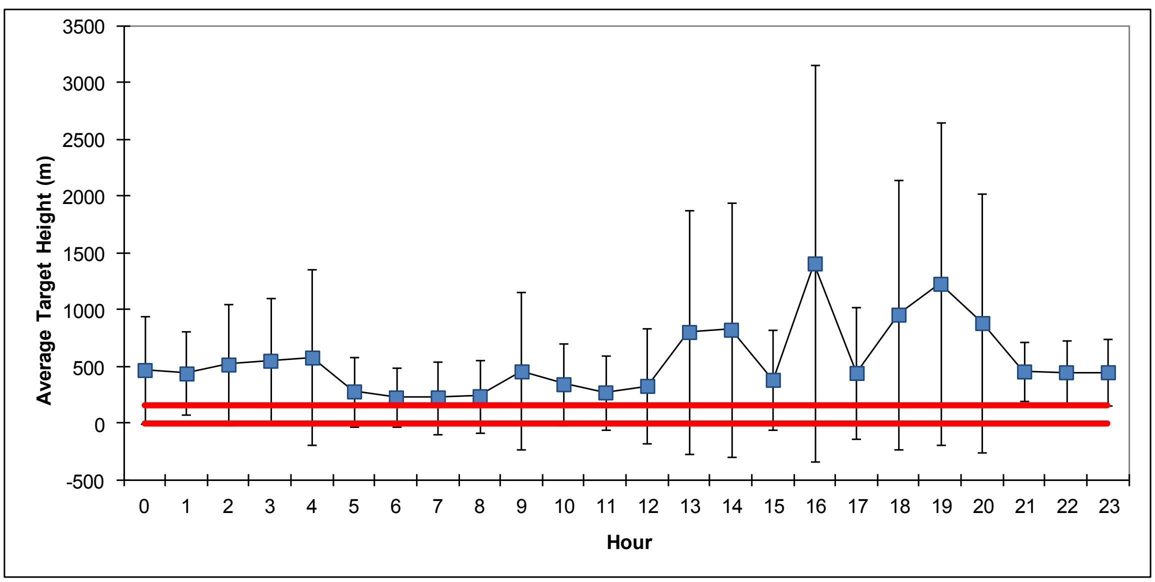

Figure 3-4. Average hourly target heights AGL during the spring 2011 season. Error bars represent standard deviation for each hour and red lines represent the top and bottom of the rotor swept zone (0 – 152.4 m AGL).

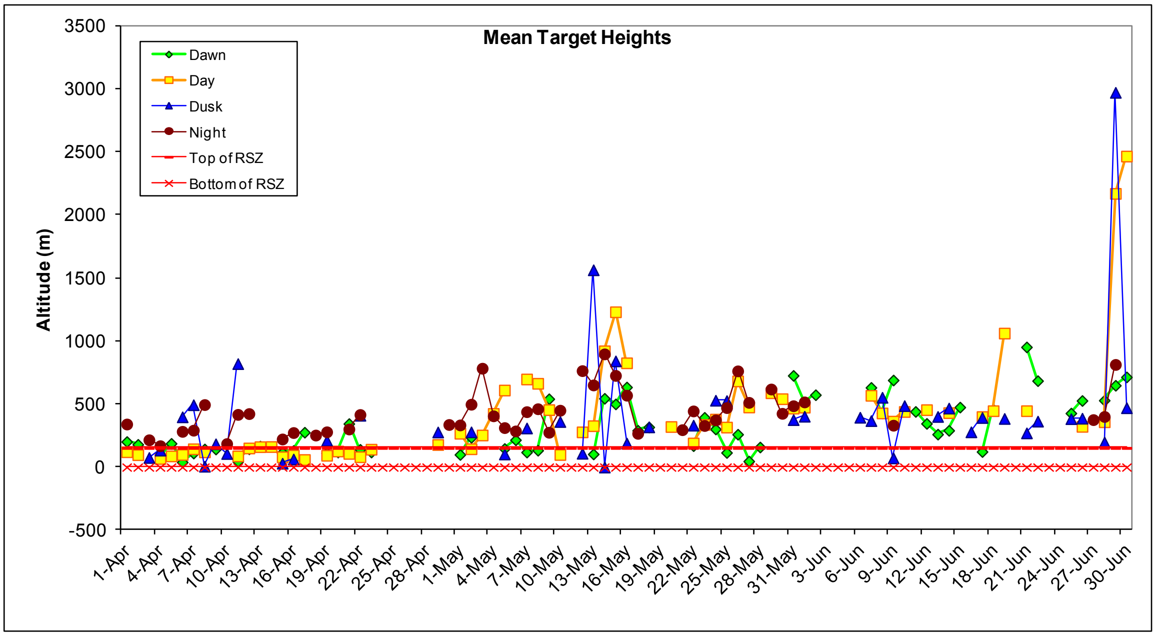

Figure 3-5. Mean target heights during four biological periods of the spring 2011 season.

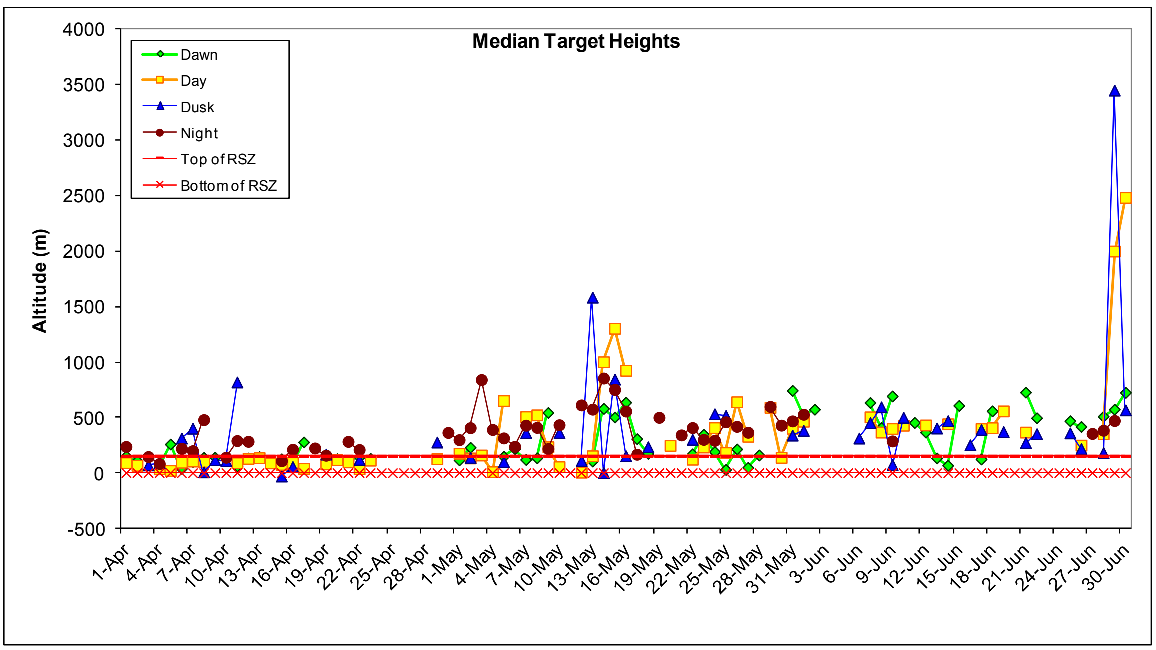

Figure 3-6. Median target heights during four biological periods of the spring 2011 season.

Table 3-3. Summary of mean and median target heights during four biological periods of the spring 2011 season. The top presents averages of mean and median target heights calculated during each biological period having at least 50% data in that time period; the bottom presents the overall mean and median target heights when all targets in each of the four biological periods were combined.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average mean target height	315.3	417.8	416.6	432.2
Average median target height	290.9	349.9	401.0	368.2
All targets for season combined				
Mean target height	222.5	539.9	1392.3	484.5
Median target height	135.3	251.2	555.3	415.4

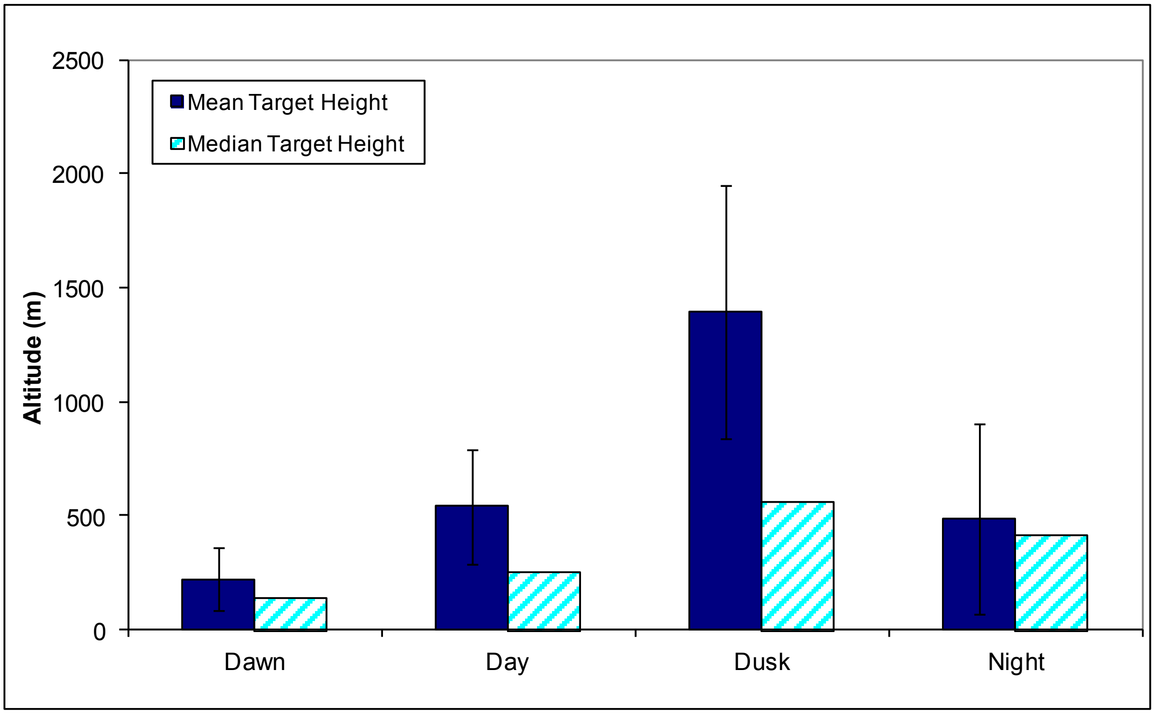

Figure 3-7. Overall mean and median target heights when all targets in each of the four biological periods were combined during the spring 2011 season. Error bars represent one standard deviation.

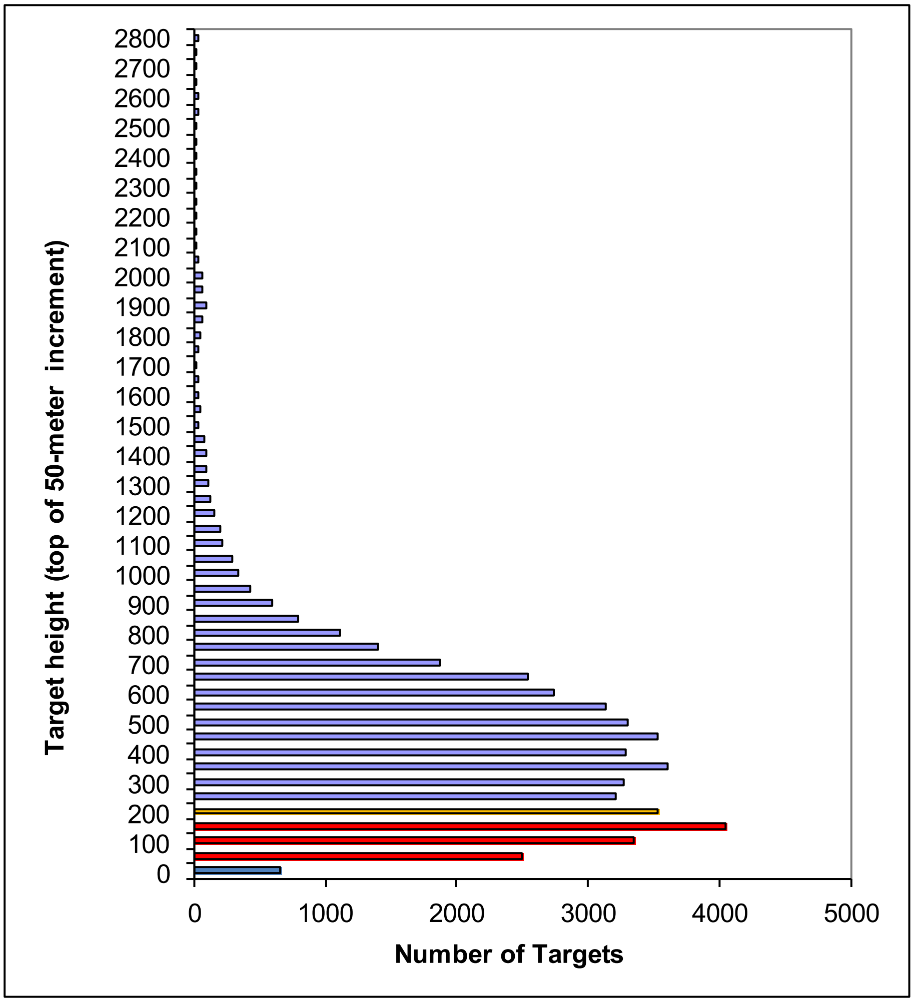

Figure 3-8. Number of targets occurring in each 50-meter increment during the spring 2011 season. Red indicates rotor swept heights, and orange indicates altitudes partially within rotor swept heights.

Table 3-4. Summary of target passage rates and percent of targets above, within and below the RSZ during four biological periods of the spring 2011 season.

	Dawn	Day	Dusk	Night
All targets for season combined				
% targets above RSZ	42.0%	60.7%	85.7%	86.7%
% targets within RSZ	53.9%	35.4%	11.0%	12.7%
% targets below RSZ	4.1%	3.9%	3.2%	0.6%
% targets below turbine height	58.0%	39.3%	14.3%	13.3%
Target data calculated for each date				
Average % of targets in RSZ	41.1%	40.0%	26.6%	22.9%
Min target percentage within RSZ	0.0%	0.0%	0.0%	1.1%
Max target percentage within RSZ	100.0%	86.6%	100.0%	50.0%
Average target passage rate above RSZ	6.6	12.6	15.9	75.5
Average target passage rate within RSZ	8.4	7.5	2.3	10.7
Average target passage rate below RSZ	0.6	0.8	0.6	0.5

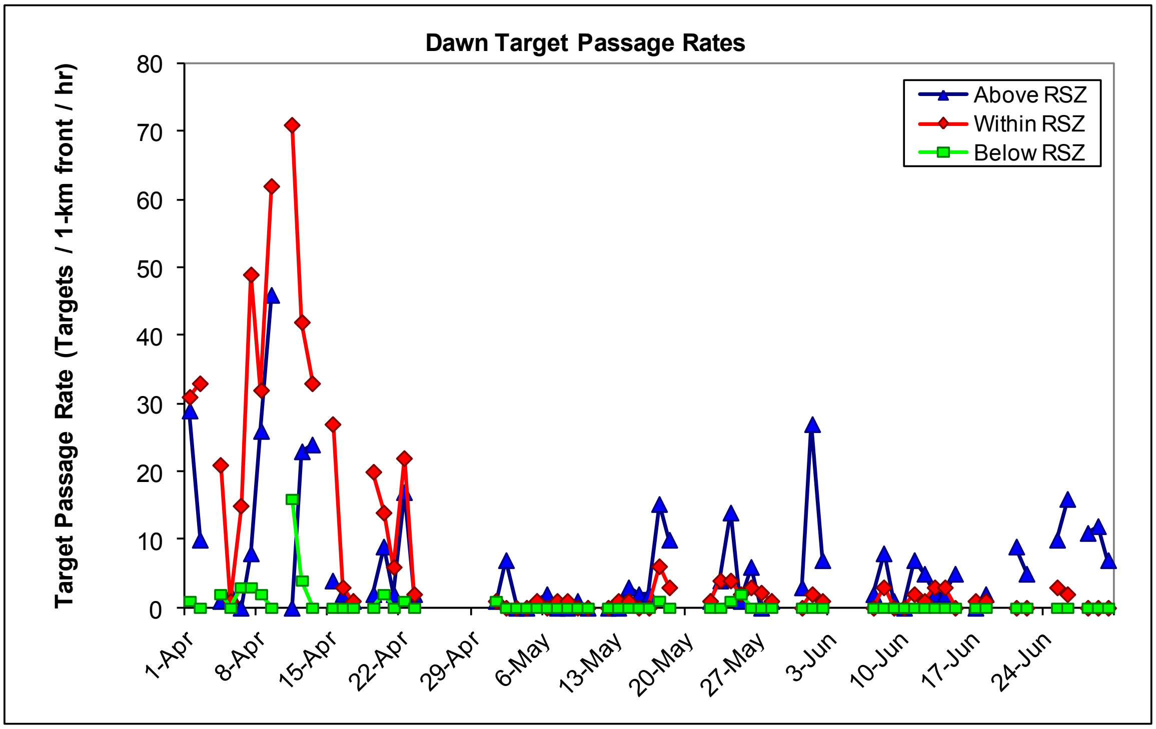

Figure 3-9. Target passage rates below, at, and above the rotor swept zone (RSZ) during dawns of the spring 2011 season.

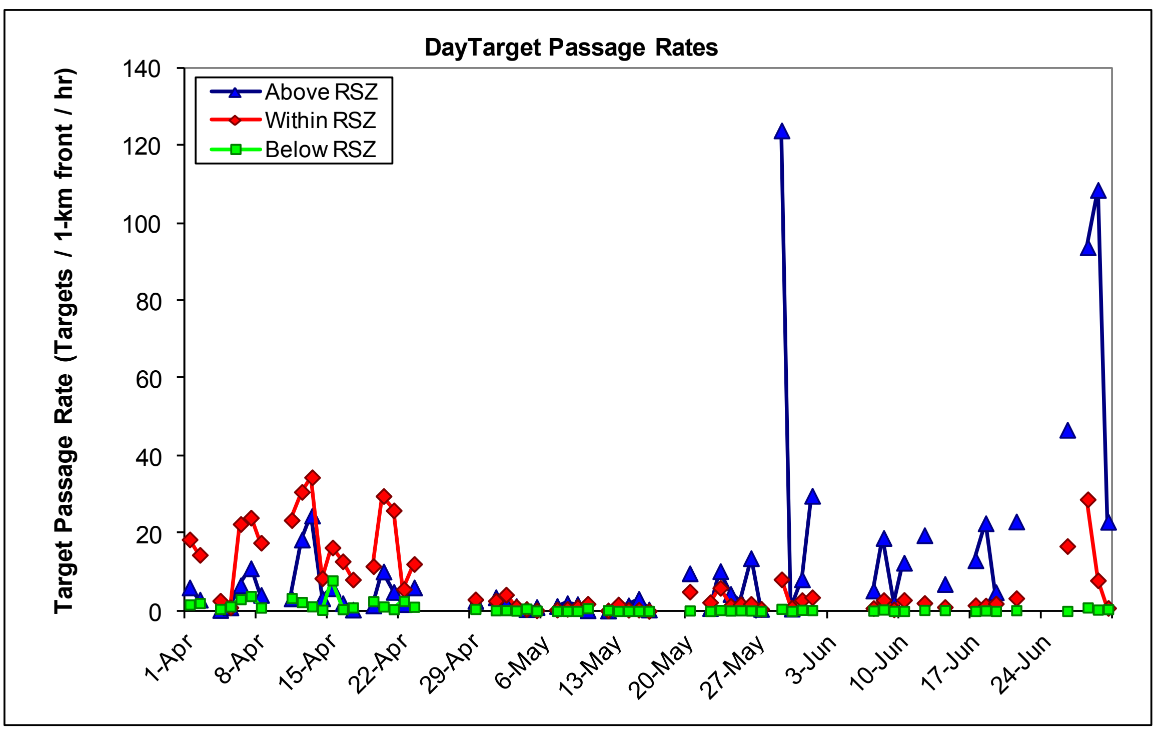

Figure 3-10. Target passage rates below, at, and above the rotor swept zone (RSZ) during days of the spring 2011 season.

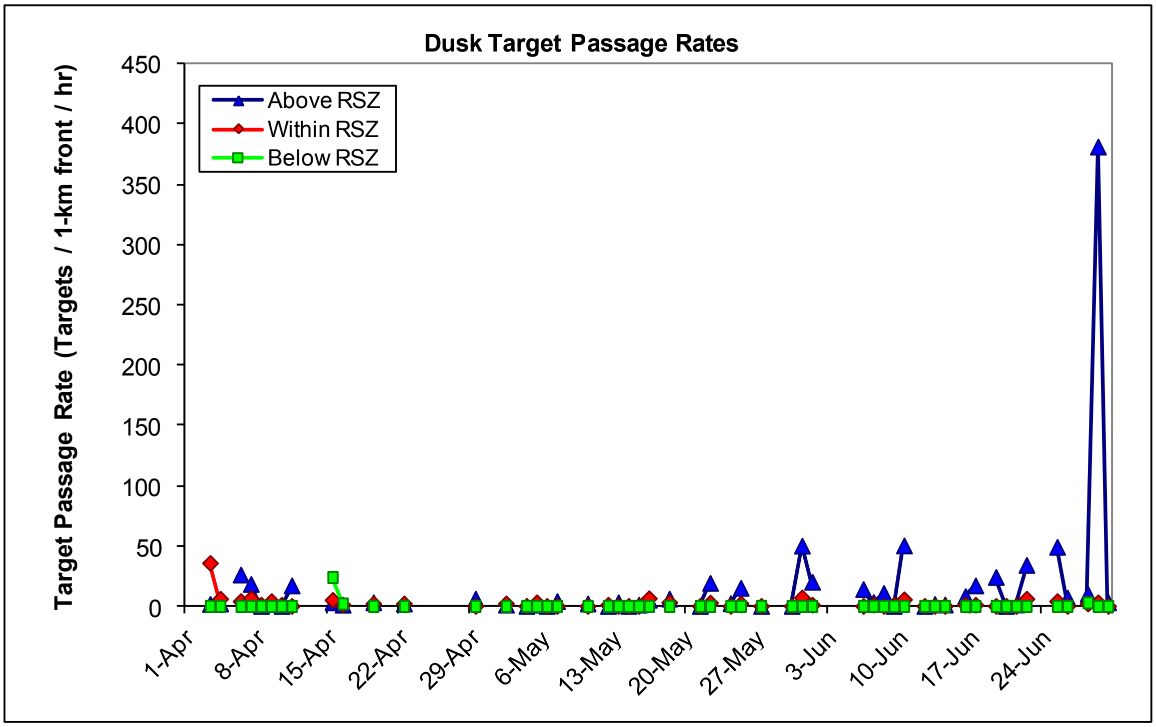

Figure 3-11. Target passage rates below, at, and above the rotor swept zone (RSZ) during dusks of the spring 2011 season.

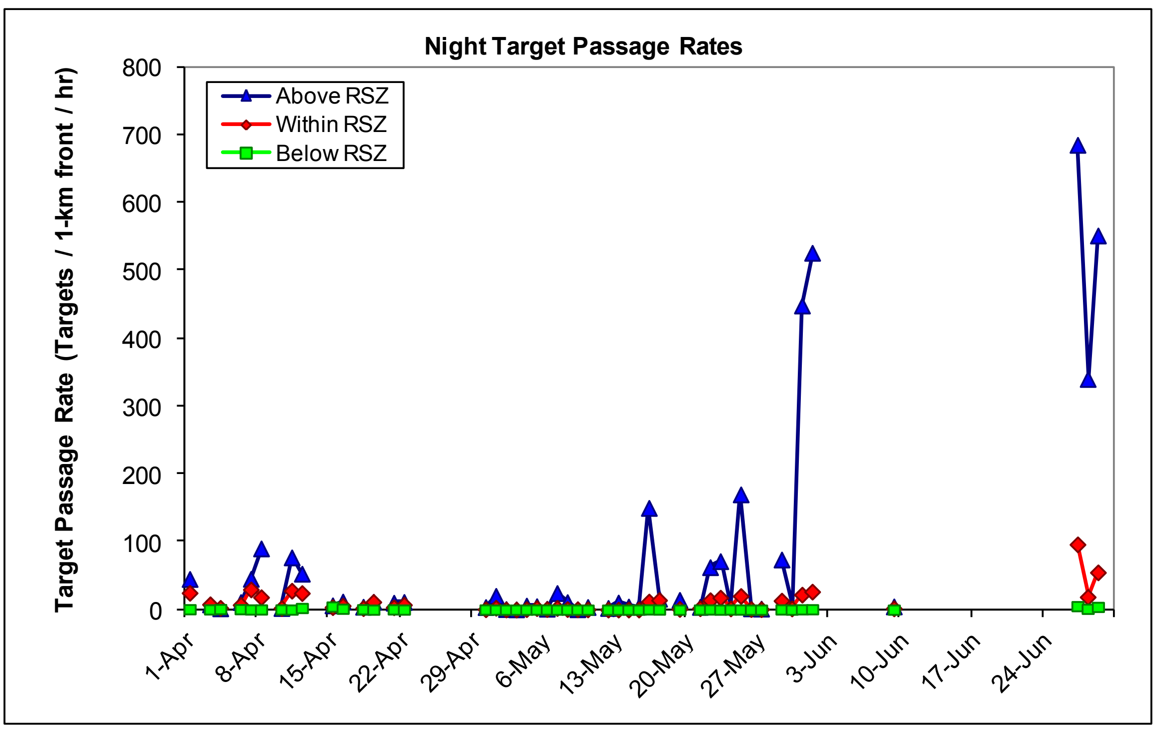

Figure 3-12. Target passage rates below, at, and above the rotor swept zone (RSZ) during nights of the spring 2011 season.

3.3 Horizontal Radar Data

3.3.1 Target Directions

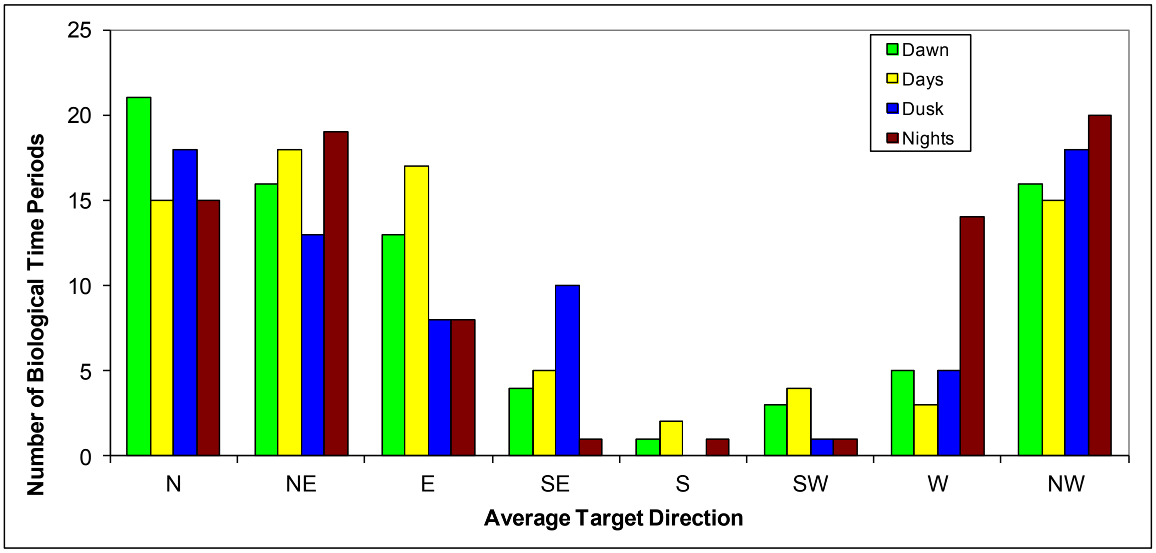

Figure 3-13. Distribution of average target movements among eight directions during dawns, days, dusks, and nights during the spring 2011 season.

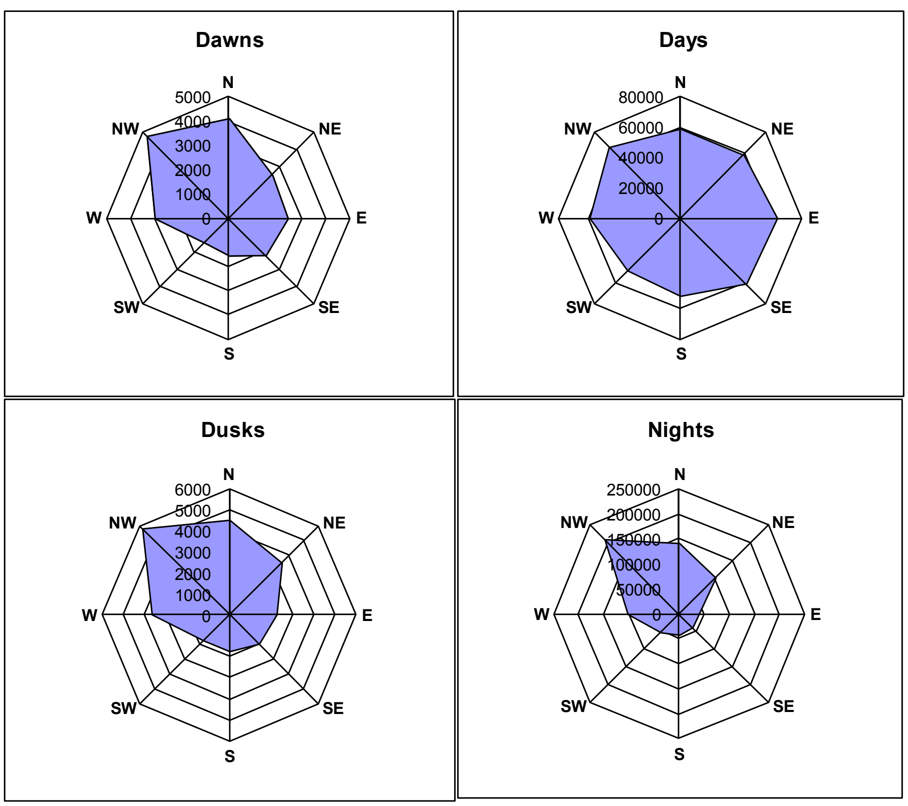

Figure 3-14. Cumulative target direction of all targets during all dawns, days, dusks, and nights during the spring 2011 season.

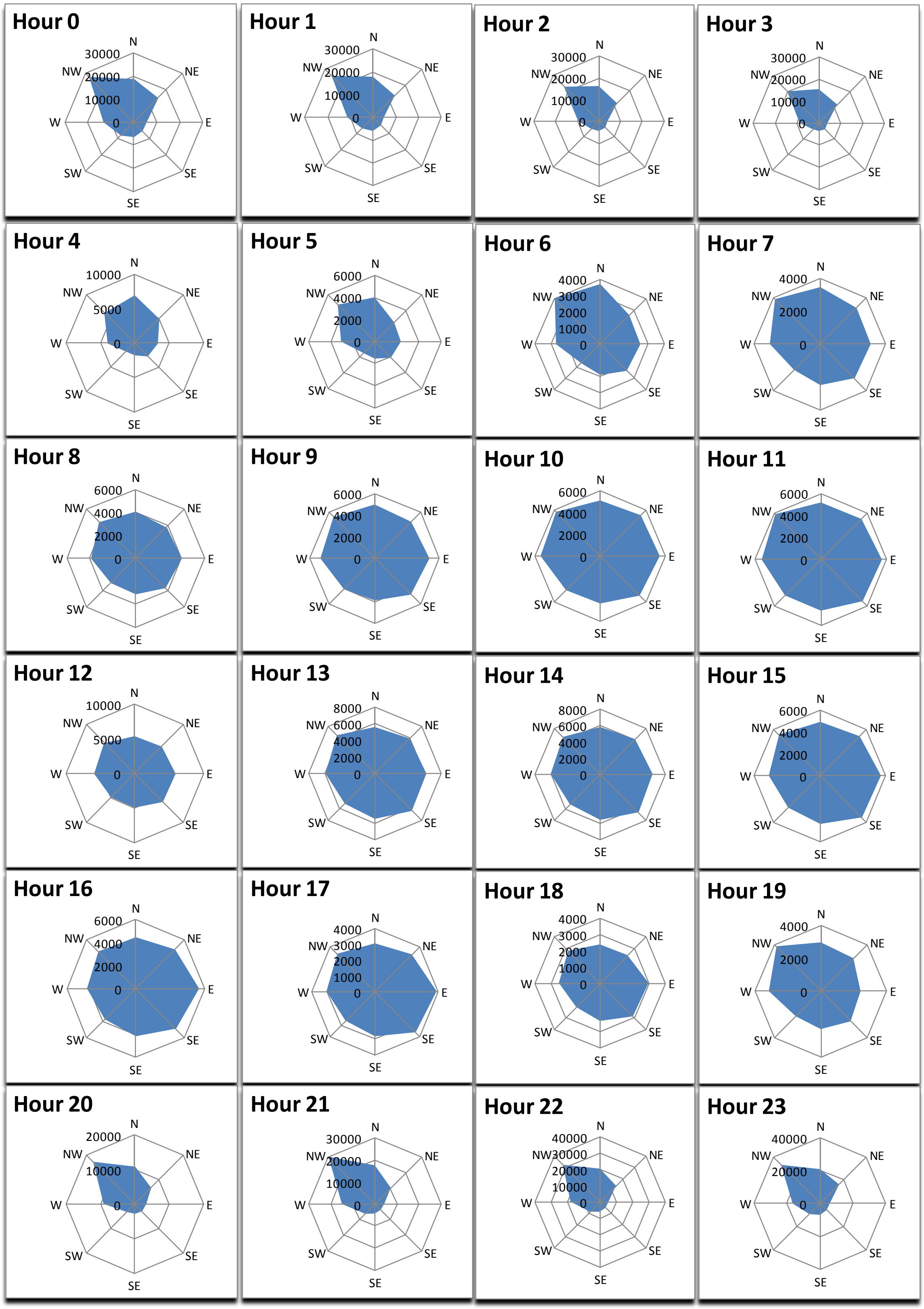

Figure 3-15. Directional distributions for targets during four biological periods of the spring 2011 study period.

4 RESULTS for the Summer 2011 Season

4.1 Level of Effort

The MERLIN Avian Radar System operated at Site 3 during the Summer 2011 season (July 1 – August 15, 2011).

Table 4-1. Effort of radar monitoring during the summer 2011 season.

Radar	Time in reporting period	Time radar collected data	Radar downtime	Radar data with rain and/or insects	Useable radar data
Vertical radar (hrs)	1104	1103.7	0.3	538.1	565.6
Horizontal radar (hrs)	1104	983.8	120.2	13.8	970

4.2 Vertical Radar Data

4.2.1 Target Passage Rates Over Time

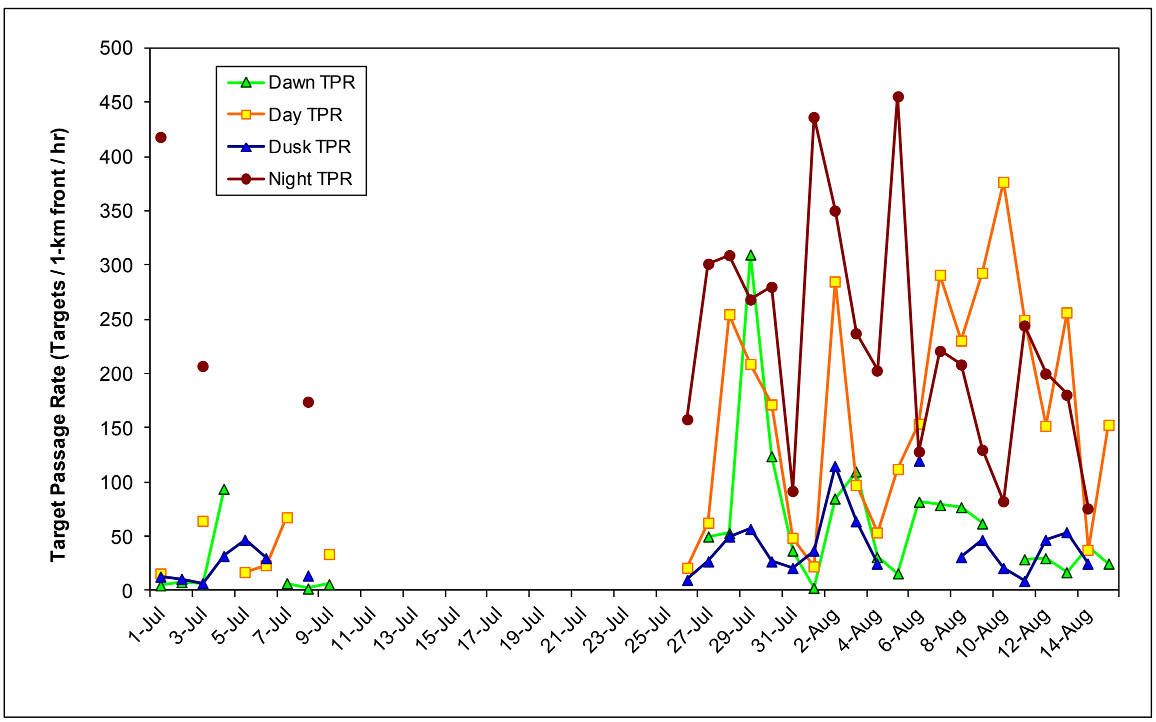

Figure 4-1. Target passage rates during dawns, days, dusks, and nights of the summer 2011 season.

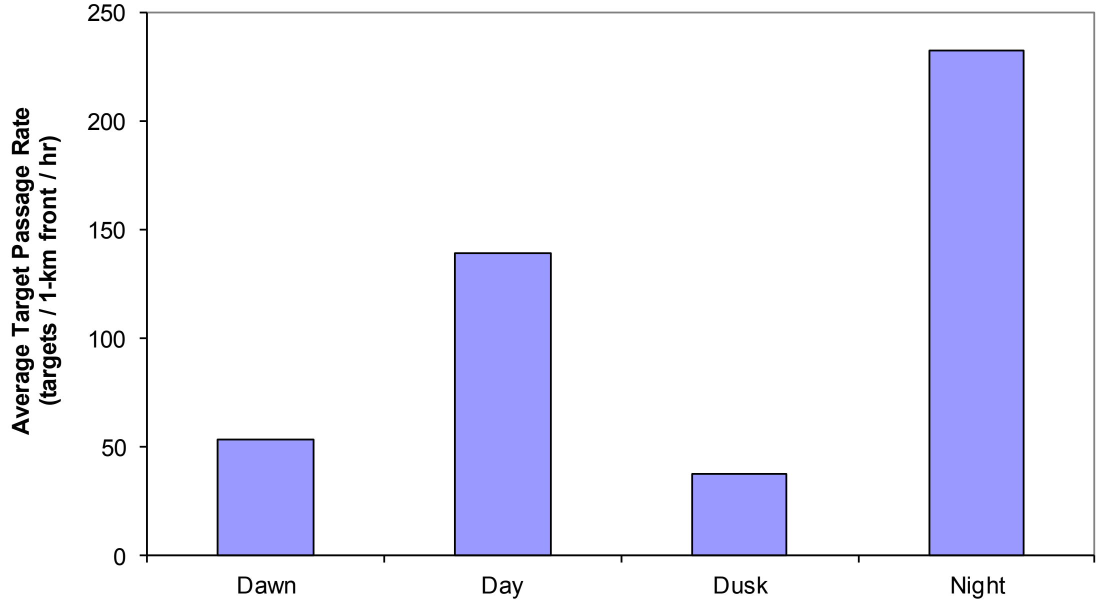

Figure 4-2. Average target passage rates for dawns, days, dusks, and nights of the summer 2011 season.

Table 4-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for four biological periods during the summer 2011 season.

	Dawn	Day	Dusk	Night
Average	53.4	139.1	37.6	233.2
Standard Deviation	63.5	108.4	29.0	108.2
Median	34.0	112.3	30.0	208.5
Minimum	2.0	15.9	7.0	75.9
Maximum	310.0	376.9	120.0	455.8
Range	308.0	361.0	113.0	380.0

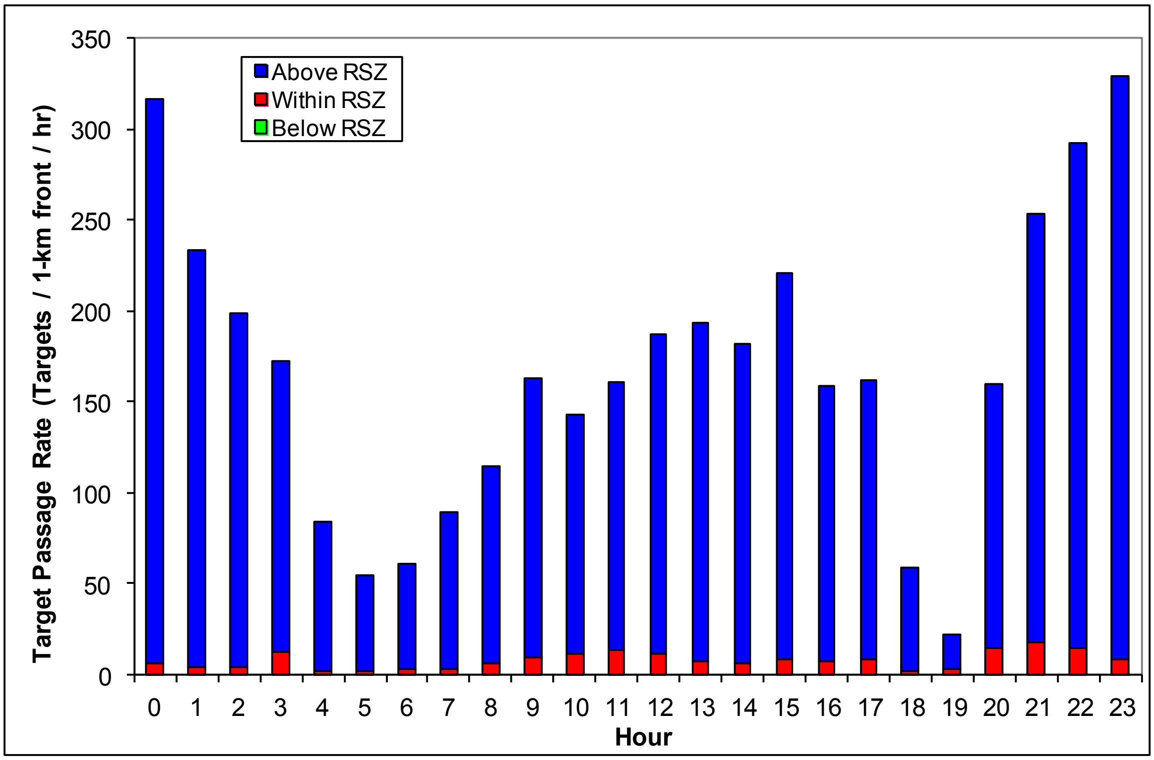

Figure 4-3. Hourly activity (average target passage rates) during the summer 2011 season.

4.2.2 Altitudinal Distribution of Targets

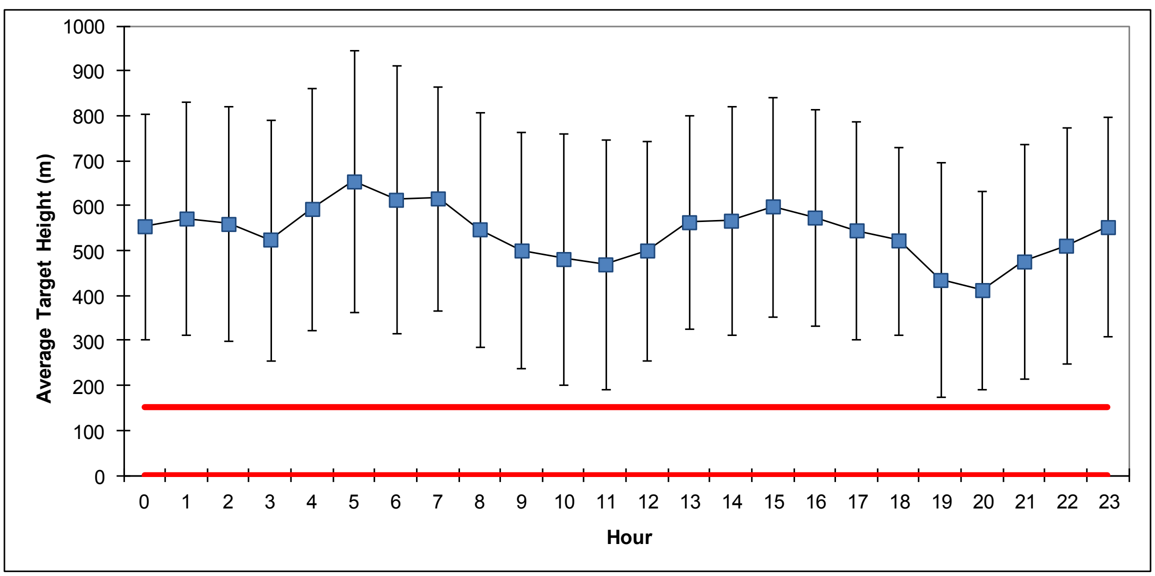

Figure 4-4. Average hourly target heights AGL during the summer 2011 season. Error bars represent standard deviation for each hour and red lines represent the top and bottom of the rotor swept zone (0 – 152.4 m AGL).

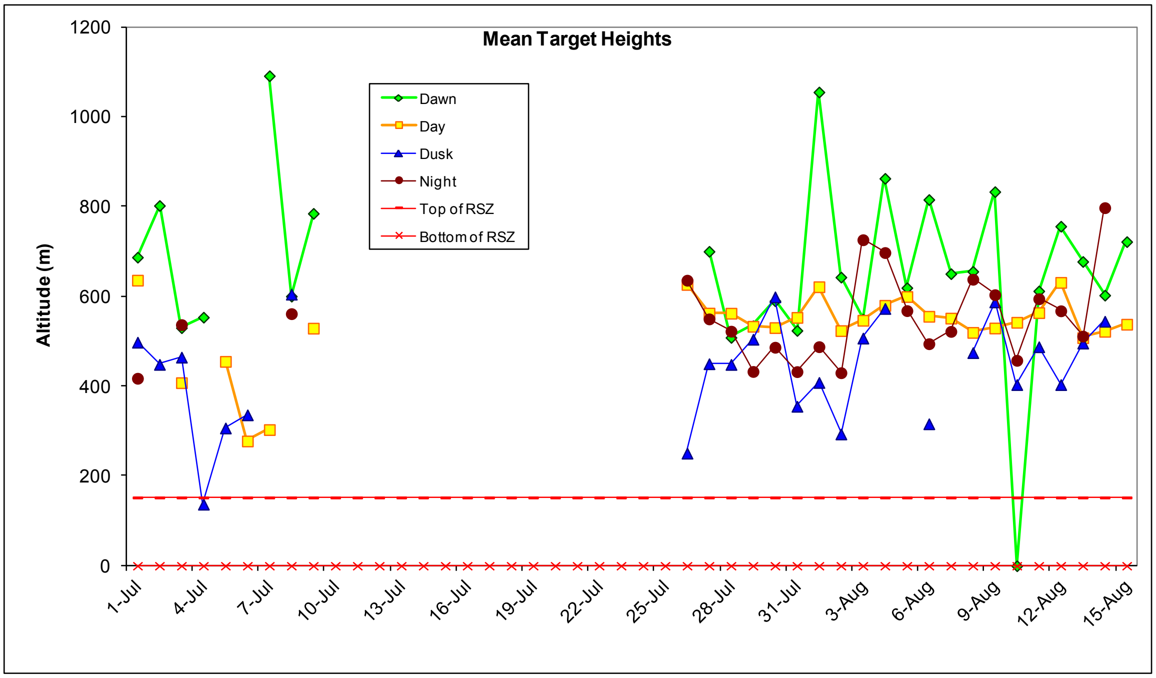

Figure 4-5. Mean target heights during four biological periods of the summer 2011 season.

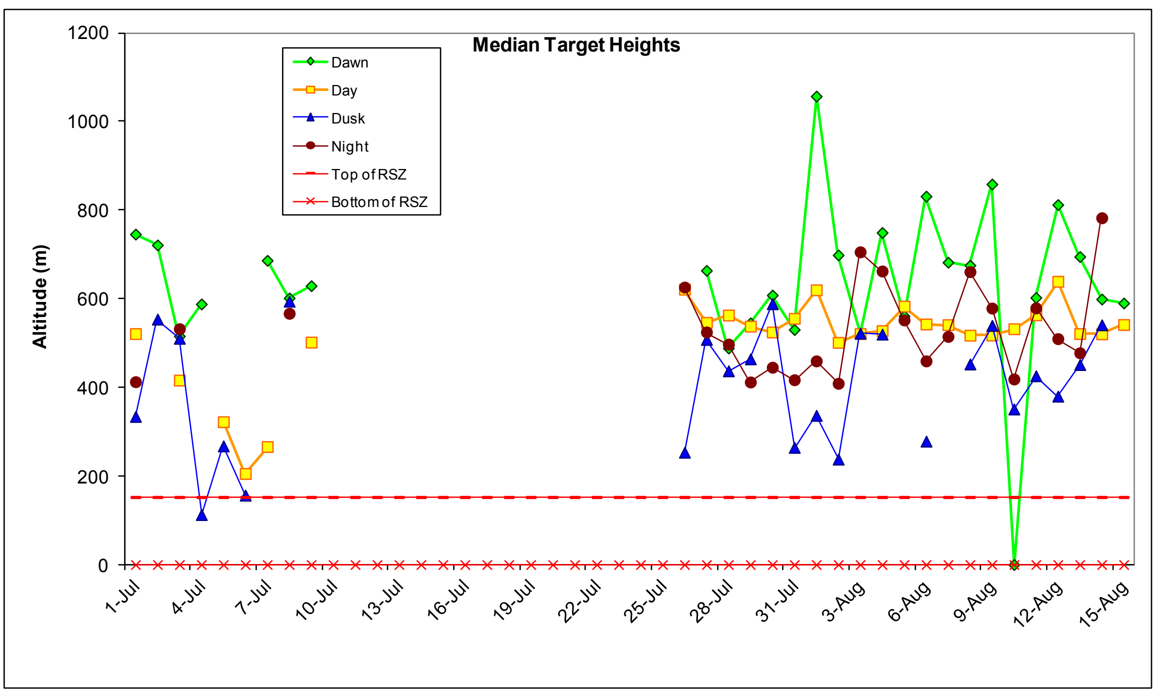

Figure 4-6. Median target heights during four biological periods of the summer 2011 season.

Table 4-3. Summary of mean and median target heights during four biological periods of the summer 2011 season. The top presents averages of mean and median target heights calculated during each biological period having at least 50% data in that time period; the bottom presents the overall mean and median target heights when all targets in each of the four biological periods were combined.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average mean target height	691.7	530.7	436.5	551.7
Average median target height	663.4	509.9	403.1	530.4
All targets for season combined				
Mean target height	640.1	538.6	417.6	530.8
Median target height	613.0	531.9	372.8	499.9

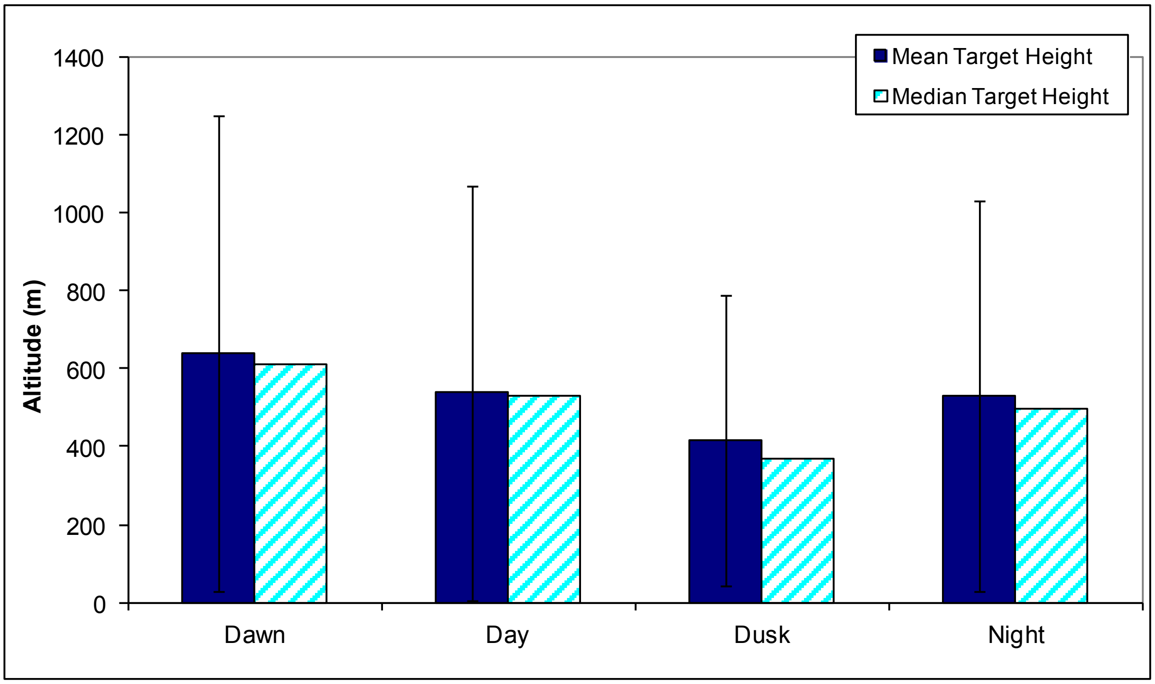

Figure 4-7. Overall mean and median target heights when all targets in each of the four biological periods were combined during the summer 2011 season. Error bars represent one standard deviation.

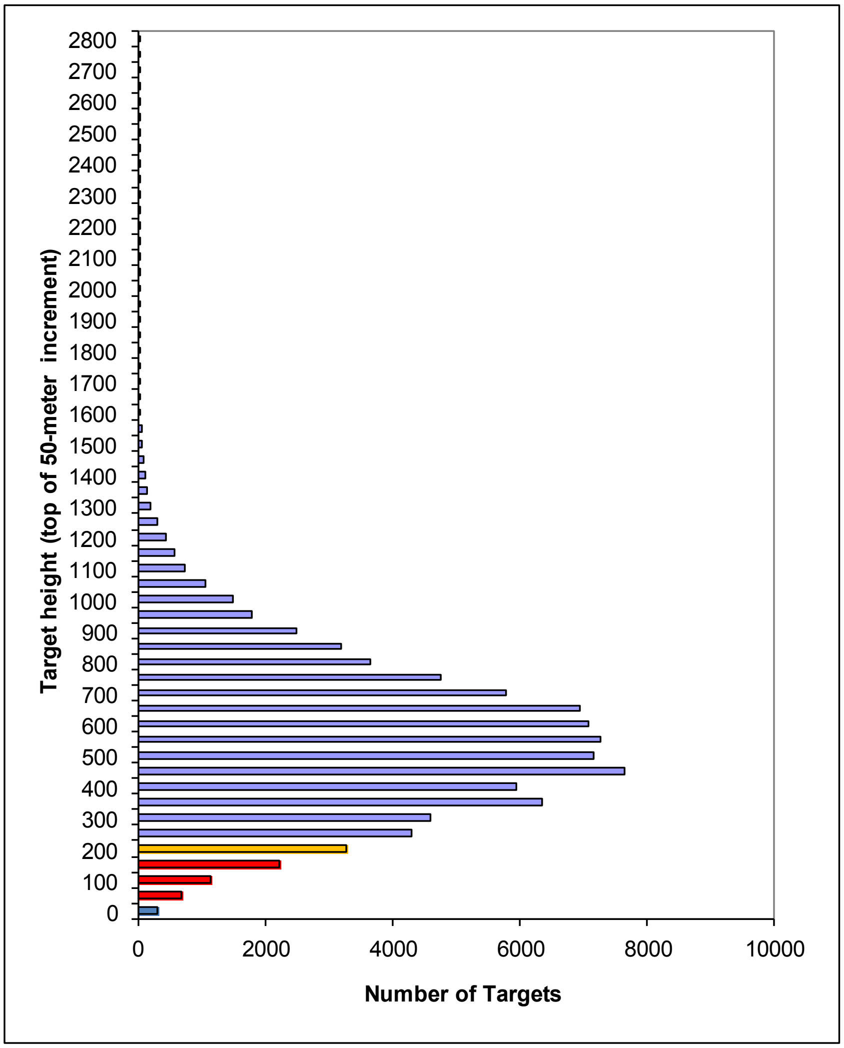

Figure 4-8. Number of targets occurring in each 50-meter increment during the summer 2011 season. Red indicates rotor swept heights, and orange indicates altitudes partially within rotor swept heights.

Table 4-4. Summary of target passage rates and percent of targets above, within and below the RSZ during four biological periods of the summer 2011 season.

	Dawn	Day	Dusk	Night
All targets for season combined				
% targets above RSZ	95.4%	94.9%	87.3%	96.6%
% targets within RSZ	3.7%	4.6%	12.3%	3.3%
% targets below RSZ	0.9%	0.4%	0.5%	0.1%
% targets below turbine height	4.6%	5.1%	12.7%	3.4%
Target data calculated for each date				
Average % of targets in RSZ	3.3%	6.4%	11.2%	3.1%
Min target percentage within RSZ	0.0%	0.0%	0.0%	0.1%
Max target percentage within RSZ	14.3%	33.3%	75.0%	9.9%
Average target passage rate above RSZ	50.9	131.9	32.6	225.0
Average target passage rate within RSZ	2.0	6.6	4.9	7.8
Average target passage rate below RSZ	0.5	0.6	0.2	0.4

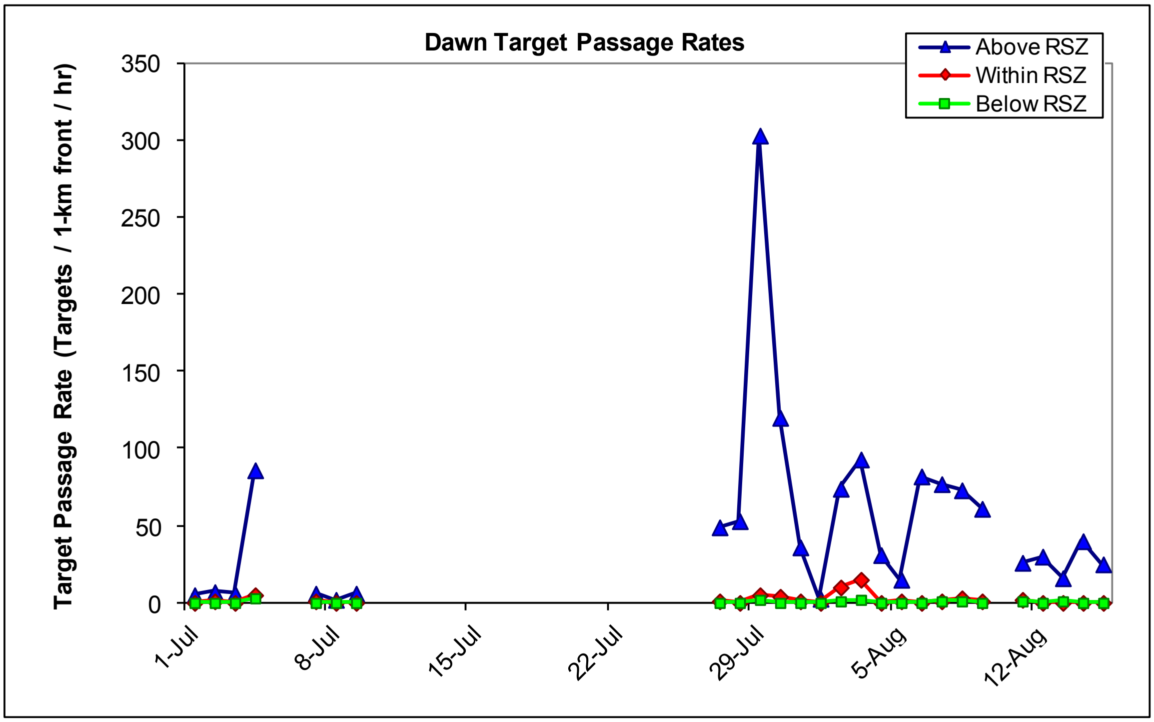

Figure 4-9. Target passage rates below, at, and above the rotor swept zone (RSZ) during dawns of the summer 2011 season.

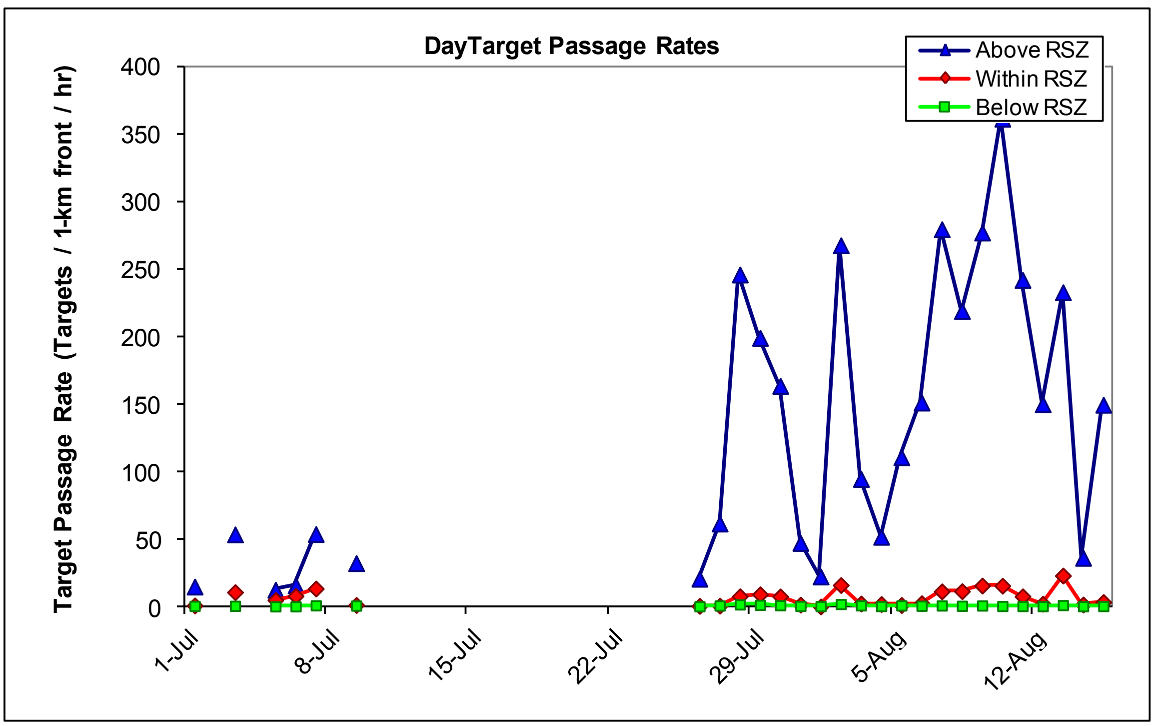

Figure 4-10. Target passage rates below, at, and above the rotor swept zone (RSZ) during days of the summer 2011 season.

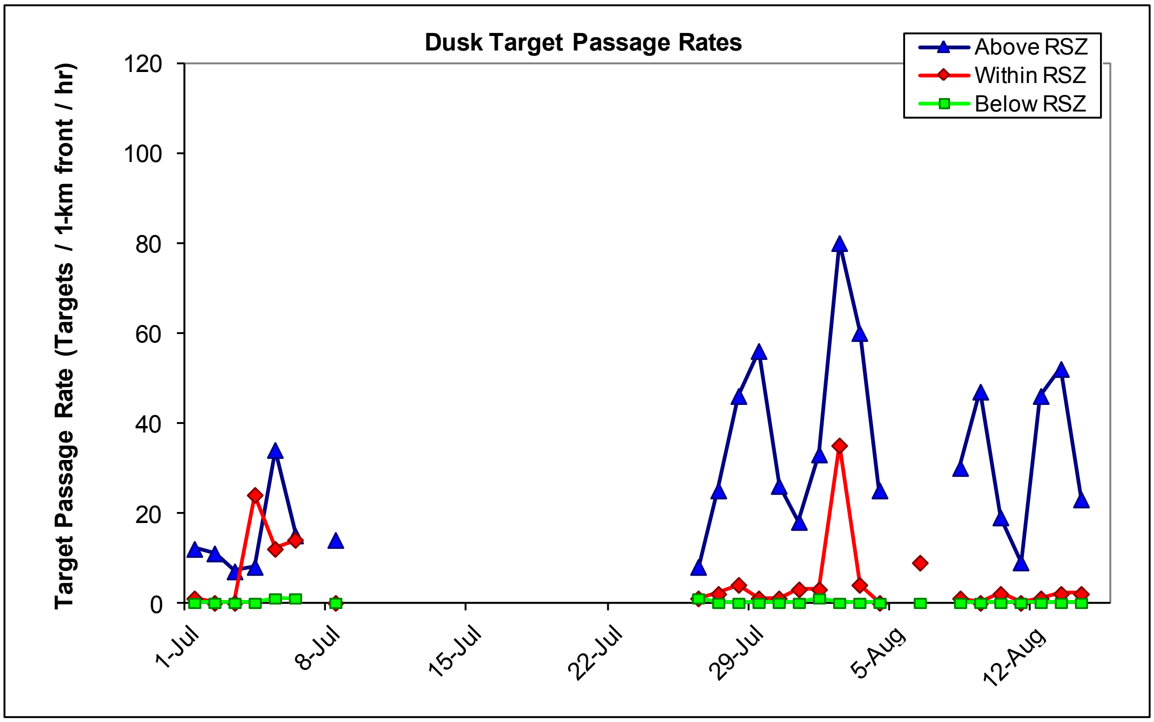

Figure 4-11. Target passage rates below, at, and above the rotor swept zone (RSZ) during dusks of the summer 2011 season.

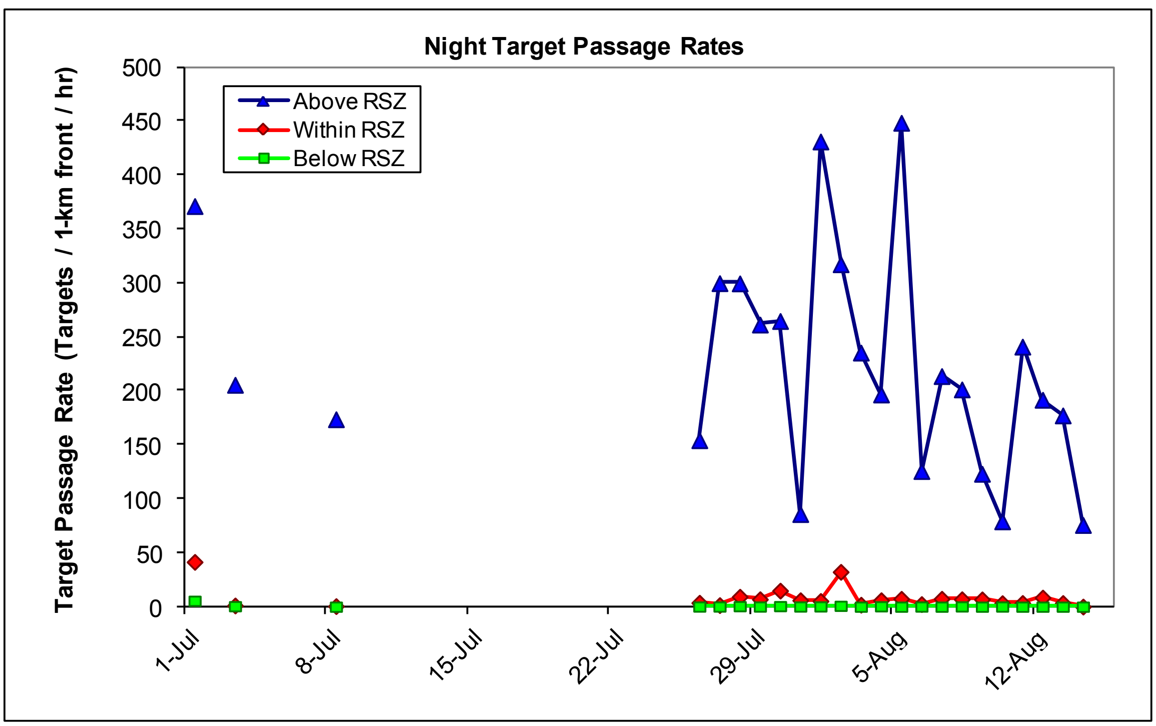

Figure 4-12. Target passage rates below, at, and above the rotor swept zone (RSZ) during nights of the summer 2011 season.

4.3 Horizontal Radar Data

4.3.1 Target Directions

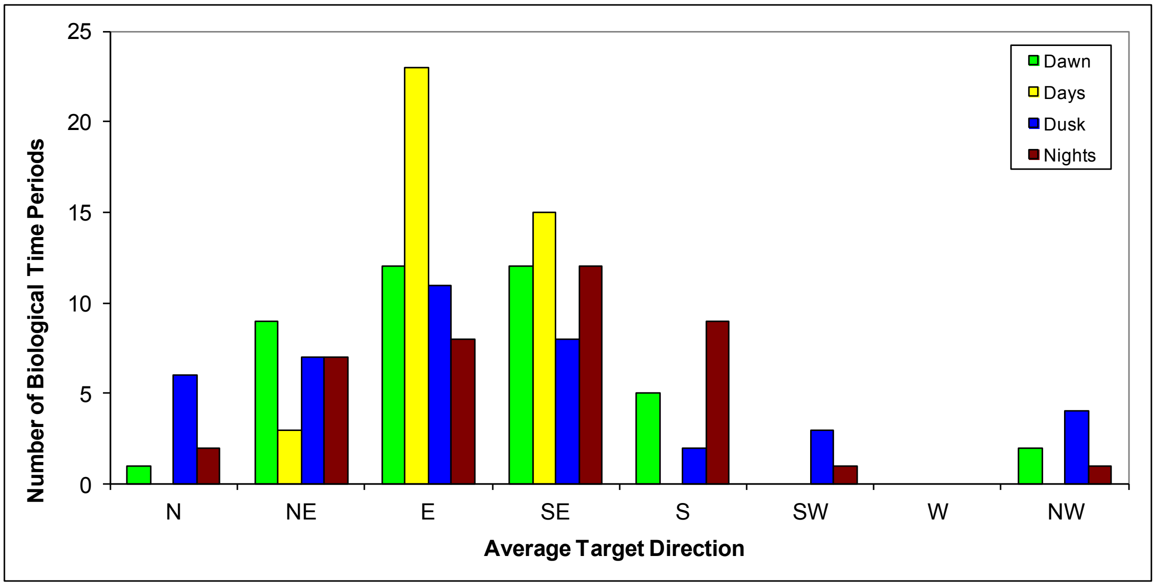

Figure 4-13. Distribution of average target movements among eight directions during dawns, days, dusks, and nights during the summer 2011 season.

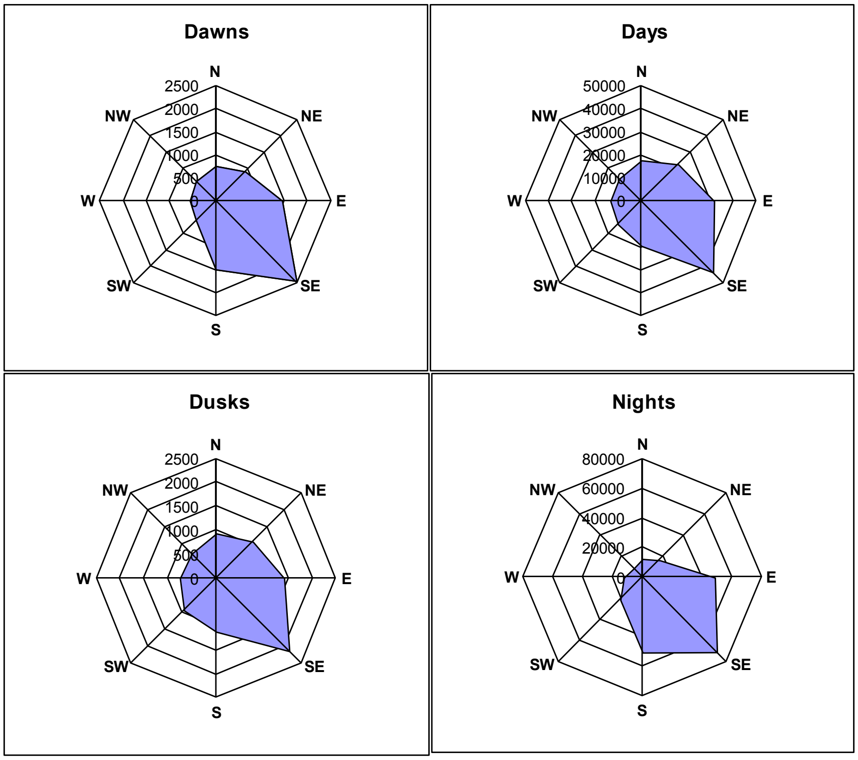

Figure 4-14. Cumulative target direction of all targets during all dawns, days, dusks, and nights during the summer 2011 season.

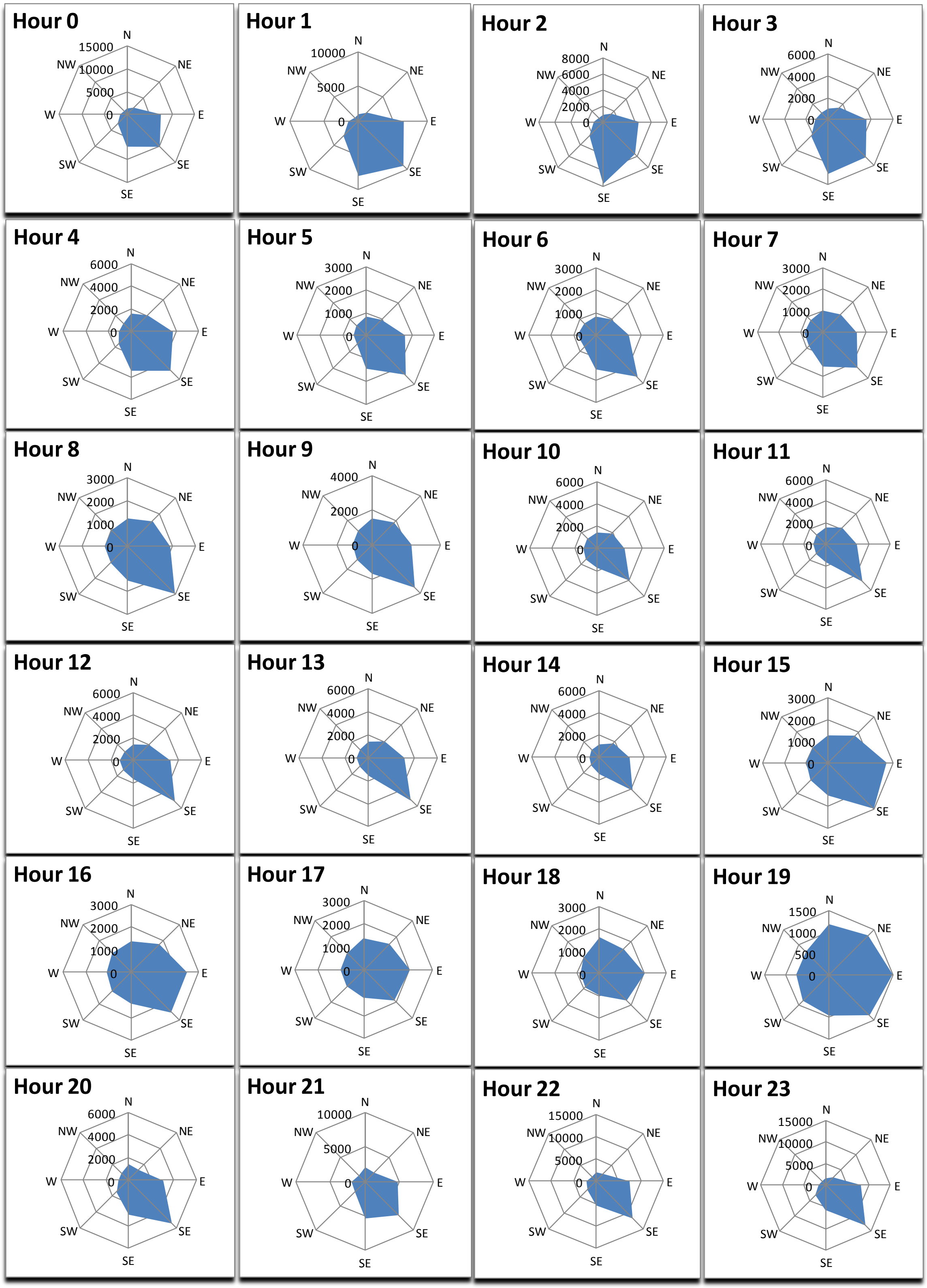

Figure 4-15. Directional distributions for targets during four biological periods of the summer 2011 study period.

5 RESULTS for the Fall 2011 Season

5.1 Level of Effort

The MERLIN Avian Radar System operated at Sites 1 and 4 during the Fall 2011 season (August 16 – November 16, 2011).

Table 5-1. Effort of radar monitoring during the fall 2011 season.

Radar	Time In Reporting Period	Time radar collected data	Radar downtime	Radar data with rain and/or insects	Useable radar data
Vertical Radar (hrs)	2232	1938.9	293.1	282.5	1656.4
Horizontal Radar (hrs)	2232	1710.7	521.3	139.7	1571

5.2 Vertical Radar Data

5.2.1 Target Passage Rates Over Time

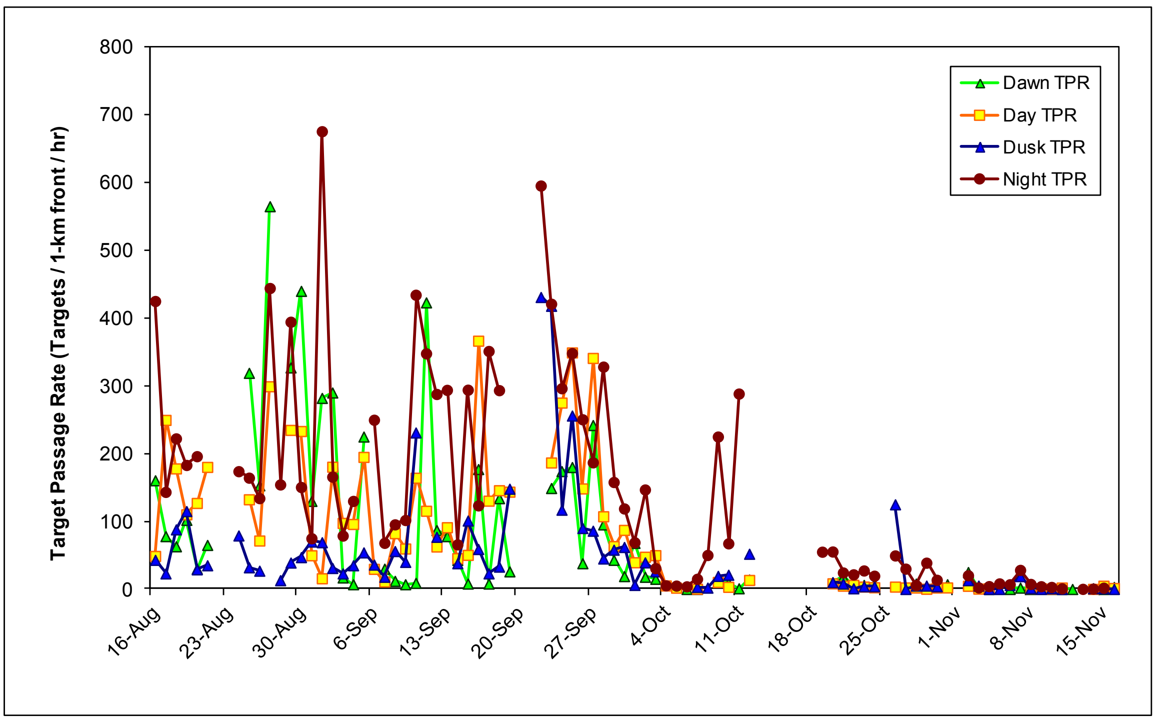

Figure 5-1. Target passage rates during dawns, days, dusks, and nights of the fall 2011 season.

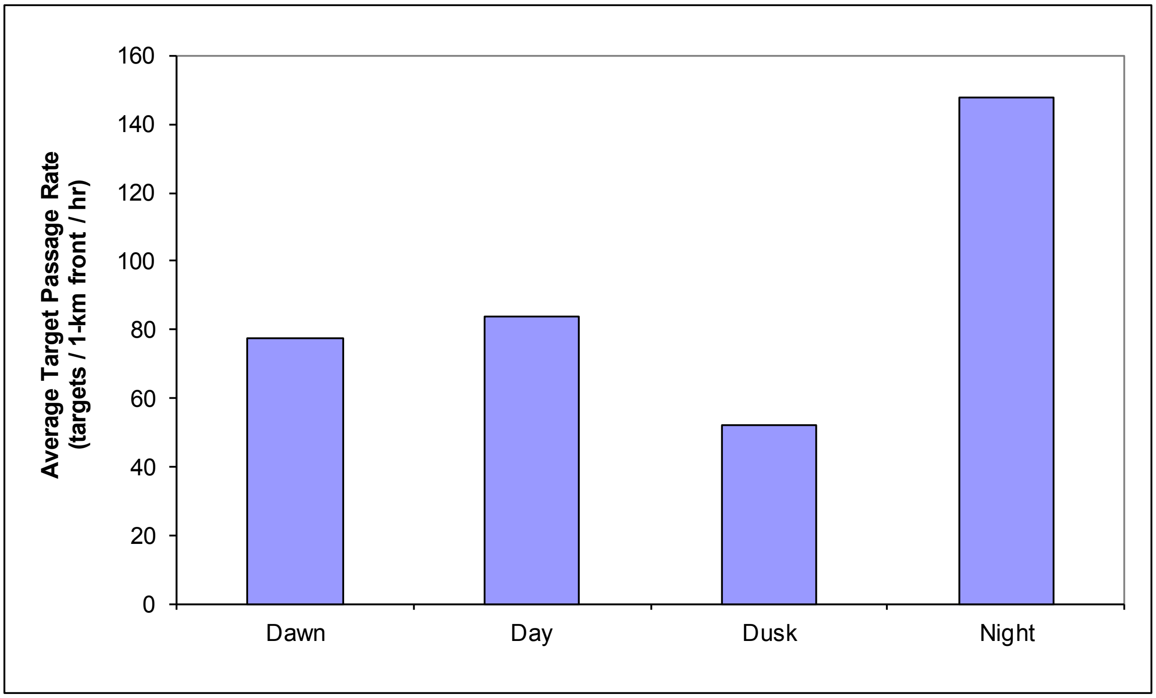

Figure 5-2. Average target passage rates for dawns, days, dusks, and nights of the fall 2011 season.

Table 5-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for four biological periods during the fall 2011 season.

	Dawn	Day	Dusk	Night
Average	77.3	83.8	52.2	148.1
Standard Deviation	120.3	97.7	81.0	154.3
Median	17.0	49.7	30.0	98.6
Minimum	0.0	0.1	0.0	0.2
Maximum	565.0	366.5	431.0	675.7
Range	565.0	366.4	431.0	675.5

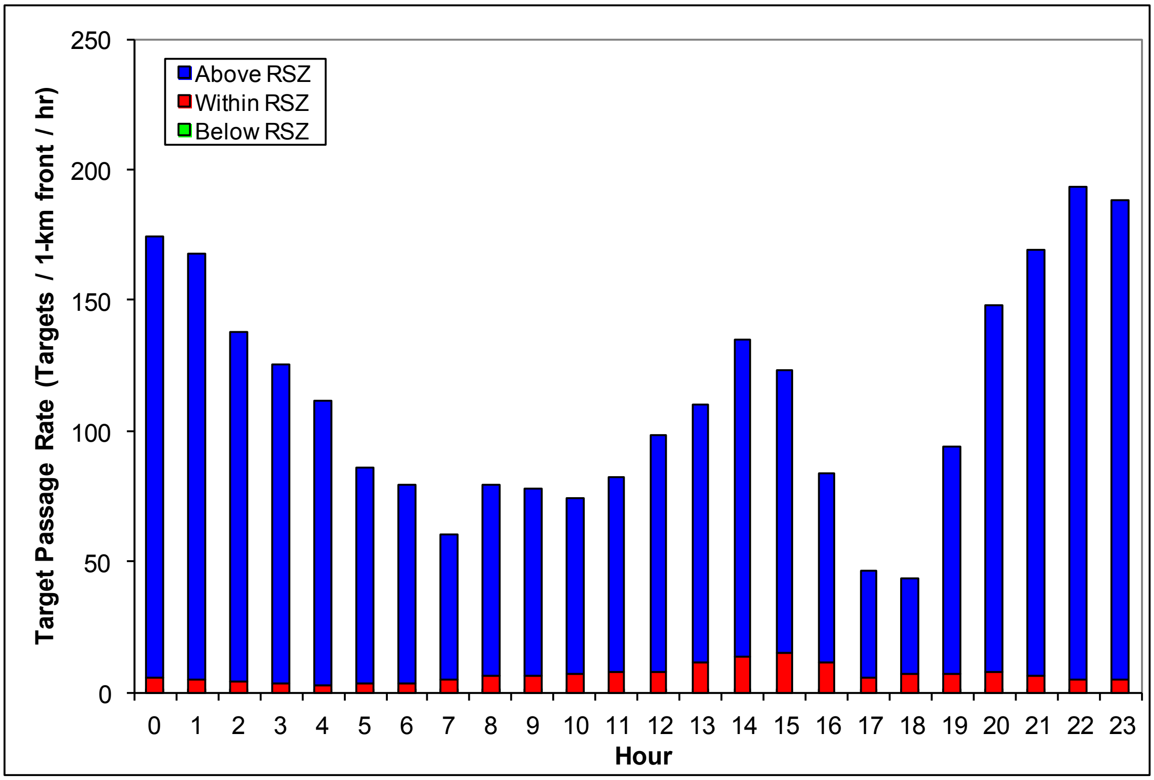

Figure 5-3. Hourly activity (average target passage rates) during the fall 2011 season.

5.2.2 Altitudinal Distribution of Targets

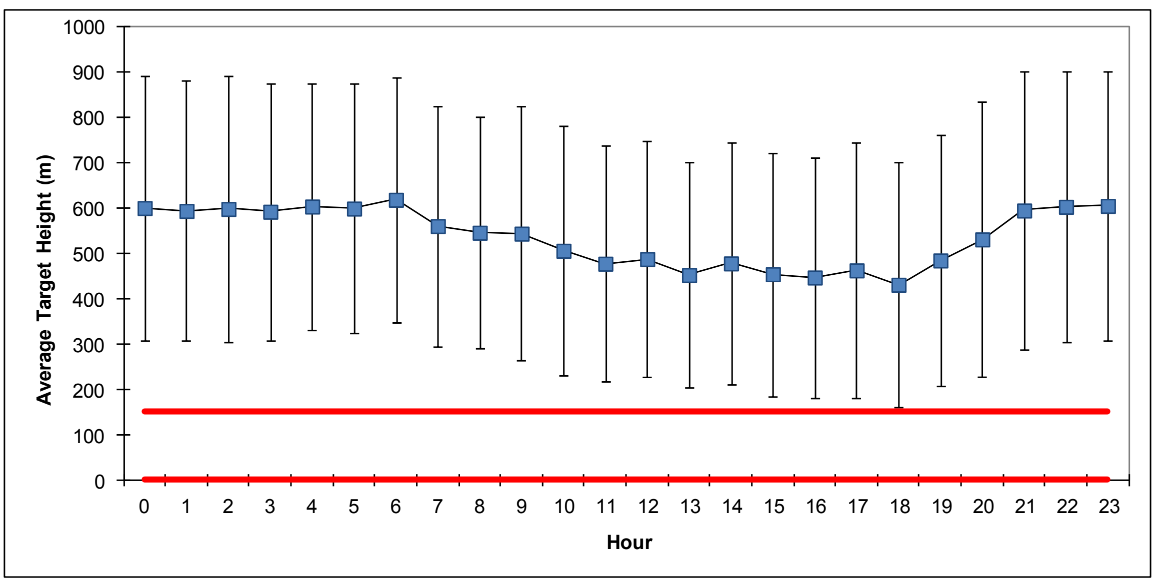

Figure 5-4. Average hourly target heights AGL during the fall 2011 season. Error bars represent standard deviation for each hour and red lines represent the top and bottom of the rotor swept zone (0 – 152.4 m AGL).

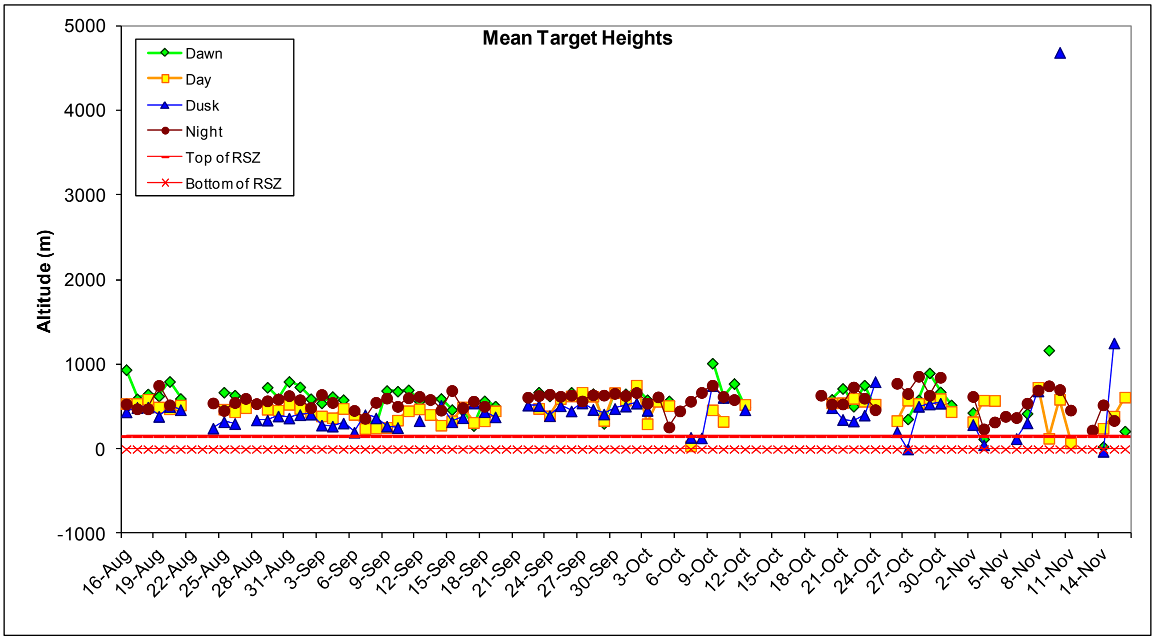

Figure 5-5. Mean target heights during four biological periods of the fall 2011 season.

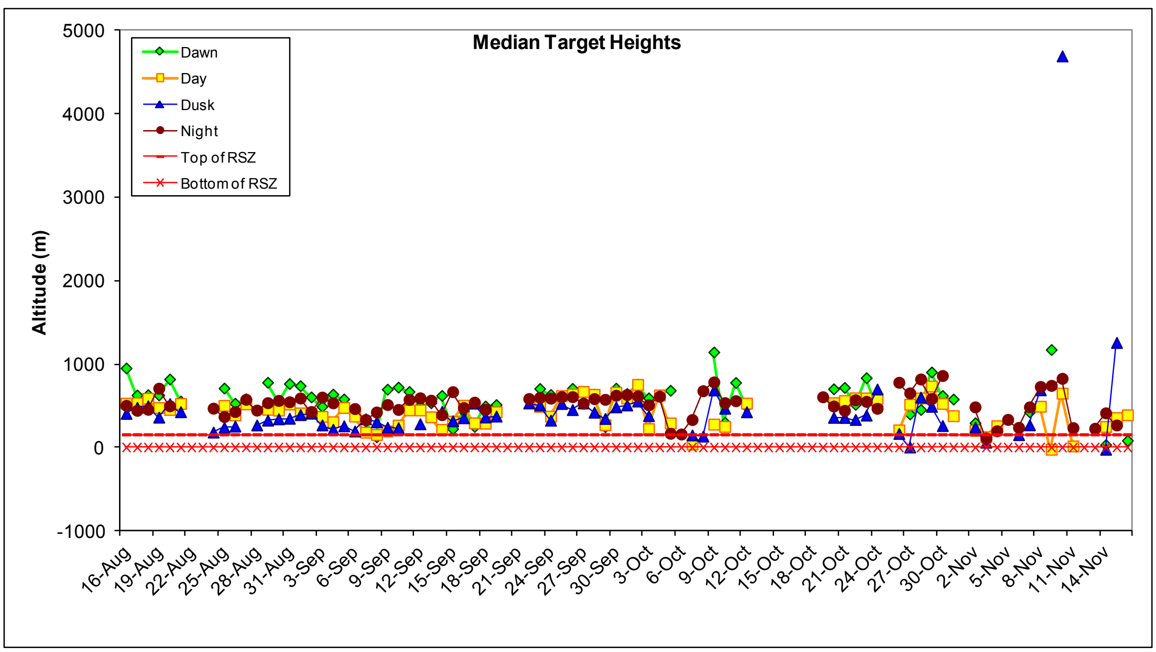

Figure 5-6. Median target heights during four biological periods of the fall 2011 season.

Table 5-3. Summary of mean and median target heights during four biological periods of the fall 2011 season. The top presents averages of mean and median target heights calculated during each biological period having at least 50% data in that time period; the bottom presents the overall mean and median target heights when all targets in each of the four biological periods were combined.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average mean target height	592.2	461.0	478.1	567.4
Average median target height	575.0	415.0	443.5	512.2
All targets for season combined				
Mean target height	631.7	488.3	421.4	587.8
Median target height	610.1	481.3	404.2	547.7

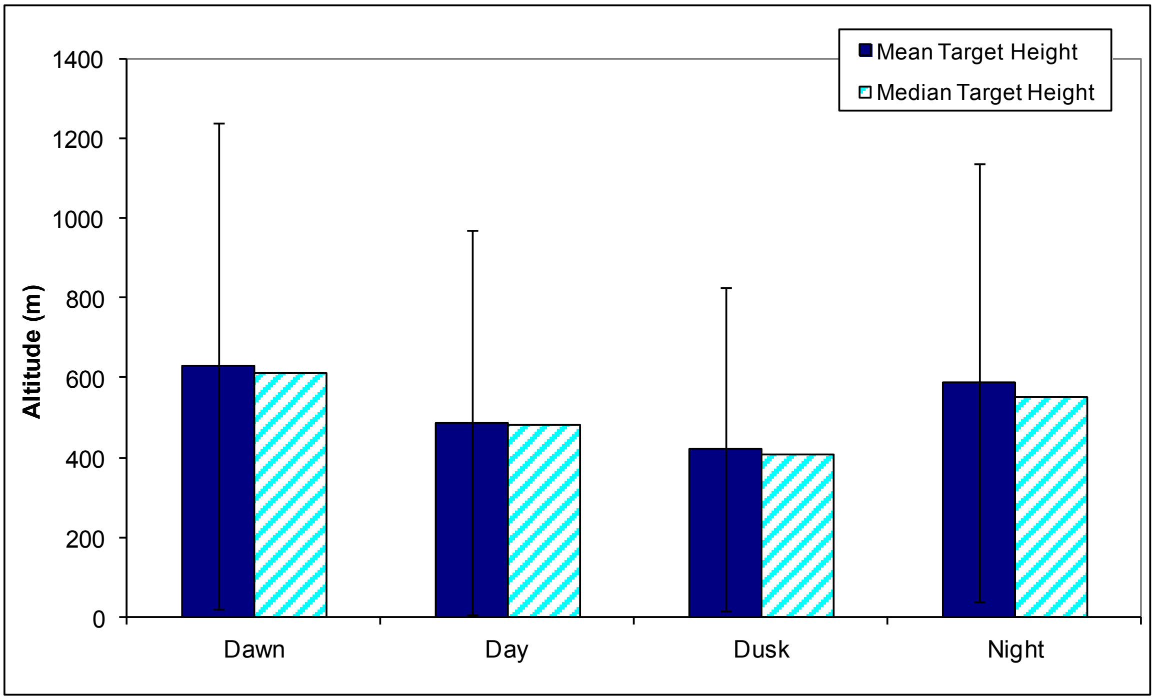

Figure 5-7. Overall mean and median target heights when all targets in each of the four biological periods were combined during the fall 2011 season. Error bars represent one standard deviation.

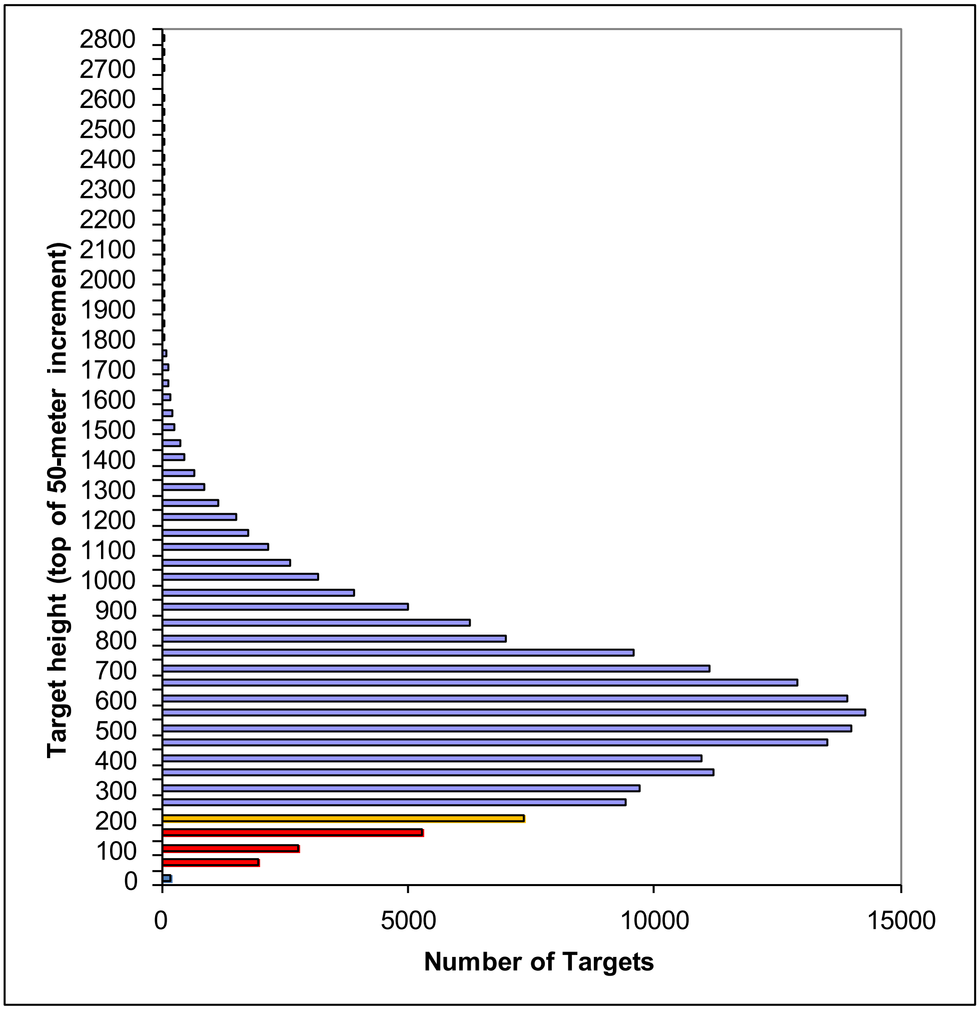

Figure 5-8. Number of targets occurring in each 50-meter increment during the fall 2011 season. Red indicates rotor swept heights, and orange indicates altitudes partially within rotor swept heights.

Table 5-4. Summary of target passage rates and percent of targets above, within and below the RSZ during four biological periods of the fall 2011 season.

	Dawn	Day	Dusk	Night
All targets for season combined				
% targets above RSZ	96.2%	90.2%	89.2%	97.0%
% targets within RSZ	3.8%	9.6%	10.7%	3.0%
% targets below RSZ	0.1%	0.2%	0.1%	0.0%
% targets below turbine height	3.8%	9.8%	10.8%	3.0%
Target data calculated for each date				
Average % of targets in RSZ	9.8%	16.5%	13.9%	9.2%
Min target percentage within RSZ	0.0%	0.0%	0.0%	0.3%
Max target percentage within RSZ	100.0%	100.0%	100.0%	57.1%
Average target passage rate above RSZ	74.4	75.2	46.6	143.4
Average target passage rate within RSZ	2.9	8.4	5.6	4.6
Average target passage rate below RSZ	0.0	0.2	0.1	0.0

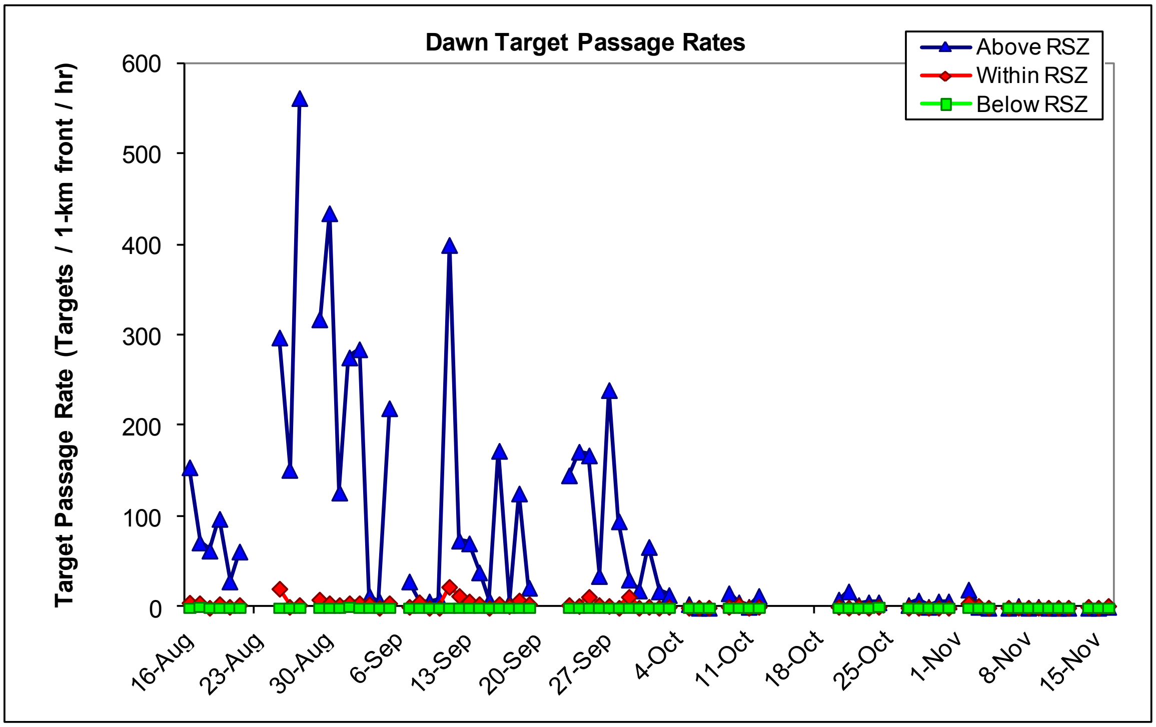

Figure 5-9. Target passage rates below, at, and above the rotor swept zone (RSZ) during dawns of the fall 2011 season.

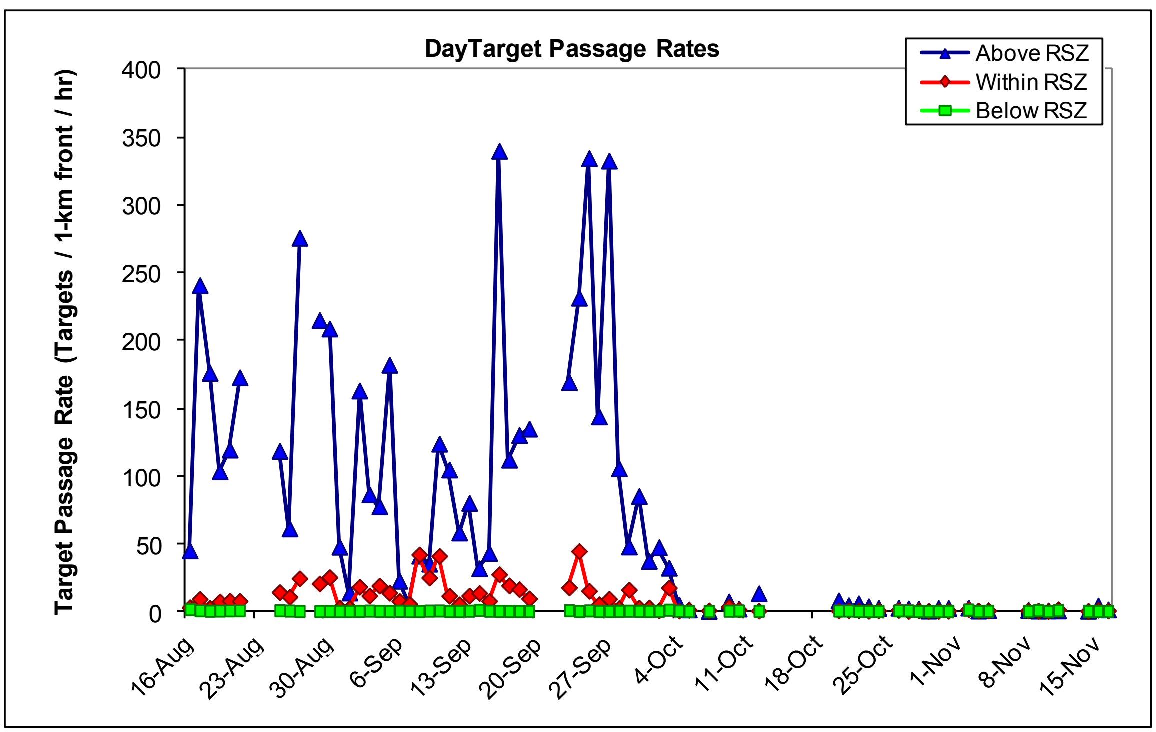

Figure 5-10. Target passage rates below, at, and above the rotor swept zone (RSZ) during days of the fall 2011 season.

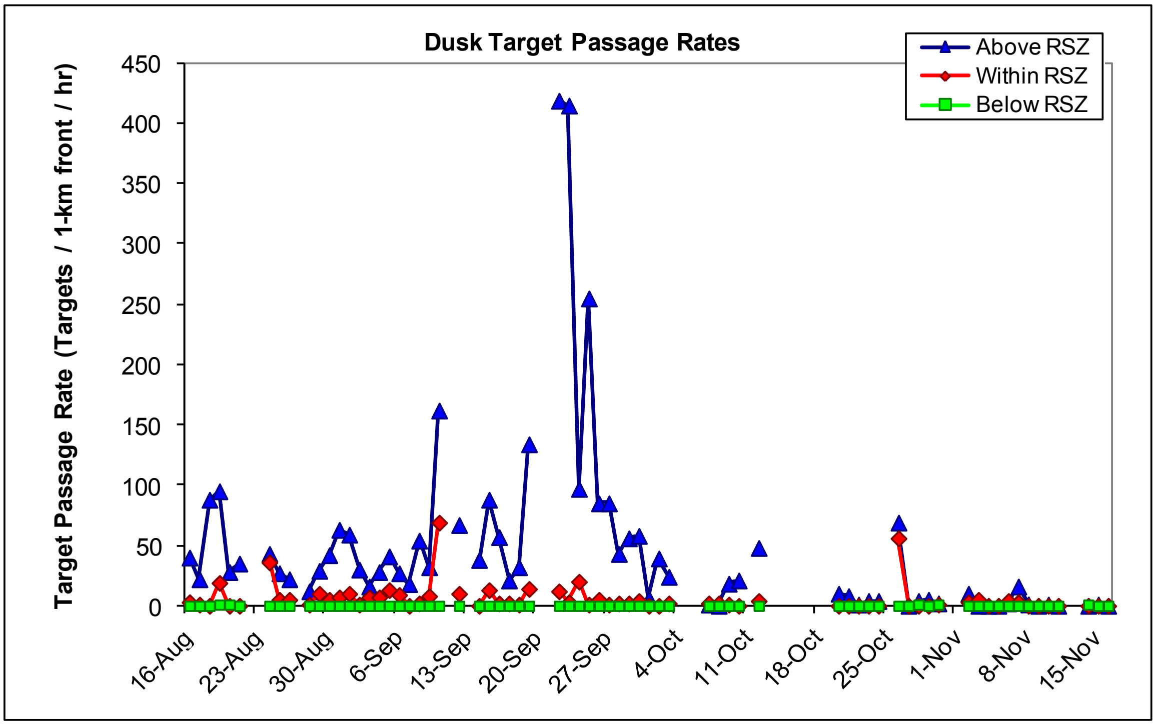

Figure 5-11. Target passage rates below, at, and above the rotor swept zone (RSZ) during dusks of the fall 2011 season.

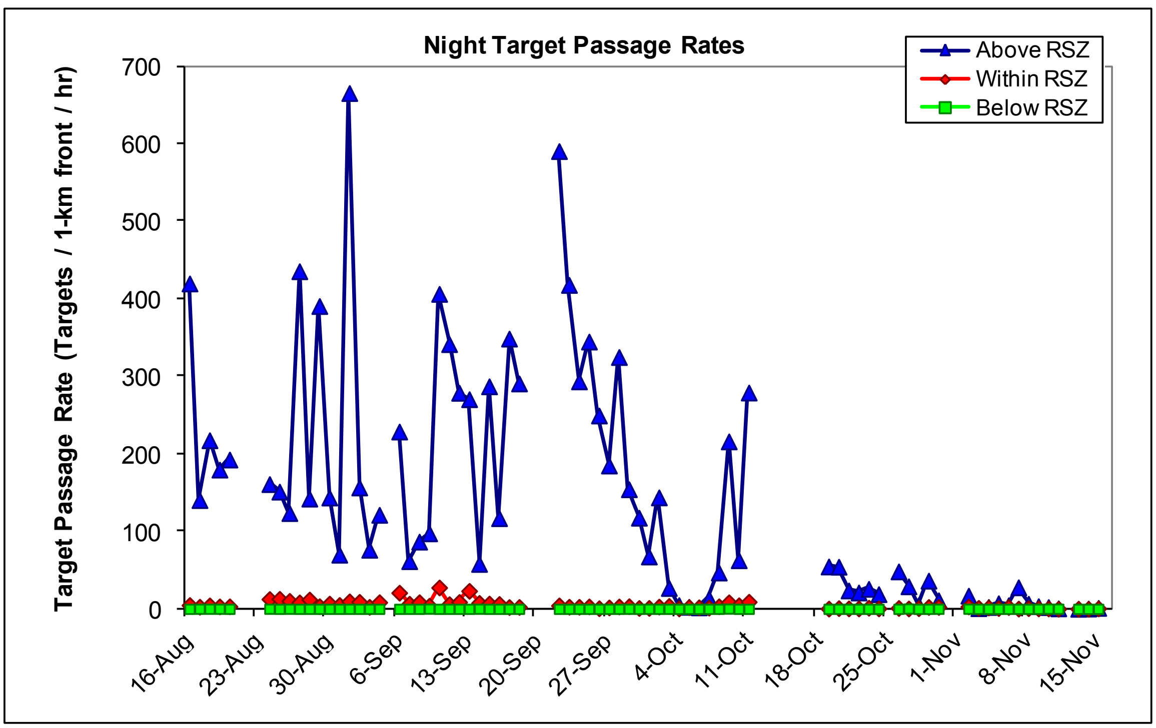

Figure 5-12. Target passage rates below, at, and above the rotor swept zone (RSZ) during nights of the fall 2011 season.

5.3 Horizontal Radar Data

5.3.1 Target Directions

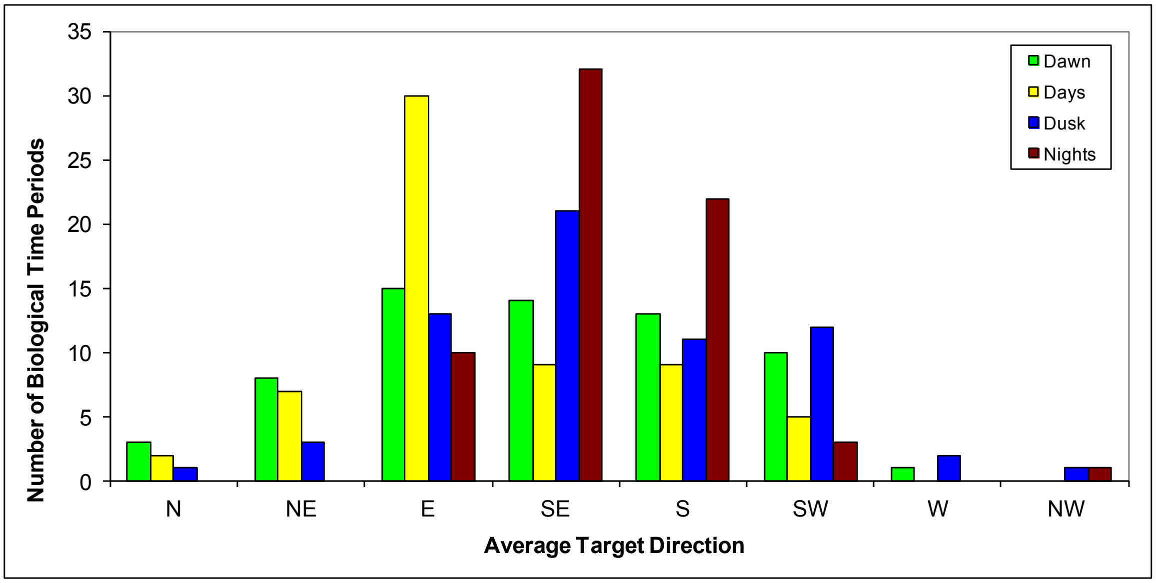

Figure 5-13. Distribution of average target movements among eight directions during dawns, days, dusks, and nights during the fall 2011 season.

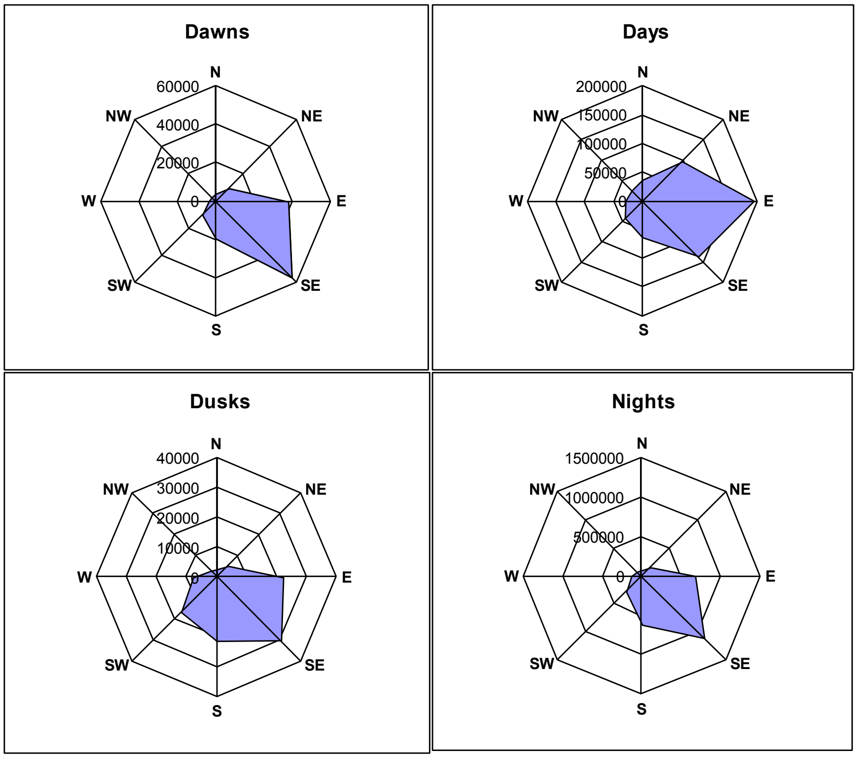

Figure 5-14. Cumulative target direction of all targets during all dawns, days, dusks, and nights during the fall 2011 season.

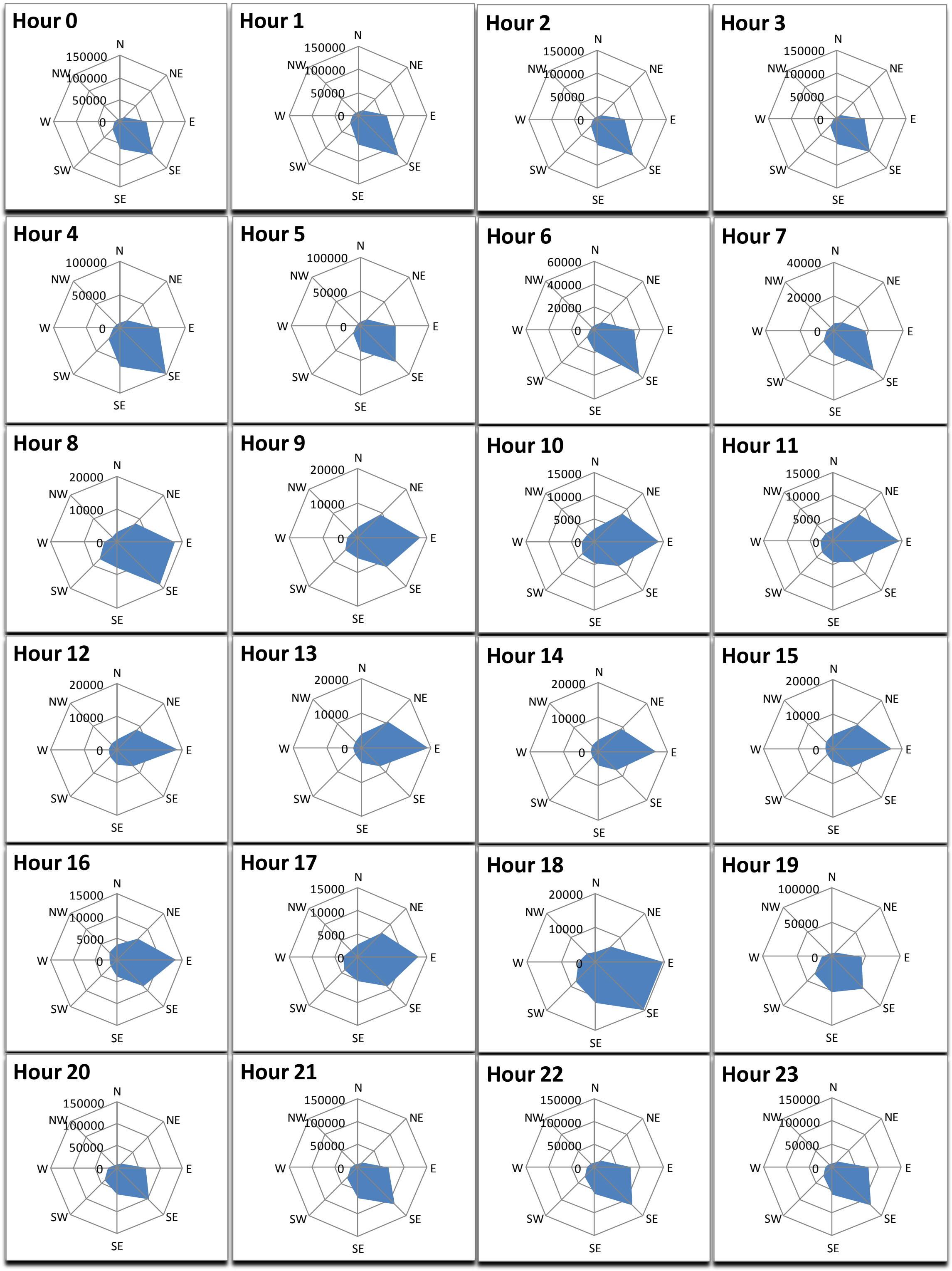

Figure 5-15. Directional distributions for targets during four biological periods of the fall 2011 study period.

6 RESULTS for Site 1 (August 26 – September 20, 2011)

6.1 Level of Effort

The MERLIN Avian Radar System operated at Site1 August 26 – September 20, 2011.

Table 6-1. Effort of radar monitoring at site 1.

Radar	Time In Reporting Period	Time radar collected data	Radar downtime	Radar data with rain and/or insects	Useable radar data
Vertical Radar (hrs)	624	598.4	25.6	77	521.4
Horizontal Radar (hrs)	624	520.3	103.7	57	463.3

6.2 Vertical Radar Data

6.2.1 Target Passage Rates Over Time

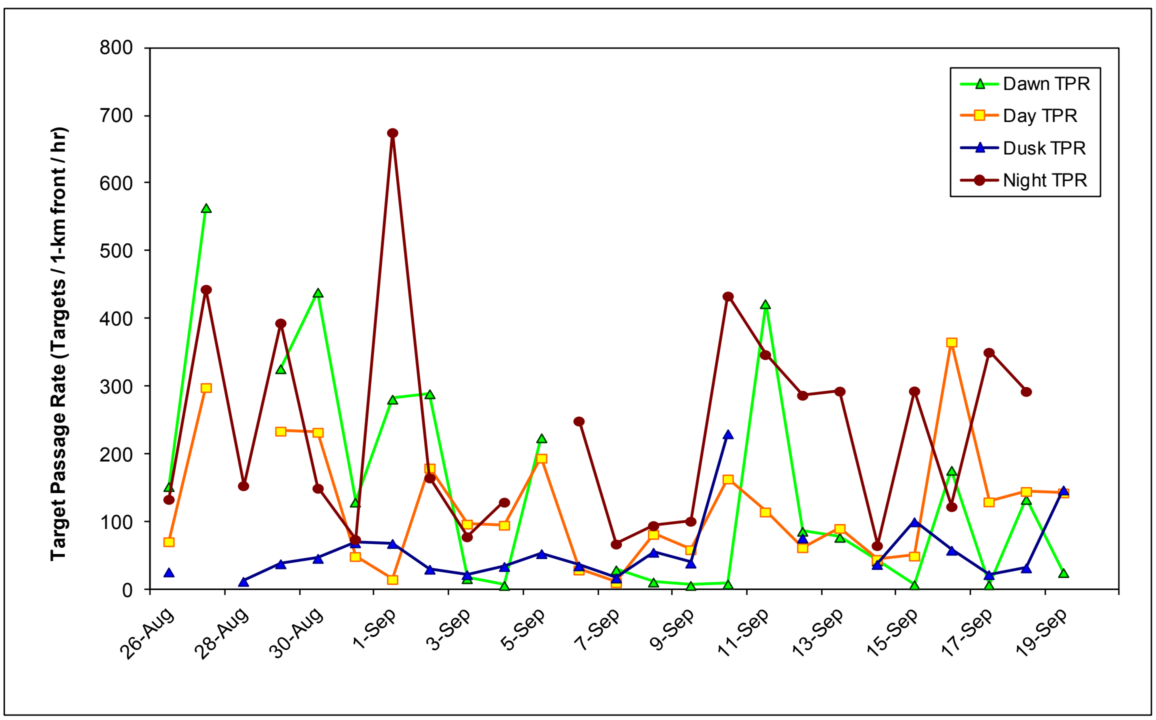

Figure 6-1. Target passage rates during dawns, days, dusks, and nights at site 1.

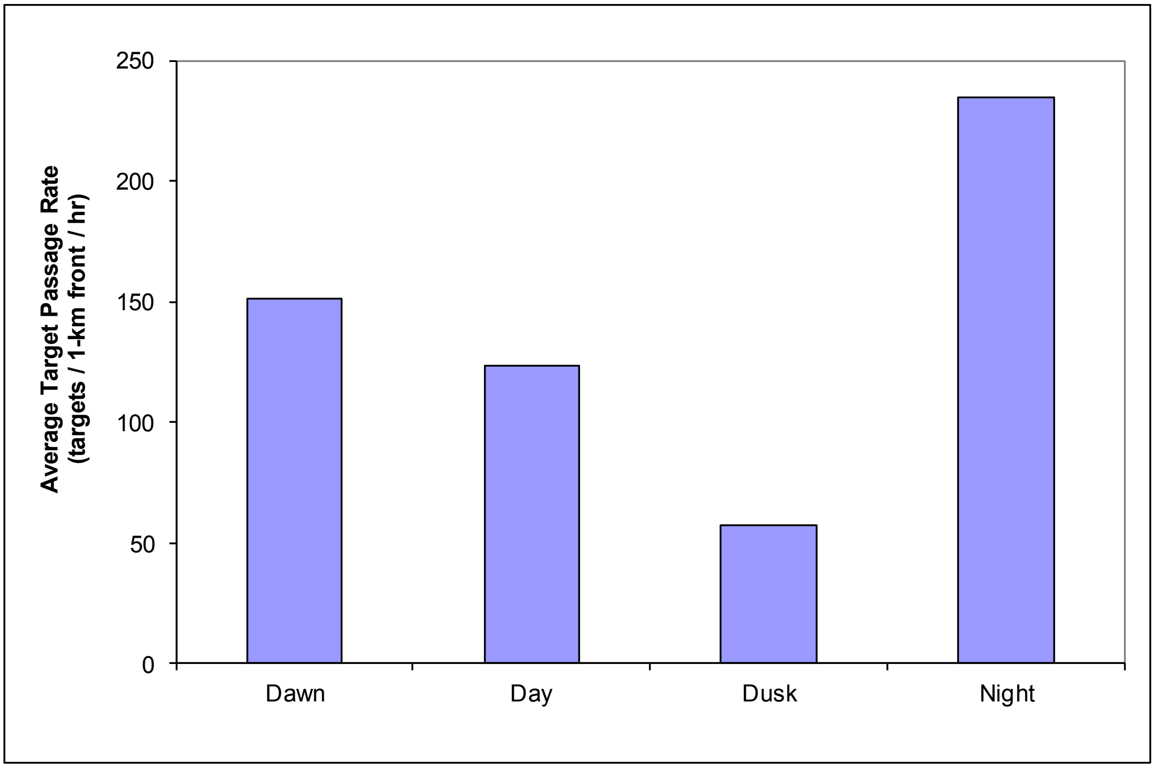

Figure 6-2. Average target passage rates for dawns, days, dusks, and nights at site 1.

Table 6-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for four biological periods at site 1.

	Dawn	Day	Dusk	Night
Average	151.2	123.8	57.6	235.2
Standard Deviation	164.4	90.9	49.3	156.5
Median	87.0	96.7	39.5	165.8
Minimum	7.0	11.1	13.0	65.8
Maximum	565.0	366.5	231.0	675.7
Range	558.0	355.4	218.0	609.8

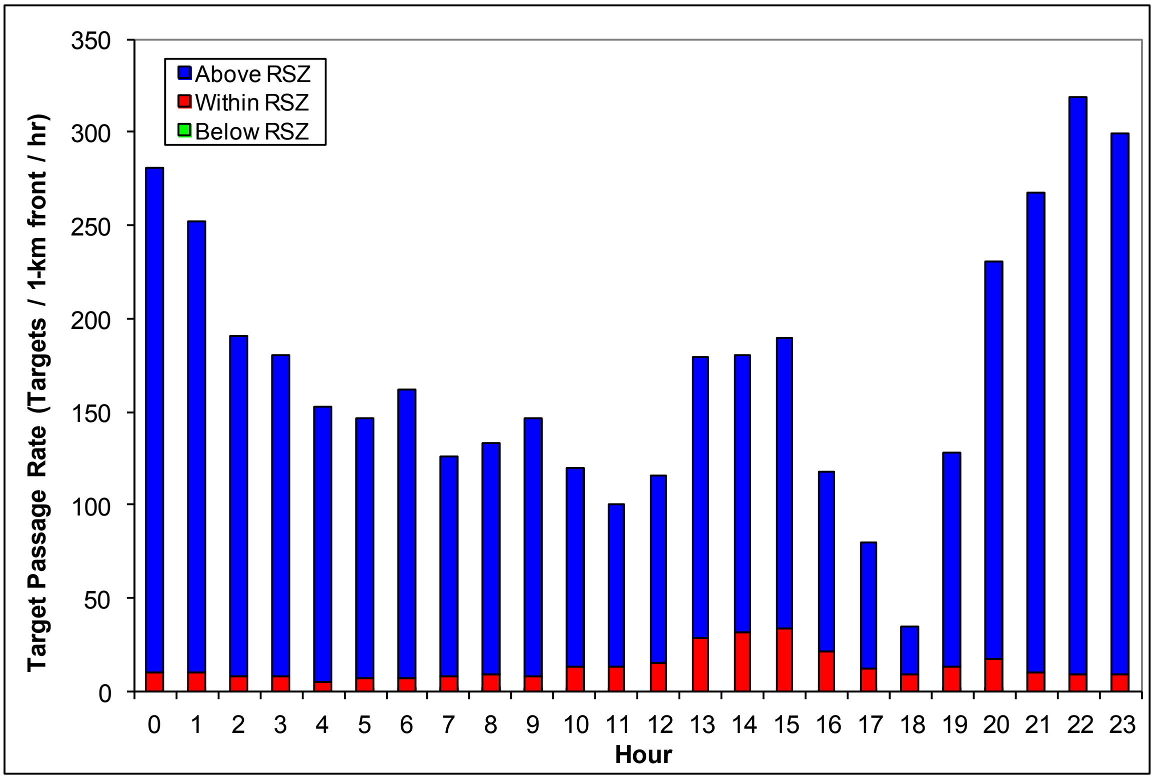

Figure 6-3. Hourly activity (average target passage rates) at site 1.

6.2.2 Altitudinal Distribution of Targets

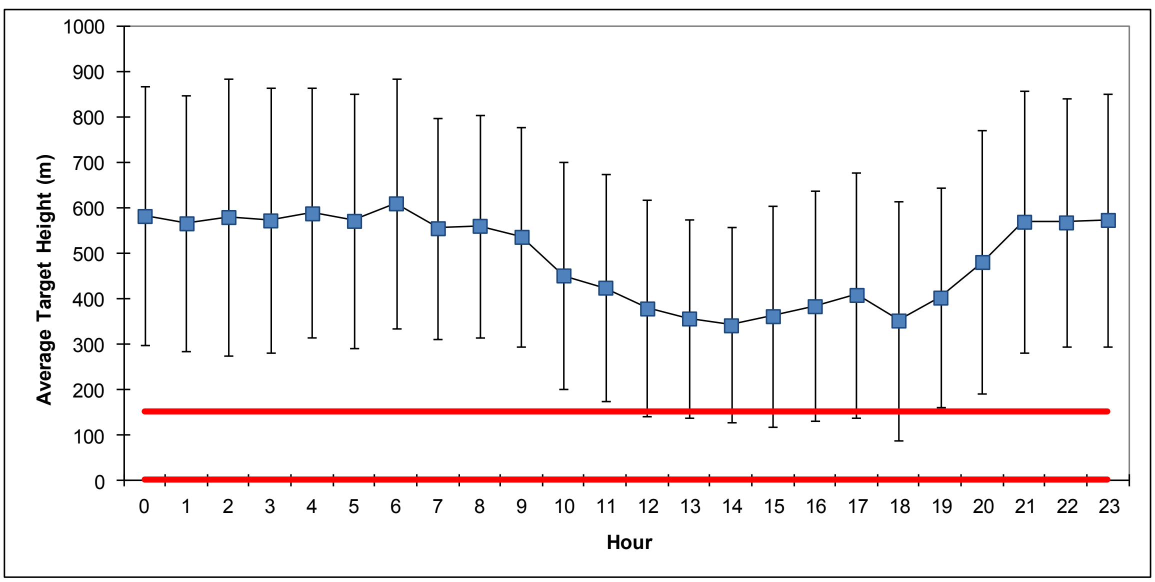

Figure 6-4. Average hourly target heights AGL at site 1. Error bars represent standard deviation for each hour and red lines represent the top and bottom of the rotor swept zone (0 – 152.4 m AGL).

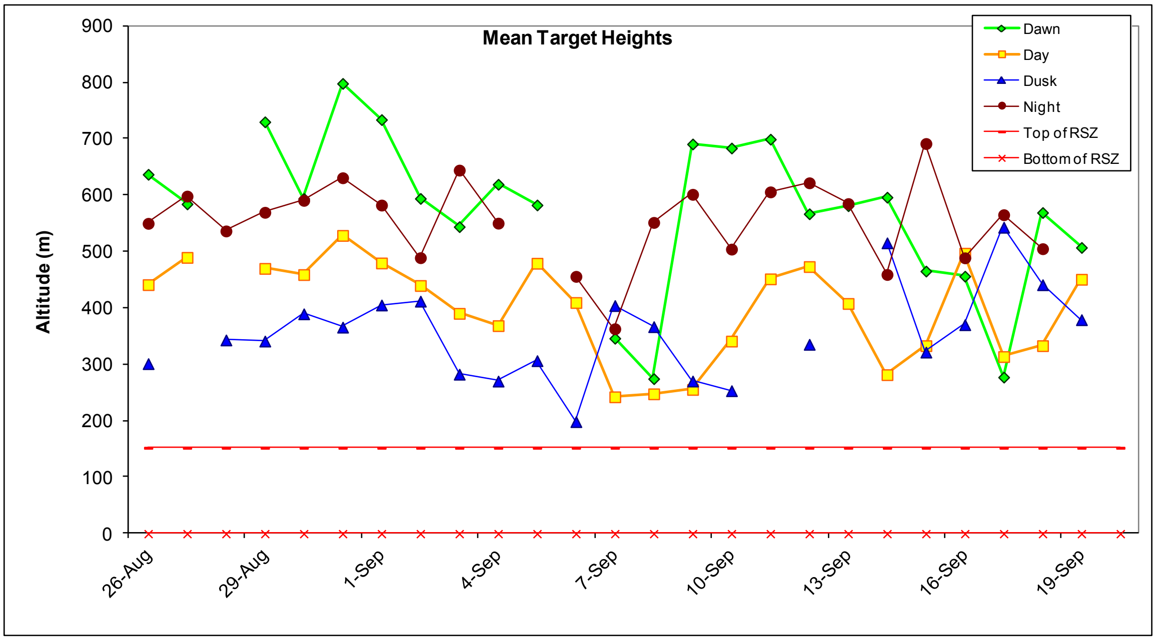

Figure 6-5. Mean target heights during four biological periods at site 1.

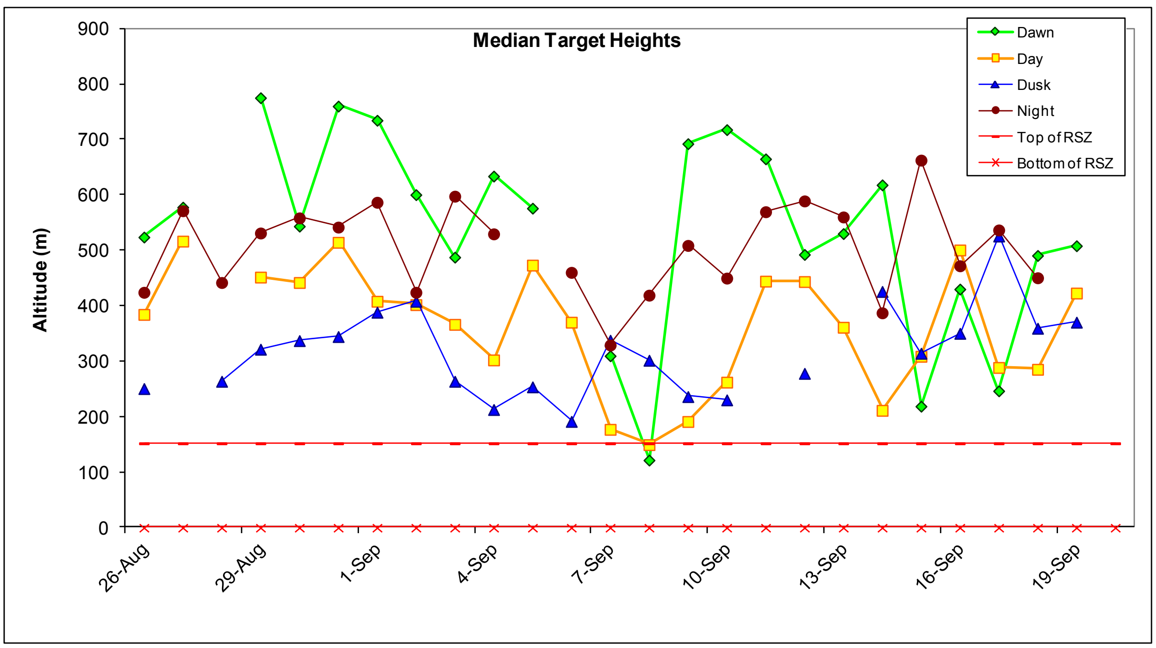

Figure 6-6. Median target heights during four biological periods at site 1.

Table 6-3. Summary of mean and median target heights during four biological periods at site 1. The top presents averages of mean and median target heights calculated during each biological period having at least 50% data in that time period; the bottom presents the overall mean and median target heights when all targets in each of the four biological periods were combined.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average mean target height	571.5	399.8	355.7	554.5
Average median target height	533.5	362.2	317.2	505.1
All targets for season combined				
Mean target height	622.4	432.3	340.0	559.5
Median target height	586.1	408.7	303.0	524.6

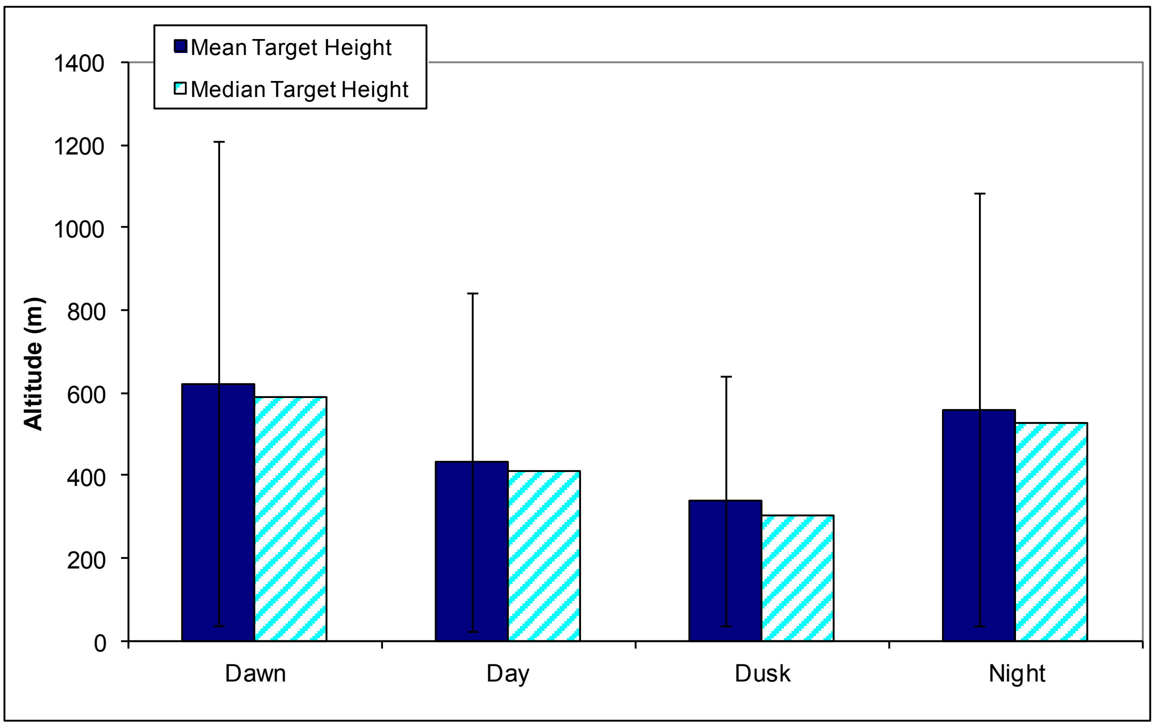

Figure 6-7. Overall mean and median target heights when all targets in each of the four biological periods were combined at site 1. Error bars represent one standard deviation.

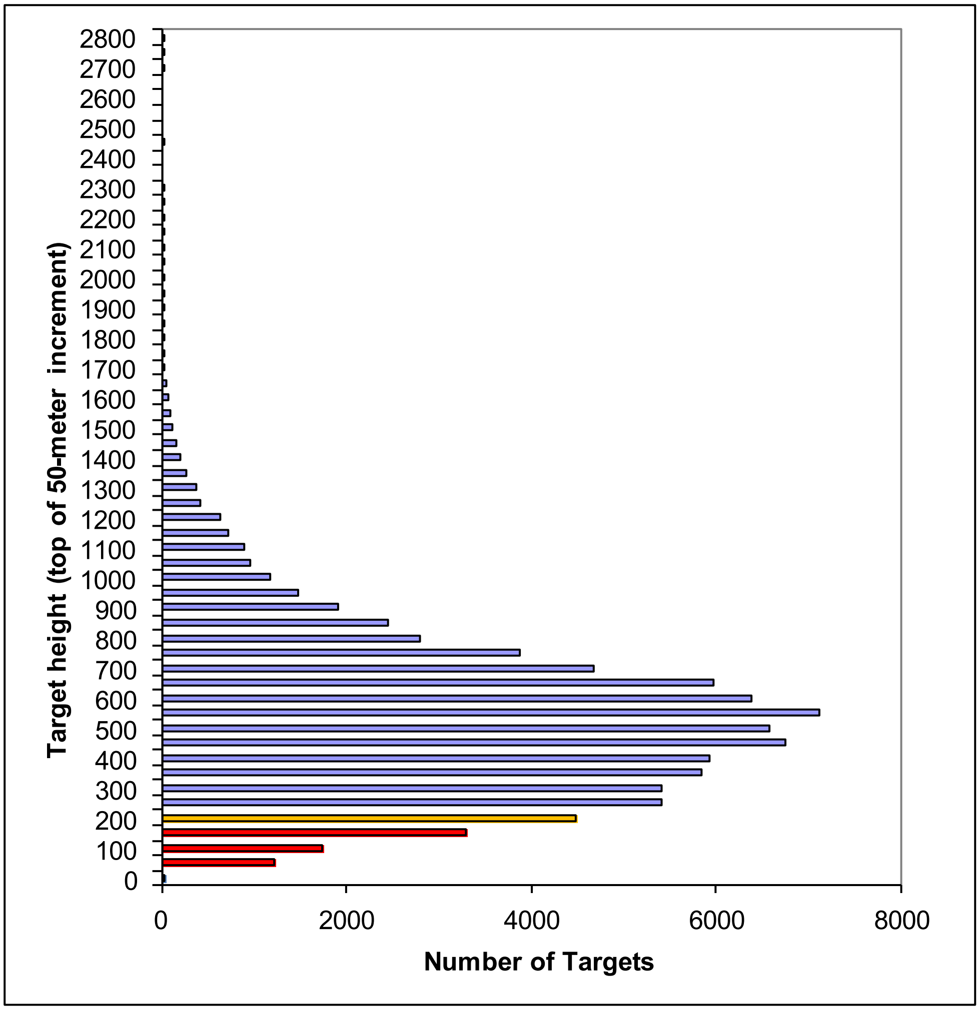

Figure 6-8. Number of targets occurring in each 50-meter increment at site 1. Red indicates rotor swept heights, and orange indicates altitudes partially within rotor swept heights.

Table 6-4. Summary of target passage rates and percent of targets above, within and below the RSZ during four biological periods at site 1.

	Dawn	Day	Dusk	Night
All targets for season combined				
% targets above RSZ	96.8%	87.2%	84.5%	96.2%
% targets within RSZ	3.2%	12.7%	15.5%	3.8%
% targets below RSZ	0.0%	0.1%	0.0%	0.0%
% targets below turbine height	3.2%	12.8%	15.5%	3.8%
Target data calculated for each date				
Average % of targets in RSZ	7.7%	17.1%	13.3%	5.1%
Min target percentage within RSZ	0.0%	4.8%	0.0%	0.7%
Max target percentage within RSZ	50.0%	50.5%	30.4%	11.7%
Average target passage rate above RSZ	146.3	107.7	48.7	226.2
Average target passage rate within RSZ	4.9	16.0	8.9	9.0
Average target passage rate below RSZ	0.0	0.1	0.0	0.0

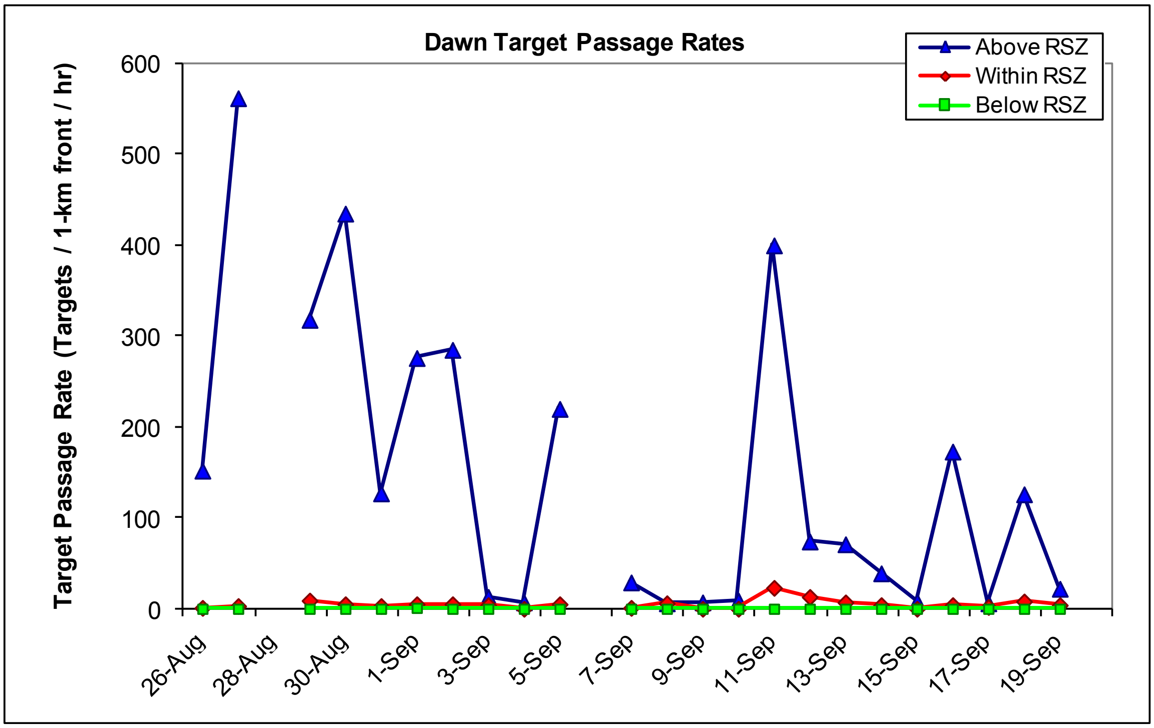

Figure 6-9. Target passage rates below, at, and above the rotor swept zone (RSZ) during dawns at site 1.

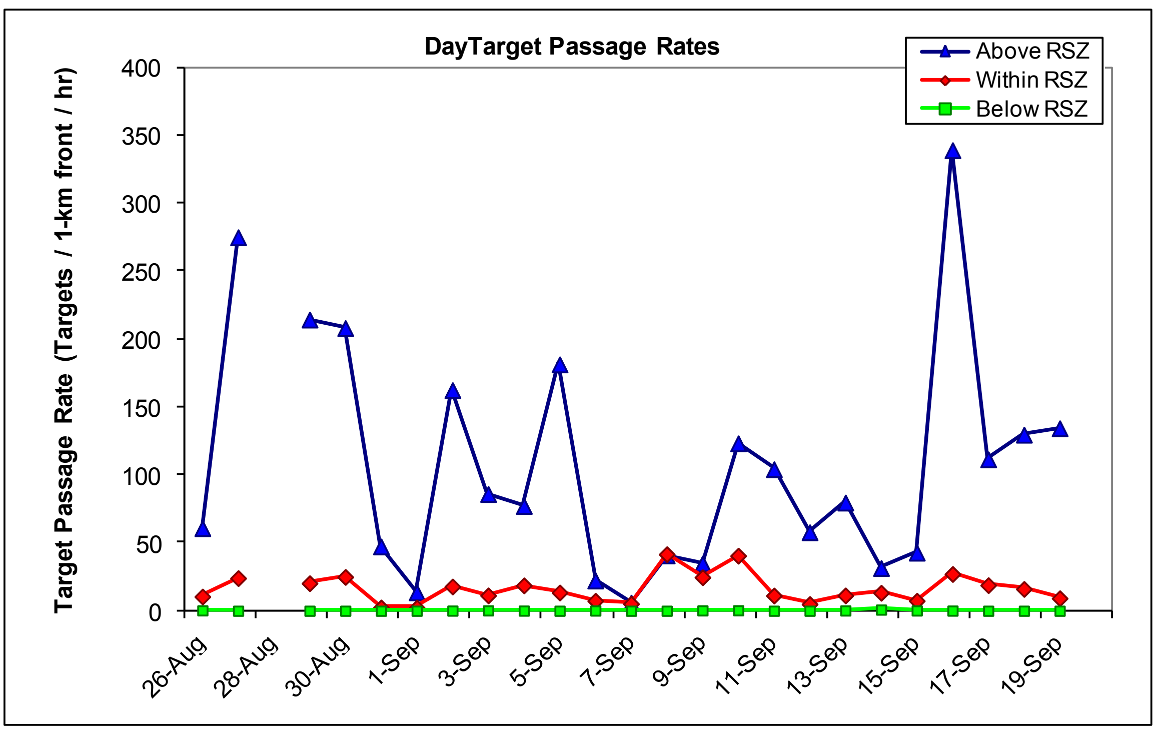

Figure 6-10. Target passage rates below, at, and above the rotor swept zone (RSZ) during days at site 1.

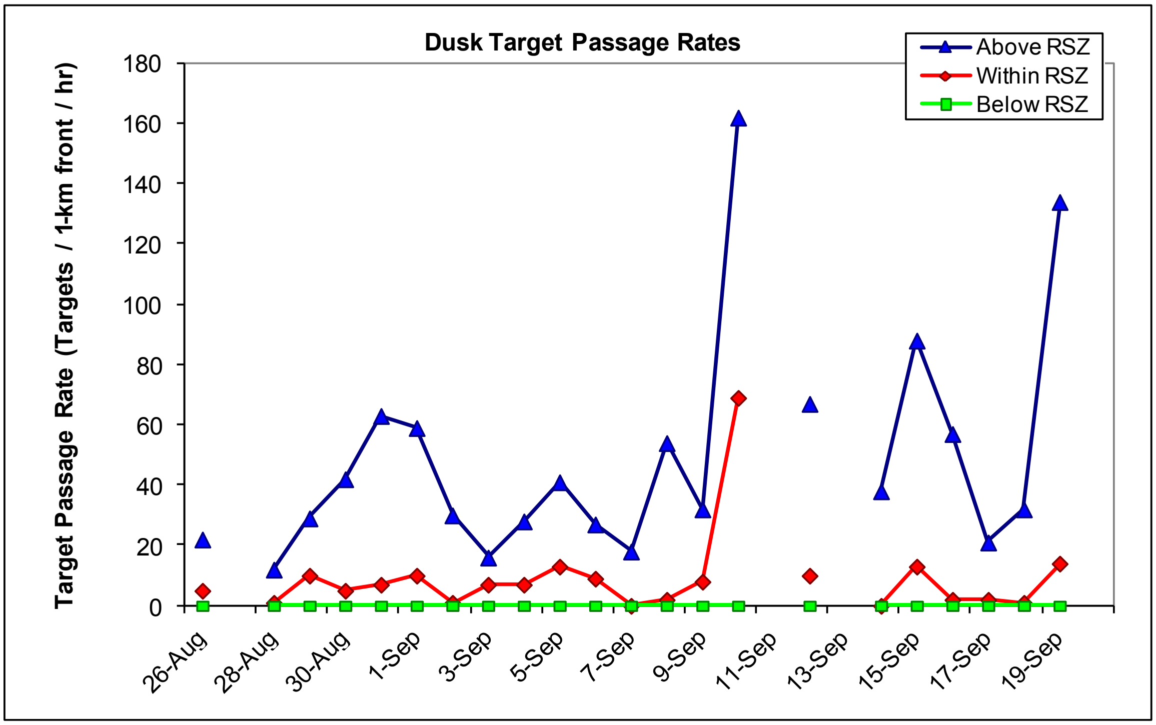

Figure 6-11. Target passage rates below, at, and above the rotor swept zone (RSZ) during dusks at site 1.

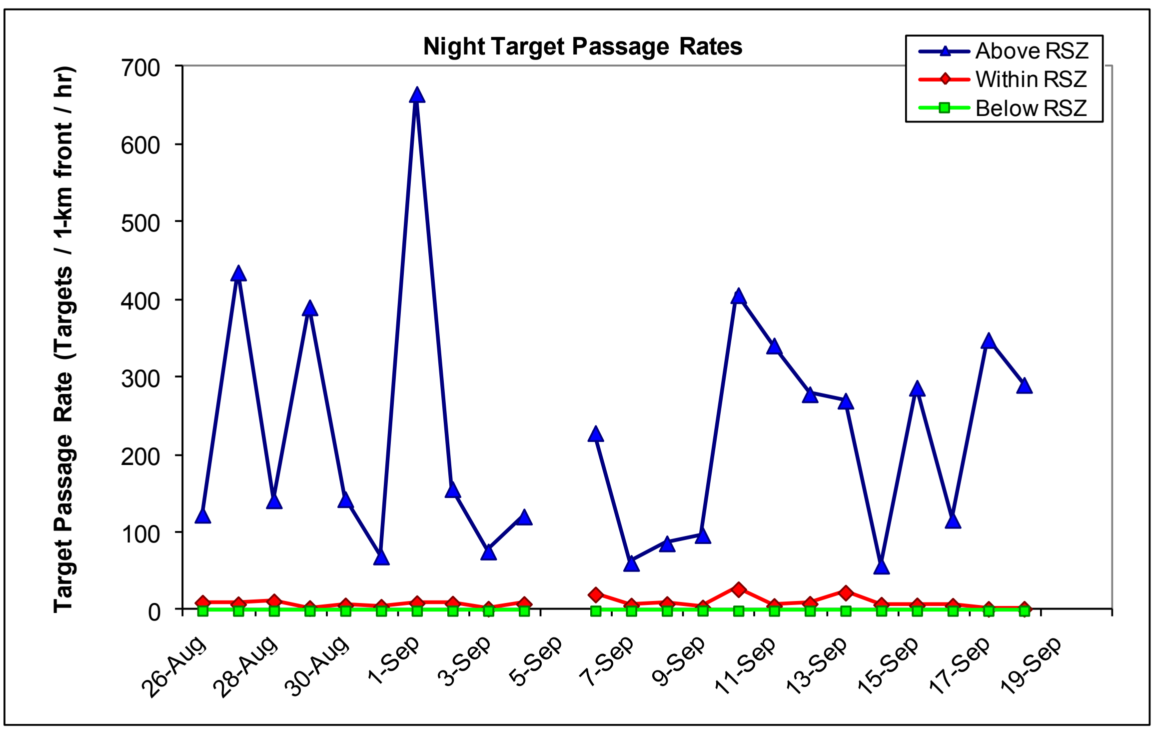

Figure 6-12. Target passage rates below, at, and above the rotor swept zone (RSZ) during nights at site 1.

6.3 Horizontal Radar Data

6.3.1 Target Directions

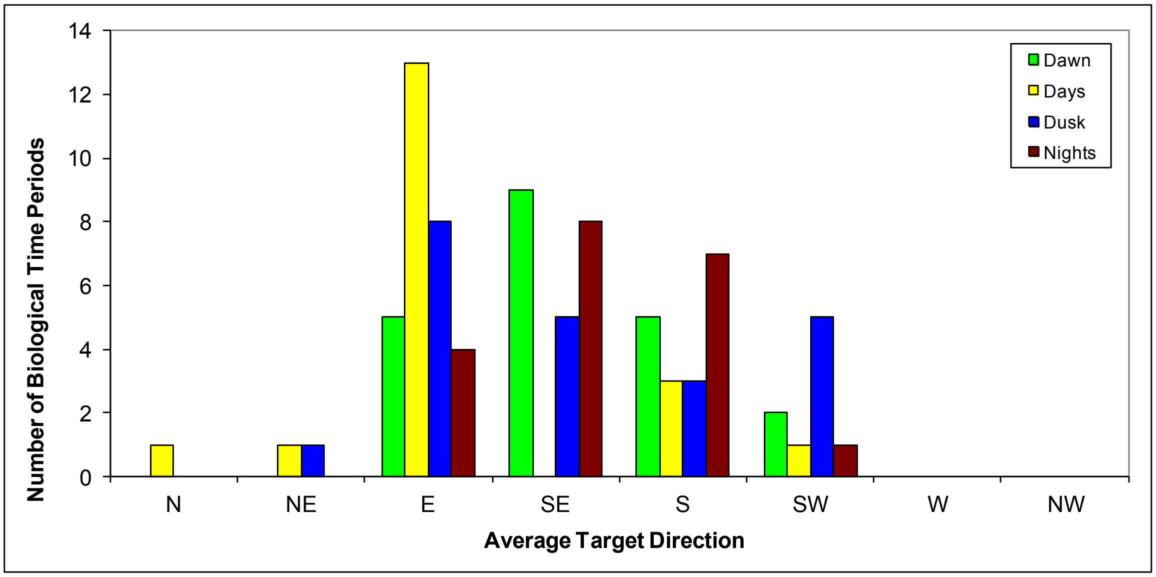

Figure 6-13. Distribution of average target movements among eight directions during dawns, days, dusks, and nights at site 1.

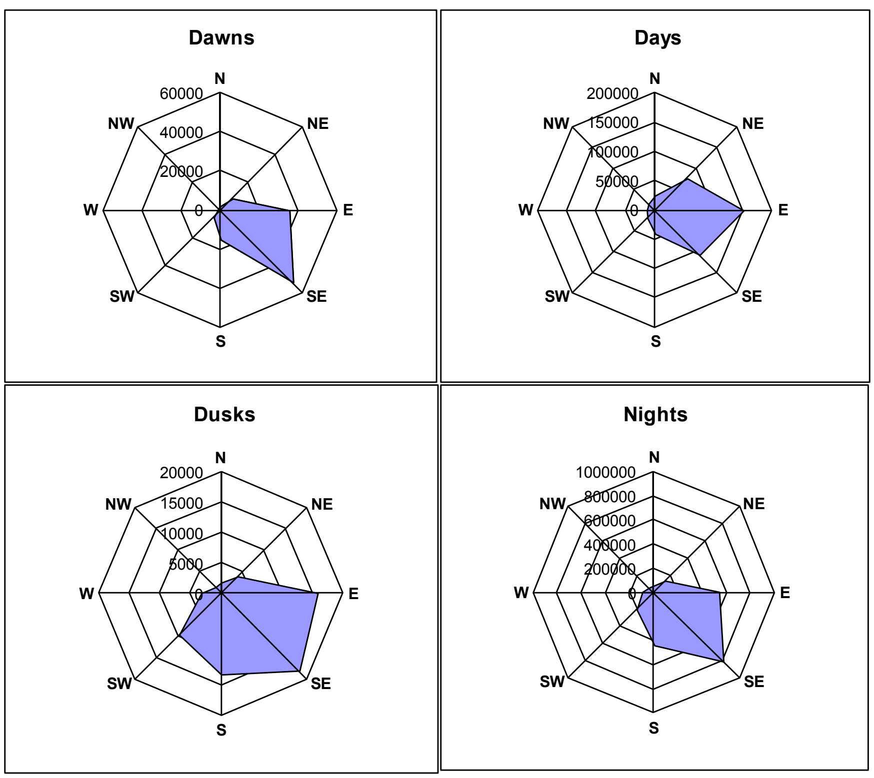

Figure 6-14. Cumulative target direction of all targets during all dawns, days, dusks, and nights at site 1.

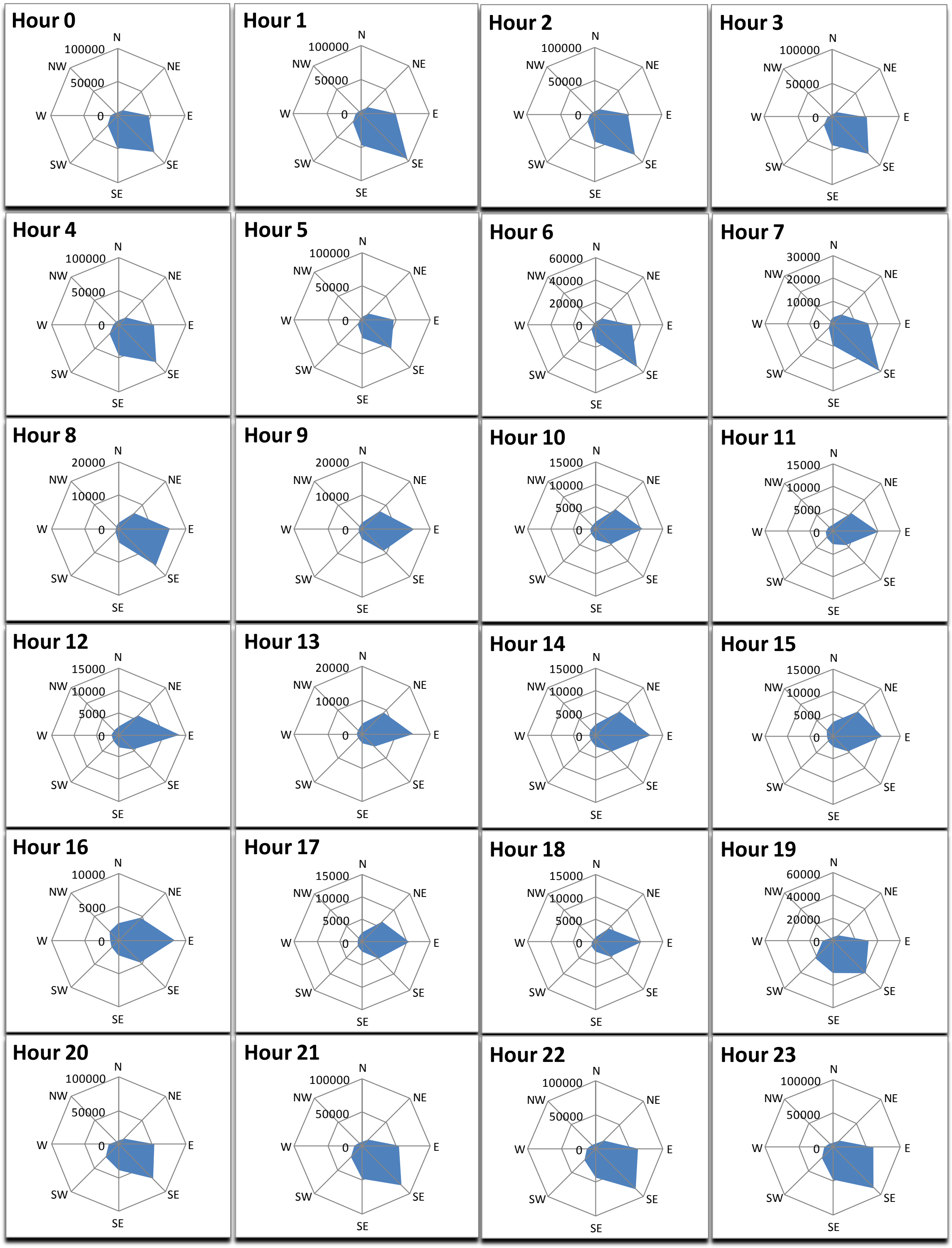

Figure 6-15. Directional distributions for targets during four biological periods at site 1.

7 RESULTS for Site 2 (April 28 – June 27, 2011)

7.1 Level of Effort

The MERLIN Avian Radar System operated at Site 2 from April 28 to June 27, 2011.

Table 7-1. Effort of radar monitoring at site 2.

Radar	Time In Reporting Period	Time radar collected data	Radar downtime	Radar data with rain and/or insects	Useable radar data
Vertical Radar (hrs)	1464	1349.9	114.1	549.3	800.6
Horizontal Radar (hrs)	1464	1359.9	104.1	48	1311.9

7.2 Vertical Radar Data

7.2.1 Target Passage Rates Over Time

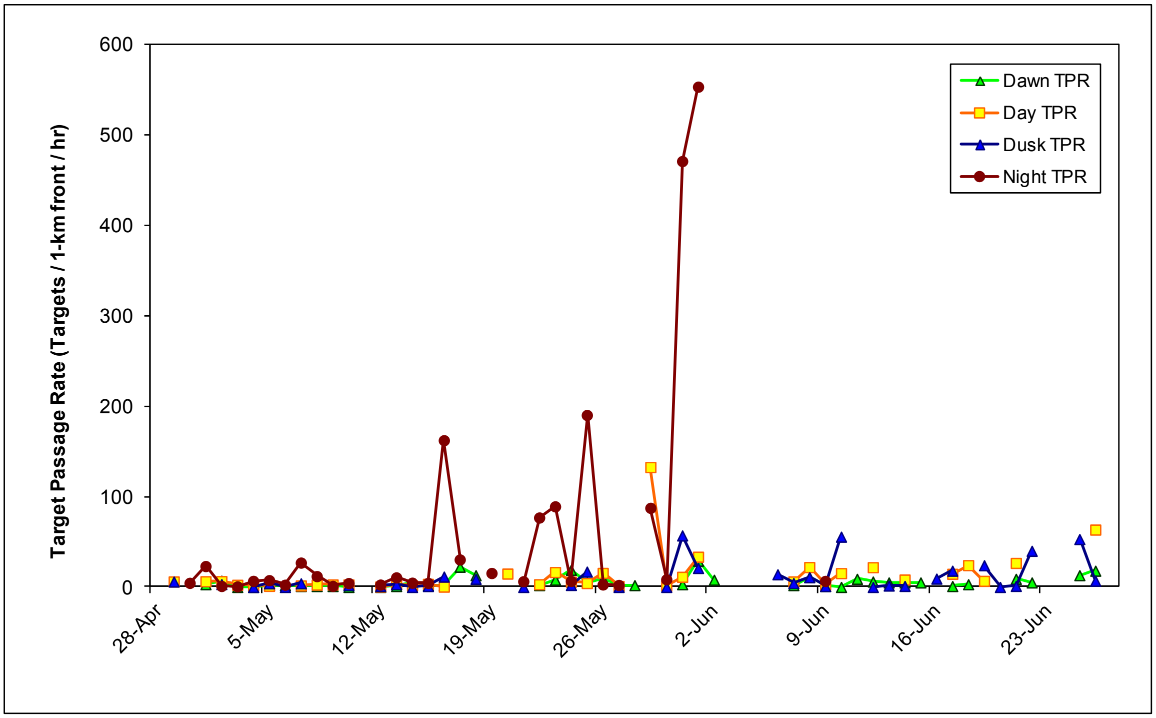

Figure 7-1. Target passage rates during dawns, days, dusks, and nights at site 2.

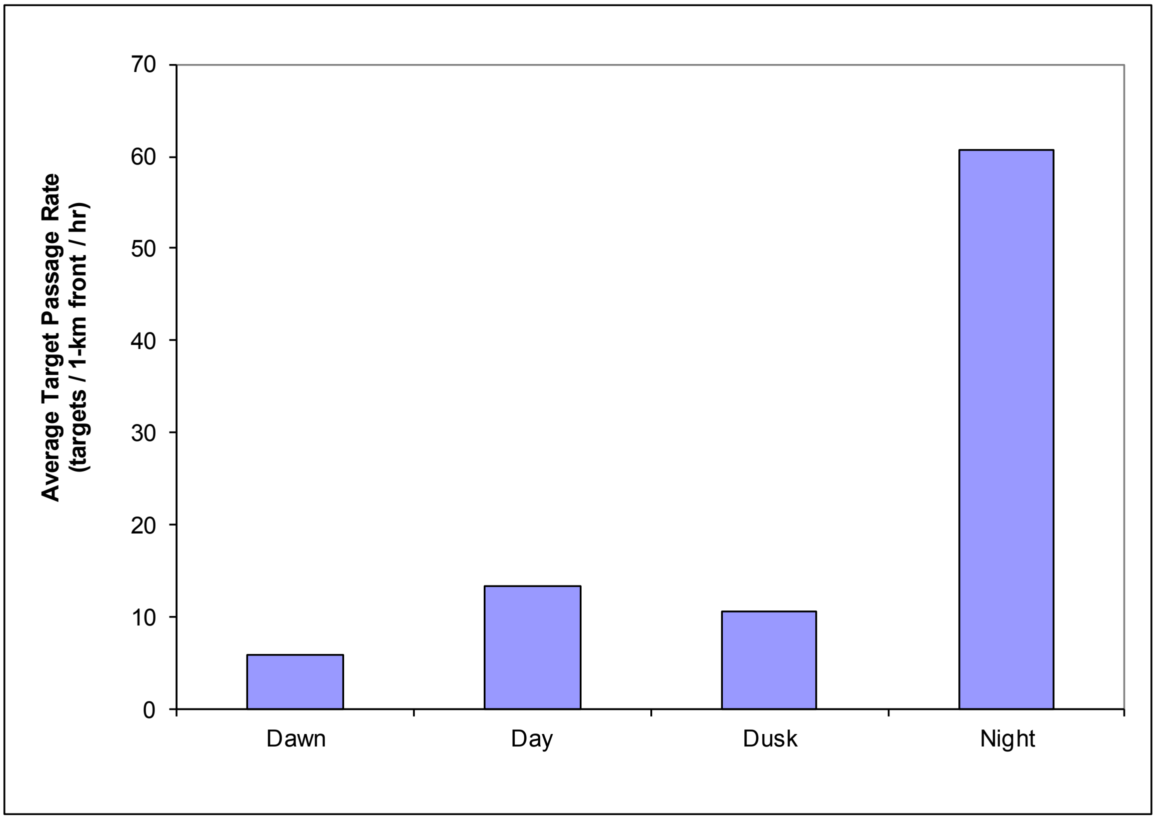

Figure 7-2. Average target passage rates for dawns, days, dusks, and nights at site 2.

Table 7-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for four biological periods at site 2.

	Dawn	Day	Dusk	Night
Average	5.8	13.3	10.6	60.7
Standard Deviation	6.5	23.6	16.1	131.9
Median	3.0	6.1	3.6	7.1
Minimum	0.0	0.4	0.0	0.6
Maximum	29.0	132.6	57.0	553.4
Range	29.0	132.3	57.0	552.8

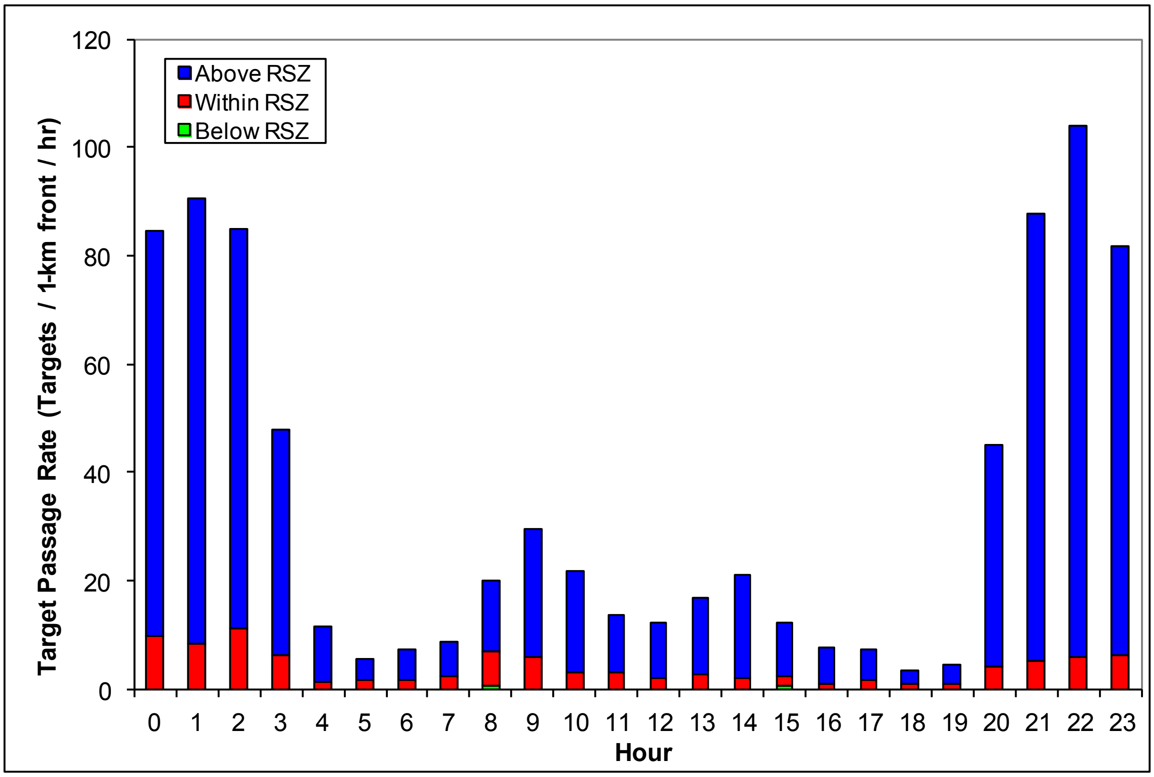

Figure 7-3. Hourly activity (average target passage rates) at site 2.

7.2.2 Altitudinal Distribution of Targets

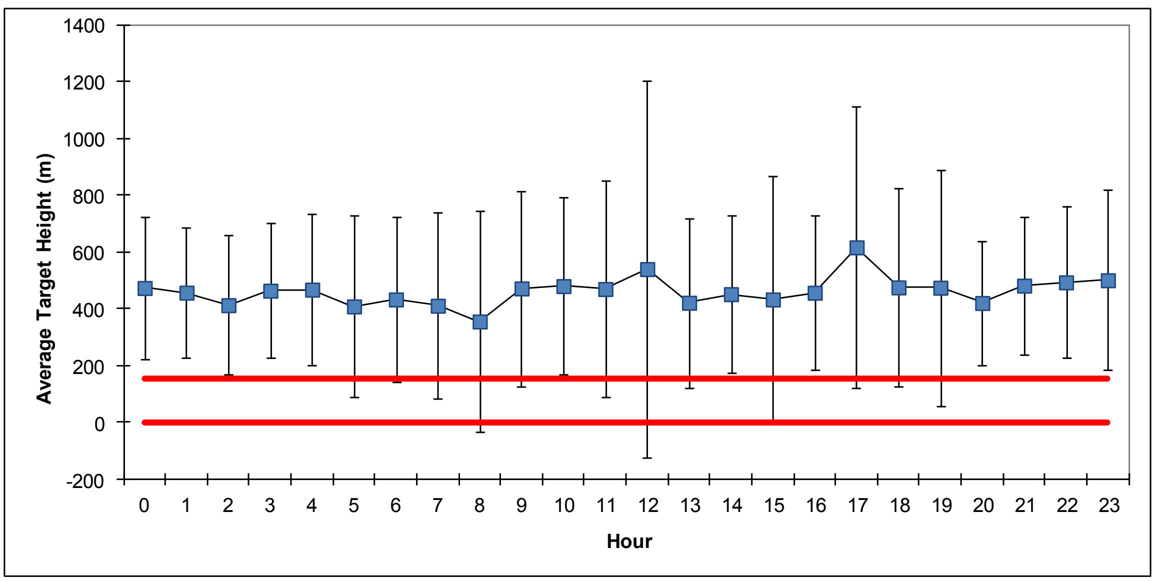

Figure 7-4. Average hourly target heights AGL at site 2. Error bars represent standard deviation for each hour and red lines represent the top and bottom of the rotor swept zone (0 – 152.4 m AGL).

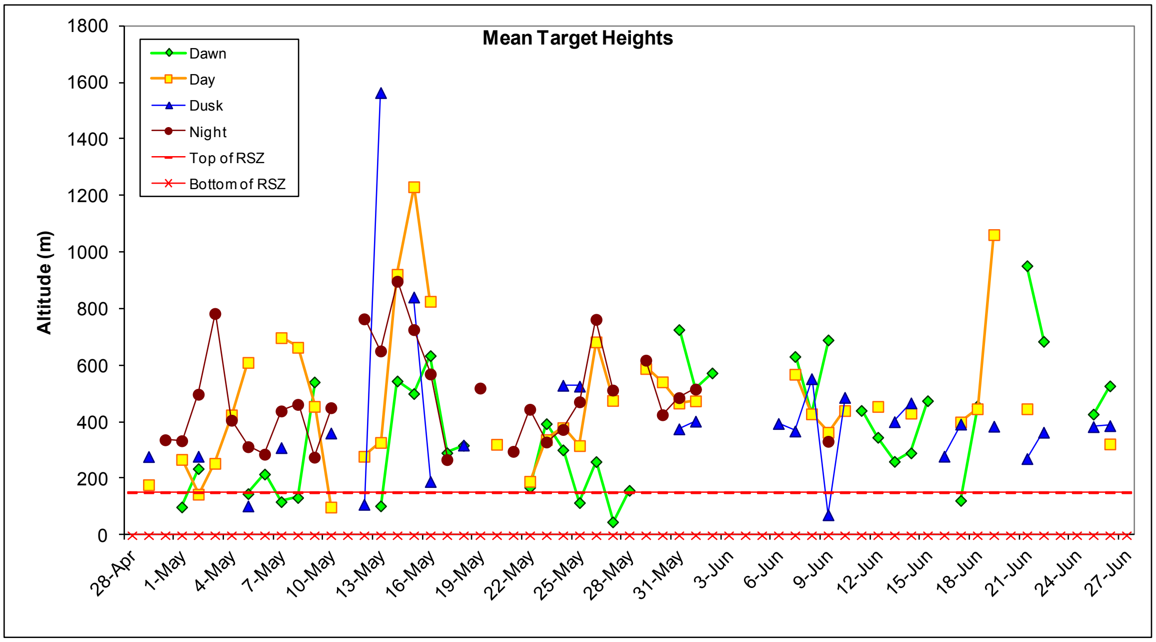

Figure 7-5. Mean target heights during four biological periods at site 2.

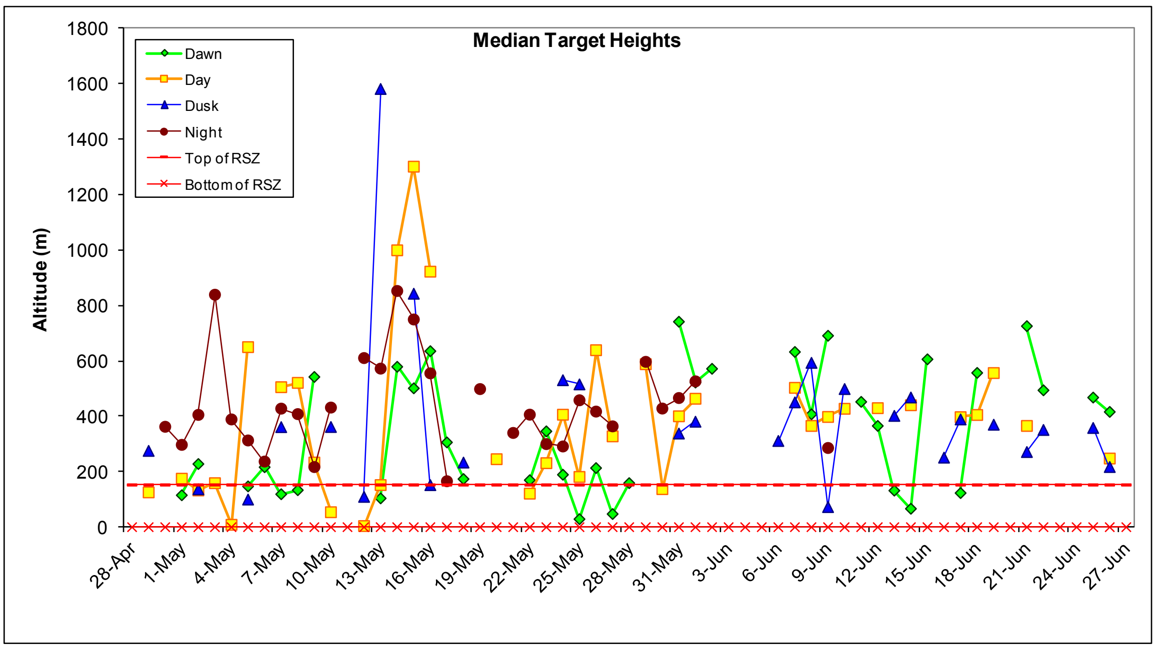

Figure 7-6. Median target heights during four biological periods at site 2.

Table 7-3. Summary of mean and median target heights during four biological periods at site 2. The top presents averages of mean and median target heights calculated during each biological period having at least 50% data in that time period; the bottom presents the overall mean and median target heights when all targets in each of the four biological periods were combined.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average mean target height	375.8	474.5	407.6	485.8
Average median target height	349.4	384.3	390.1	440.4
All targets for season combined				
Mean target height	415.3	451.5	412.9	466.5
Median target height	371.1	407.5	372.8	446.5

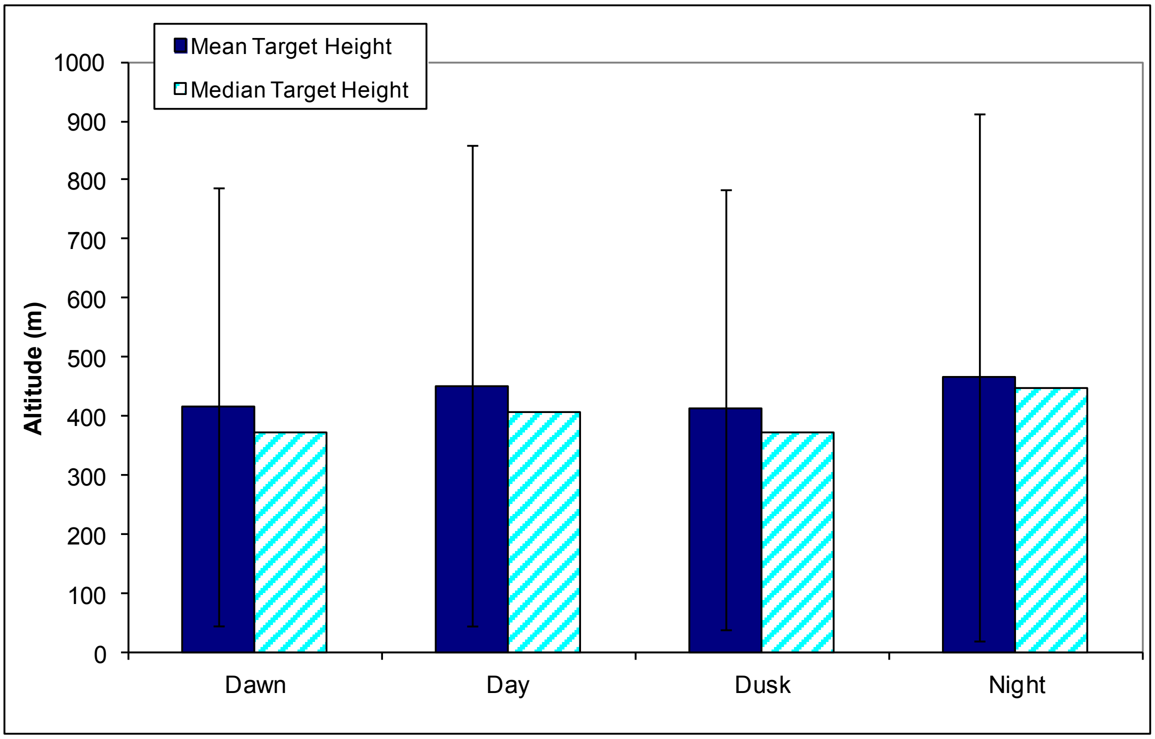

Figure 7-7. Overall mean and median target heights when all targets in each of the four biological periods were combined at site 2. Error bars represent one standard deviation.

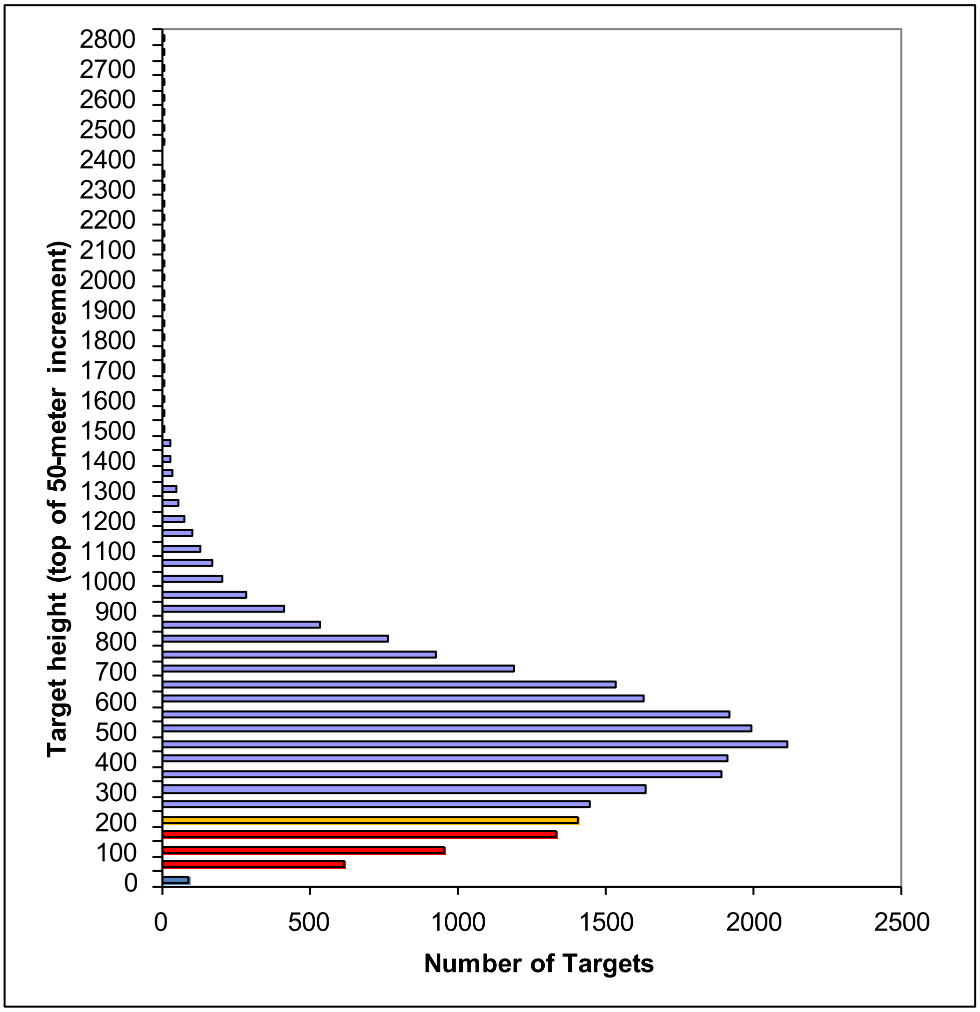

Figure 7-8. Number of targets occurring in each 50-meter increment at site 2. Red indicates rotor swept heights, and orange indicates altitudes partially within rotor swept heights.

Table 7-4. Summary of target passage rates and percent of targets above, within and below the RSZ during four biological periods at site 2.

	Dawn	Day	Dusk	Night
All targets for season combined				
% targets above RSZ	75.4%	81.0%	88.3%	91.0%
% targets within RSZ	22.5%	17.8%	11.7%	8.9%
% targets below RSZ	2.1%	1.2%	0.0%	0.2%
% targets below turbine height	24.6%	19.0%	11.7%	9.0%
Target data calculated for each date				
Average % of targets in RSZ	31.8%	27.7%	19.1%	18.1%
Min target percentage within RSZ	0.0%	0.0%	0.0%	1.1%
Max target percentage within RSZ	100.0%	75.0%	100.0%	50.0%
Average target passage rate above RSZ	4.3	10.9	9.4	55.2
Average target passage rate within RSZ	1.3	2.3	1.3	5.4
Average target passage rate below RSZ	0.1	0.1	0.0	0.1

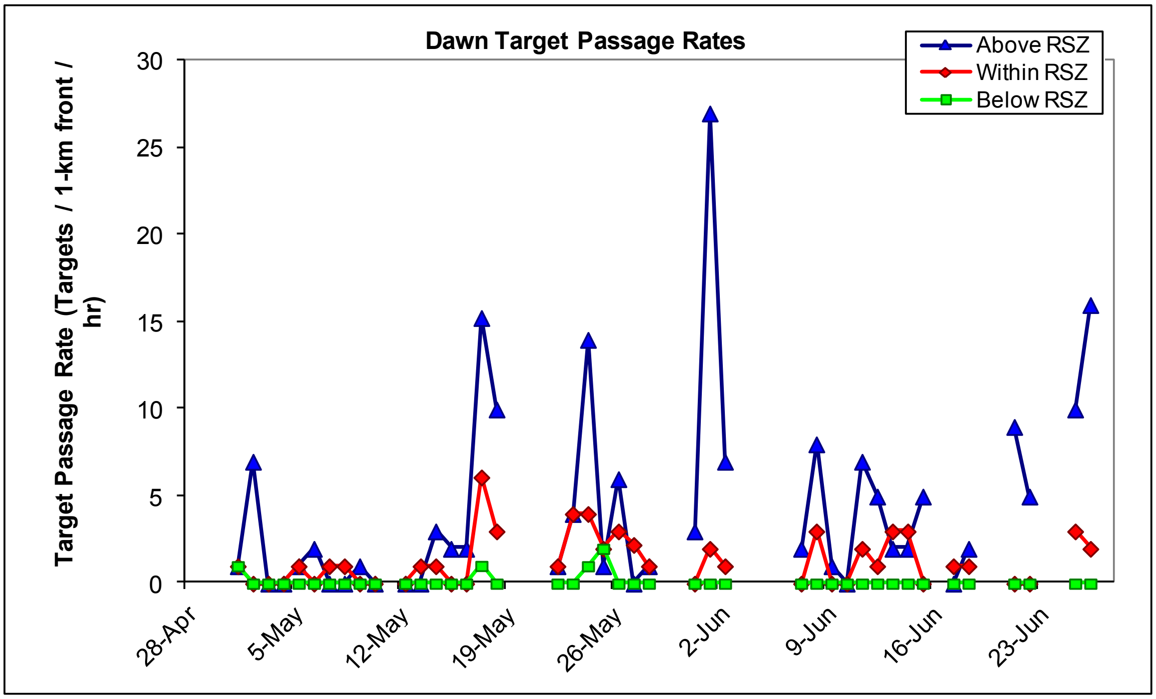

Figure 7-9. Target passage rates below, at, and above the rotor swept zone (RSZ) during dawns at site 2.

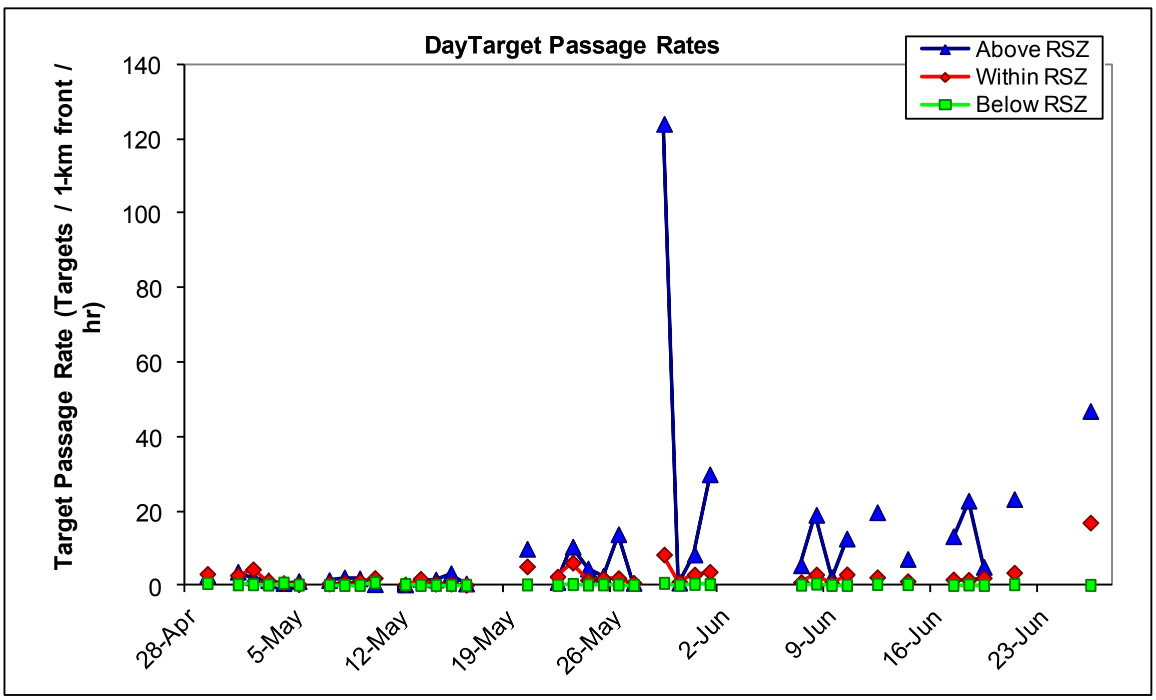

Figure 7-10. Target passage rates below, at, and above the rotor swept zone (RSZ) during days at site 2.

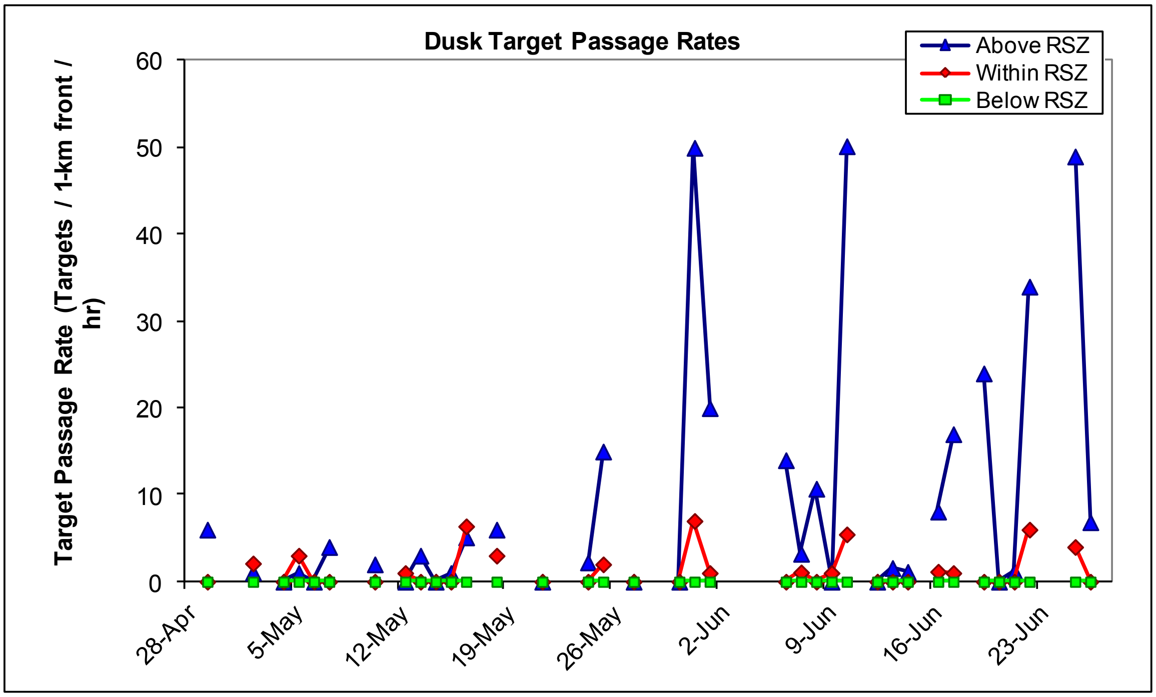

Figure 7-11. Target passage rates below, at, and above the rotor swept zone (RSZ) during dusks at site 2.

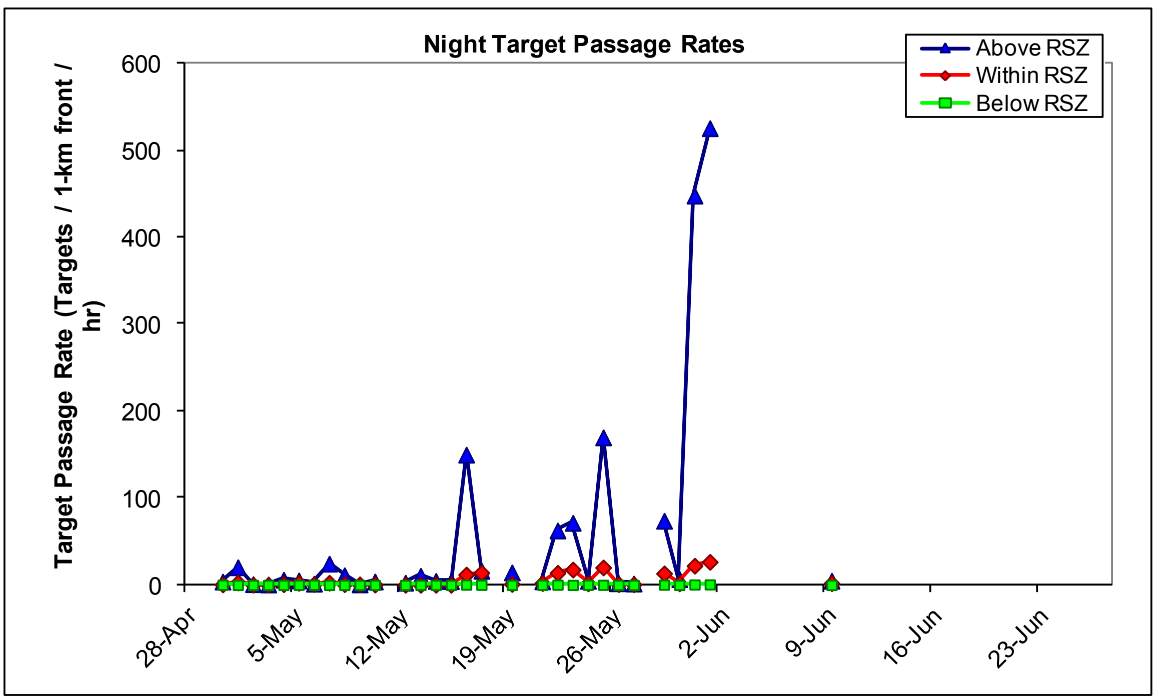

Figure 7-12. Target passage rates below, at, and above the rotor swept zone (RSZ) during nights at site 2.

7.3 Horizontal Radar Data

7.3.1 Target Directions

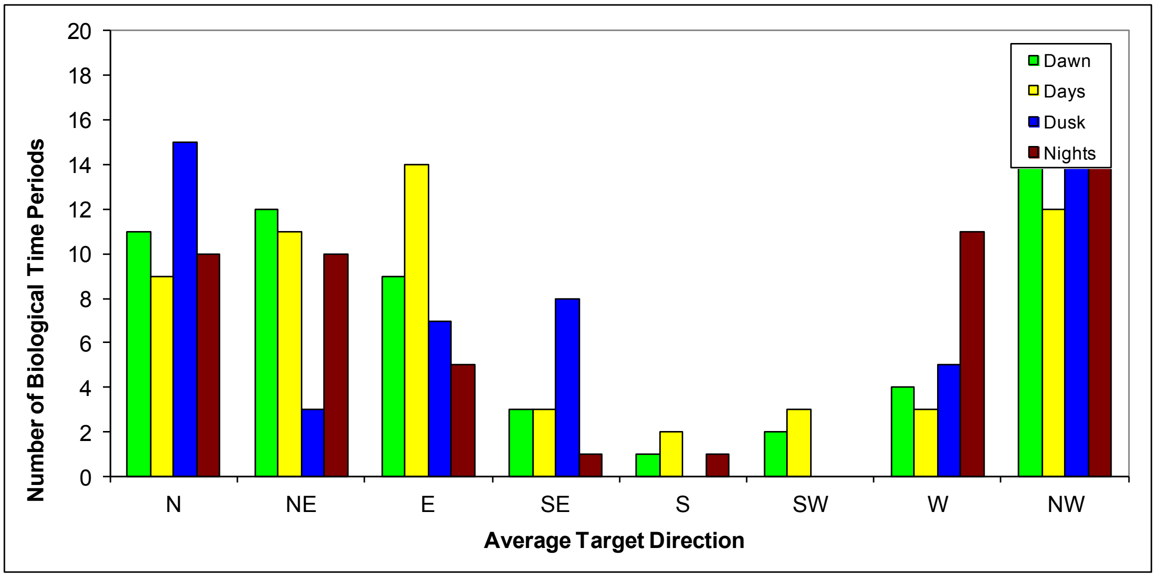

Figure 7-13. Distribution of average target movements among eight directions during dawns, days, dusks, and nights at site 2.

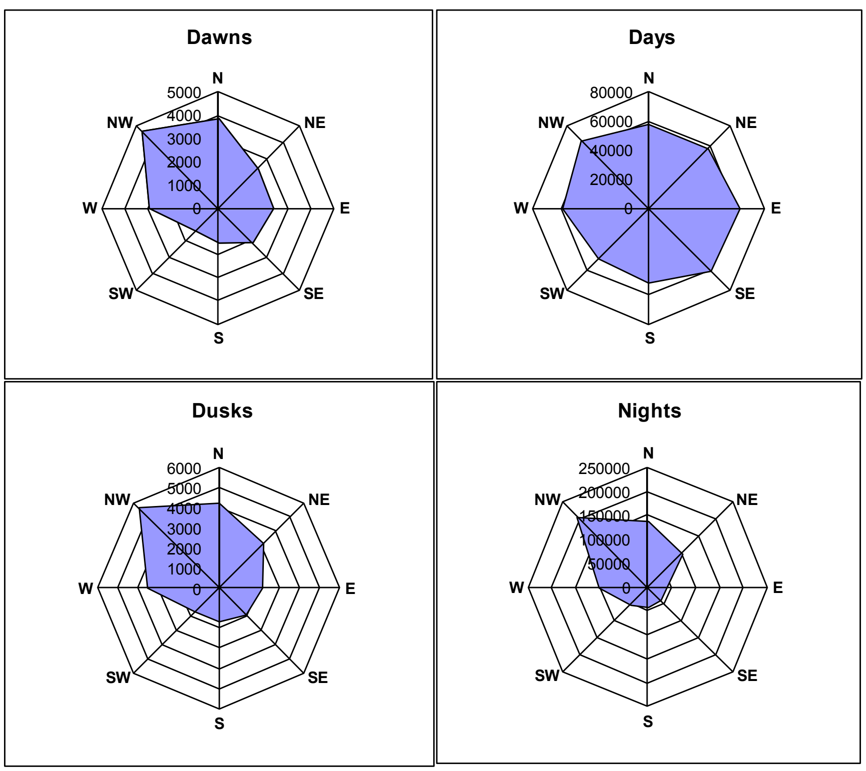

Figure 7-14. Cumulative target direction of all targets during all dawns, days, dusks, and nights at site 2.

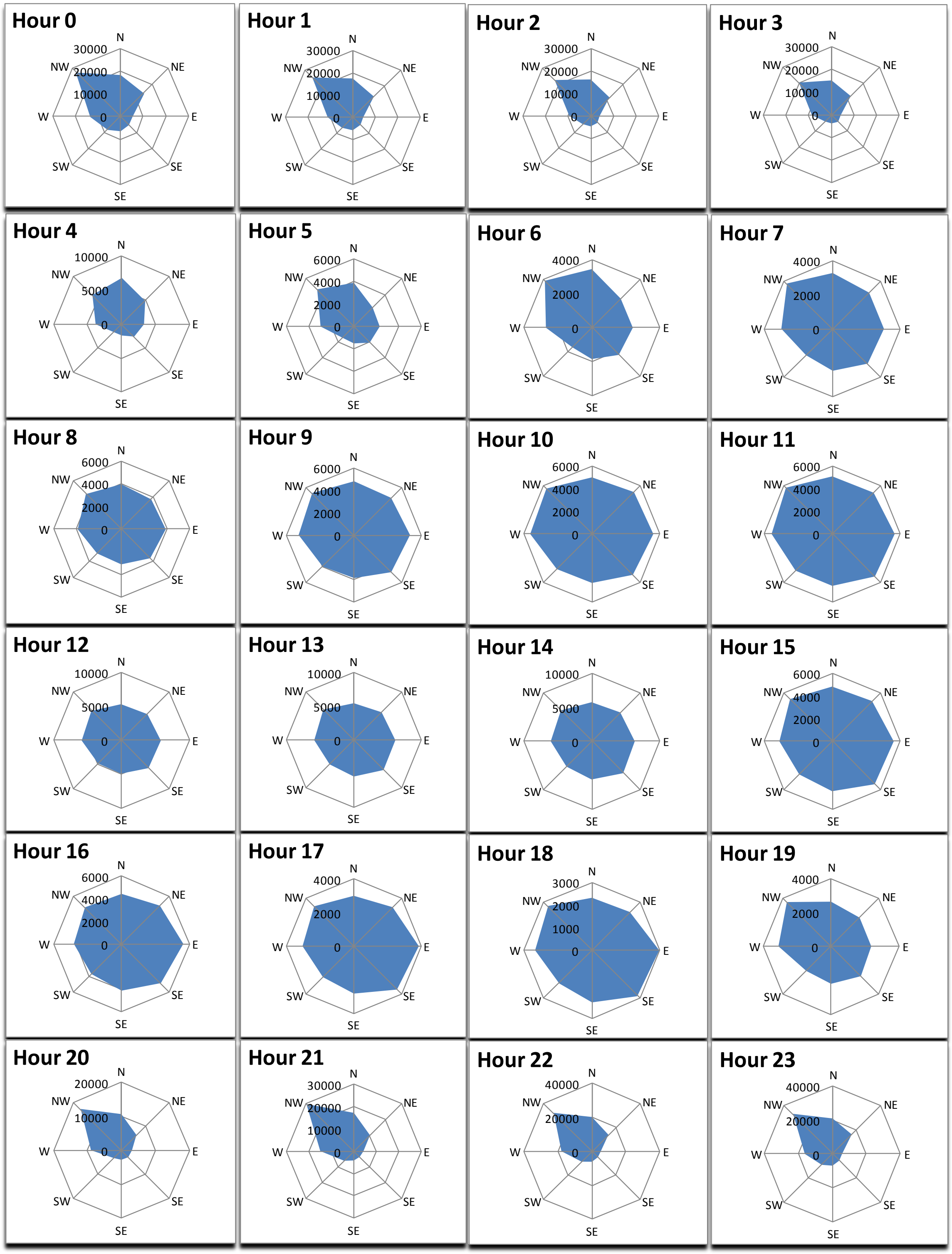

Figure 7-15. Directional distributions for targets during four biological periods at site 2.

8 RESULTS for Site 3 (July 1 – August 22, 2011)

8.1 Level of Effort

The MERLIN Avian Radar System operated at Site 3 from July 1 to August 22, 2011.

Table 8-1. Effort of radar monitoring at site 3.

Radar	Time In Reporting Period	Time radar collected data	Radar downtime	Radar data with rain and/or insects	Useable radar data
Vertical Radar (hrs)	1272	1247.7	24.3	555.4	692.3
Horizontal Radar (hrs)	1272	983.8	288.2	13.8	970

8.2 Vertical Radar Data

8.2.1 Target Passage Rates Over Time

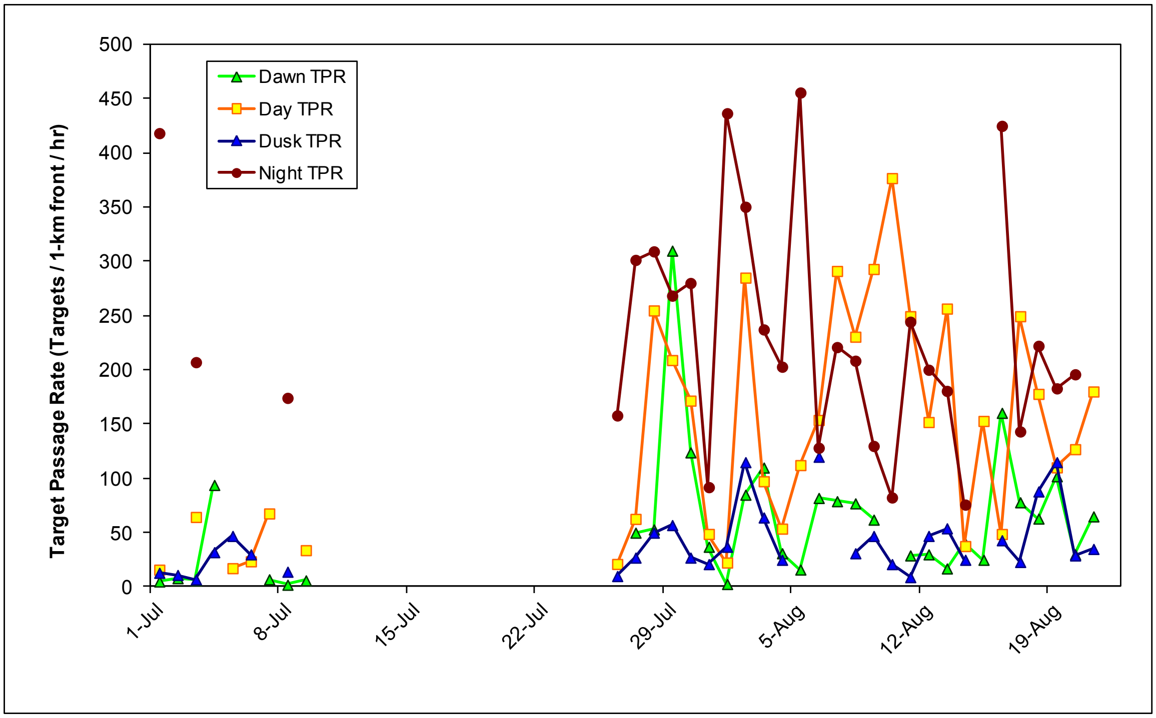

Figure 8-1. Target passage rates during dawns, days, dusks, and nights at site 3.

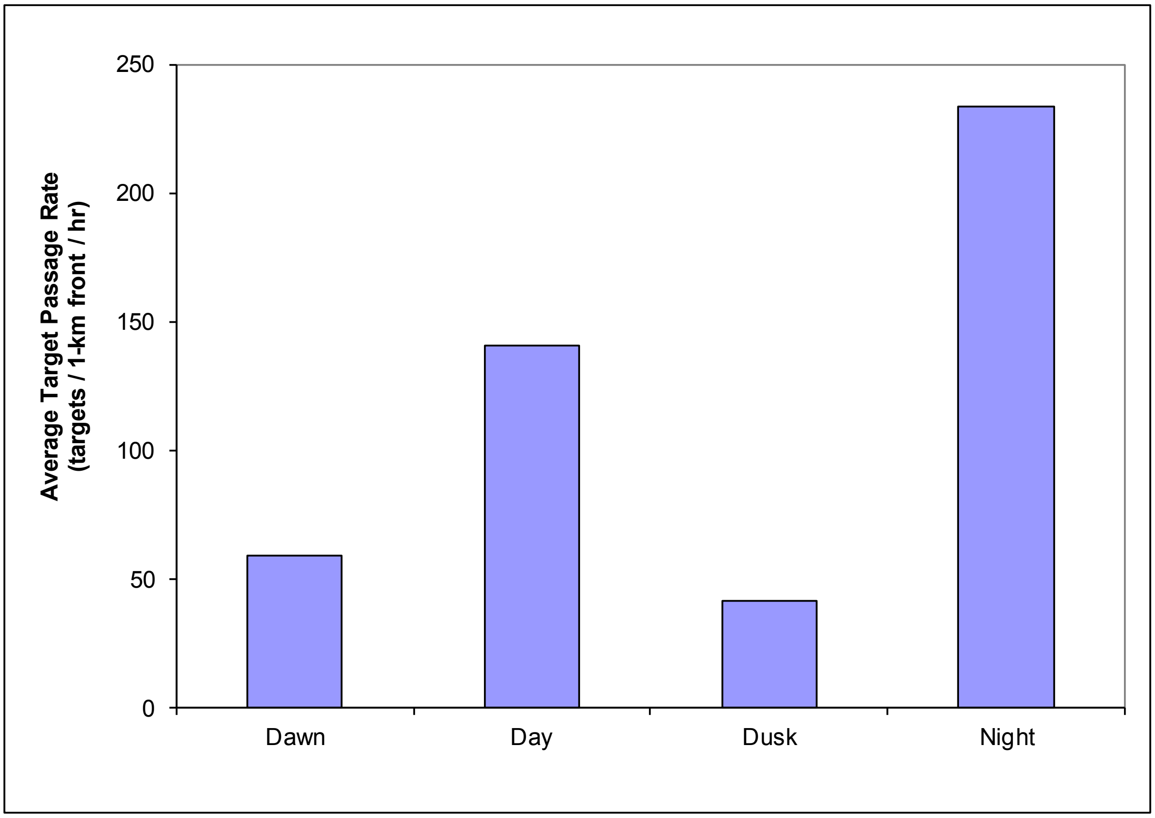

Figure 8-2. Average target passage rates for dawns, days, dusks, and nights at site 3.

Table 8-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for four biological periods at site 3.

	Dawn	Day	Dusk	Night
Average	58.9	140.9	41.1	233.4
Standard Deviation	60.9	101.6	30.9	106.5
Median	45.0	127.0	31.0	207.9
Minimum	2.0	15.9	7.0	75.9
Maximum	310.0	376.9	120.0	455.8
Range	308.0	361.0	113.0	380.0

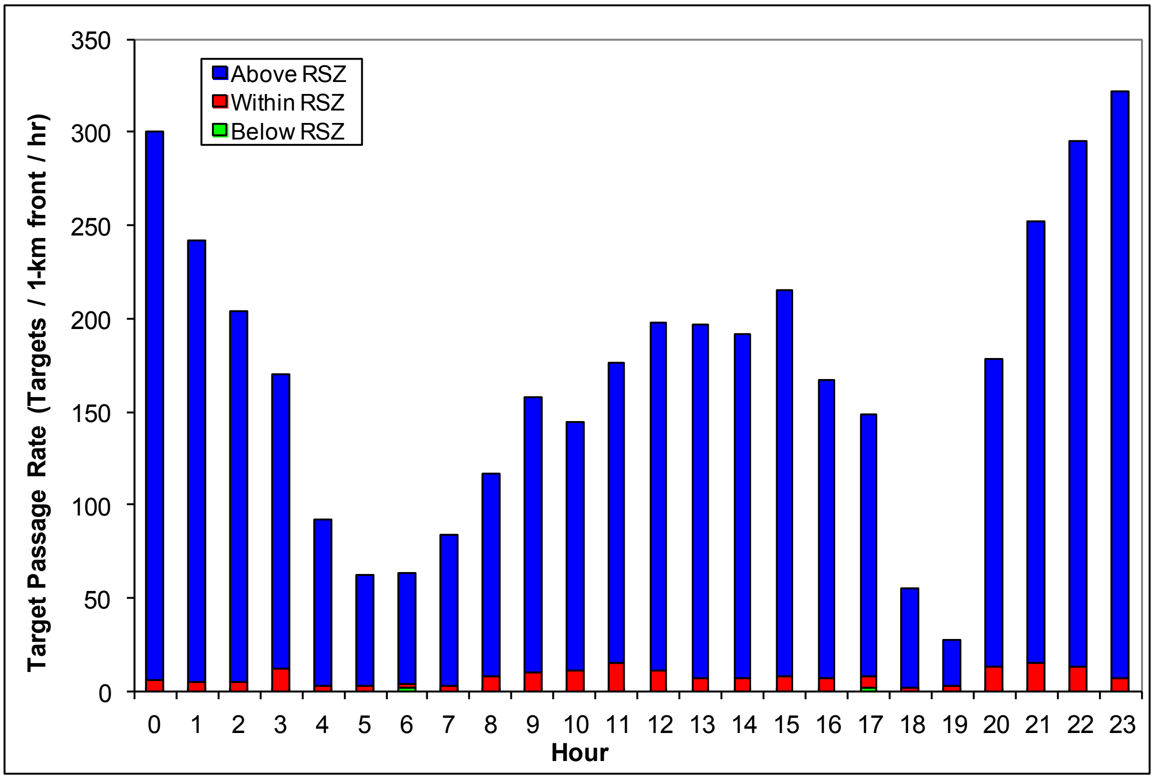

Figure 8-3. Hourly activity (average target passage rates) at site 3.

8.2.2 Altitudinal Distribution of Targets

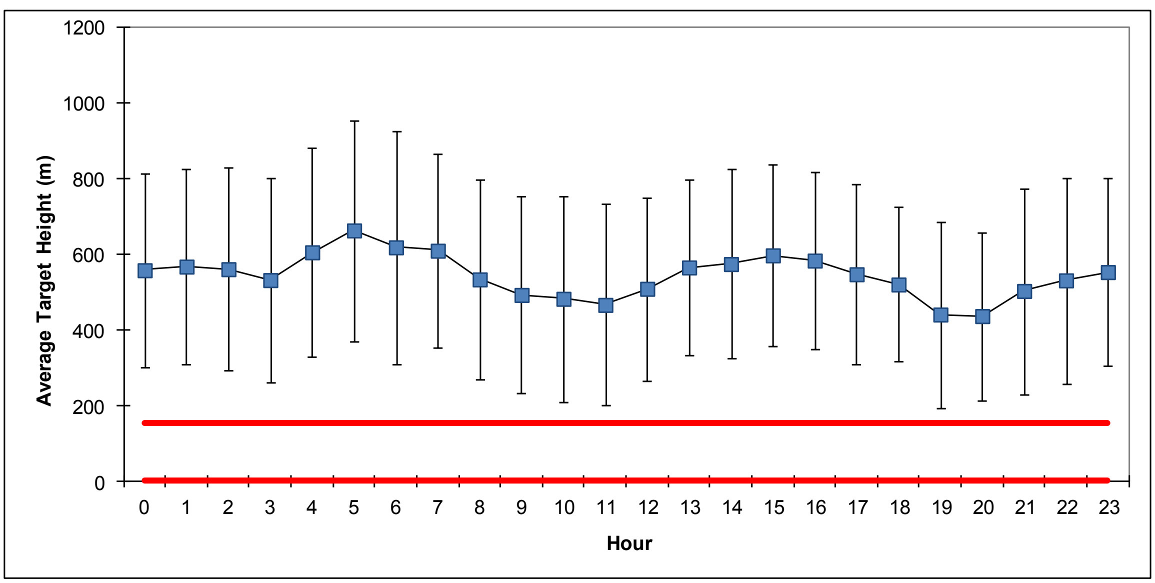

Figure 8-4. Average hourly target heights AGL at site 3. Error bars represent standard deviation for each hour and red lines represent the top and bottom of the rotor swept zone (0 – 152.4 m AGL).

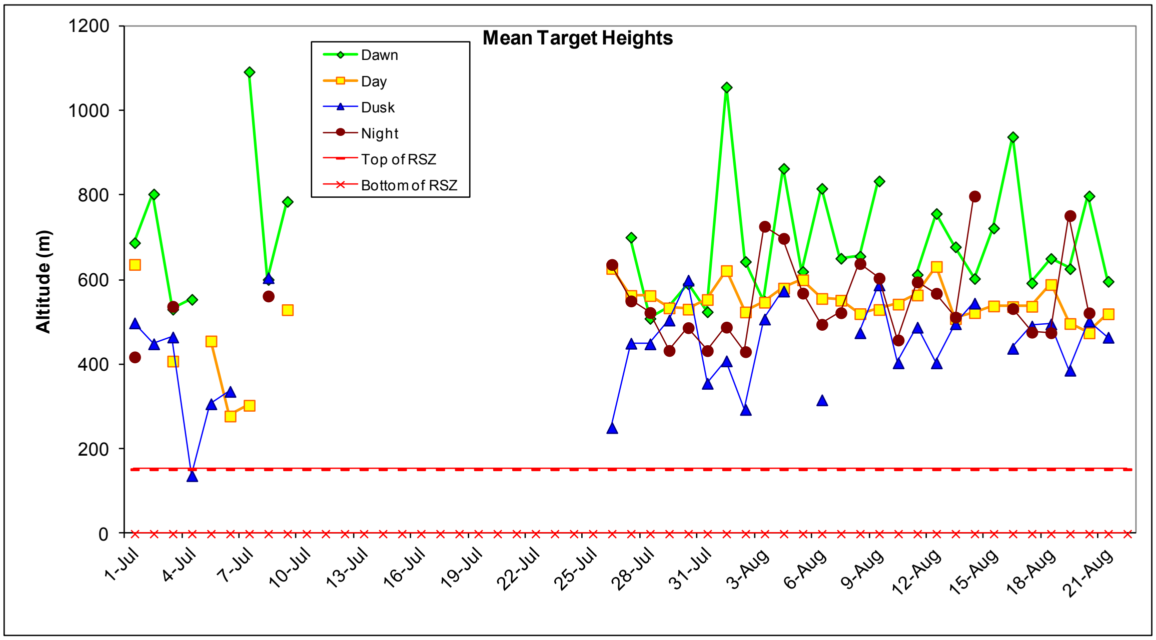

Figure 8-5. Mean target heights during four biological periods at site 3.

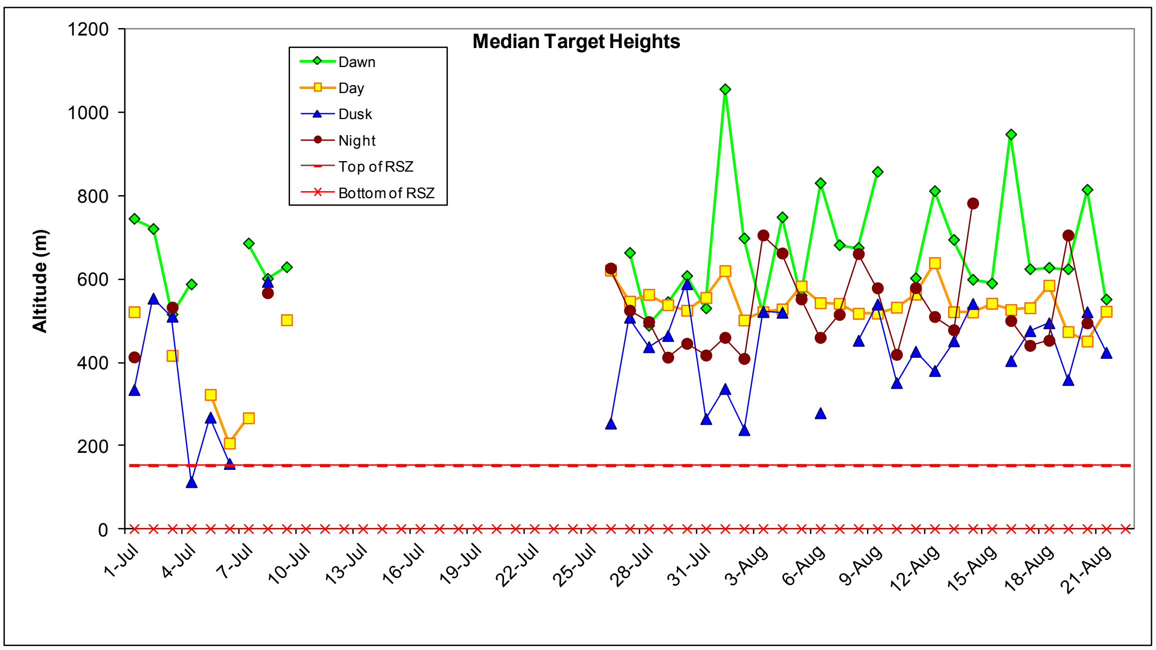

Figure 8-6. Median target heights during four biological periods at site 3.

Table 8-3. Summary of mean and median target heights during four biological periods of the spring 2011 season. The top presents averages of mean and median target heights calculated during each biological period having at least 50% data in that time period; the bottom presents the overall mean and median target heights when all targets in each of the four biological periods were combined.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average mean target height	693.4	529.9	441.7	551.7
Average median target height	670.0	510.7	411.4	528.2
All targets for season combined				
Mean target height	657.0	537.6	425.8	539.0
Median target height	627.0	531.9	394.4	506.0

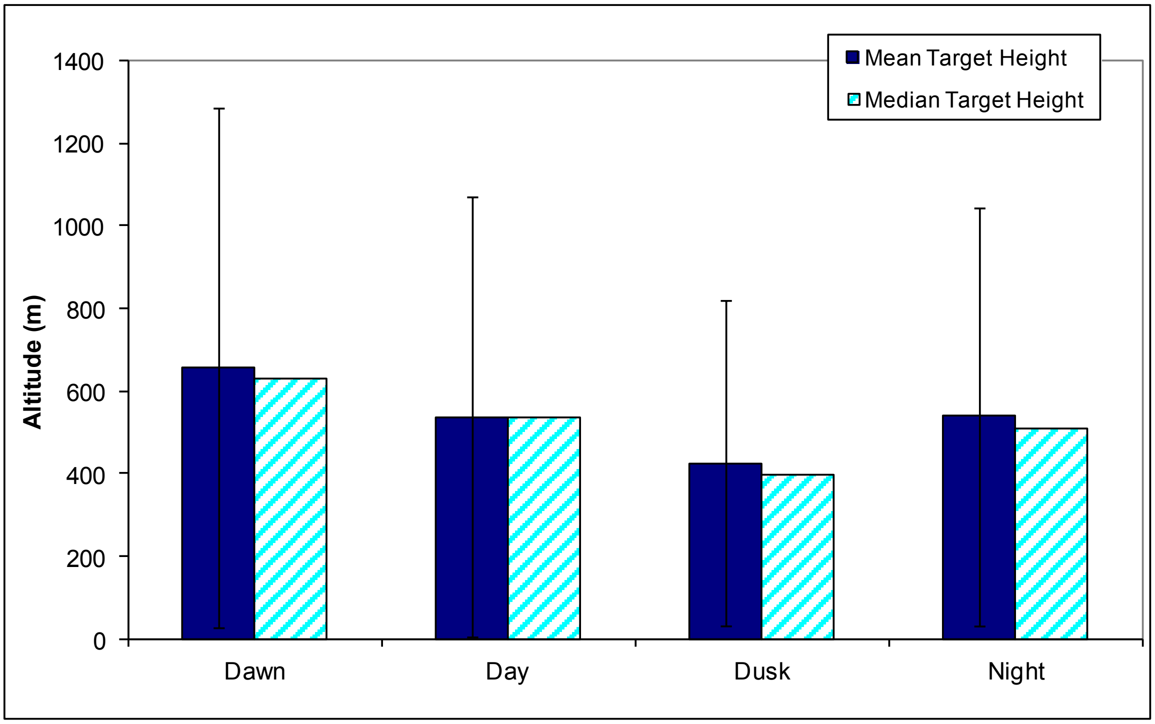

Figure 8-7. Overall mean and median target heights when all targets in each of the four biological periods were combined at site 3. Error bars represent one standard deviation.

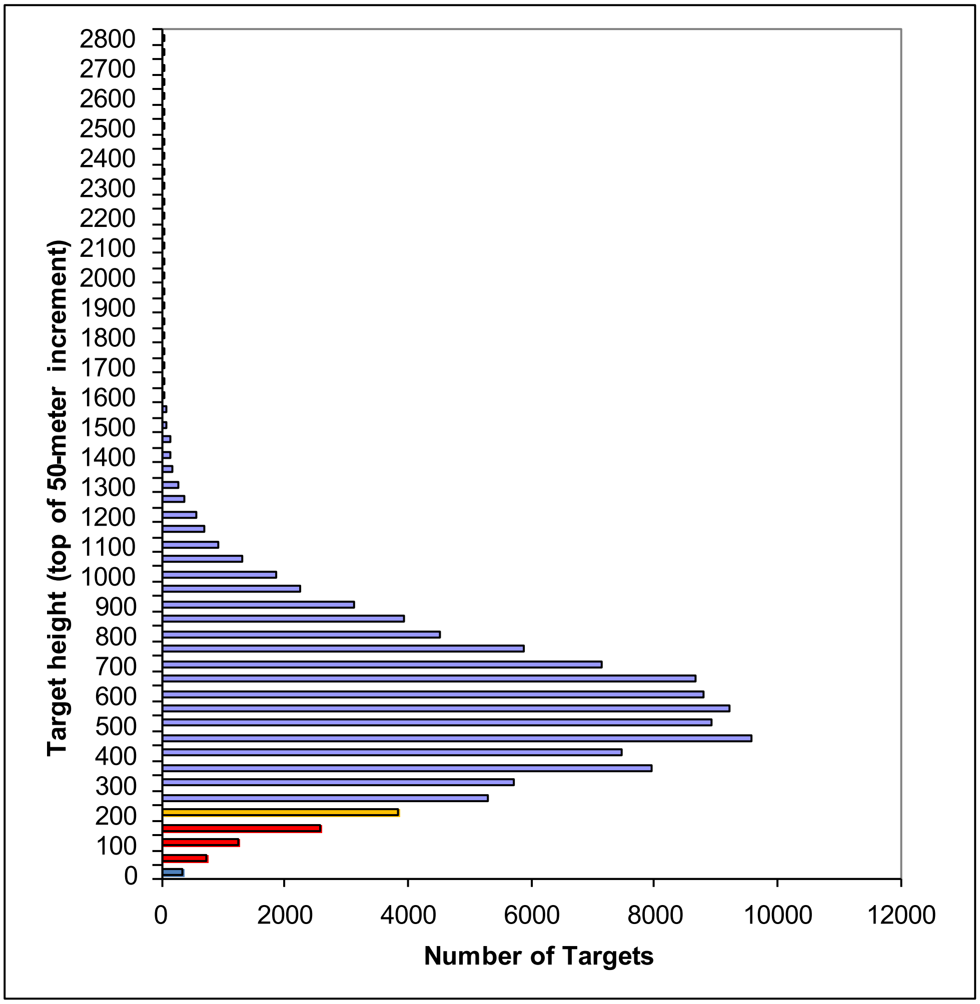

Figure 8-8. Number of targets occurring in each 50-meter increment at site 3. Red indicates rotor swept heights, and orange indicates altitudes partially within rotor swept heights.

Table 8-4. Summary of target passage rates and percent of targets above, within and below the RSZ during four biological periods at site 3.

	Dawn	Day	Dusk	Night
All targets for season combined				
% targets above RSZ	95.5%	95.1%	88.7%	96.9%
% targets within RSZ	3.7%	4.5%	10.8%	3.0%
% targets below RSZ	0.7%	0.4%	0.5%	0.1%
% targets below turbine height	4.5%	4.9%	11.3%	3.1%
Target data calculated for each date				
Average % of targets in RSZ	3.4%	6.1%	9.9%	2.9%
Min target percentage within RSZ	0.0%	0.0%	0.0%	0.1%
Max target percentage within RSZ	14.3%	33.3%	75.0%	9.9%
Average target passage rate above RSZ	56.4	133.8	36.2	225.9
Average target passage rate within RSZ	2.2	6.5	4.7	7.1
Average target passage rate below RSZ	0.4	0.6	0.2	0.3

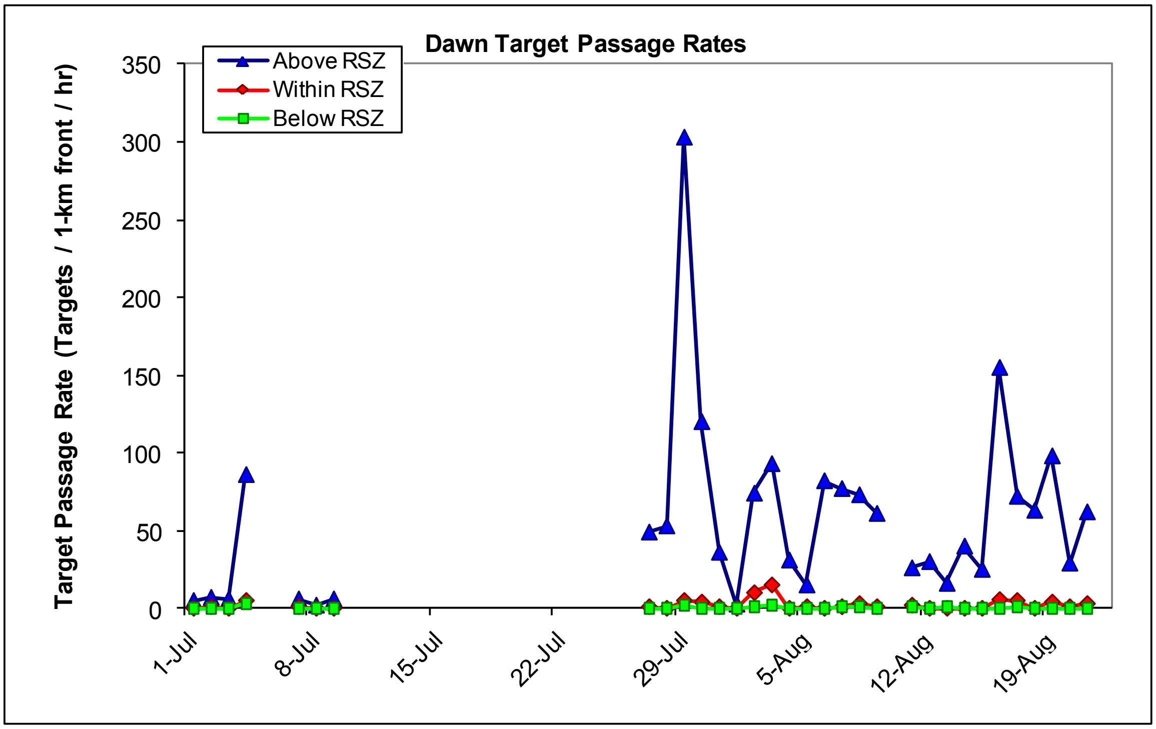

Figure 8-9. Target passage rates below, at, and above the rotor swept zone (RSZ) during dawns at site 3.

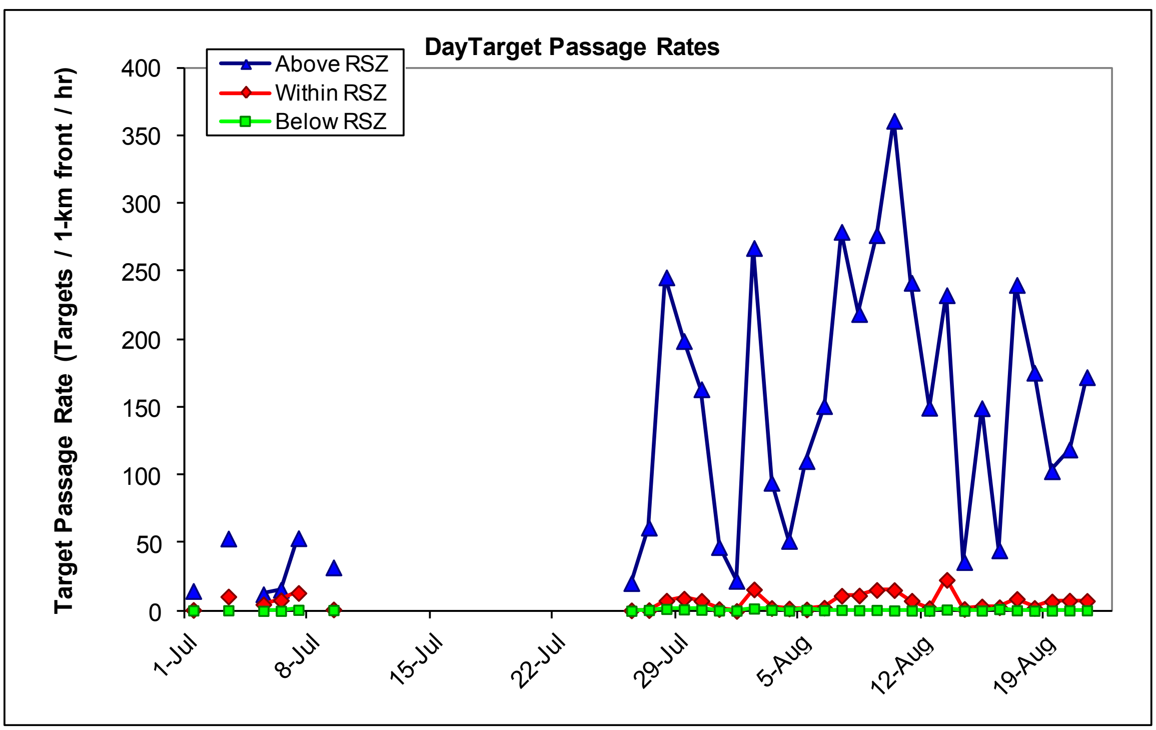

Figure 8-10. Target passage rates below, at, and above the rotor swept zone (RSZ) during days at site 3.

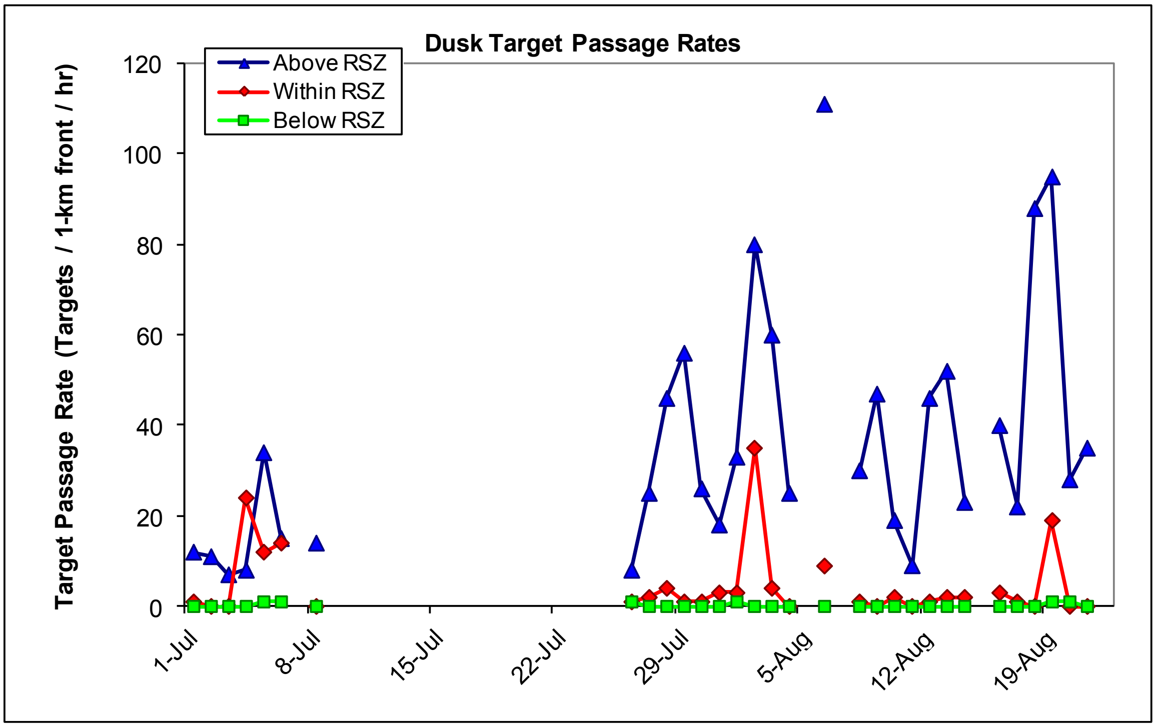

Figure 8-11. Target passage rates below, at, and above the rotor swept zone (RSZ) during dusks at site 3.

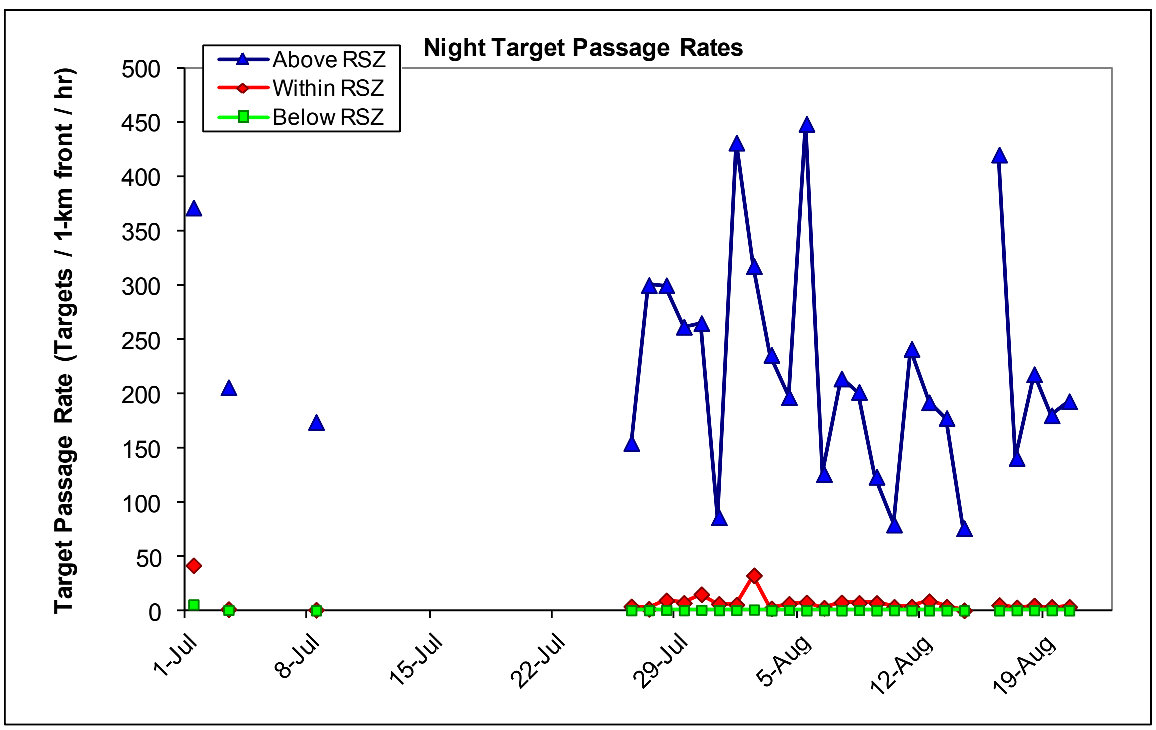

Figure 8-12. Target passage rates below, at, and above the rotor swept zone (RSZ) during nights at site 3.

8.3 Horizontal Radar Data

8.3.1 Target Directions

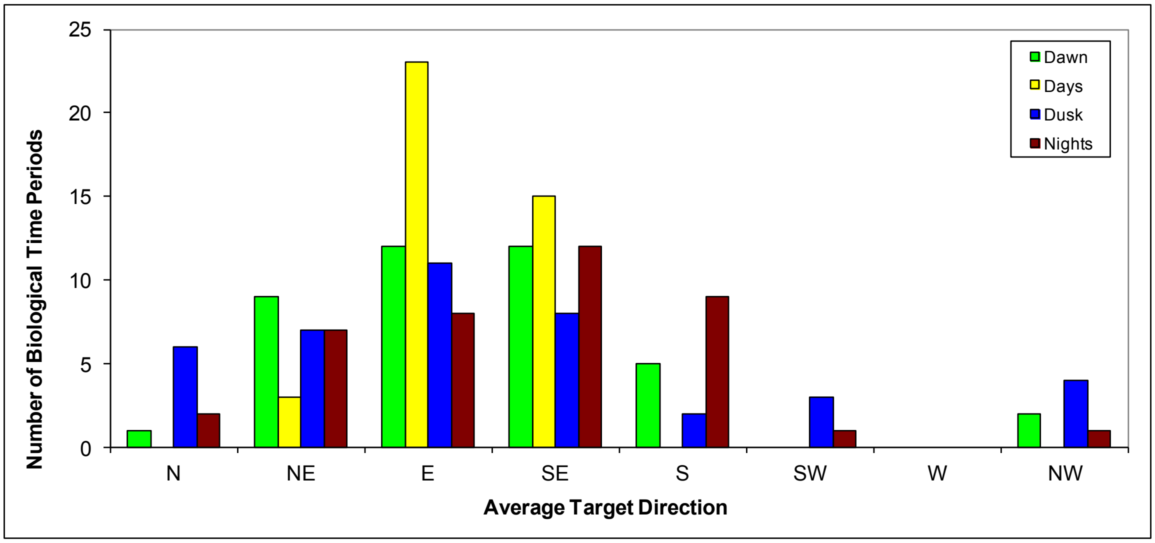

Figure 8-13. Distribution of average target movements among eight directions during dawns, days, dusks, and nights at site 3.

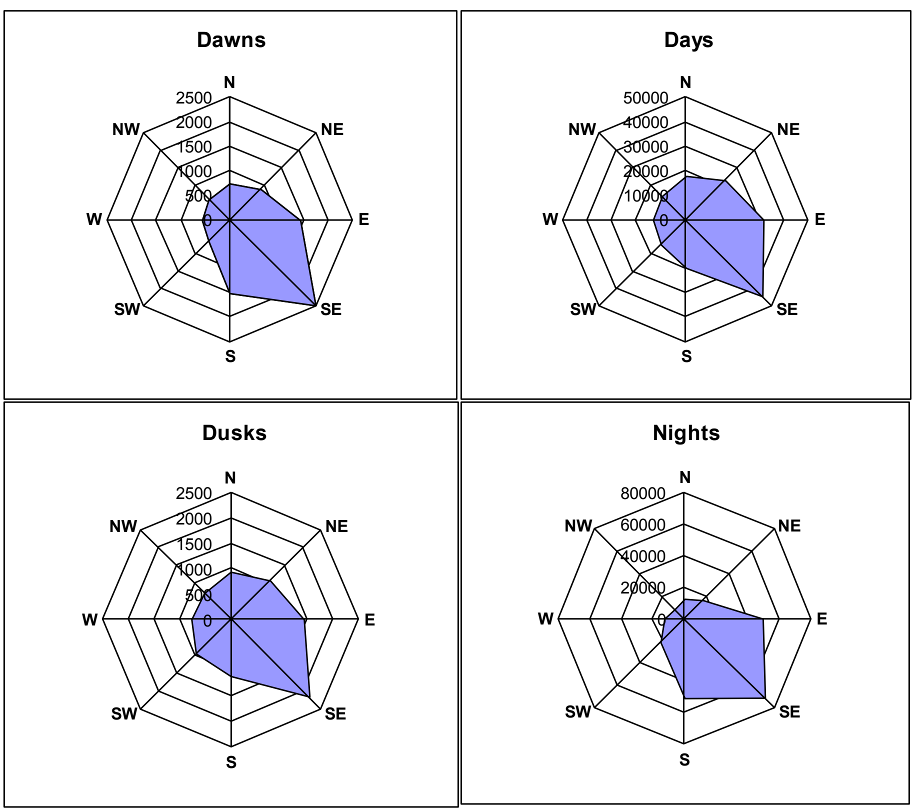

Figure 8-14. Cumulative target direction of all targets during all dawns, days, dusks, and nights at site 3.

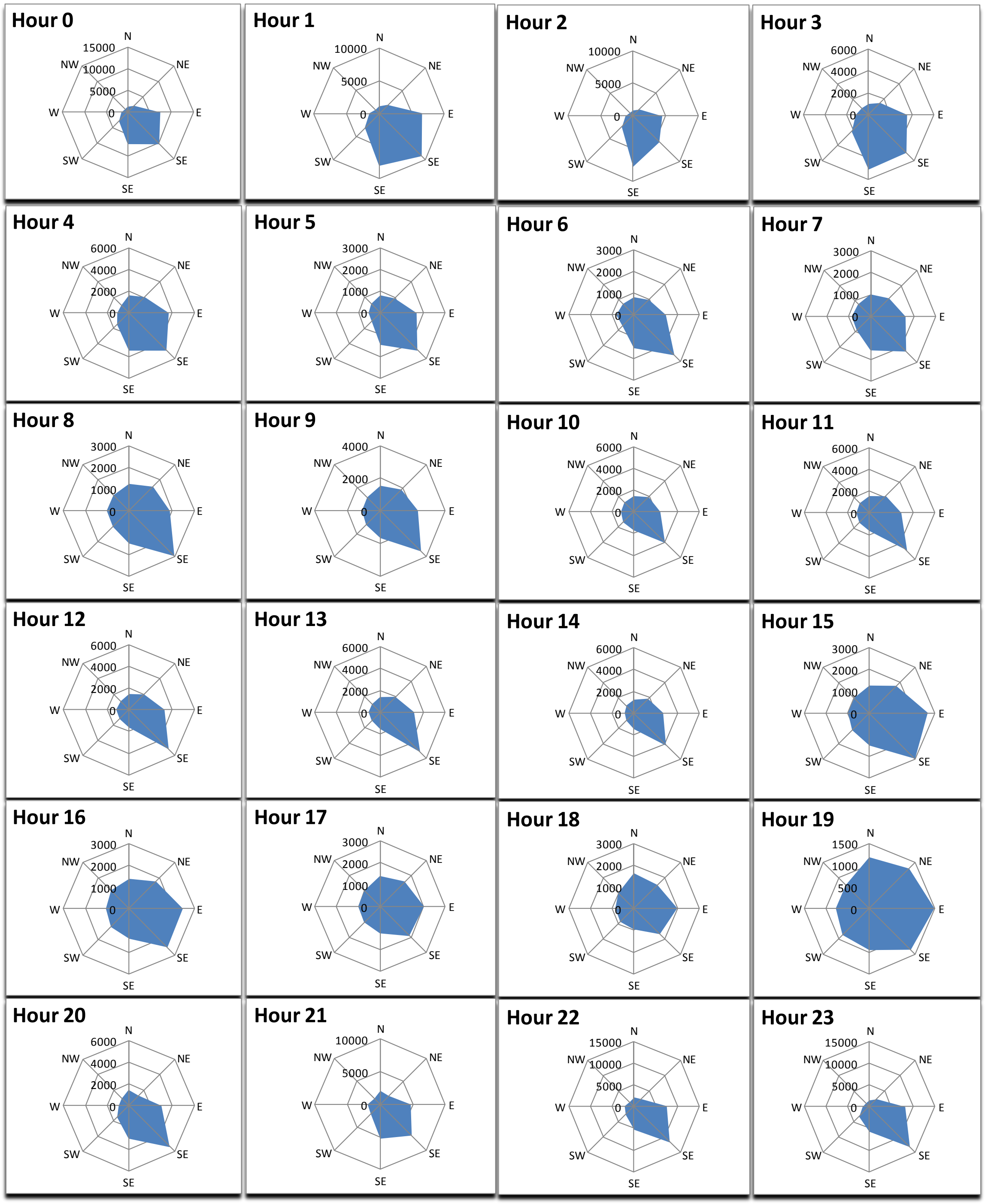

Figure 8-15. Directional distributions for targets during four biological periods at site 3.

9 RESULTS for Site 4 (September 24 – November 16, 2011)

9.1 Level of Effort

The MERLIN Avian Radar System operated at Site 4 from September 24 to November 16, 2011.

Table 9-1. Effort of radar monitoring at site 4.

Radar	Time In Reporting Period	Time radar collected data	Radar downtime	Radar data with rain and/or insects	Useable radar data
Vertical Radar (hrs)	1296	1127.6	168.4	185	942.6
Horizontal Radar (hrs)	1296	1127.7	168.3	82	1045.7

9.2 Vertical Radar Data

9.2.1 Target Passage Rates Over Time

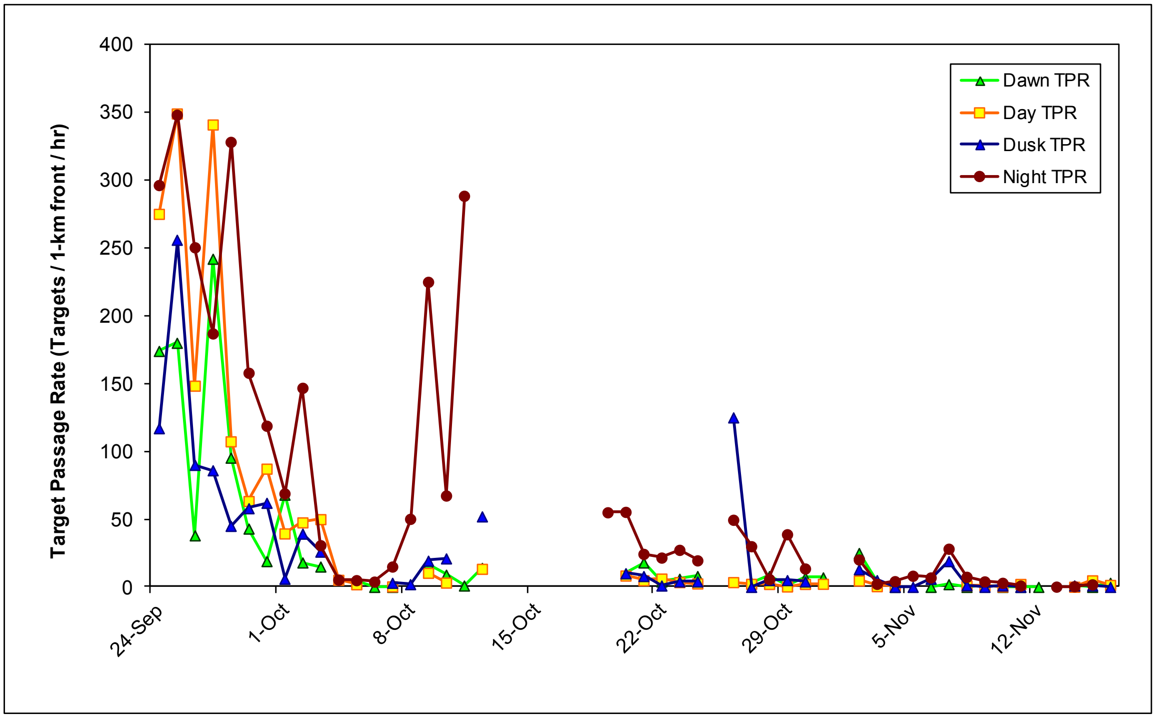

Figure 9-1. Target passage rates during dawns, days, dusks, and nights at site 4.

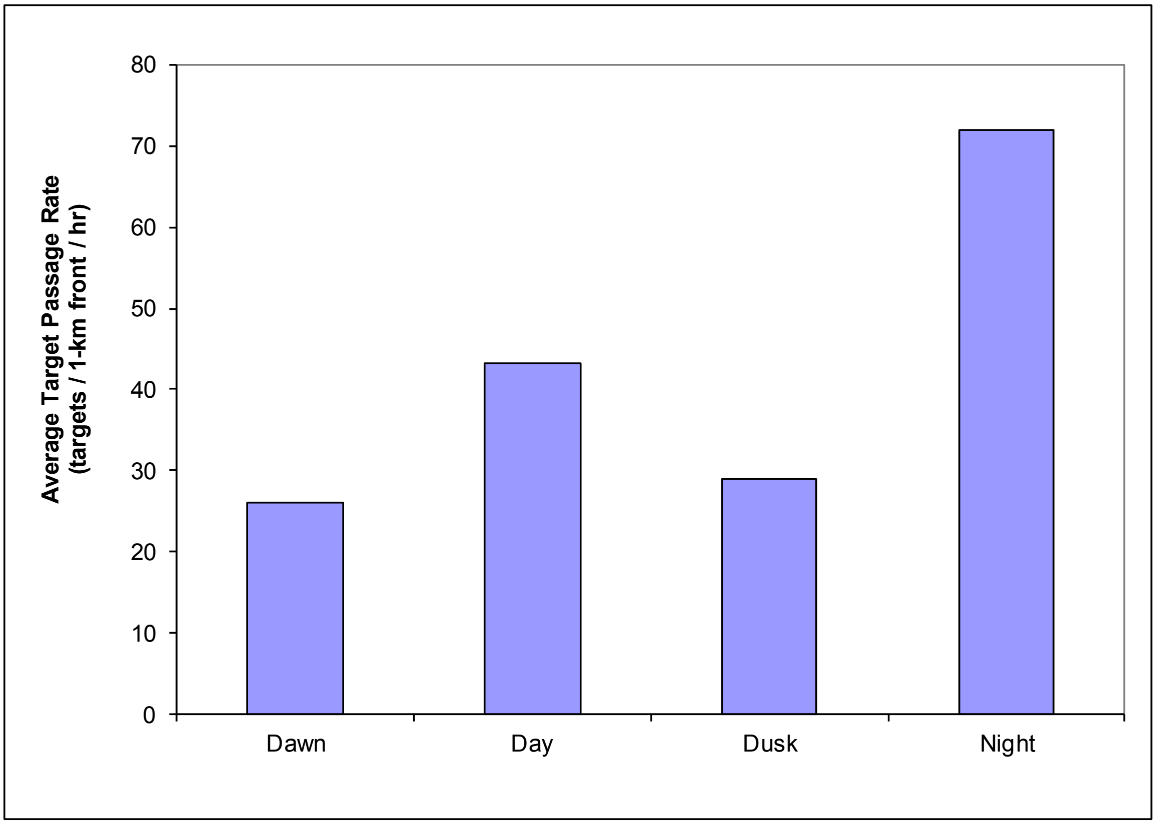

Figure 9-2. Average target passage rates for dawns, days, dusks, and nights at site 4.

Table 9-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for four biological periods at site 4.

	Dawn	Day	Dusk	Night
Average	26.1	43.2	28.8	72.0
Standard Deviation	54.0	90.8	50.6	101.1
Median	6.5	3.5	5.5	25.8
Minimum	0.0	0.1	0.0	0.2
Maximum	242.0	349.1	256.0	348.2
Range	242.0	349.0	256.0	348.0

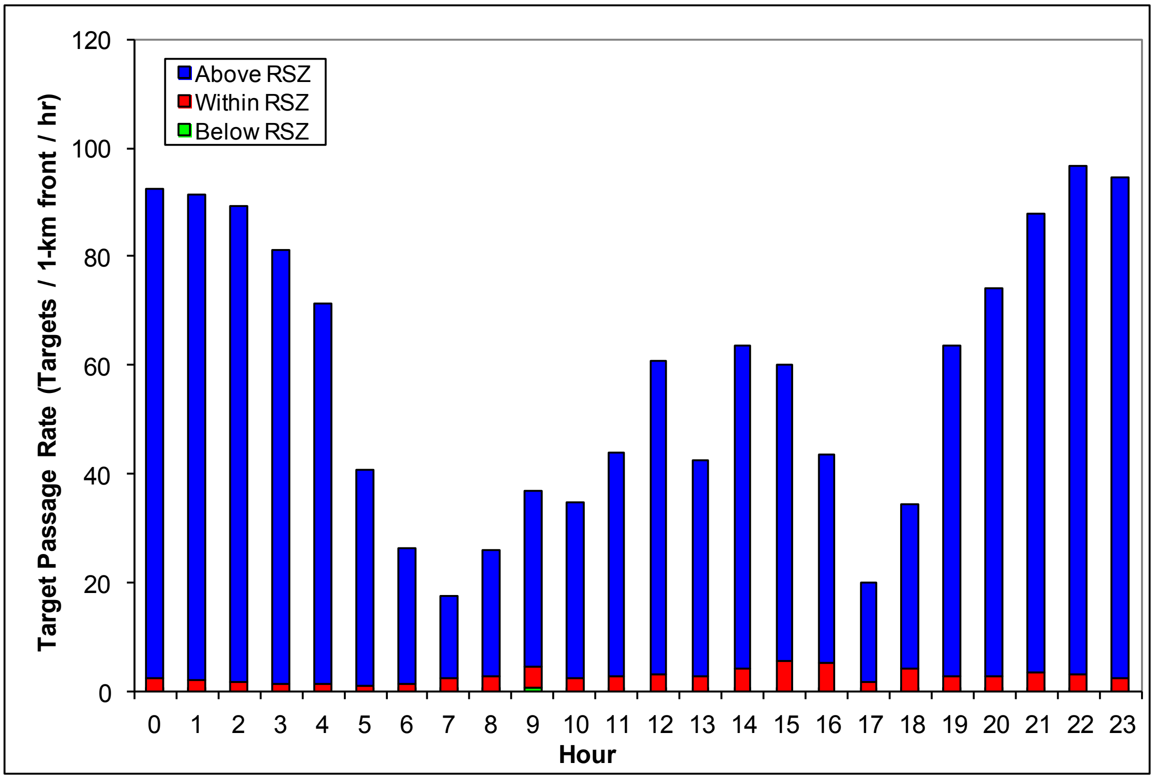

Figure 9-3. Hourly activity (average target passage rates) at site 4.

9.2.2 Altitudinal Distribution of Targets

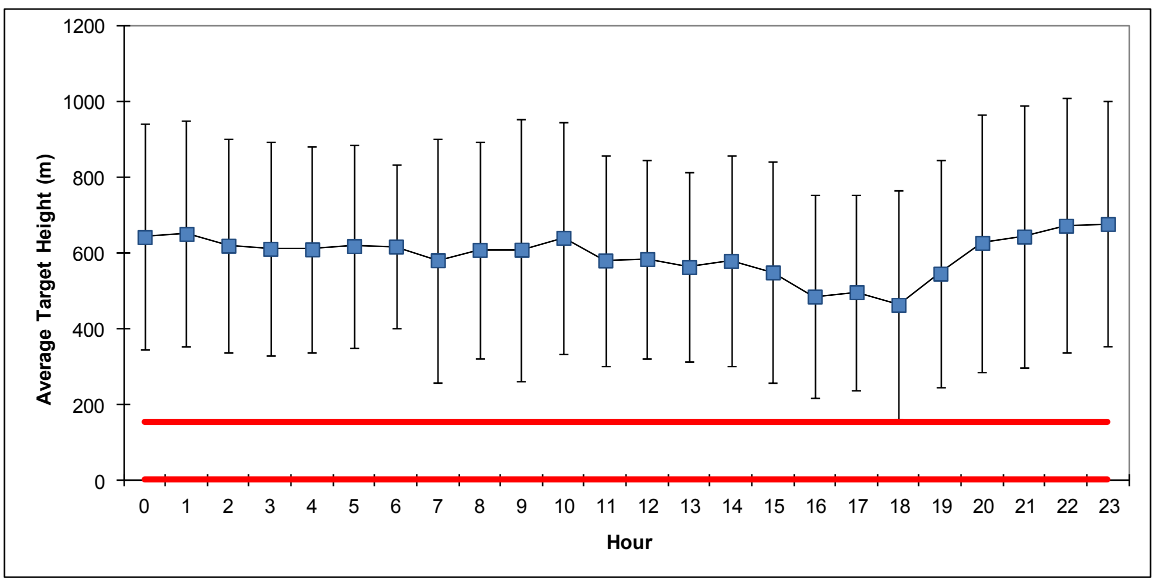

Figure 9-4. Average hourly target heights AGL at site 4. Error bars represent standard deviation for each hour and red lines represent the top and bottom of the rotor swept zone (0 – 152.4 m AGL).

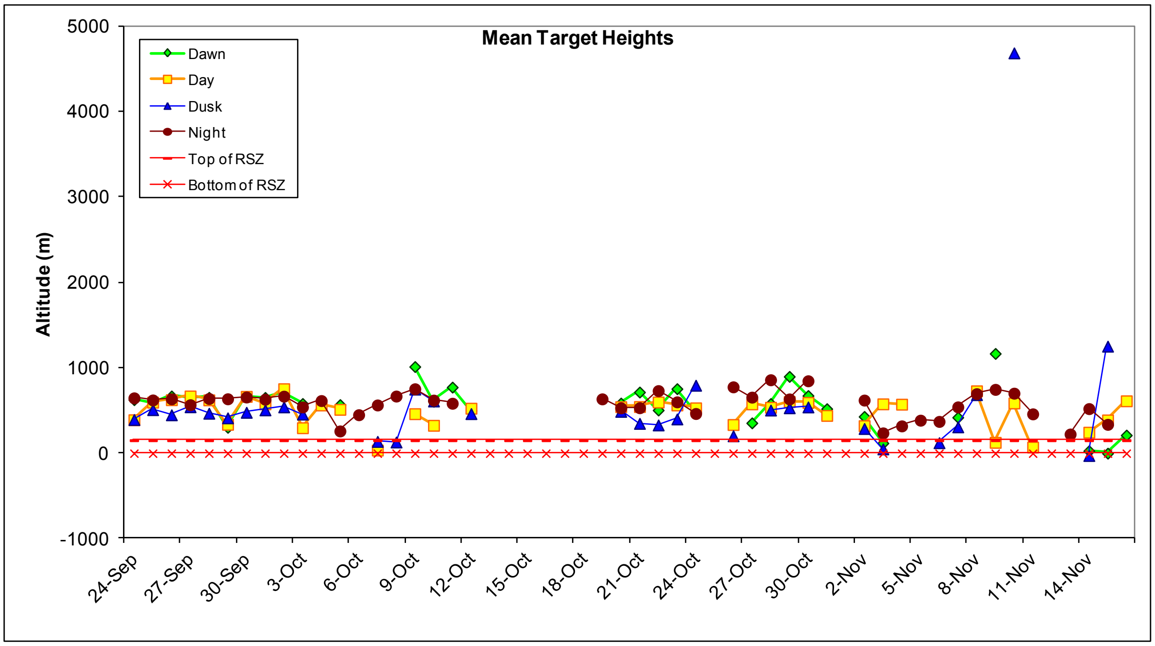

Figure 9-5. Mean target heights during four biological periods at site 4.

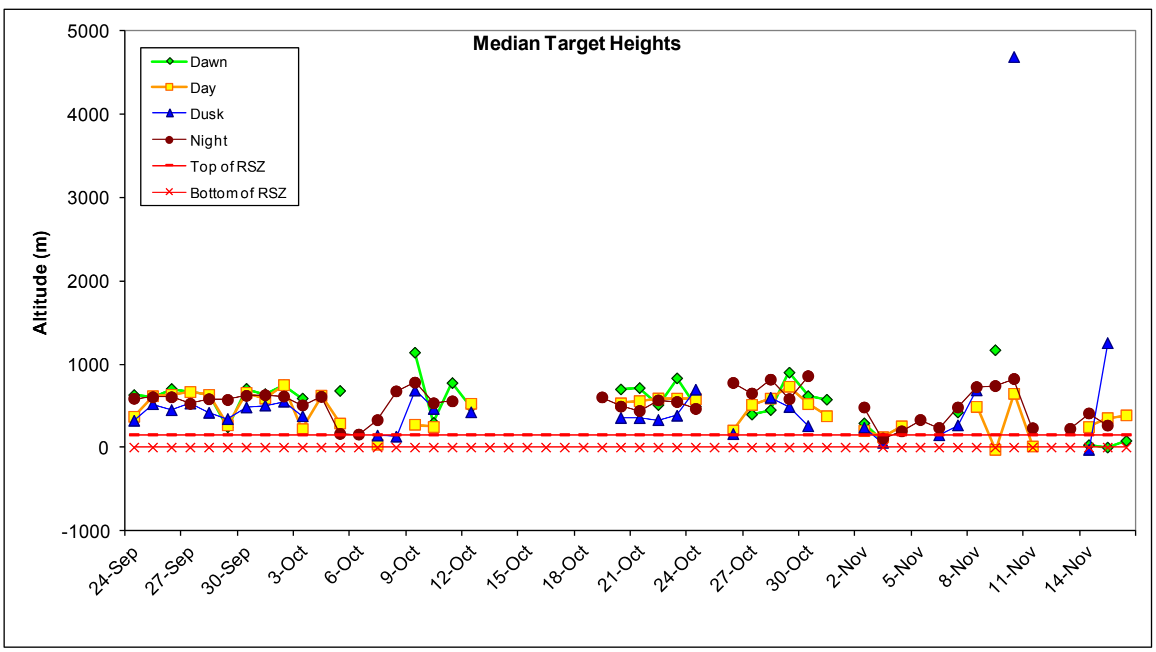

Figure 9-6. Median target heights during four biological periods at site 4.

Table 9-3. Summary of mean and median target heights during four biological periods at site 4. The top presents averages of mean and median target heights calculated during each biological period having at least 50% data in that time period; the bottom presents the overall mean and median target heights when all targets in each of the four biological periods were combined.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average mean target height	581.4	489.3	574.6	577.0
Average median target height	573.6	428.8	540.2	516.3
All targets for season combined				
Mean target height	611.0	571.6	450.0	632.0
Median target height	625.8	582.5	428.1	588.3

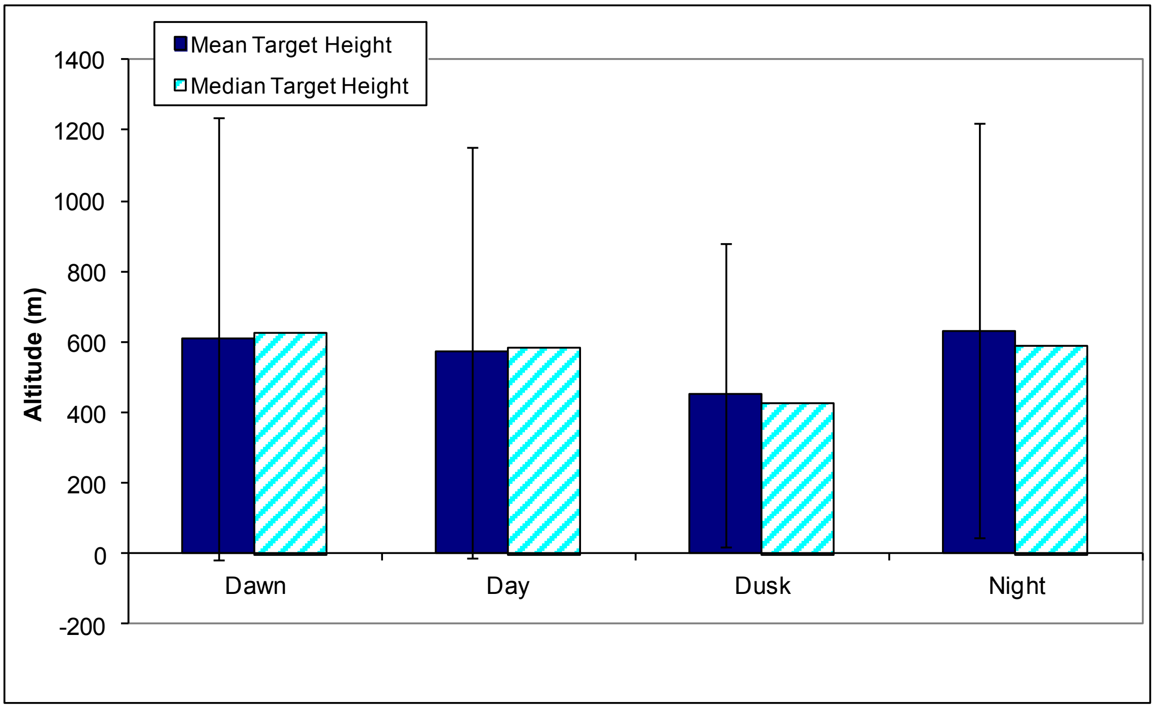

Figure 9-7. Overall mean and median target heights when all targets in each of the four biological periods were combined at site 4. Error bars represent one standard deviation.

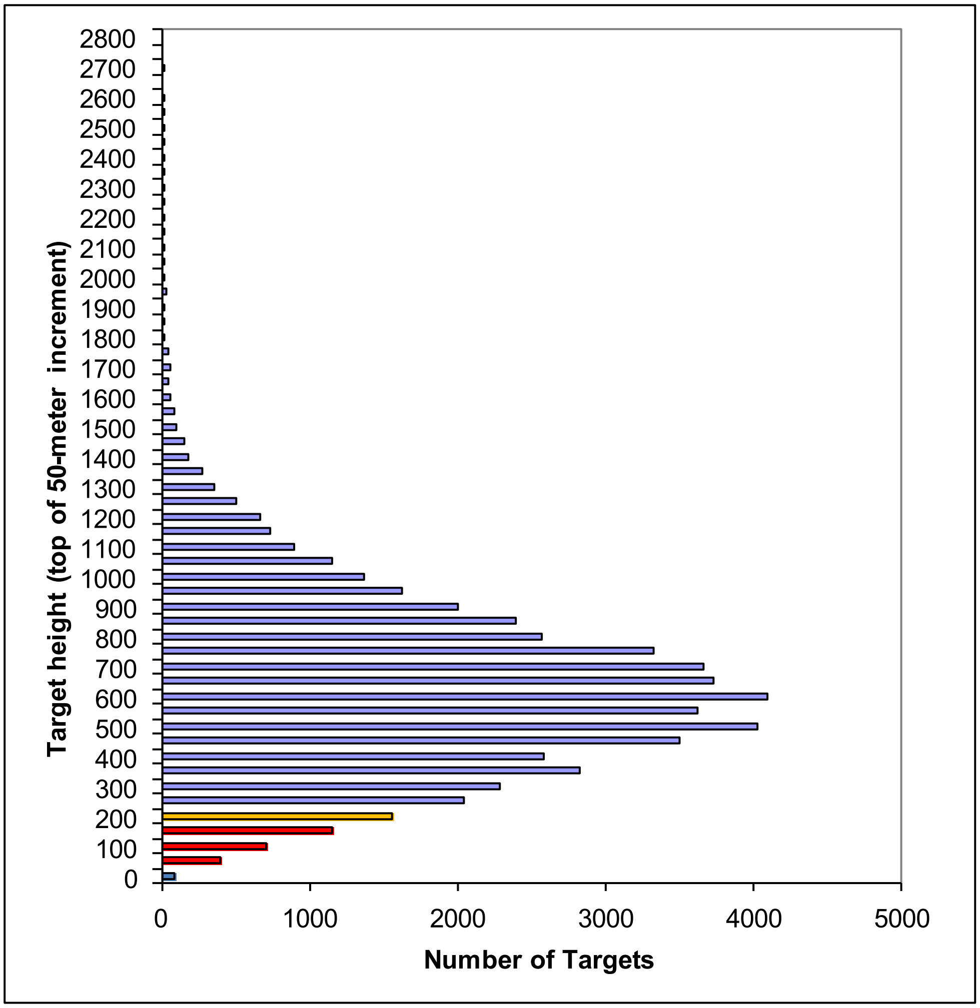

Figure 9-8. Number of targets occurring in each 50-meter increment at site 4. Red indicates rotor swept heights, and orange indicates altitudes partially within rotor swept heights.

Table 9-4. Summary of target passage rates and percent of targets above, within and below the RSZ during four biological periods at site 4.

	Dawn	Day	Dusk	Night
All targets for season combined				
% targets above RSZ	95.0%	92.3%	89.2%	97.4%
% targets within RSZ	5.0%	7.3%	10.6%	2.5%
% targets below RSZ	0.1%	0.4%	0.3%	0.1%
% targets below turbine height	5.0%	7.7%	10.8%	2.6%
Target data calculated for each date				
Average % of targets in RSZ	12.9%	18.5%	15.7%	12.8%
Min target percentage within RSZ	0.0%	0.0%	0.0%	0.3%
Max target percentage within RSZ	100.0%	100.0%	100.0%	57.1%
Average target passage rate above RSZ	24.8	39.6	25.7	70.0
Average target passage rate within RSZ	1.3	3.4	3.1	1.9
Average target passage rate below RSZ	0.0	0.2	0.1	0.0

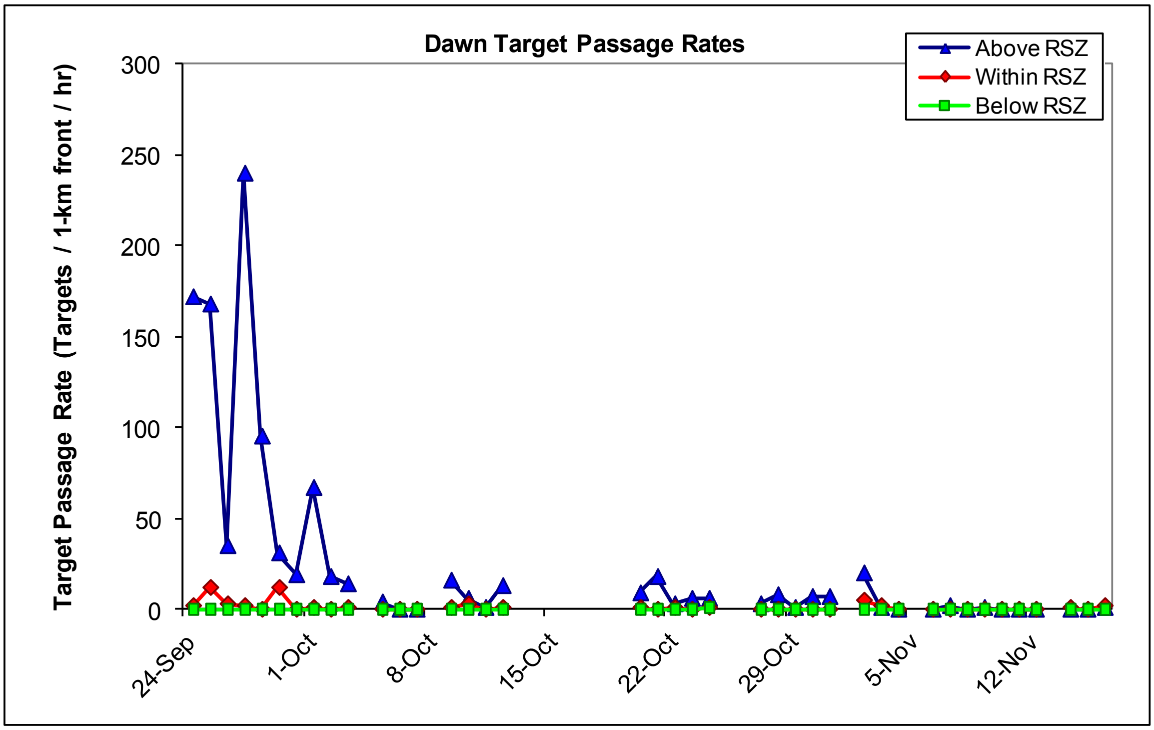

Figure 9-9. Target passage rates below, at, and above the rotor swept zone (RSZ) during dawns at site 4.

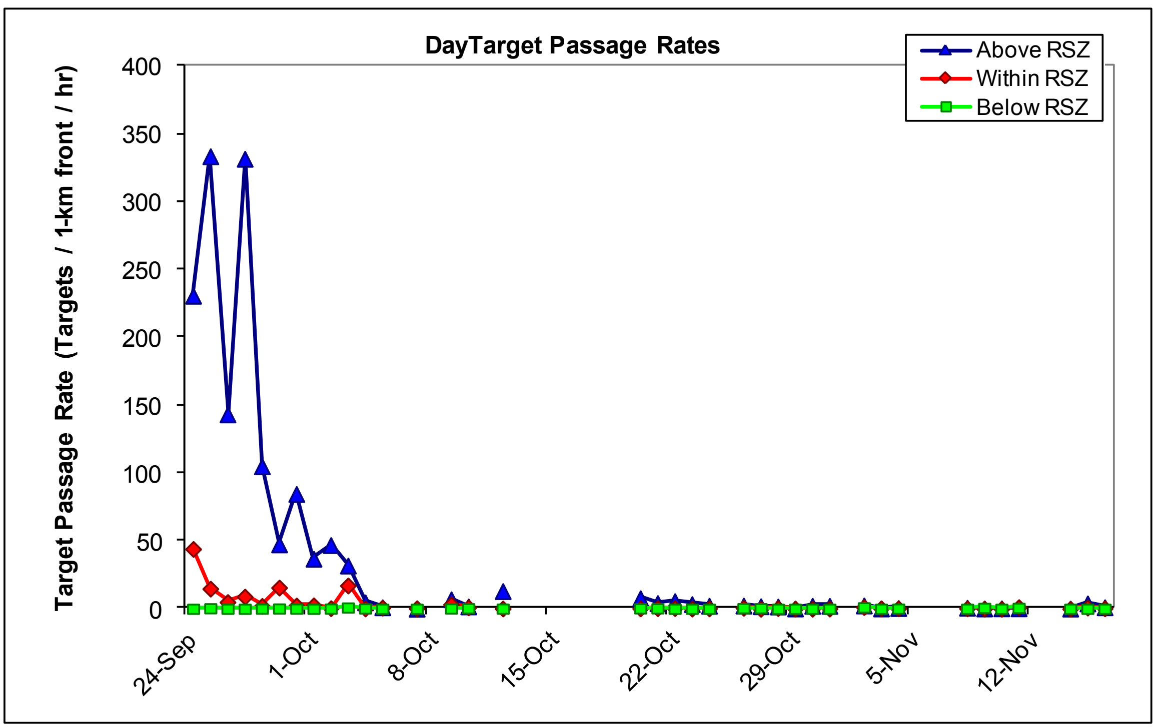

Figure 9-10. Target passage rates below, at, and above the rotor swept zone (RSZ) during days at site 4.

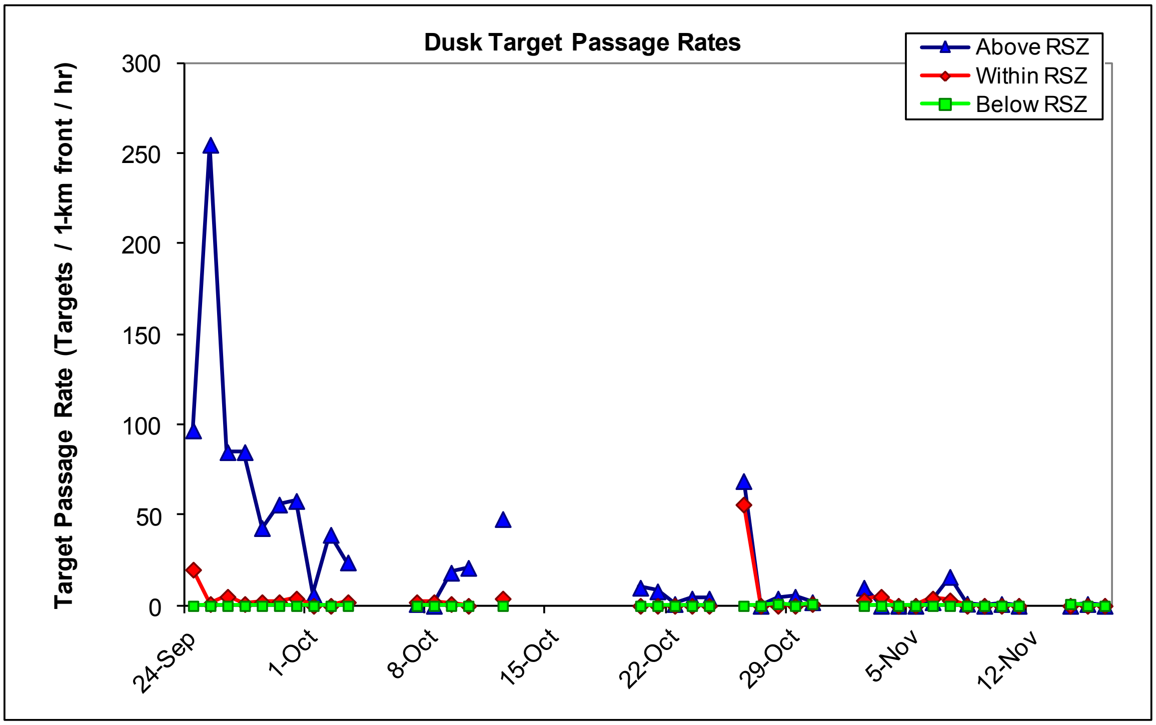

Figure 9-11. Target passage rates below, at, and above the rotor swept zone (RSZ) during dusks at site 4.

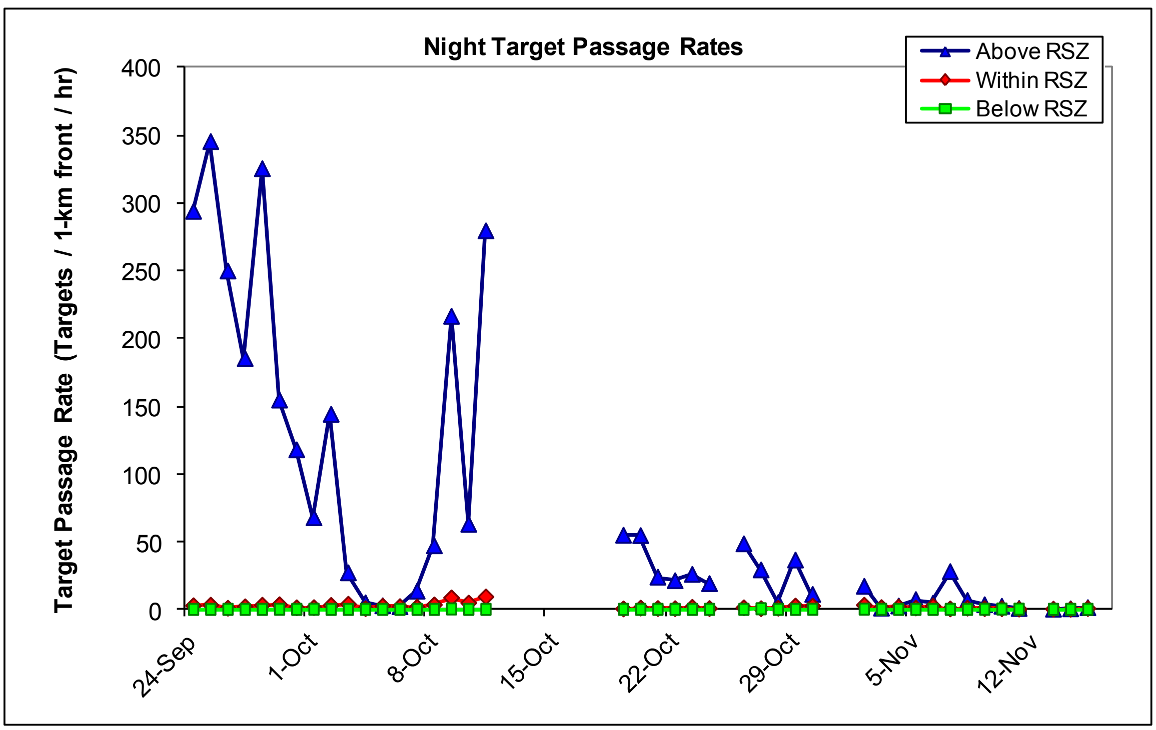

Figure 9-12. Target passage rates below, at, and above the rotor swept zone (RSZ) during nights at site 4.

9.3 Horizontal Radar Data

9.3.1 Target Directions

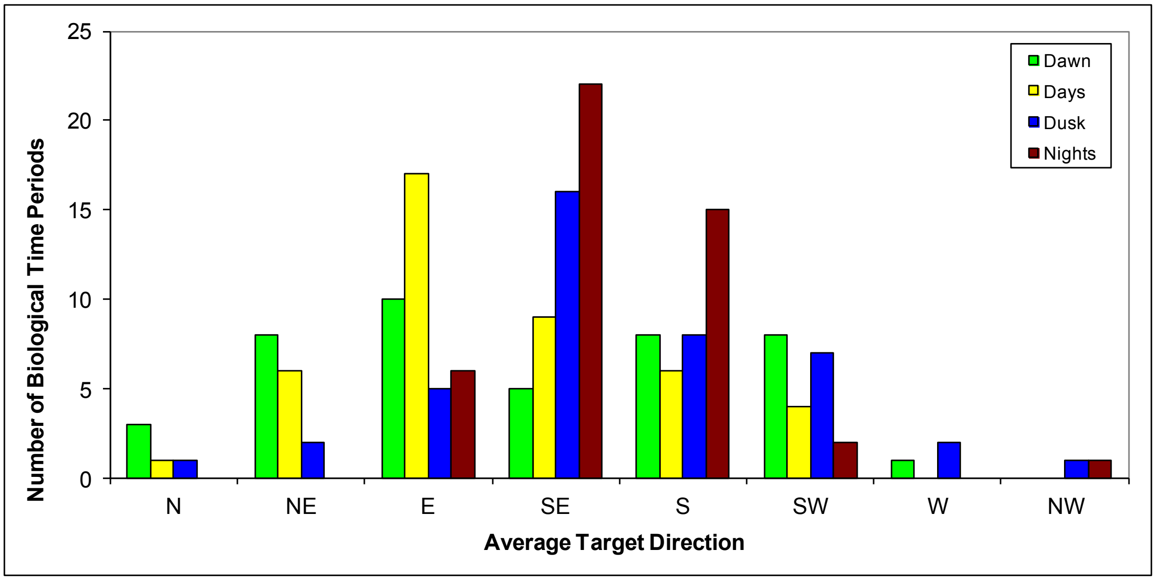

Figure 9-13. Distribution of average target movements among eight directions during dawns, days, dusks, and nights at site 4.

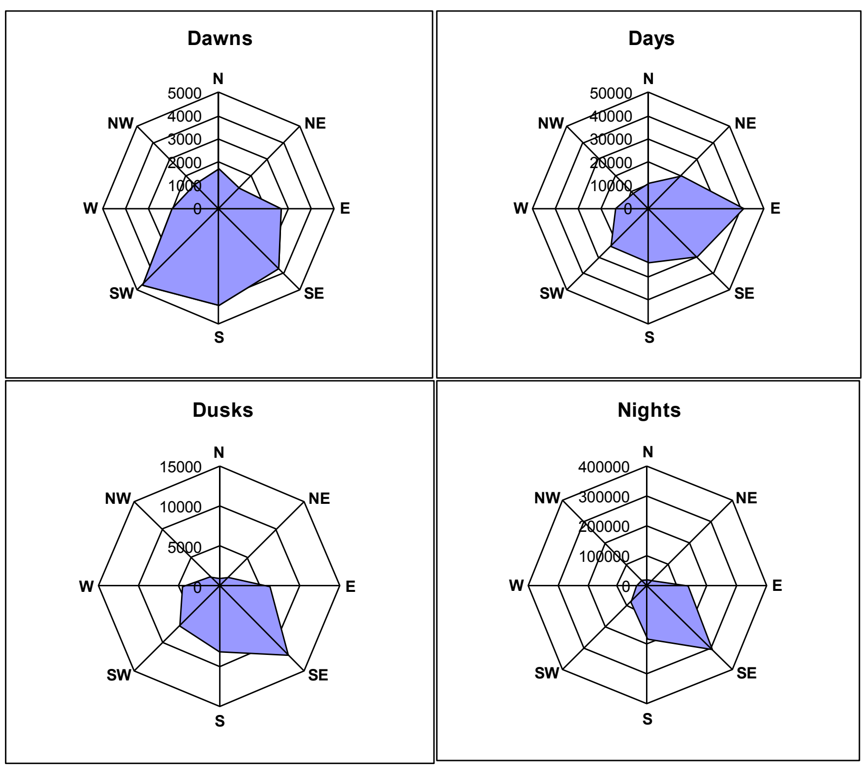

Figure 9-14. Cumulative target direction of all targets during all dawns, days, dusks, and nights at site 4.

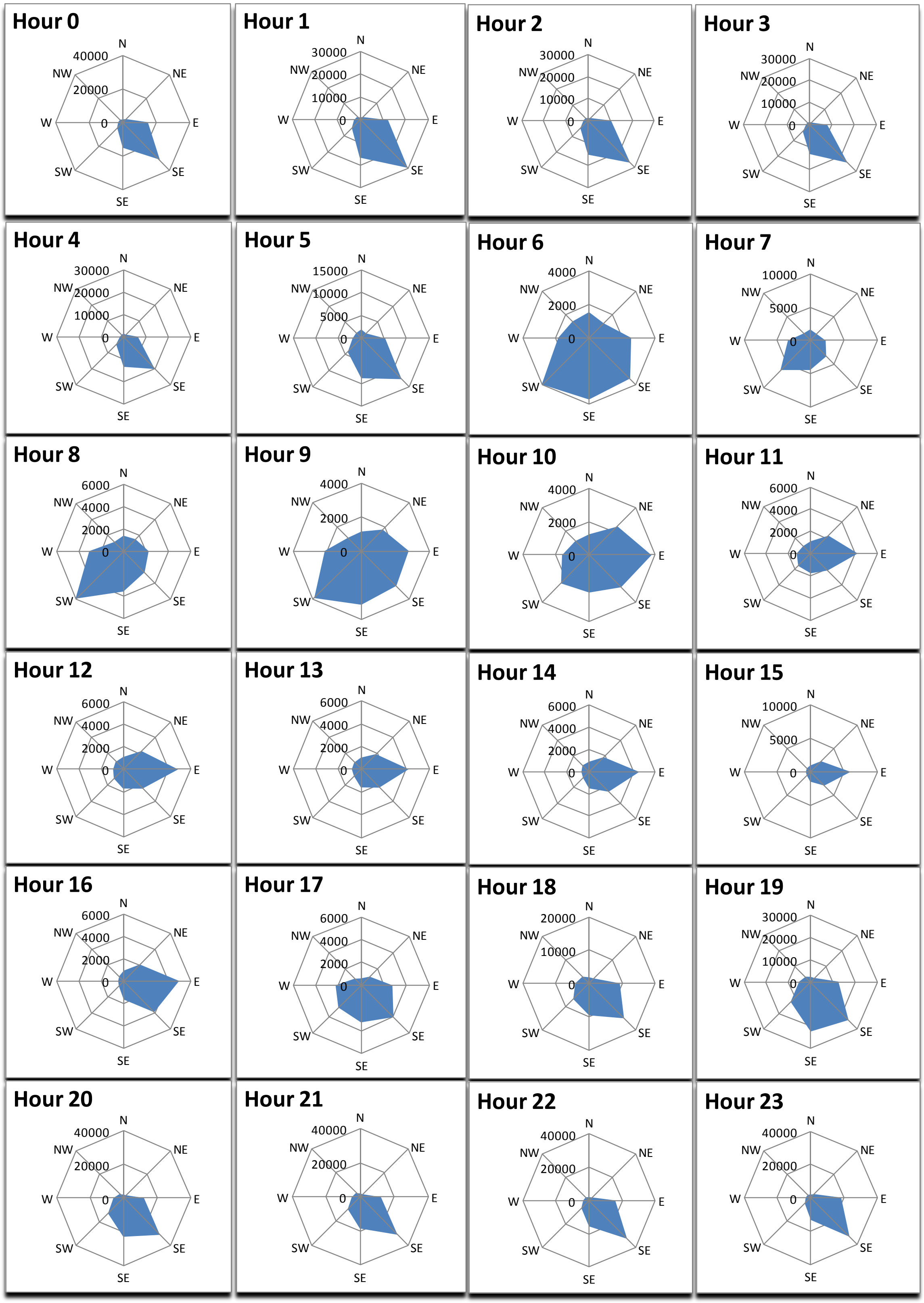

Figure 9-15. Directional distributions for targets during four biological periods at site 4.

10 RESULTS for Site 5 (March 16 – April 23, 2011)

10.1 Level of Effort

The MERLIN Avian Radar System operated at Site 5 from March 16 – April 23, 2011.

Table 10-1. Effort of radar monitoring at site 5.

Radar	Time In Reporting Period	Time radar collected data	Radar downtime	Radar data with rain and/or insects	Useable radar data
Vertical Radar (hrs)	936	897.2	38.8	223.6	673.6
Horizontal Radar (hrs)	936	878.5	57.5	49.5	829

10.2 Vertical Radar Data

10.2.1 Target Passage Rates Over Time

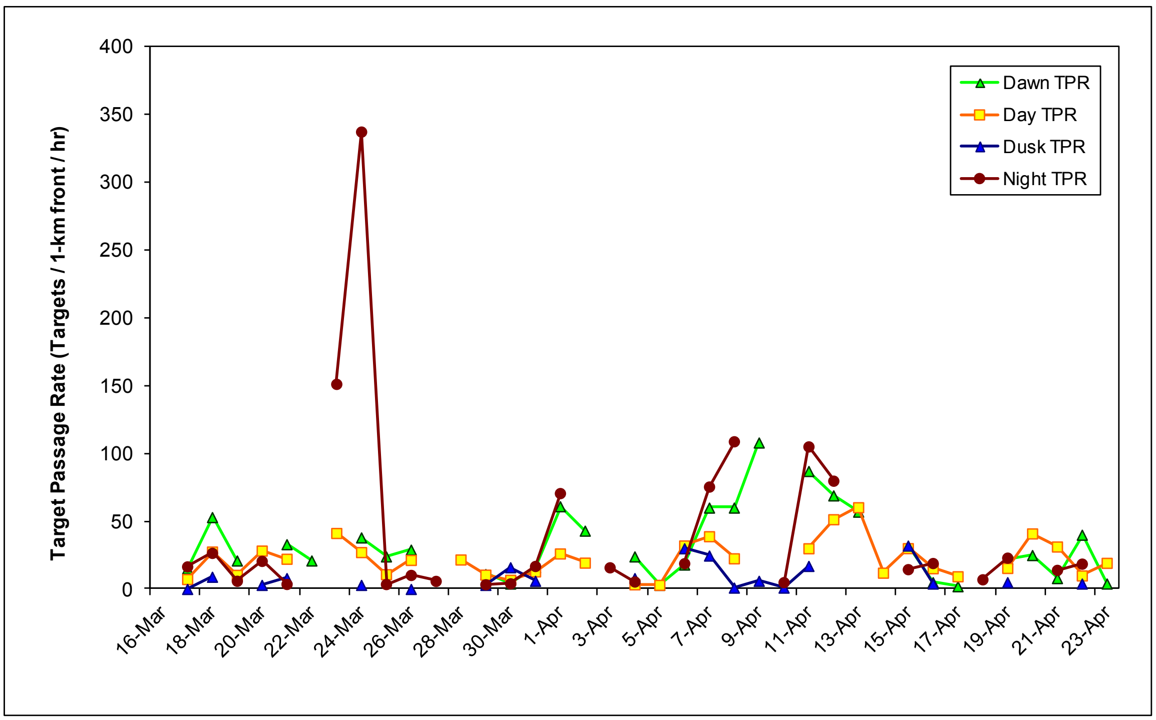

Figure 10-1. Target passage rates during dawns, days, dusks, and nights at site 5.

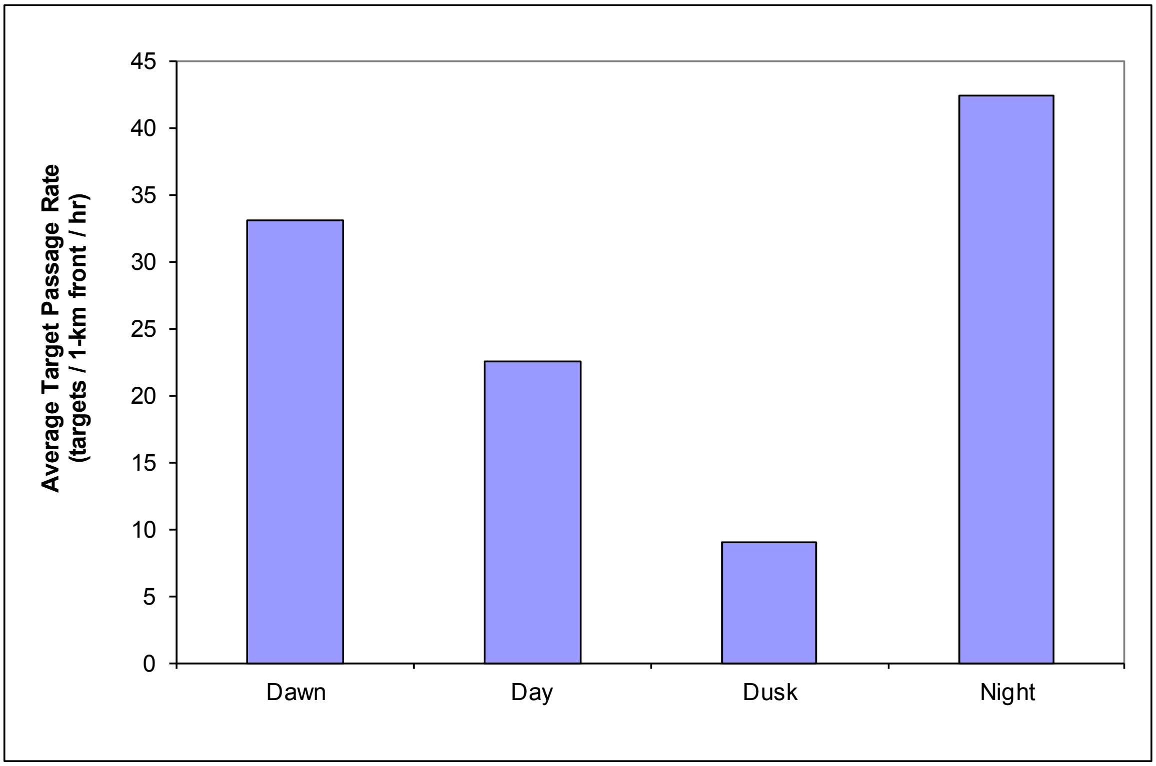

Figure 10-2. Average target passage rates for dawns, days, dusks, and nights at site 5.

Table 10-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for four biological periods at site 5.

	Dawn	Day	Dusk	Night
Average	33.1	22.5	9.0	42.5
Standard Deviation	26.4	13.8	9.8	69.5
Median	24.5	21.6	5.5	16.8
Minimum	2.0	3.0	0.0	3.4
Maximum	108.0	60.3	32.0	337.3
Range	106.0	57.3	32.0	333.9

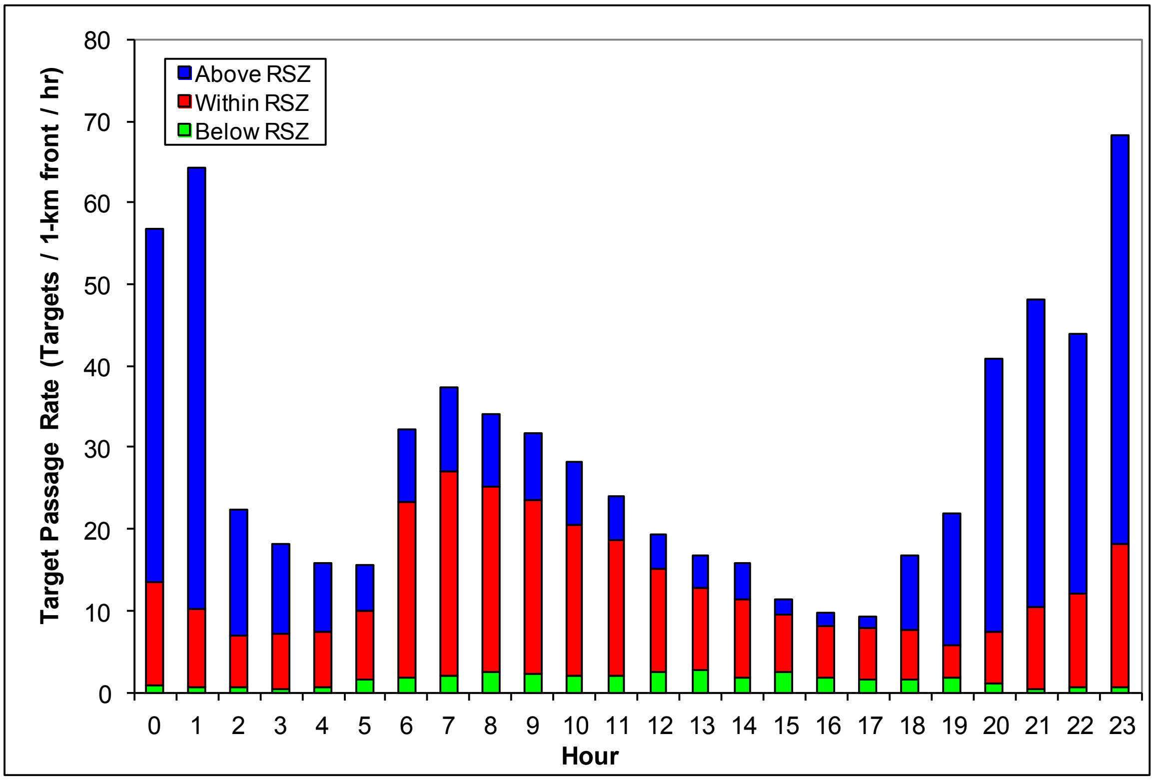

Figure 10-3. Hourly activity (average target passage rates) at site 5.

10.2.2 Altitudinal Distribution of Targets

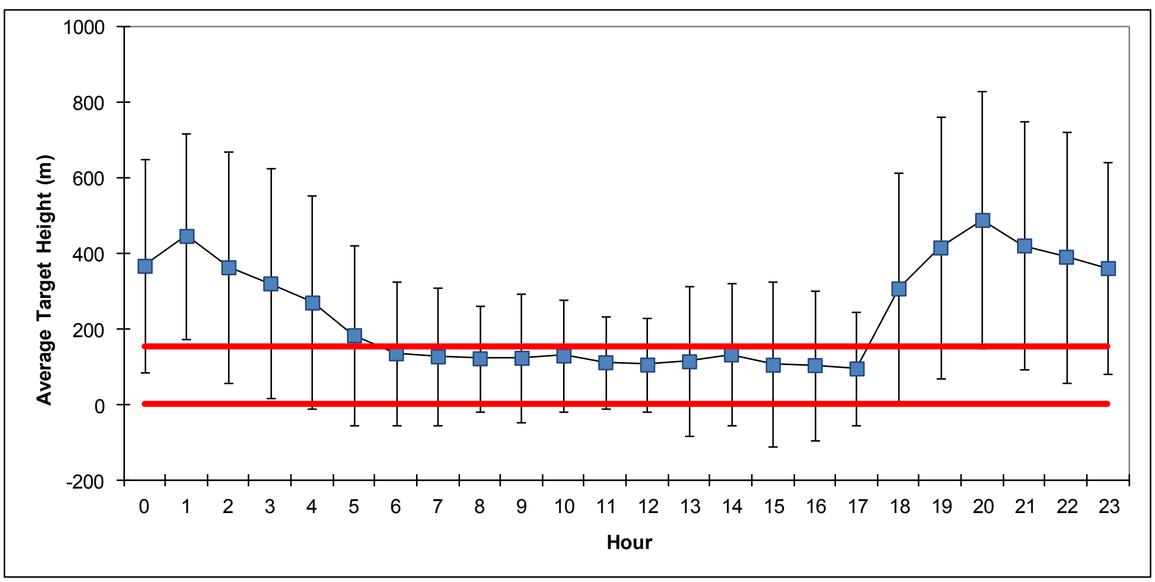

Figure 10-4. Average hourly target heights AGL at site 5. Error bars represent standard deviation for each hour and red lines represent the top and bottom of the rotor swept zone (0 – 152.4 m AGL).

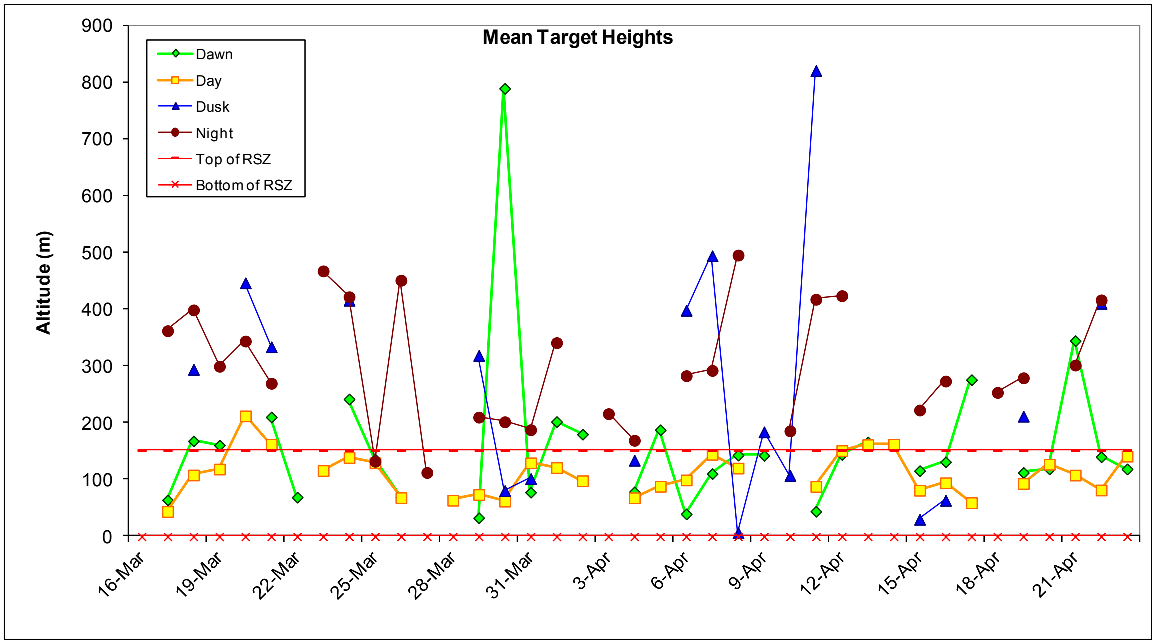

Figure 10-5. Mean target heights during four biological periods at site 5.

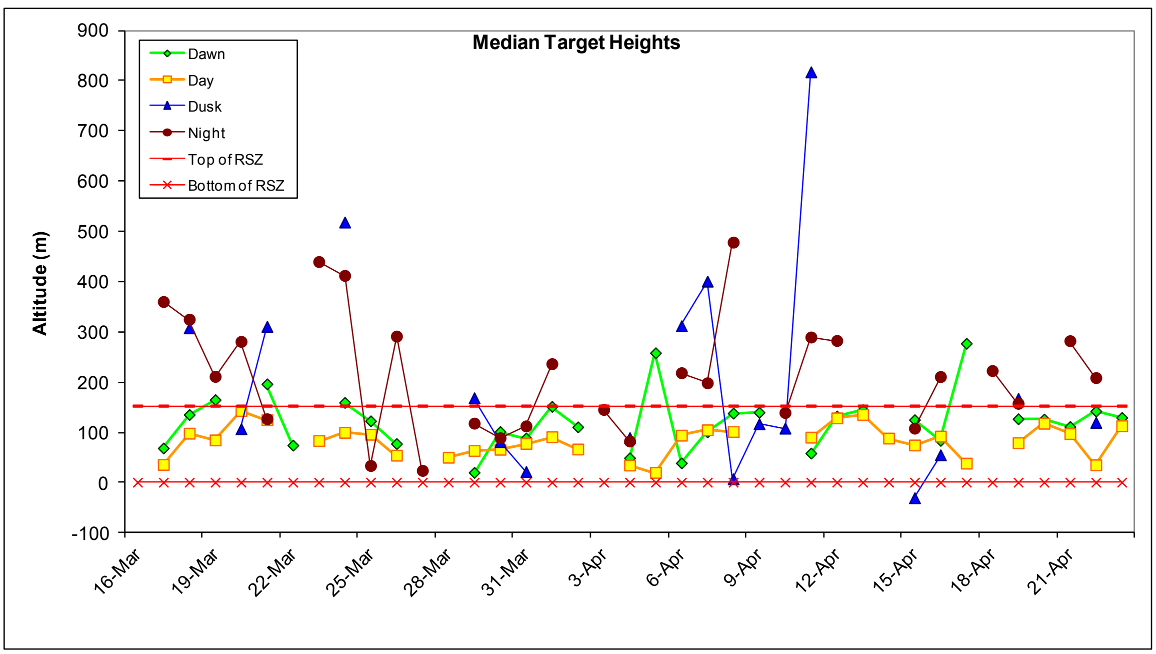

Figure 10-6. Median target heights during four biological periods at site 5.

Table 10-3. Summary of mean and median target heights during four biological periods at site 5. The top presents averages of mean and median target heights calculated during each biological period having at least 50% data in that time period; the bottom presents the overall mean and median target heights when all targets in each of the four biological periods were combined.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average mean target height	160.9	110.2	270.0	301.6
Average median target height	121.2	83.2	203.8	216.8
All targets for season combined				
Mean target height	138.2	120.7	408.9	391.7
Median target height	112.5	96.9	336.0	327.1

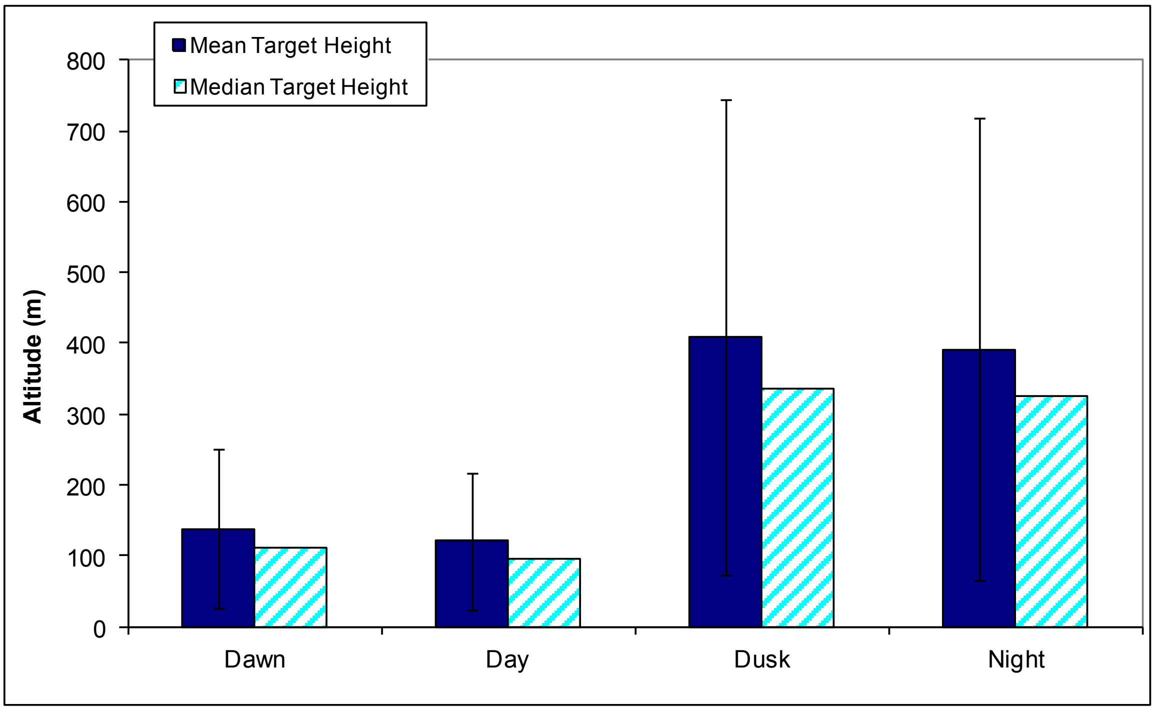

Figure 10-7. Overall mean and median target heights when all targets in each of the four biological periods were combined at site 5. Error bars represent one standard deviation.

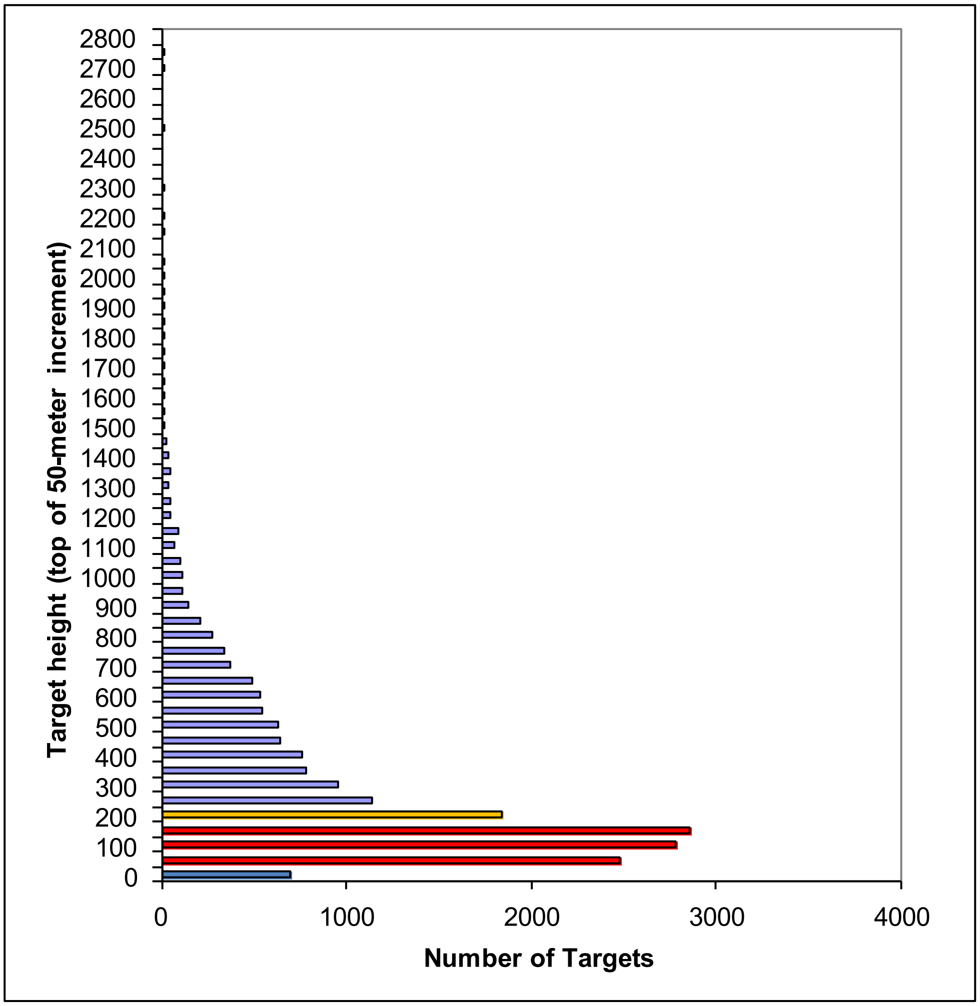

Figure 10-8. Number of targets occurring in each 50-meter increment at site 5. Red indicates rotor swept heights, and orange indicates altitudes partially within rotor swept heights.

Table 10-4. Summary of target passage rates and percent of targets above, within and below the RSZ during four biological periods at site 5.

	Dawn	Day	Dusk	Night
All targets for season combined				
% targets above RSZ	28.9%	24.8%	52.5%	74.5%
% targets within RSZ	66.3%	66.1%	27.9%	23.9%
% targets below RSZ	4.8%	9.1%	19.6%	1.5%
% targets below turbine height	71.1%	75.2%	47.5%	25.5%
Target data calculated for each date				
Average % of targets in RSZ	67.0%	68.1%	41.0%	36.3%
Min target percentage within RSZ	33.3%	30.8%	0.0%	10.6%
Max target percentage within RSZ	95.2%	86.6%	100.0%	64.0%
Average target passage rate above RSZ	9.8	5.6	4.8	32.1
Average target passage rate within RSZ	21.8	15.0	2.5	9.7
Average target passage rate below RSZ	1.5	1.9	1.8	0.7

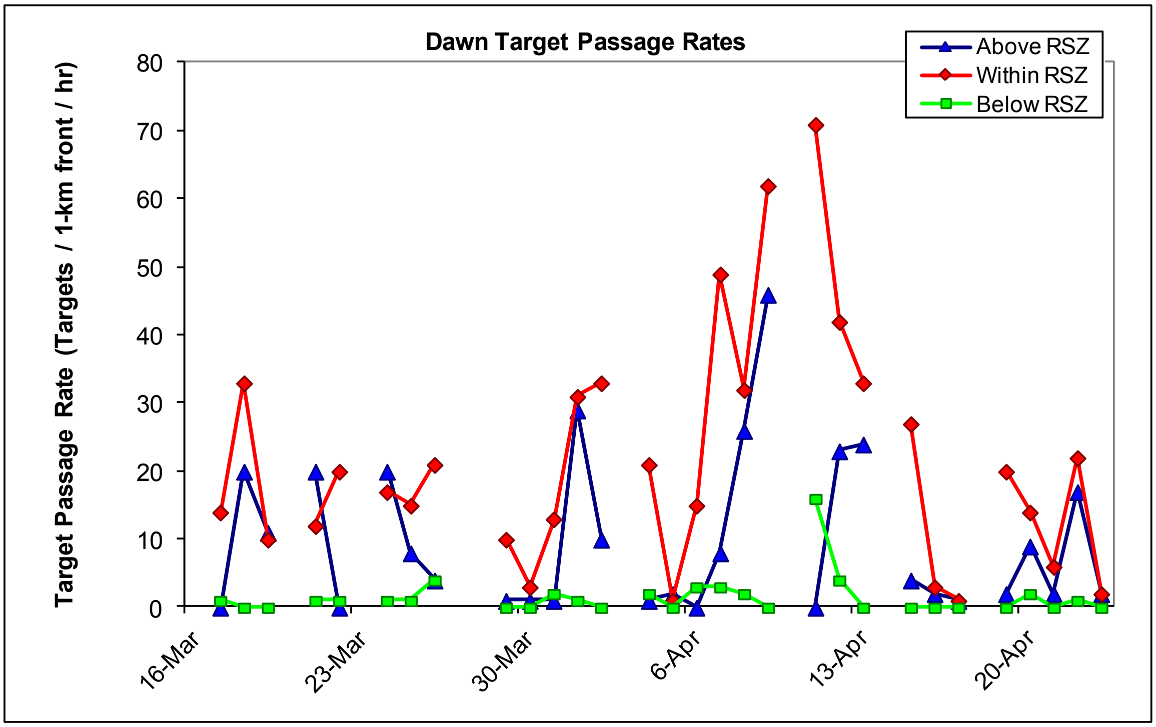

Figure 10-9. Target passage rates below, at, and above the rotor swept zone (RSZ) during dawns at site 5.

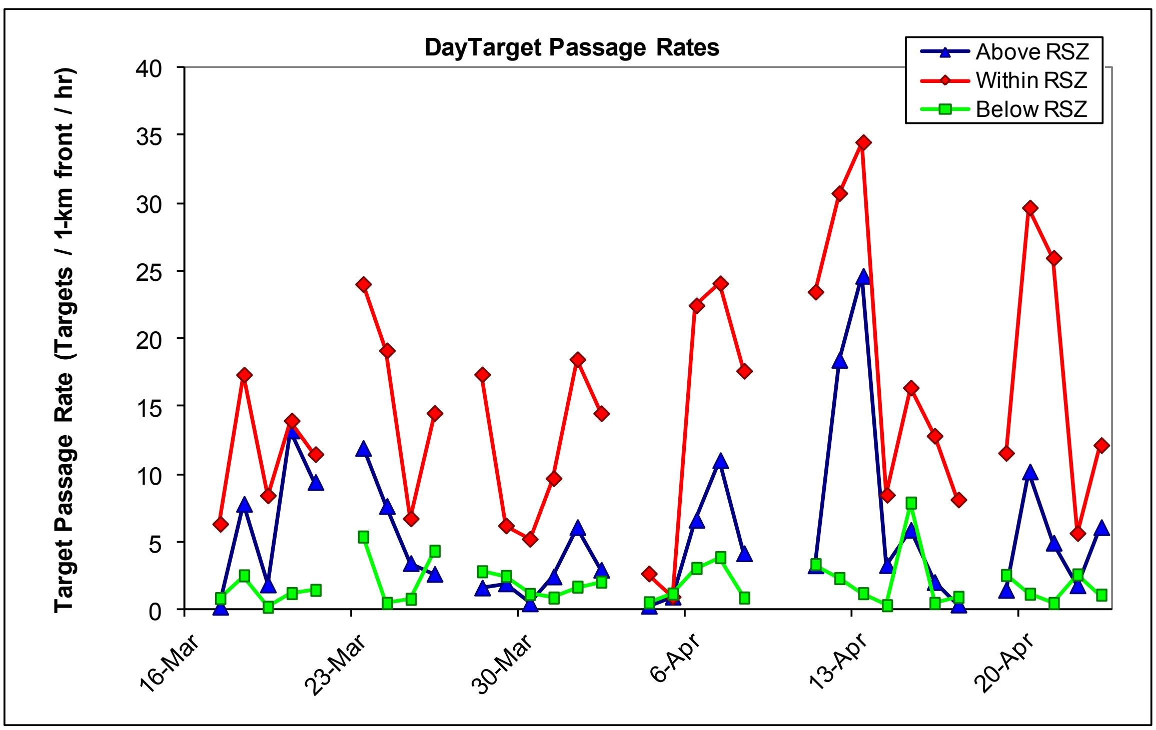

Figure 10-10. Target passage rates below, at, and above the rotor swept zone (RSZ) during days at site 5.

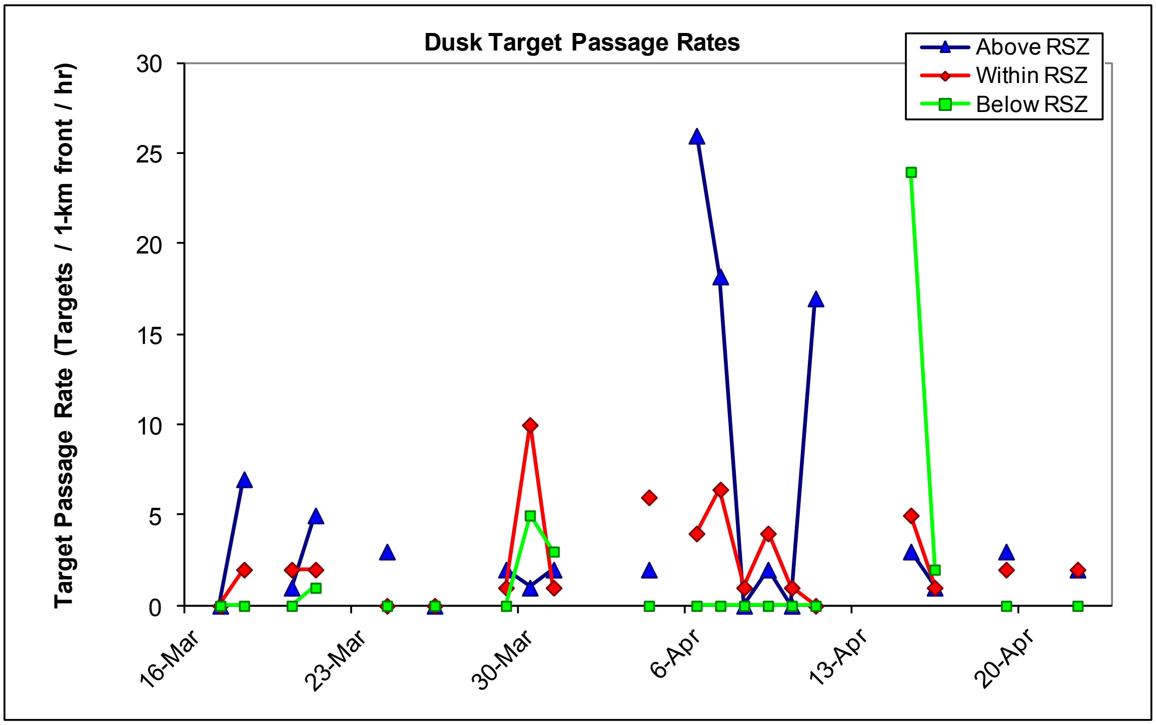

Figure 10-11. Target passage rates below, at, and above the rotor swept zone (RSZ) during dusks at site 5.

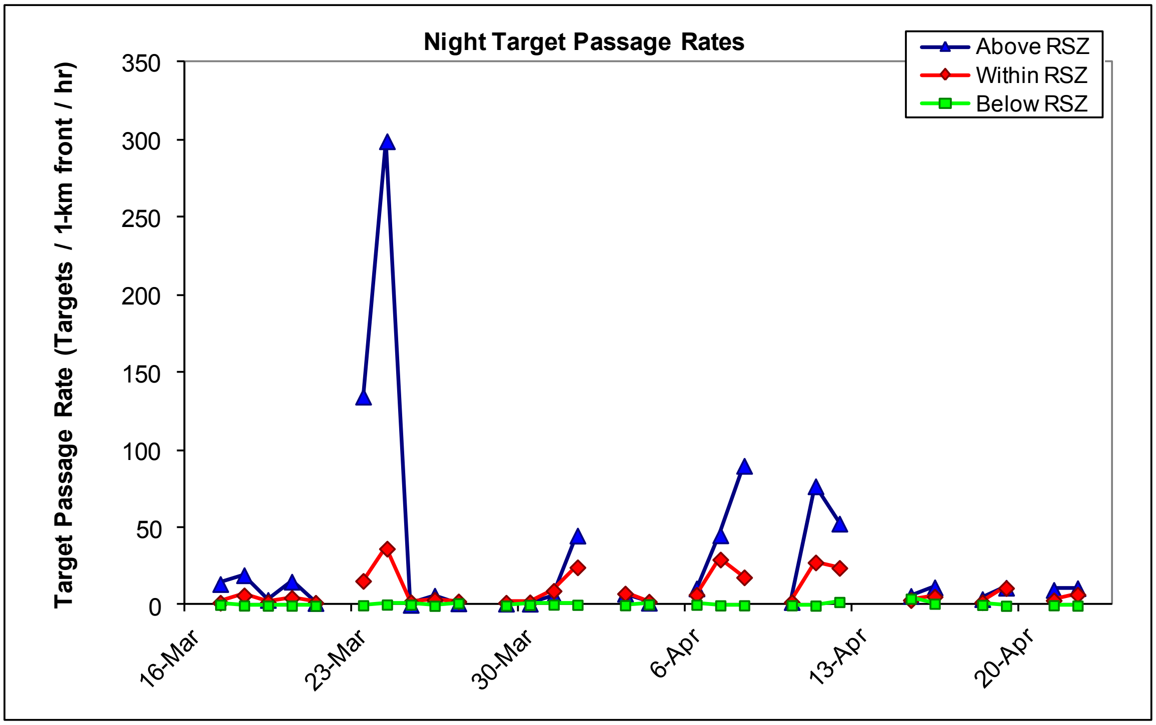

Figure 10-12. Target passage rates below, at, and above the rotor swept zone (RSZ) during nights at site 5.

10.3 Horizontal Radar Data

10.3.1 Target Directions

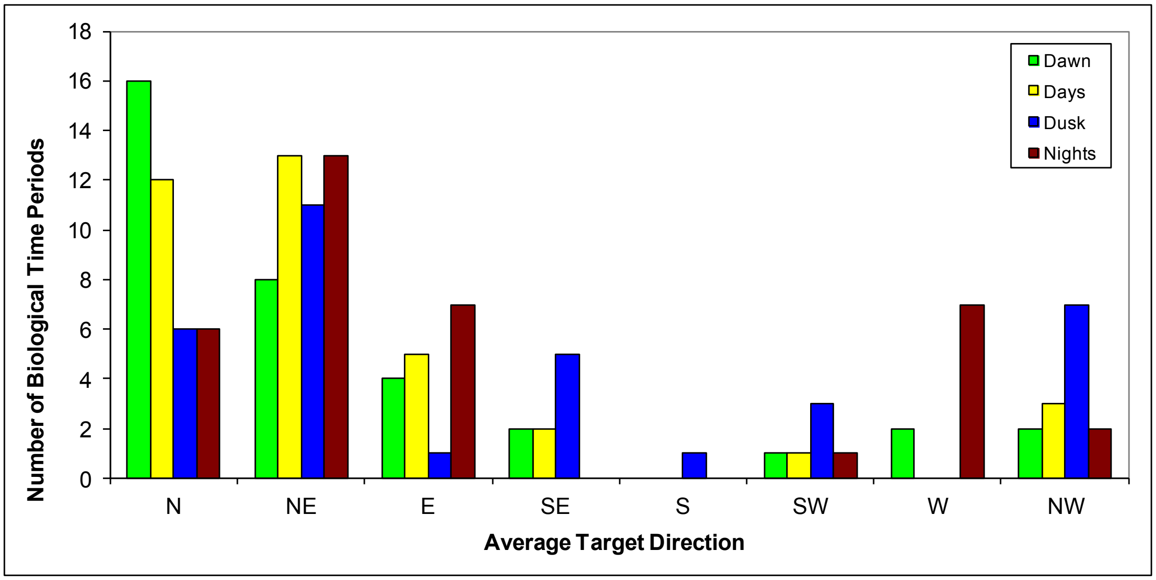

Figure 10-13. Distribution of average target movements among eight directions during dawns, days, dusks, and nights at site 5.

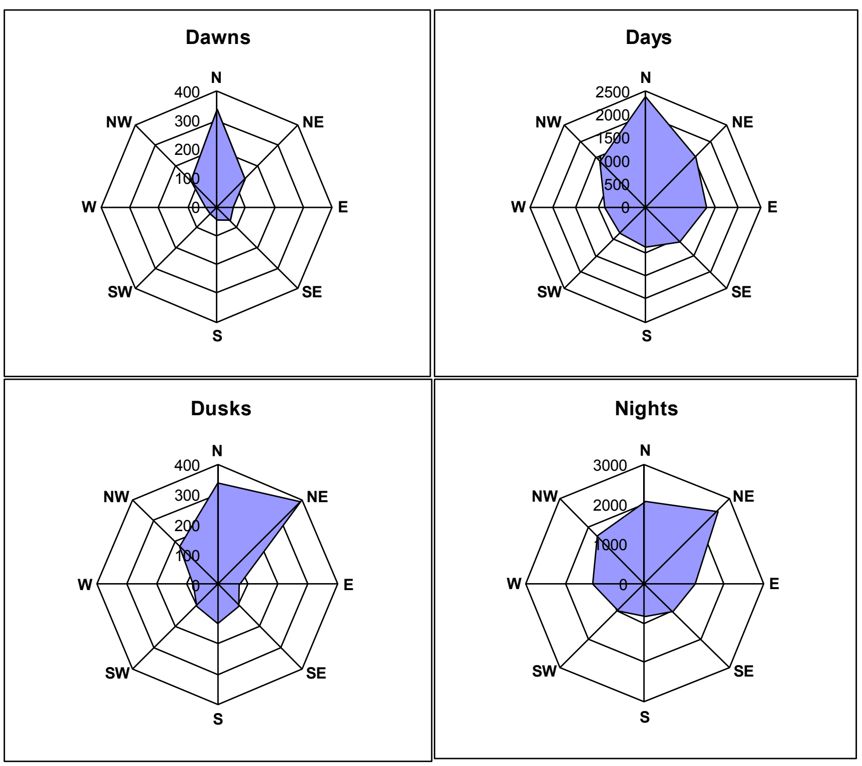

Figure 10-14. Cumulative target direction of all targets during all dawns, days, dusks, and nights at site 5.

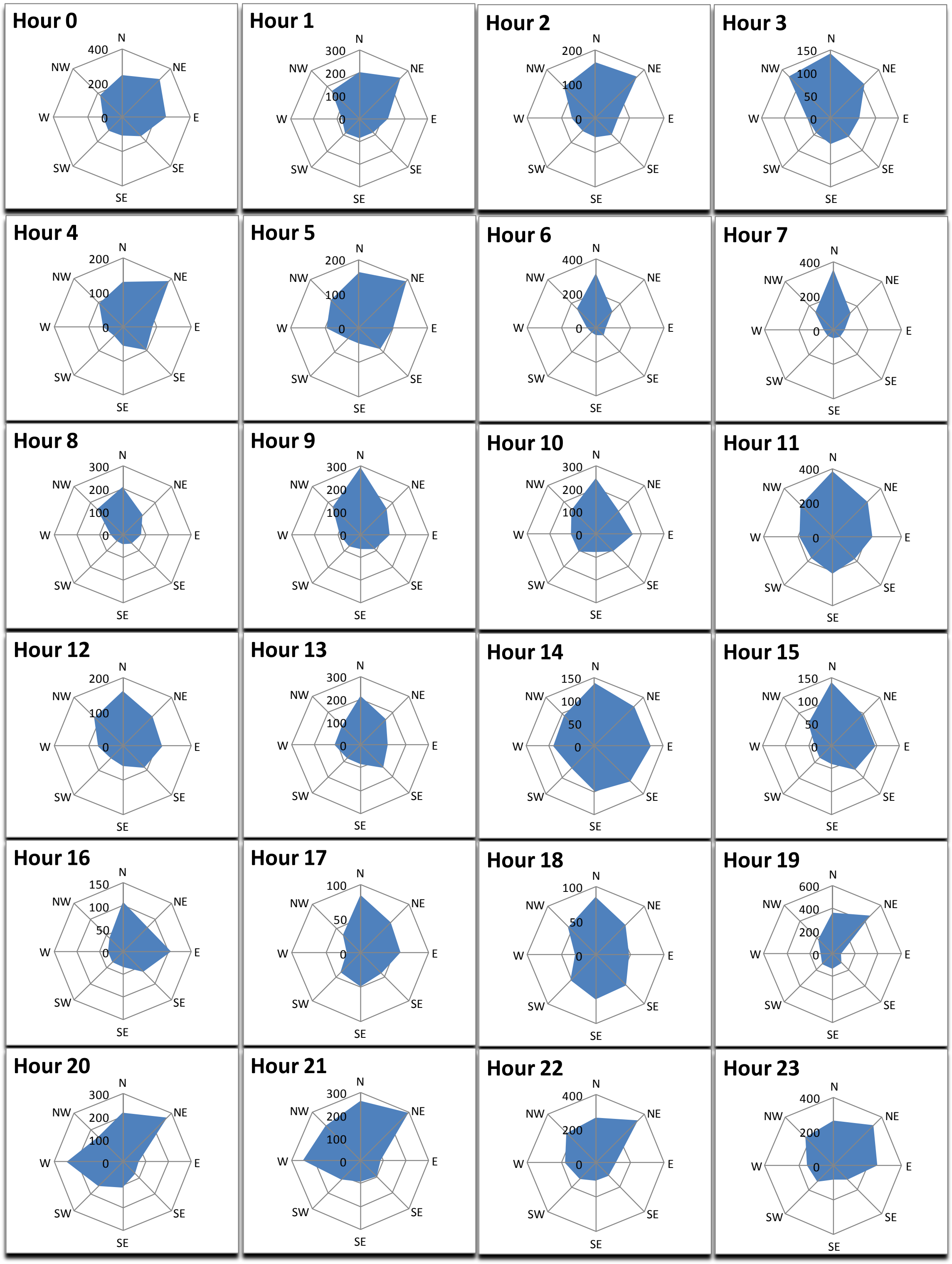

Figure 10-15. Directional distributions for targets during four biological periods at site 5.

Literature Cited

Zar, J. H. 1999. Biostatistical Analysis. Fourth edition. Prentice-Hall, Englewood Cliffs, New Jersey, USA.

Appendix A - Glossary

1-km Front – Area extending 0.5 km on either side of the VSR, or 1 km on one side of the VSR, forming a 1 km^2 area through which target passage rates are quantified. This area occurs entirely within the radar scanned zone.

Dawn – 30 minutes before sunrise to 30 minutes after sunrise.

Day – 30 minutes after sunrise to 30 minutes before sunset.

Dusk – 30 minutes before sunset to 30 minutes after sunset.

Night – 30 minutes after sunset to 30 minutes before sunrise the next day.

Rotor Swept Area (RSA) - The circular area “swept” by the blades during operation of a wind turbine, specific to type of wind turbine.

Rotor Swept Zone (RSZ) – The 1-km wide band within the 1-km front that encompasses the lowest and highest points swept by a wind turbine’s blades (RSA). Specific to each project and calculated using the manufacturer’s specifications for the wind turbine proposed for the project.

Plot – A single scan of a target or other objects.

Target Passage Rate – Number of specified targets passing through a 1-km wide front during 1 hour. This rate is standardized for effort, or the proportion of minutes radar data was recorded during a given time period.

Target - Object detected by MERLIN Radar and identified by MERLIN software as a biological object (e.g. bird, bat, insect) based on scanned size, speed, and other characteristics.

Track – The entire sequence of target plots that are recorded as long as an object still fits the definition of a target.

Tracking – The MERLIN software begins to track a target after it has met the criteria of a biological target for three scans. The target continues to be tracked until either the target is lost, or target fails to meet the criteria for three of the last four scans.

Appendix B - Abbreviations

AGL – Above Ground Level

HSR – Horizontal Surveillance Radar

km – kilometer

m – meter

mi – mile

nm – Nautical miles (approximately 1.15 miles)

RSA – Rotor Swept Area

RSZ – Rotor Swept Zone

VSR – Vertical Scanning Radar

MERLIN^{TM} Avian Radar Survey for the Chokecherry and Sierra Madre Wind Energy Project

Graphical Data Report for November, 2011 – March, 2013

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August 1, 2013

Notice

This graphical data report was prepared by DeTect, Inc. (DeTect) for SWCA Environmental Consultants (SWCA) in the course of performing work at the Chokecherry and Sierra Madre Wind Energy Project owned by the Power Company of Wyoming, LLC (PCW), under DeTect's contract with SWCA. The data and information developed as a result of this study, and presented in this report, are the property of the client and are not to be disclosed to third parties without the express written consent of SWCA and PCW.

Table of Contents

MERLIN™ Avian Radar Survey
Graphical Data Report for Nov 2011 – Mar 2013

1 INTRODUCTION

This report presents radar data collected at the proposed Chokecherry and Sierra Madre Wind Project site during five seasons:

- Winter 2011-12 (November 16, 2011 – March 31, 2012),
- Spring 2012 (April 1 – June 30, 2012),
- Summer 2012 (July 1 – August 15, 2012),
- Fall 2012 (August 16 – November 15, 2012),
- Winter 2012-13 (November 16, 2012 – March 31, 2013)

as well as five sites:

- Site 4 (November 16, 2011 – January 26, 2012)
- Site 6 (February 2 – April 29, 2012)
- Site 8 (May 19 – July 17, 2012)
- Site 9 (July 21 – September 29, 2012)
- Site 10 (October 3, 2012 – March 31, 2013)

As can be noted by the date ranges of radar data collected at each site, Winter 2011-12 includes data from Sites 4 and 6, Spring 2012 includes data from Site 6 and 8, Summer 2012 includes data from Site 9, Fall 2012 includes data from Sites 9 and 10, and Winter 2012-13 includes data from Site 10.

2 METHODS

2.1 Radar Equipment, Software, and Data Collection

2.1.1 MERLIN Avian Radar System

The MERLIN avian radar system is an advanced, automated radar system used for remote detection and tracking of bird and bat activity. A remote data uplink allowed remote system monitoring, access to recorded data, and system administration. The MERLIN system collected radar data continuously (24 hours a day, 7 days a week), with the exception of limited periods of system maintenance or downtime.

A model XS25200e MERLIN avian radar system was used to survey this site during November 2011 through March 2013. This system used dual marine radar sensors: a 25-kW power, magnetron, X-band frequency (3 cm wavelength), vertical-scanning radar (VSR) sensor, and a 200-W power, solid state, S-band (10 cm wavelength), horizontal surveillance radar (HSR) sensor with Doppler. The solid state sensor uses a solid state transmitter instead of a magnetron which allows for a more focused transmission and requires less voltage. This HSR also used high pulse compression of short- and medium--pulsed radar energy.

The VSR operates in the vertical plane transmitting a 20°, wedge-shaped beam from horizon-to-horizon using the vertical scanning technique (Harmata et al. 1999) (Fig. 2-1) at a scan rate of 24 RPM's, or 1 scan every 2.5 seconds, and a range setting of 2.0 nm to either side and above the radar. The X-band used for this VSR is a short wavelength radar (3 cm) and is susceptible to interference from very small targets such as precipitation. The VSR data is used to determine target altitudes, as well as target counts and passage rates.

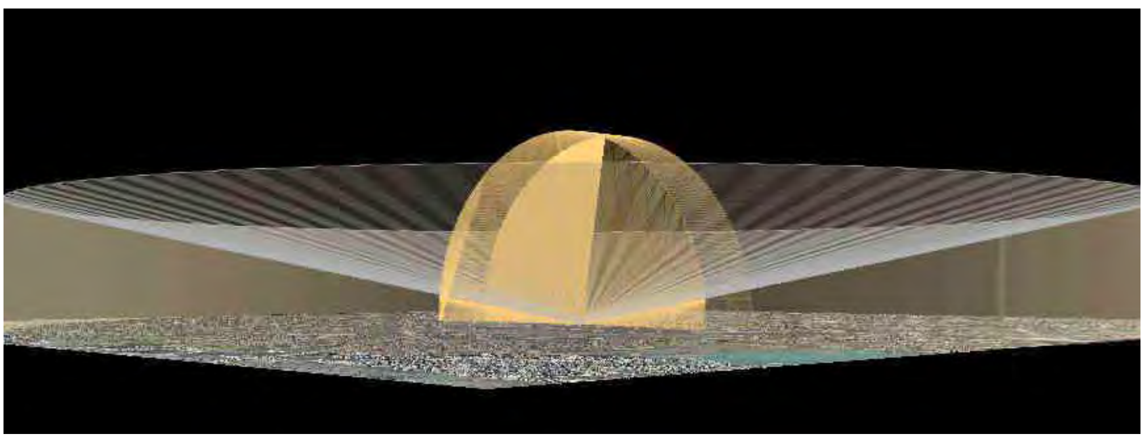

Figure 2-1. Illustration of beam coverage of the horizontal surveillance radar (HSR) and the vertical scanning radar (VSR).

The HSR radar scans 360° in the horizontal plane tra nsmitting a 25°, wedge-shaped beam relatively perpendicular to the VSR (Fig. 2-1) at a scan rate of 24 RPM's, or 1 scan every 2.5 seconds, and a range setting of 4.0 nm radius. The S-band used for the HSR has the advantage of greater detection range and less interference from ground clutter and precipitation. It is also less sensitive to insect contamination. The HSR data is used to determine directional movement of targets over and through the project area.

2.1.2 MERLIN Avian Radar Processing Software

The Merlin avian radar system uses modern, marine-grade radar signal processing technology to collect, process, and store 12-bit digitized radar data from both the VSR and HSR. Target data from both radars is processed in real-time by the MERLIN software at the radar with all data on targets, tracks, and system parameters recorded to internal system databases.

The MERLIN avian radar processing software uses automated clutter suppression in conjunction with biological target detection, tracking, and data recording to identify and track targets in the survey area. The software also identifies noise (undesired signals such as ground clutter and interference) within a given radar environment and applies a statistical approach to suppressing the noise while still allowing targets within the noise to be detected, tracked, and recorded. This maximizes the probability of detecting moving targets in high clutter environments (such as over vegetation). The application of CFAR (constant false alarm rate) algorithms and ground clutter mapping techniques are also included in the MERLIN software, and provide automated, high resolution data while minimizing the amount of display lost to ground clutter.

The detection and tracking algorithms in the MERLIN software locate plot sequences of biological targets in the raw radar data that fit together into a sequence over time as the radar scans. When a target meeting the criteria of a bird-like target is tracked for a minimum of three out of four sequential scans or plots, a track is written to the system database. A target continues to track as long as it is detected three out of the last four scans or plots. Although the criteria for identifying bird targets has been developed to only track targets that are most likely birds, these are not separable from bats which are included within the targets tracks, and targets such as insects or clutter that will occasionally be falsely identified and tracked as bird targets. However, the inclusion of non-bird / bat targets is minimized through optimization of operational settings in the software, visual ground-truthing, and application of custom database queries.

It must also be noted that an individual radar echo does not necessarily represent an individual bird or bat, as individuals moving in and out of the radar beam (e.g. circling, flying behind a large obstacle) would be “counted” by the radar system multiple times. Similarly, some flocks of birds may be recorded as a single target if individuals cannot be distinguished. Within the MERLIN system, each target is assigned a unique, 128-digit, identification number which facilitates analysis of extended surveys. Therefore, an individual radar echo is referred to as a biological “target” in this study, and when counted together they represent an index of bird / bat activity or exposure level for a given period of time, and not necessarily a count of individuals.

2.2 Data Analysis

2.2.1 Radar Data

HSR and VSR data were reviewed by SWCA Environmental Consultants staff. Rain and insect events were marked in both the VSR and HSR data. Final data analysis was conducted in DeTect’s Data Center in Panama City, Florida.

TrackPlot images (15-minute increments) of the radar data were manually reviewed, and previously marked events were separated into either insect events or rain / other contamination events. Any missed contamination events were also marked. All 15-min increments containing contamination were removed from the final datasets and noted in the level of effort metrics. Level of effort queries were run on both data with, and without, time periods marked as insect contamination. This allowed us to derive the amount of time containing insect activity. Graphical output however, was produced using only data without the time periods marked as insect contamination. This matches methods used on data from this site presented in the 2011 report.

The Data Center uses Microsoft Windows® based computer systems, networks, and SQL (structured query language) servers for database processing and analysis. In order to minimize false tracks (insects, ground clutter, interference, etc.) in both the horizontal and vertical data, targets that were only plotted once after they were defined as a target (leaving only one row in the database) were considered low quality and eliminated from the database. Masks were also applied to areas that exhibited false tracking as indicated by SWCA.

The cleaned radar data was analyzed during dawns (30 minutes before to 30 minutes after sunrise), days (30 minutes after sunrise to 30 minutes before sunset), dusks (30 minutes before sunset to 30 minutes after sunset), and nights (30 minutes after sunset to 30 minutes before sunrise the next day). Hourly time periods and seasonal summaries were also used for some analyses.

2.2.2 Vertical Radar Data - Target Counts and Altitudes

The VSR data collected was used to develop information on target passage rates and heights within the project area. As targets passed along or through the VSR beam, the position and altitude above ground level (AGL) of the target was recorded with each scan of the radar. The position and altitude reported for a target is taken from the scan producing the greatest target area as that is the scan most likely having the best “look” at the target. Theoretically, that is also the scan closest to the center of the beam and therefore would have the least slant range error in the altitude measurement. Each target’s altitudes were then used to derive mean and median target heights, as well as to group targets into one of three categories: below rotor swept zone, within rotor swept zone, or above rotor swept zone. For the purposes of this graphical analysis a rotor swept zone of 0-152.4 m (0-500 ft) AGL was considered.

The VSR data were standardized to a 1-km front per hour, generally the industry standard for most migratory and wind energy avian studies and risk analyses. For this report, target passage rates are further defined as the number of targets detected within a standard 1-km front of the radar during a one hour period. Target passage rates were standardized into an hourly rate by dividing the target count by the number of minutes of radar data within a given time period, minus any time lost or contaminated, and multiplied by 60. Target passage rates (below, within, and above the rotor swept zone, as well as total), and mean and median target heights, were calculated for each biological period and hour during this survey. Target passage rates were also averaged by biological period and hour. Comprehensive target passage rates, in which all targets were grouped by a given time period regardless of date, were also calculated hourly. Both grand and comprehensive mean target heights were calculated; the former being the average of the average target heights for a period of time across the season, and the latter being the average height of all targets within a given time period regardless of date. Median target heights were both averaged across biological periods and hours, and calculated by biological period. The distribution of targets within 50-m increments is also presented.

2.2.3 Horizontal Radar Data - Target Directions

The HSR data collected was used to develop information on the movement of targets within the project area. As targets were detected by the HSR, their bearings were recorded on each scan of the radar. The average bearing of each target was then generated from all the scans as the target passed through the HSR beam. Date-time information was derived using the last plot of the track.

The HSR data were queried and an average target direction was generated for each biological period and hour; target (angular) concentrations were also calculated for each biological period. The comprehensive directional distribution of all targets was illustrated by biological period and hour in Microsoft Office Excel by developing frequency tables of target numbers occurring in 45° increments: eight groups centered on north, northeast, east, southeast, south, southwest, west, and northwest.

Calculations of mean direction and angular concentration (*r*) for these time periods were calculated using SQL and formulas based on Zar 1999. The value of *r* is a measure of concentration; it has no units and varies from 0 (no concentration, all values very dispersed) to 1.0 (all data concentrated in the same direction), whereas 1-*r* is a measure of angular dispersion (Zar 1999).

3 RESULTS for the Winter 2011-12 Season

3.1 Level of Effort

Table 3-1 presents available time, time radar data were collected, amount of radar data that were removed due to rain, high levels of insect activity, or other contamination, and the resulting time of radar data used for analyses, during the Winter 2011-12 Season (November 16, 2011 – March 31, 2012). The MERLIN avian radar system operated at Site 4 until January 26, 2012 and at Site 6 after February 2, 2012.

Table 3-1. Radar monitoring effort during the Winter 2011-12 season.

	Vertical Radar		Horizontal Radar	
	Hours	%	Hours	%
Time in season	3287.0		3287.0	
Time radar down	169.6	5.2%	168.5	5.1%
Time radar collected data	3117.4	94.8%	3118.6	94.9%
Unuseable radar data[1] due to rain or other contamination	566.7	18.2%	2.0	0.1%
Unuseable radar data[2] due to insects	0.0	0.0%	-	-
Useable radar data[3]	2550.7	77.6%	3116.6	94.8%

1 - Percent indicates portion of time with radar data that was lost due to rain or other contamination.
2 - Percent indicates portion of time with radar data that was lost due to high insect activity.
3 - Percent indicates portion of season with useable radar data.

3.2 Vertical Radar Data

Data collected from the vertical scanning radar (VSR) were used to quantify target activity and heights.

3.2.1 Target Passage Rates Over Time

Data is presented as a rate equaling total number of targets / 1-km front / hr for each biological period (Fig. 3-1) and as an average by biological period (Fig. 3-2) and hour (Fig. 3-3). Summary statistics are presented in table 3-2.

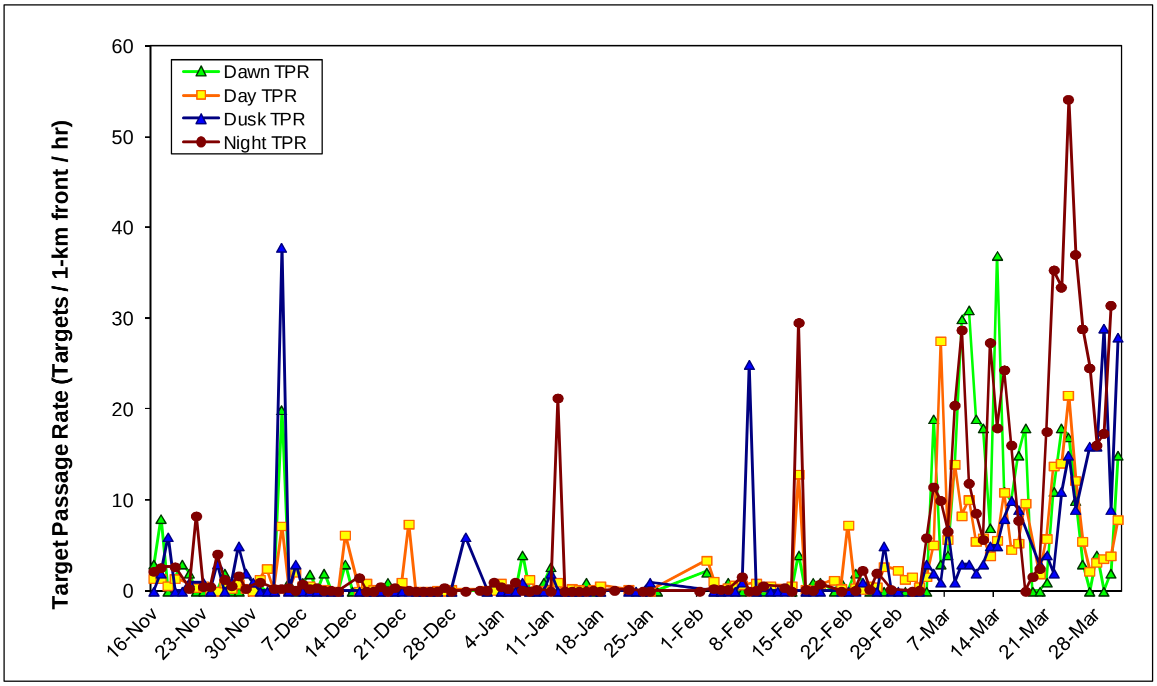

Figure 3-1. Target passage rates (TPR) during biological periods of the Winter 2011-12 season.

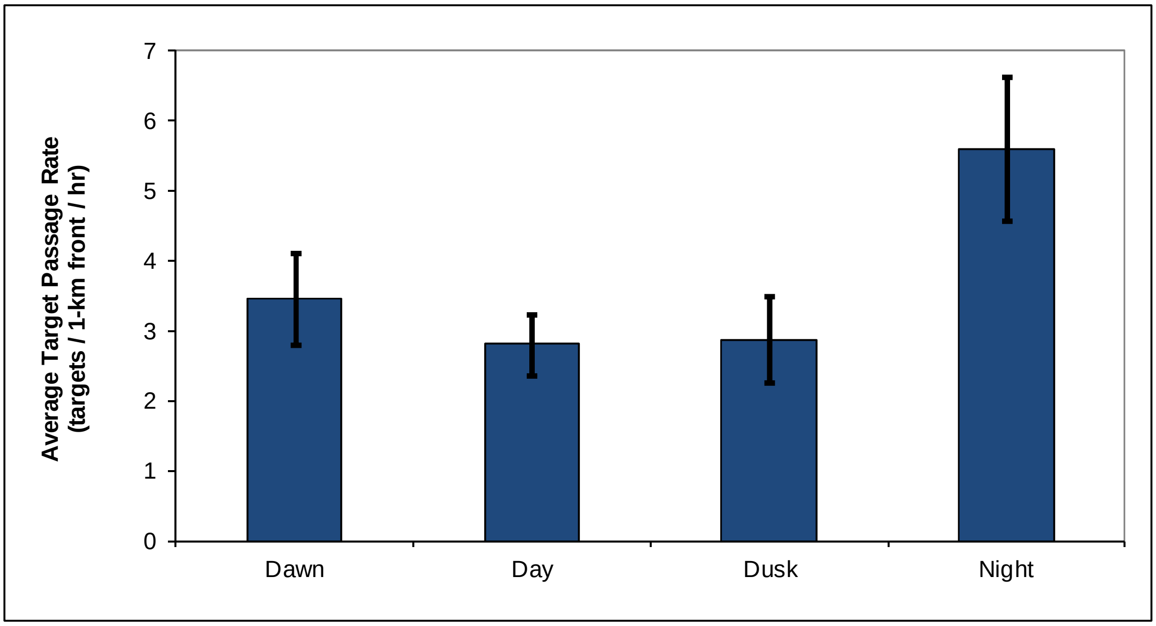

Figure 3-2. Average target passage rates (TPR) by biological period during the Winter 2011-12 season. Error bars represent one standard error.

Table 3-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for biological periods during the Winter 2011-12 season.

	Dawn	Day	Dusk	Night
Average	3.5	2.8	2.9	5.6
Standard Deviation	7.1	4.6	6.4	10.6
Standard Error	0.7	0.4	0.6	1.0
Median	0.0	0.7	0.0	0.4
Minimum	0.0	0.0	0.0	0.0
Maximum	37.0	27.6	37.9	54.2

Both average and comprehensive hourly target passage rates are presented in Fig 3-3: average rates are the average of each date's hourly target rate in a given hour, while comprehensive rates use targets grouped by hour, regardless of date.

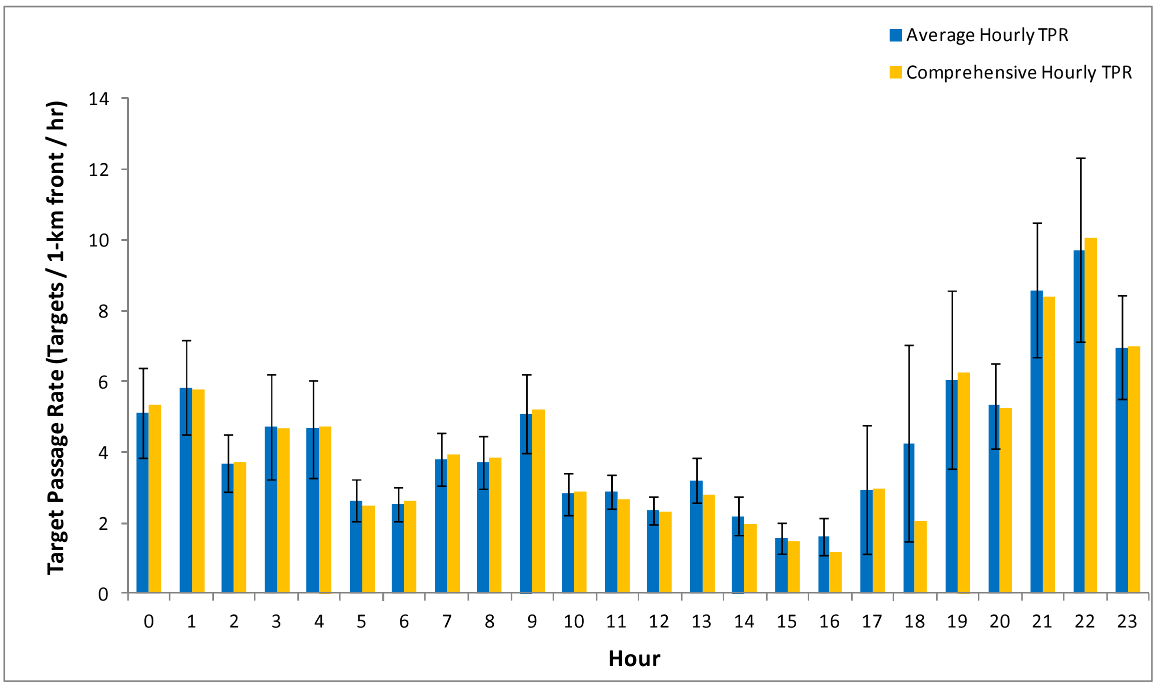

Figure 3-3. Average and comprehensive hourly target passage rates during the Winter 2011-12 season. Error bars represent one standard error.

3.2.2 Altitudinal Distribution of Targets

Mean and median target heights are presented for each biological period (Fig. 3-4 and Fig. 3-5, respectively) of the Winter 2011-12 season.

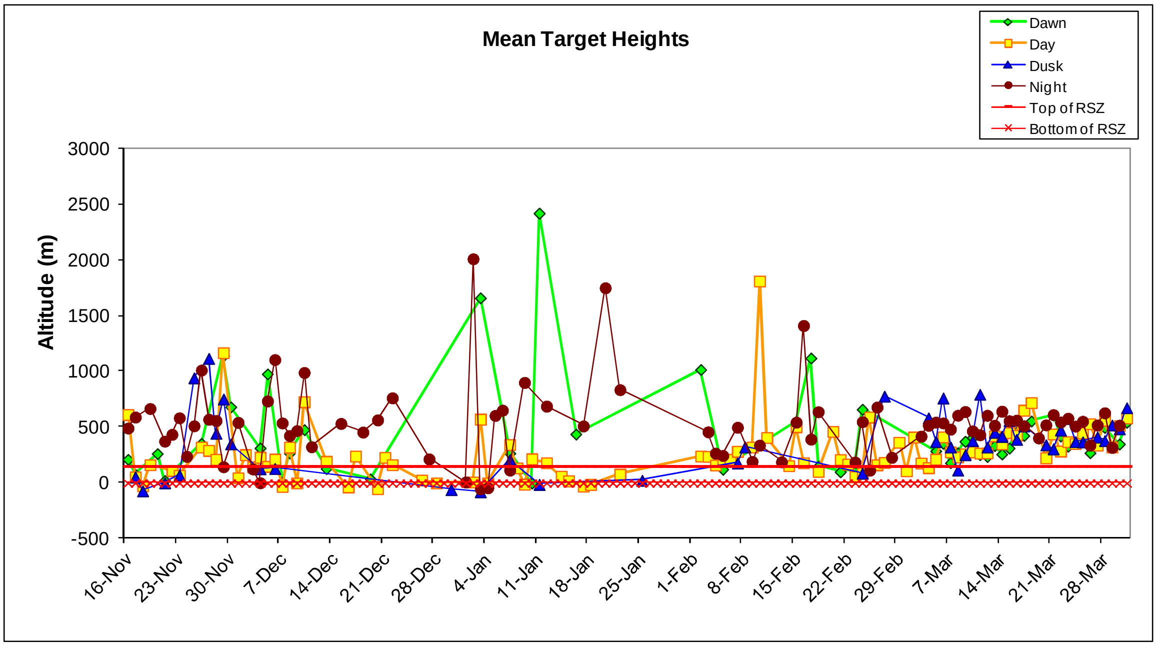

Figure 3-4. Mean target heights during the Winter 2011-12 season. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

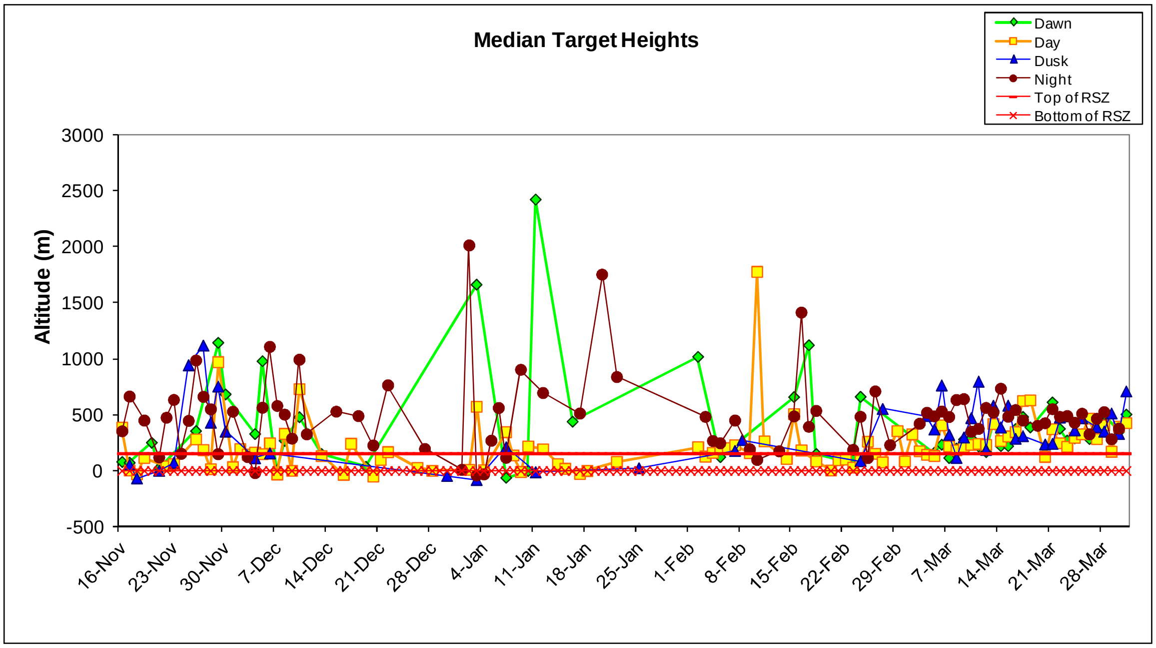

Figure 3-5. Median target heights during the Winter 2011-12 season. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

The mean and median target heights during each biological period were calculated for all dates with ≥ 50% data for that time period, averaged into a grand mean and average median, and presented in Table 3-3 (top) and illustrated in Figure 3-6 (blue bars). The comprehensive mean and median target heights for each biological period (when all targets were combined regardless of date) are also listed in Table 3-3 (bottom) and illustrated in Figure 3-6 (green bars).

Table 3-3. Summary of mean and median target heights during biological periods of the Winter 2011-12 season. Darker colors in color-coded rows indicate greater values within that row.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Grand mean target height	442.0	274.8	366.9	524.8
Average median target height	410.9	219.6	347.1	486.0
All targets for season combined				
Comprehensive mean target height	366.3	360.3	433.6	540.7
Comprehensive median target height	272.2	257.9	359.1	482.5

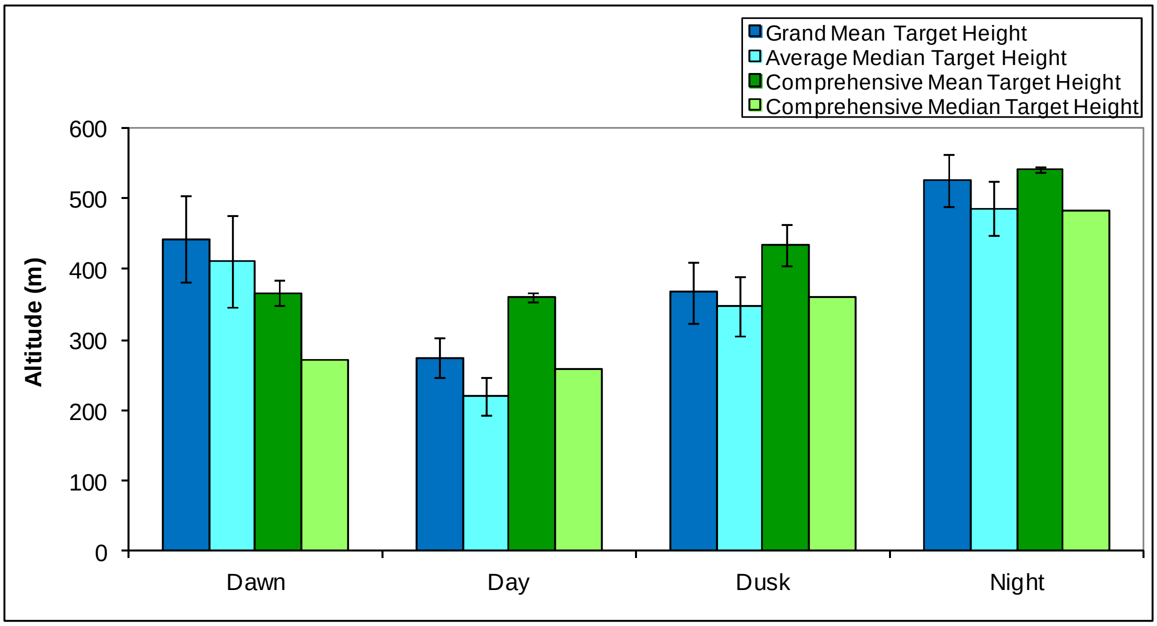

Figure 3-6. Grand mean and average median target heights averaged across individual biological periods (blue bars), and comprehensive mean and median target heights of all targets grouped by biological period (green bars), during the Winter 2011-12 season. Error bars represent one standard error.

Hourly target heights were averaged into a grand hourly target mean and an average hourly target median for each of 24 hours; a comprehensive hourly target mean was also calculated by pooling all targets within a given hour together, regardless of date (Fig. 3-7).

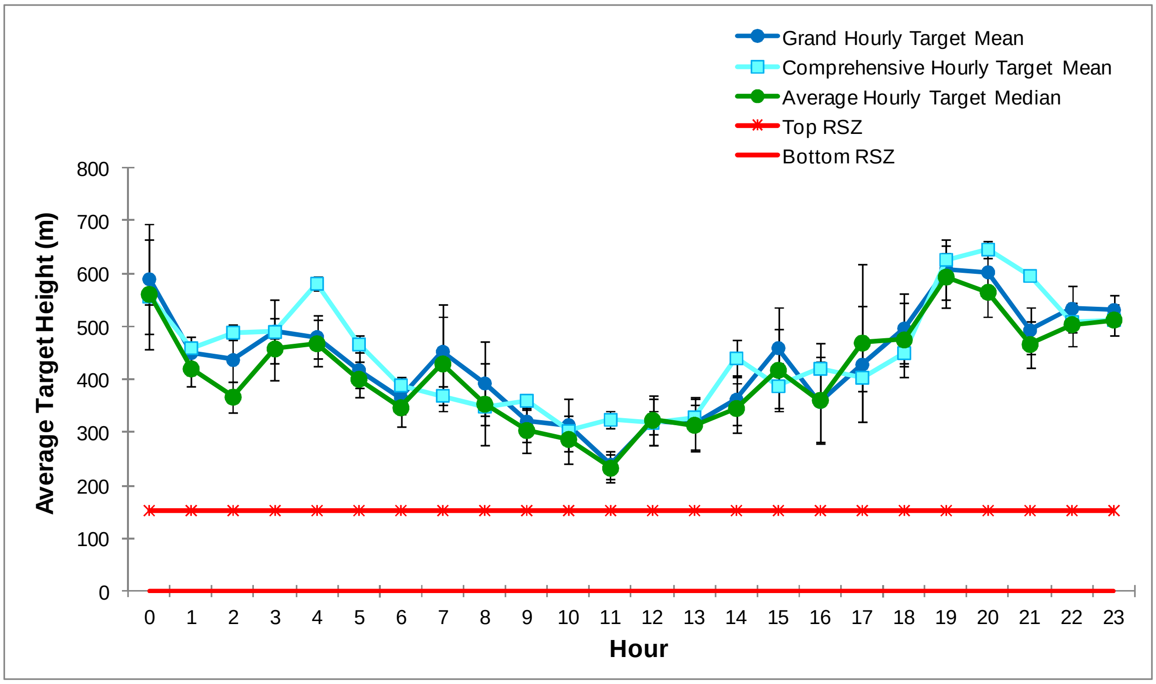

Figure 3-7. Hourly target heights during the Winter 2011-12 season. Error bars represent one standard error. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

The distribution of all targets detected during dawns, days, dusks, and nights of the Winter 2011-12 season are shown using 50-meter increments (Fig. 3-8).

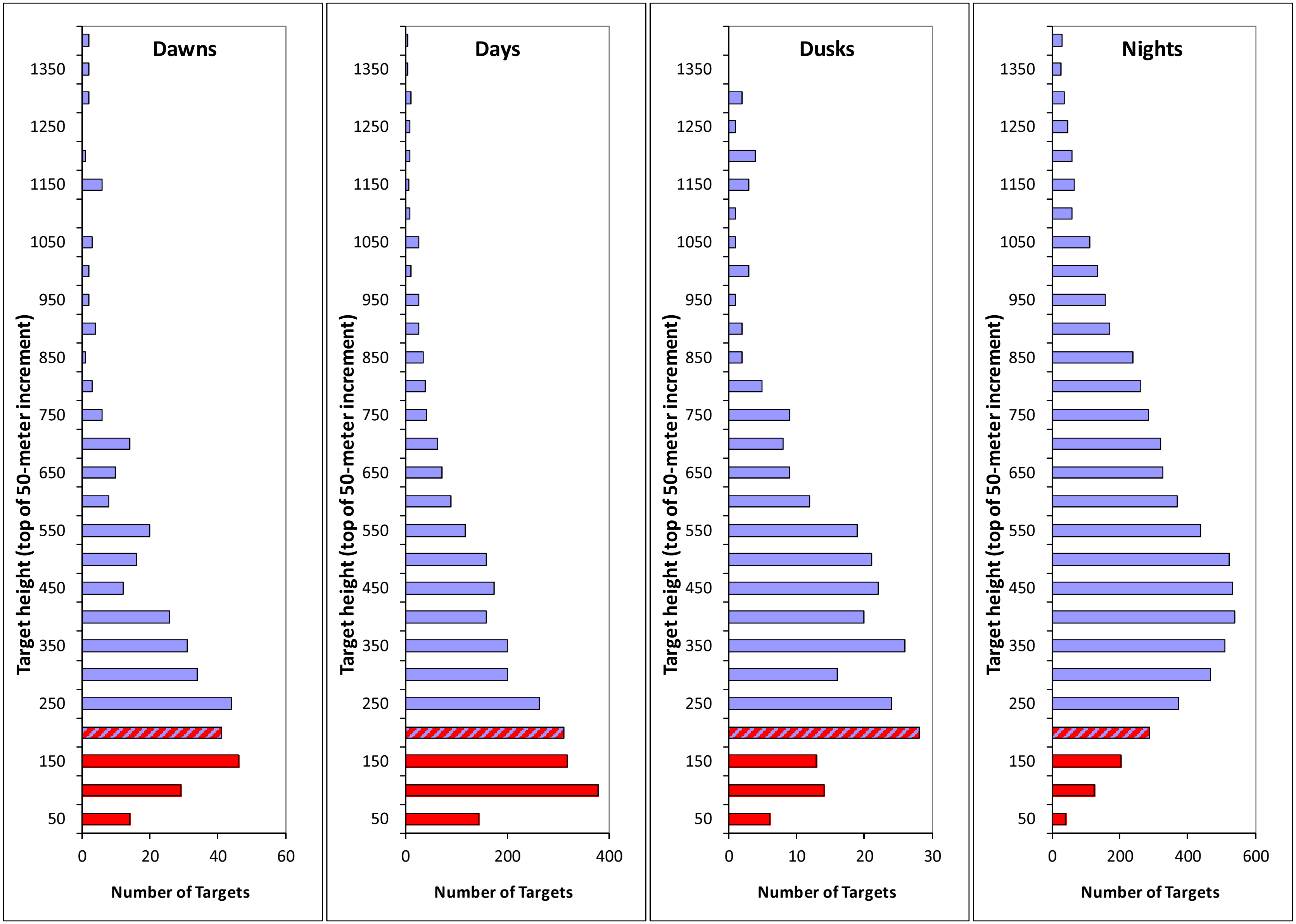

Figure 3-8. Number of targets occurring in each 50-meter increment during biological periods of the Winter 2011-12 season. Red indicates rotor swept heights, and red-blue hashed indicates altitudes partially within rotor swept heights.

Using a RSZ of 0-152.4 m AGL, target passage rates below, within, and above the RSZ were calculated for each date. Individual target passage rates are presented for dawns (Fig. 3-10) days (Fig. 3-11), dusks (Fig 3-12), and nights (Fig. 3-13). Percent targets below, within, and above the RSZ were also calculated seasonally, with all targets detected during each biological period of the Winter 2011-12 season combined together (Table 3-4, bottom). Average hourly target passage rates below, within, and above the rotor swept zone are also given (Fig. 3-9).

Table 3-4. Summary of target passage rates and percent of targets above, within and below the RSZ (0-152.4 m AGL) during biological periods of the Winter 2011-12 season. Darker colors indicate greater values.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average target passage rate above RSZ	2.6	1.9	2.3	5.3
Average target passage rate within RSZ	0.8	0.8	0.4	0.3
Average target passage rate below RSZ	0.1	0.1	0.2	0.0
Average % of targets in RSZ	28.7%	37.6%	19.2%	13.8%
Min target percentage within RSZ	0.0%	0.0%	0.0%	0.0%
Max target percentage within RSZ	100.0%	100.0%	100.0%	100.0%
All targets for season combined				
% targets above RSZ	75.1%	70.0%	82.0%	95.1%
% targets within RSZ	23.4%	27.2%	11.5%	4.5%
% targets below RSZ	1.5%	2.8%	6.4%	0.4%
% targets below turbine height	24.9%	30.0%	18.0%	4.9%

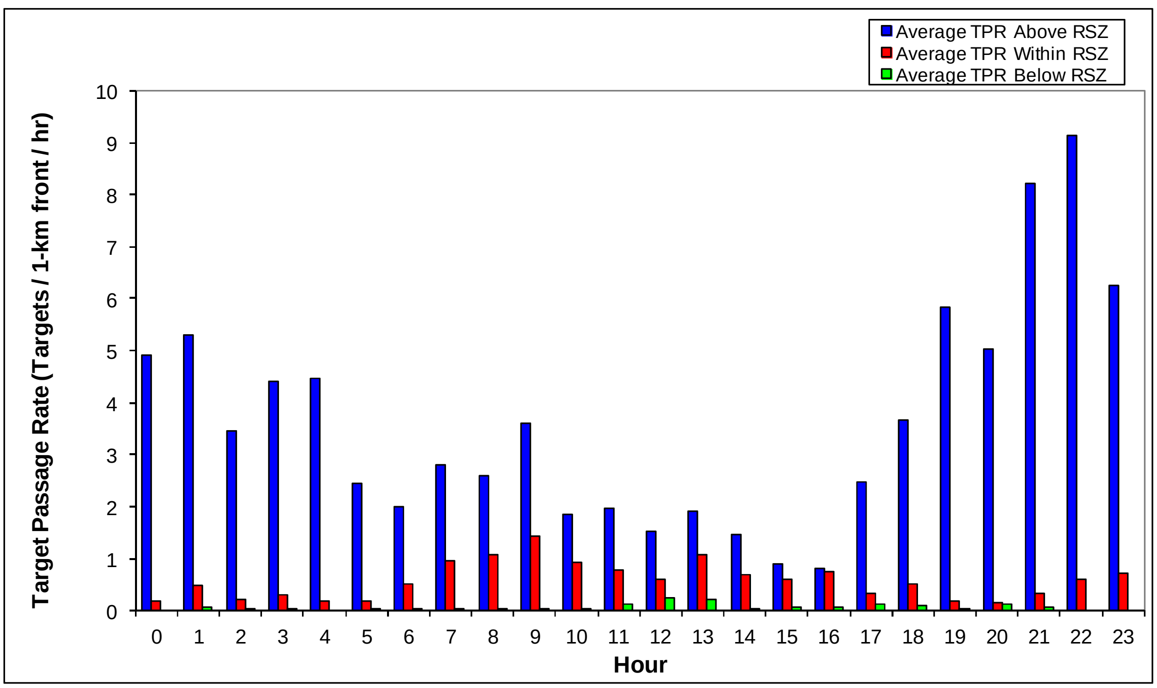

Figure 3-9. Average hourly target passage rates during the Winter 2011-12 season.

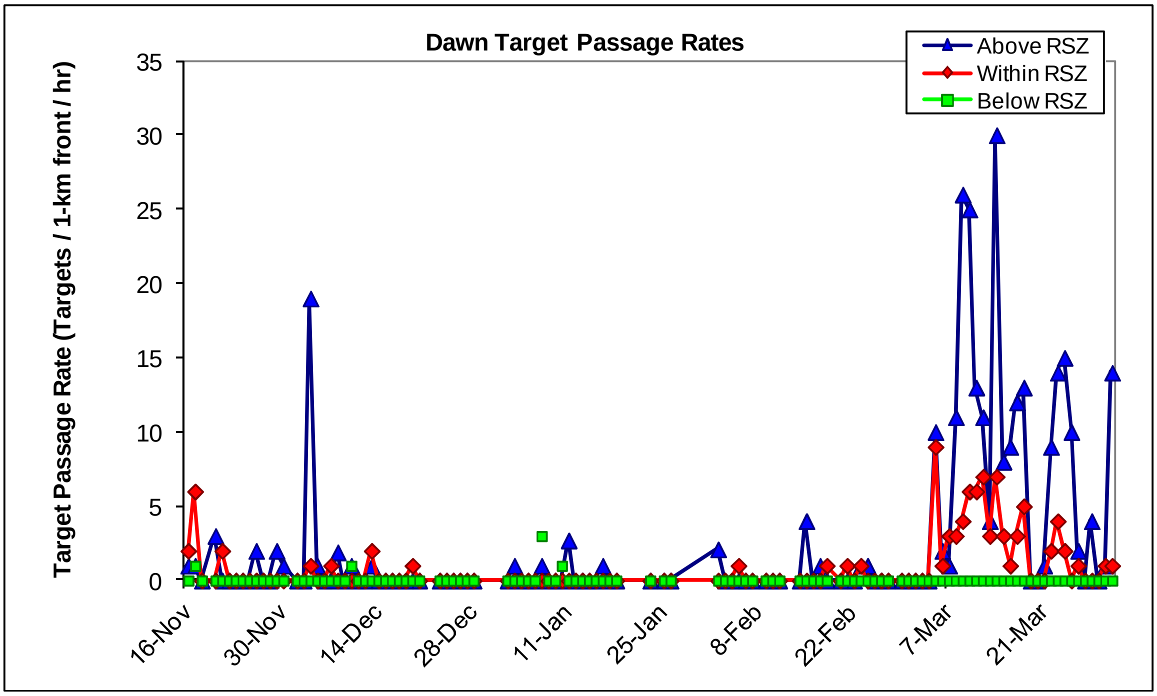

Figure 3-10. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dawns of the Winter 2011-12 season.

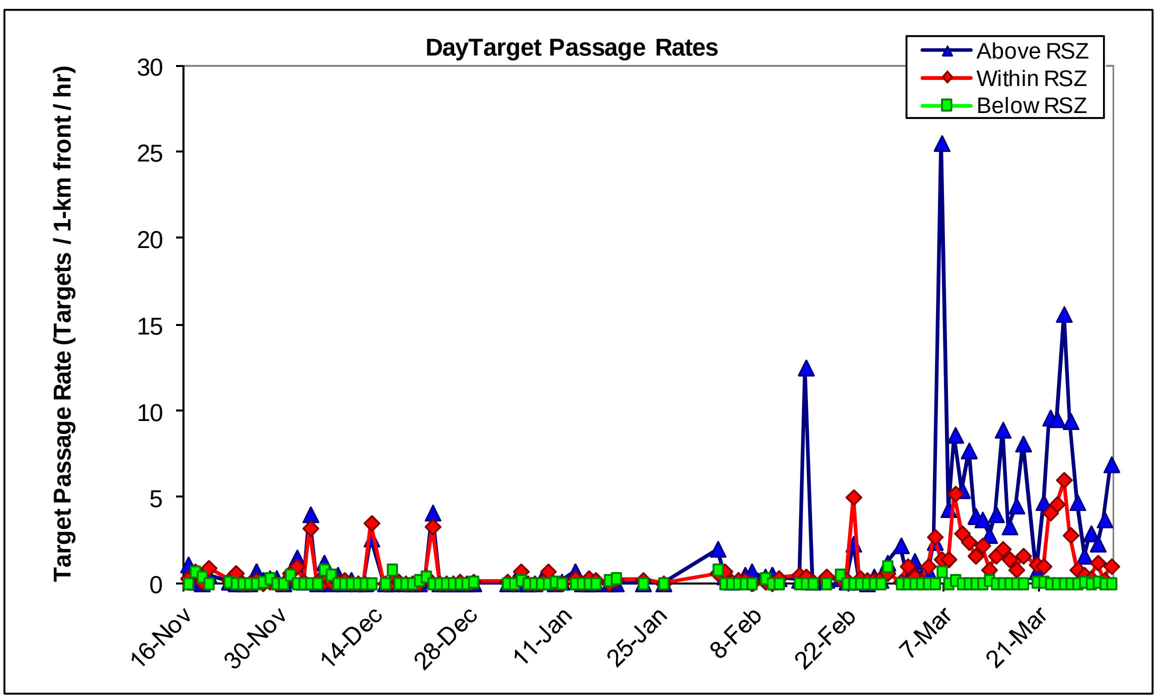

Figure 3-11. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during days of the Winter 2011-12 season.

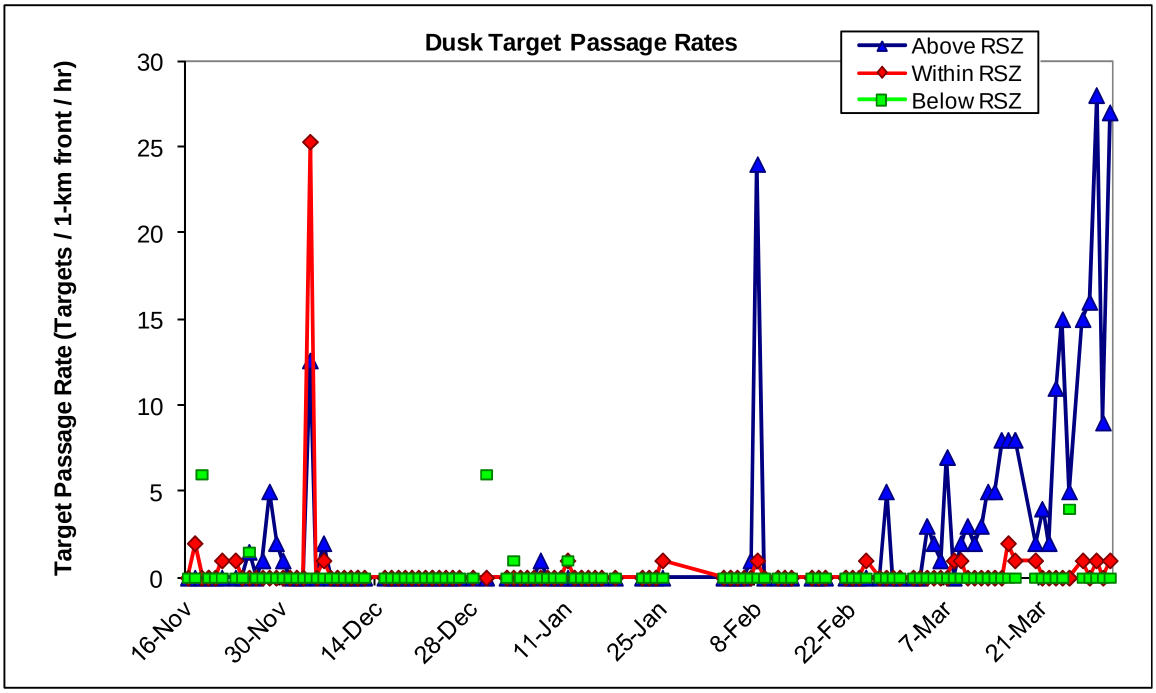

Figure 3-12. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dusks of the Winter 2011-12 season.

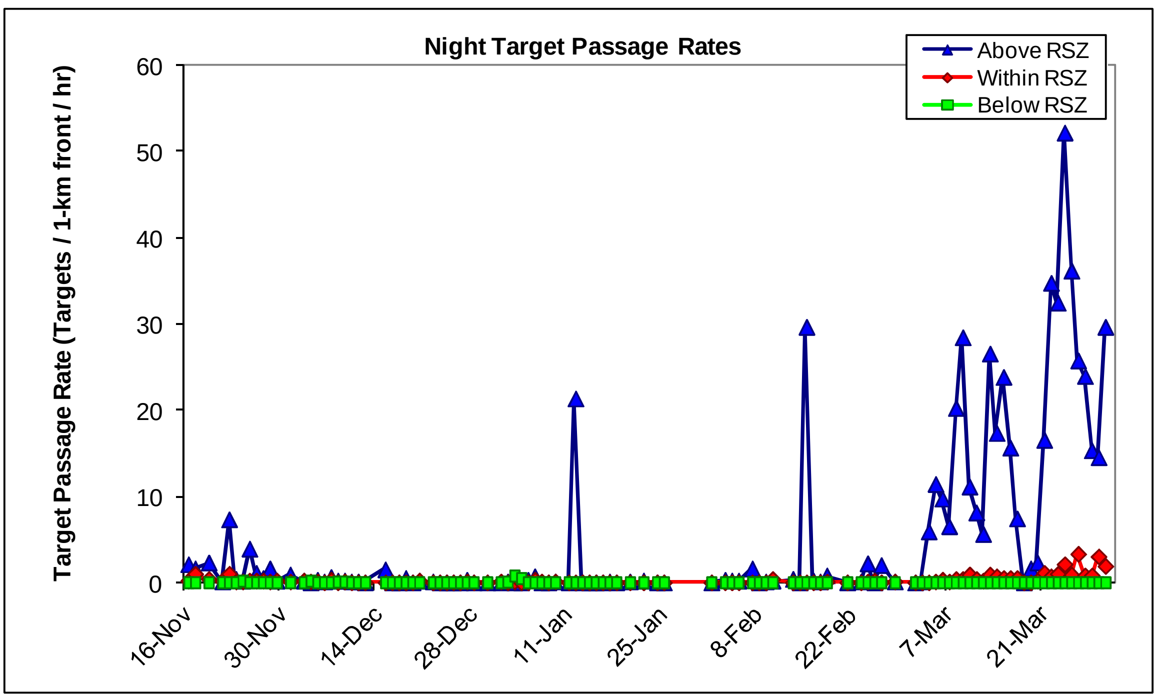

Figure 3-13. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during nights of the Winter 2011-12 season.

3.3 Horizontal Radar Data

The Horizontal Surveillance Radar (HSR) was used to determine directional movements of targets during biological periods of the Winter 2011-12 season.

3.3.1 Target Directions

Average target directions were calculated for each biological period (Fig. 3-14). Average target directions were also calculated seasonally (comprehensive distribution), with all targets detected during the Winter 2011-12 season combined together by biological period (Fig. 3-15) and hour (Fig. 3-16).

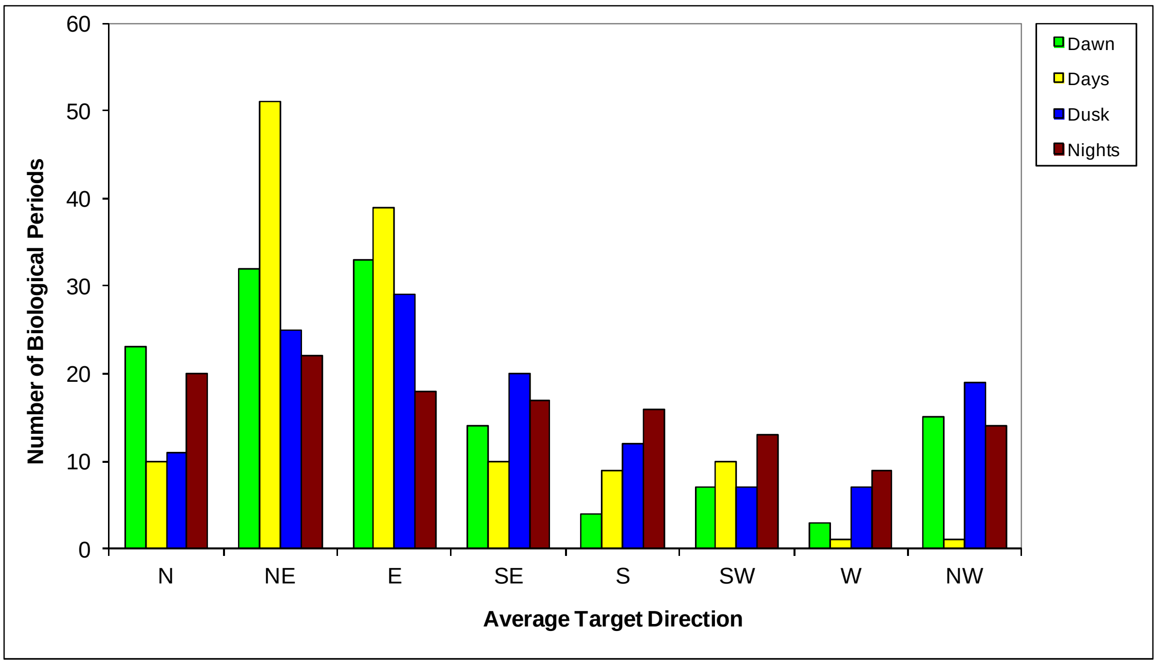

Figure 3-14. Distribution of average target movements among eight directions during dawns, days, dusks, and nights of the Winter 2011-12 season.

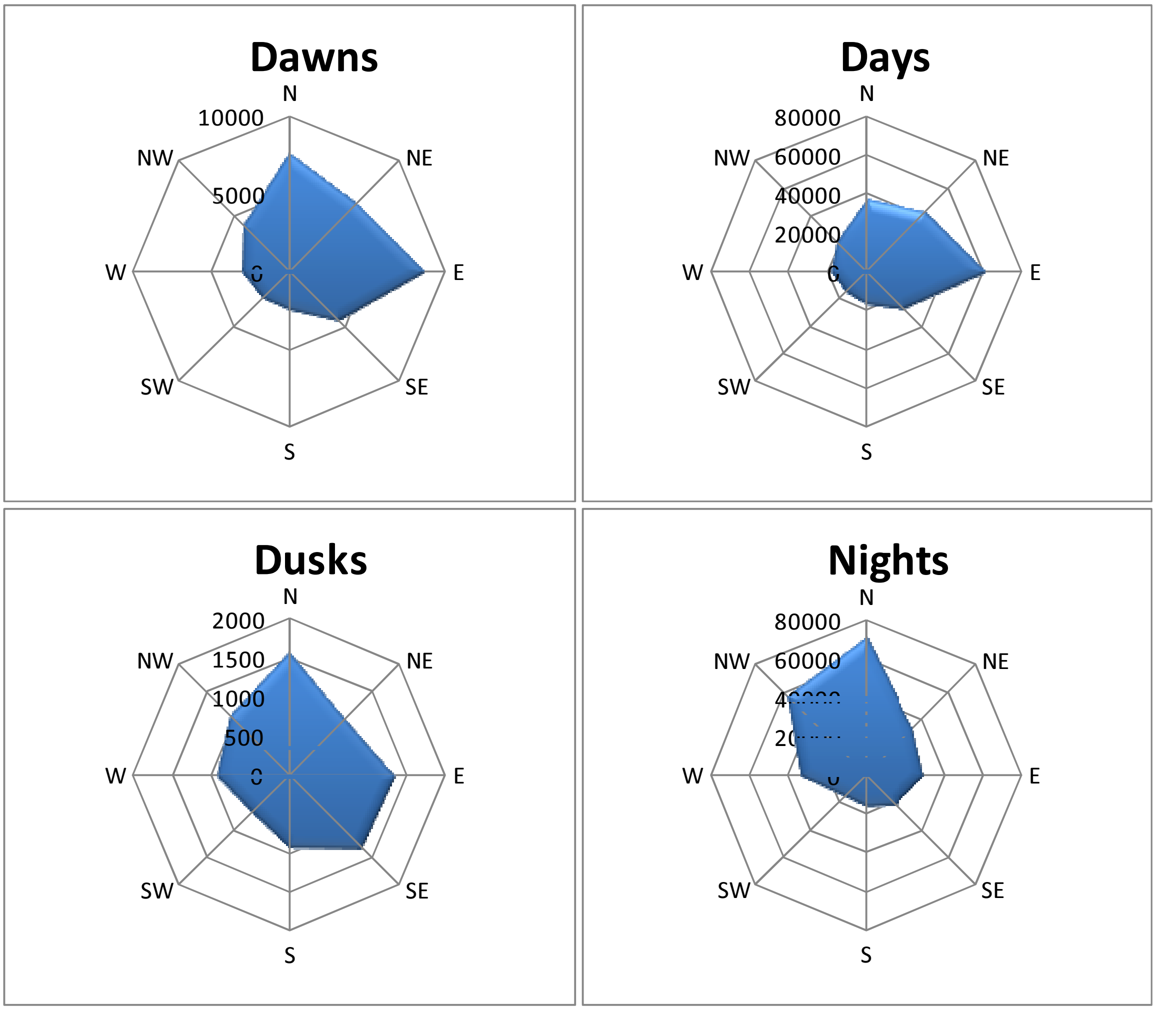

Figure 3-15. Comprehensive distribution of all target's directions during dawns, days, dusks, and nights of the Winter 2011-12 season.

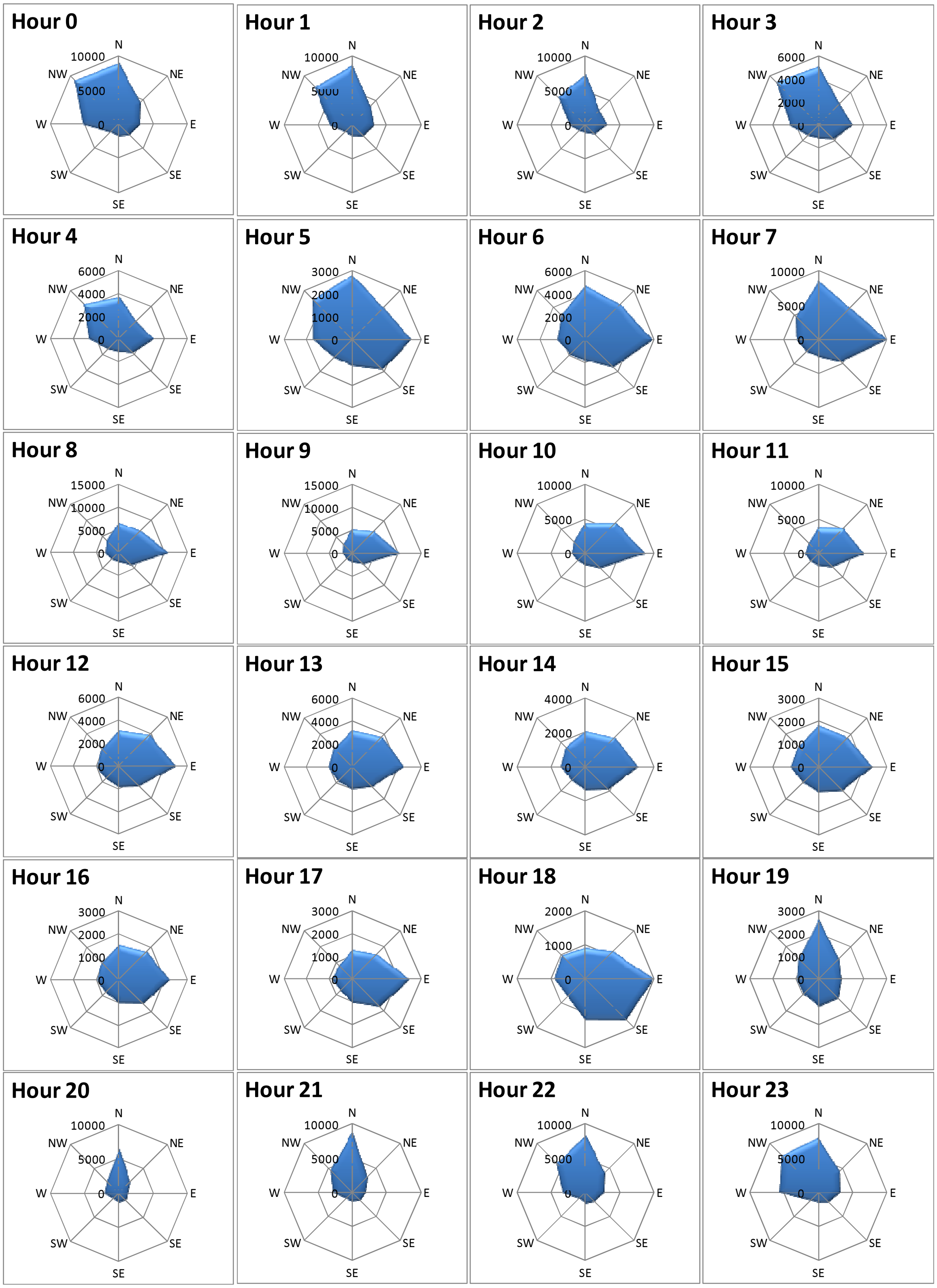

Figure 3-16. Comprehensive distribution of all target's directions by hour during the Winter 2011-12 season.

4 RESULTS for the Spring 2012 Season

4.1 Level of Effort

Table 4-1 presents available time, time radar data were collected, amount of radar data that were removed due to rain, high levels of insect activity, or other contamination, and the resulting time of radar data used for analyses, during the Spring 2012 Season (April 1 – June 30, 2012). The MERLIN avian radar system operated at Site 6 until February 2, 2012 and at Site 8 after May 19, 2012.

Table 4-1. Radar monitoring effort during the Spring 2012 season.

	Vertical Radar		Horizontal Radar	
	Hours	%	Hours	%
Time in season	2183.0		2183.0	
Time radar down	473.2	21.7%	473.1	21.7%
Time radar collected data	1709.8	78.3%	1709.9	78.3%
Unuseable radar data[1] due to rain or other contamination	274.4	16.0%	8.8	0.5%
Unuseable radar data[2] due to insects	231.3	13.5%	-	-
Useable radar data[3]	1204.2	55.2%	1701.2	77.9%

1 - Percent indicates portion of time with radar data that was lost due to rain or other contamination.
2 - Percent indicates portion of time with radar data that was lost due to high insect activity.
3 - Percent indicates portion of season with useable radar data.

4.2 Vertical Radar Data

Data collected from the vertical scanning radar (VSR) were used to quantify target activity and heights.

4.2.1 Target Passage Rates Over Time

Data is presented as a rate equaling total number of targets / 1-km front / hr for each biological period (Fig. 4-1) and as an average by biological period (Fig. 4-2) and hour (Fig. 4-3). Summary statistics are presented in table 4-2.

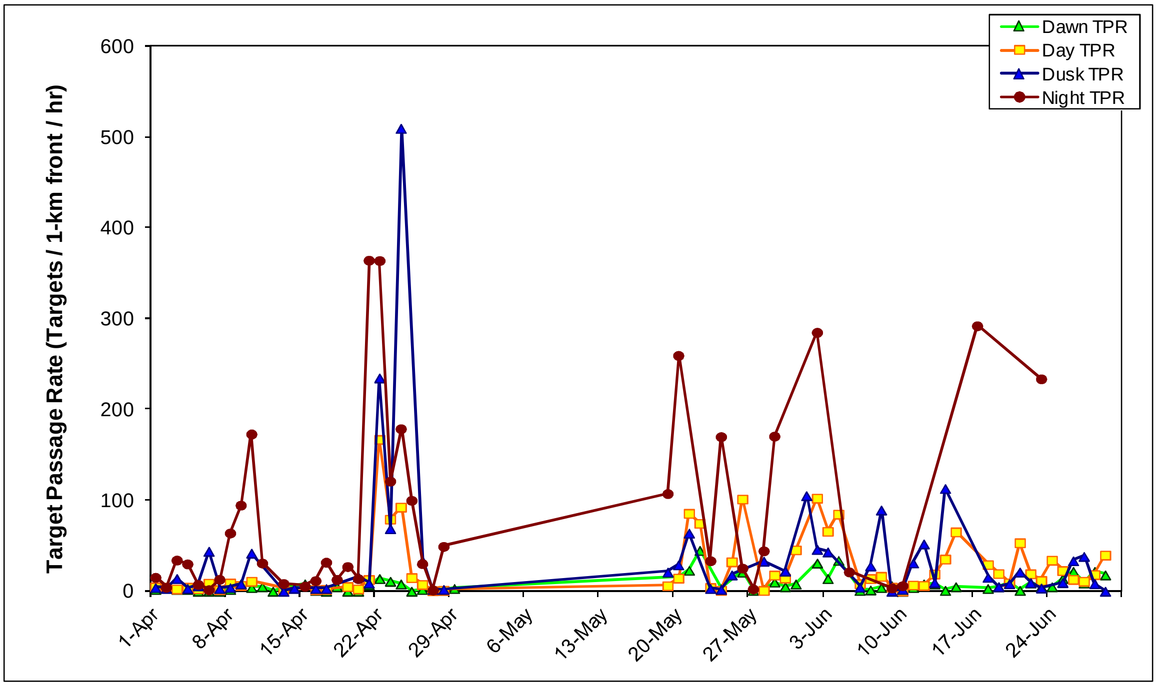

Figure 4-1. Target passage rates (TPR) during biological periods of the Spring 2012 season.

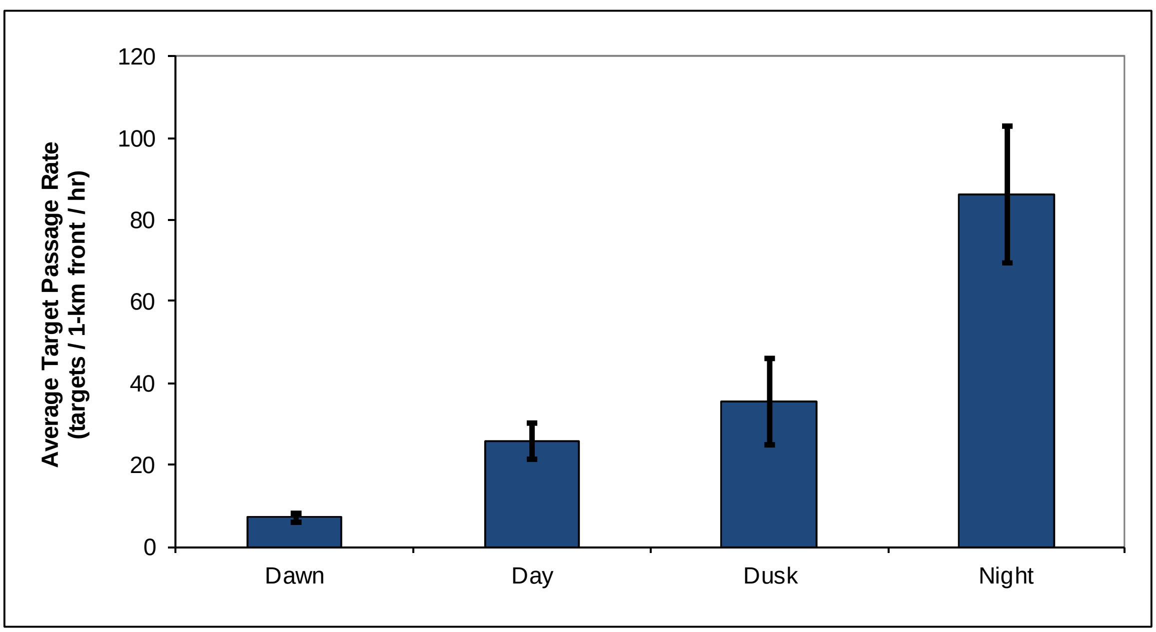

Figure 4-2. Average target passage rates (TPR) by biological period during the Spring 2012 season. Error bars represent one standard error.

Table 4-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for biological periods during the Spring 2012 season.

	Dawn	Day	Dusk	Night
Average	7.4	26.0	35.6	86.3
Standard Deviation	9.1	33.9	77.2	106.3
Standard Error	1.2	4.4	10.6	16.8
Median	5.0	12.4	9.6	31.6
Minimum	0.0	0.3	0.0	1.4
Maximum	45.0	167.3	510.0	364.7

Both average and comprehensive hourly target passage rates are presented in Fig 4-3: average rates are the average of each date's hourly target rate in a given hour, while comprehensive rates use targets grouped by hour, regardless of date.

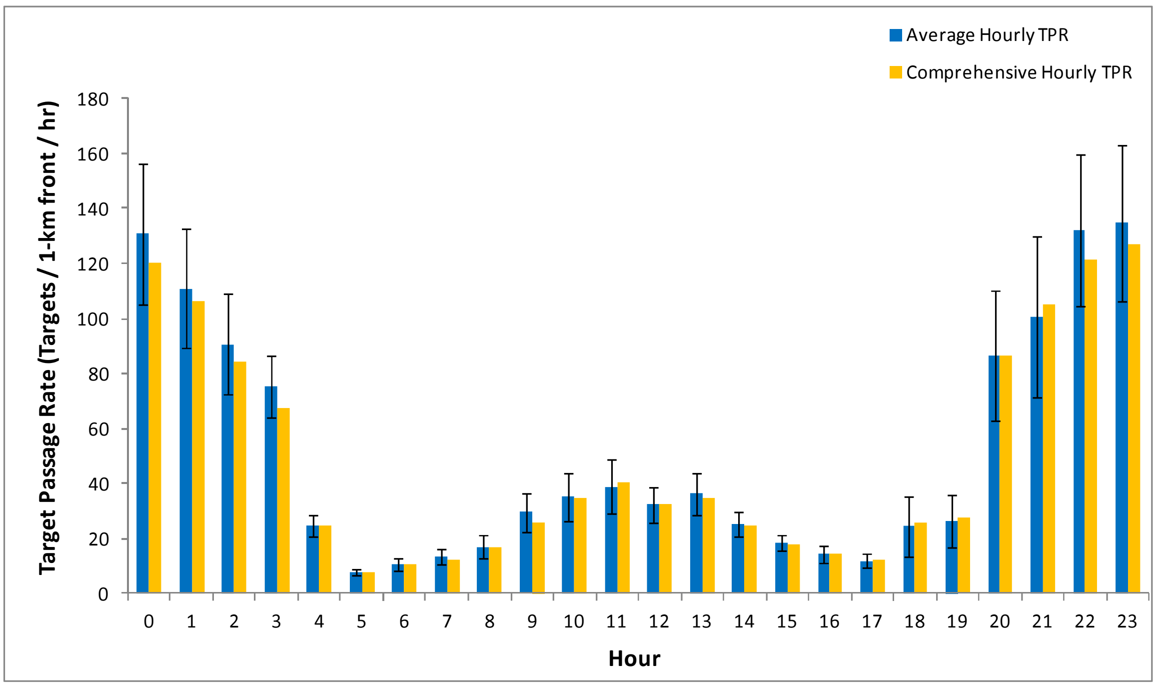

Figure 4-3. Average and comprehensive hourly target passage rates during the Spring 2012 season. Error bars represent one standard error.

4.2.2 Altitudinal Distribution of Targets

Mean and median target heights are presented for each biological period (Fig. 4-4 and Fig. 4-5, respectively) of the Spring 2012 season.

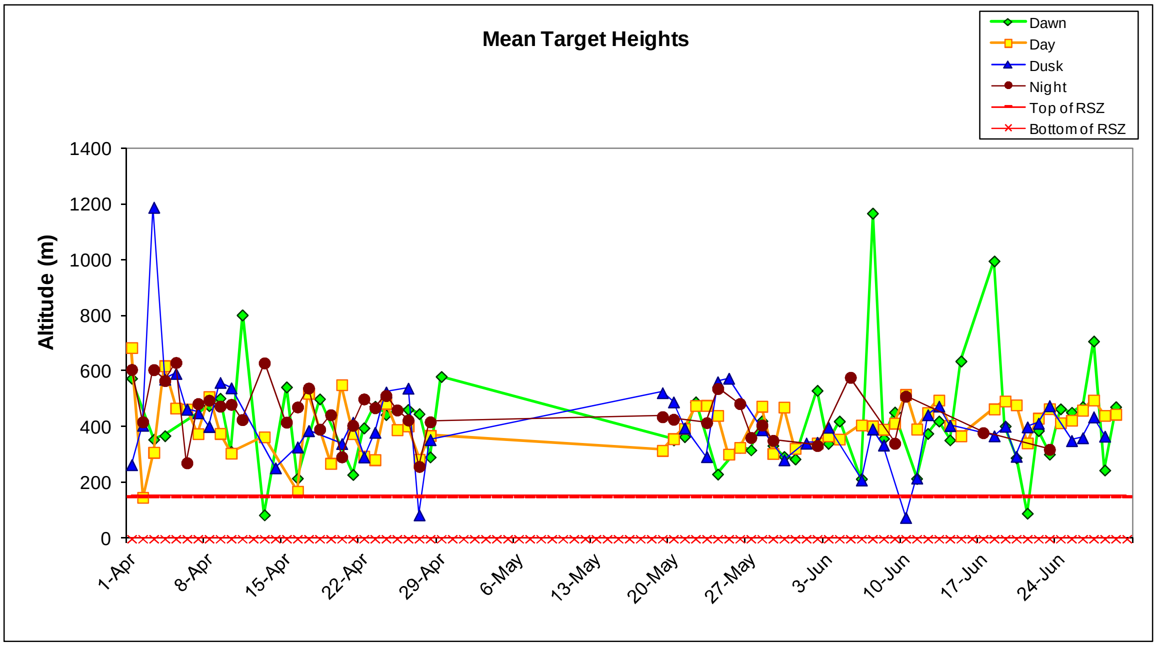

Figure 4-4. Mean target heights during the Spring 2012 season. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

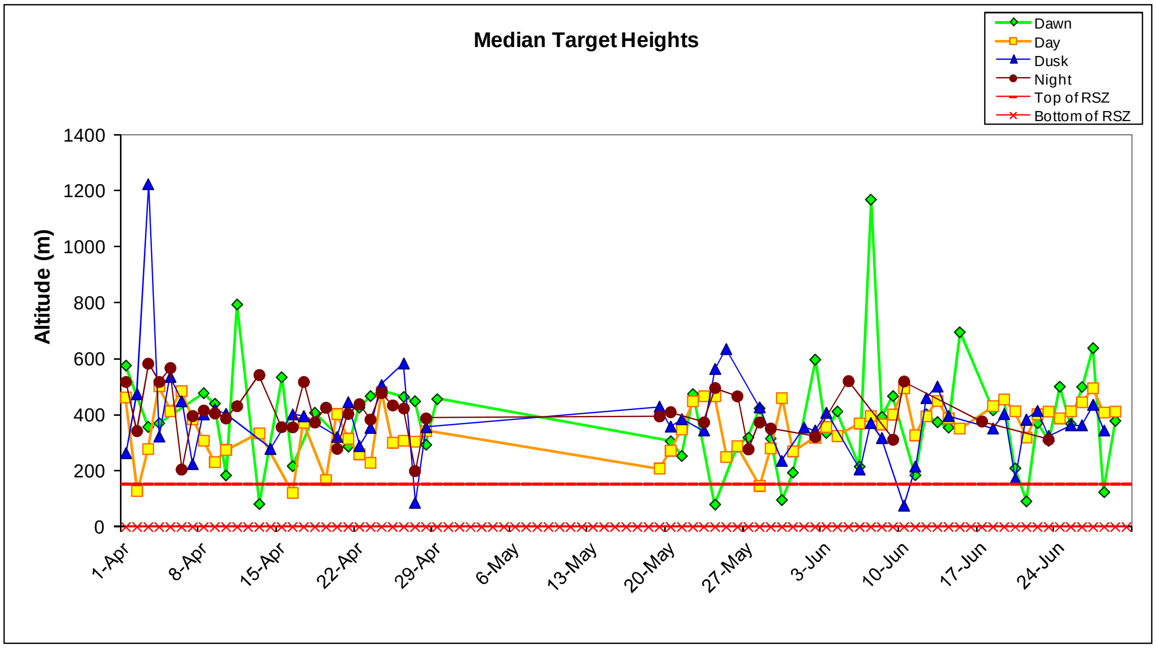

Figure 4-5. Median target heights during the Spring 2012 season. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

The mean and median target heights during each biological period were calculated for all dates with ≥ 50% data for that time period, averaged into a grand mean and average median, and presented in Table 4-3 (top) and illustrated in Figure 4-6 (blue bars). The comprehensive mean and median target heights for each biological period (when all targets were combined regardless of date) are also listed in Table 4-3 (bottom) and illustrated in Figure 4-6 (green bars).

Table 4-3. Summary of mean and median target heights during biological periods of the Spring 2012 season. Darker colors in color-coded rows indicate greater values within that row.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Grand mean target height	421.0	407.0	408.2	450.6
Average median target height	386.0	353.8	386.0	406.3
All targets for season combined				
Comprehensive mean target height	423.7	388.9	428.2	437.5
Comprehensive median target height	396.2	353.6	392.9	401.7

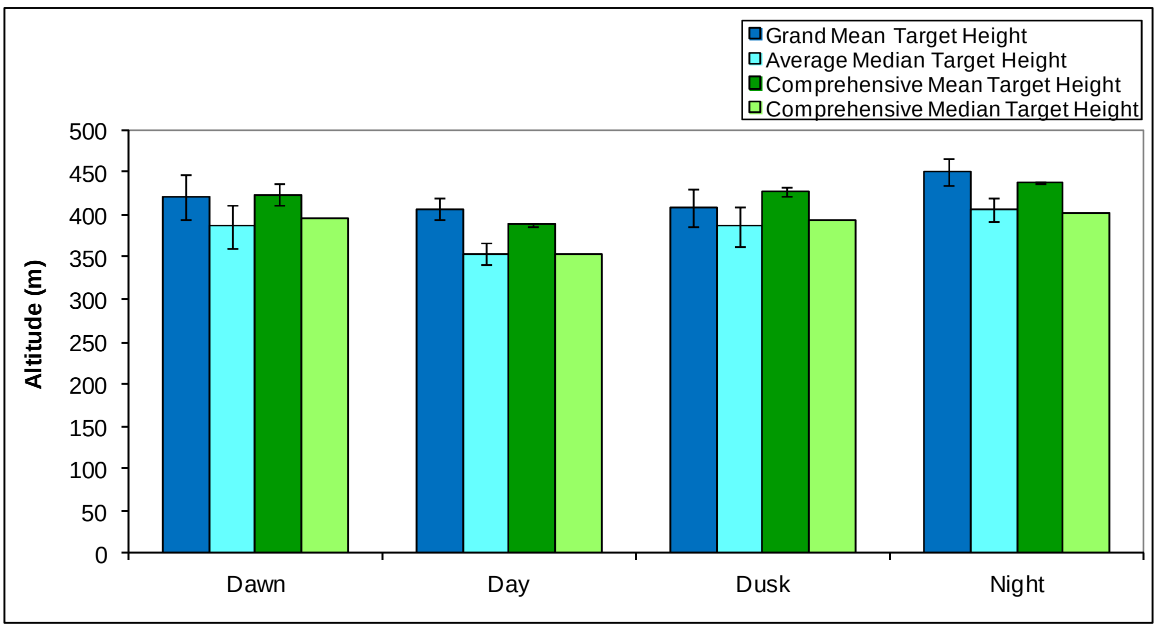

Figure 4-6. Grand mean and average median target heights averaged across individual biological periods (blue bars), and comprehensive mean and median target heights of all targets grouped by biological period (green bars), during the Spring 2012 season. Error bars represent one standard error.

Hourly target heights were averaged into a grand hourly target mean and an average hourly target median for each of 24 hours; a comprehensive hourly target mean was also calculated by pooling all targets within a given hour together, regardless of date (Fig. 4-7).

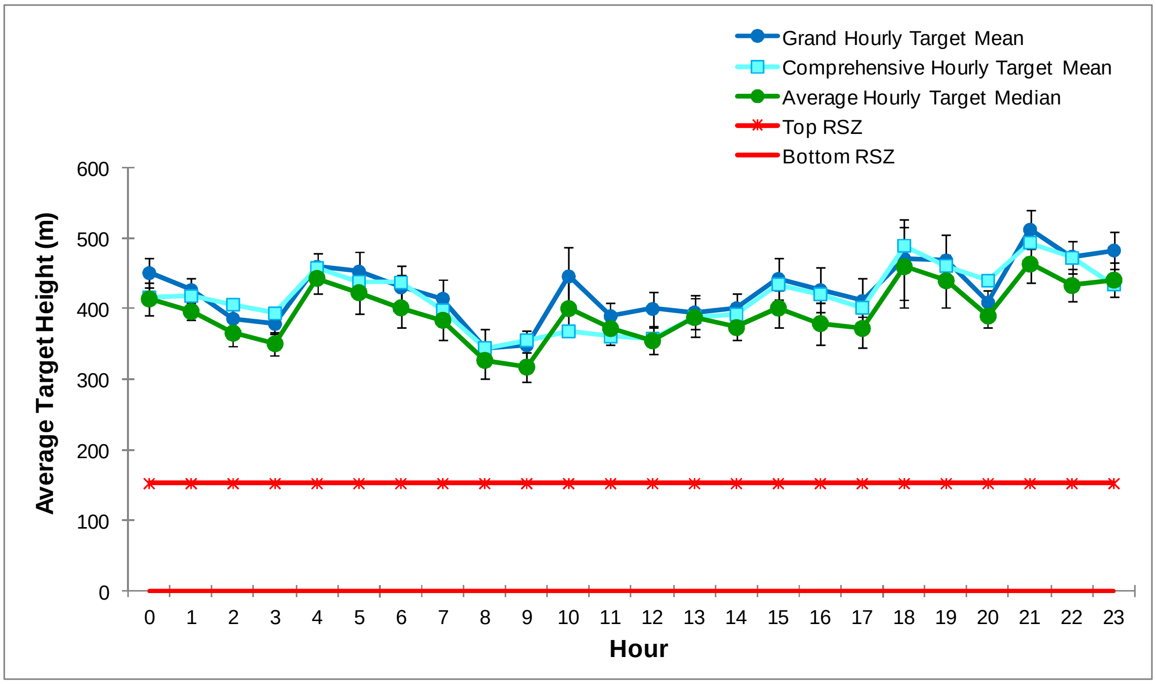

Figure 4-7. Hourly target heights during the Spring 2012 season. Error bars represent one standard error. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

The distribution of all targets detected during dawns, days, dusks, and nights of the Spring 2012 season are shown using 50-meter increments (Fig. 4-8).

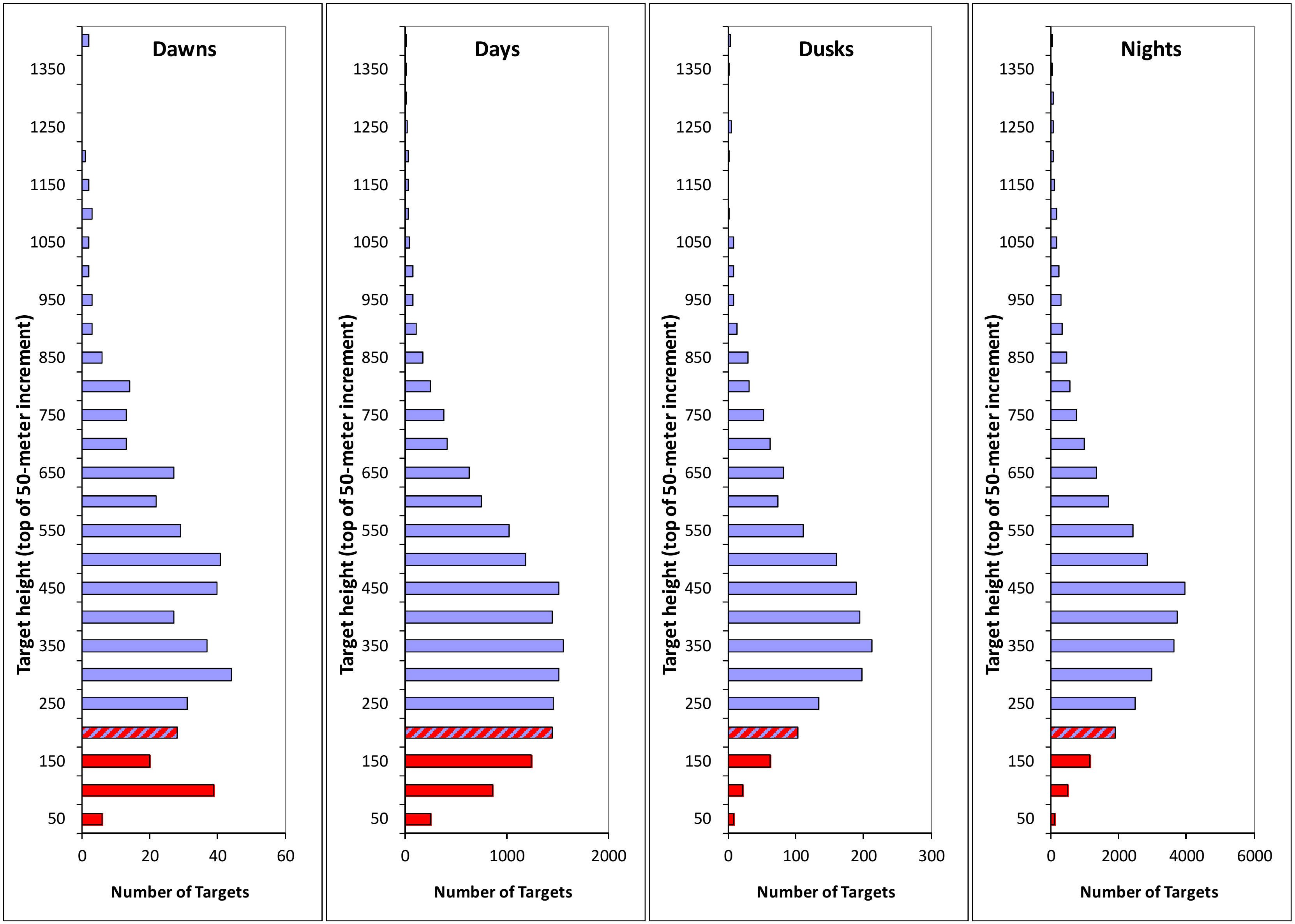

Figure 4-8. Number of targets occurring in each 50-meter increment during biological periods of the Spring 2012 season. Red indicates rotor swept heights, and red-blue hashed indicates altitudes partially within rotor swept heights.

Using a RSZ of 0-152.4 m AGL, target passage rates below, within, and above the RSZ were calculated for each date. Individual target passage rates are presented for dawns (Fig. 4-10) days (Fig. 4-11), dusks (Fig 4-12), and nights (Fig. 4-13). Percent targets below, within, and above the RSZ were also calculated seasonally, with all targets detected during each biological period of the Spring 2012 season combined together (Table 4-4, bottom). Average hourly target passage rates below, within, and above the rotor swept zone are also given (Fig. 4-9).

Table 4-4. Summary of target passage rates and percent of targets above, within and below the RSZ (0-152.4 m AGL) during biological periods of the Spring 2012 season. Darker colors indicate greater values.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average target passage rate above RSZ	6.4	22.0	33.7	81.0
Average target passage rate within RSZ	1.1	3.9	1.9	5.3
Average target passage rate below RSZ	0.0	0.0	0.0	0.0
Average % of targets in RSZ	16.8%	16.9%	9.2%	7.7%
Min target percentage within RSZ	0.0%	1.8%	0.0%	0.3%
Max target percentage within RSZ	100.0%	67.9%	100.0%	35.3%
All targets for season combined				
% targets above RSZ	85.7%	85.8%	94.8%	94.4%
% targets within RSZ	14.3%	14.2%	5.2%	5.6%
% targets below RSZ	0.0%	0.1%	0.0%	0.0%
% targets below turbine height	14.3%	14.2%	5.2%	5.6%

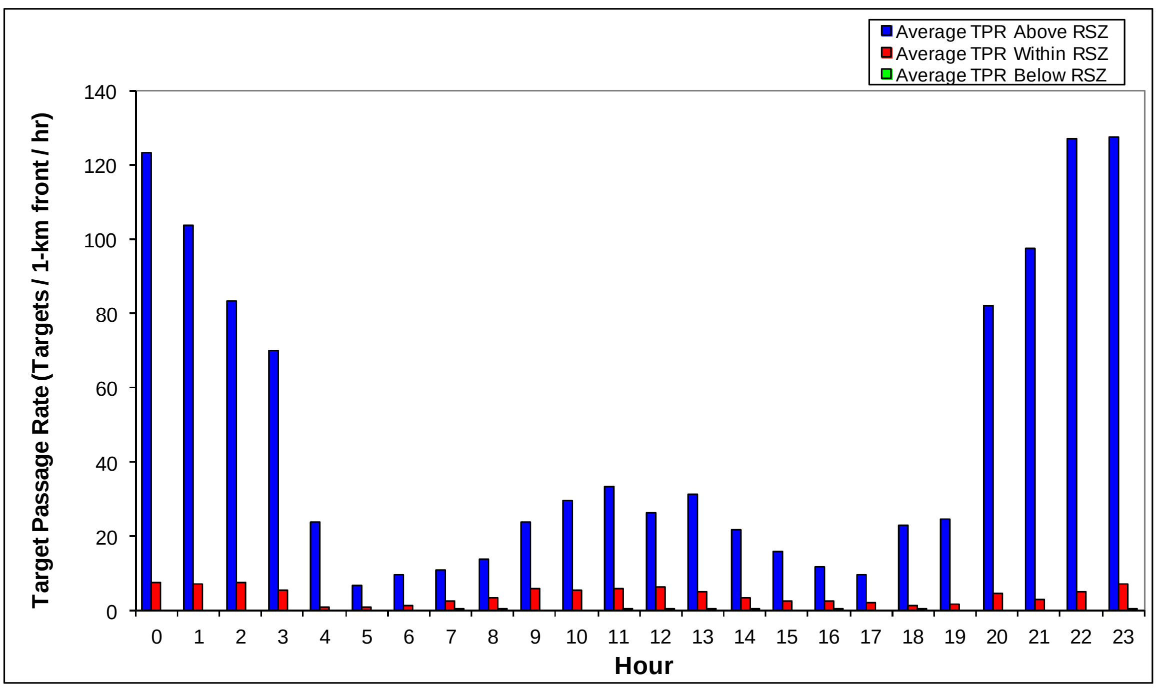

Figure 4-9. Average hourly target passage rates during the Spring 2012 season.

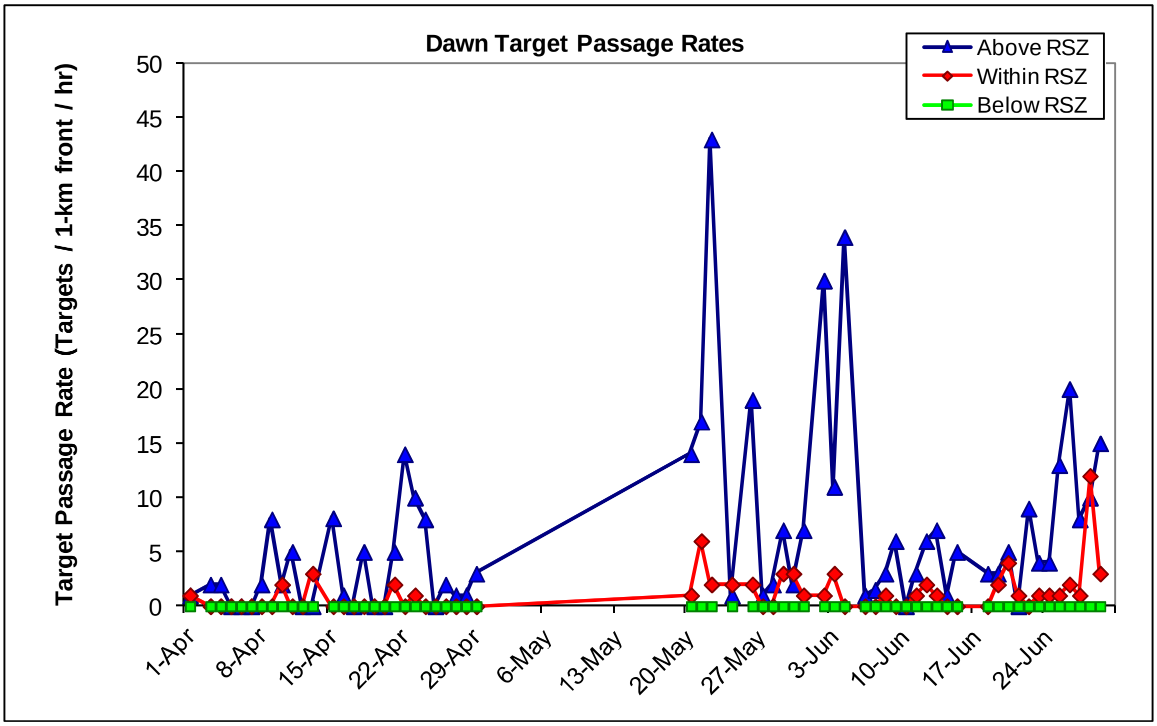

Figure 4-10. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dawns of the Spring 2012 season.

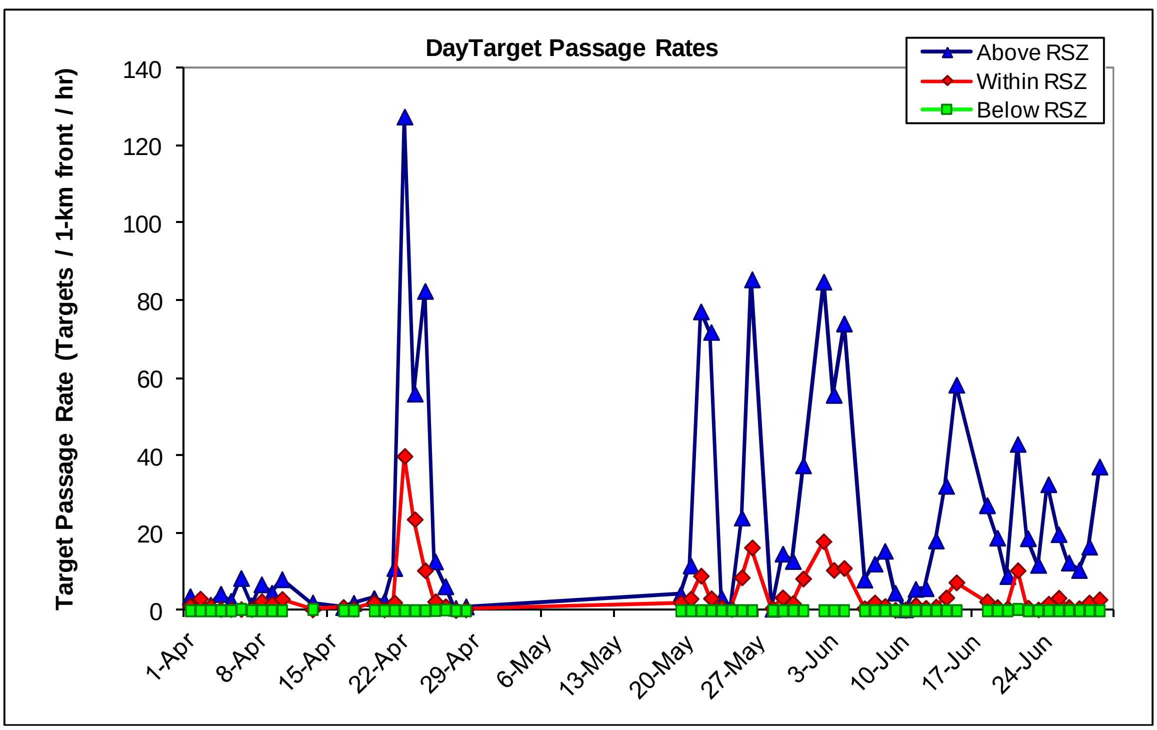

Figure 4-11. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during days of the Spring 2012 season.

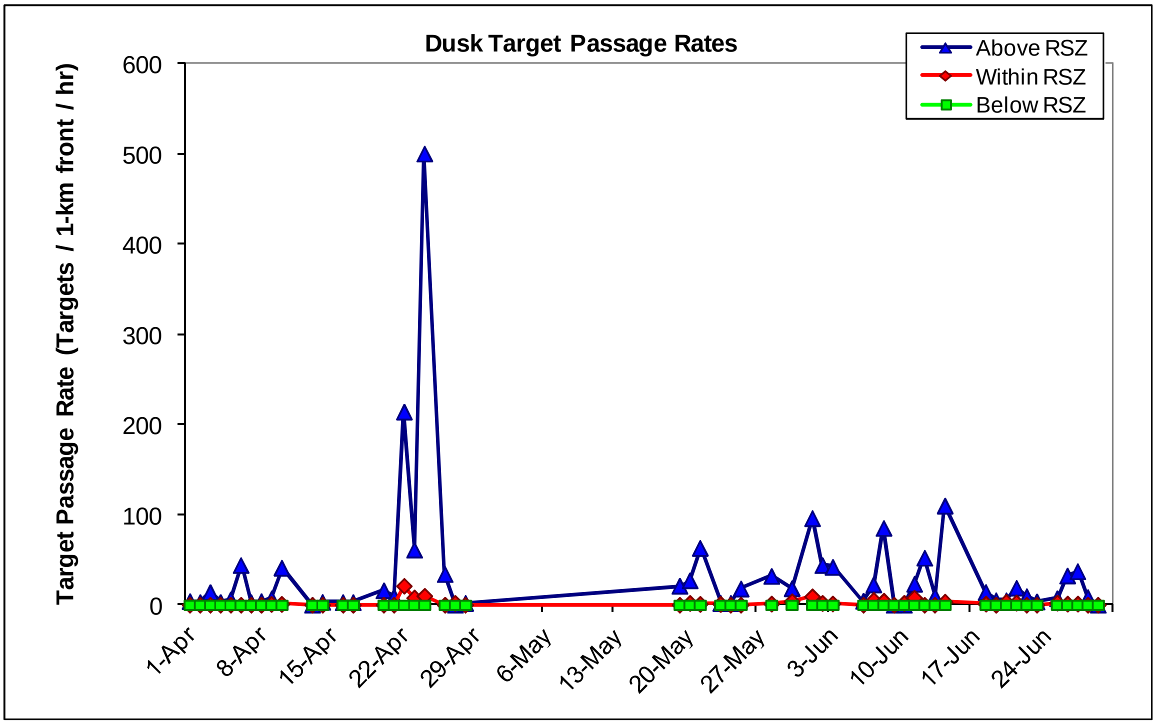

Figure 4-12. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dusks of the Spring 2012 season.

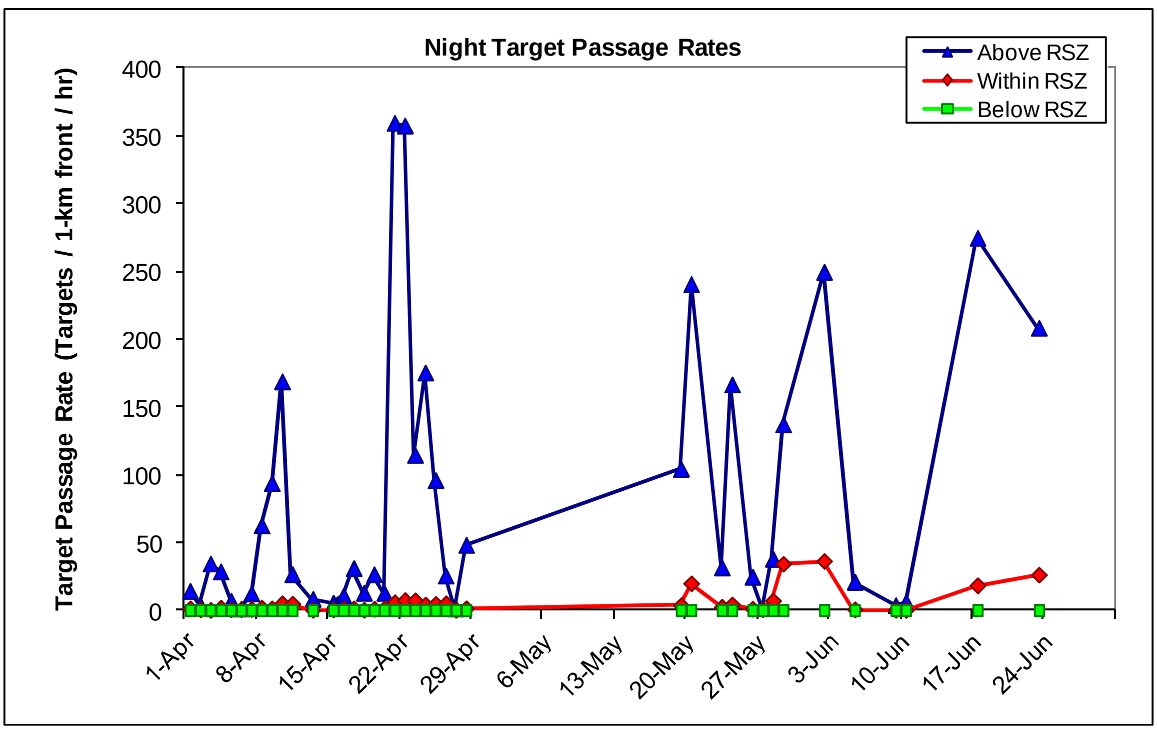

Figure 4-13. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during nights of the Spring 2012 season.

4.3 Horizontal Radar Data

The Horizontal Surveillance Radar (HSR) was used to determine directional movements of targets during biological periods of the Spring 2012 season.

4.3.1 Target Directions

Average target directions were calculated for each biological period (Fig. 4-14). Average target directions were also calculated seasonally (comprehensive distribution), with all targets detected during the Spring 2012 season combined together by biological period (Fig. 4-15) and hour (Fig. 4-16).

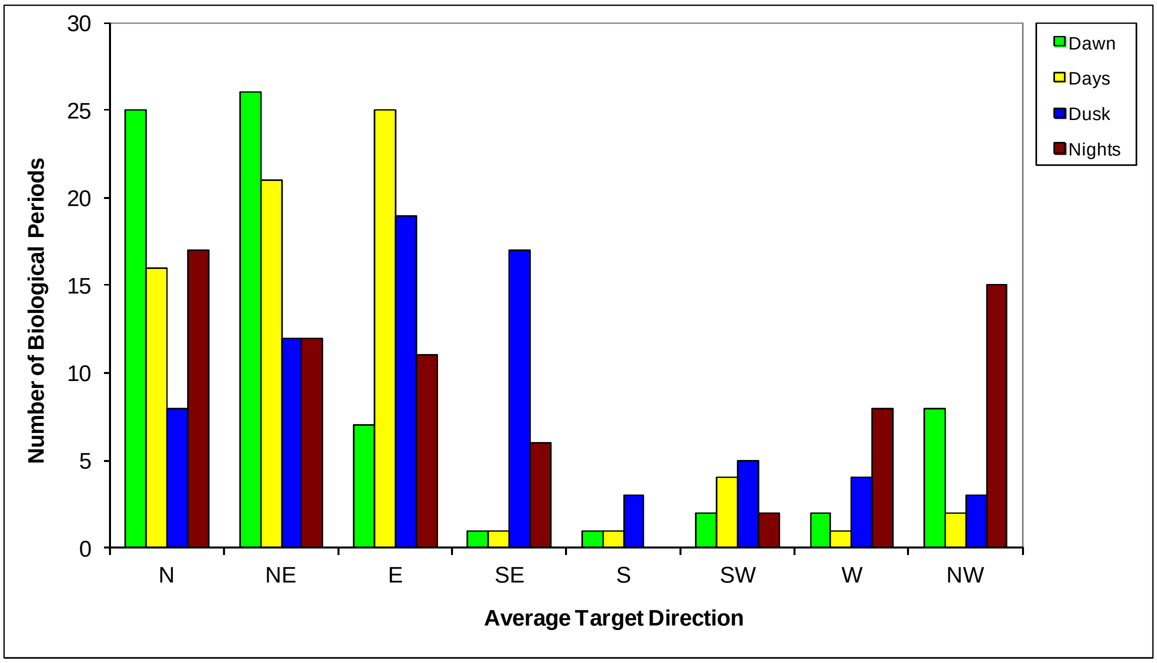

Figure 4-14. Distribution of average target movements among eight directions during dawns, days, dusks, and nights of the Spring 2012 season.

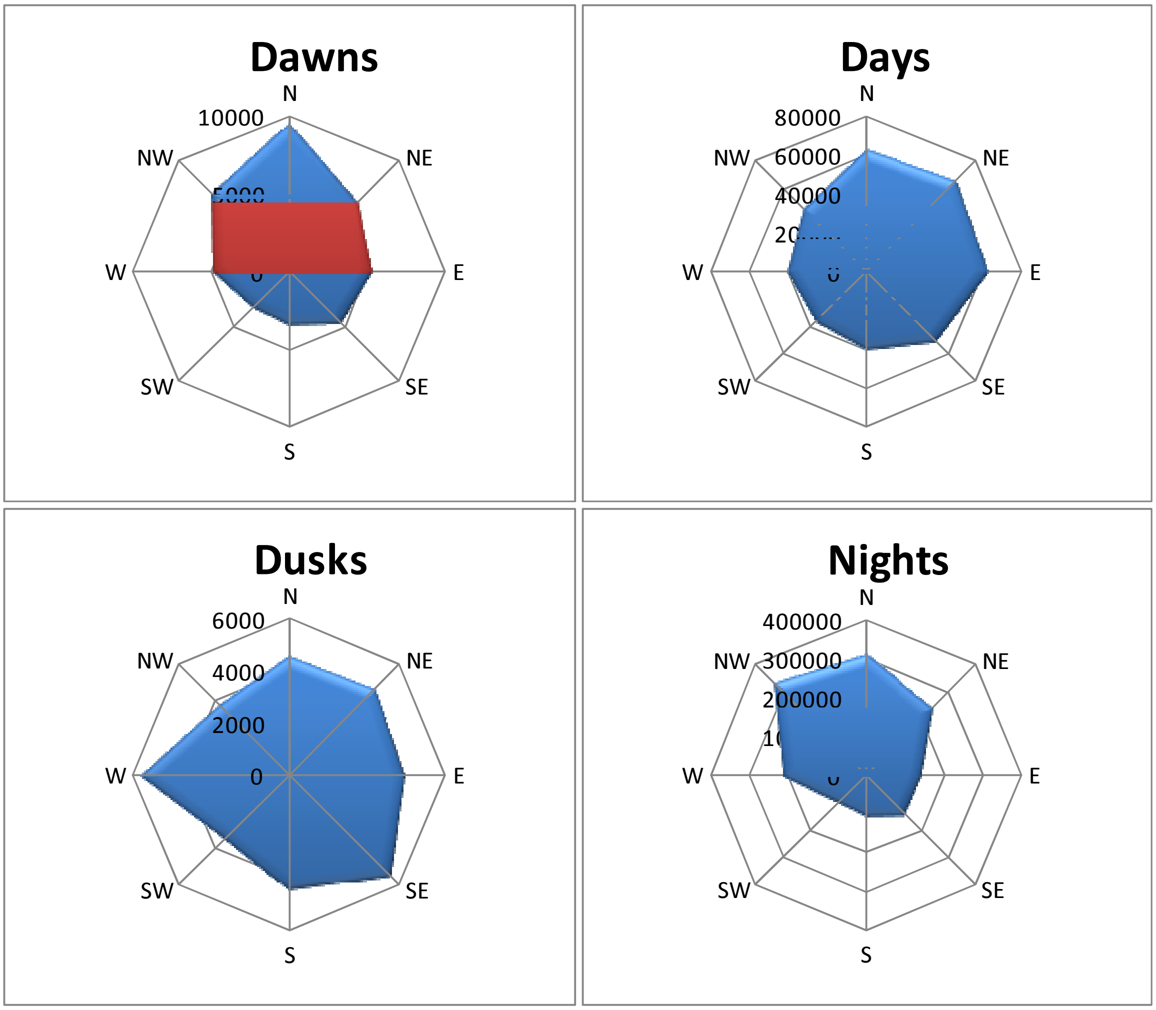

Figure 4-15. Comprehensive distribution of all target's directions during dawns, days, dusks, and nights of the Spring 2012 season.

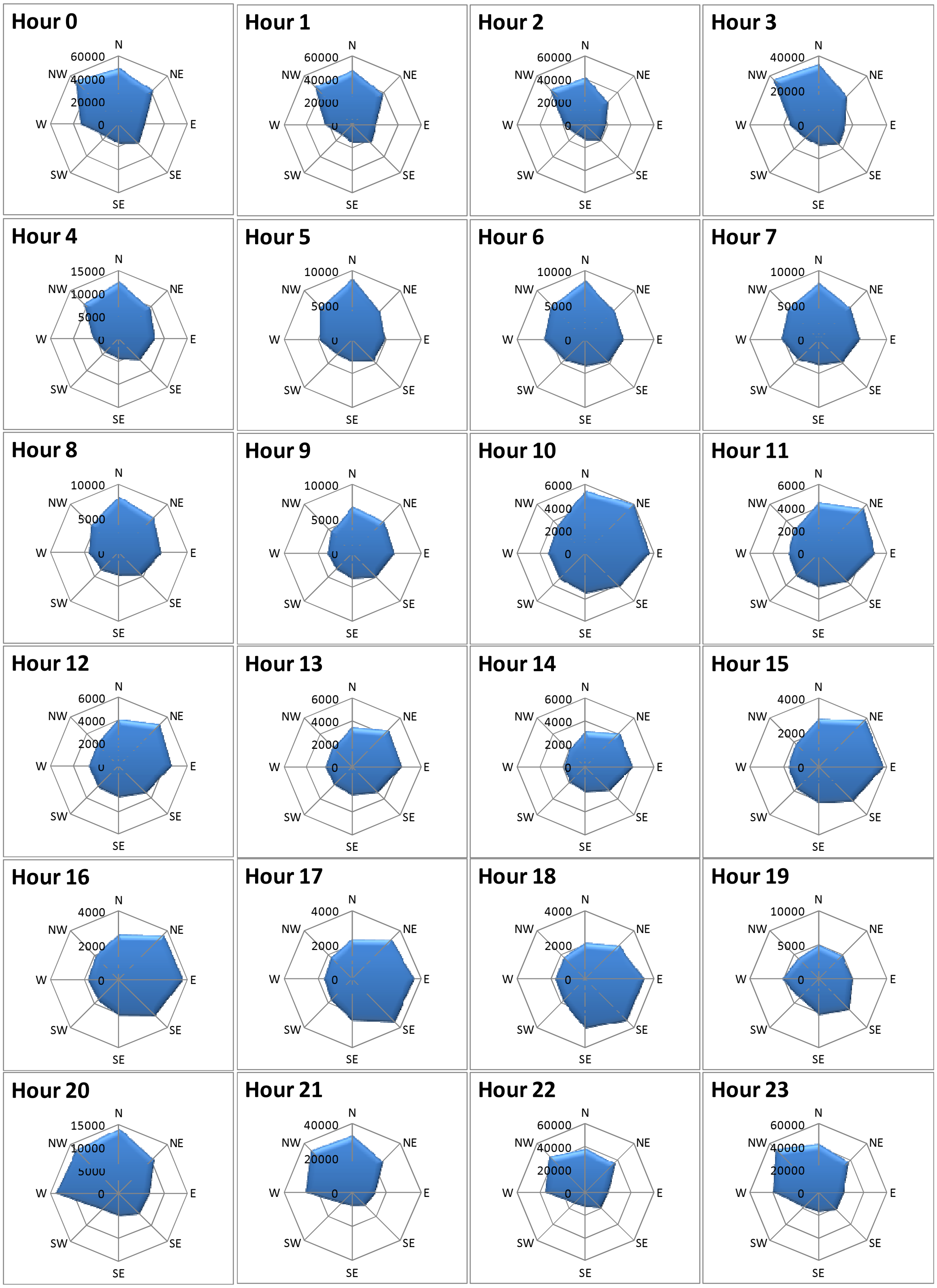

Figure 4-16. Comprehensive distribution of all target's directions by hour during the Spring 2012 season.

5 RESULTS for the Summer 2012 Season

5.1 Level of Effort

Table 5-1 presents available time, time radar data were collected, amount of radar data that were removed due to rain, high levels of insect activity, or other contamination, and the resulting time of radar data used for analyses, during the Summer 2012 Season (July 1 – August 15, 2012). The MERLIN avian radar system operated at Site 8 until July 17, 2012 and at Site 9 after July 21, 2012.

Table 5-1. Radar monitoring effort during the Summer 2012 season.

	Vertical Radar		Horizontal Radar	
	Hours	%	Hours	%
Time in season	1104.6		1104.6	
Time radar down	88.7	8.0%	88.6	8.0%
Time radar collected data	1015.9	92.0%	1016.0	92.0%
Unuseable radar data[1] due to rain or other contamination	104.5	10.3%	13.5	1.3%
Unuseable radar data[2] due to insects	0.0	0.0%	-	-
Useable radar data[3]	911.4	82.5%	1002.5	90.8%

1 - Percent indicates portion of time w ith radar data that w as lost due to rain or other contamination.
2 - Percent indicates portion of time w ith radar data that w as lost due to high insect activity.
3 - Percent indicates portion of season w ith useable radar data.

5.2 Vertical Radar Data

Data collected from the vertical scanning radar (VSR) were used to quantify target activity and heights.

5.2.1 Target Passage Rates Over Time

Data is presented as a rate equaling total number of targets / 1-km front / hr for each biological period (Fig. 5-1) and as an average by biological period (Fig. 5-2) and hour (Fig. 5-3). Summary statistics are presented in table 5-2.

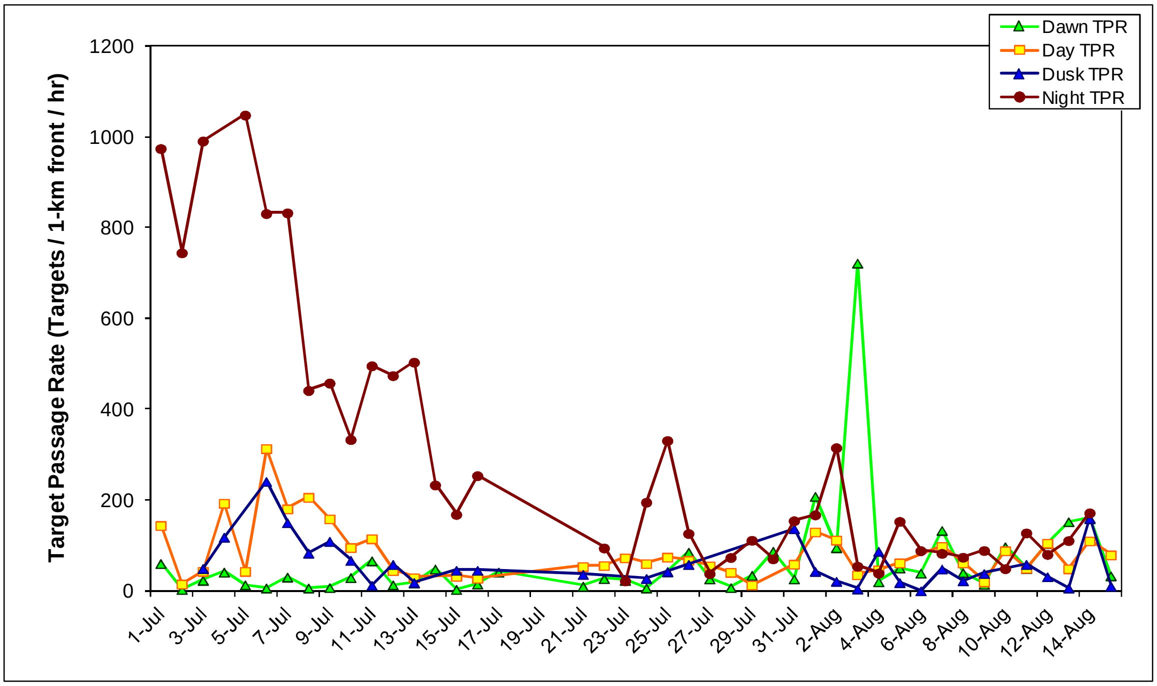

Figure 5-1. Target passage rates (TPR) during biological periods of the Summer 2012 season.

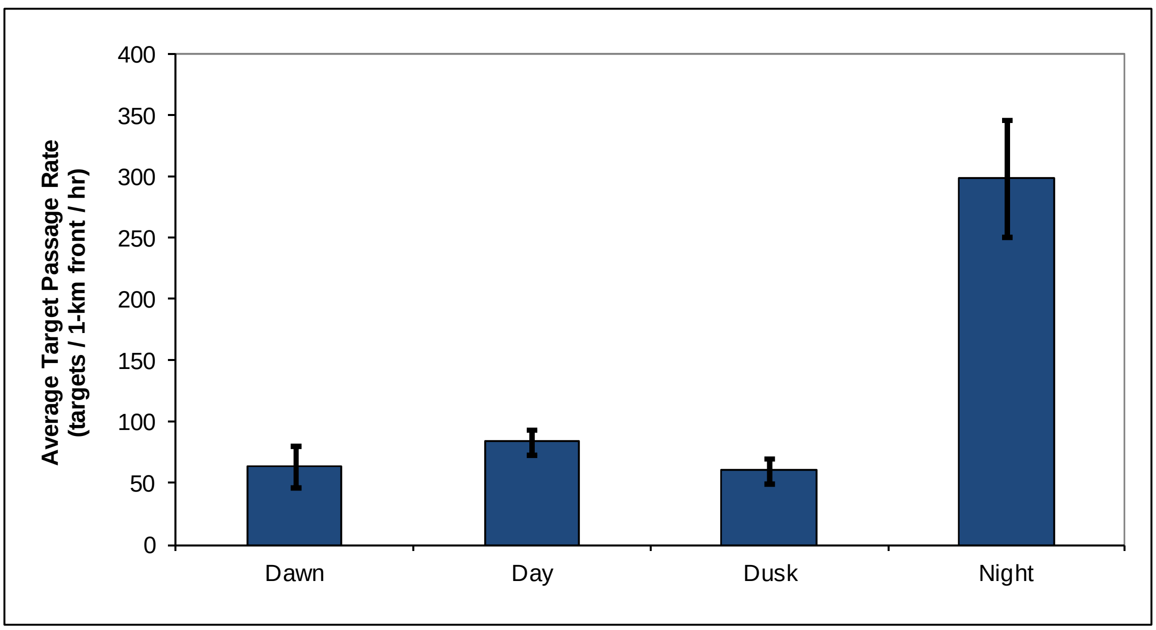

Figure 5-2. Average target passage rates (TPR) by biological period during the Summer 2012 season. Error bars represent one standard error.

Table 5-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for biological periods during the Summer 2012 season.

	Dawn	Day	Dusk	Night
Average	64.0	83.8	60.3	298.5
Standard Deviation	113.0	61.6	54.4	298.1
Standard Error	17.2	9.9	9.8	47.7
Median	34.0	62.2	46.0	168.4
Minimum	4.0	13.7	1.0	23.0
Maximum	723.0	314.2	242.0	1049.2

Both average and comprehensive hourly target passage rates are presented in Fig 5-3: average rates are the average of each date's hourly target rate in a given hour, while comprehensive rates use targets grouped by hour, regardless of date.

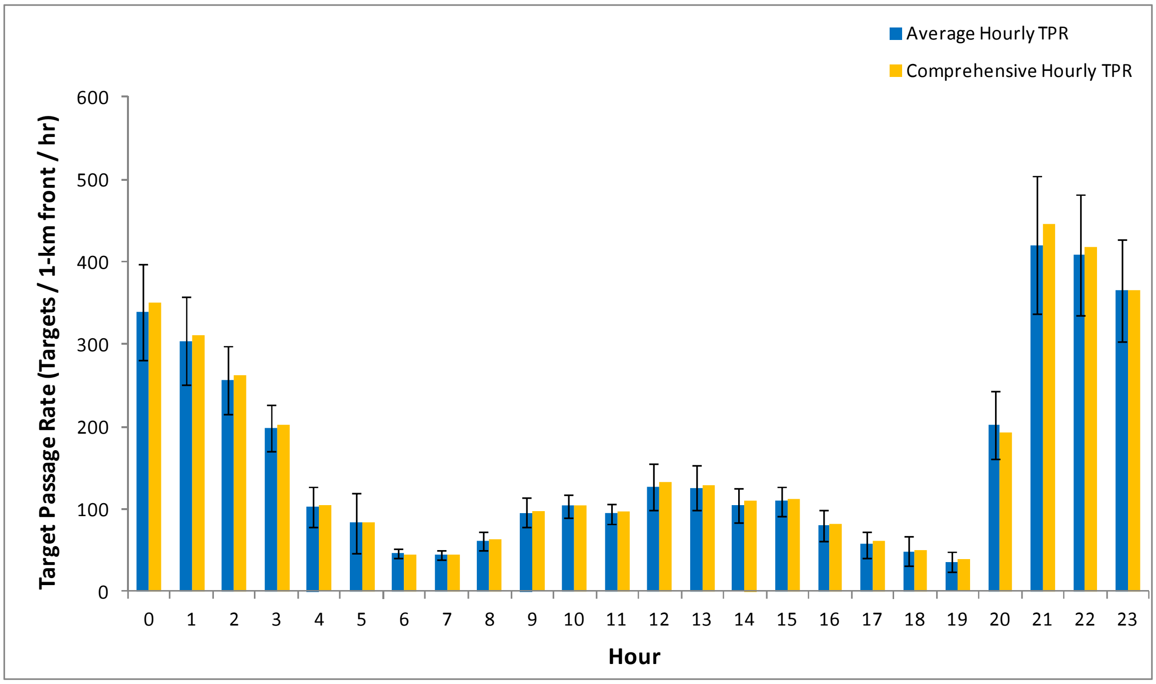

Figure 5-3. Average and comprehensive hourly target passage rates during the Summer 2012 season. Error bars represent one standard error.

5.2.2 Altitudinal Distribution of Targets

Mean and median target heights are presented for each biological period (Fig. 5-4 and Fig. 5-5, respectively) of the Summer 2012 season.

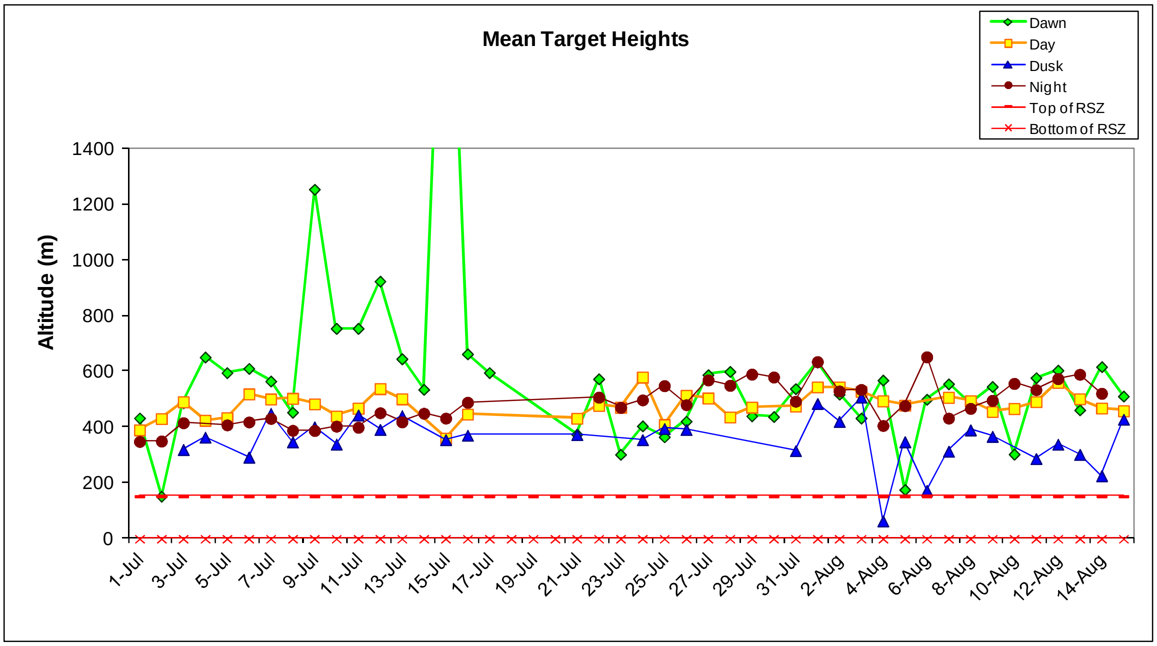

Figure 5-4. Mean target heights during the Summer 2012 season. Red lines represent top and bottom of the RSZ (0-152.4 m AGL). July 15th dawn value is 2,610 m.

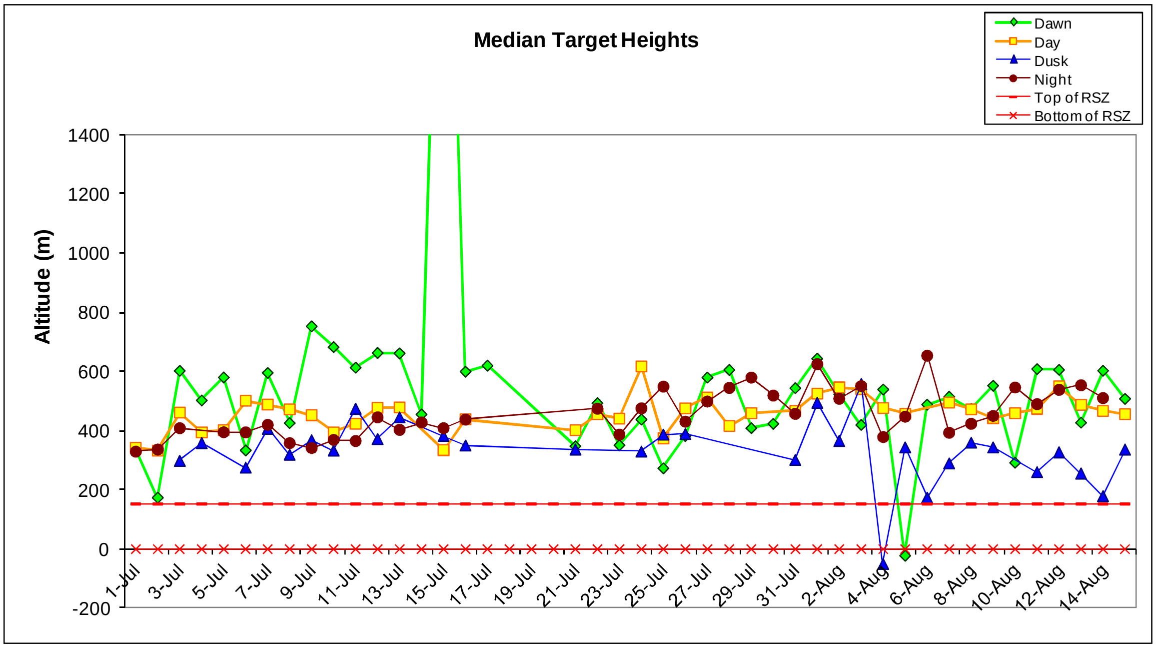

Figure 5-5. Median target heights during the Summer 2012 season. Red lines represent top and bottom of the RSZ (0-152.4 m AGL). July 15th dawn value is 3,018 m.

The mean and median target heights during each biological period were calculated for all dates with ≥ 50% data for that time period, averaged into a grand mean and average median, and presented in Table 5-3 (top) and illustrated in Figure 5-6 (blue bars). The comprehensive mean and median target heights for each biological period (when all targets were combined regardless of date) are also listed in Table 5-3 (bottom) and illustrated in Figure 5-6 (green bars).

Table 5-3. Summary of mean and median target heights during biological periods of the Summer 2012 season. Darker colors in color-coded rows indicate greater values within that row.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Grand mean target height	586.9	479.8	354.9	484.7
Average median target height	549.6	458.0	334.2	457.0
All targets for season combined				
Comprehensive mean target height	509.0	483.3	358.8	433.6
Comprehensive median target height	492.3	459.3	343.8	408.7

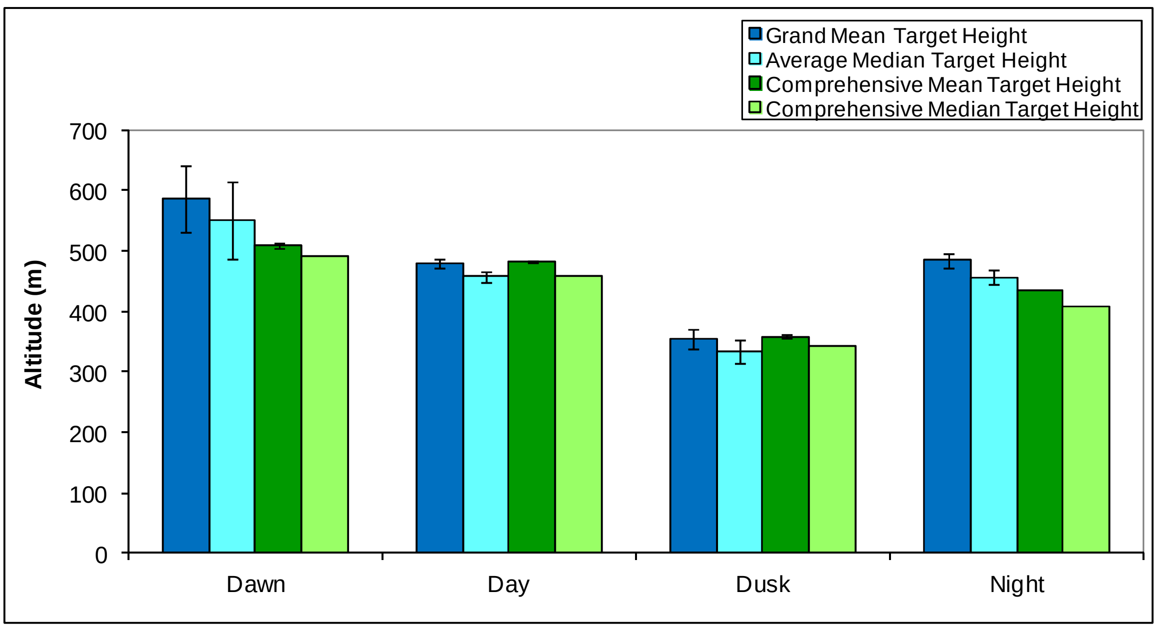

Figure 5-6. Grand mean and average median target heights averaged across individual biological periods (blue bars), and comprehensive mean and median target heights of all targets grouped by biological period (green bars), during the Summer 2012 season. Error bars represent one standard error.

Hourly target heights were averaged into a grand hourly target mean and an average hourly target median for each of 24 hours; a comprehensive hourly target mean was also calculated by pooling all targets within a given hour together, regardless of date (Fig. 5-7).

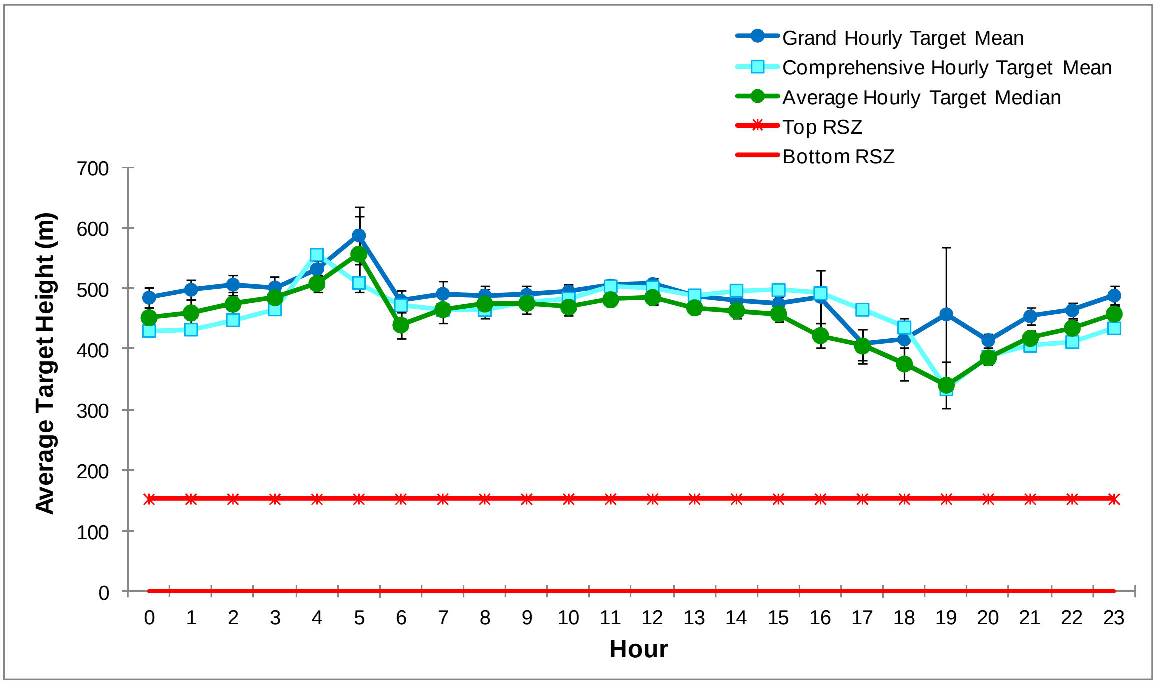

Figure 5-7. Hourly target heights during the Summer 2012 season. Error bars represent one standard error. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

The distribution of all targets detected during dawns, days, dusks, and nights of the Summer 2012 season are shown using 50-meter increments (Fig. 5-8).

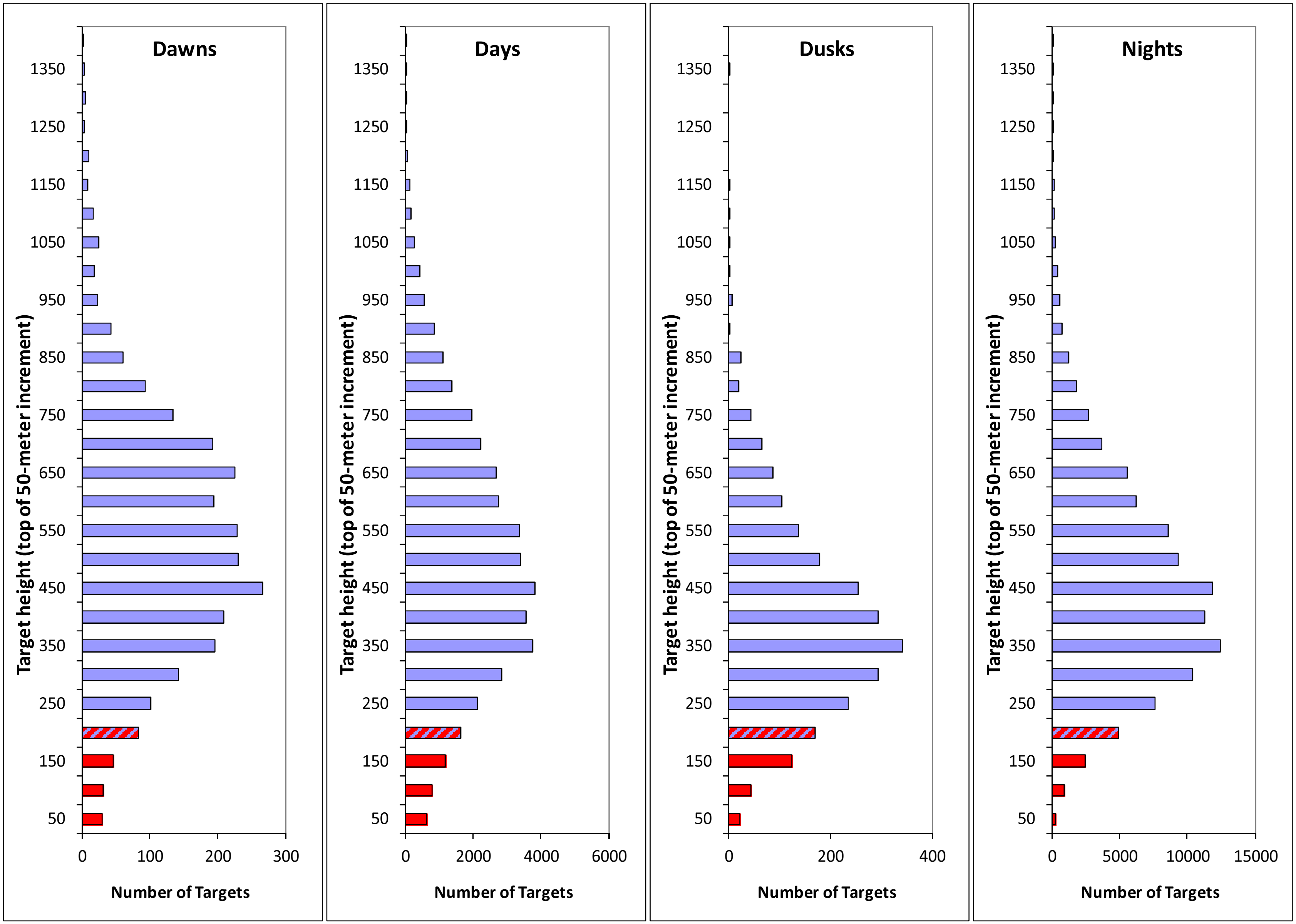

Figure 5-8. Number of targets occurring in each 50-meter increment during biological periods of the Summer 2012 season. Red indicates rotor swept heights, and red-blue hashed indicates altitudes partially within rotor swept heights.

Using a RSZ of 0-152.4 m AGL, target passage rates below, within, and above the RSZ were calculated for each date. Individual target passage rates are presented for dawns (Fig. 5-10) days (Fig. 5-11), dusks (Fig 5-12), and nights (Fig. 5-13). Percent targets below, within, and above the RSZ were also calculated seasonally, with all targets detected during each biological period of the Summer 2012 season combined together (Table 5-4, bottom). Average hourly target passage rates below, within, and above the rotor swept zone are also given (Fig. 5-9).

Table 5-4. Summary of target passage rates and percent of targets above, within and below the RSZ (0-152.4 m AGL) during biological periods of the Summer 2012 season. Darker colors indicate greater values.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average target passage rate above RSZ	59.7	78.0	52.3	287.7
Average target passage rate within RSZ	2.6	5.3	5.6	10.6
Average target passage rate below RSZ	1.7	0.5	2.5	0.2
Average % of targets in RSZ	6.7%	7.5%	7.3%	2.5%
Min target percentage within RSZ	0.0%	2.2%	0.0%	0.1%
Max target percentage within RSZ	33.3%	25.0%	37.5%	12.7%
All targets for season combined				
% targets above RSZ	93.2%	93.0%	86.6%	96.4%
% targets within RSZ	4.1%	6.4%	9.3%	3.5%
% targets below RSZ	2.7%	0.6%	4.1%	0.1%
% targets below turbine height	6.8%	7.0%	13.4%	3.6%

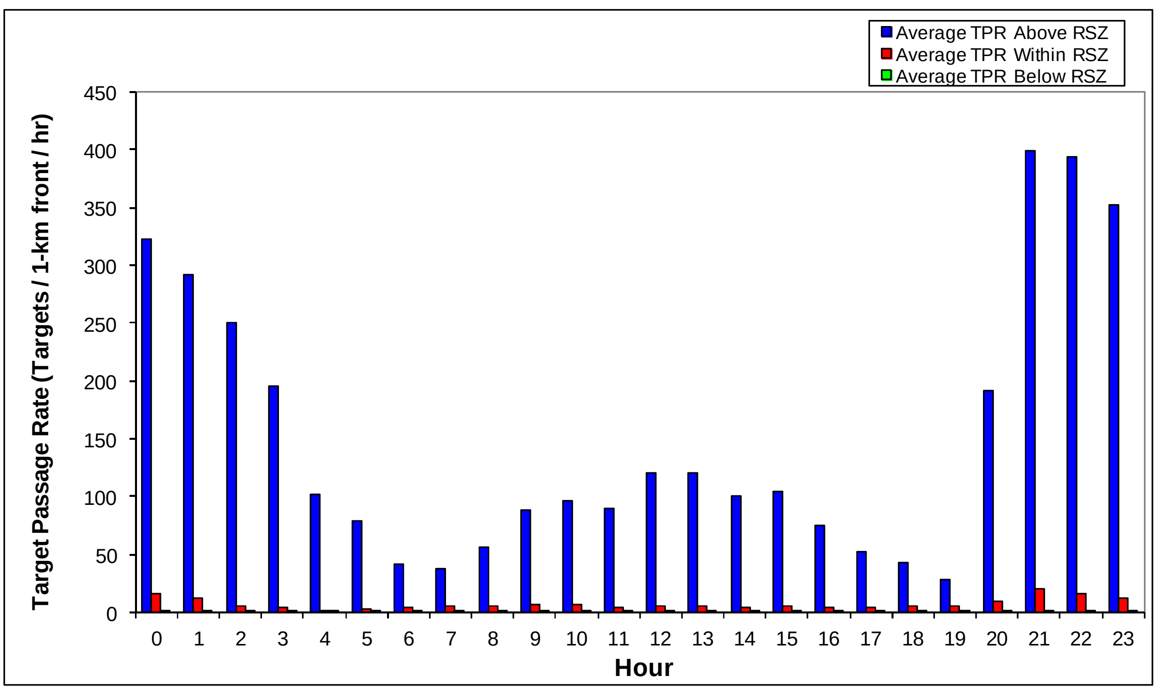

Figure 5-9. Average hourly target passage rates during the Summer 2012 season.

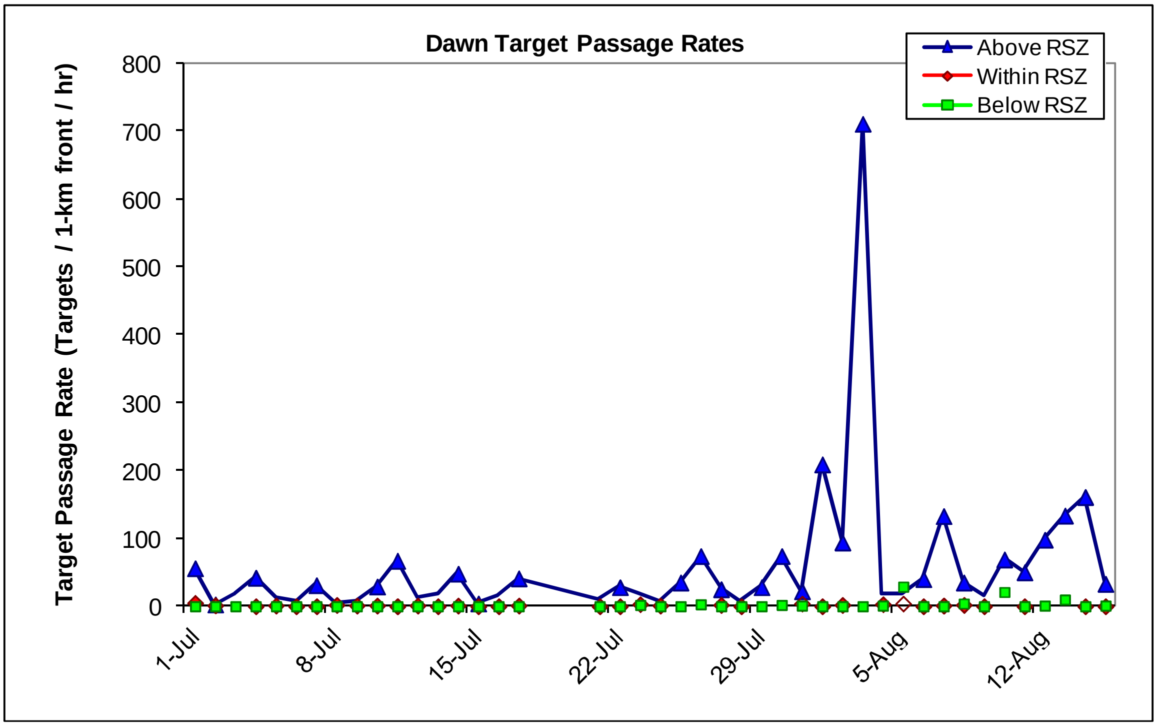

Figure 5-10. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dawns of the Summer 2012 season.

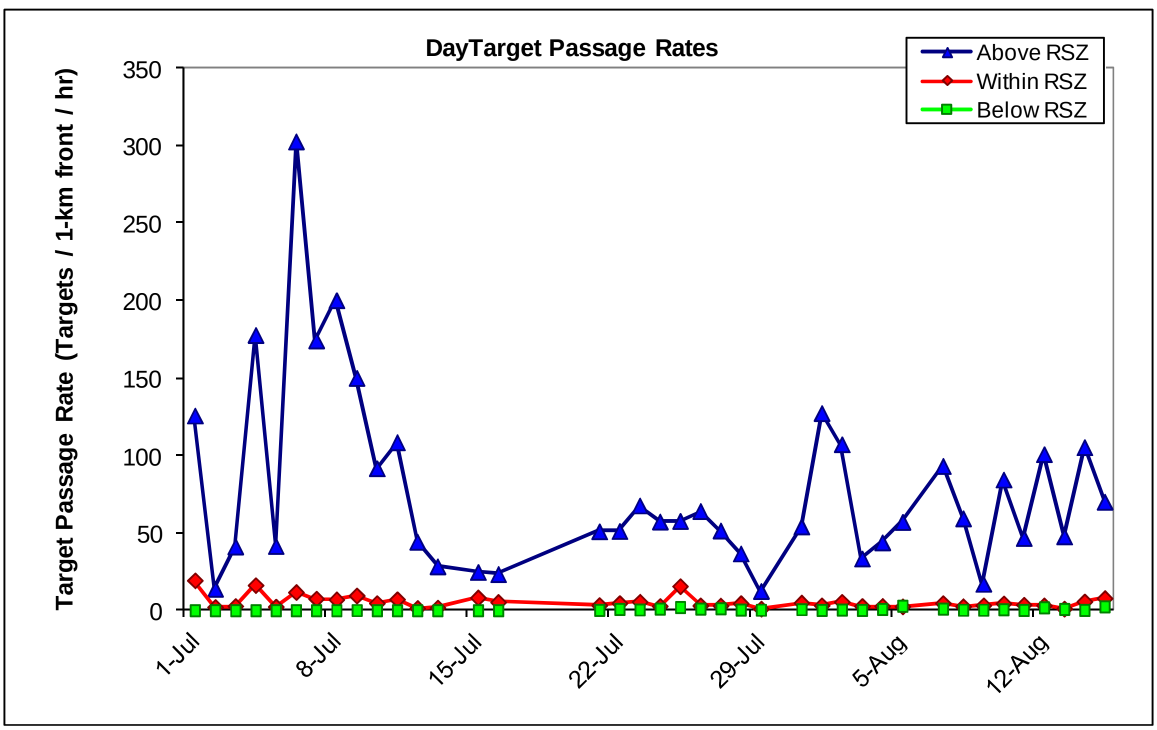

Figure 5-11. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during days of the Summer 2012 season.

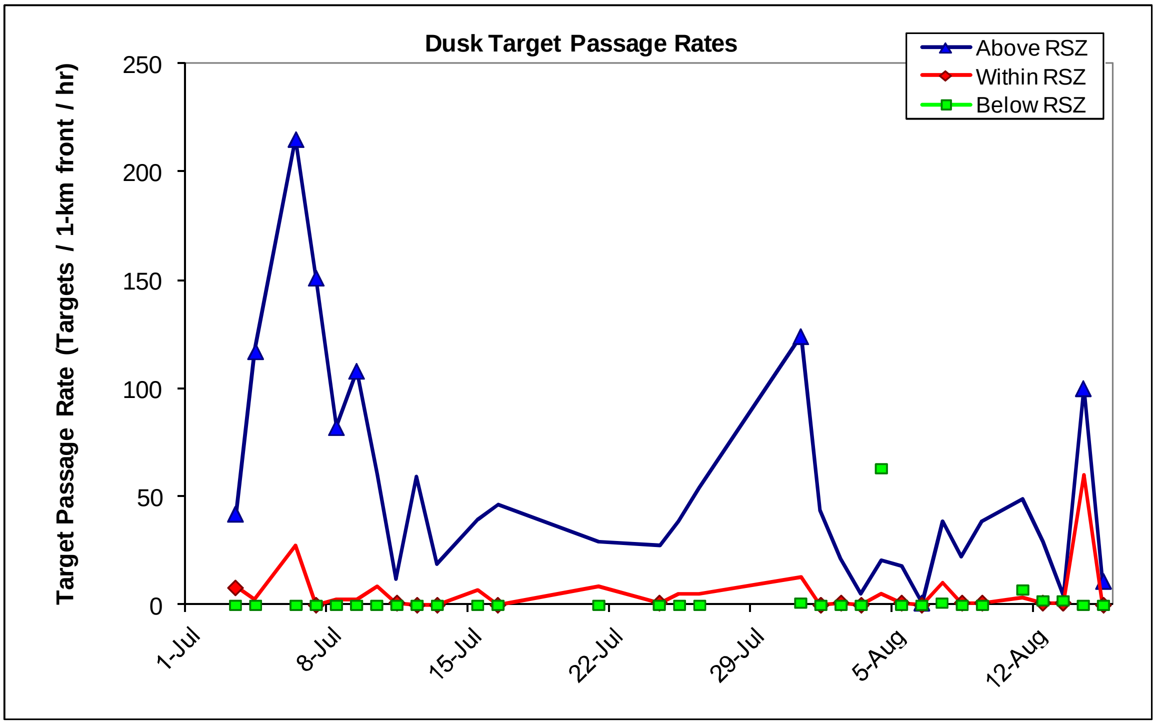

Figure 5-12. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dusks of the Summer 2012 season.

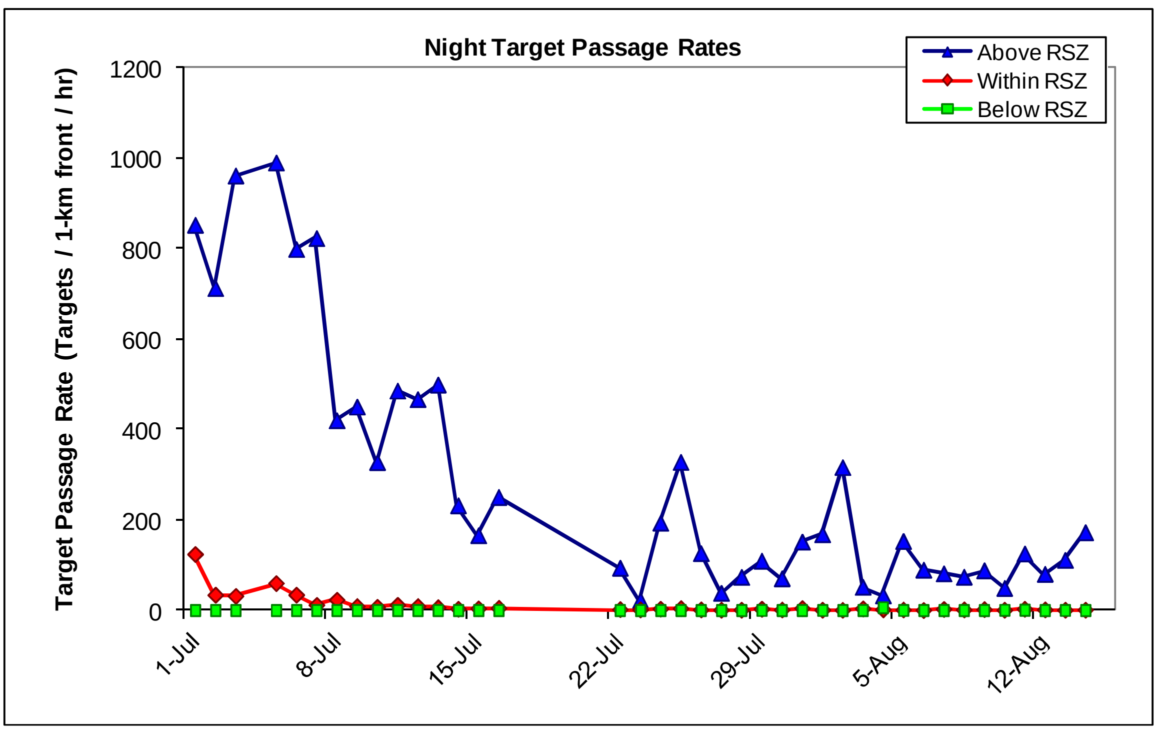

Figure 5-13. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during nights of the Summer 2012 season.

5.3 Horizontal Radar Data

The Horizontal Surveillance Radar (HSR) was used to determine directional movements of targets during biological periods of the Summer 2012 season.

5.3.1 Target Directions

Average target directions were calculated for each biological period (Fig. 5-14). Average target directions were also calculated seasonally (comprehensive distribution), with all targets detected during the Summer 2012 season combined together by biological period (Fig. 5-15) and hour (Fig. 5-16).

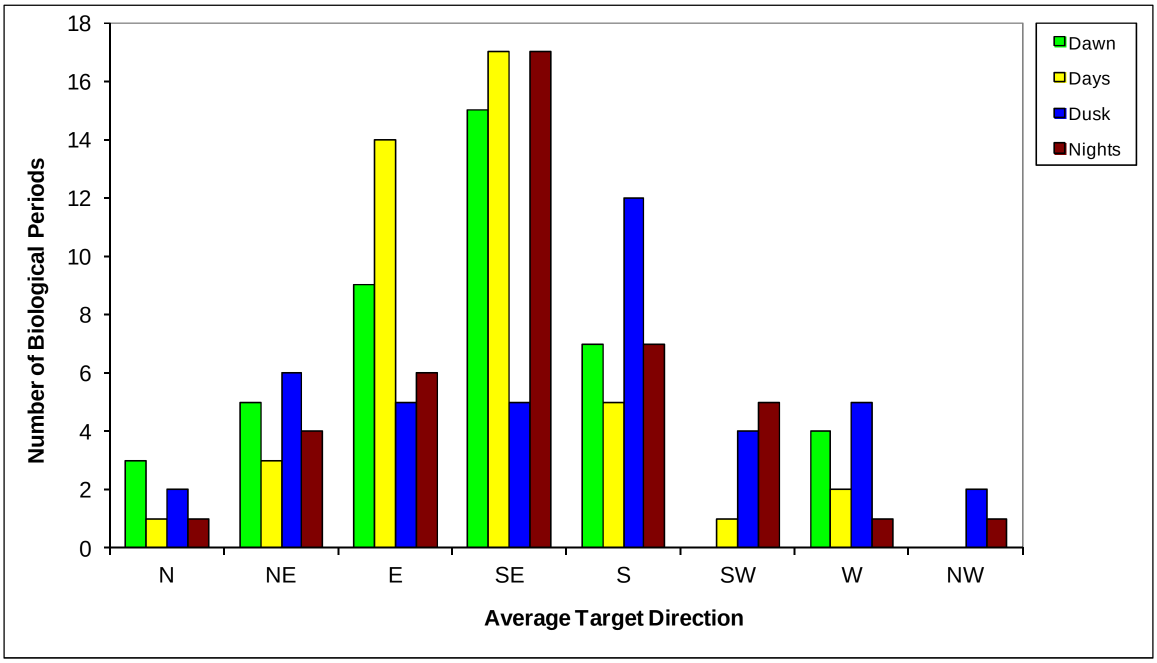

Figure 5-14. Distribution of average target movements among eight directions during dawns, days, dusks, and nights of the Summer 2012 season.

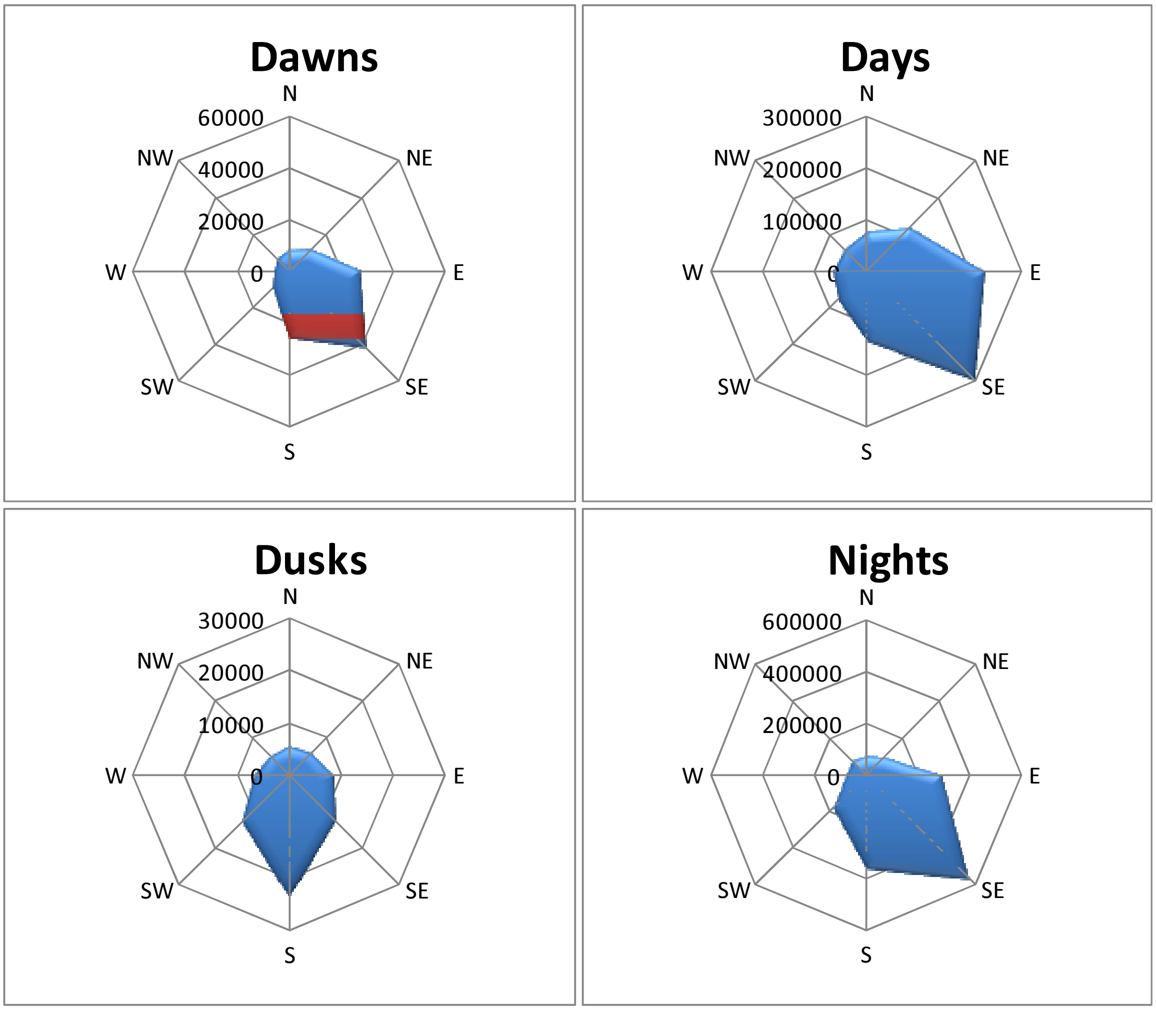

Figure 5-15. Comprehensive distribution of all target's directions during dawns, days, dusks, and nights of the Summer 2012 season.

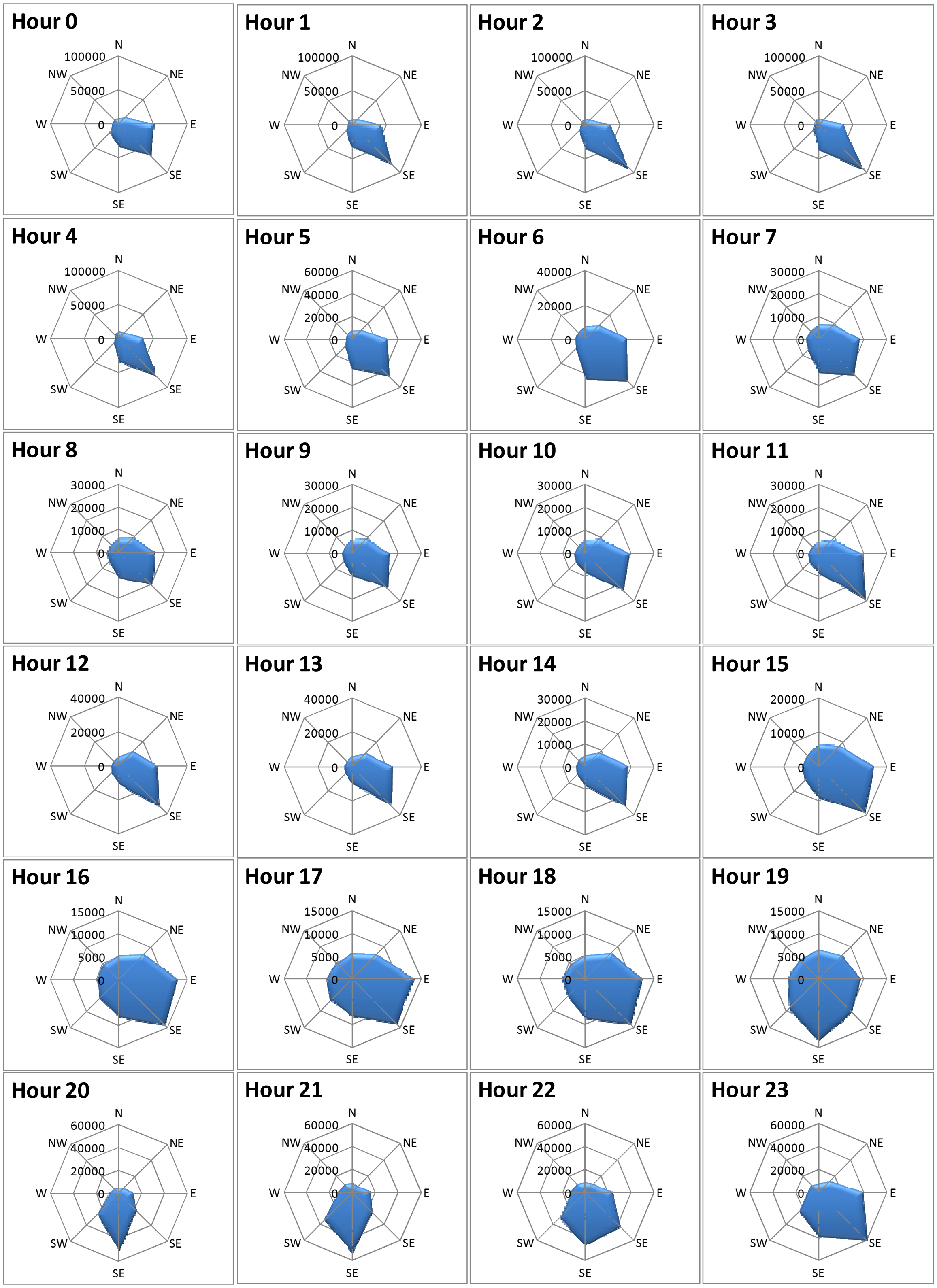

Figure 5-16. Comprehensive distribution of all target's directions by hour during the Summer 2012 season.

6 RESULTS for the Fall 2012 Season

6.1 Level of Effort

Table 6-1 presents available time, time radar data were collected, amount of radar data that were removed due to rain, high levels of insect activity, or other contamination, and the resulting time of radar data used for analyses, during the Fall 2012 Season (August 16 – November 15, 2012). The MERLIN avian radar system operated at Site 9 until September 29, 2012 and at Site 10 after October 3, 2012.

Table 6-1. Radar monitoring effort during the Fall 2012 season.

	Vertical Radar		Horizontal Radar	
	Hours	**%**	**Hours**	**%**
Time in season	2209.4		2209.4	
Time radar down	92.9	4.2%	92.7	4.2%
Time radar collected data	2116.6	95.8%	2116.7	95.8%
Unuseable radar data[1] due to rain or other contamination	215.0	10.2%	15.5	0.7%
Unuseable radar data[2] due to insects	34.8	1.6%	-	-
Useable radar data[3]	1866.9	84.5%	2101.2	95.1%

1 - Percent indicates portion of time w ith radar data that w as lost due to rain or other contamination.
2 - Percent indicates portion of time w ith radar data that w as lost due to high insect activity.
3 - Percent indicates portion of season w ith useable radar data.

6.2 Vertical Radar Data

Data collected from the vertical scanning radar (VSR) were used to quantify target activity and heights.

6.2.1 Target Passage Rates Over Time

Data is presented as a rate equaling total number of targets / 1-km front / hr for each biological period (Fig. 6-1) and as an average by biological period (Fig. 6-2) and hour (Fig. 6-3). Summary statistics are presented in table 6-2.

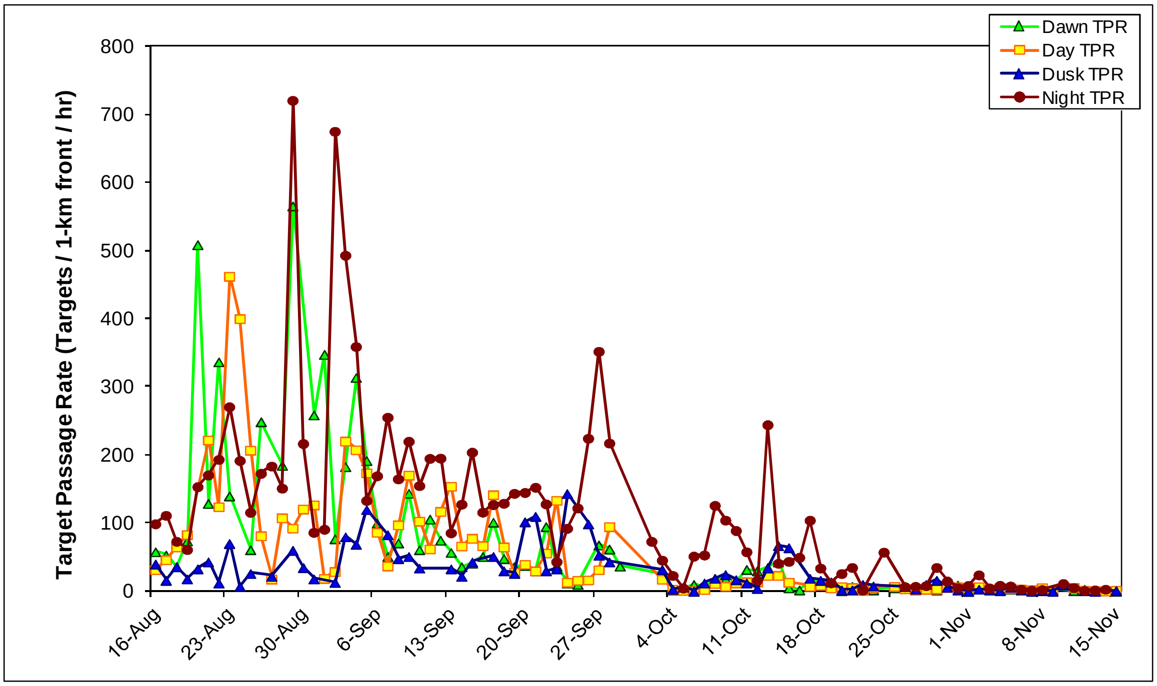

Figure 6-1. Target passage rates (TPR) during biological periods of the Fall 2012 season.

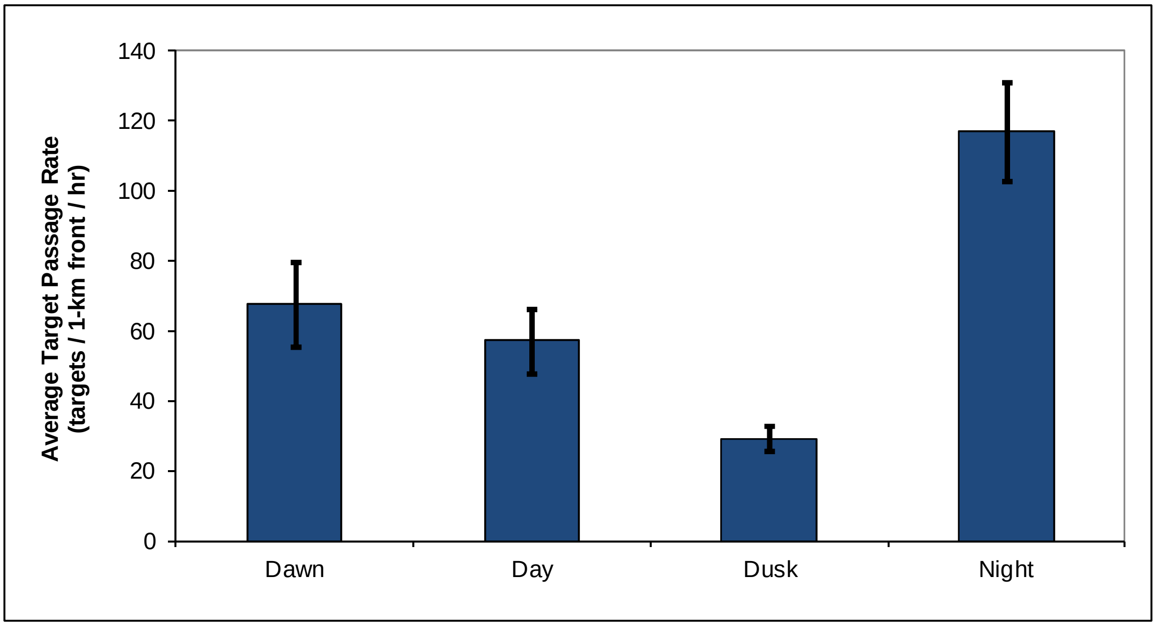

Figure 6-2. Average target passage rates (TPR) by biological period during the Fall 2012 season. Error bars represent one standard error.

Table 6-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for biological periods during the Fall 2012 season.

	Dawn	Day	Dusk	Night
Average	67.7	57.2	29.2	117.1
Standard Deviation	108.7	83.6	31.6	131.2
Standard Error	12.1	9.1	3.6	14.2
Median	32.0	17.7	18.0	91.1
Minimum	0.0	0.2	0.0	1.1
Maximum	566.0	462.8	143.5	721.1

Both average and comprehensive hourly target passage rates are presented in Fig 6-3: average rates are the average of each date’s hourly target rate in a given hour, while comprehensive rates use targets grouped by hour, regardless of date.

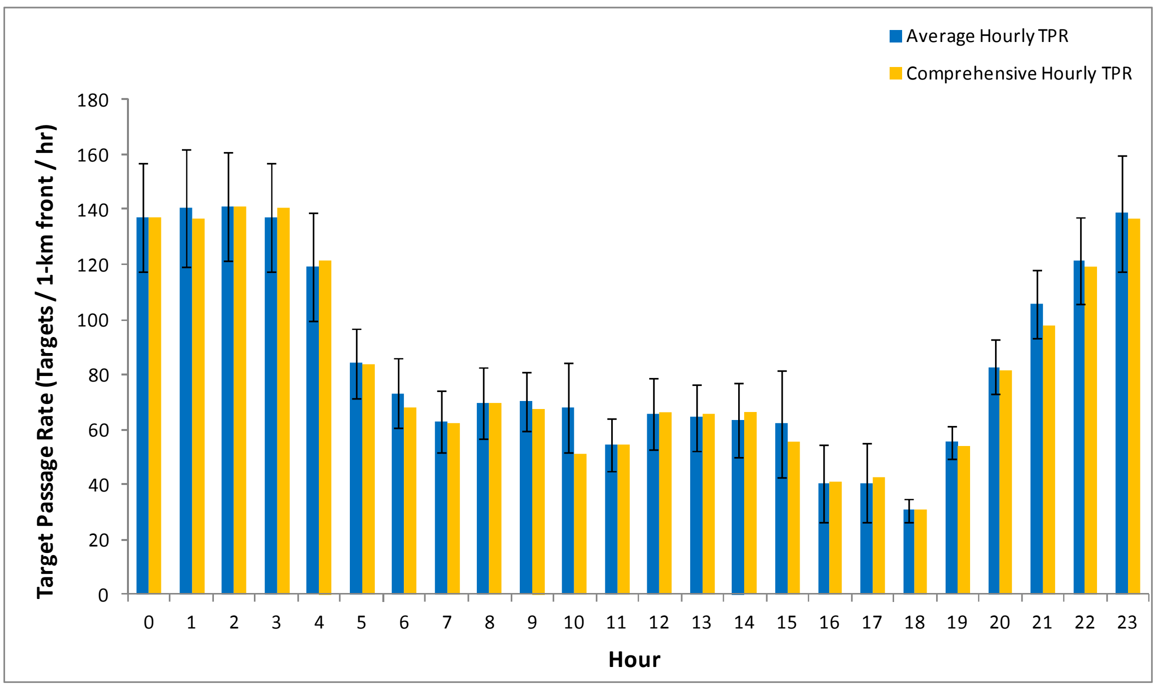

Figure 6-3. Average and comprehensive hourly target passage rates during the Fall 2012 season. Error bars represent one standard error.

6.2.2 Altitudinal Distribution of Targets

Mean and median target heights are presented for each biological period (Fig. 6-4 and Fig. 6-5, respectively) of the Fall 2012 season.

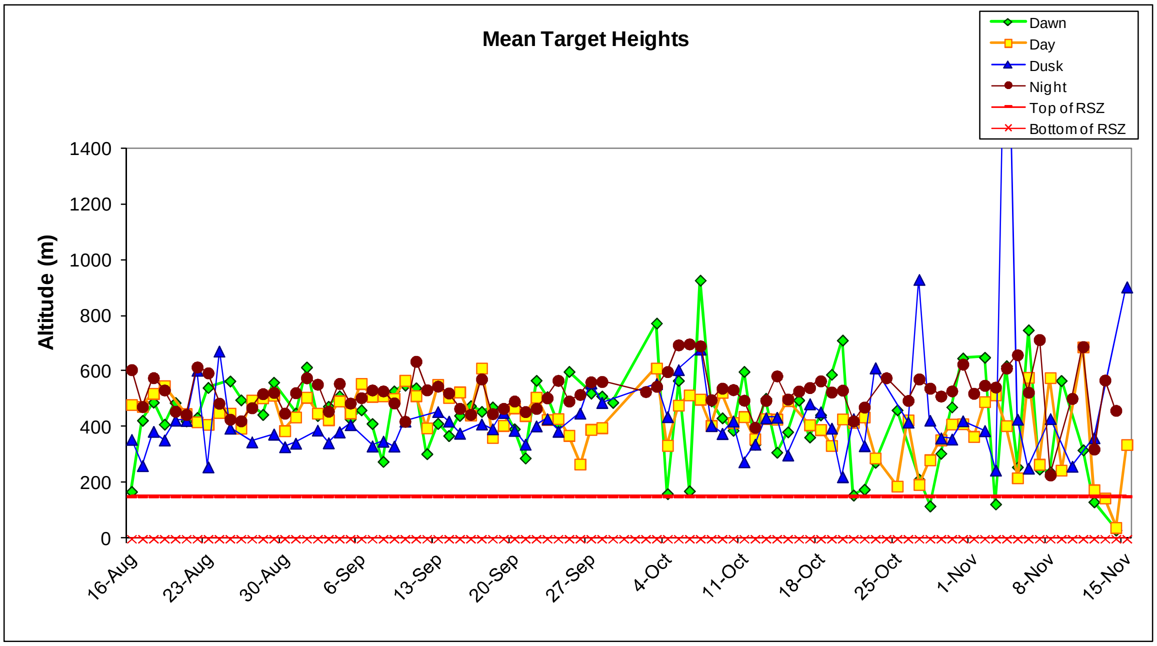

Figure 6-4. Mean target heights during the Fall 2012 season. Red lines represent top and bottom of the RSZ (0-152.4 m AGL). November 4th dusk value is 2,285 m.

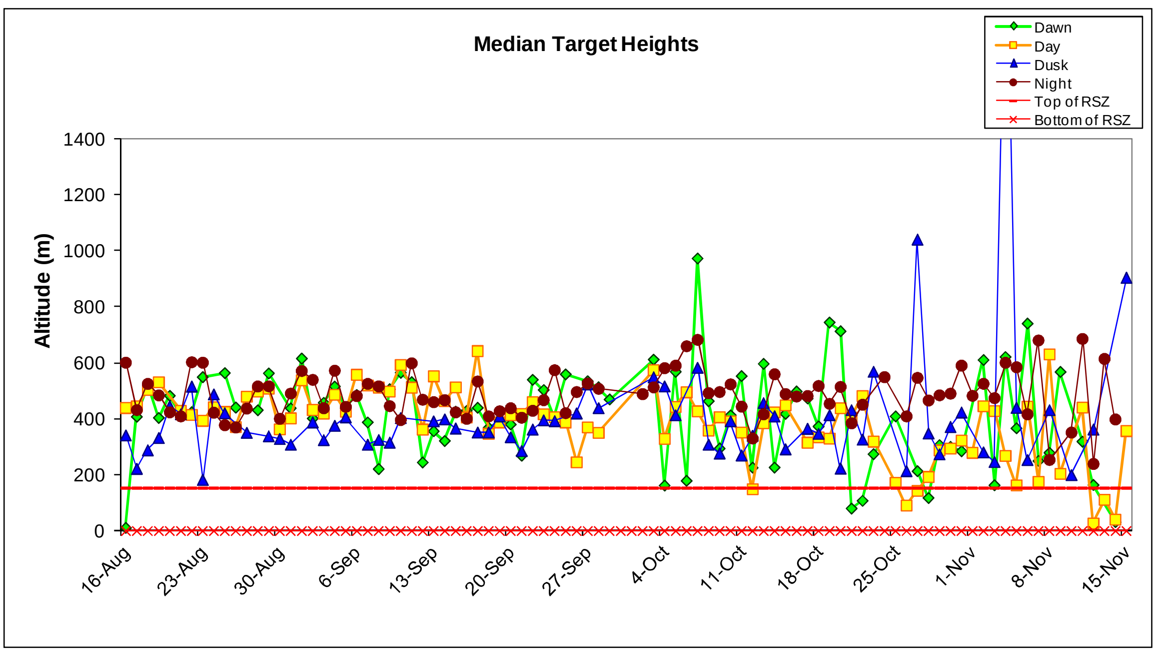

Figure 6-5. Median target heights during the Fall 2012 season. Red lines represent top and bottom of the RSZ (0-152.4 m AGL). November 4th dusk value is 2,285 m.

The mean and median target heights during each biological period were calculated for all dates with ≥ 50% data for that time period, averaged into a grand mean and average median, and presented in Table 6-3 (top) and illustrated in Figure 6-6 (blue bars). The comprehensive mean and median target heights for each biological period (when all targets were combined regardless of date) are also listed in Table 6-3 (bottom) and illustrated in Figure 6-6 (green bars).

Table 6-3. Summary of mean and median target heights during biological periods of the Fall 2012 season. Darker colors in color-coded rows indicate greater values within that row.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Grand mean target height	434.1	427.8	444.8	525.7
Average median target height	412.4	387.6	410.8	486.4
All targets for season combined				
Comprehensive mean target height	484.9	464.2	393.3	520.2
Comprehensive median target height	482.5	445.0	358.1	488.3

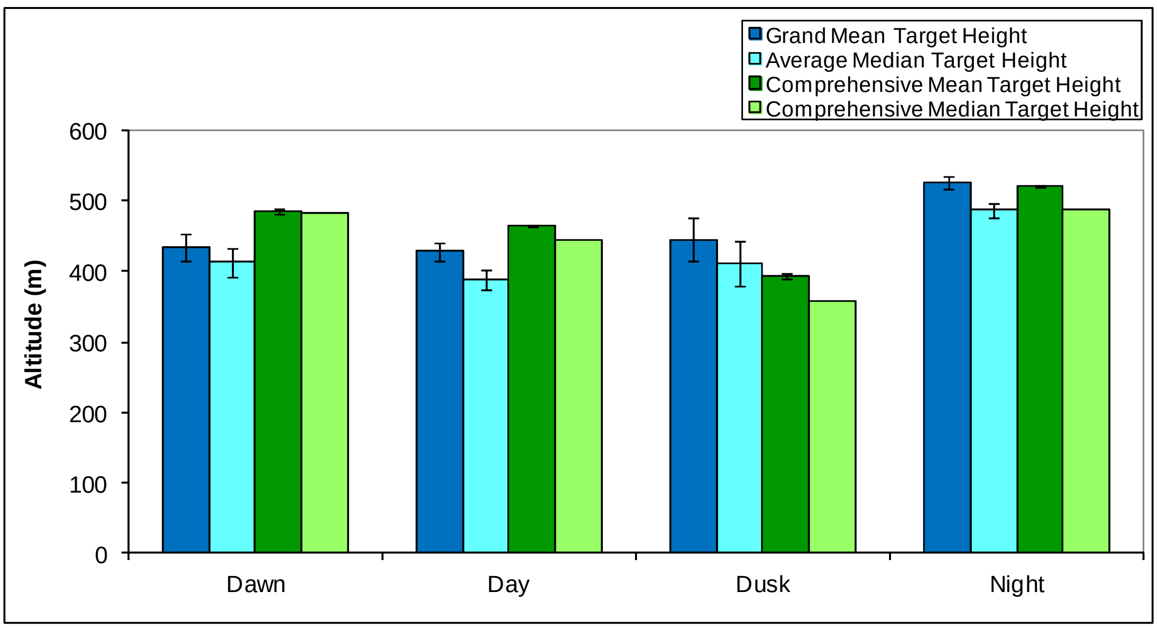

Figure 6-6. Grand mean and average median target heights averaged across individual biological periods (blue bars), and comprehensive mean and median target heights of all targets grouped by biological period (green bars), during the Fall 2012 season. Error bars represent one standard error.

Hourly target heights were averaged into a grand hourly target mean and an average hourly target median for each of 24 hours; a comprehensive hourly target mean was also calculated by pooling all targets within a given hour together, regardless of date (Fig. 6-7).

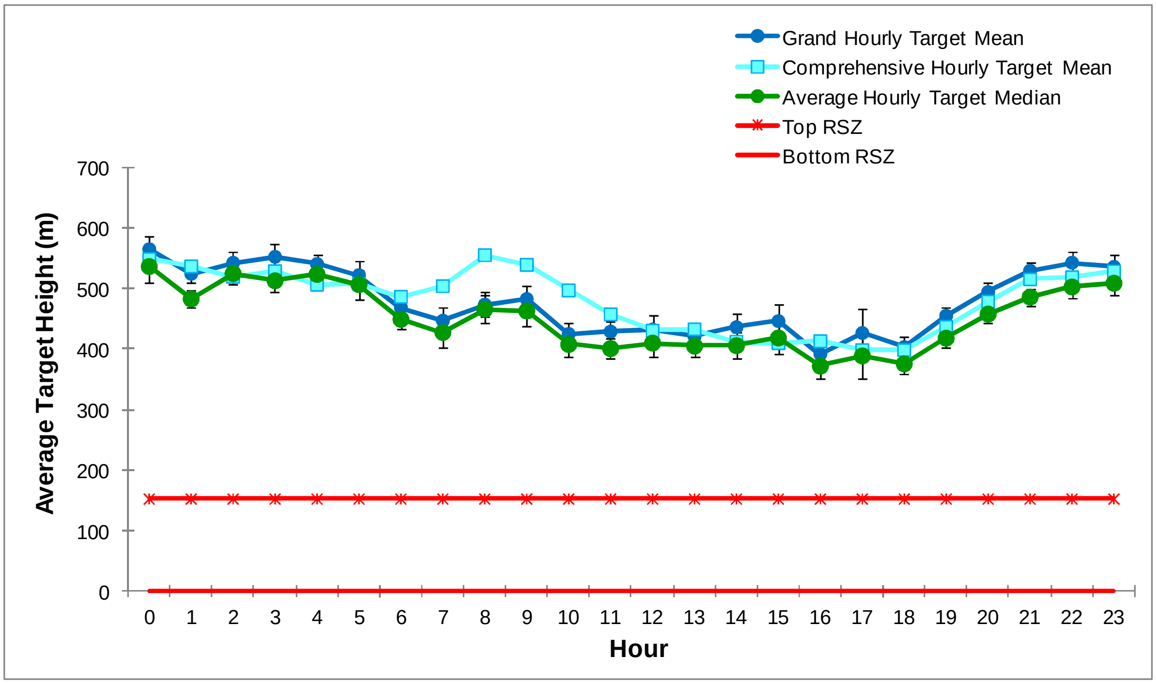

Figure 6-7. Hourly target heights during the Fall 2012 season. Error bars represent one standard error. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

The distribution of all targets detected during dawns, days, dusks, and nights of the Fall 2012 season are shown using 50-meter increments (Fig. 6-8).

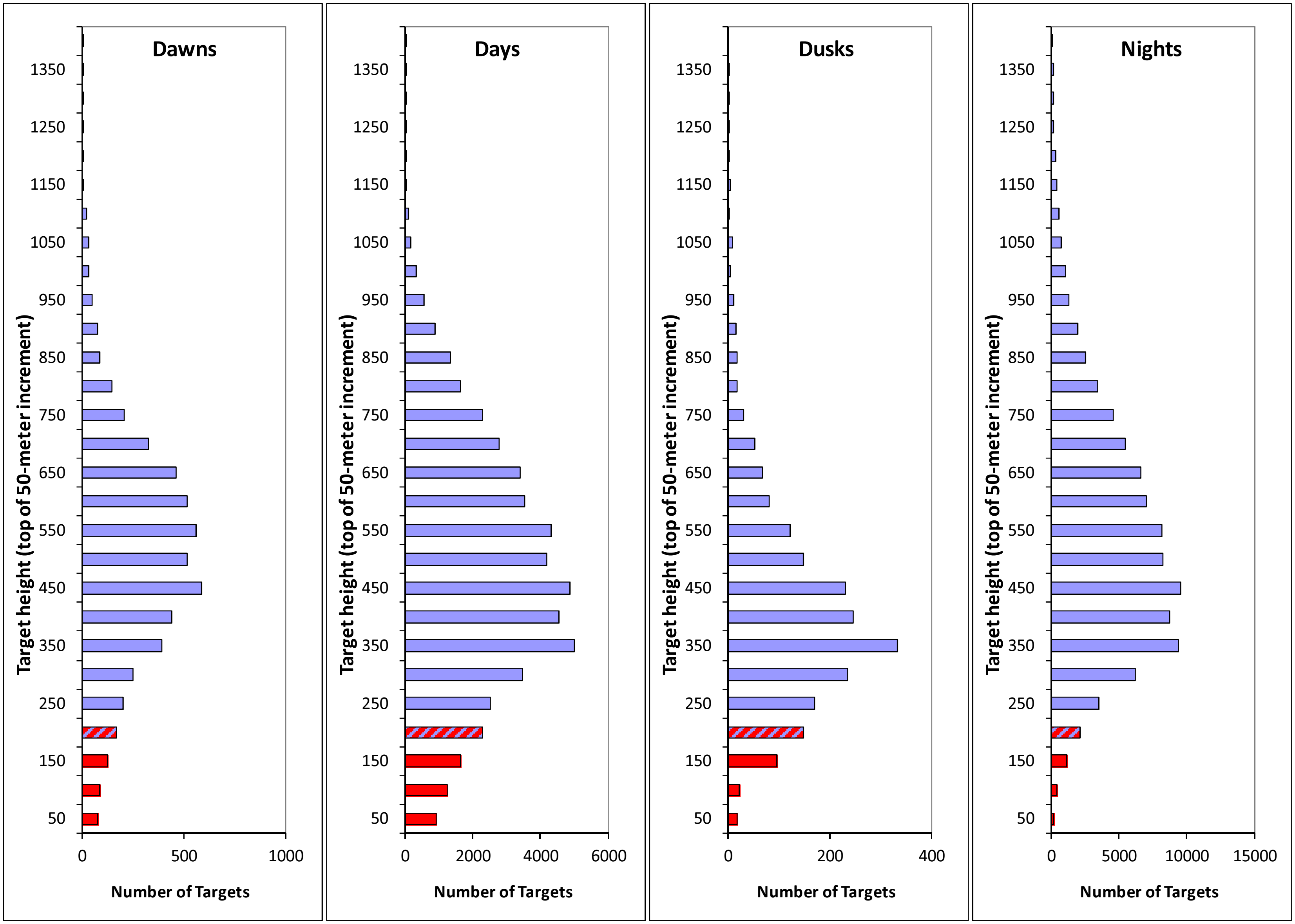

Figure 6-8. Number of targets occurring in each 50-meter increment during biological periods of the Fall 2012 season. Red indicates rotor swept heights, and red-blue hashed indicates altitudes partially within rotor swept heights.

Using a RSZ of 0-152.4 m AGL, target passage rates below, within, and above the RSZ were calculated for each date. Individual target passage rates are presented for dawns (Fig. 6-10) days (Fig. 6-11), dusks (Fig 6-12), and nights (Fig. 6-13). Percent targets below, within, and above the RSZ were also calculated seasonally, with all targets detected during each biological period of the Fall 2012 season combined together (Table 6-4, bottom). Average hourly target passage rates below, within, and above the rotor swept zone are also given (Fig. 6-9).

Table 6-4. Summary of target passage rates and percent of targets above, within and below the RSZ (0-152.4 m AGL) during biological periods of the Fall 2012 season. Darker colors indicate greater values.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average target passage rate above RSZ	63.3	52.4	27.2	114.8
Average target passage rate within RSZ	3.7	4.4	1.9	2.3
Average target passage rate below RSZ	0.7	0.3	0.1	0.1
Average % of targets in RSZ	16.3%	16.1%	6.5%	4.5%
Min target percentage within RSZ	0.0%	0.0%	0.0%	0.3%
Max target percentage within RSZ	100.0%	100.0%	50.0%	44.4%
All targets for season combined				
% targets above RSZ	93.4%	91.9%	93.1%	98.0%
% targets within RSZ	5.6%	7.5%	6.7%	2.0%
% targets below RSZ	1.0%	0.6%	0.2%	0.1%
% targets below turbine height	6.6%	8.1%	6.9%	2.0%

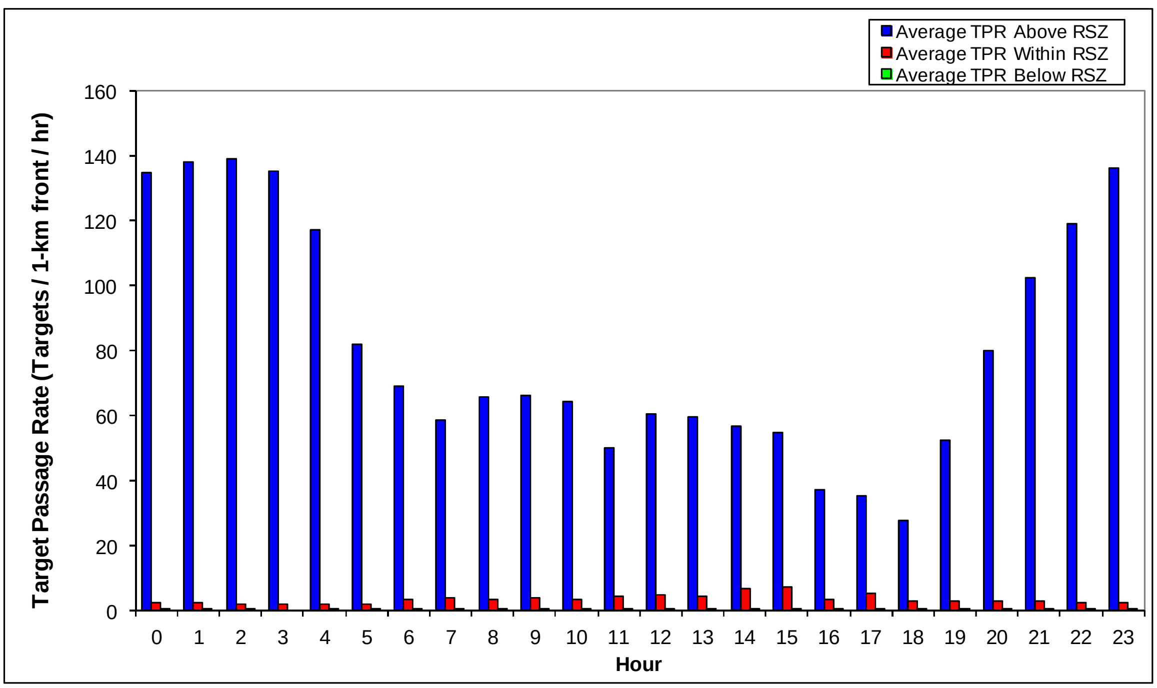

Figure 6-9. Average hourly target passage rates during the Fall 2012 season.

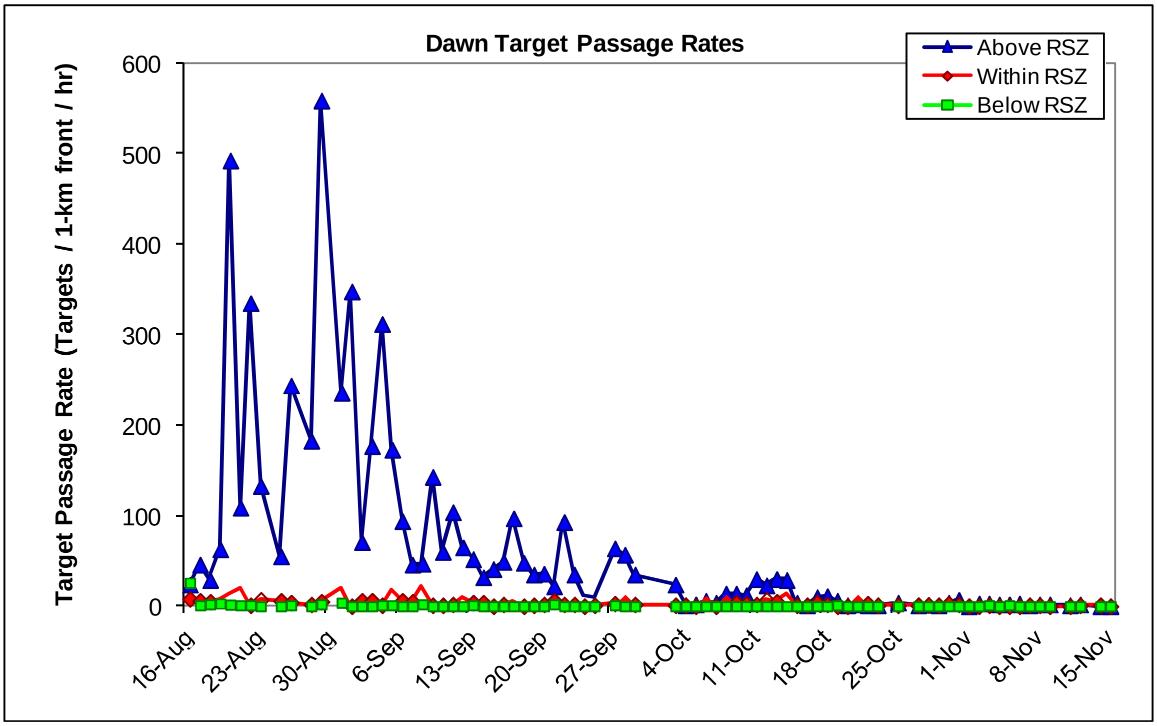

Figure 6-10. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dawns of the Fall 2012 season.

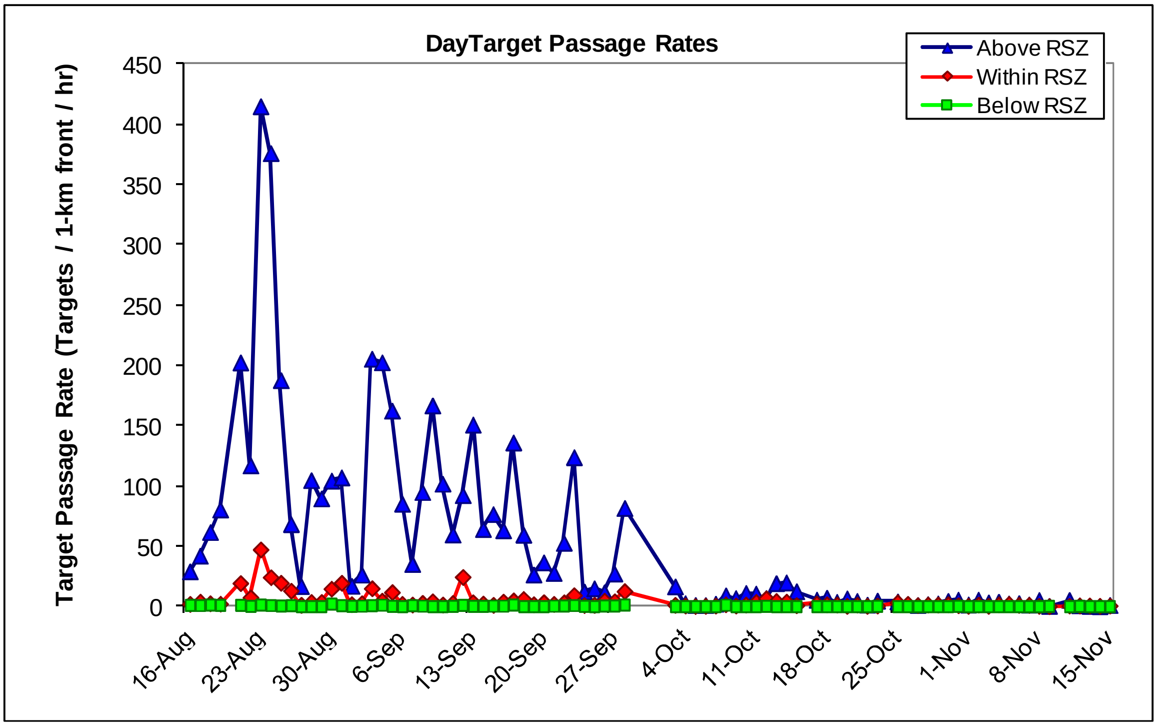

Figure 6-11. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during days of the Fall 2012 season.

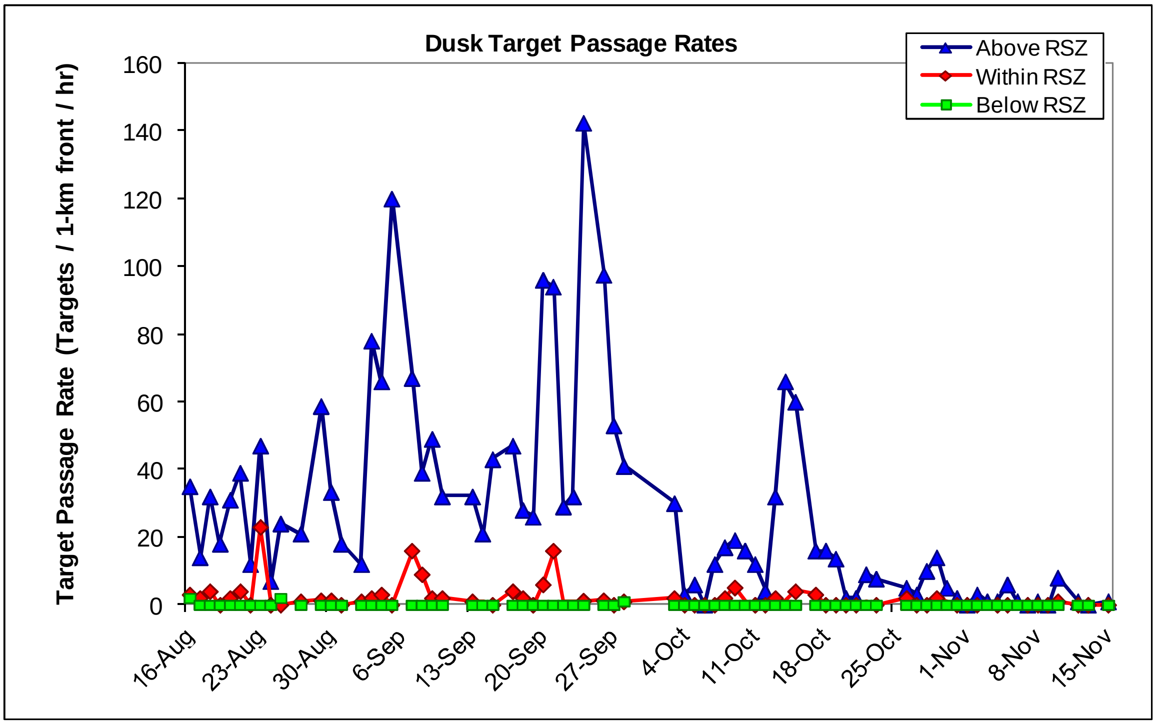

Figure 6-12. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dusks of the Fall 2012 season.

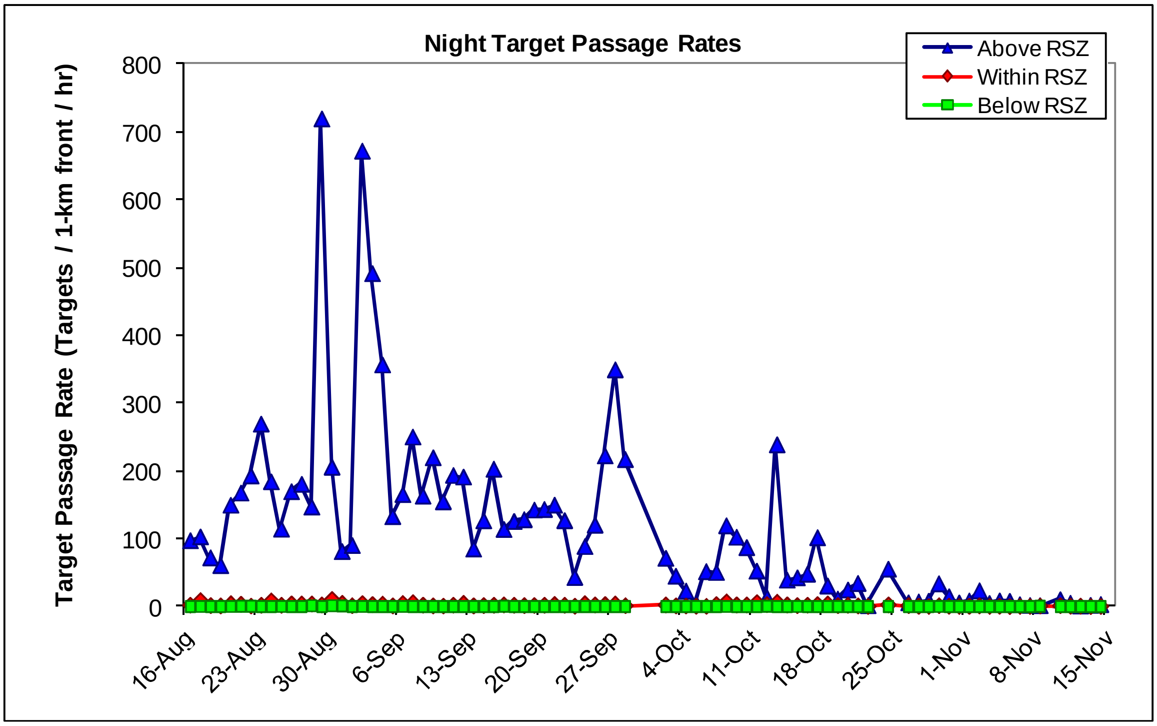

Figure 6-13. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during nights of the Fall 2012 season.

6.3 Horizontal Radar Data

The Horizontal Surveillance Radar (HSR) was used to determine directional movements of targets during biological periods of the Fall 2012 season.

6.3.1 Target Directions

Average target directions were calculated for each biological period (Fig. 6-14). Average target directions were also calculated seasonally (comprehensive distribution), with all targets detected during the Fall 2012 season combined together by biological period (Fig. 6-15) and hour (Fig. 6-16).

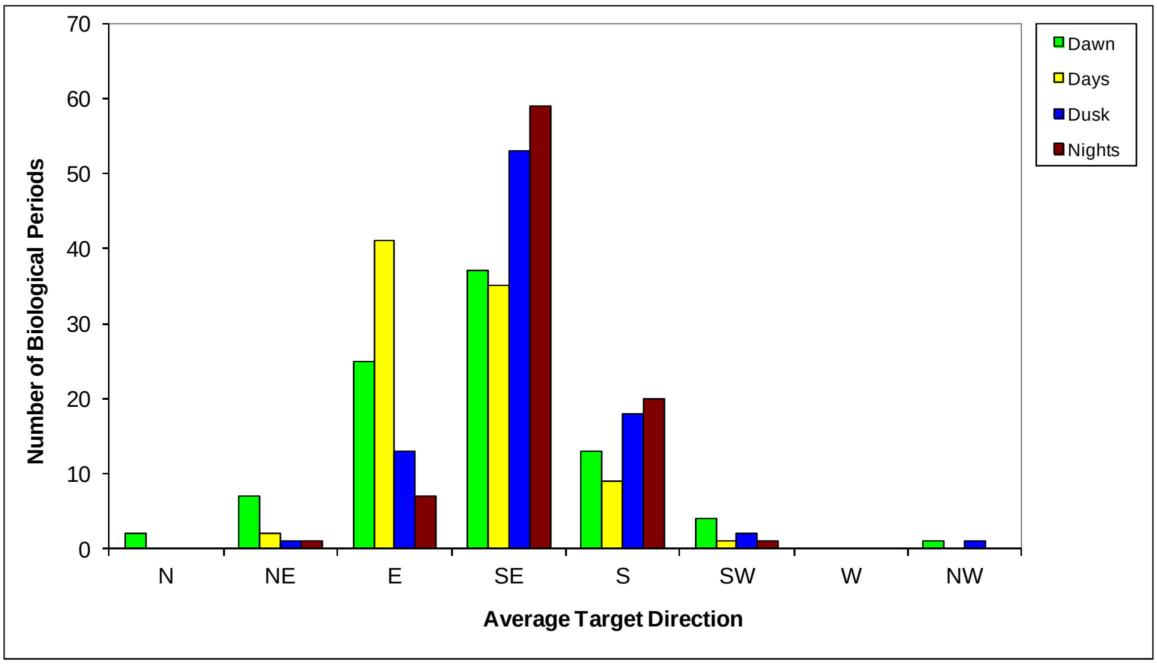

Figure 6-14. Distribution of average target movements among eight directions during dawns, days, dusks, and nights of the Fall 2012 season.

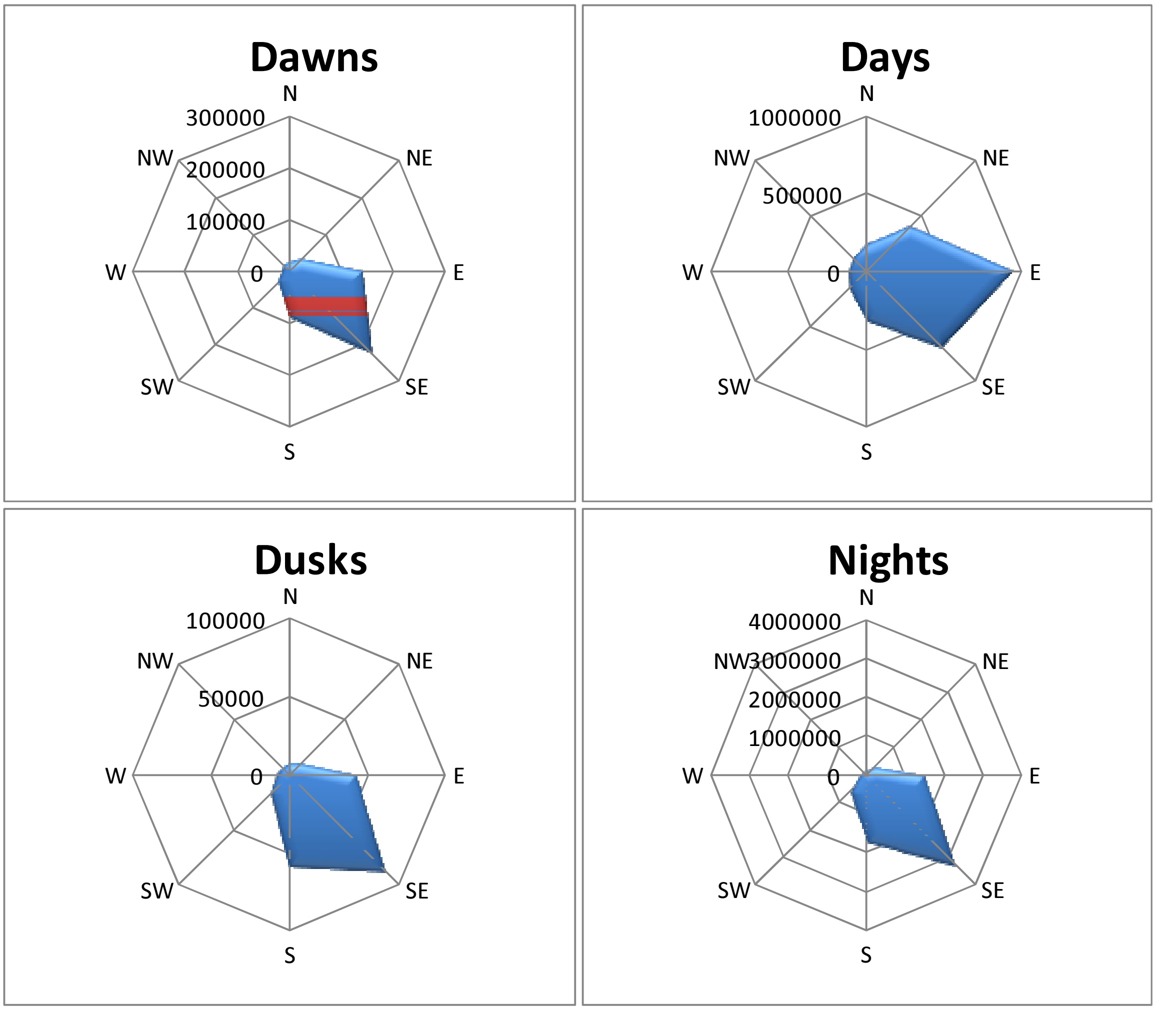

Figure 6-15. Comprehensive distribution of all target's directions during dawns, days, dusks, and nights of the Fall 2012 season.

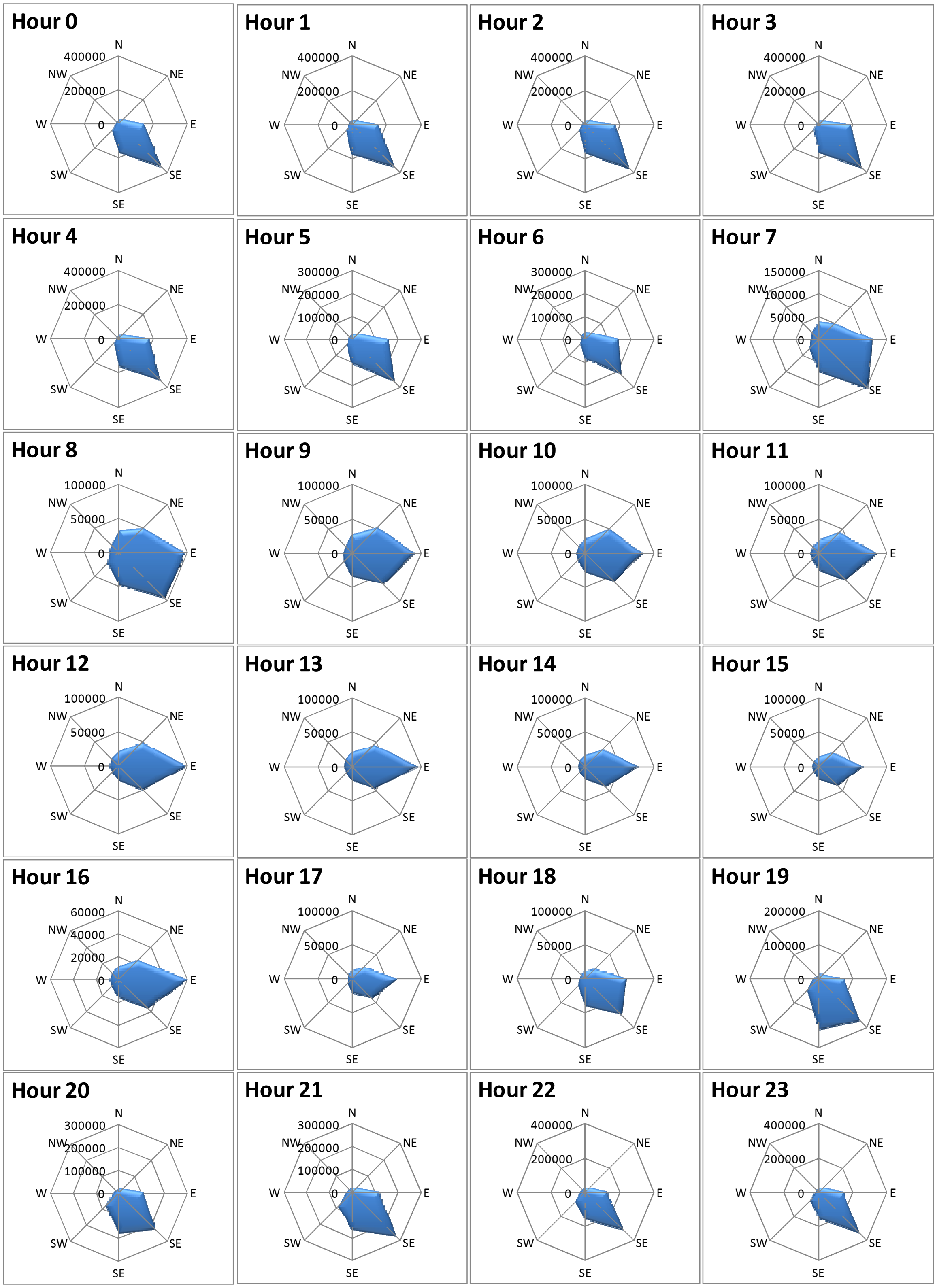

Figure 6-16. Comprehensive distribution of all target's directions by hour during the Fall 2012 season.

7 RESULTS for the Winter 2012-13 Season

7.1 Level of Effort

Table 7-1 presents available time, time radar data were collected, amount of radar data that were removed due to rain, high levels of insect activity, or other contamination, and the resulting time of radar data used for analyses, during the Winter 2012-13 Season (November 16, 2012 – March 31, 2013). The MERLIN avian radar system operated at Site 10 during this entire season.

Table 7-1. Radar monitoring effort during the Winter 2012-13 season.

	Vertical Radar		Horizontal Radar	
	Hours	%	Hours	%
Time in season	3262.8		3262.8	
Time radar down	579.7	17.8%	14.8	0.5%
Time radar collected data	2683.1	82.2%	3248.1	99.5%
Unuseable radar data[1] due to rain or other contamination	469.1	17.5%	6.5	0.2%
Unuseable radar data[2] due to insects	16.8	0.6%	-	-
Useable radar data[3]	2197.3	67.3%	3241.6	99.3%

1 - Percent indicates portion of time with radar data that was lost due to rain or other contamination.
2 - Percent indicates portion of time with radar data that was lost due to high insect activity.
3 - Percent indicates portion of season with useable radar data.

7.2 Vertical Radar Data

Data collected from the vertical scanning radar (VSR) were used to quantify target activity and heights.

7.2.1 Target Passage Rates Over Time

Data is presented as a rate equaling total number of targets / 1-km front / hr for each biological period (Fig. 7-1) and as an average by biological period (Fig. 7-2) and hour (Fig. 7-3). Summary statistics are presented in table 7-2.

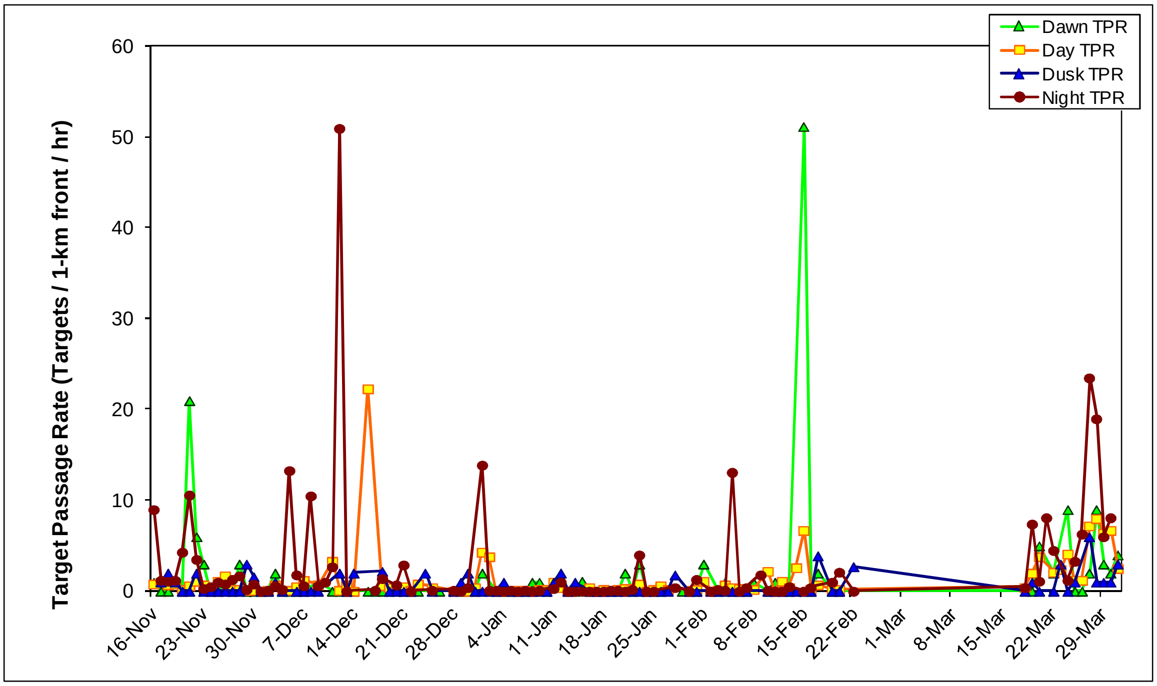

Figure 7-1. Target passage rates (TPR) during biological periods of the Winter 2012-13 season.

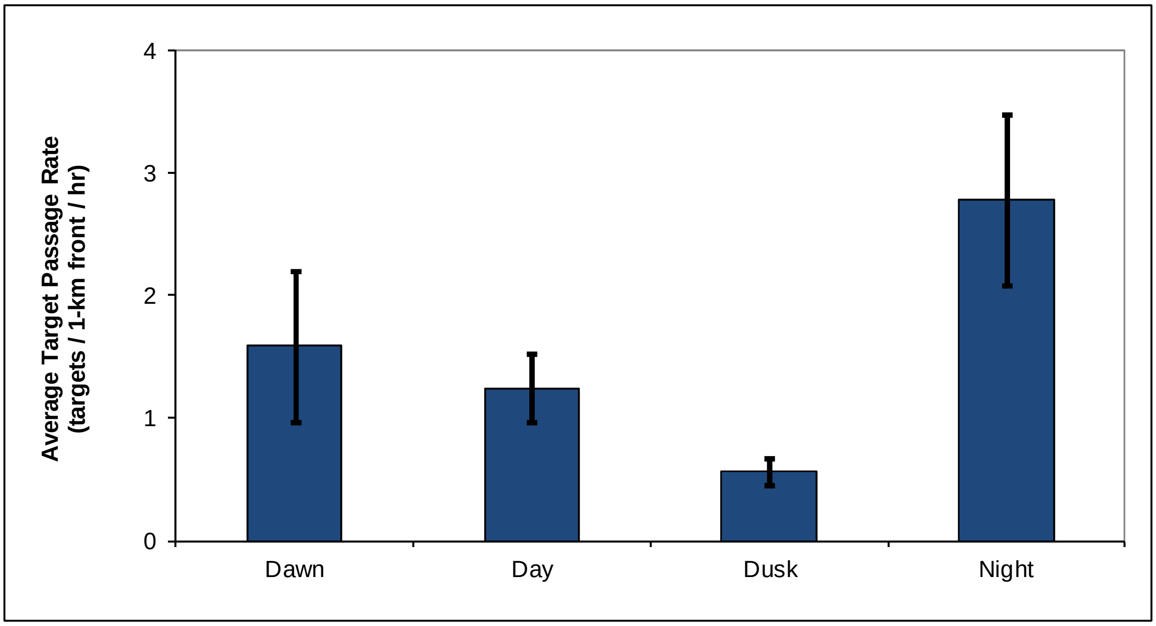

Figure 7-2. Average target passage rates (TPR) by biological period during the Winter 2012-13 season. Error bars represent one standard error.

Table 7-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for biological periods during the Winter 2012-13 season.

	Dawn	Day	Dusk	Night
Average	1.6	1.2	0.6	2.8
Standard Deviation	5.9	2.7	1.1	6.7
Standard Error	0.6	0.3	0.1	0.7
Median	0.0	0.4	0.0	0.4
Minimum	0.0	0.0	0.0	0.0
Maximum	51.2	22.3	6.0	51.0

Both average and comprehensive hourly target passage rates are presented in Fig 7-3: average rates are the average of each date's hourly target rate in a given hour, while comprehensive rates use targets grouped by hour, regardless of date.

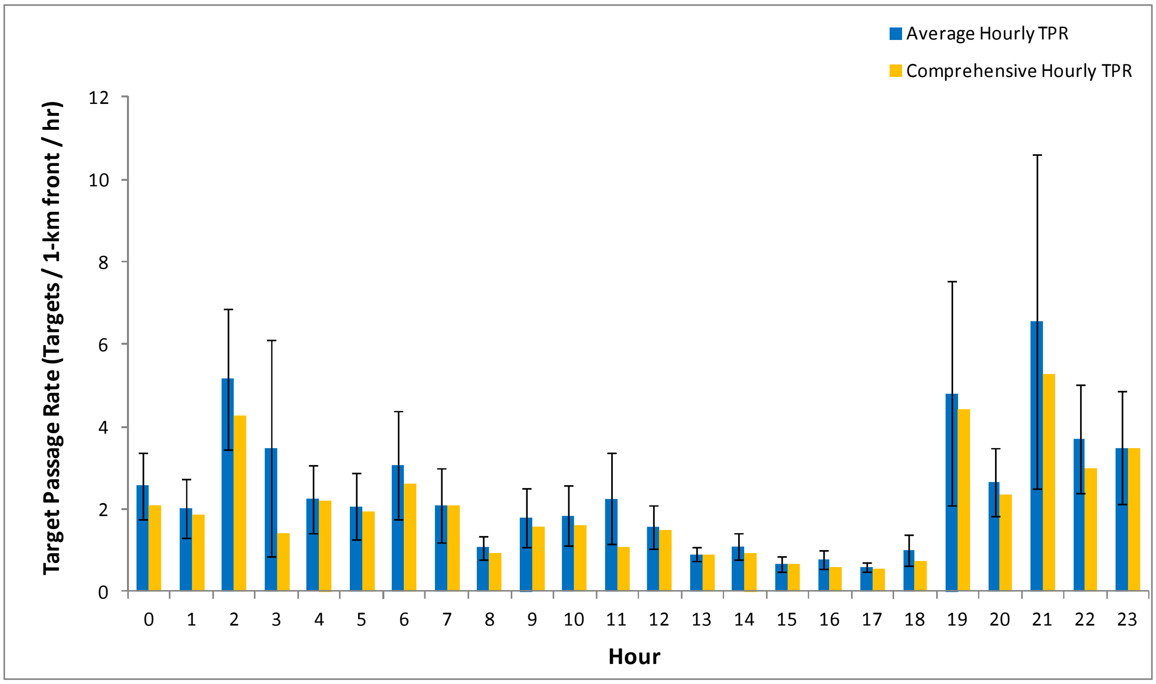

Figure 7-3. Average and comprehensive hourly target passage rates during the Winter 2012-13 season. Error bars represent one standard error.

7.2.2 Altitudinal Distribution of Targets

Mean and median target heights are presented for each biological period (Fig. 7-4 and Fig. 7-5, respectively) of the Winter 2012-13 season.

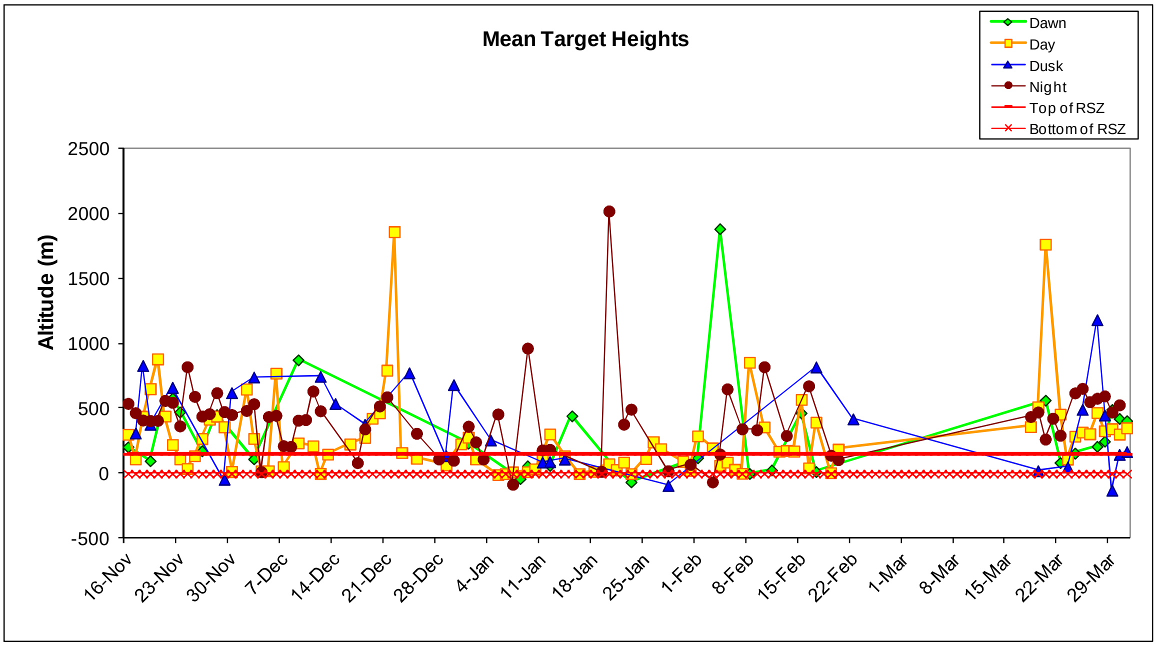

Figure 7-4. Mean target heights during the Winter 2012-13 season. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

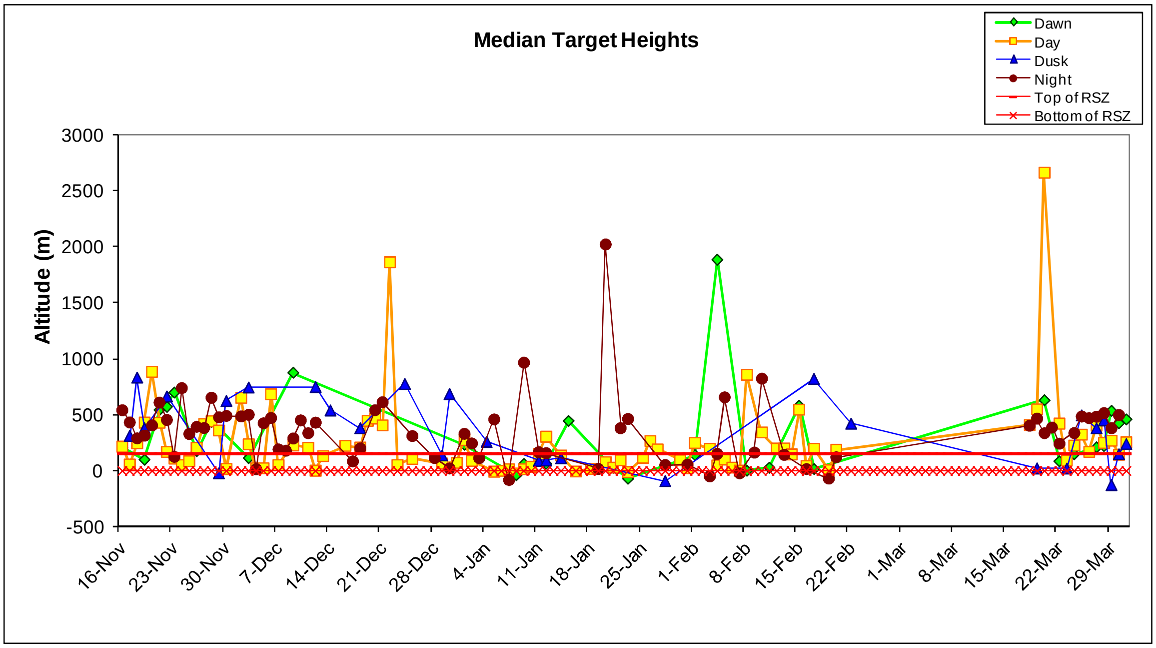

Figure 7-5. Median target heights during the Winter 2012-13 season. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

The mean and median target heights during each biological period were calculated for all dates with ≥ 50% data for that time period, averaged into a grand mean and average median, and presented in Table 7-3 (top) and illustrated in Figure 7-6 (blue bars). The comprehensive mean and median target heights for each biological period (when all targets were combined regardless of date) are also listed in Table 7-3 (bottom) and illustrated in Figure 7-6 (green bars).

Table 7-3. Summary of mean and median target heights during biological periods of the Winter 2012-13 season. Darker colors in color-coded rows indicate greater values within that row.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Grand mean target height	312.8	274.8	388.5	417.3
Average median target height	326.9	255.3	361.9	356.3
All targets for season combined				
Comprehensive mean target height	374.3	344.7	464.0	502.3
Comprehensive median target height	345.5	221.1	286.1	437.8

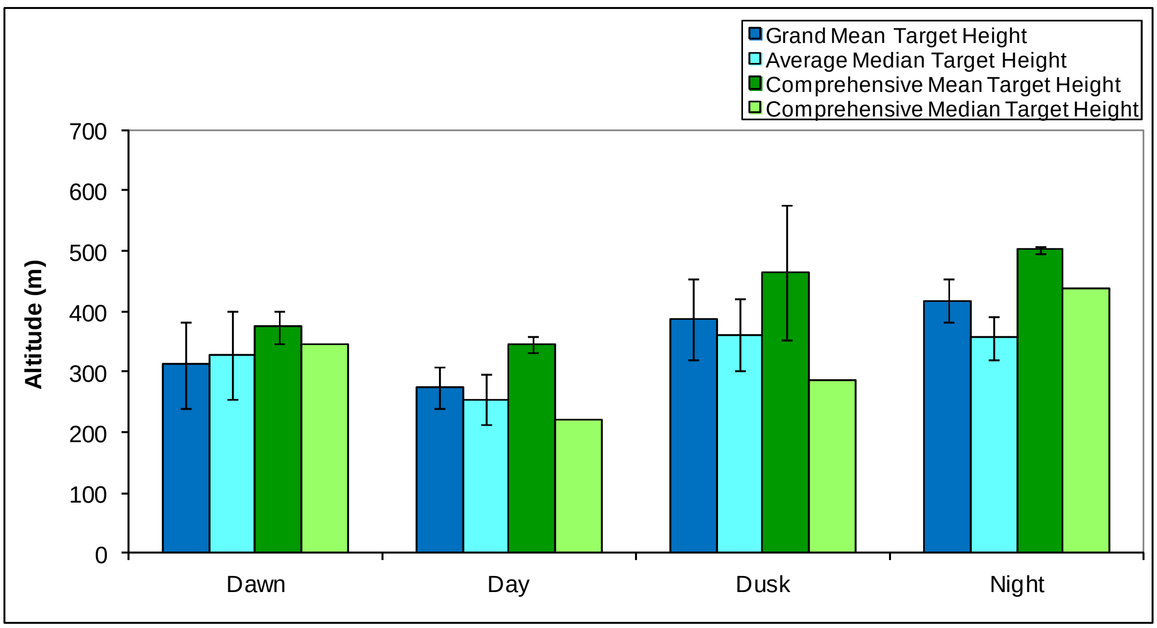

Figure 7-6. Grand mean and average median target heights averaged across individual biological periods (blue bars), and comprehensive mean and median target heights of all targets grouped by biological period (green bars), during the Winter 2012-13 season. Error bars represent one standard error.

Hourly target heights were averaged into a grand hourly target mean and an average hourly target median for each of 24 hours; a comprehensive hourly target mean was also calculated by pooling all targets within a given hour together, regardless of date (Fig. 7-7).

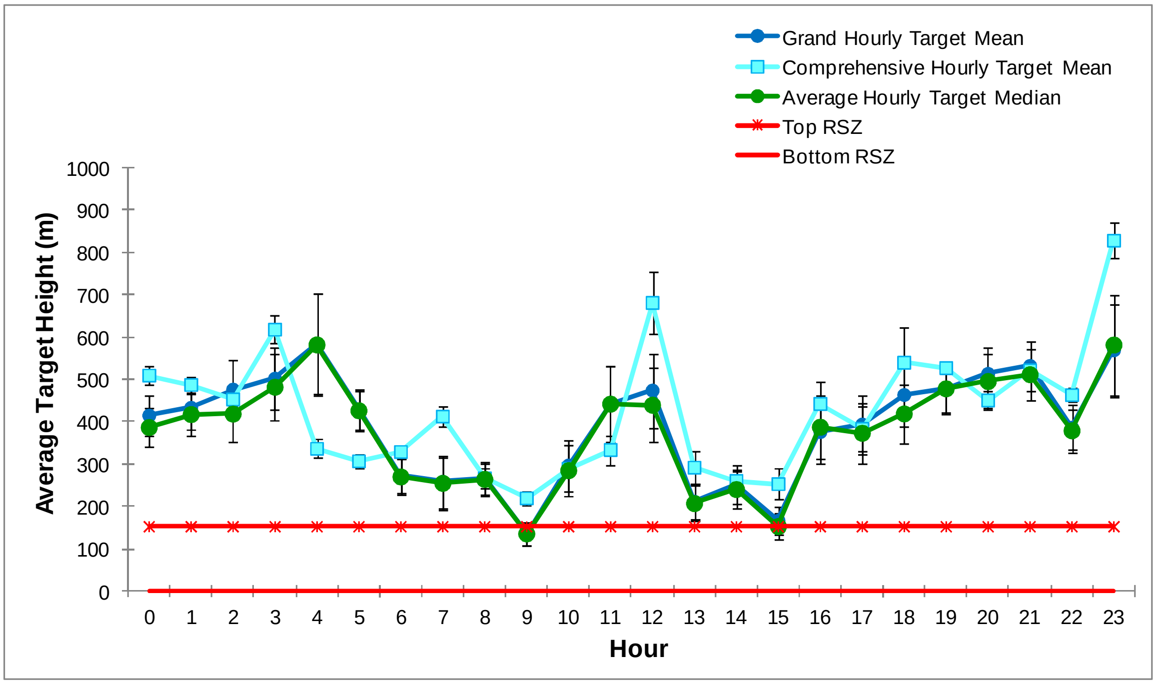

Figure 7-7. Hourly target heights during the Winter 2012-13 season. Error bars represent one standard error. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

The distribution of all targets detected during dawns, days, dusks, and nights of the Winter 2012-13 season are shown using 50-meter increments (Fig. 7-8).

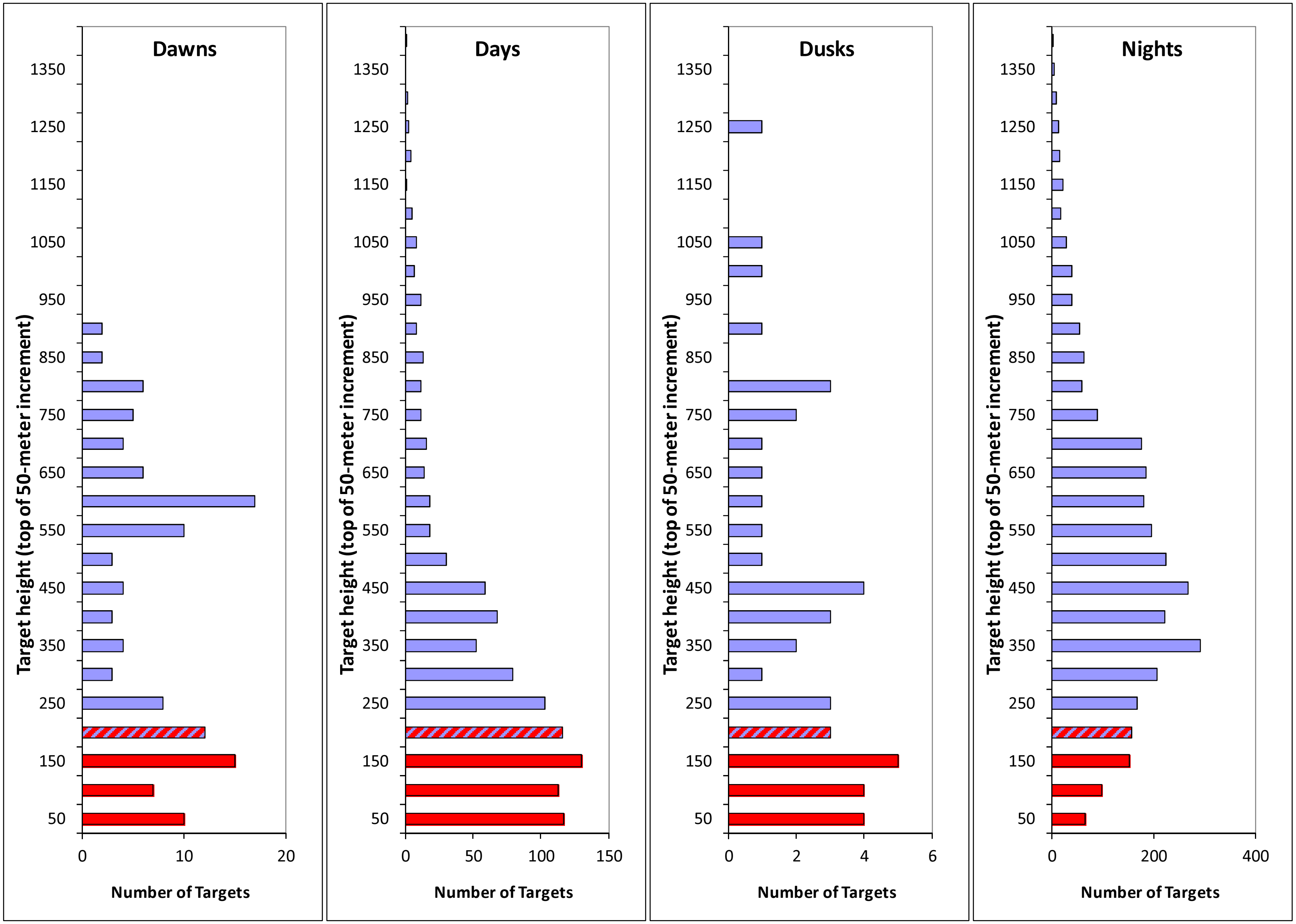

Figure 7-8. Number of targets occurring in each 50-meter increment during biological periods of the Winter 2012-13 season. Red indicates rotor swept heights, and red-blue hashed indicates altitudes partially within rotor swept heights.

Using a RSZ of 0-152.4 m AGL, target passage rates below, within, and above the RSZ were calculated for each date. Individual target passage rates are presented for dawns (Fig. 7-10) days (Fig. 7-11), dusks (Fig 7-12), and nights (Fig. 7-13). Percent targets below, within, and above the RSZ were also calculated seasonally, with all targets detected during each biological period of the Winter 2012-13 season combined together (Table 7-4, bottom). Average hourly target passage rates below, within, and above the rotor swept zone are also given (Fig. 7-9).

Table 7-4. Summary of target passage rates and percent of targets above, within and below the RSZ (0-152.4 m AGL) during biological periods of the Winter 2012-13 season. Darker colors indicate greater values.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average target passage rate above RSZ	1.2	0.8	0.4	2.5
Average target passage rate within RSZ	0.4	0.4	0.1	0.2
Average target passage rate below RSZ	0.1	0.0	0.1	0.0
Average % of targets in RSZ	37.0%	46.8%	26.8%	22.3%
Min target percentage within RSZ	0.0%	0.0%	0.0%	0.0%
Max target percentage within RSZ	100.0%	100.0%	100.0%	100.0%
All targets for season combined				
% targets above RSZ	72.4%	64.5%	65.3%	90.5%
% targets within RSZ	23.6%	33.5%	24.5%	8.3%
% targets below RSZ	4.1%	2.0%	10.2%	1.2%
% targets below turbine height	27.6%	35.5%	34.7%	9.5%

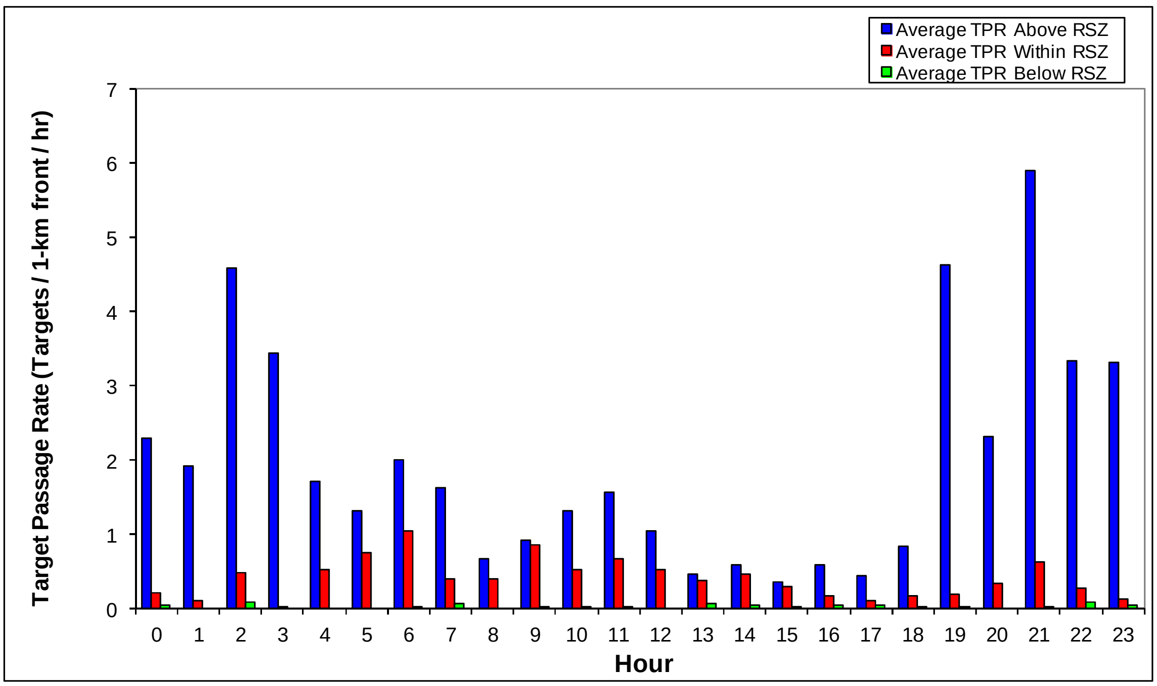

Figure 7-9. Average hourly target passage rates during the Winter 2012-13 season.

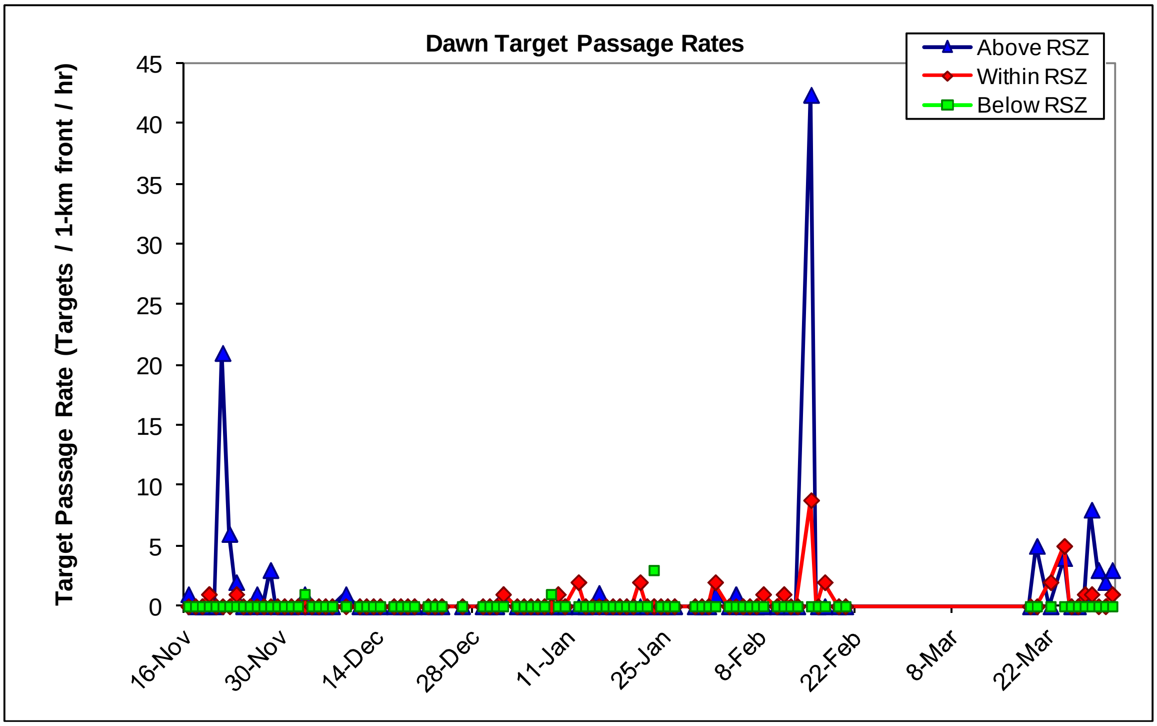

Figure 7-10. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dawns of the Winter 2012-13 season.

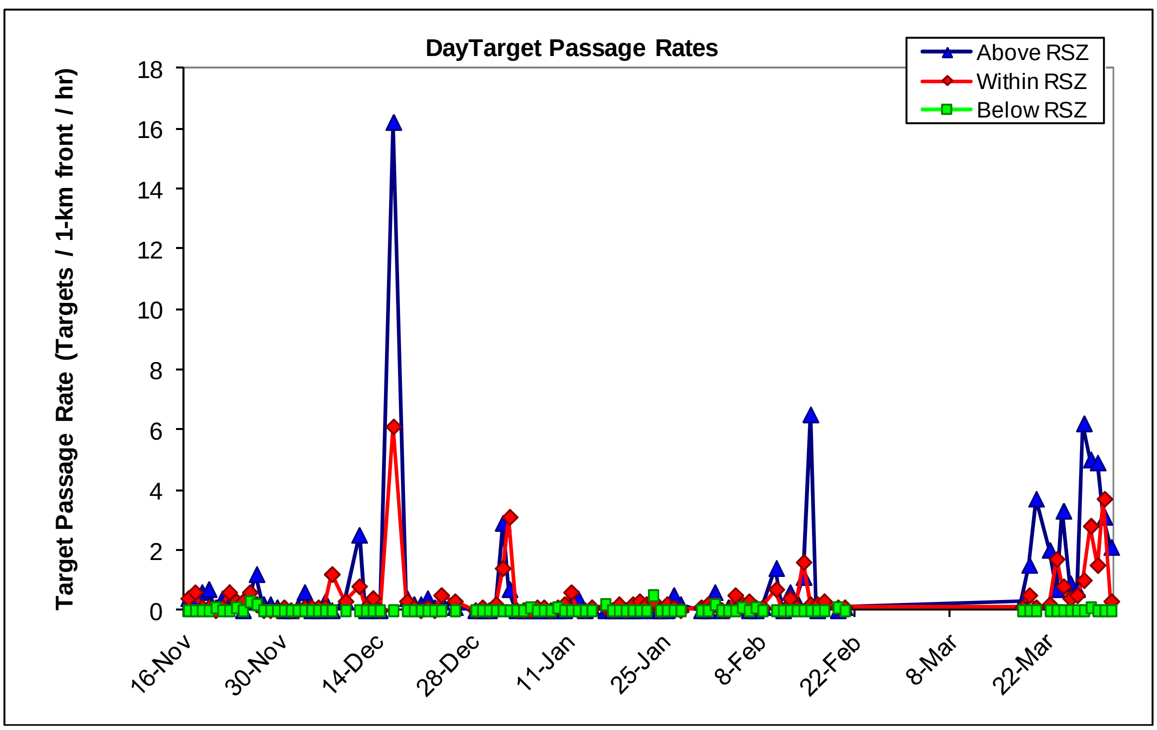

Figure 7-11. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during days of the Winter 2012-13 season.

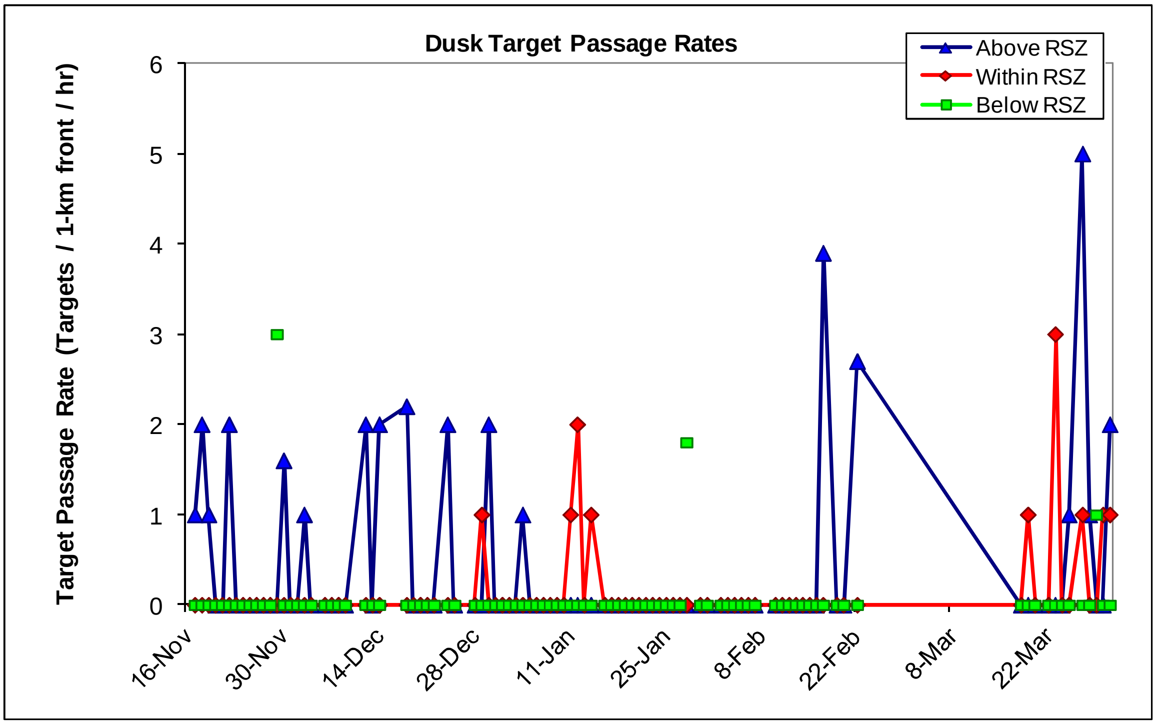

Figure 7-12. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dusks of the Winter 2012-13 season.

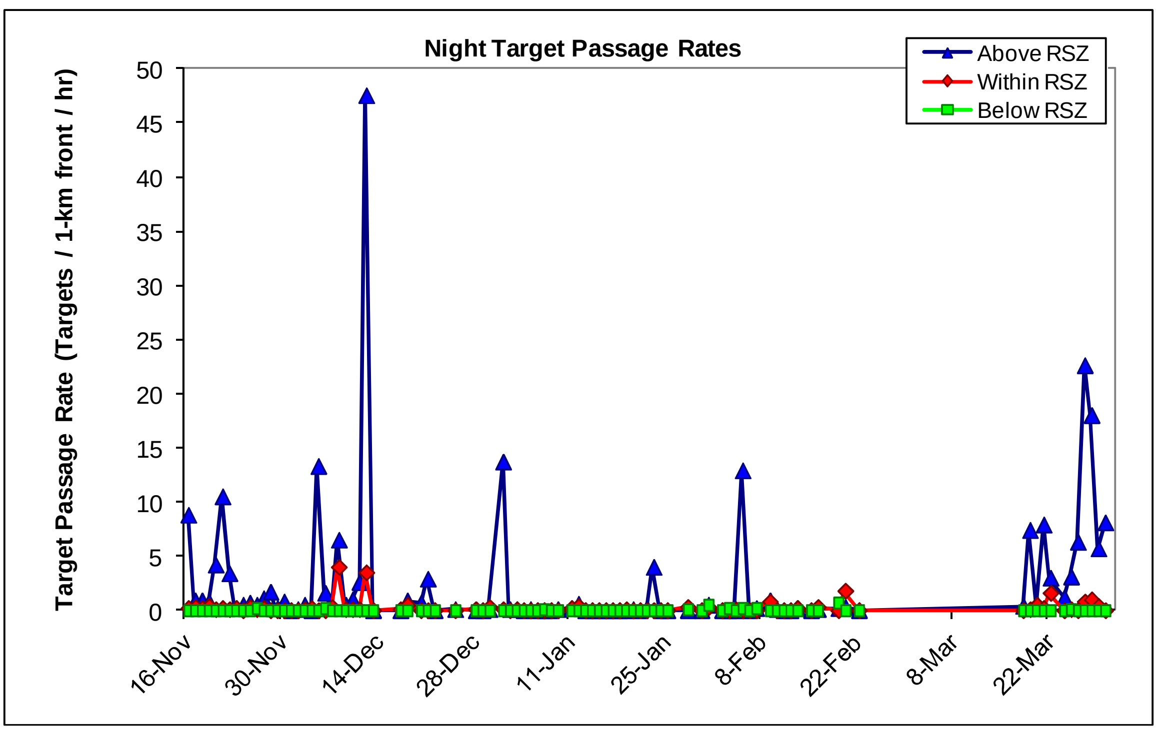

Figure 7-13. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during nights of the Winter 2012-13 season.

7.3 Horizontal Radar Data

The Horizontal Surveillance Radar (HSR) was used to determine directional movements of targets during biological periods of the Winter 2012-13 season.

7.3.1 Target Directions

Average target directions were calculated for each biological period (Fig. 7-14). Average target directions were also calculated seasonally (comprehensive distribution), with all targets detected during the Winter 2012-13 season combined together by biological period (Fig. 7-15) and hour (Fig. 7-16).

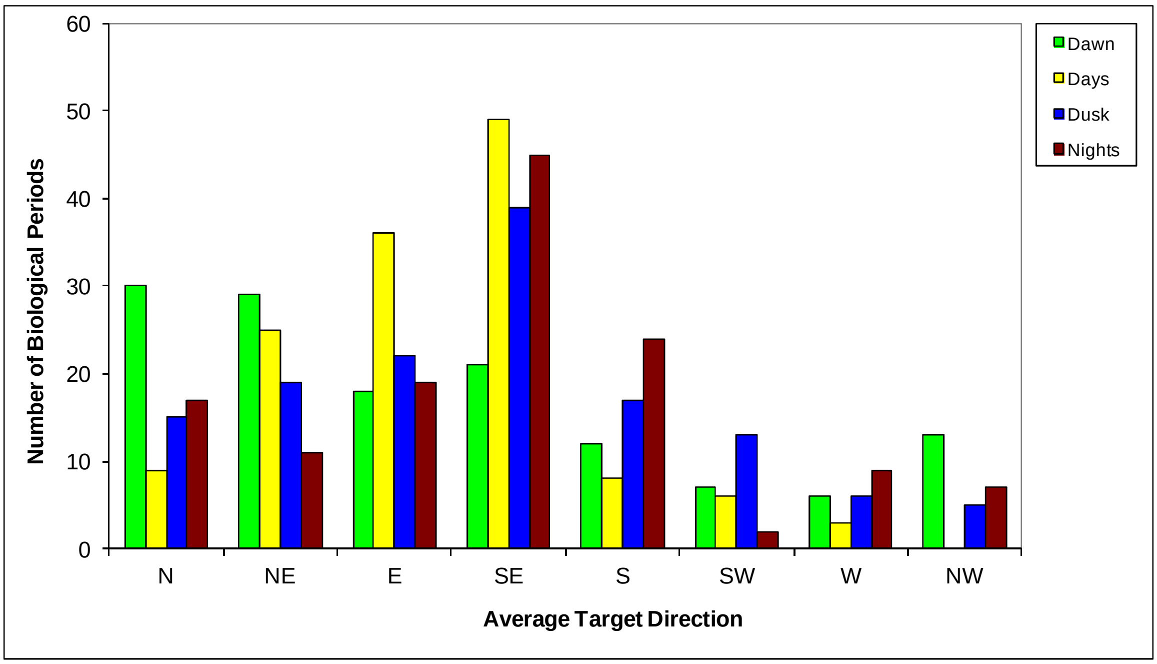

Figure 7-14. Distribution of average target movements among eight directions during dawns, days, dusks, and nights of the Winter 2012-13 season.

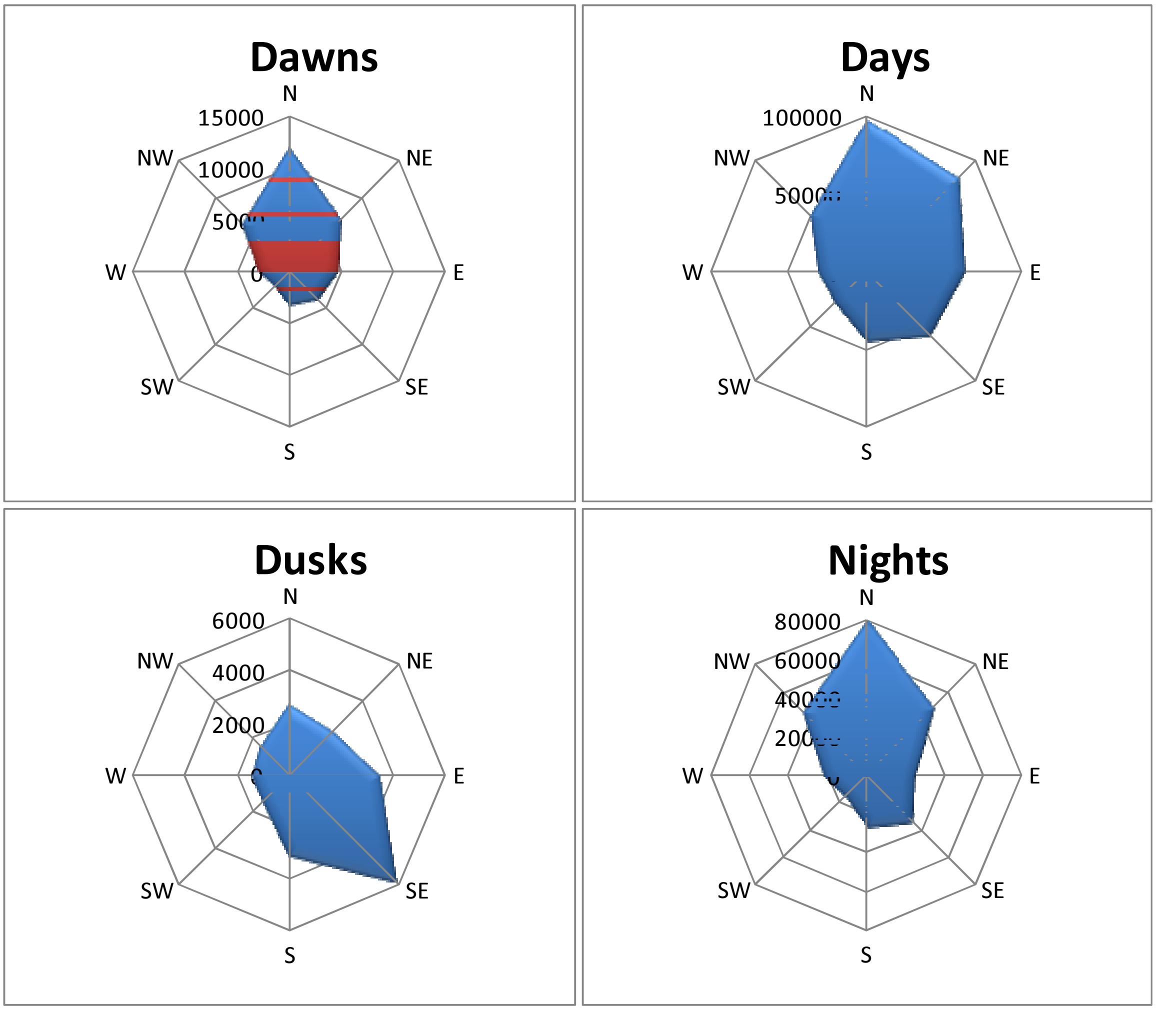

Figure 7-15. Comprehensive distribution of all target's directions during dawns, days, dusks, and nights of the Winter 2012-13 season.

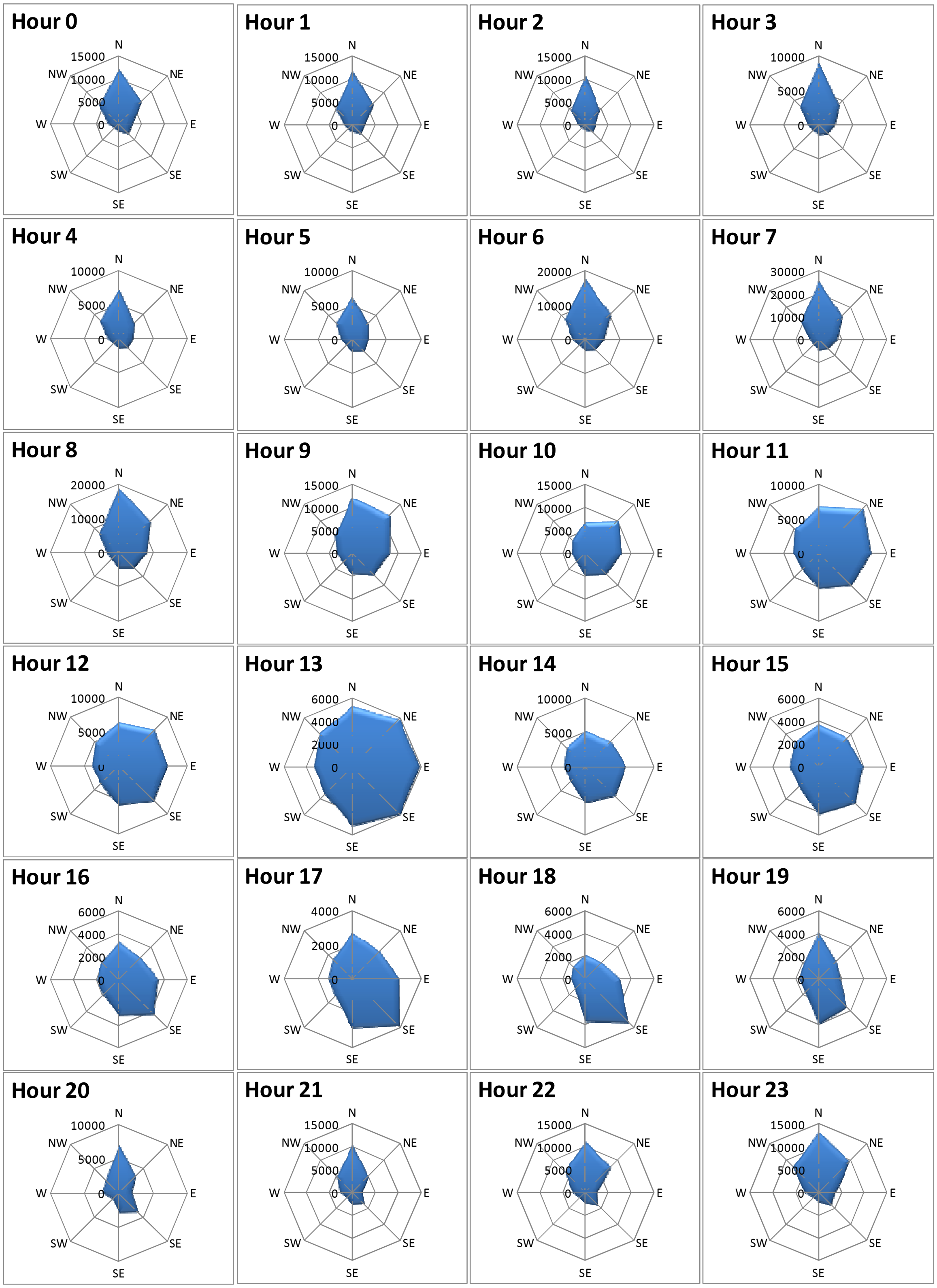

Figure 7-16. Comprehensive distribution of all target's directions by hour during the Winter 2012-13 season.

8 RESULTS for Site 4 (Nov 16, 2011 – Jan 26, 2012)

8.1 Level of Effort

Table 8-1 presents available time, time radar data were collected, amount of radar data that were removed due to rain, high levels of insect activity, or other contamination, and the resulting time of radar data used for analyses, for Site 4 (November 16, 2011 – January 26, 2012).

Table 8-1. Radar monitoring effort at Site 4 (November 16, 2011 – January 26, 2012).

	Vertical Radar		Horizontal Radar	
	Hours	**%**	**Hours**	**%**
Time in season	1728.5		1728.5	
Time radar down	26.4	1.5%	25.8	1.5%
Time radar collected data	1702.0	98.5%	1702.7	98.5%
Unuseable radar data[1] due to rain or other contamination	341.5	20.1%	0.5	0.0%
Unuseable radar data[2] due to insects	0.0	0.0%	-	-
Useable radar data[3]	1360.5	78.7%	1702.2	98.5%

1 - Percent indicates portion of time with radar data that was lost due to rain or other contamination.
2 - Percent indicates portion of time with radar data that was lost due to high insect activity.
3 - Percent indicates portion of season with useable radar data.

8.2 Vertical Radar Data

Data collected from the vertical scanning radar (VSR) were used to quantify target activity and heights.

8.2.1 Target Passage Rates Over Time

Data is presented as a rate equaling total number of targets / 1-km front / hr for each biological period (Fig. 8-1) and as an average by biological period (Fig. 8-2) and hour (Fig. 8-3). Summary statistics are presented in table 8-2.

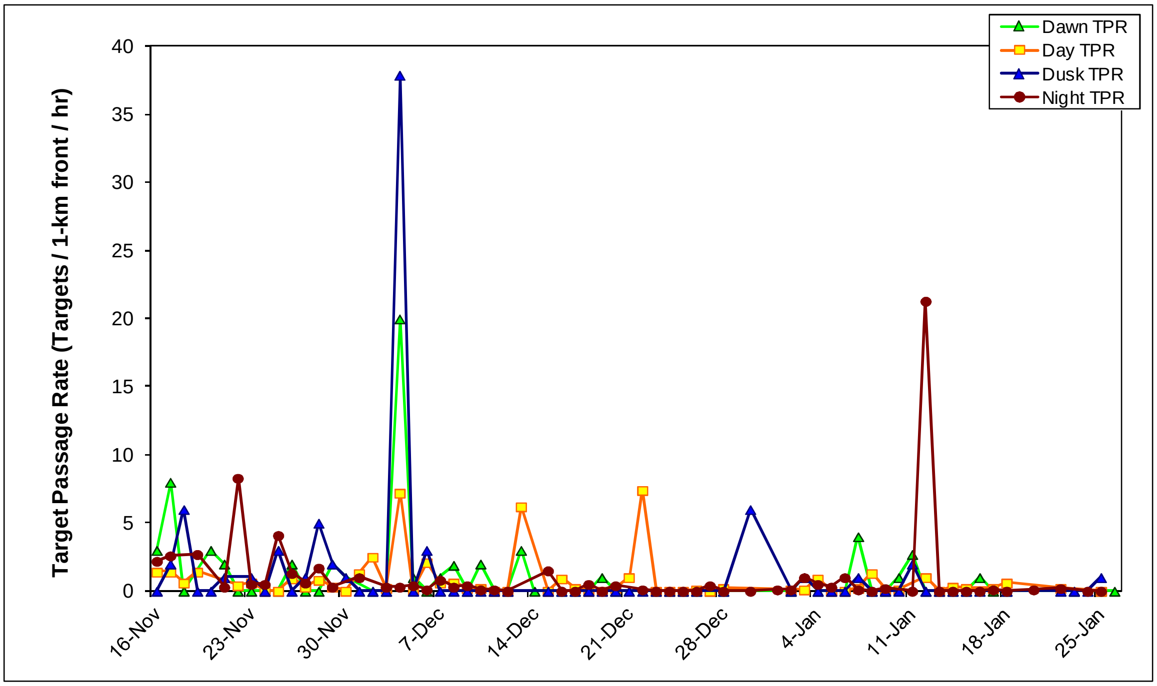

Figure 8-1. Target passage rates (TPR) during biological periods at Site 4 (November 16, 2011 – January 26, 2012).

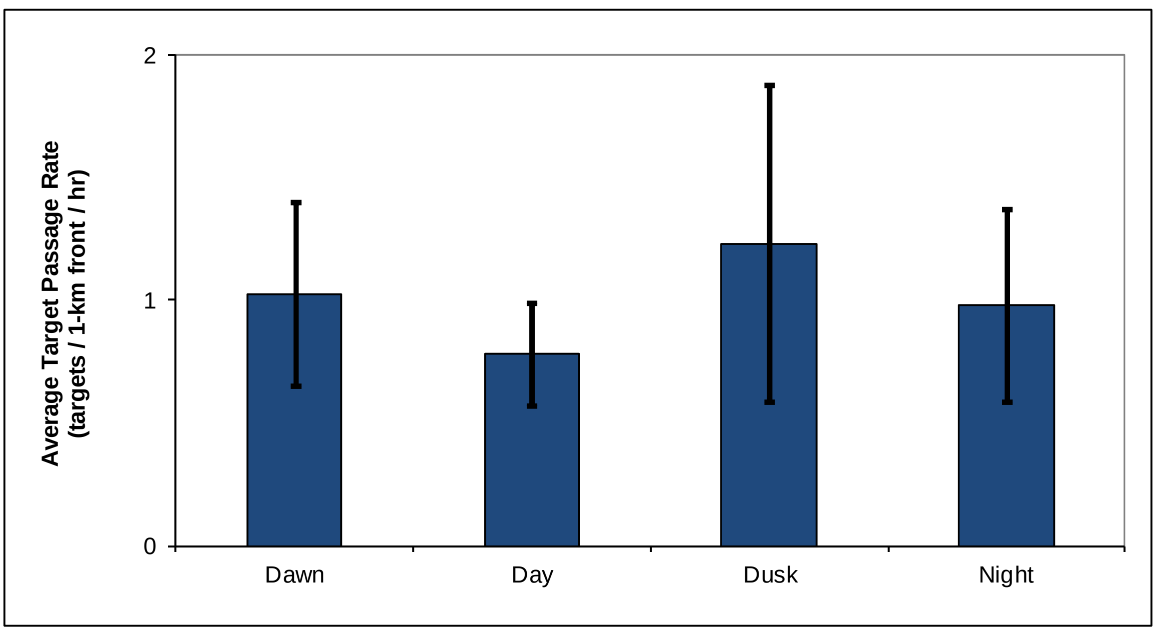

Figure 8-2. Average target passage rates (TPR) by biological period at Site 4 (November 16, 2011 – January 26, 2012). Error bars represent one standard error.

Table 8-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for biological periods at Site 4 (November 16, 2011 – January 26, 2012).

	Dawn	Day	Dusk	Night
Average	1.0	0.8	1.2	1.0
Standard Deviation	2.9	1.6	5.0	3.0
Standard Error	0.4	0.2	0.6	0.4
Median	0.0	0.2	0.0	0.2
Minimum	0.0	0.0	0.0	0.0
Maximum	20.0	7.4	37.9	21.3

Both average and comprehensive hourly target passage rates are presented in Fig 8-3: average rates are the average of each date's hourly target rate in a given hour, while comprehensive rates use targets grouped by hour, regardless of date.

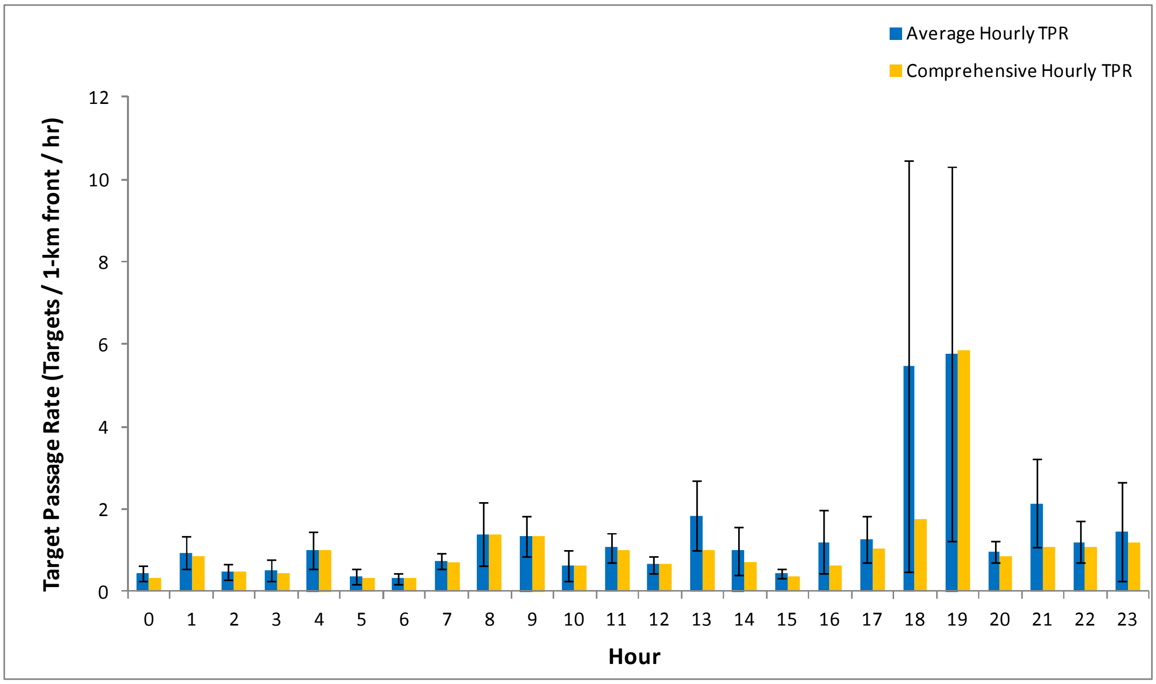

Figure 8-3. Average and comprehensive hourly target passage rates at Site 4 (November 16, 2011 – January 26, 2012). Error bars represent one standard error.

8.2.2 Altitudinal Distribution of Targets

Mean and median target heights are presented for each biological period (Fig. 8-4 and Fig. 8-5, respectively) at Site 4 (November 16, 2011 – January 26, 2012).

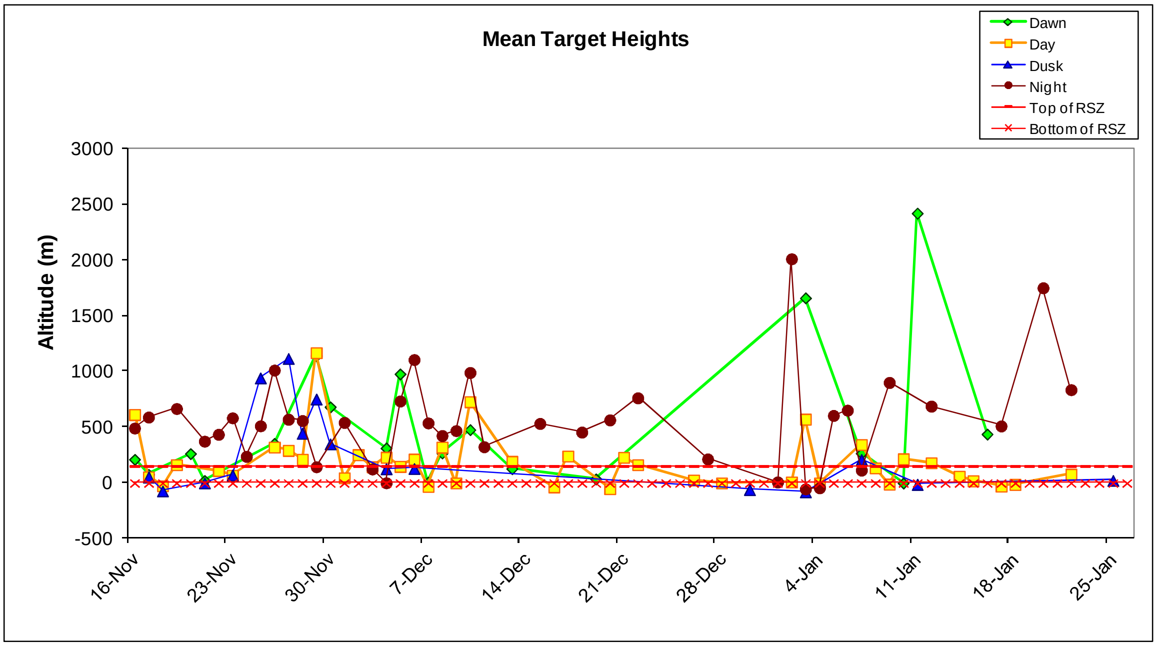

Figure 8-4. Mean target heights at Site 4 (November 16, 2011 – January 26, 2012). Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

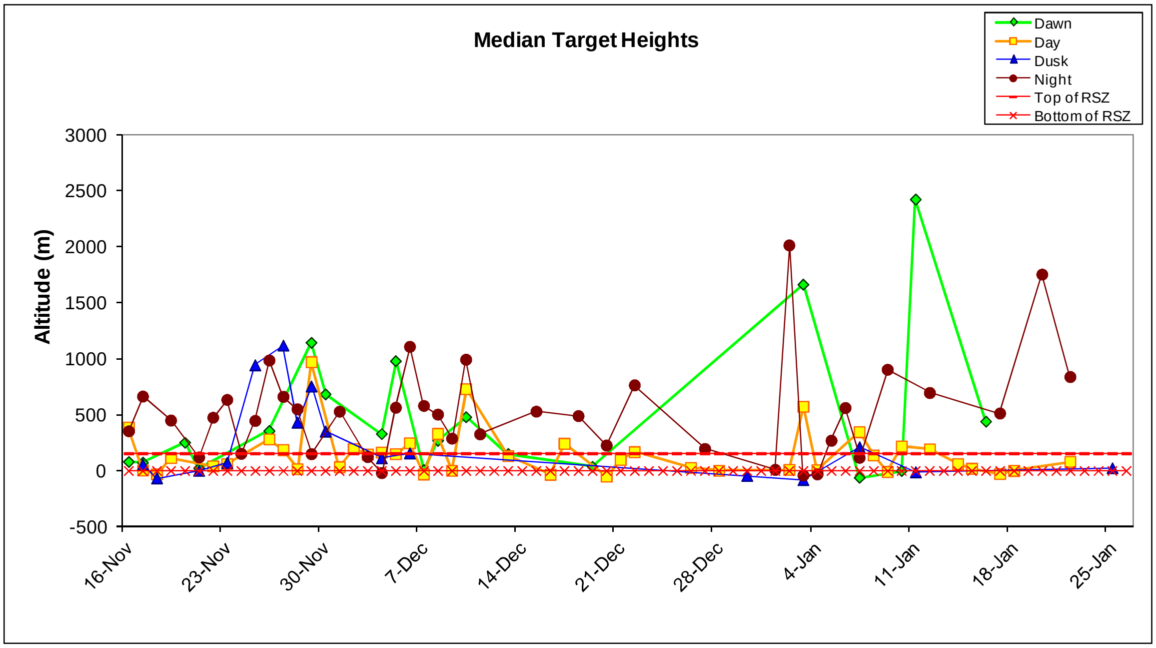

Figure 8-5. Median target heights at Site 4 (November 16, 2011 – January 26, 2012). Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

The mean and median target heights during each biological period were calculated for all dates with ≥ 50% data for that time period, averaged into a grand mean and average median, and presented in Table 8-3 (top) and illustrated in Figure 8-6 (blue bars). The comprehensive mean and median target heights for each biological period (when all targets were combined regardless of date) are also listed in Table 8-3 (bottom) and illustrated in Figure 8-6 (green bars).

Table 8-3. Summary of mean and median target heights during biological periods at Site 4 (November 16, 2011 – January 26, 2012). Darker colors in color-coded rows indicate greater values within that row.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Grand mean target height	513.3	179.8	249.8	563.6
Average median target height	490.0	150.1	250.9	523.4
All targets for season combined				
Comprehensive mean target height	384.3	224.2	334.1	535.0
Comprehensive median target height	233.5	137.8	90.5	517.2

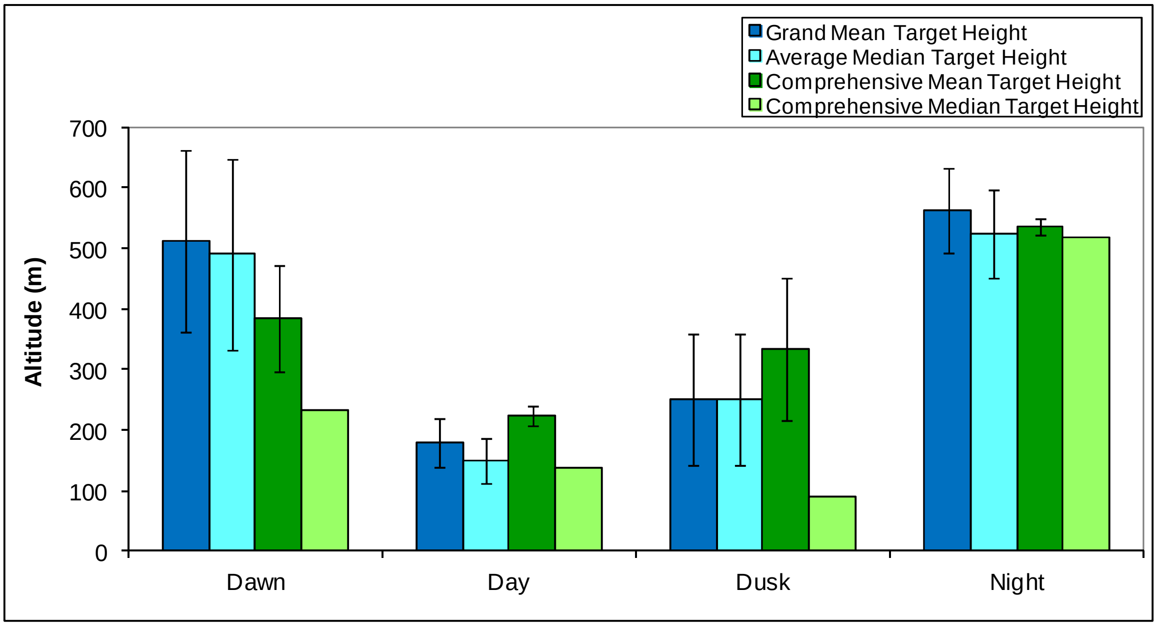

Figure 8-6. Grand mean and average median target heights averaged across individual biological periods (blue bars), and comprehensive mean and median target heights of all targets grouped by biological period (green bars), at Site 4 (November 16, 2011 – January 26, 2012). Error bars represent one standard error.

Hourly target heights were averaged into a grand hourly target mean and an average hourly target median for each of 24 hours; a comprehensive hourly target mean was also calculated by pooling all targets within a given hour together, regardless of date (Fig. 8-7).

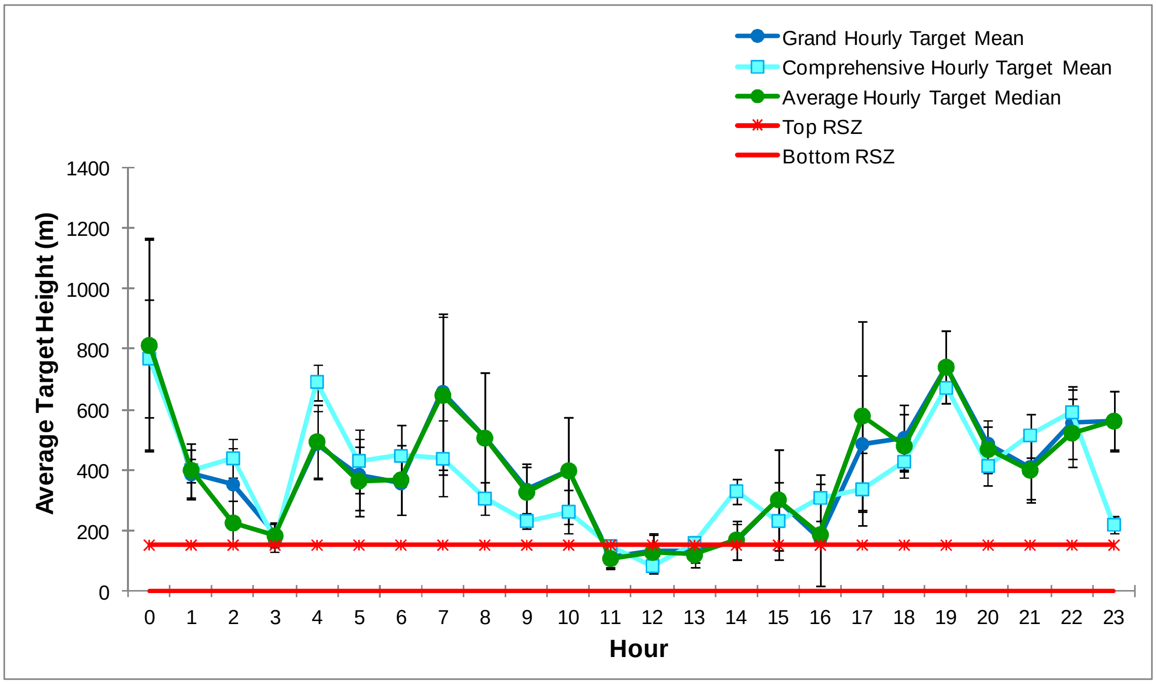

Figure 8-7. Hourly target heights at Site 4 (November 16, 2011 – January 26, 2012). Error bars represent one standard error. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

The distribution of all targets detected during dawns, days, dusks, and nights at Site 4 (November 16, 2011 – January 26, 2012) are shown using 50-meter increments (Fig. 8-8).

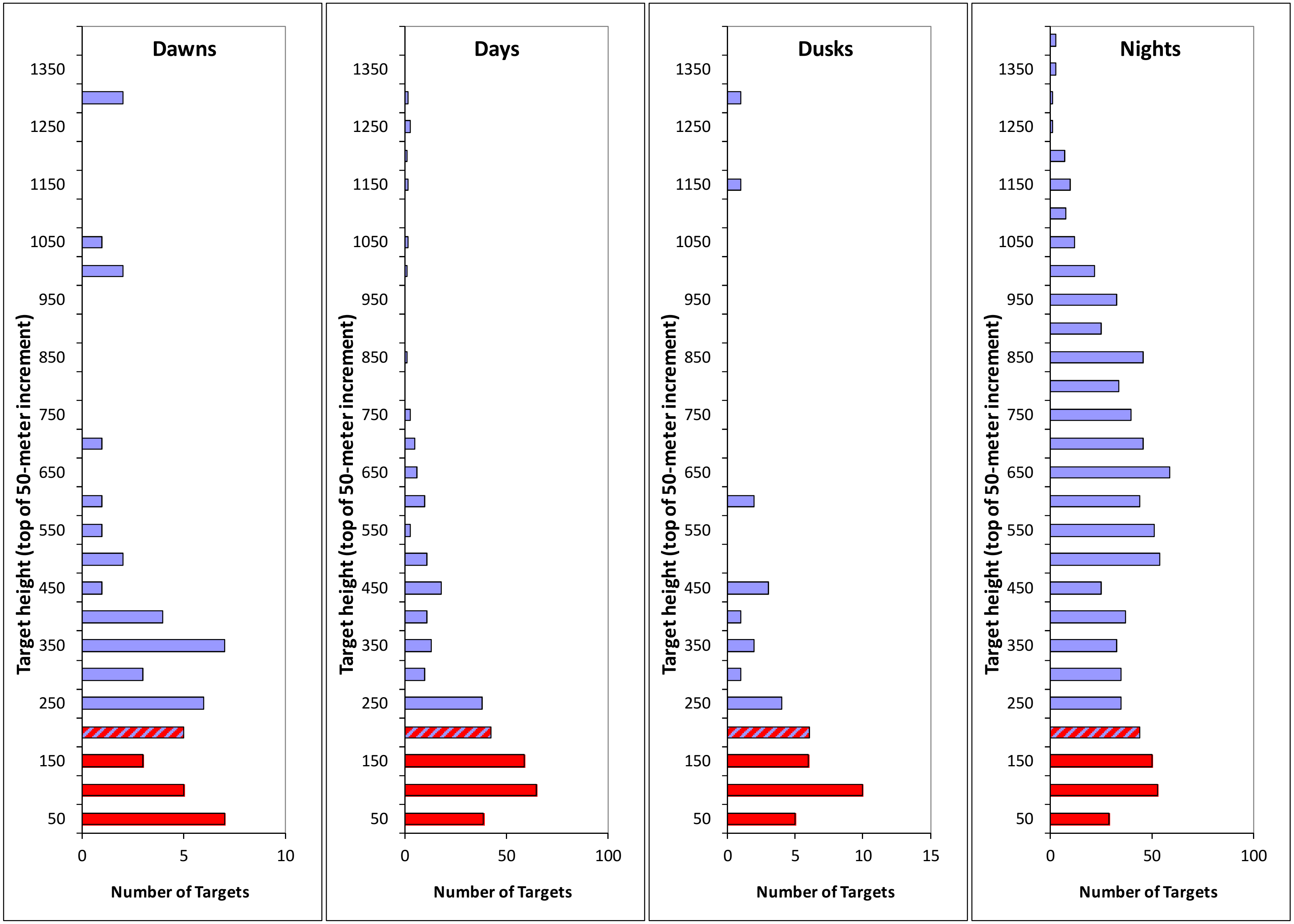

Figure 8-8. Number of targets occurring in each 50-meter increment during biological periods at Site 4 (November 16, 2011 – January 26, 2012). Red indicates rotor swept heights, and red-blue hashed indicates altitudes partially within rotor swept heights.

Using a RSZ of 0-152.4 m AGL, target passage rates below, within, and above the RSZ were calculated for each date. Individual target passage rates are presented for dawns (Fig. 8-10) days (Fig. 8-11), dusks (Fig 8-12), and nights (Fig. 8-13). Percent targets below, within, and above the RSZ were also calculated seasonally, with all targets detected during each biological period at Site 4 (November 16, 2011 – January 26, 2012) combined together (Table 8-4, bottom). Average hourly target passage rates below, within, and above the rotor swept zone are also given (Fig. 8-9).

Table 8-4. Summary of target passage rates and percent of targets above, within and below the RSZ (0-152.4 m AGL) during biological periods at Site 4 (November 16, 2011 – January 26, 2012). Darker colors indicate greater values.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average target passage rate above RSZ	0.7	0.3	0.4	0.9
Average target passage rate within RSZ	0.3	0.3	0.5	0.1
Average target passage rate below RSZ	0.1	0.1	0.3	0.0
Average % of targets in RSZ	27.0%	42.2%	34.4%	20.4%
Min target percentage within RSZ	0.0%	0.0%	0.0%	0.0%
Max target percentage within RSZ	100.0%	100.0%	100.0%	100.0%
All targets for season combined				
% targets above RSZ	64.4%	43.3%	35.6%	87.1%
% targets within RSZ	25.4%	41.8%	39.0%	9.1%
% targets below RSZ	10.2%	14.8%	25.4%	3.8%
% targets below turbine height	35.6%	56.7%	64.4%	12.9%

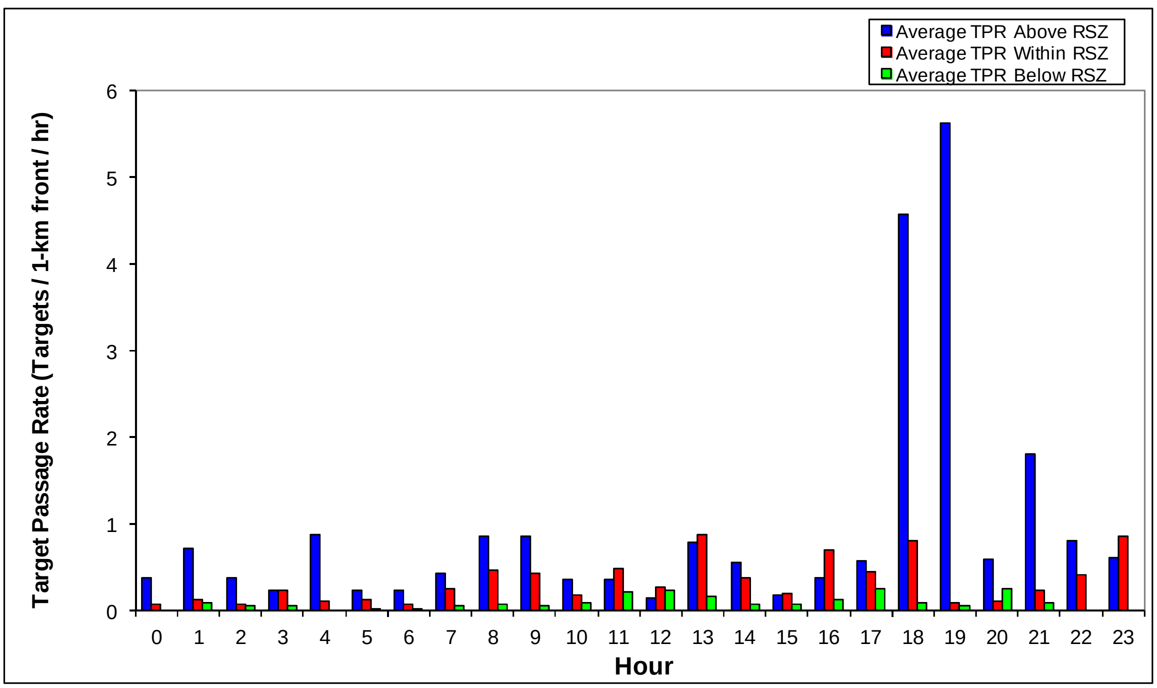

Figure 8-9. Average hourly target passage rates at Site 4 (November 16, 2011 – January 26, 2012).

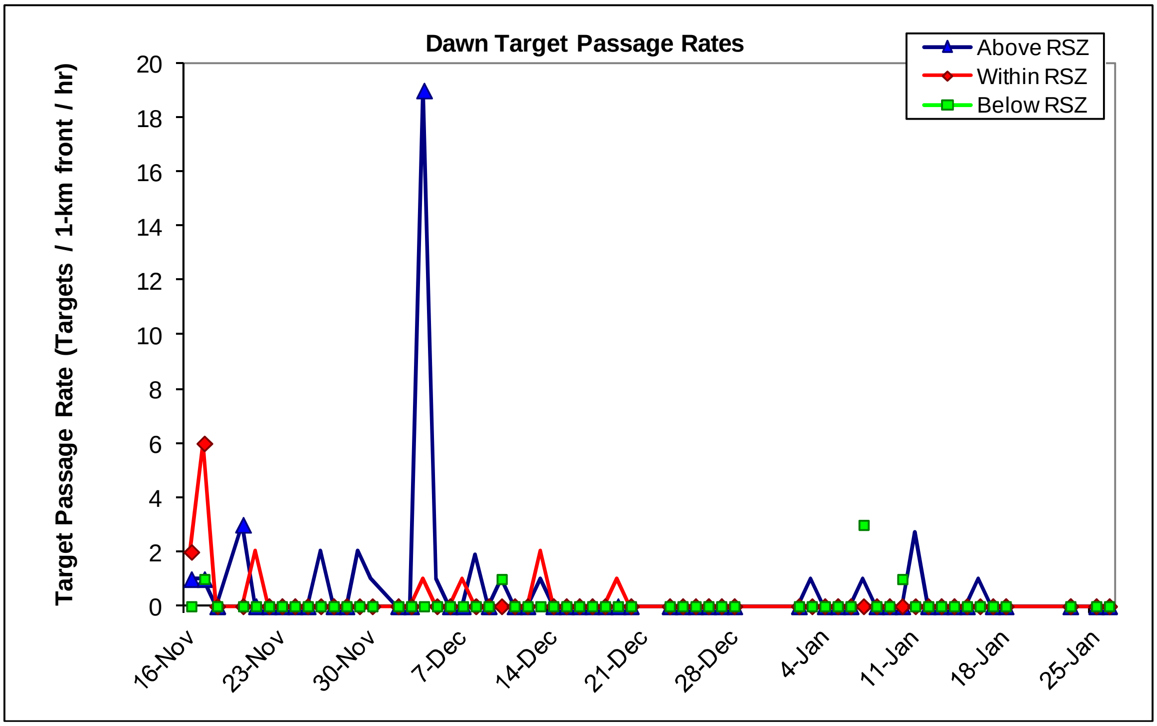

Figure 8-10. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dawns at Site 4 (November 16, 2011 – January 26, 2012).

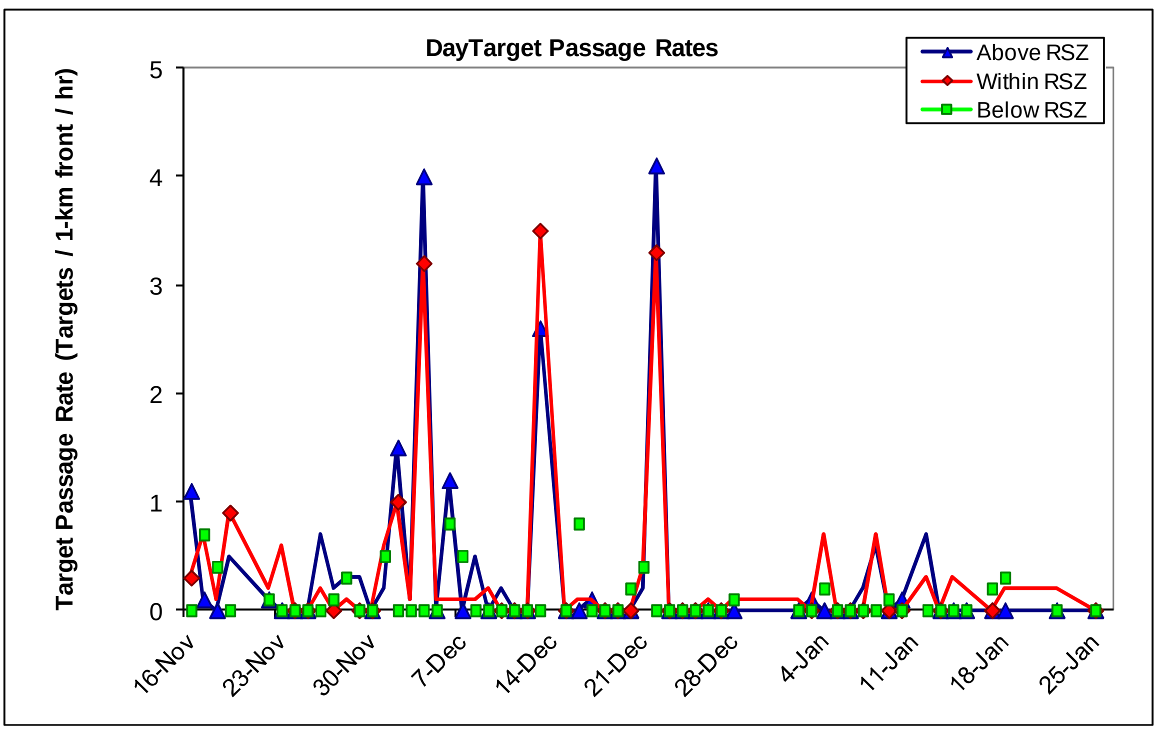

Figure 8-11. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during days at Site 4 (November 16, 2011 – January 26, 2012).

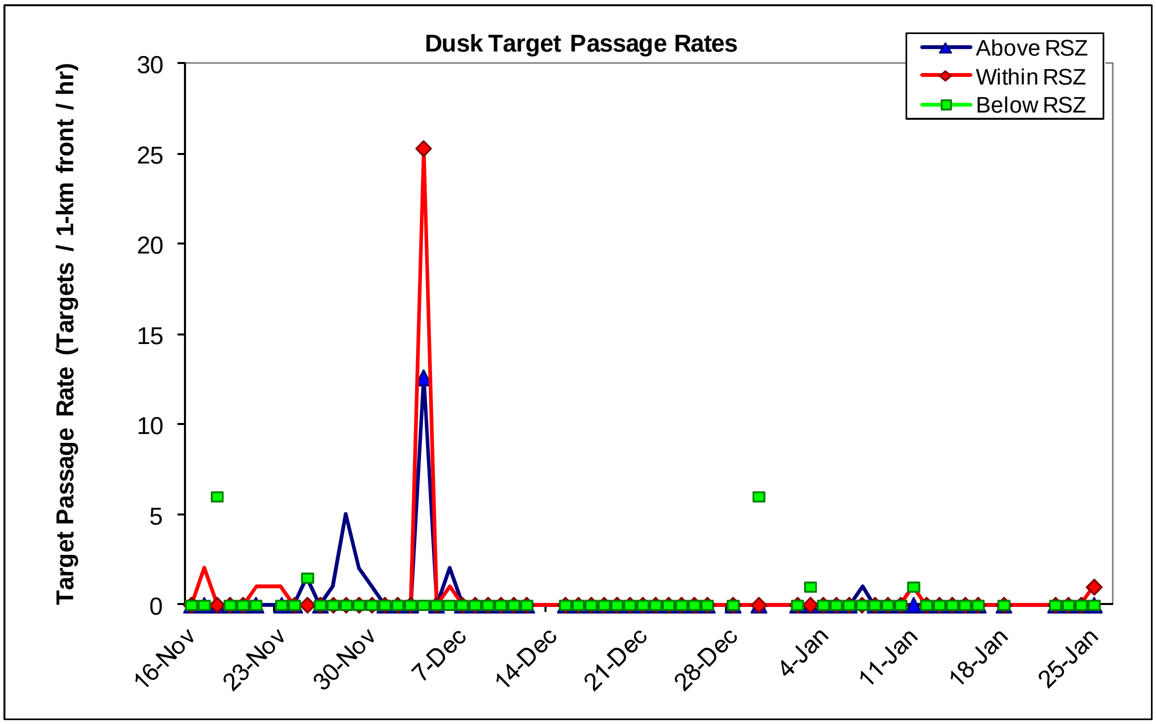

Figure 8-12. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dusks at Site 4 (November 16, 2011 – January 26, 2012).

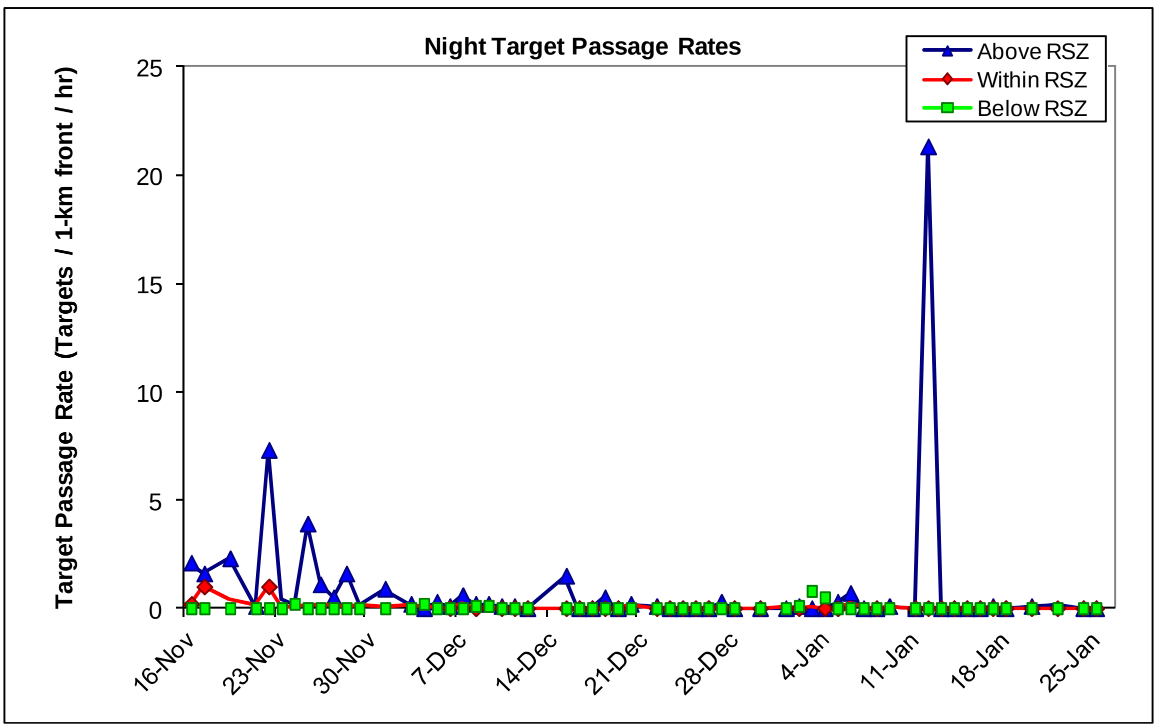

Figure 8-13. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during nights at Site 4 (November 16, 2011 – January 26, 2012).

8.3 Horizontal Radar Data

The Horizontal Surveillance Radar (HSR) was used to determine directional movements of targets during biological periods at Site 4 (November 16, 2011 – January 26, 2012).

8.3.1 Target Directions

Average target directions were calculated for each biological period (Fig. 8-14). Average target directions were also calculated seasonally (comprehensive distribution), with all targets detected at Site 4 (November 16, 2011 – January 26, 2012) combined together by biological period (Fig. 8-15) and hour (Fig. 8-16).

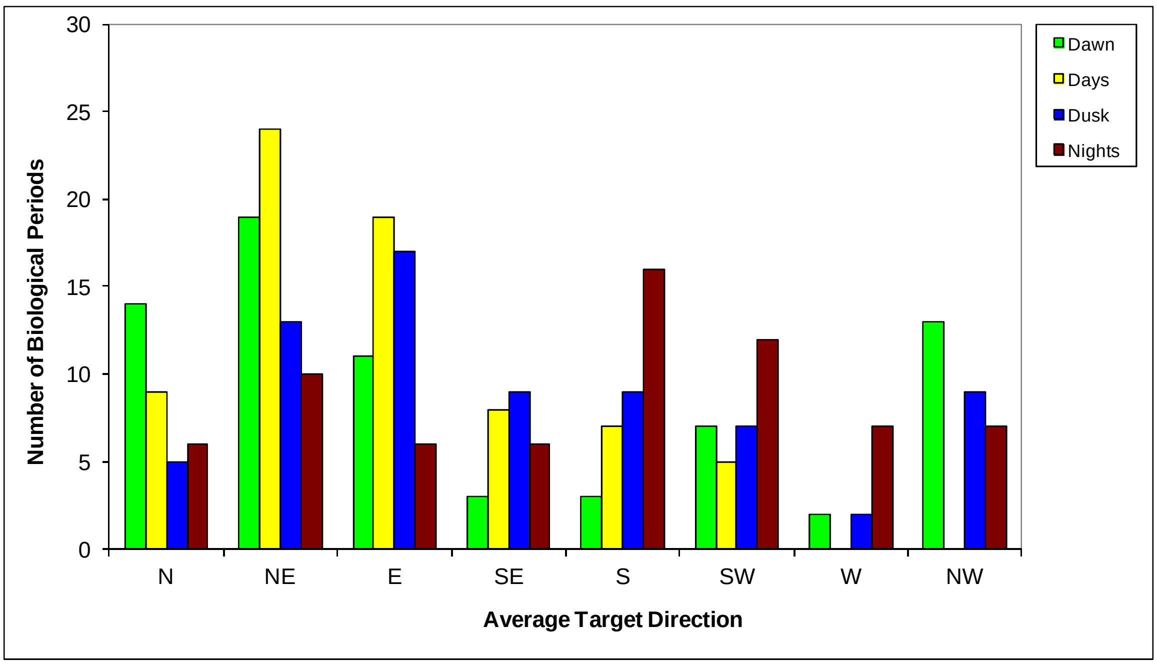

Figure 8-14. Distribution of average target movements among eight directions during dawns, days, dusks, and nights at Site 4 (November 16, 2011 – January 26, 2012).

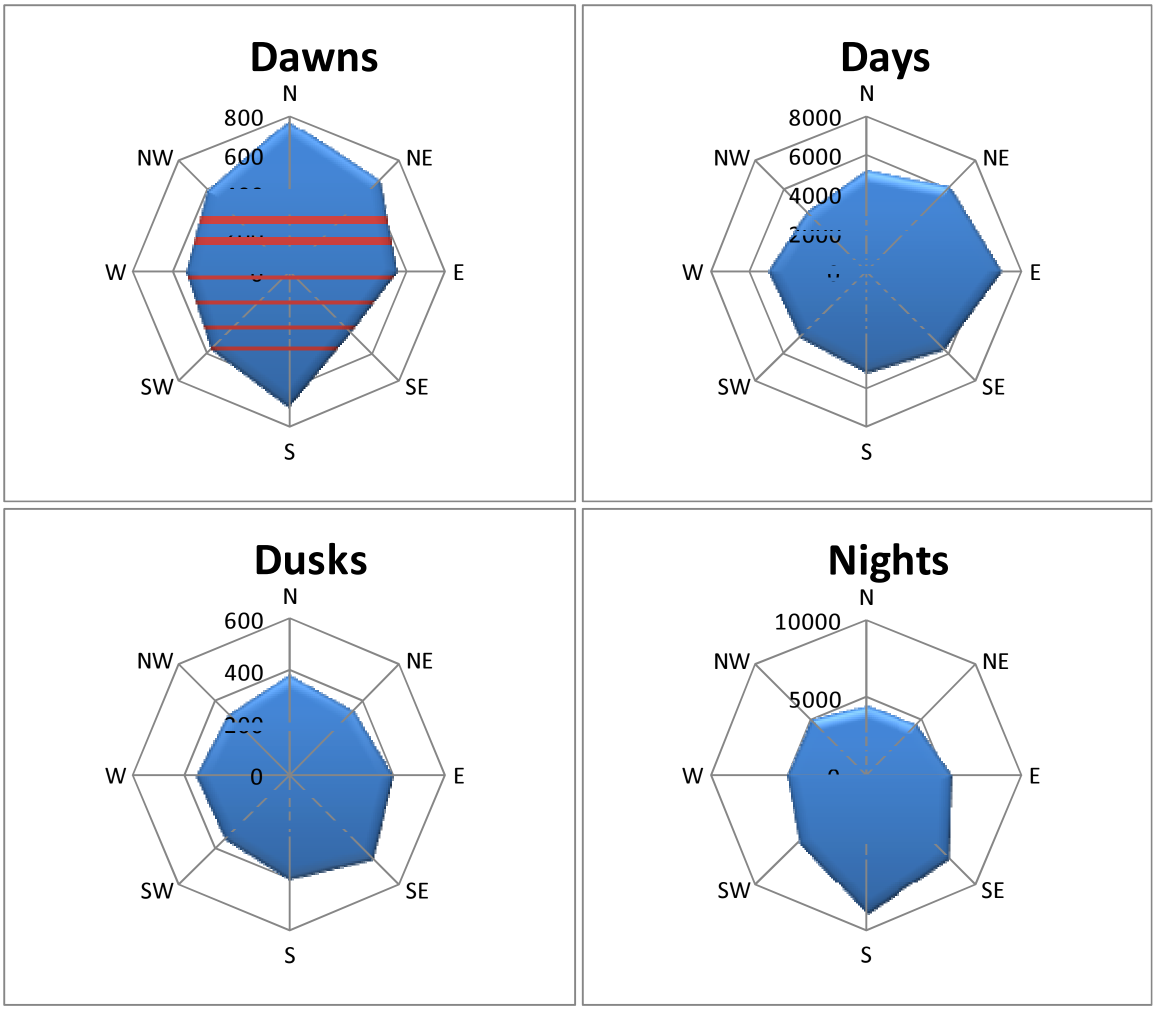

Figure 8-15. Comprehensive distribution of all target's directions during dawns, days, dusks, and nights at Site 4 (November 16, 2011 – January 26, 2012).

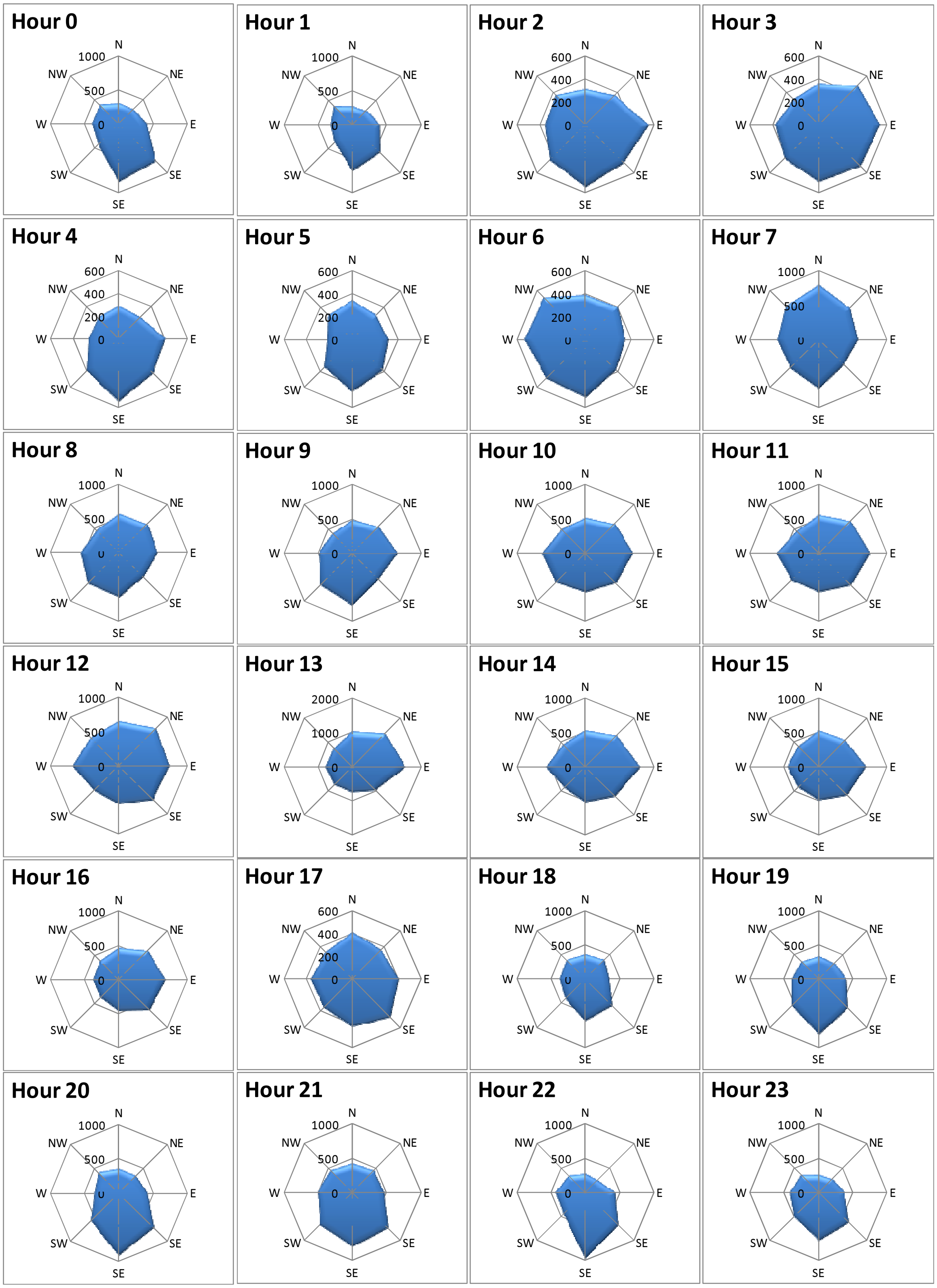

Figure 8-16. Comprehensive distribution of all target's directions by hour at Site 4 (November 16, 2011 – January 26, 2012).

9 RESULTS for Site 6 (February 2 – April 29, 2012)

9.1 Level of Effort

Table 9-1 presents available time, time radar data were collected, amount of radar data that were removed due to rain, high levels of insect activity, or other contamination, and the resulting time of radar data used for analyses, for Site 6 (February 2 - April 29, 2012).

Table 9-1. Radar monitoring effort at Site 6 (February 2 - April 29, 2012).

	Vertical Radar		Horizontal Radar	
	Hours	%	Hours	%
Time in season	2110.0		2110.0	
Time radar down	18.1	0.9%	17.5	0.8%
Time radar collected data	2091.9	99.1%	2092.5	99.2%
Unuseable radar data[1] due to rain or other contamination	297.3	14.2%	6.0	0.3%
Unuseable radar data[2] due to insects	49.5	2.4%	-	-
Useable radar data[3]	1745.1	82.7%	2086.5	98.9%

1 - Percent indicates portion of time with radar data that was lost due to rain or other contamination.
2 - Percent indicates portion of time with radar data that was lost due to high insect activity.
3 - Percent indicates portion of season with useable radar data.

9.2 Vertical Radar Data

Data collected from the vertical scanning radar (VSR) were used to quantify target activity and heights.

9.2.1 Target Passage Rates Over Time

Data is presented as a rate equaling total number of targets / 1-km front / hr for each biological period (Fig. 9-1) and as an average by biological period (Fig. 9-2) and hour (Fig. 9-3). Summary statistics are presented in table 9-2.

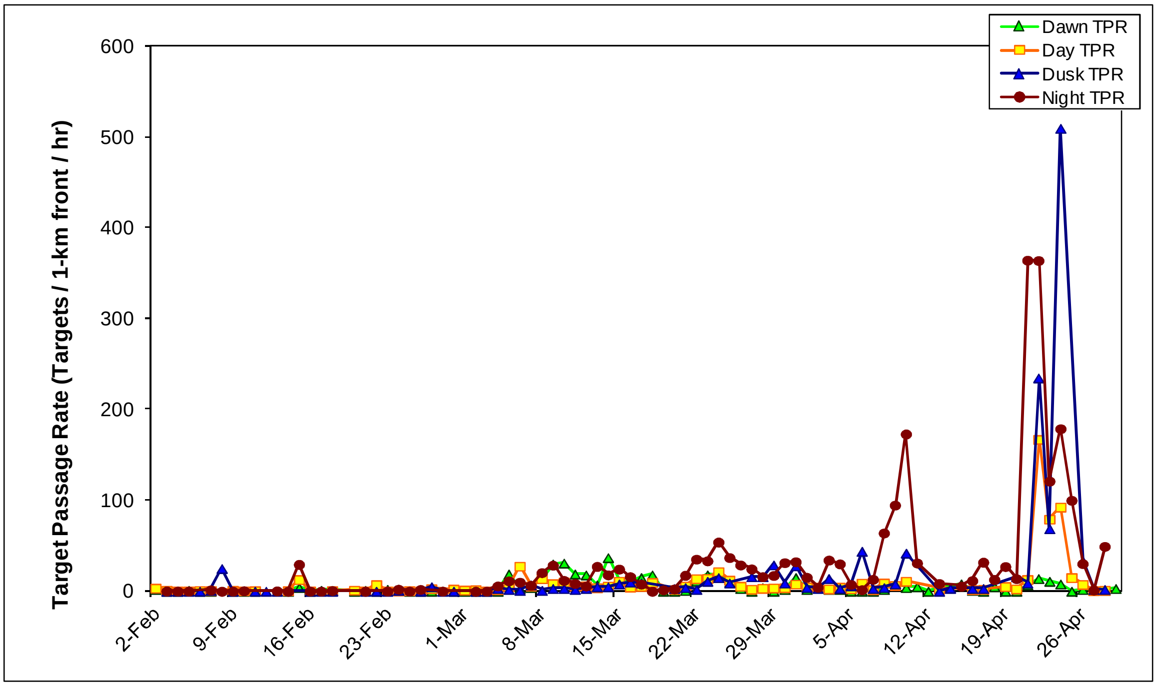

Figure 9-1. Target passage rates (TPR) during biological periods at Site 6 (February 2 - April 29, 2012).

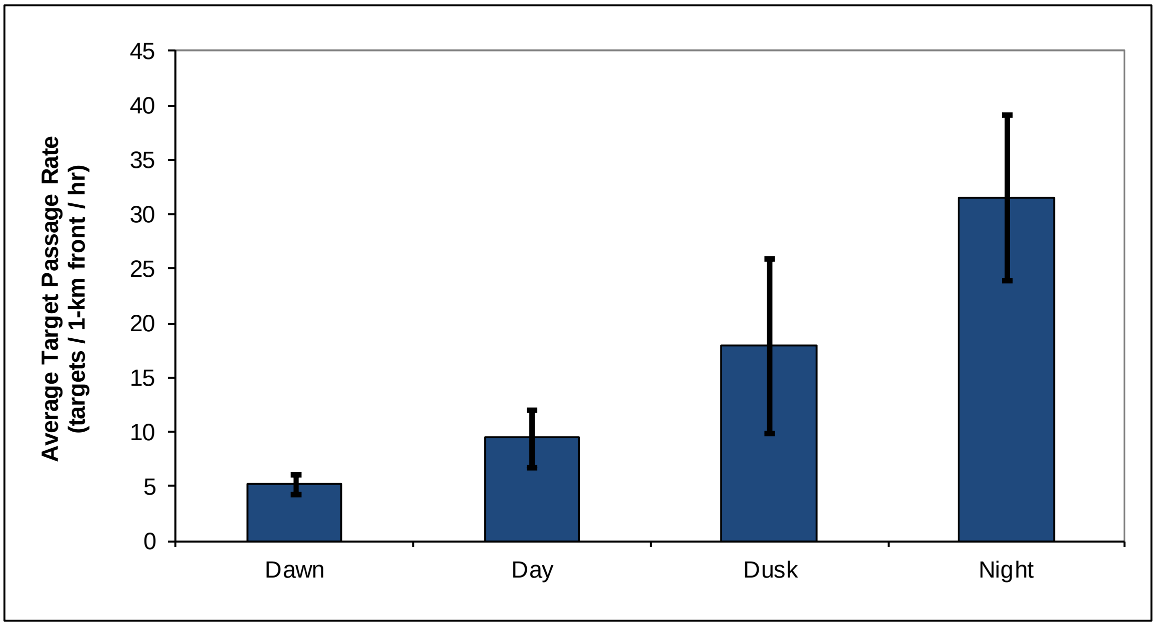

Figure 9-2. Average target passage rates (TPR) by biological period at Site 6 (February 2 - April 29, 2012). Error bars represent one standard error.

Table 9-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for biological periods at Site 6 (February 2 - April 29, 2012).

	Dawn	Day	Dusk	Night
Average	5.2	9.4	17.9	31.6
Standard Deviation	7.9	23.3	66.7	65.4
Standard Error	0.9	2.7	8.0	7.5
Median	2.0	3.9	3.0	11.9
Minimum	0.0	0.2	0.0	0.0
Maximum	37.0	167.3	510.0	364.7

Both average and comprehensive hourly target passage rates are presented in Fig 9-3: average rates are the average of each date's hourly target rate in a given hour, while comprehensive rates use targets grouped by hour, regardless of date.

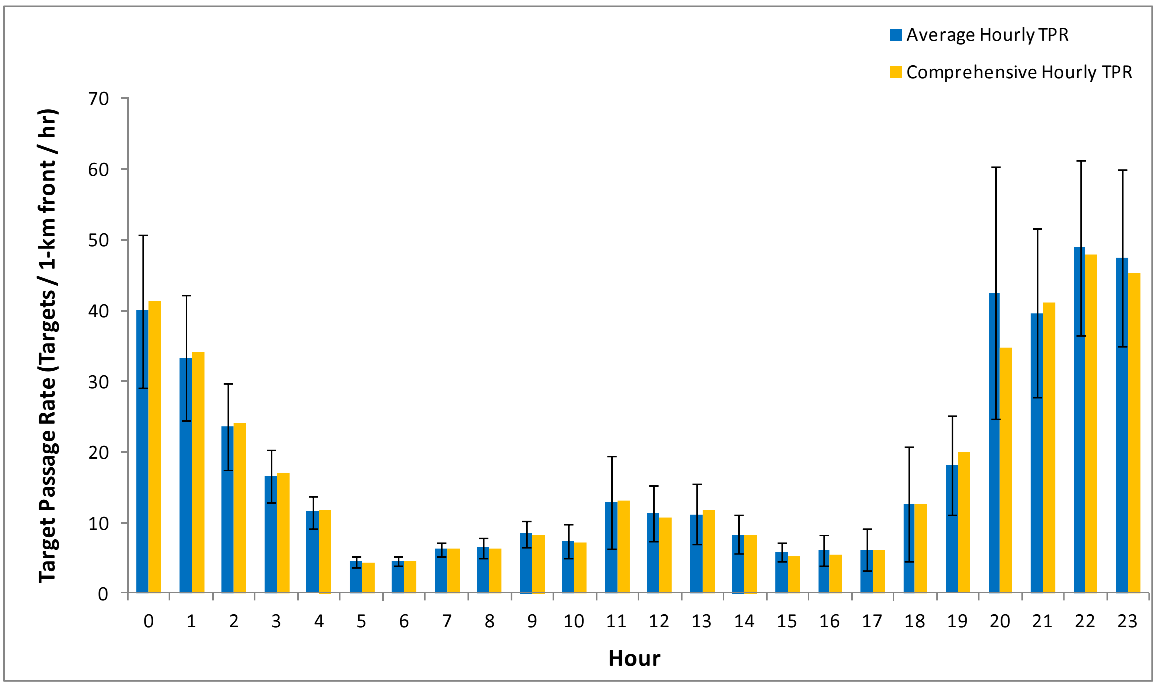

Figure 9-3. Average and comprehensive hourly target passage rates at Site 6 (February 2 - April 29, 2012). Error bars represent one standard error.

9.2.2 Altitudinal Distribution of Targets

Mean and median target heights are presented for each biological period (Fig. 9-4 and Fig. 9-5, respectively) at Site 6 (February 2 - April 29, 2012).

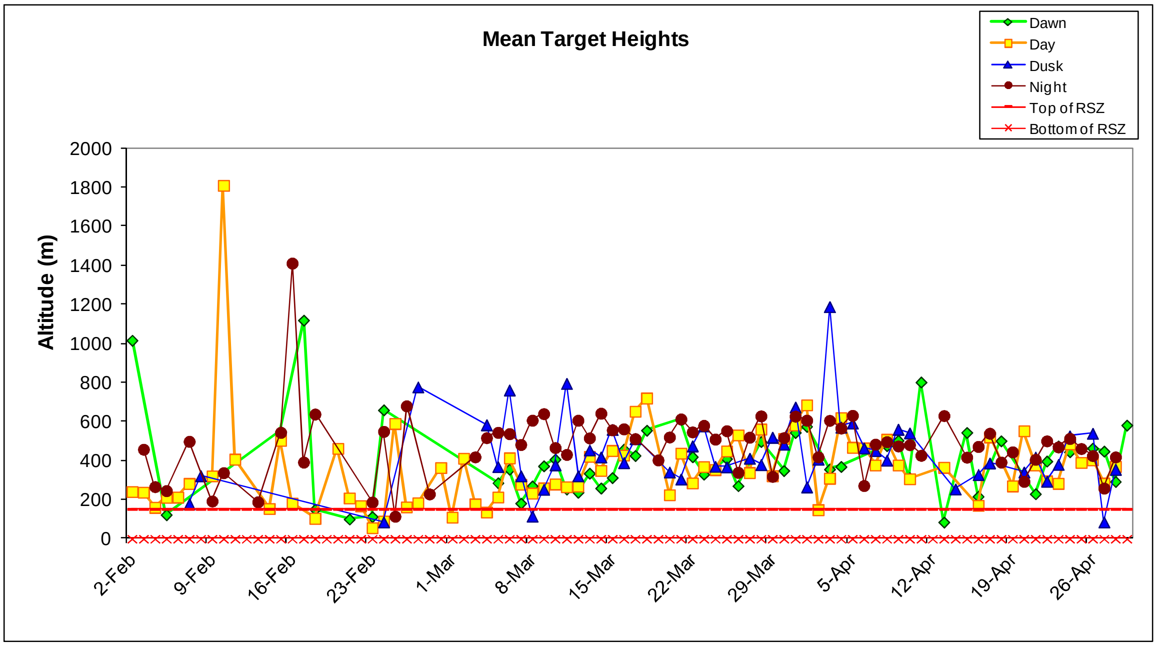

Figure 9-4. Mean target heights at Site 6 (February 2 - April 29, 2012). Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

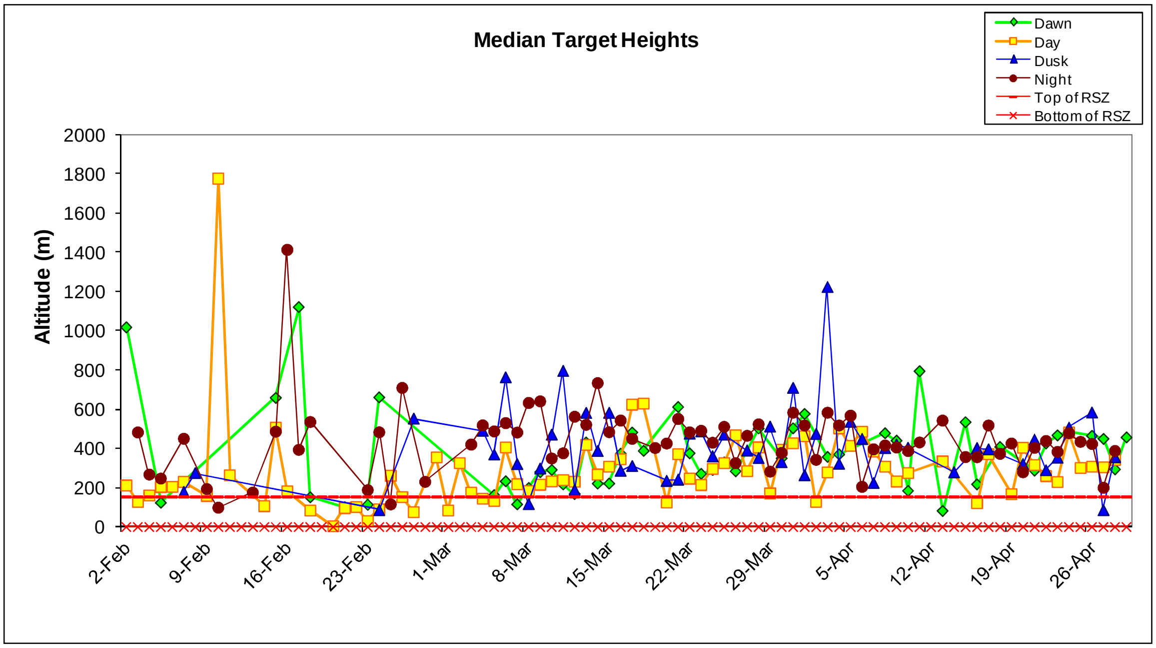

Figure 9-5. Median target heights at Site 6 (February 2 - April 29, 2012). Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

The mean and median target heights during each biological period were calculated for all dates with ≥ 50% data for that time period, averaged into a grand mean and average median, and presented in Table 9-3 (top) and illustrated in Figure 9-6 (blue bars). The comprehensive mean and median target heights for each biological period (when all targets were combined regardless of date) are also listed in Table 9-3 (bottom) and illustrated in Figure 9-6 (green bars).

Table 9-3. Summary of mean and median target heights during biological periods at Site 6 (February 2 - April 29, 2012). Darker colors in color-coded rows indicate greater values within that row.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Grand mean target height	408.7	363.0	437.5	483.0
Average median target height	379.9	288.9	406.7	439.7
All targets for season combined				
Comprehensive mean target height	380.0	373.1	462.1	489.8
Comprehensive median target height	300.2	295.4	414.2	427.0

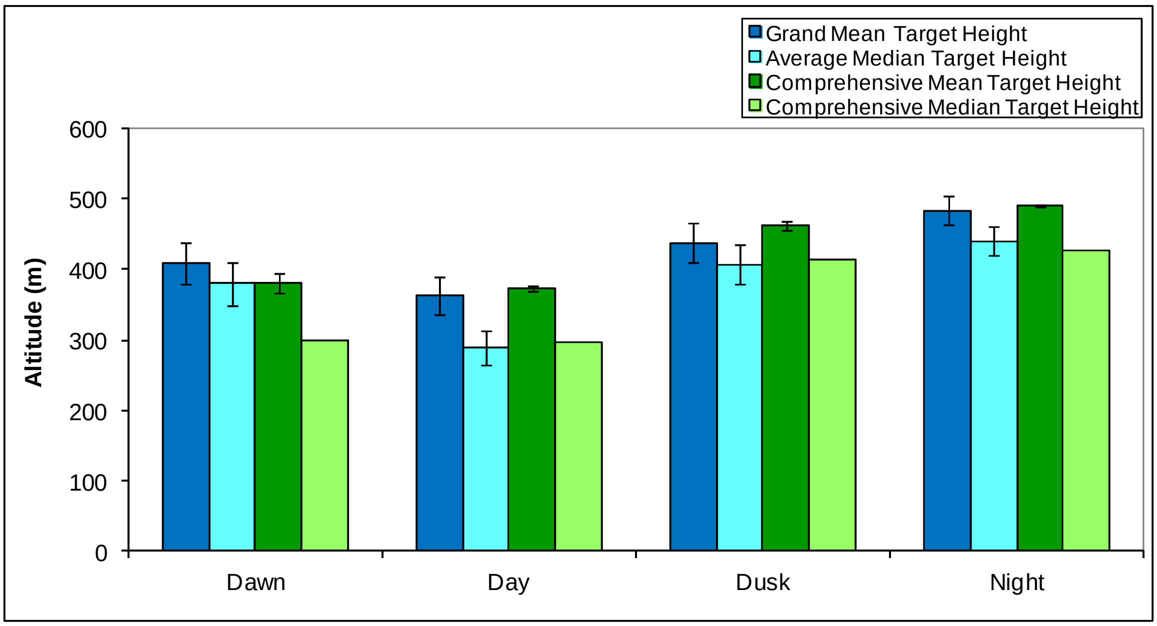

Figure 9-6. Grand mean and average median target heights averaged across individual biological periods (blue bars), and comprehensive mean and median target heights of all targets grouped by biological period (green bars), at Site 6 (February 2 - April 29, 2012). Error bars represent one standard error.

Hourly target heights were averaged into a grand hourly target mean and an average hourly target median for each of 24 hours; a comprehensive hourly target mean was also calculated by pooling all targets within a given hour together, regardless of date (Fig. 9-7).

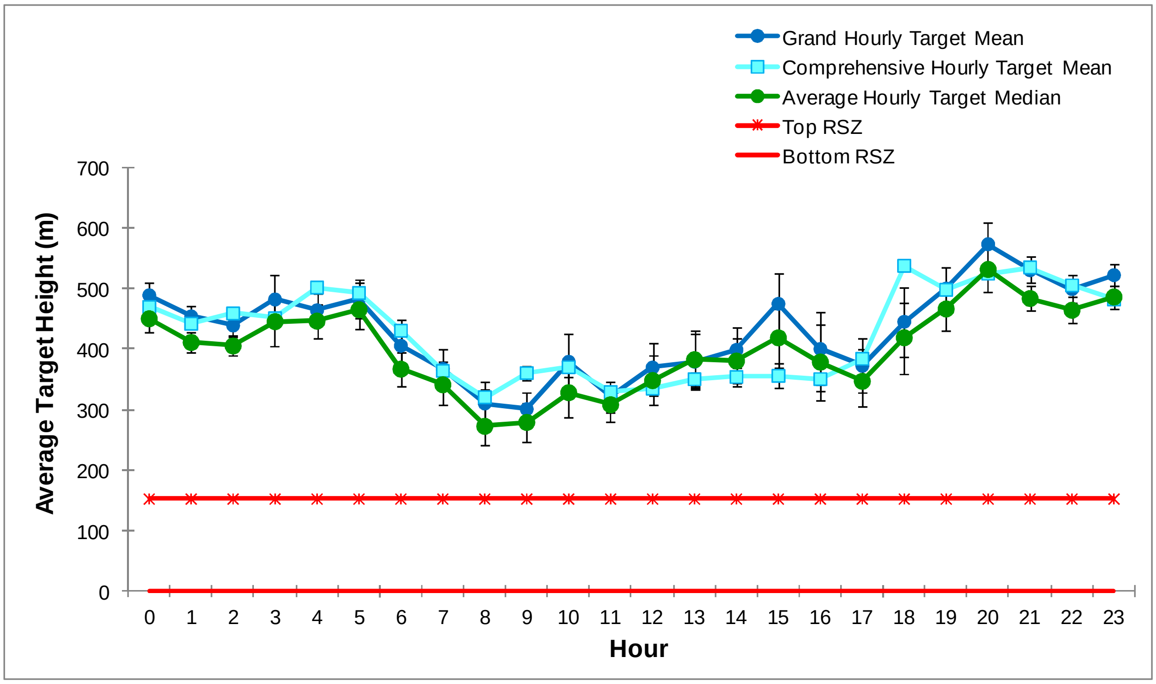

Figure 9-7. Hourly target heights at Site 6 (February 2 - April 29, 2012). Error bars represent one standard error. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

The distribution of all targets detected during dawns, days, dusks, and nights at Site 6 (February 2 - April 29, 2012) are shown using 50-meter increments (Fig. 9-8).

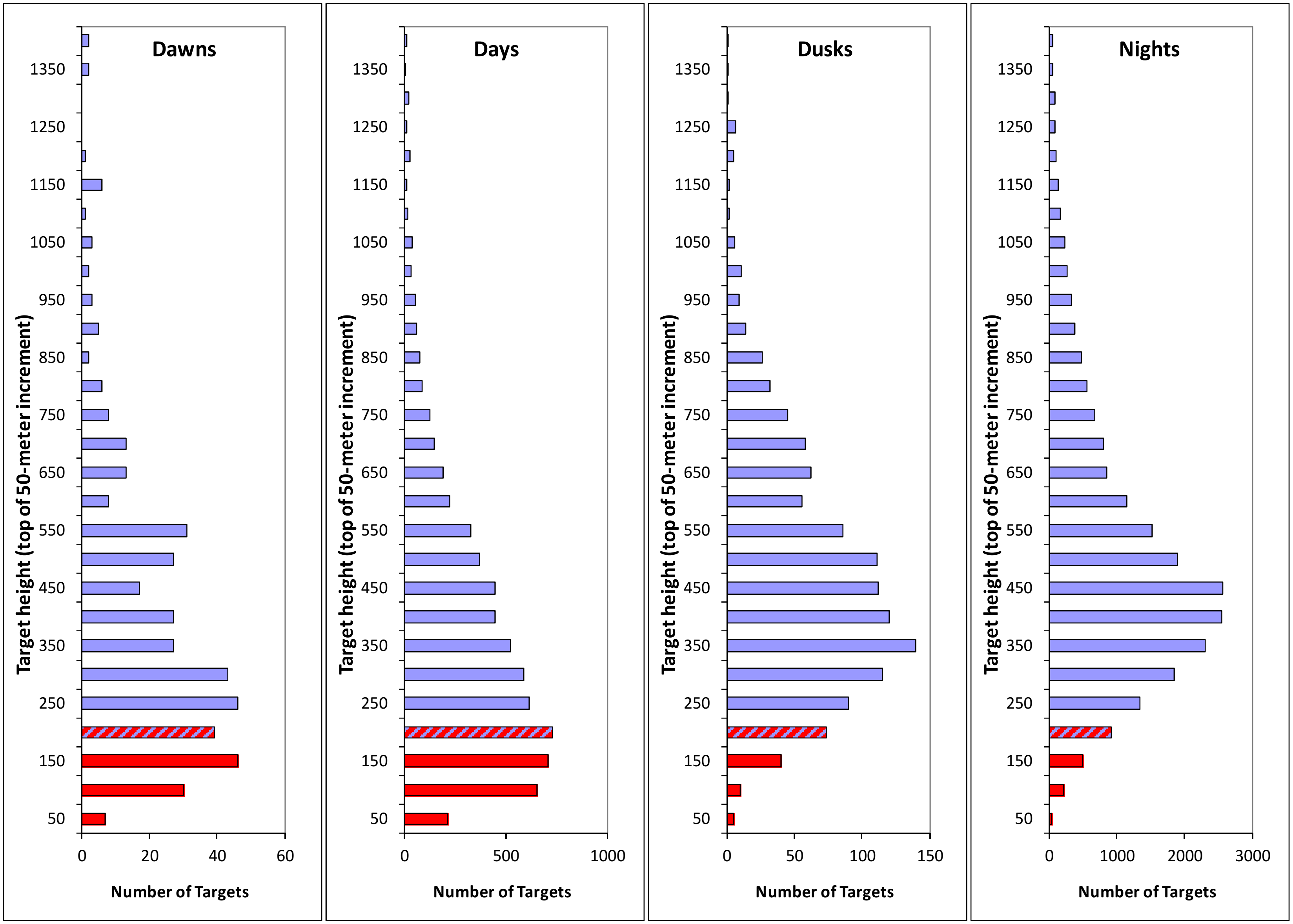

Figure 9-8. Number of targets occurring in each 50-meter increment during biological periods at Site 6 (February 2 - April 29, 2012). Red indicates rotor swept heights, and red-blue hashed indicates altitudes partially within rotor swept heights.

Using a RSZ of 0-152.4 m AGL, target passage rates below, within, and above the RSZ were calculated for each date. Individual target passage rates are presented for dawns (Fig. 9-10) days (Fig. 9-11), dusks (Fig 9-12), and nights (Fig. 9-13). Percent targets below, within, and above the RSZ were also calculated seasonally, with all targets detected during each biological period at Site 6 (February 2 - April 29, 2012) combined together (Table 9-4, bottom). Average hourly target passage rates below, within, and above the rotor swept zone are also given (Fig. 9-9).

Table 9-4. Summary of target passage rates and percent of targets above, within and below the RSZ (0-152.4 m AGL) during biological periods at Site 6 (February 2 - April 29, 2012). Darker colors indicate greater values.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average target passage rate above RSZ	4.1	7.2	17.1	30.5
Average target passage rate within RSZ	1.0	2.1	0.8	1.1
Average target passage rate below RSZ	0.0	0.1	0.1	0.0
Average % of targets in RSZ	23.1%	30.3%	9.0%	7.5%
Min target percentage within RSZ	0.0%	0.0%	0.0%	0.0%
Max target percentage within RSZ	100.0%	100.0%	100.0%	100.0%
All targets for season combined				
% targets above RSZ	79.7%	76.8%	95.4%	96.6%
% targets within RSZ	20.3%	22.6%	4.3%	3.4%
% targets below RSZ	0.0%	0.7%	0.3%	0.0%
% targets below turbine height	20.3%	23.2%	4.6%	3.4%

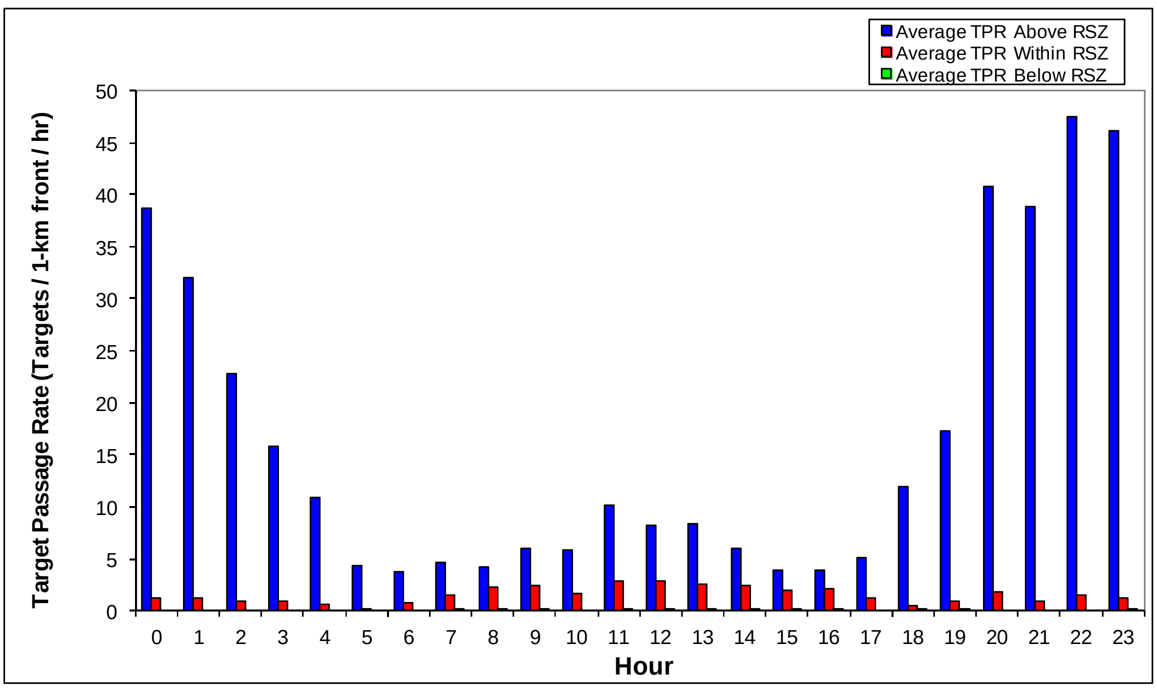

Figure 9-9. Average hourly target passage rates at Site 6 (February 2 - April 29, 2012).

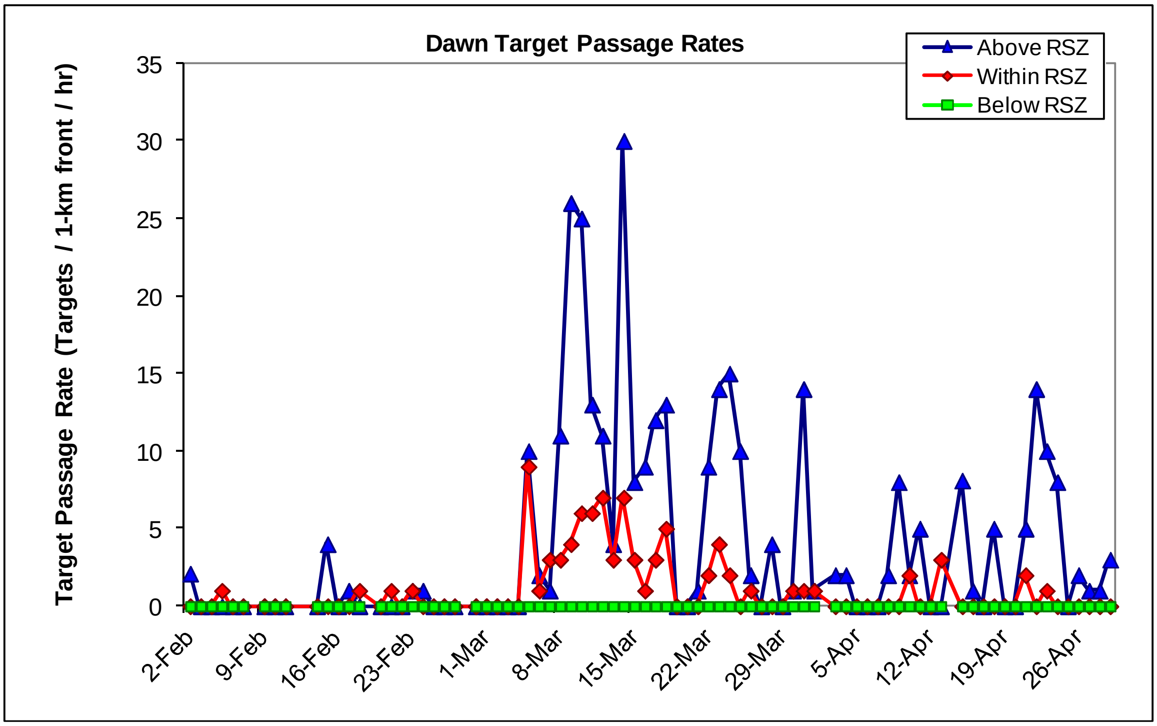

Figure 9-10. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dawns at Site 6 (February 2 - April 29, 2012).

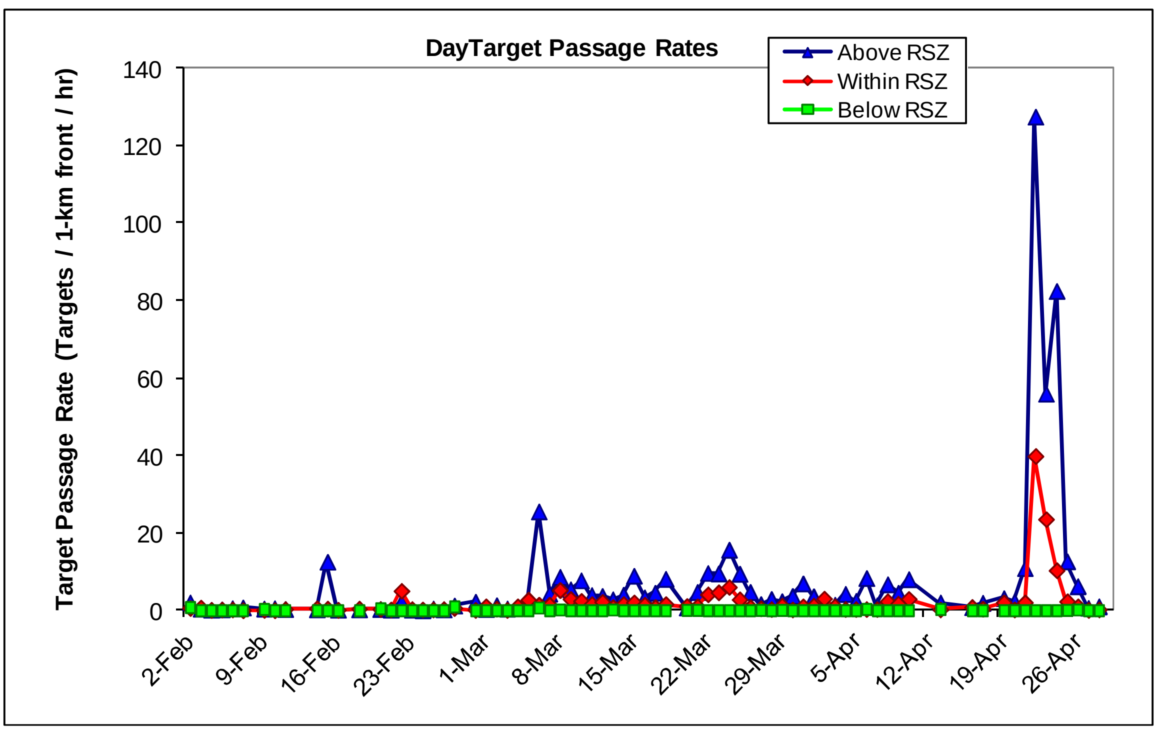

Figure 9-11. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during days at Site 6 (February 2 - April 29, 2012).

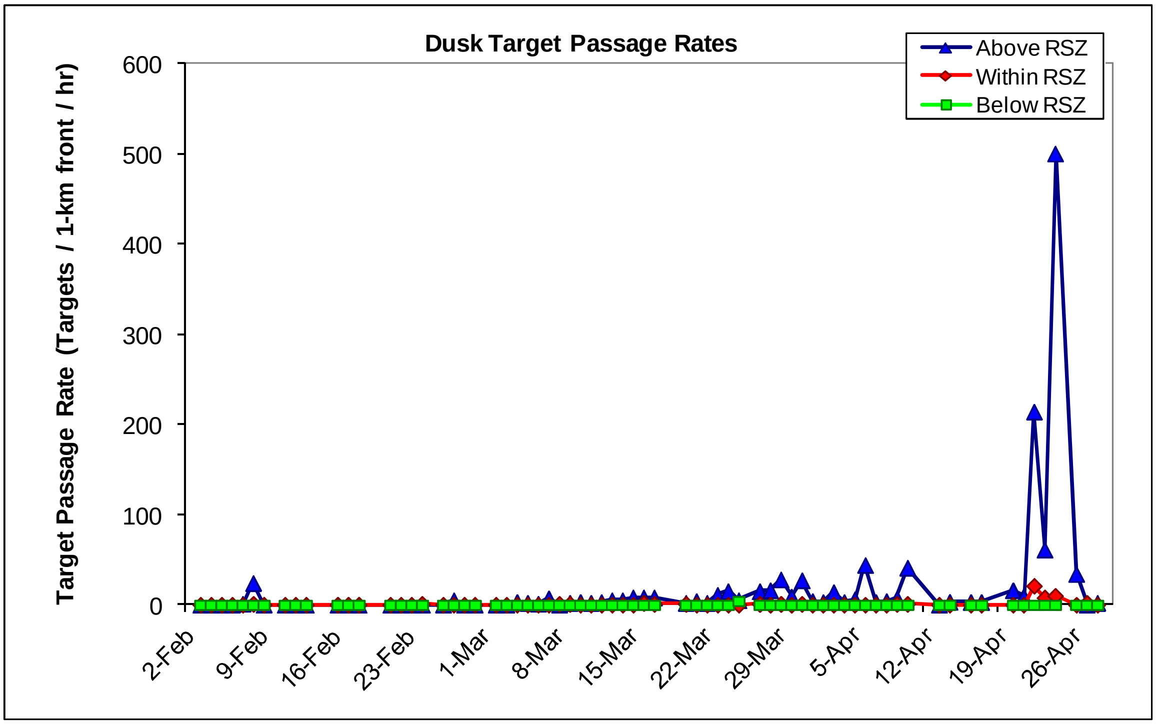

Figure 9-12. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dusks at Site 6 (February 2 - April 29, 2012).

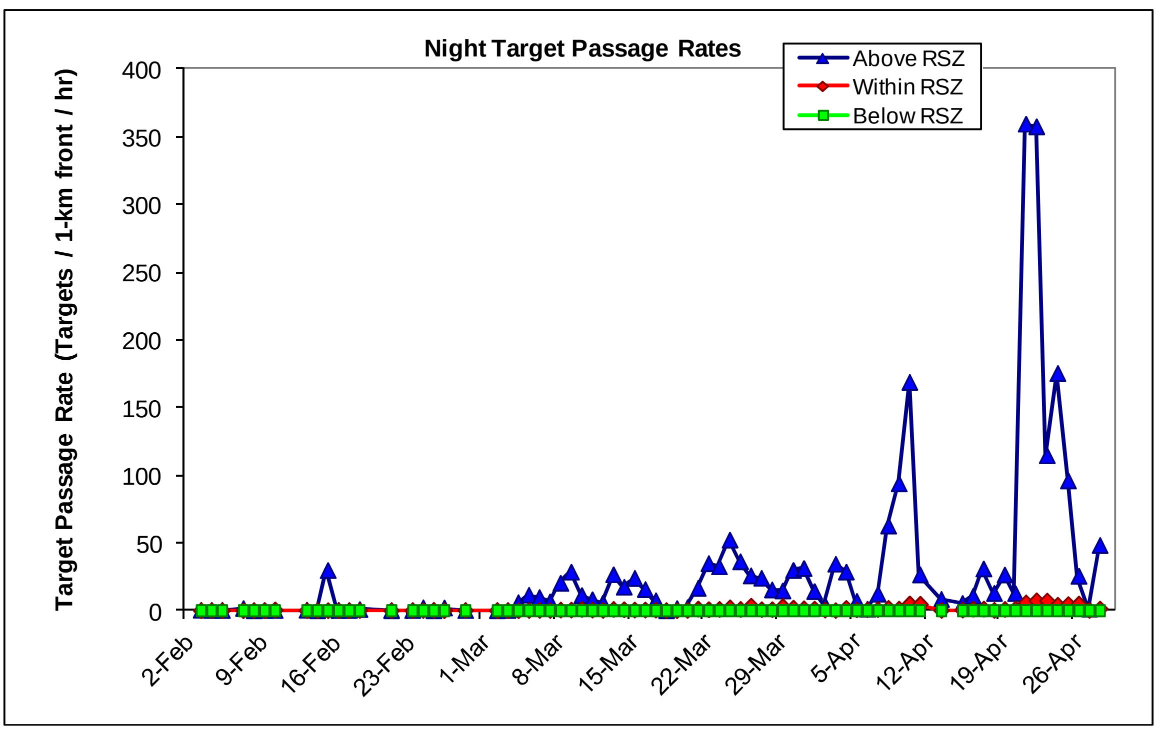

Figure 9-13. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during nights at Site 6 (February 2 - April 29, 2012).

9.3 Horizontal Radar Data

The Horizontal Surveillance Radar (HSR) was used to determine directional movements of targets during biological periods at Site 6 (February 2 - April 29, 2012).

9.3.1 Target Directions

Average target directions were calculated for each biological period (Fig. 9-14). Average target directions were also calculated seasonally (comprehensive distribution), with all targets detected at Site 6 (February 2 - April 29, 2012) combined together by biological period (Fig. 9-15) and hour (Fig. 9-16).

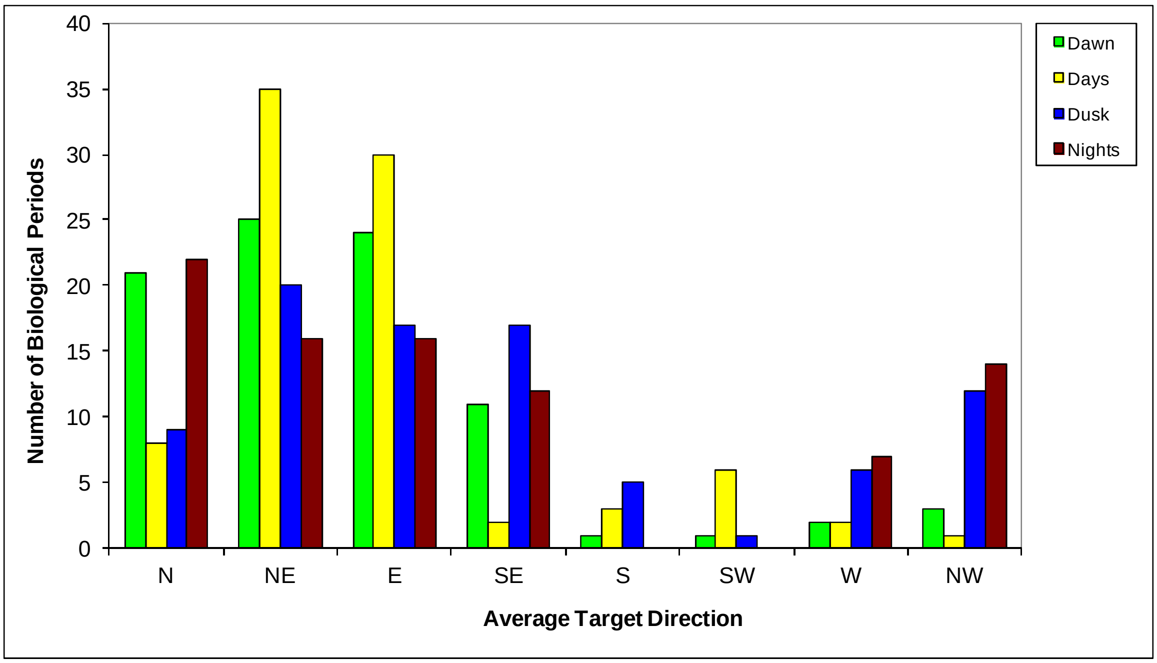

Figure 9-14. Distribution of average target movements among eight directions during dawns, days, dusks, and nights at Site 6 (February 2 - April 29, 2012).

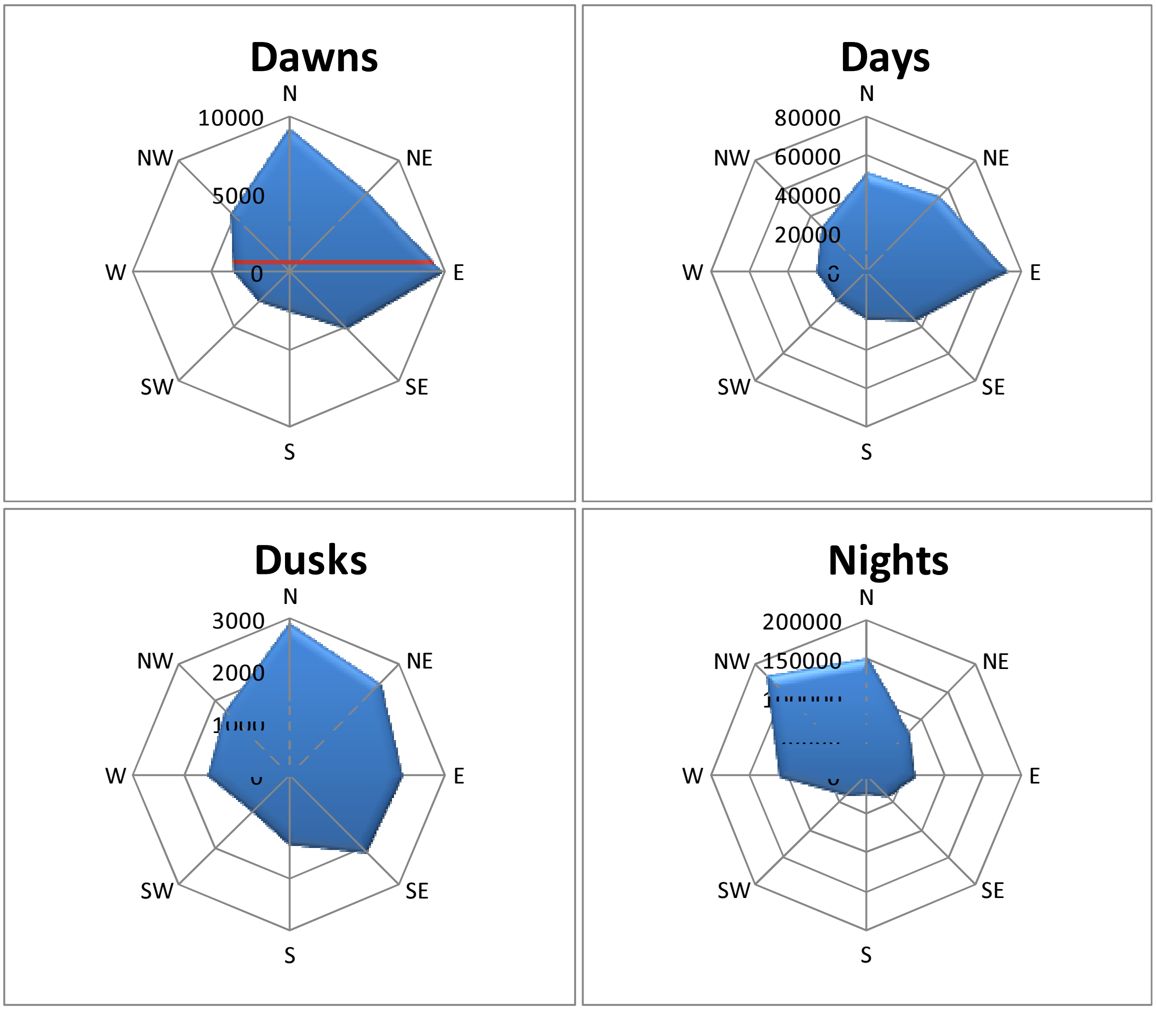

Figure 9-15. Comprehensive distribution of all target's directions during dawns, days, dusks, and nights at Site 6 (February 2 - April 29, 2012).

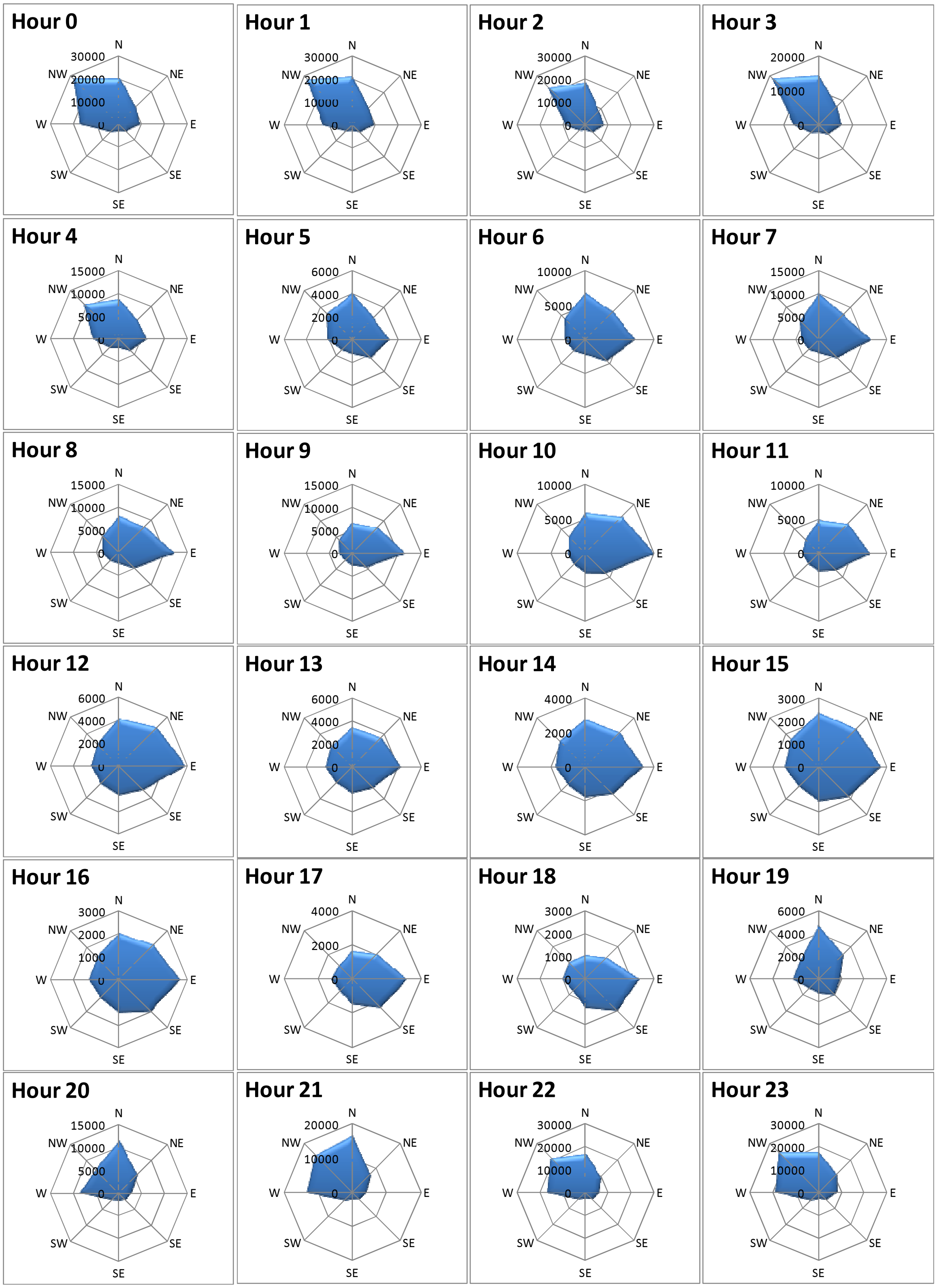

Figure 9-16. Comprehensive distribution of all target's directions by hour at Site 6 (February 2 - April 29, 2012).

10 RESULTS for Site 8 (May 19 – July 17, 2012)

10.1 Level of Effort

Table 10-1 presents available time, time radar data were collected, amount of radar data that were removed due to rain, high levels of insect activity, or other contamination, and the resulting time of radar data used for analyses, for Site 8 (May 19 - July 17, 2012).

Table 10-1. Radar monitoring effort at Site 8 (May 19 - July 17, 2012).

	Vertical Radar		Horizontal Radar	
	Hours	**%**	**Hours**	**%**
Time in season	1440.1		1440.1	
Time radar down	16.3	1.1%	16.2	1.1%
Time radar collected data	1423.8	98.9%	1423.9	98.9%
Unuseable radar data[1] due to rain or other contamination	215.8	15.2%	9.0	0.6%
Unuseable radar data[2] due to insects	294.3	20.7%	-	-
Useable radar data[3]	913.8	63.5%	1414.9	98.3%

1 - Percent indicates portion of time with radar data that was lost due to rain or other contamination.
2 - Percent indicates portion of time with radar data that was lost due to high insect activity.
3 - Percent indicates portion of season with useable radar data.

10.2 Vertical Radar Data

Data collected from the vertical scanning radar (VSR) were used to quantify target activity and heights.

10.2.1 Target Passage Rates Over Time

Data is presented as a rate equaling total number of targets / 1-km front / hr for each biological period (Fig. 10-1) and as an average by biological period (Fig. 10-2) and hour (Fig. 10-3). Summary statistics are presented in table 10-2.

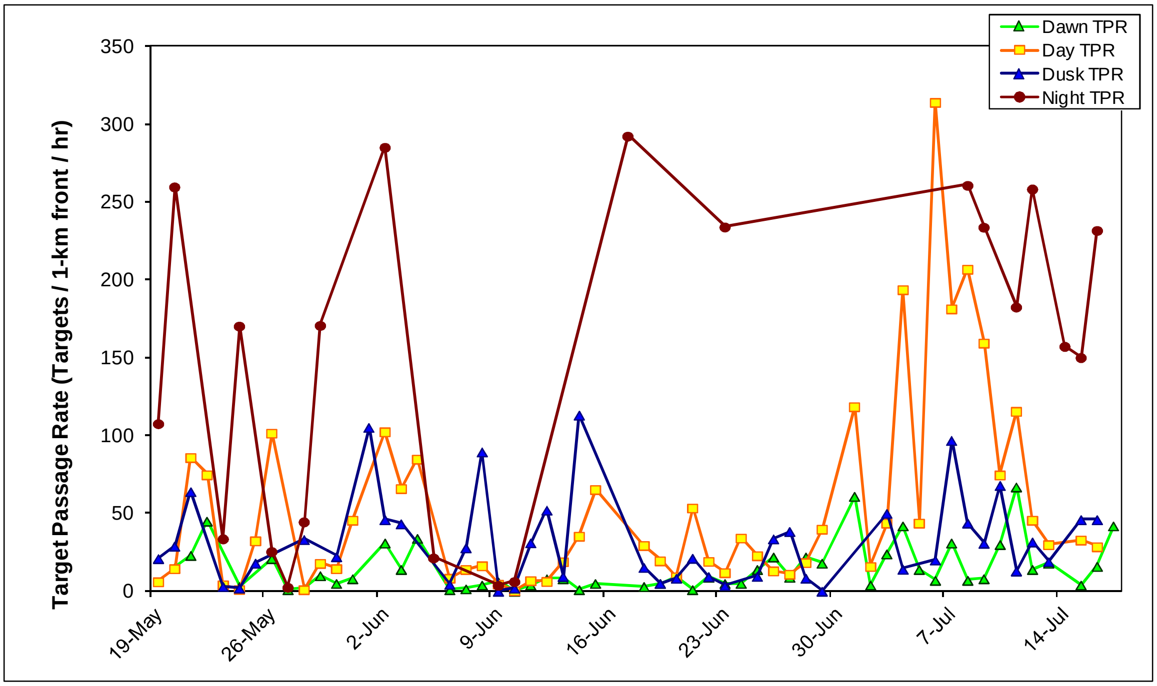

Figure 10-1. Target passage rates (TPR) during biological periods at Site 8 (May 19 - July 17, 2012).

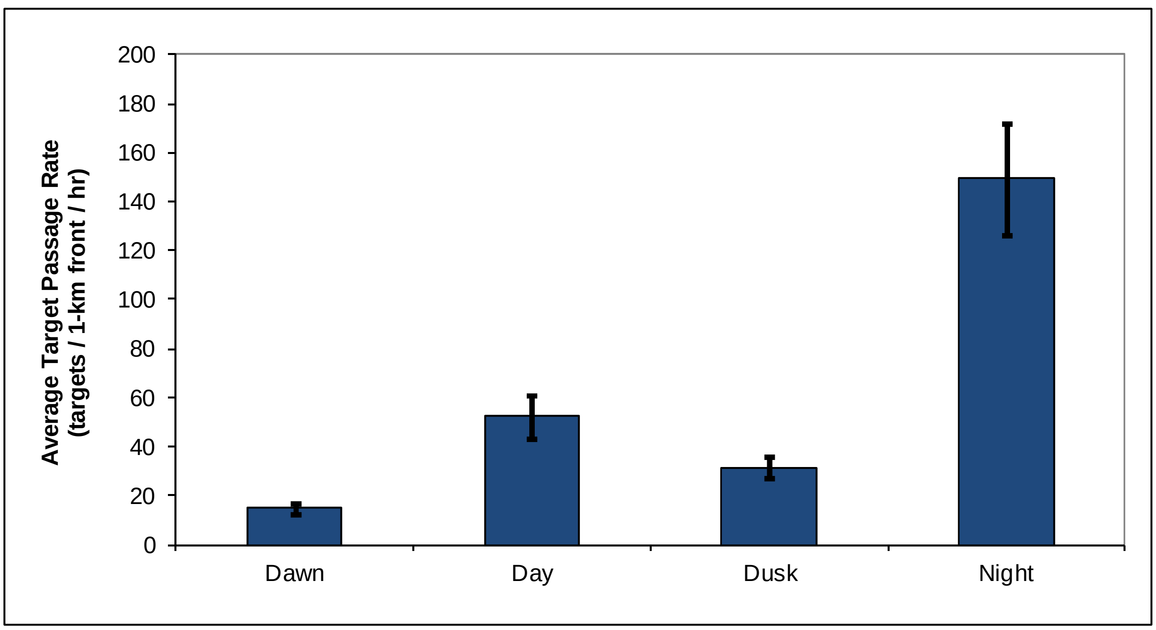

Figure 10-2. Average target passage rates (TPR) by biological period at Site 8 (May 19 - July 17, 2012). Error bars represent one standard error.

Table 10-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for biological periods at Site 8 (May 19 - July 17, 2012).

	Dawn	Day	Dusk	Night
Average	14.9	52.3	31.4	149.2
Standard Deviation	15.3	62.9	28.8	104.8
Standard Error	2.1	8.7	4.4	22.9
Median	9.0	29.7	22.2	170.4
Minimum	0.0	0.3	0.0	2.5
Maximum	67.0	314.2	113.2	292.5

Both average and comprehensive hourly target passage rates are presented in Fig 10-3: average rates are the average of each date's hourly target rate in a given hour, while comprehensive rates use targets grouped by hour, regardless of date.

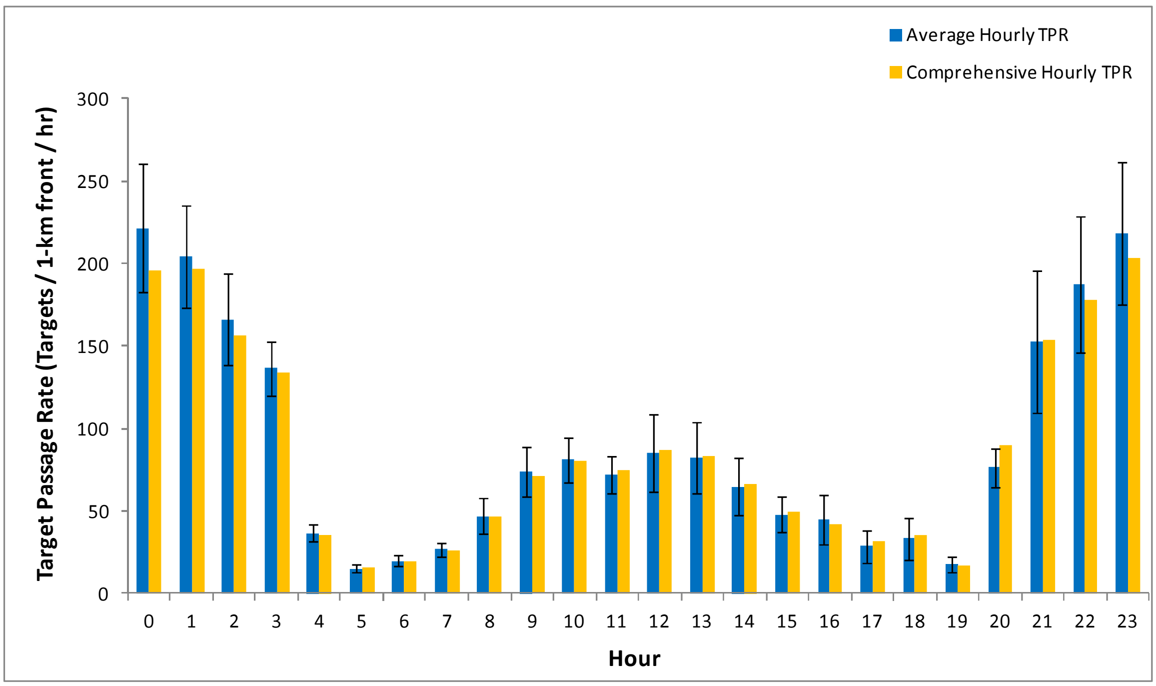

Figure 10-3. Average and comprehensive hourly target passage rates at Site 8 (May 19 - July 17, 2012). Error bars represent one standard error.

10.2.2 Altitudinal Distribution of Targets

Mean and median target heights are presented for each biological period (Fig. 10-4 and Fig. 10-5, respectively) at Site 8 (May 19 - July 17, 2012).

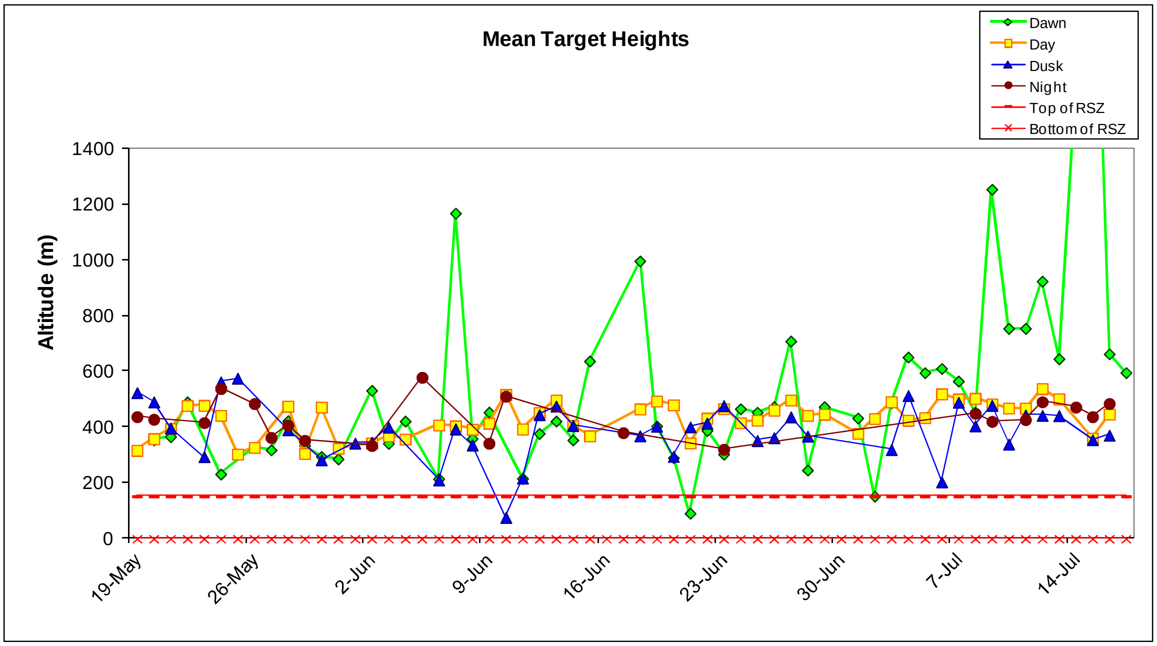

Figure 10-4. Mean target heights at Site 8 (May 19 - July 17, 2012). Red lines represent top and bottom of the RSZ (0-152.4 m AGL). July 15th dawn value is 2,610 m.

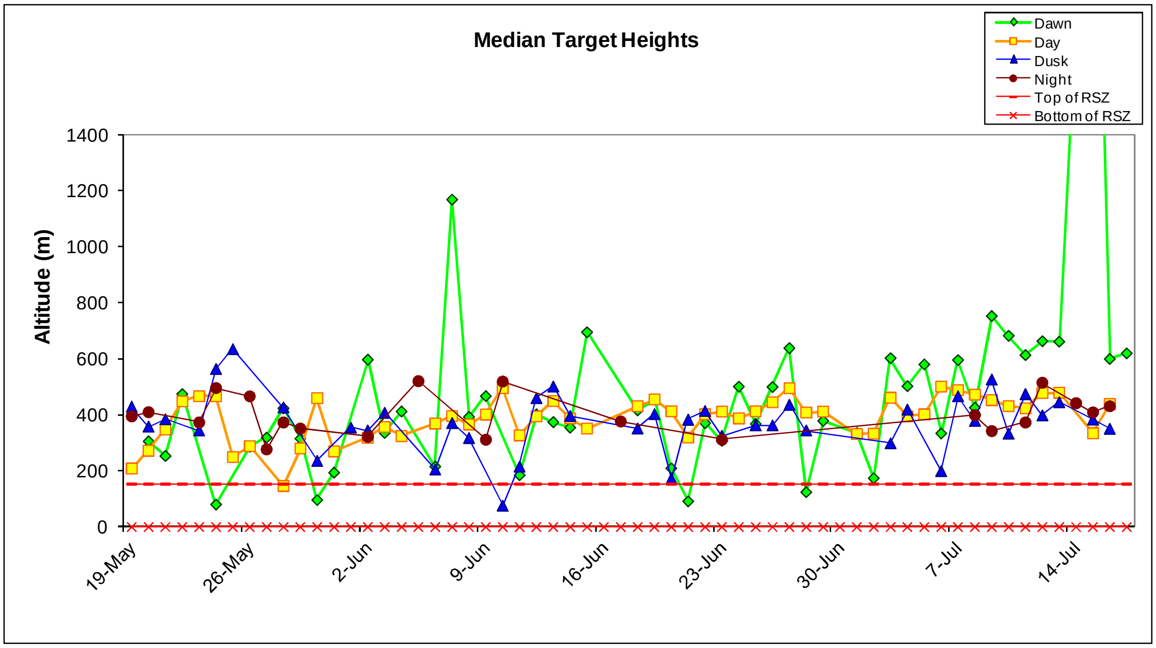

Figure 10-5. Median target heights at Site 8 (May 19 - July 17, 2012). Red lines represent top and bottom of the RSZ (0-152.4 m AGL). July 15th dawn value is 3,018 m.

The mean and median target heights during each biological period were calculated for all dates with ≥ 50% data for that time period, averaged into a grand mean and average median, and presented in Table 10-3 (top) and illustrated in Figure 10-6 (blue bars). The comprehensive mean and median target heights for each biological period (when all targets were combined regardless of date) are also listed in Table 10-3 (bottom) and illustrated in Figure 10-6 (green bars).

Table 10-3. Summary of mean and median target heights during biological periods at Site 8 (May 19 - July 17, 2012). Darker colors in color-coded rows indicate greater values within that row.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Grand mean target height	527.7	429.4	386.6	432.5
Average median target height	477.0	389.3	371.7	400.4
All targets for season combined				
Comprehensive mean target height	538.2	445.9	388.3	425.5
Comprehensive median target height	470.9	416.1	369.6	398.1

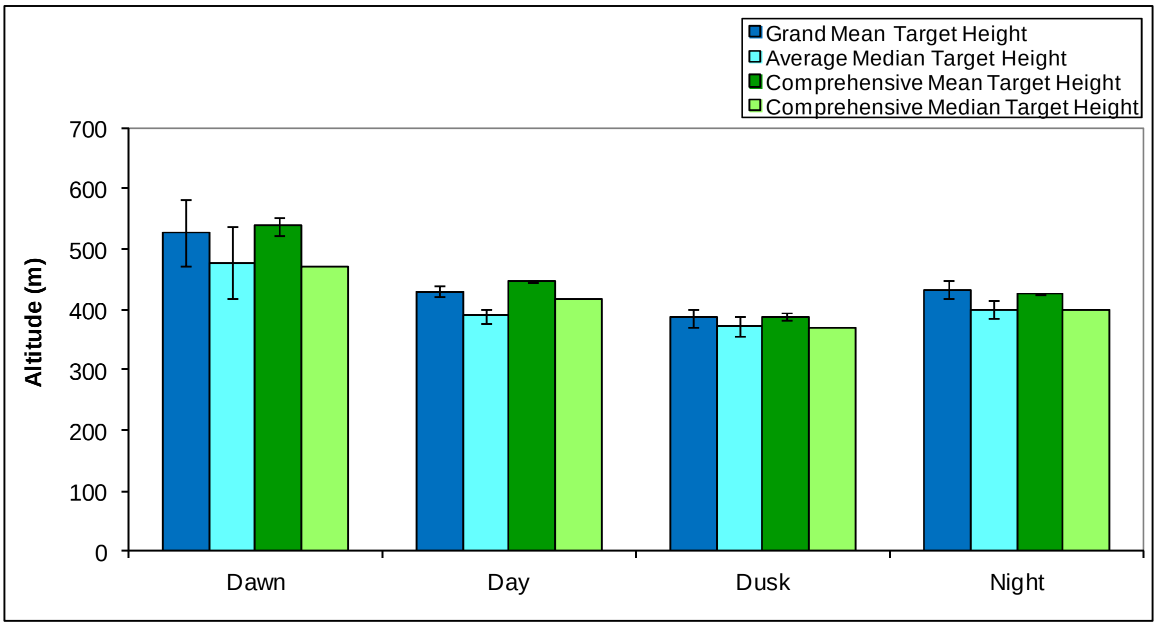

Figure 10-6. Grand mean and average median target heights averaged across individual biological periods (blue bars), and comprehensive mean and median target heights of all targets grouped by biological period (green bars), at Site 8 (May 19 - July 17, 2012). Error bars represent one standard error.

Hourly target heights were averaged into a grand hourly target mean and an average hourly target median for each of 24 hours; a comprehensive hourly target mean was also calculated by pooling all targets within a given hour together, regardless of date (Fig. 10-7).

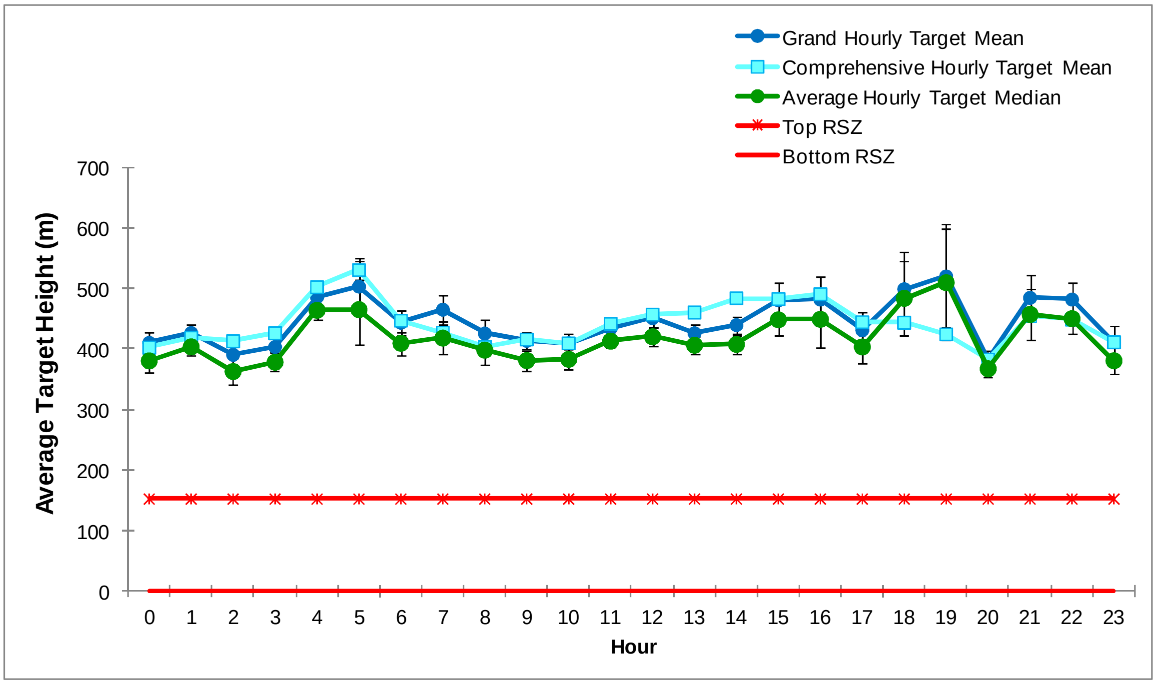

Figure 10-7. Hourly target heights at Site 8 (May 19 - July 17, 2012). Error bars represent one standard error. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

The distribution of all targets detected during dawns, days, dusks, and nights at Site 8 (May 19 - July 17, 2012) are shown using 50-meter increments (Fig. 10-8).

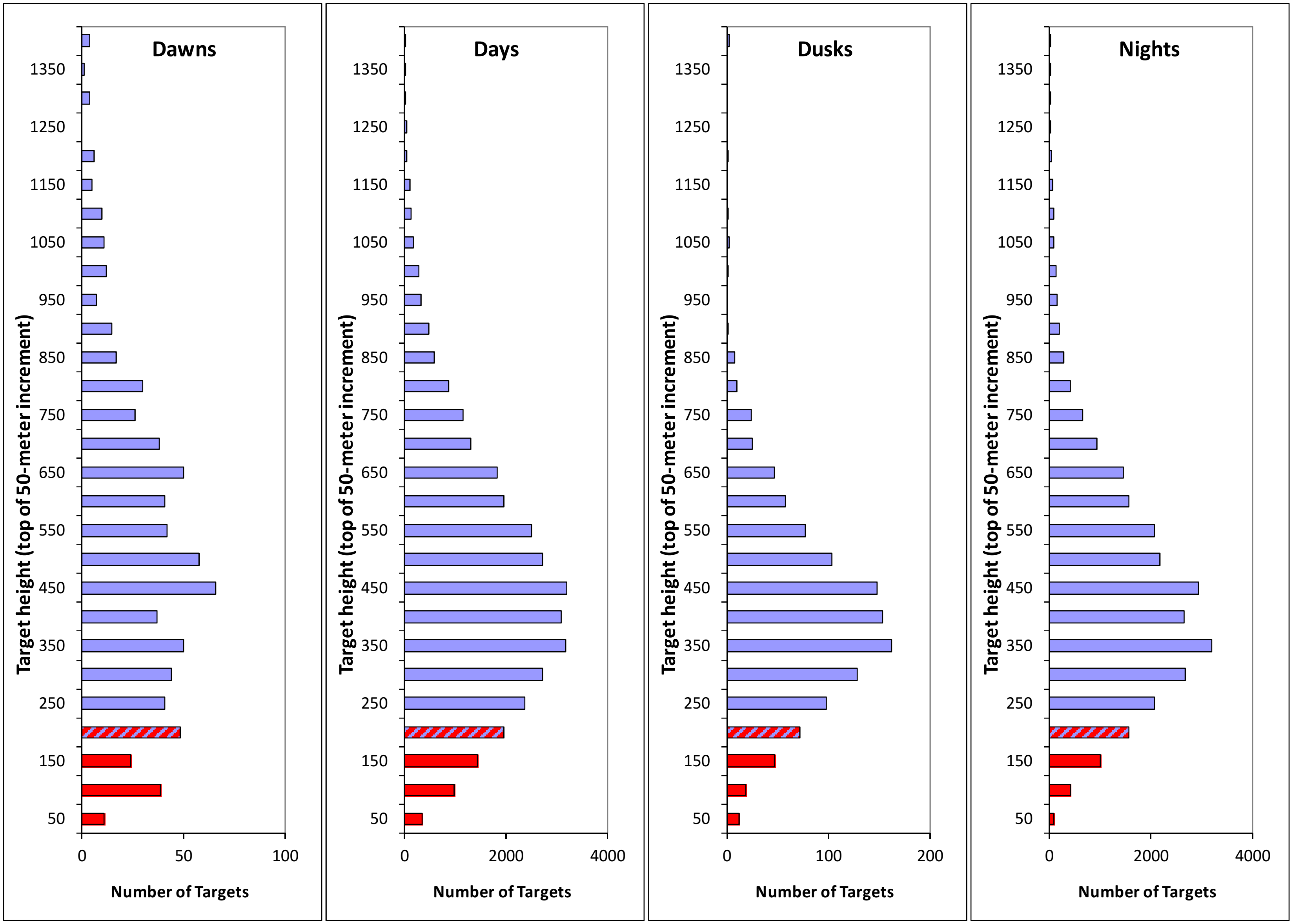

Figure 10-8. Number of targets occurring in each 50-meter increment during biological periods at Site 8 (May 19 - July 17, 2012). Red indicates rotor swept heights, and red-blue hashed indicates altitudes partially within rotor swept heights.

Using a RSZ of 0-152.4 m AGL, target passage rates below, within, and above the RSZ were calculated for each date. Individual target passage rates are presented for dawns (Fig. 10-10) days (Fig. 10-11), dusks (Fig 10-12), and nights (Fig. 10-13). Percent targets below, within, and above the RSZ were also calculated seasonally, with all targets detected during each biological period at Site 8 (May 19 - July 17, 2012) combined together (Table 10-4, bottom). Average hourly target passage rates below, within, and above the rotor swept zone are also given (Fig. 10-9).

Table 10-4. Summary of target passage rates and percent of targets above, within and below the RSZ (0-152.4 m AGL) during biological periods at Site 8 (May 19 - July 17, 2012). Darker colors indicate greater values.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average target passage rate above RSZ	13.5	47.6	29.4	140.1
Average target passage rate within RSZ	1.5	4.7	2.0	9.1
Average target passage rate below RSZ	0.0	0.0	0.0	0.0
Average % of targets in RSZ	15.5%	12.2%	9.7%	6.7%
Min target percentage within RSZ	0.0%	1.8%	0.0%	1.1%
Max target percentage within RSZ	100.0%	53.8%	100.0%	23.8%
All targets for season combined				
% targets above RSZ	90.1%	91.5%	93.5%	93.9%
% targets within RSZ	9.9%	8.5%	6.5%	6.1%
% targets below RSZ	0.0%	0.0%	0.0%	0.0%
% targets below turbine height	9.9%	8.5%	6.5%	6.1%

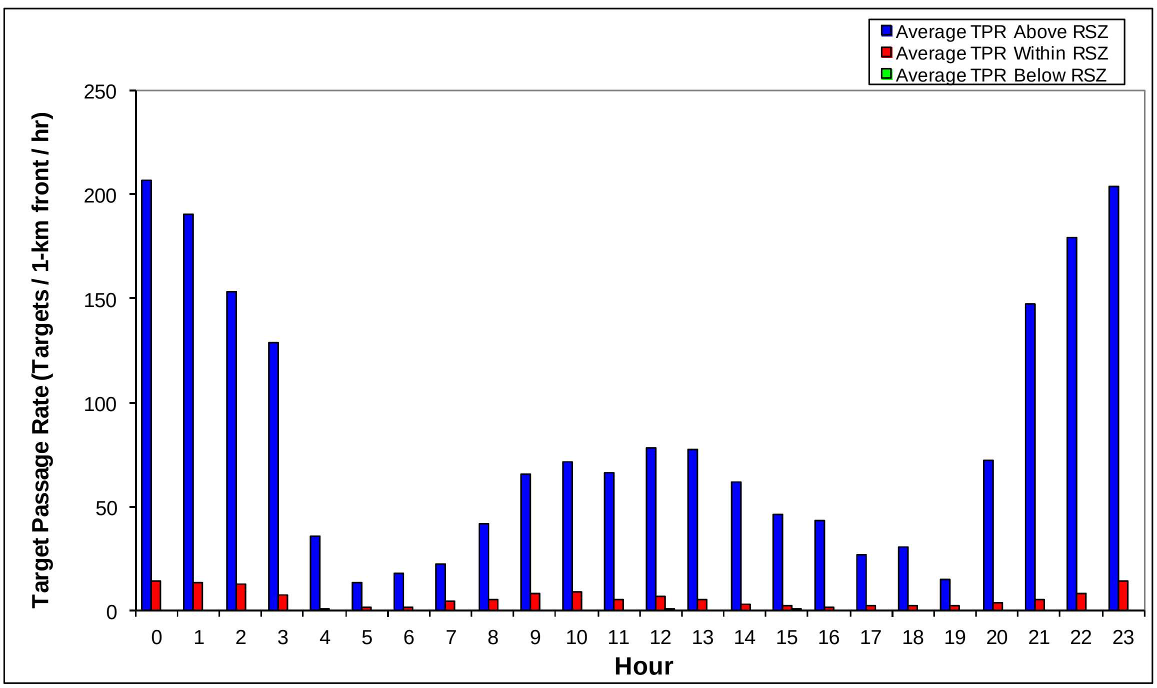

Figure 10-9. Average hourly target passage rates at Site 8 (May 19 - July 17, 2012).

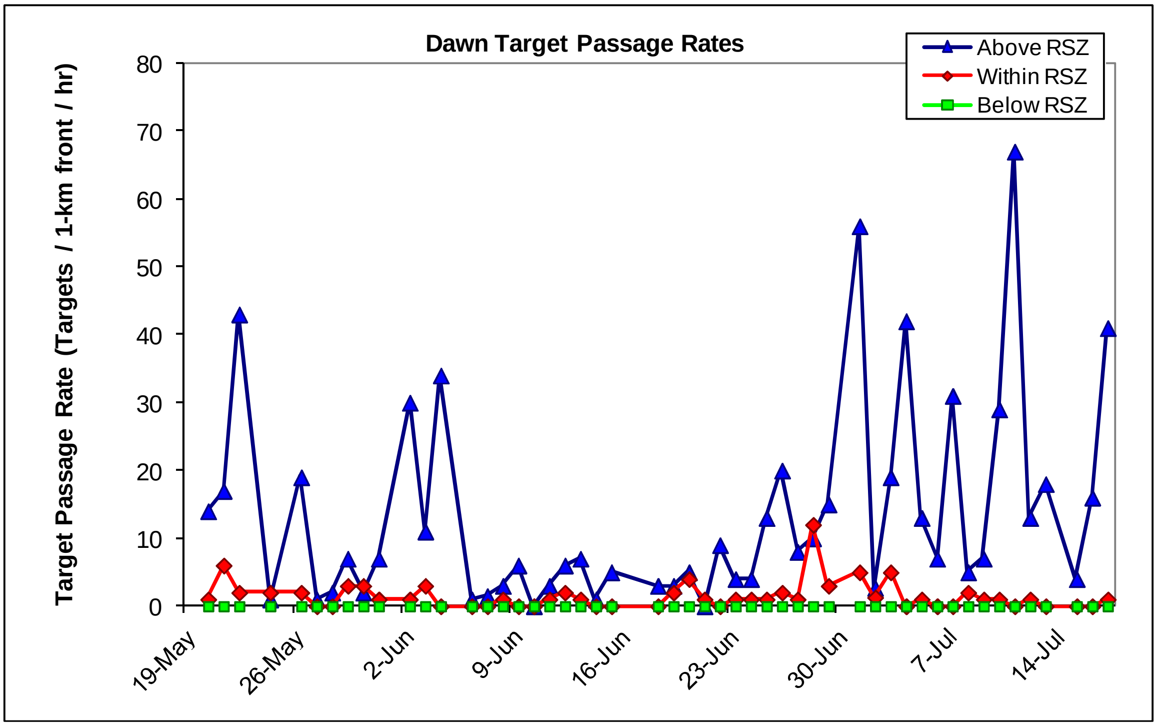

Figure 10-10. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dawns at Site 8 (May 19 - July 17, 2012).

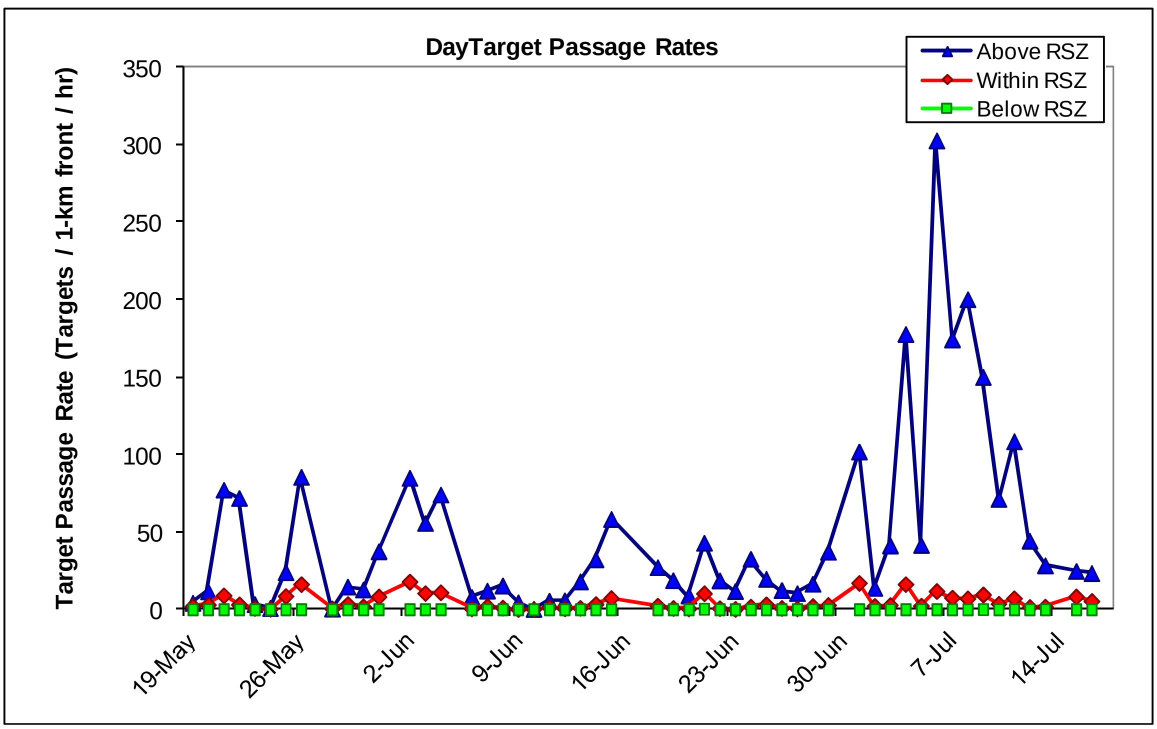

Figure 10-11. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during days at Site 8 (May 19 - July 17, 2012).

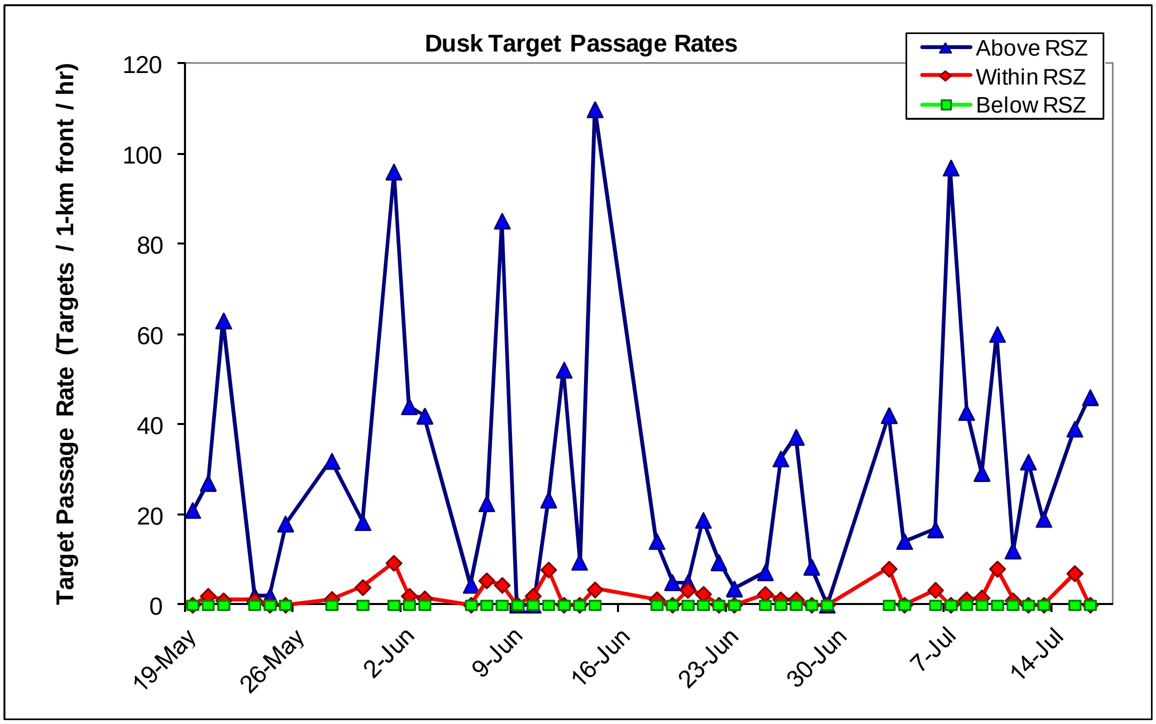

Figure 10-12. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dusks at Site 8 (May 19 - July 17, 2012).

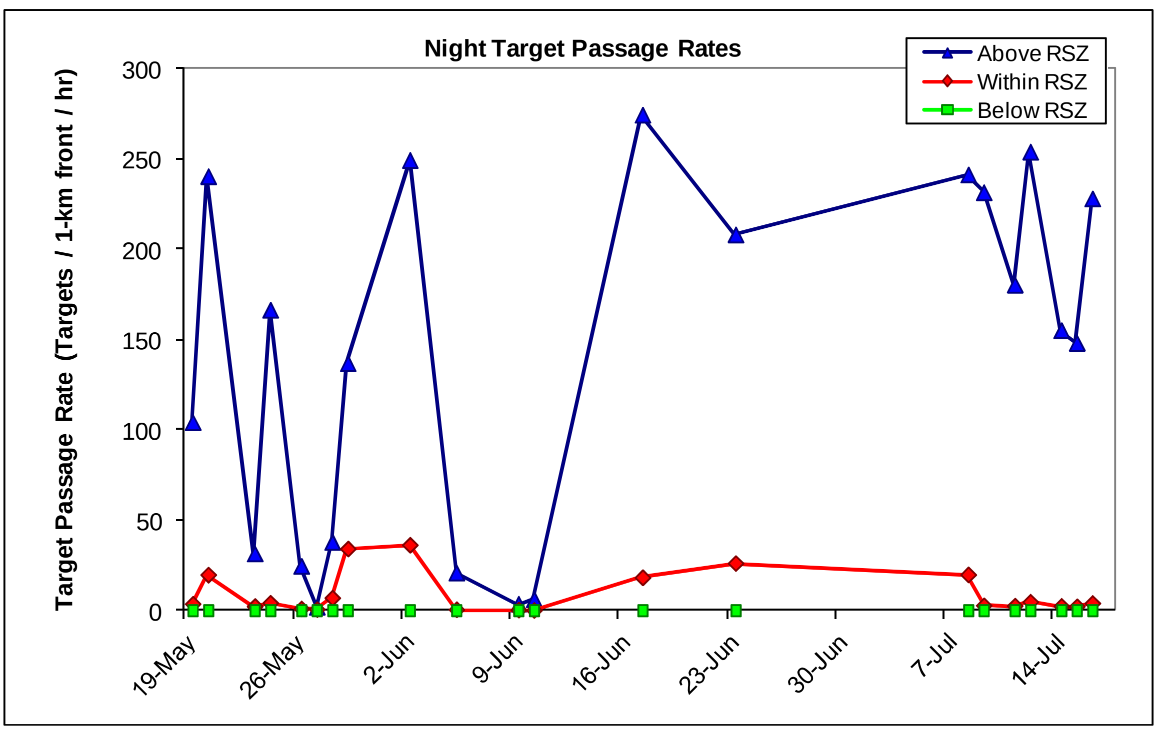

Figure 10-13. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during nights at Site 8 (May 19 - July 17, 2012).

10.3 Horizontal Radar Data

The Horizontal Surveillance Radar (HSR) was used to determine directional movements of targets during biological periods at Site 8 (May 19 - July 17, 2012).

10.3.1 Target Directions

Average target directions were calculated for each biological period (Fig. 10-14). Average target directions were also calculated seasonally (comprehensive distribution), with all targets detected at Site 8 (May 19 - July 17, 2012) combined together by biological period (Fig. 10-15) and hour (Fig. 10-16).

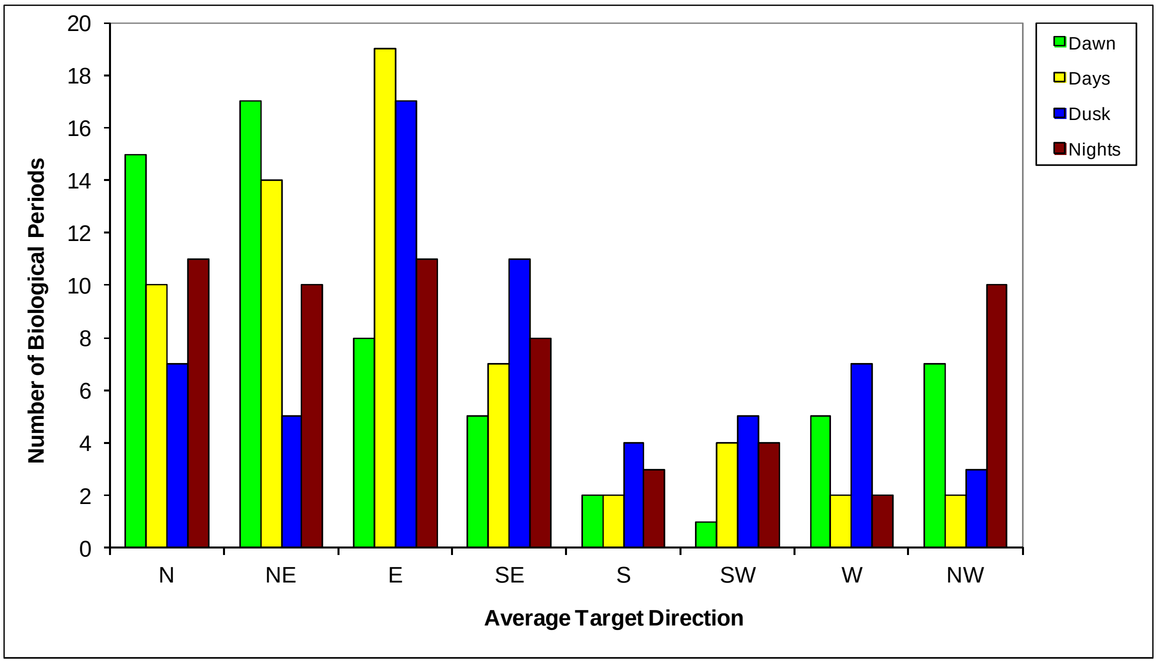

Figure 10-14. Distribution of average target movements among eight directions during dawns, days, dusks, and nights at Site 8 (May 19 - July 17, 2012).

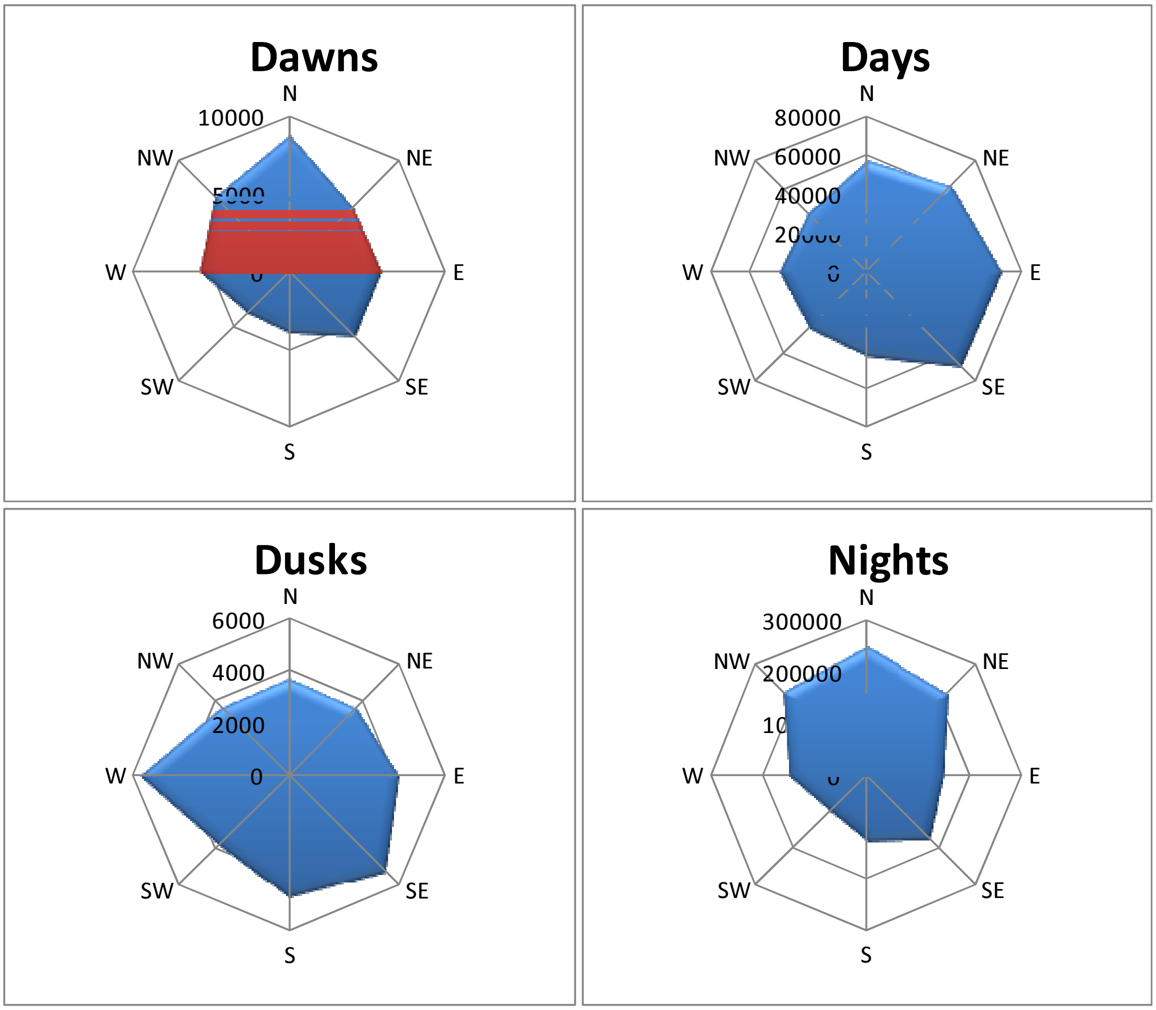

Figure 10-15. Comprehensive distribution of all target's directions during dawns, days, dusks, and nights at Site 8 (May 19 - July 17, 2012).

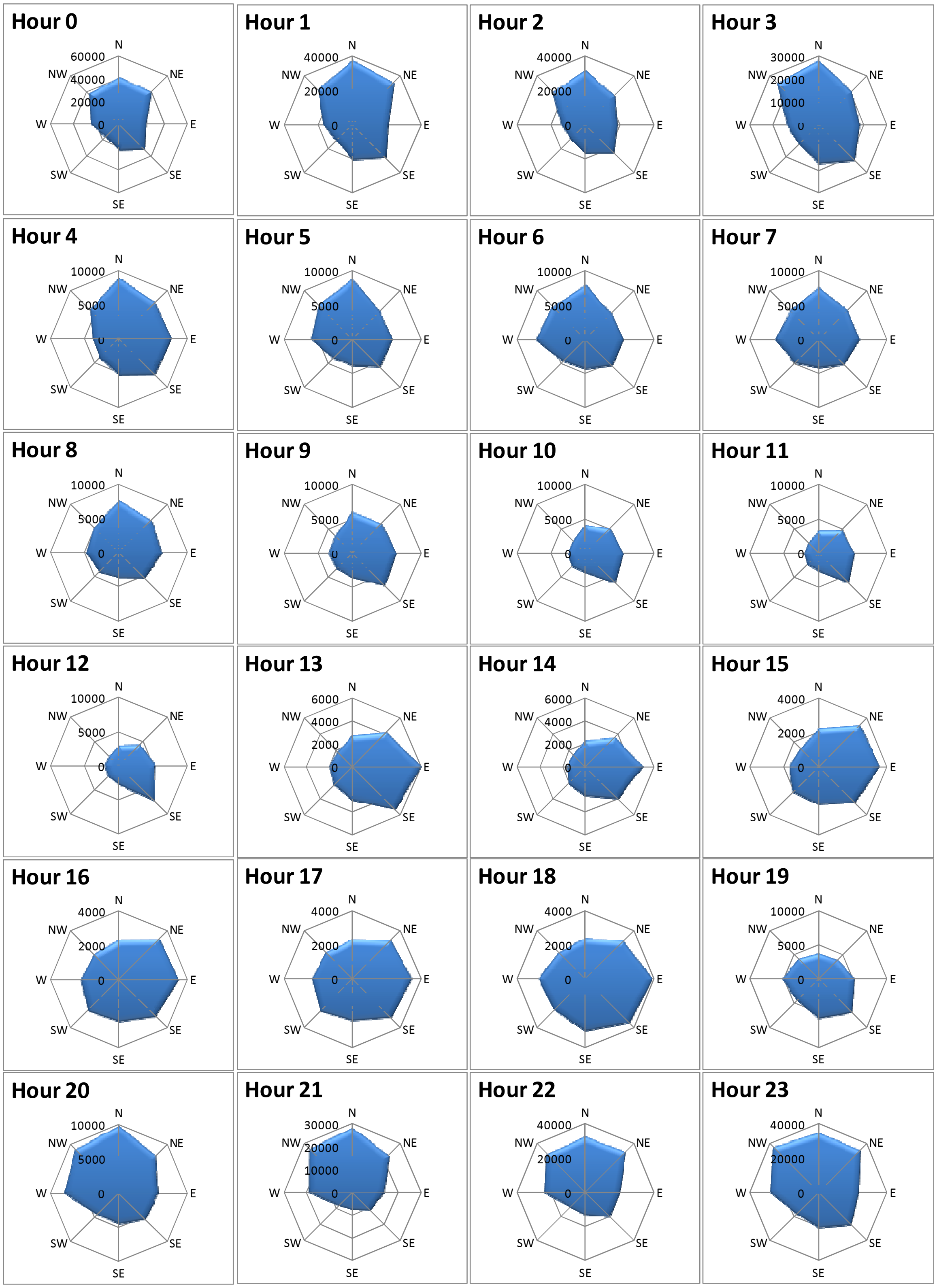

Figure 10-16. Comprehensive distribution of all target's directions by hour at Site 8 (May 19 - July 17, 2012).

11 RESULTS for Site 9 (July 21 – September 29, 2012)

11.1 Level of Effort

Table 11-1 presents available time, time radar data were collected, amount of radar data that were removed due to rain, high levels of insect activity, or other contamination, and the resulting time of radar data used for analyses, for Site 9 (July 21 - September 29, 2012).

Table 11-1. Radar monitoring effort at Site 9 (July 21 - September 29, 2012).

	Vertical Radar		Horizontal Radar	
	Hours	**%**	**Hours**	**%**
Time in season	1705.0		1705.0	
Time radar down	20.0	1.2%	19.9	1.2%
Time radar collected data	1685.0	98.8%	1685.1	98.8%
Unuseable radar data[1] due to rain or other contamination	141.8	8.4%	20.0	1.2%
Unuseable radar data[2] due to insects	33.0	2.0%	-	-
Useable radar data[3]	1510.3	88.6%	1665.1	97.7%

1 - Percent indicates portion of time w ith radar data that w as lost due to rain or other contamination.
2 - Percent indicates portion of time w ith radar data that w as lost due to high insect activity.
3 - Percent indicates portion of season w ith useable radar data.

11.2 Vertical Radar Data

Data collected from the vertical scanning radar (VSR) were used to quantify target activity and heights.

11.2.1 Target Passage Rates Over Time

Data is presented as a rate equaling total number of targets / 1-km front / hr for each biological period (Fig. 11-1) and as an average by biological period (Fig. 11-2) and hour (Fig. 11-3). Summary statistics are presented in table 11-2.

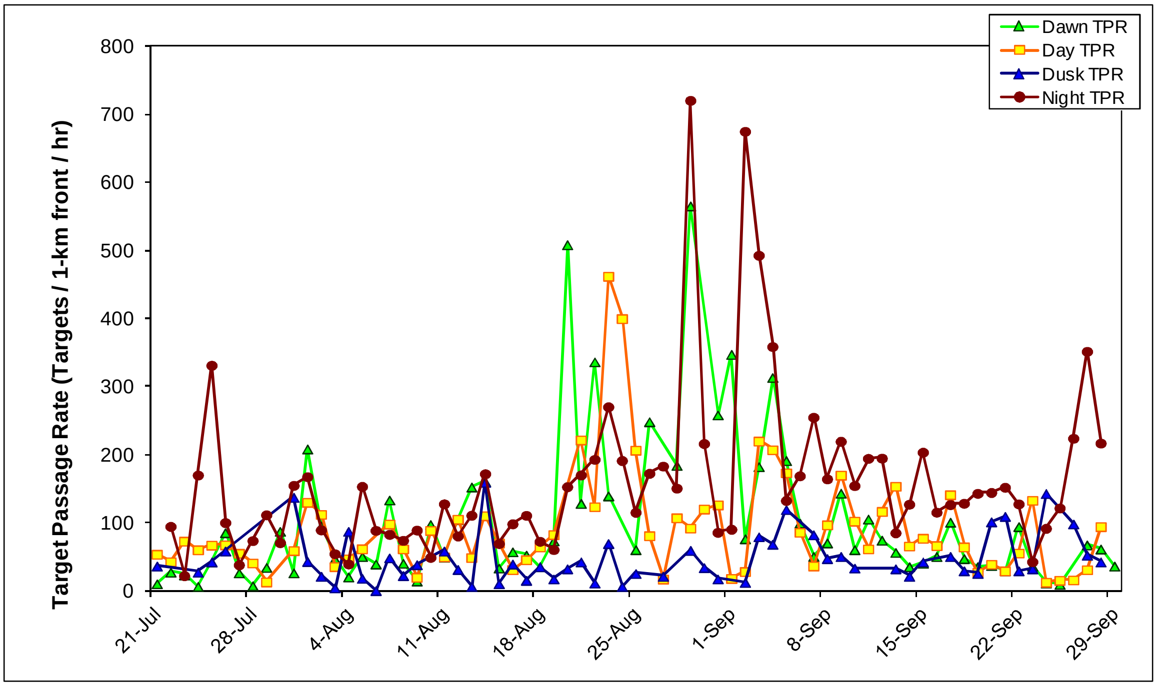

Figure 11-1. Target passage rates (TPR) during biological periods at Site 9 (July 21 - September 29, 2012).

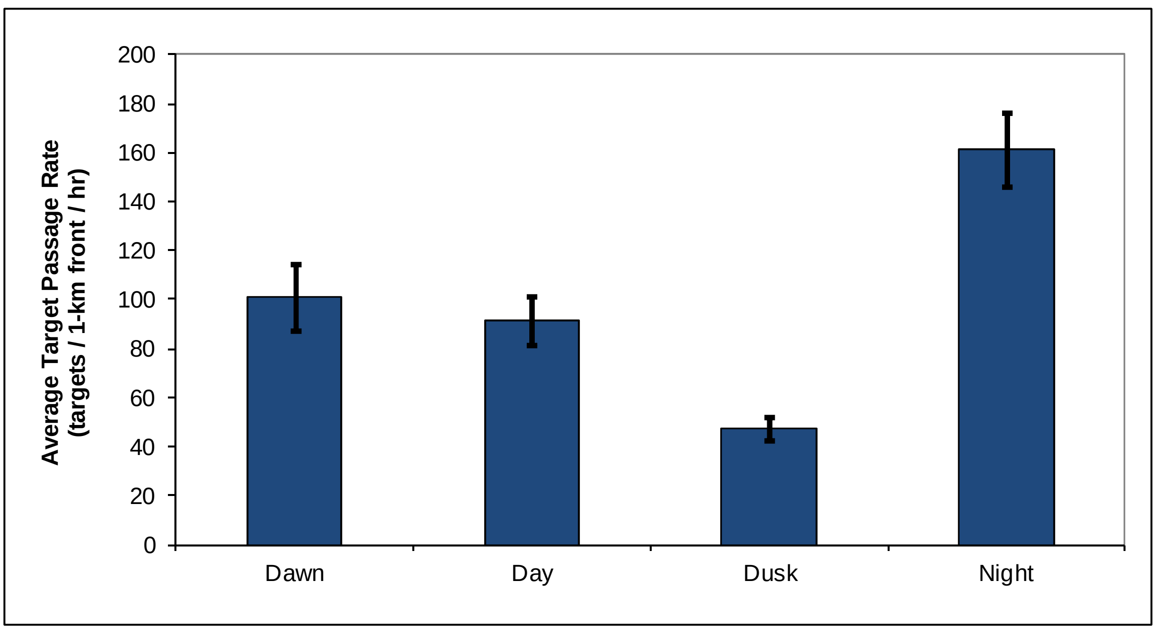

Figure 11-2. Average target passage rates (TPR) by biological period at Site 9 (July 21 - September 29, 2012). Error bars represent one standard error.

Table 11-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for biological periods at Site 9 (July 21 - September 29, 2012).

	Dawn	Day	Dusk	Night
Average	101.1	91.5	47.6	161.4
Standard Deviation	110.0	79.3	36.2	124.4
Standard Error	13.4	9.7	4.9	15.0
Median	61.0	67.6	37.0	129.2
Minimum	7.0	13.2	1.0	23.0
Maximum	566.0	462.8	160.0	721.1

Both average and comprehensive hourly target passage rates are presented in Fig 11-3: average rates are the average of each date's hourly target rate in a given hour, while comprehensive rates use targets grouped by hour, regardless of date.

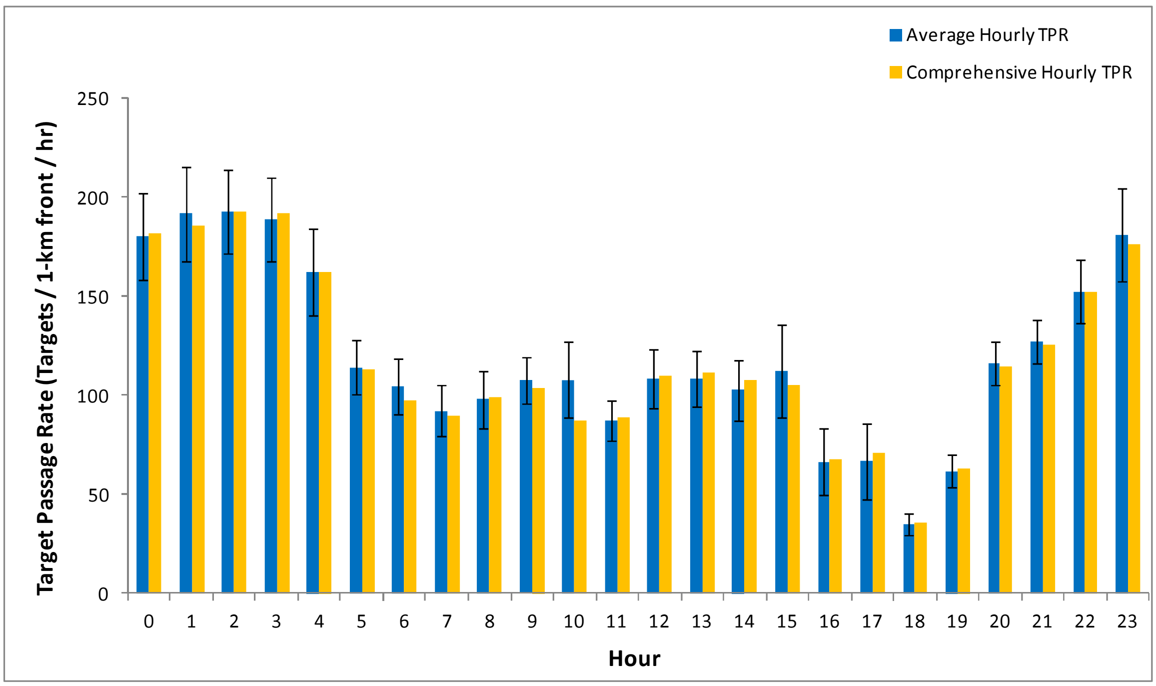

Figure 11-3. Average and comprehensive hourly target passage rates at Site 9 (July 21 - September 29, 2012). Error bars represent one standard error.

11.2.2 Altitudinal Distribution of Targets

Mean and median target heights are presented for each biological period (Fig. 11-4 and Fig. 11-5, respectively) at Site 9 (July 21 - September 29, 2012).

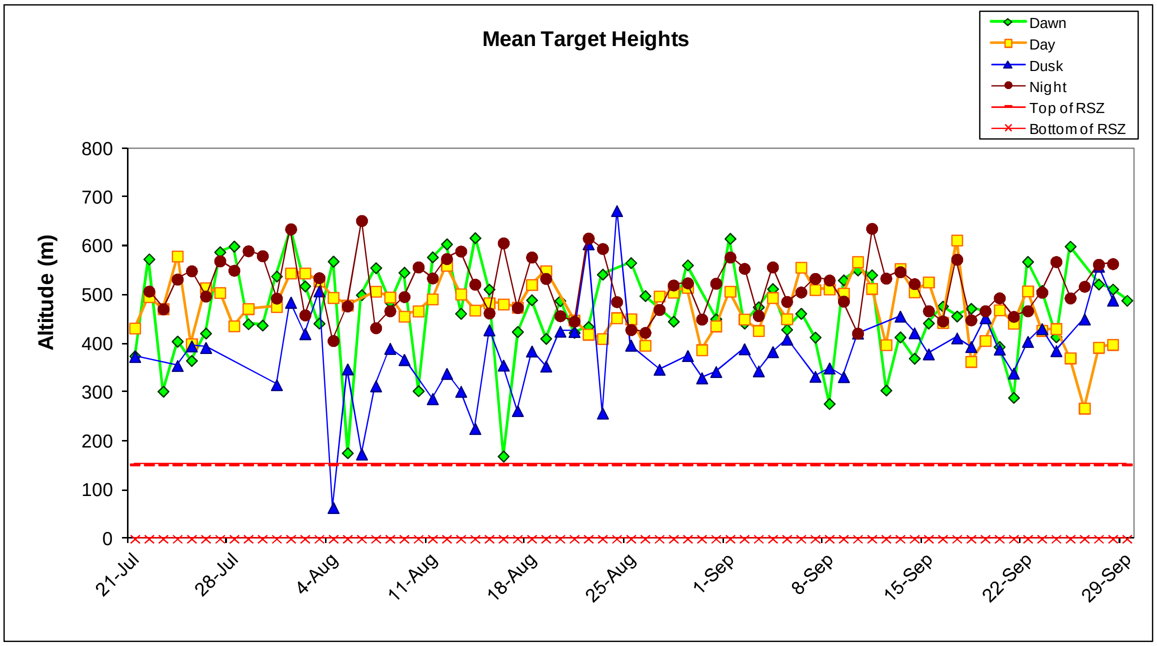

Figure 11-4. Mean target heights at Site 9 (July 21 - September 29, 2012). Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

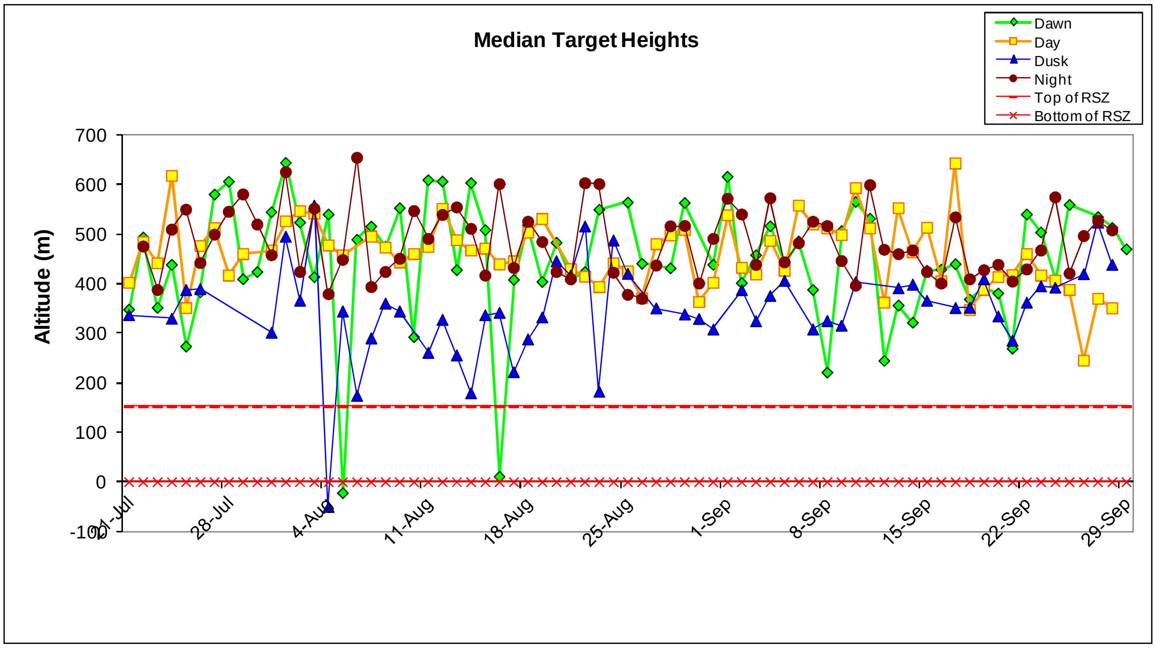

Figure 11-5. Median target heights at Site 9 (July 21 - September 29, 2012). Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

The mean and median target heights during each biological period were calculated for all dates with ≥ 50% data for that time period, averaged into a grand mean and average median, and presented in Table 11-3 (top) and illustrated in Figure 11-6 (blue bars). The comprehensive mean and median target heights for each biological period (when all targets were combined regardless of date) are also listed in Table 11-3 (bottom) and illustrated in Figure 11-6 (green bars).

Table 11-3. Summary of mean and median target heights during biological periods at Site 9 (July 21 - September 29, 2012). Darker colors in color-coded rows indicate greater values within that row.

Target data calculated for each date				
Grand mean target height	468.9	474.2	380.8	516.9
Average median target height	446.4	458.9	349.1	483.1
All targets for season combined				
Comprehensive mean target height	492.1	474.6	358.8	520.0
Comprehensive median target height	494.1	459.3	338.3	489.8

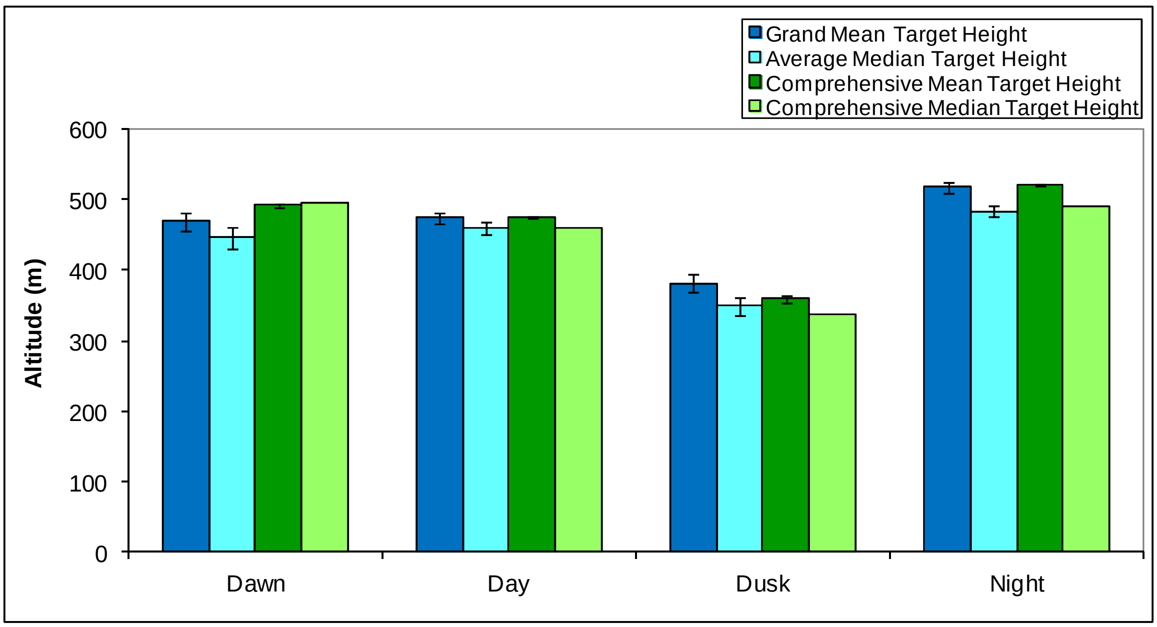

Figure 11-6. Grand mean and average median target heights averaged across individual biological periods (blue bars), and comprehensive mean and median target heights of all targets grouped by biological period (green bars), at Site 9 (July 21 - September 29, 2012). Error bars represent one standard error.

Hourly target heights were averaged into a grand hourly target mean and an average hourly target median for each of 24 hours; a comprehensive hourly target mean was also calculated by pooling all targets within a given hour together, regardless of date (Fig. 11-7).

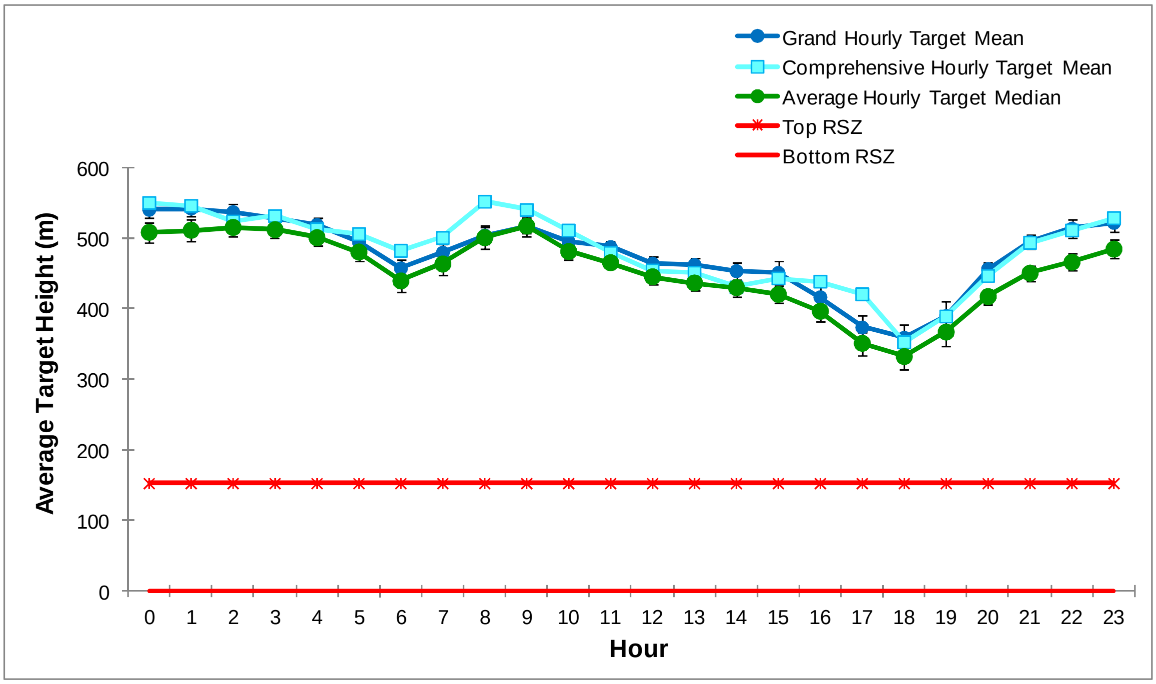

Figure 11-7. Hourly target heights at Site 9 (July 21 - September 29, 2012). Error bars represent one standard error. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

The distribution of all targets detected during dawns, days, dusks, and nights at Site 9 (July 21 - September 29, 2012) are shown using 50-meter increments (Fig. 11-8).

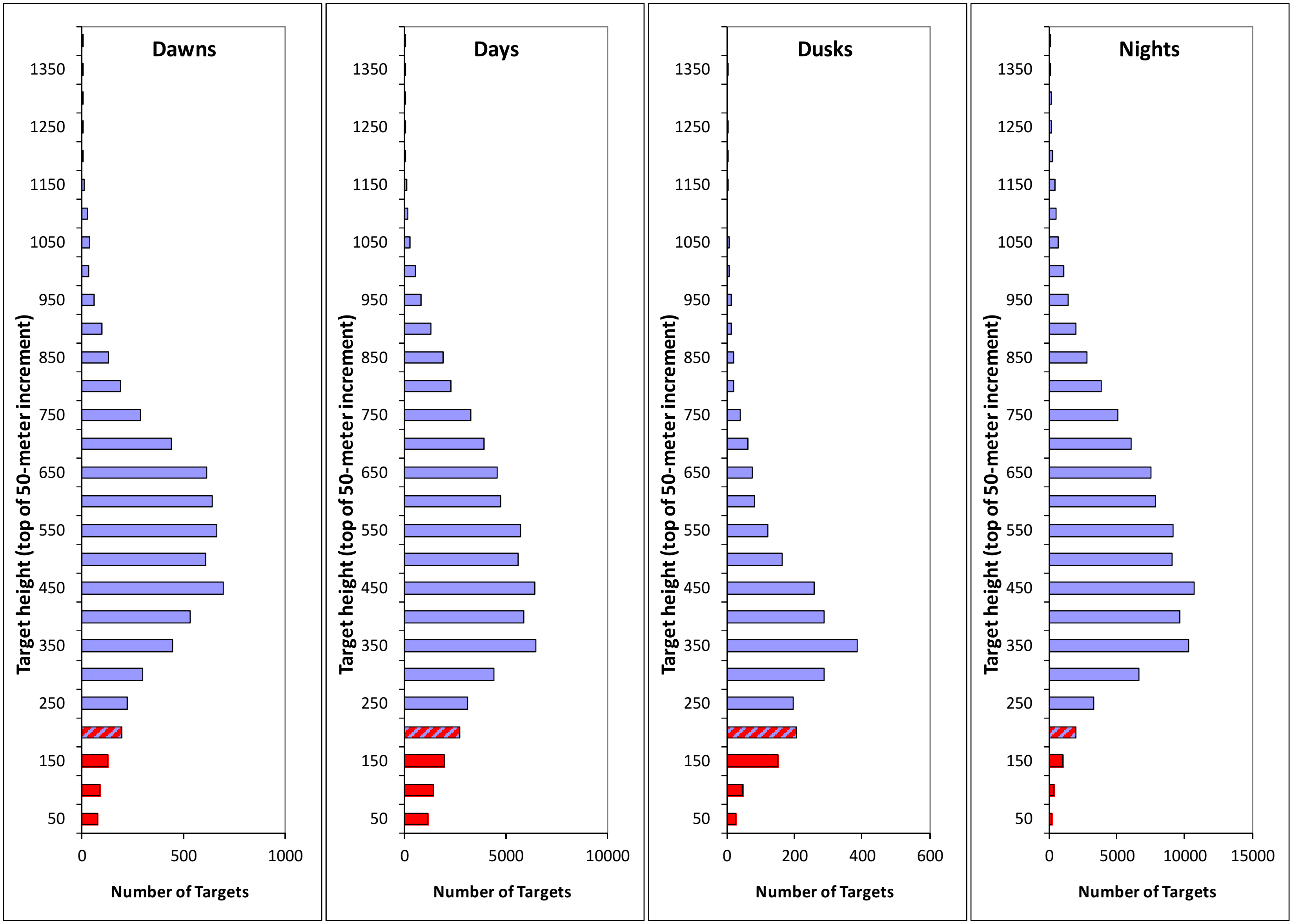

Figure 11-8. Number of targets occurring in each 50-meter increment during biological periods at Site 9 (July 21 - September 29, 2012). Red indicates rotor swept heights, and red-blue hashed indicates altitudes partially within rotor swept heights.

Using a RSZ of 0-152.4 m AGL, target passage rates below, within, and above the RSZ were calculated for each date. Individual target passage rates are presented for dawns (Fig. 11-10) days (Fig. 11-11), dusks (Fig 11-12), and nights (Fig. 11-13). Percent targets below, within, and above the RSZ were also calculated seasonally, with all targets detected during each biological period at Site 9 (July 21 - September 29, 2012) combined together (Table 11-4, bottom). Average hourly target passage rates below, within, and above the rotor swept zone are also given (Fig. 11-9).

Table 11-4. Summary of target passage rates and percent of targets above, within and below the RSZ (0-152.4 m AGL) during biological periods at Site 9 (July 21 - September 29, 2012). Darker colors indicate greater values.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average target passage rate above RSZ	94.7	84.7	41.9	158.6
Average target passage rate within RSZ	4.6	6.2	4.1	2.5
Average target passage rate below RSZ	1.9	0.7	1.5	0.2
Average % of targets in RSZ	6.6%	7.1%	6.6%	1.9%
Min target percentage within RSZ	0.0%	1.3%	0.0%	0.1%
Max target percentage within RSZ	31.0%	27.7%	37.5%	7.9%
All targets for season combined				
% targets above RSZ	93.5%	92.5%	87.8%	98.3%
% targets within RSZ	4.6%	6.7%	9.0%	1.5%
% targets below RSZ	1.9%	0.8%	3.2%	0.1%
% targets below turbine height	6.5%	7.5%	12.2%	1.7%

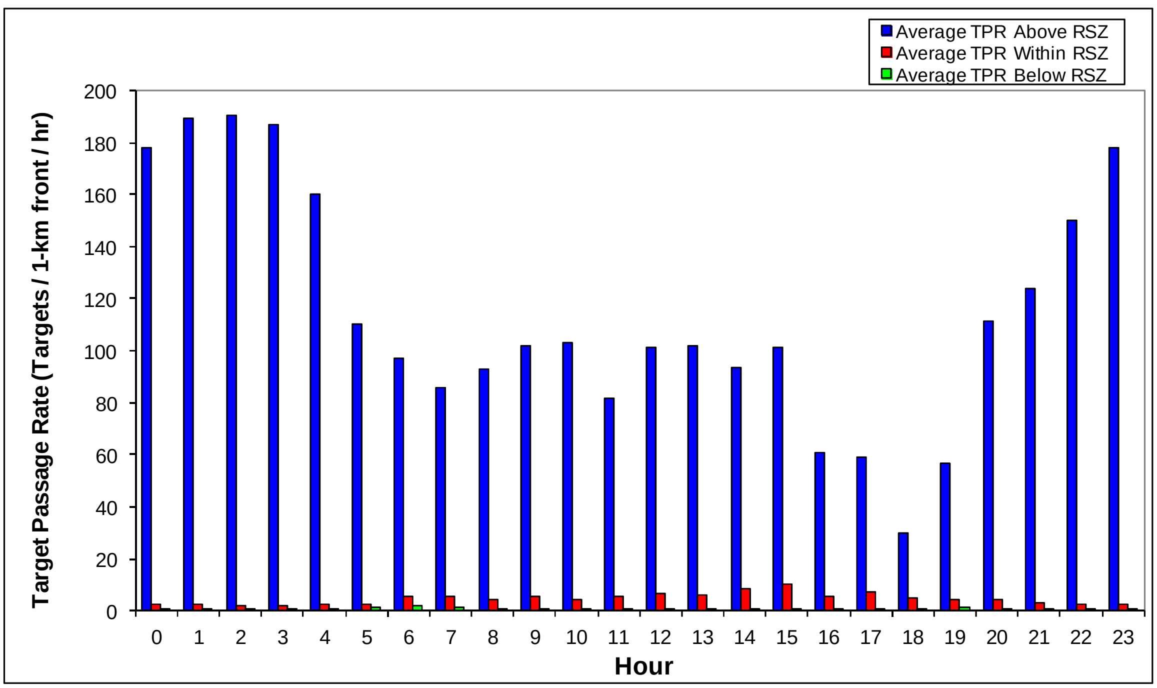

Figure 11-9. Average hourly target passage rates at Site 9 (July 21 - September 29, 2012).

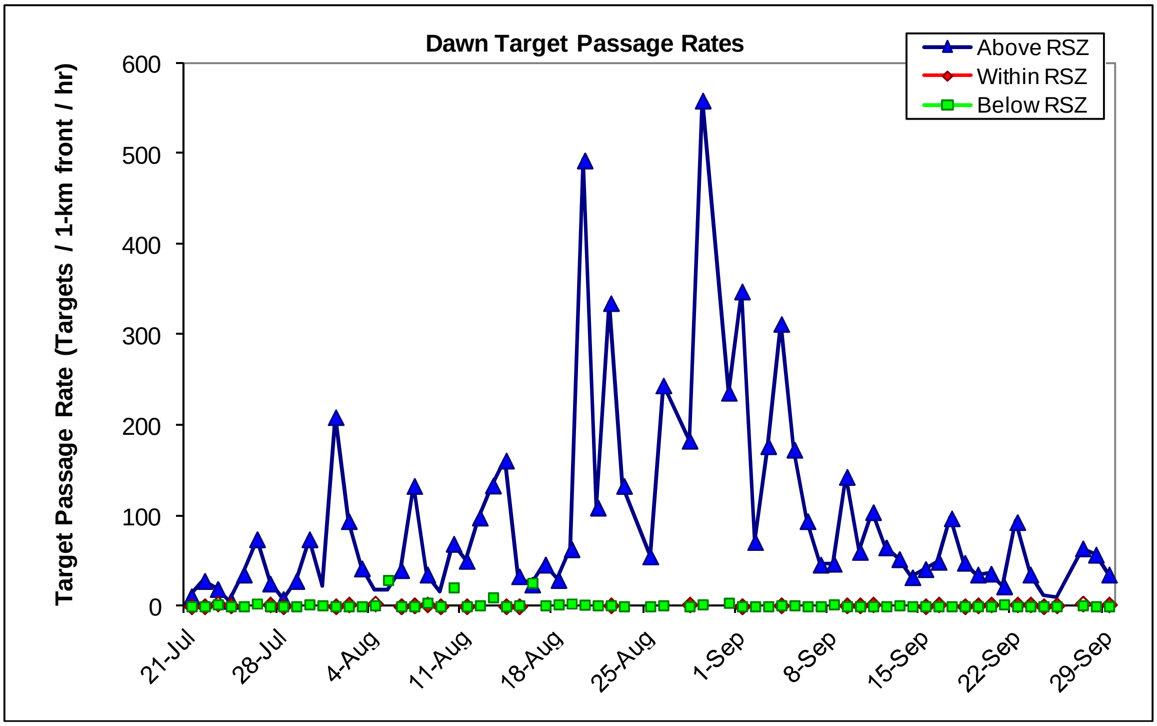

Figure 11-10. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dawns at Site 9 (July 21 - September 29, 2012).

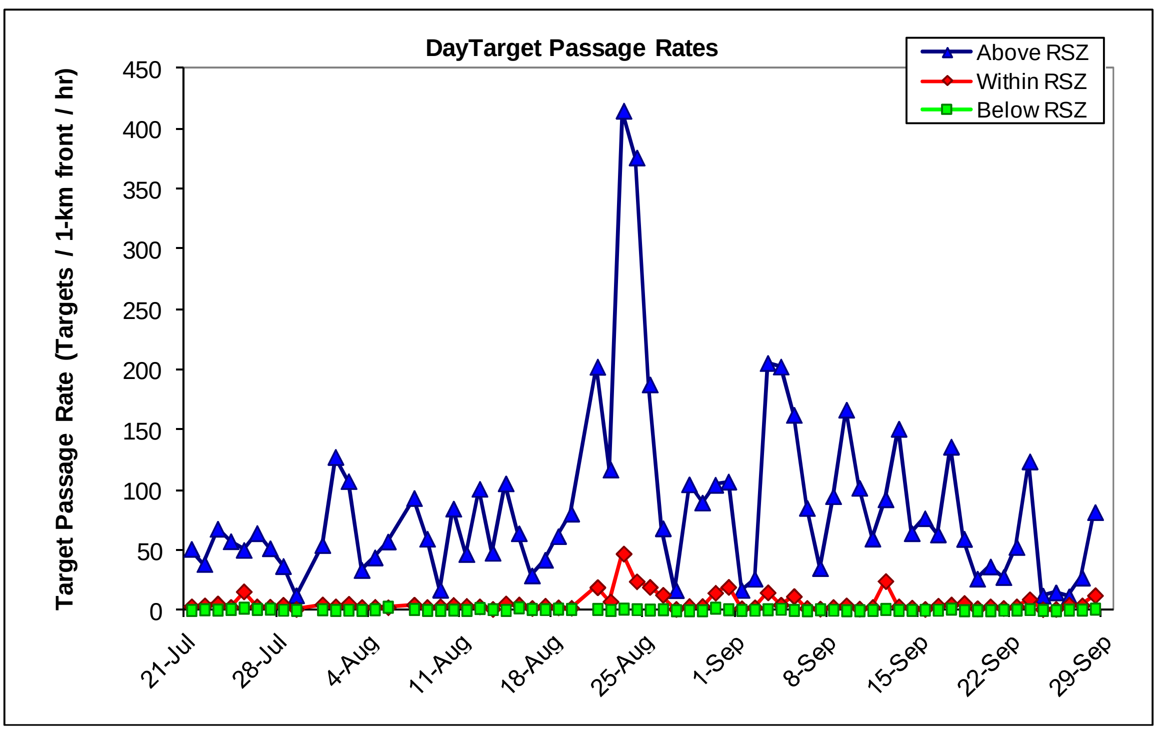

Figure 11-11. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during days at Site 9 (July 21 - September 29, 2012).

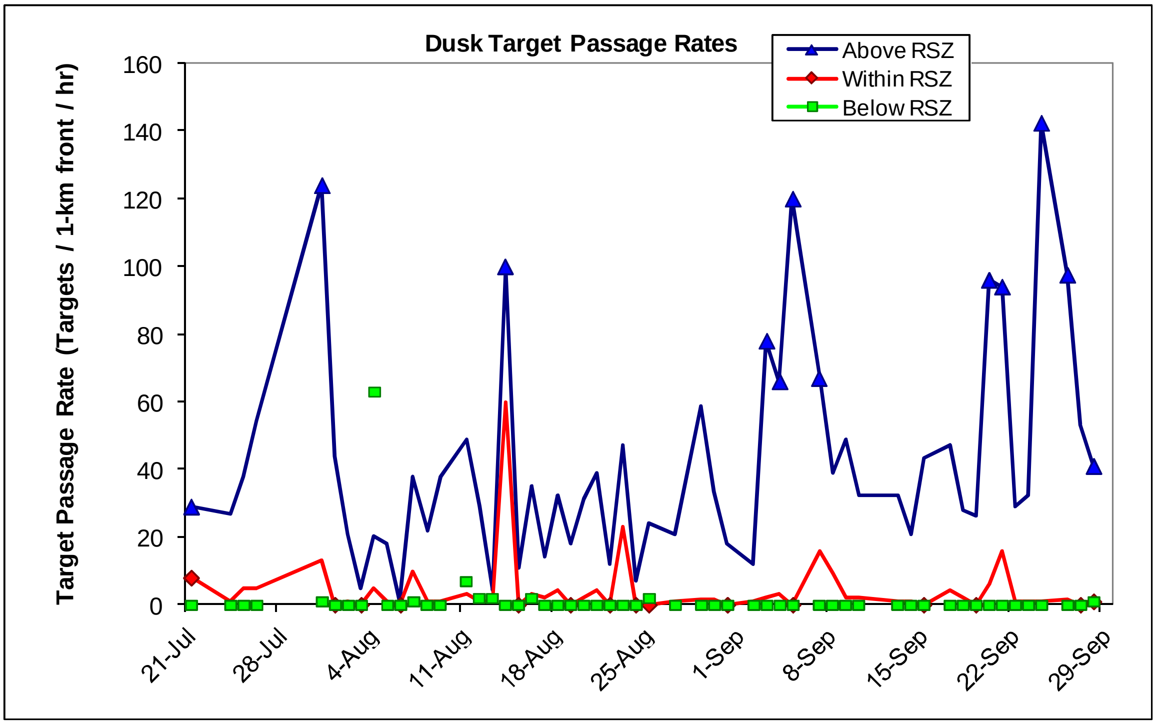

Figure 11-12. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dusks at Site 9 (July 21 - September 29, 2012).

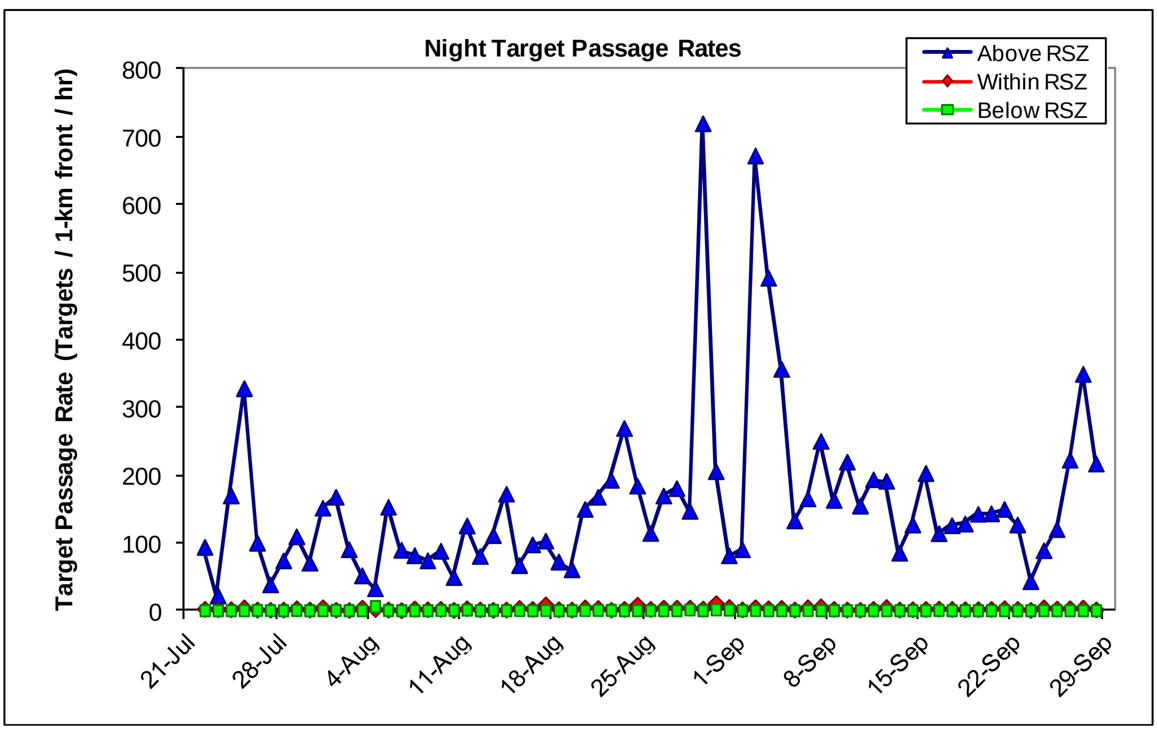

Figure 11-13. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during nights at Site 9 (July 21 - September 29, 2012).

11.3 Horizontal Radar Data

The Horizontal Surveillance Radar (HSR) was used to determine directional movements of targets during biological periods at Site 9 (July 21 - September 29, 2012).

11.3.1 Target Directions

Average target directions were calculated for each biological period (Fig. 11-14). Average target directions were also calculated seasonally (comprehensive distribution), with all targets detected at Site 9 (July 21 - September 29, 2012) combined together by biological period (Fig. 11-15) and hour (Fig. 11-16).

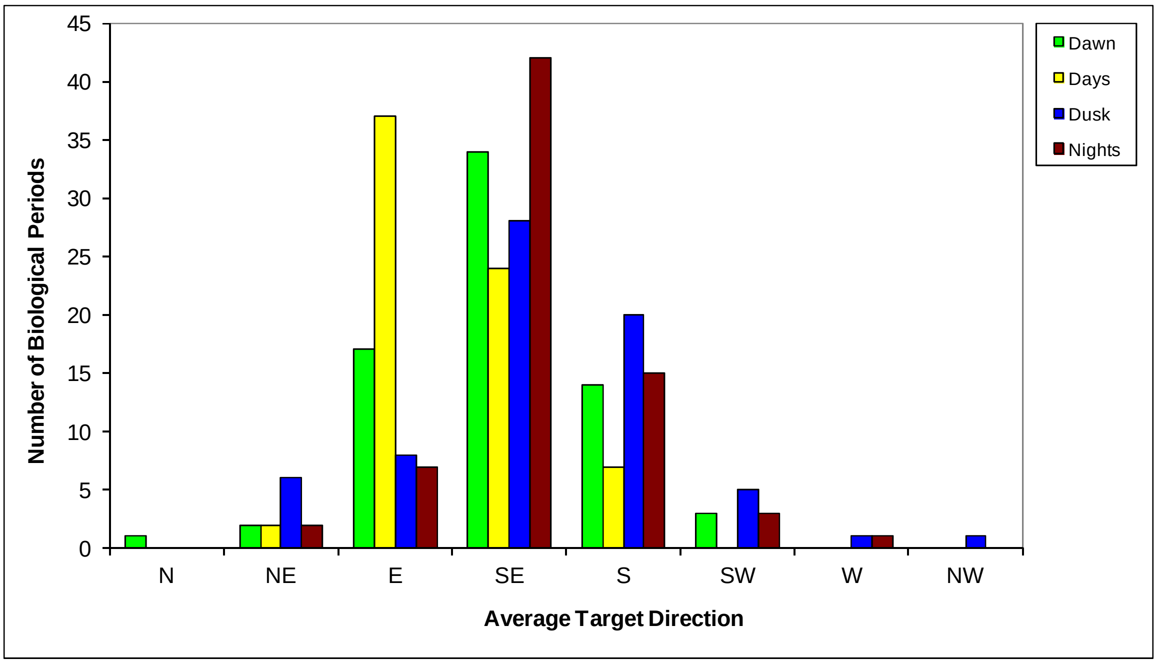

Figure 11-14. Distribution of average target movements among eight directions during dawns, days, dusks, and nights at Site 9 (July 21 - September 29, 2012).

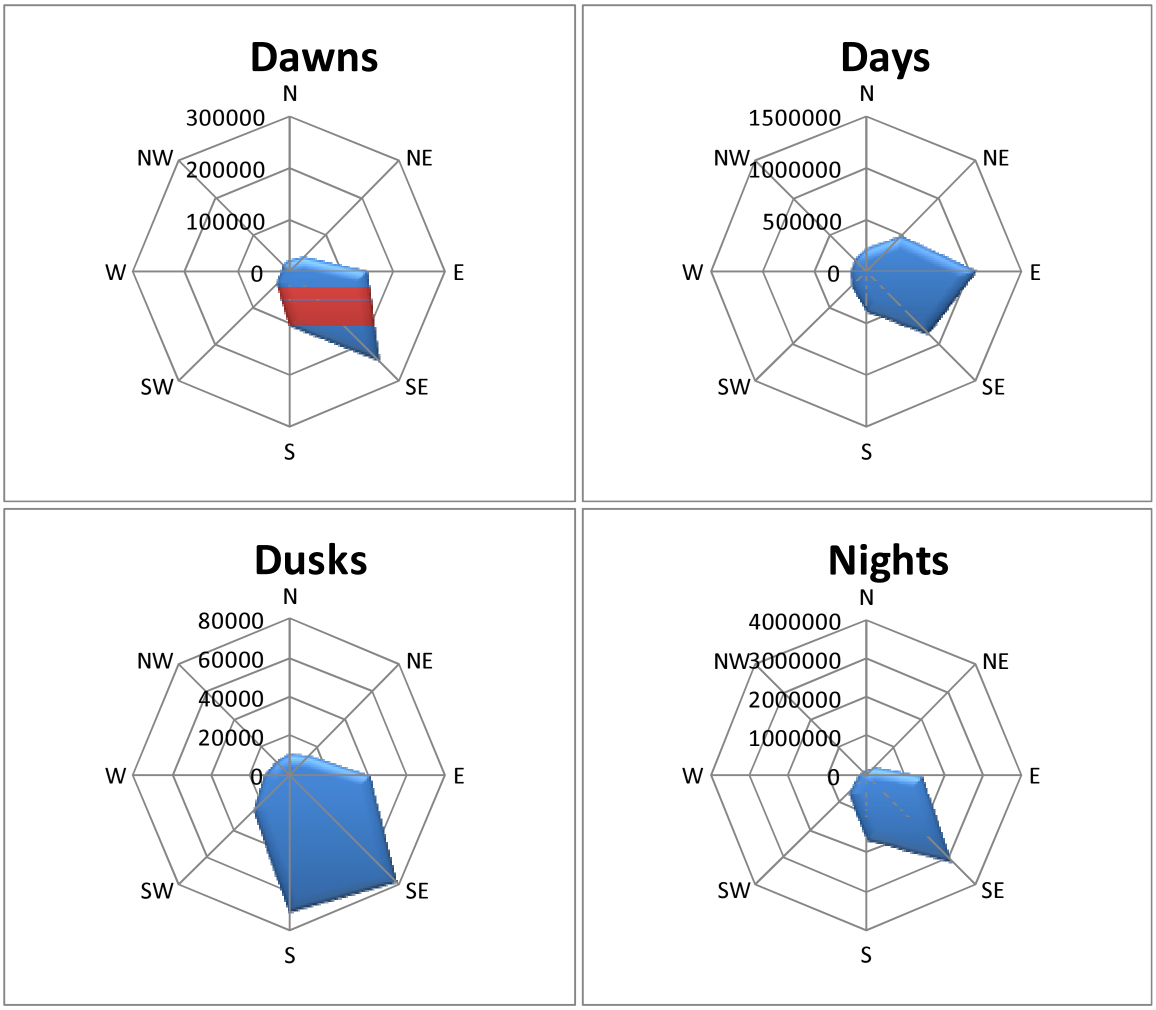

Figure 11-15. Comprehensive distribution of all target's directions during dawns, days, dusks, and nights at Site 9 (July 21 - September 29, 2012).

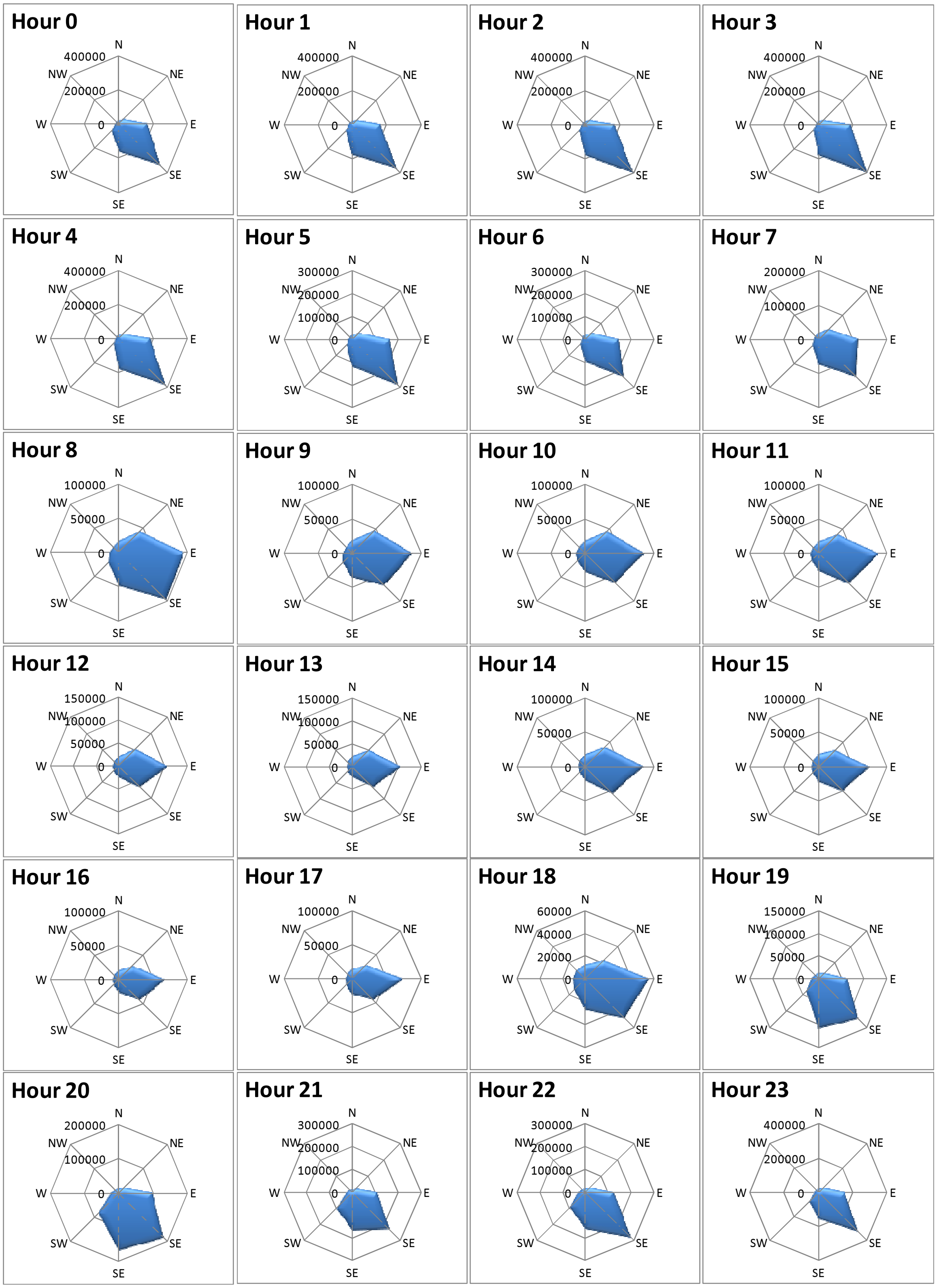

Figure 11-16. Comprehensive distribution of all target's directions by hour at Site 9 (July 21 - September 29, 2012).

12 RESULTS for Site 10 (October 3, 2012 – March 31, 2013)

12.1 Level of Effort

Table 12-1 presents available time, time radar data were collected, amount of radar data that were removed due to rain, high levels of insect activity, or other contamination, and the resulting time of radar data used for analyses, for Site 10 (October 3, 2012 - March 31, 2013).

Table 12-1. Radar monitoring effort at Site 10 (October 3, 2012 - March 31, 2013).

	Vertical Radar		Horizontal Radar	
	Hours	%	Hours	%
Time in season	4319.6		4319.6	
Time radar down	579.8	13.4%	14.8	0.3%
Time radar collected data	3739.8	86.6%	4304.8	99.7%
Unuseable radar data[1] due to rain or other contamination	606.1	16.2%	10.8	0.2%
Unuseable radar data[2] due to insects	23.3	0.6%	-	-
Useable radar data[3]	3110.4	72.0%	4294.0	99.4%

1 - Percent indicates portion of time with radar data that was lost due to rain or other contamination.
2 - Percent indicates portion of time with radar data that was lost due to high insect activity.
3 - Percent indicates portion of season with useable radar data.

12.2 Vertical Radar Data

Data collected from the vertical scanning radar (VSR) were used to quantify target activity and heights.

12.2.1 Target Passage Rates Over Time

Data is presented as a rate equaling total number of targets / 1-km front / hr for each biological period (Fig. 12-1) and as an average by biological period (Fig. 12-2) and hour (Fig. 12-3). Summary statistics are presented in table 12-2.

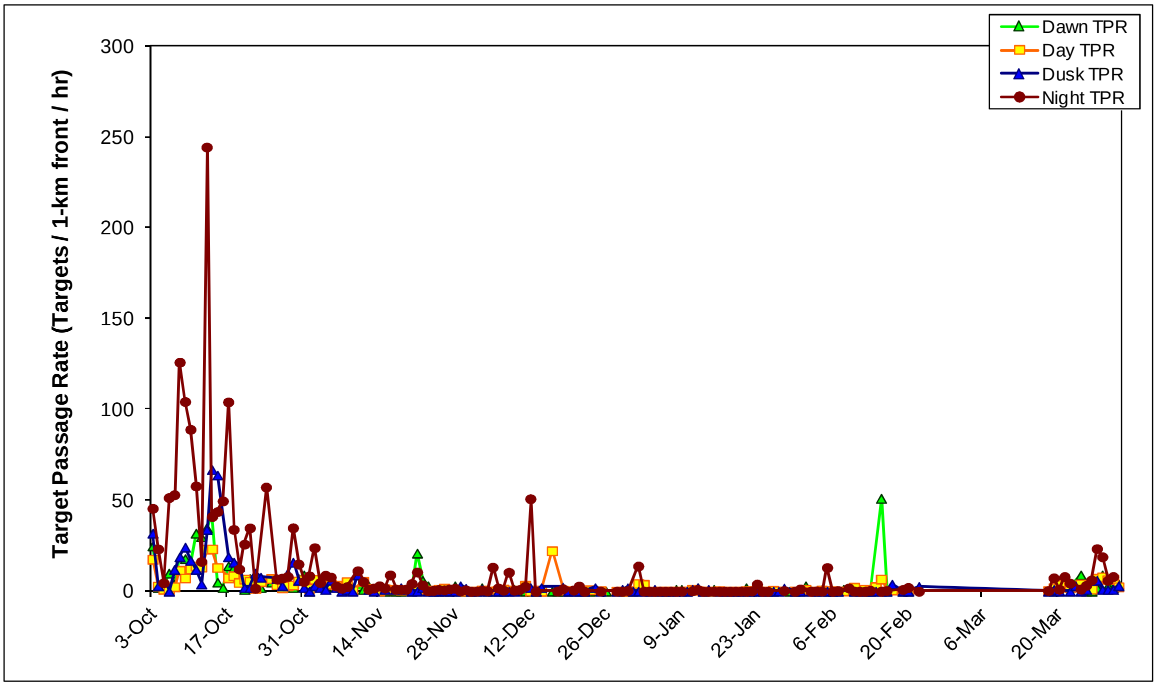

Figure 12-1. Target passage rates (TPR) during biological periods at Site 10 (October 3, 2012 - March 31, 2013).

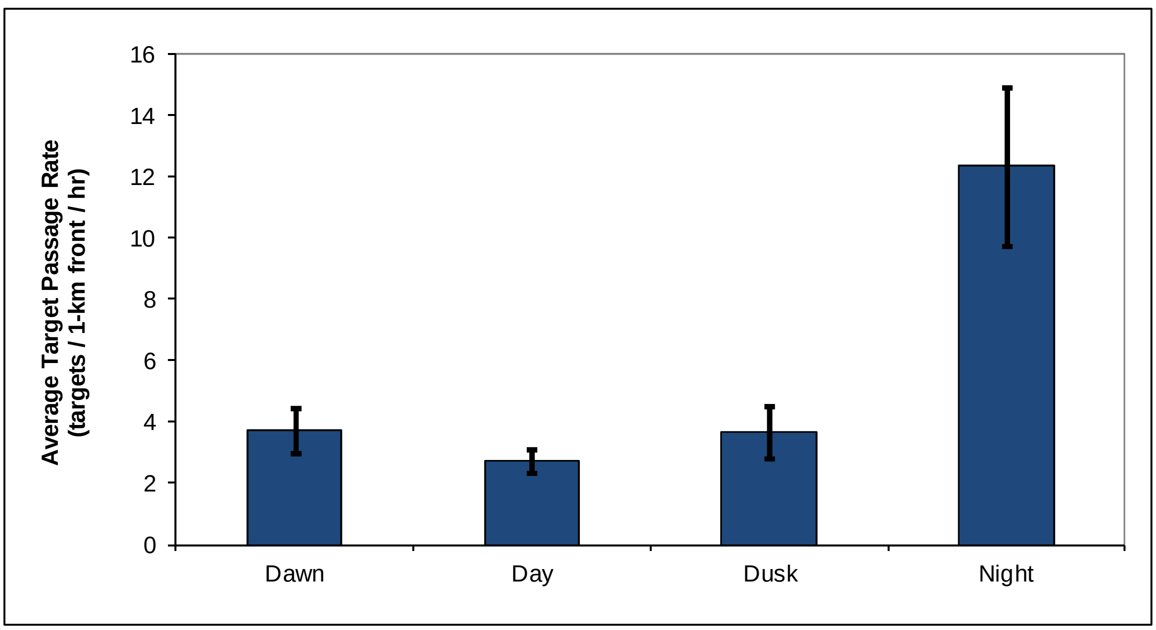

Figure 12-2. Average target passage rates (TPR) by biological period at Site 10 (October 3, 2012 - March 31, 2013). Error bars represent one standard error.

Table 12-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for biological periods at Site 10 (October 3, 2012 - March 31, 2013).

	Dawn	Day	Dusk	Night
Average	3.7	2.7	3.7	12.3
Standard Deviation	8.3	4.5	9.6	29.8
Standard Error	0.7	0.4	0.8	2.6
Median	1.0	0.8	0.0	1.3
Minimum	0.0	0.0	0.0	0.0
Maximum	51.2	23.3	67.0	244.7

Both average and comprehensive hourly target passage rates are presented in Fig 12-3: average rates are the average of each date's hourly target rate in a given hour, while comprehensive rates use targets grouped by hour, regardless of date.

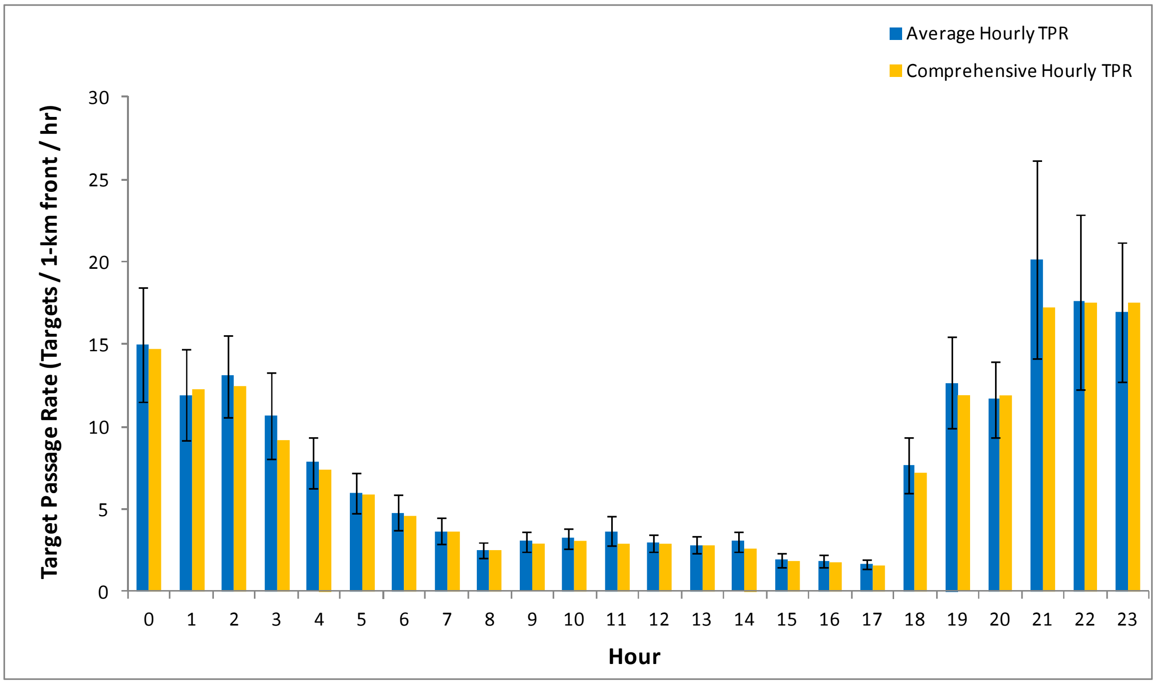

Figure 12-3. Average and comprehensive hourly target passage rates at Site 10 (October 3, 2012 - March 31, 2013). Error bars represent one standard error.

12.2.2 Altitudinal Distribution of Targets

Mean and median target heights are presented for each biological period (Fig. 12-4 and Fig. 12-5, respectively) at Site 10 (October 3, 2012 - March 31, 2013).

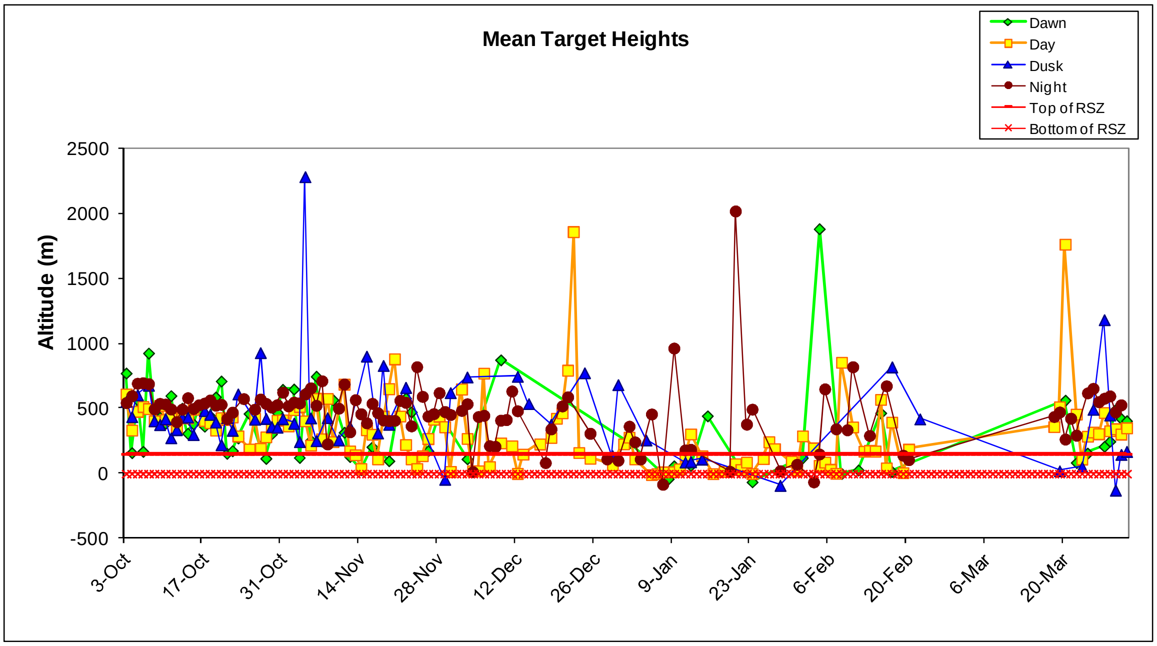

Figure 12-4. Mean target heights at Site 10 (October 3, 2012 - March 31, 2013). Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

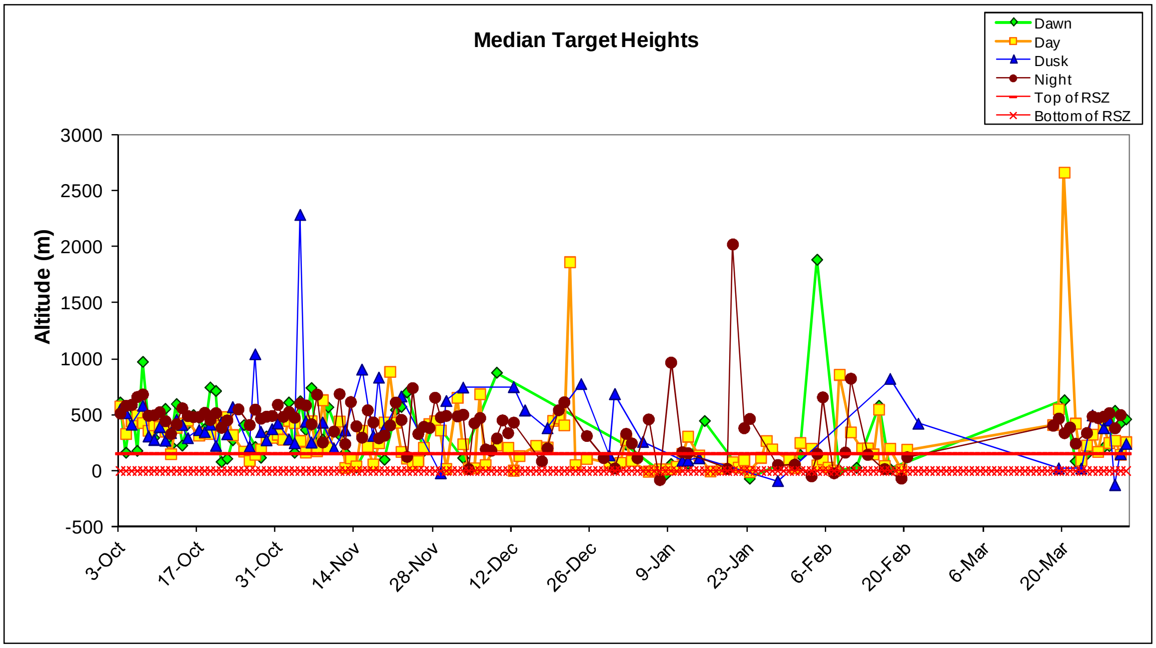

Figure 12-5. Median target heights at Site 10 (October 3, 2012 - March 31, 2013). Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

The mean and median target heights during each biological period were calculated for all dates with $\geq$ 50% data for that time period, averaged into a grand mean and average median, and presented in Table 12-3 (top) and illustrated in Figure 12-6 (blue bars). The comprehensive mean and median target heights for each biological period (when all targets were combined regardless of date) are also listed in Table 12-3 (bottom) and illustrated in Figure 12-6 (green bars).

Table 12-3. Summary of mean and median target heights during biological periods at Site 10 (October 3, 2012 - March 31, 2013). Darker colors in color-coded rows indicate greater values within that row.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Grand mean target height	365.0	312.2	444.4	462.0
Average median target height	360.1	277.8	413.9	407.0
All targets for season combined				
Comprehensive mean target height	425.1	408.8	425.7	532.3
Comprehensive median target height	399.3	332.8	359.1	487.1

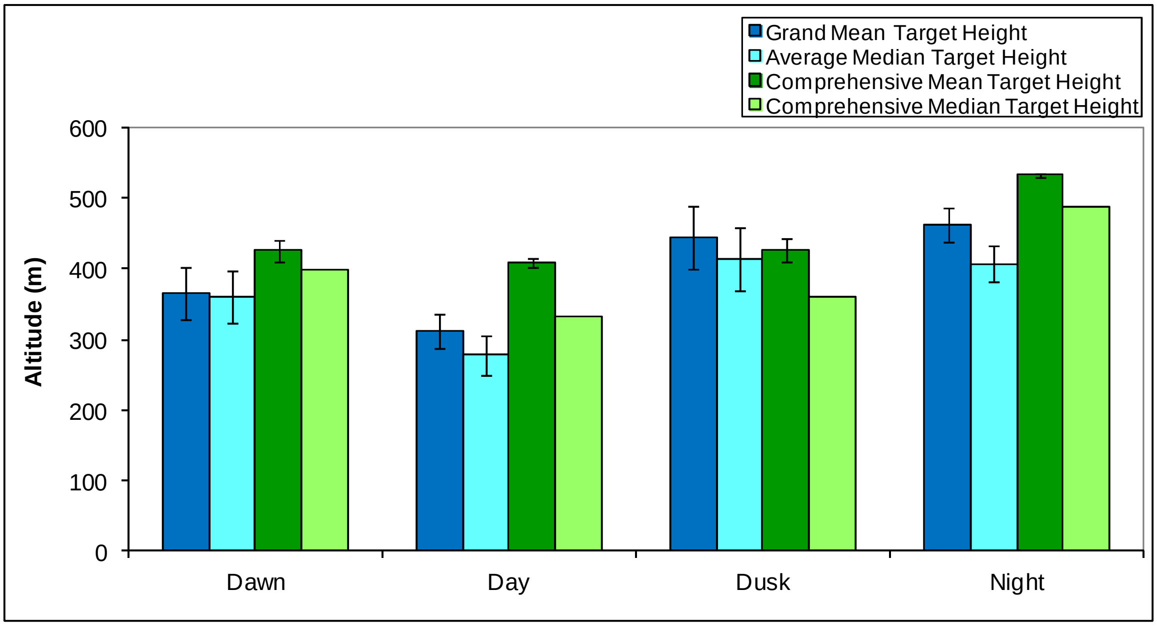

Figure 12-6. Grand mean and average median target heights averaged across individual biological periods (blue bars), and comprehensive mean and median target heights of all targets grouped by biological period (green bars), at Site 10 (October 3, 2012 - March 31, 2013). Error bars represent one standard error.

Hourly target heights were averaged into a grand hourly target mean and an average hourly target median for each of 24 hours; a comprehensive hourly target mean was also calculated by pooling all targets within a given hour together, regardless of date (Fig. 12-7).

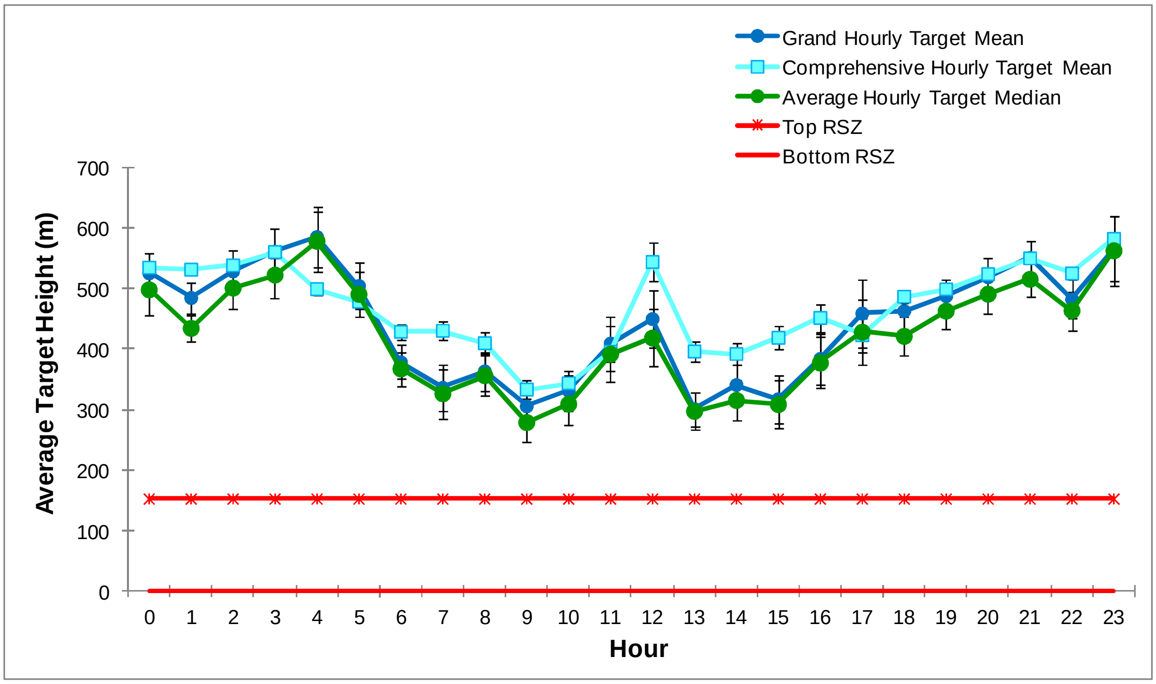

Figure 12-7. Hourly target heights at Site 10 (October 3, 2012 - March 31, 2013). Error bars represent one standard error. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

The distribution of all targets detected during dawns, days, dusks, and nights at Site 10 (October 3, 2012 - March 31, 2013) are shown using 50-meter increments (Fig. 12-8).

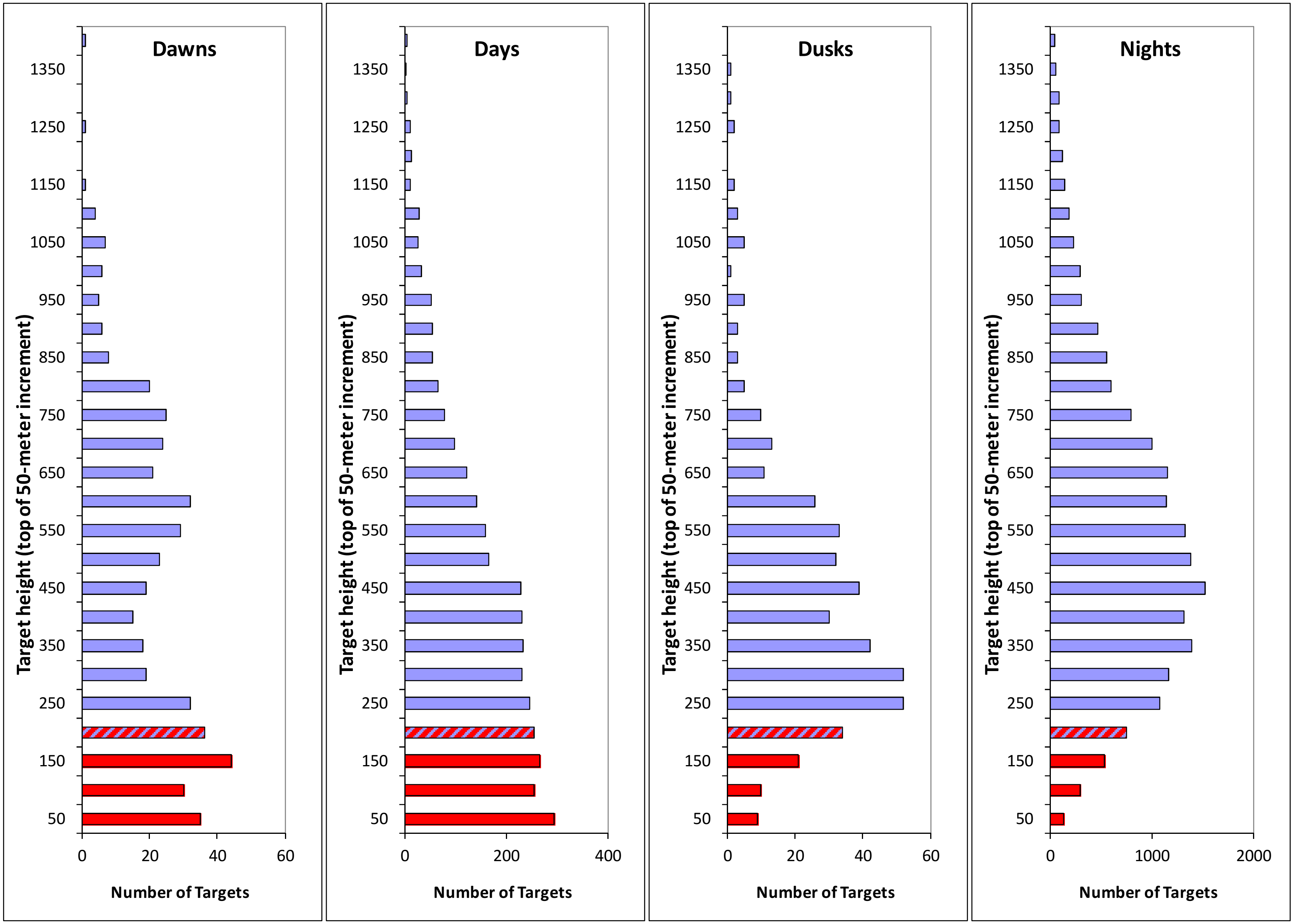

Figure 12-8. Number of targets occurring in each 50-meter increment during biological periods at Site 10 (October 3, 2012 - March 31, 2013). Red indicates rotor swept heights, and red-blue hashed indicates altitudes partially within rotor swept heights.

Using a RSZ of 0-152.4 m AGL, target passage rates below, within, and above the RSZ were calculated for each date. Individual target passage rates are presented for dawns (Fig. 12-10) days (Fig. 12-11), dusks (Fig 12-12), and nights (Fig. 12-13). Percent targets below, within, and above the RSZ were also calculated seasonally, with all targets detected during each biological period at Site 10 (October 3, 2012 - March 31, 2013) combined together (Table 12-4, bottom). Average hourly target passage rates below, within, and above the rotor swept zone are also given (Fig. 12-9).

Table 12-4. Summary of target passage rates and percent of targets above, within and below the RSZ (0-152.4 m AGL) during biological periods at Site 10 (October 3, 2012 - March 31, 2013). Darker colors indicate greater values.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average target passage rate above RSZ	2.8	2.0	3.3	11.7
Average target passage rate within RSZ	0.8	0.7	0.3	0.6
Average target passage rate below RSZ	0.1	0.0	0.0	0.0
Average % of targets in RSZ	31.3%	39.8%	16.2%	16.9%
Min target percentage within RSZ	0.0%	0.0%	0.0%	0.0%
Max target percentage within RSZ	100.0%	100.0%	100.0%	100.0%
All targets for season combined				
% targets above RSZ	75.6%	75.0%	90.3%	94.6%
% targets within RSZ	22.6%	23.6%	8.6%	5.1%
% targets below RSZ	1.7%	1.4%	1.1%	0.3%
% targets below turbine height	24.4%	25.0%	9.7%	5.4%

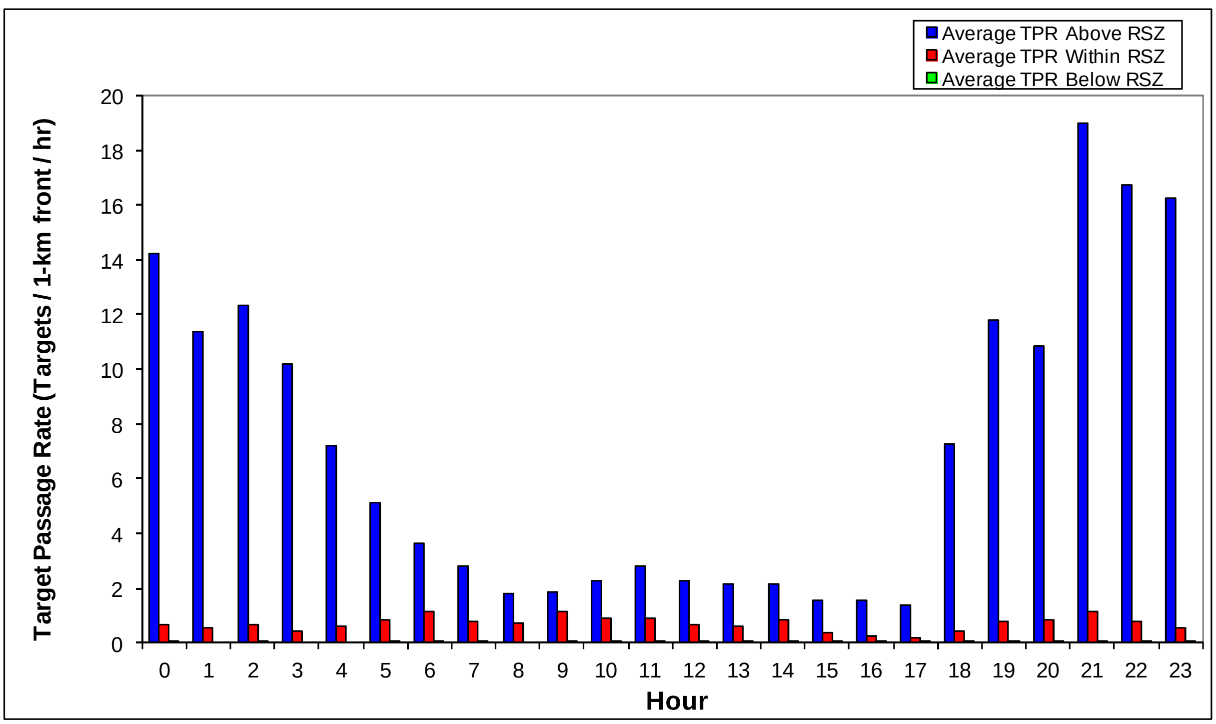

Figure 12-9. Average hourly target passage rates at Site 10 (October 3, 2012 - March 31, 2013).

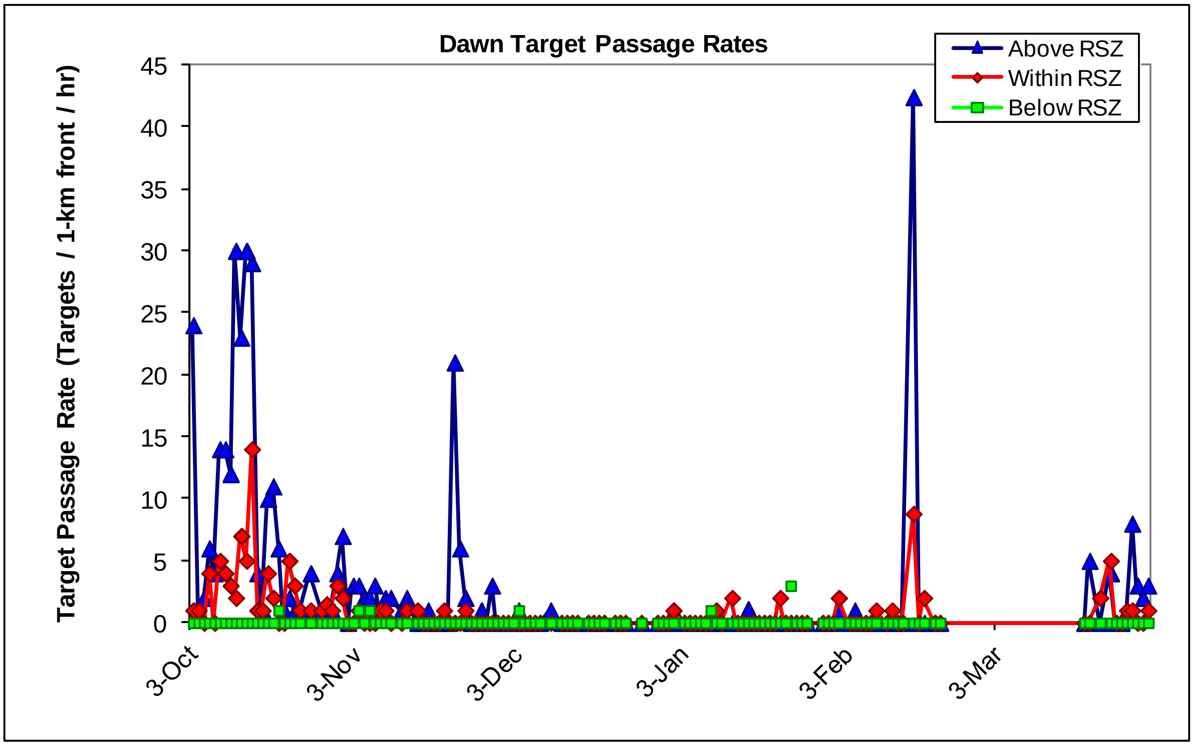

Figure 12-10. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dawns at Site 10 (October 3, 2012 - March 31, 2013).

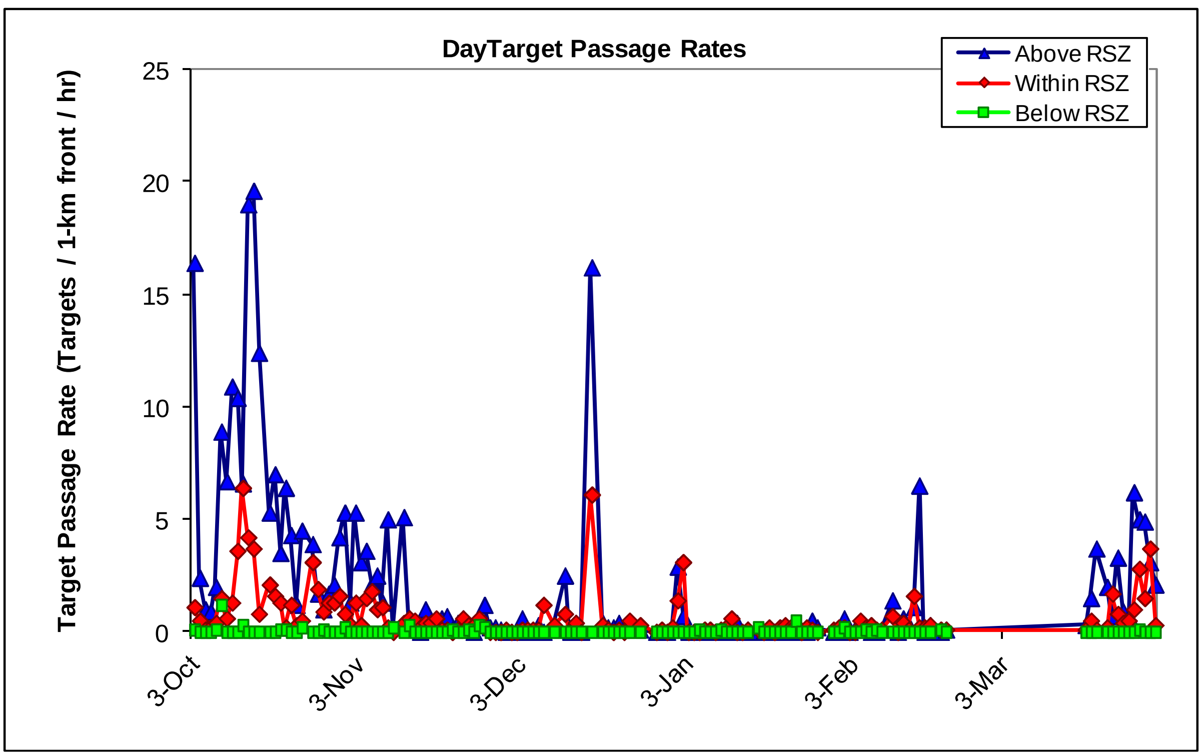

Figure 12-11. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during days at Site 10 (October 3, 2012 - March 31, 2013).

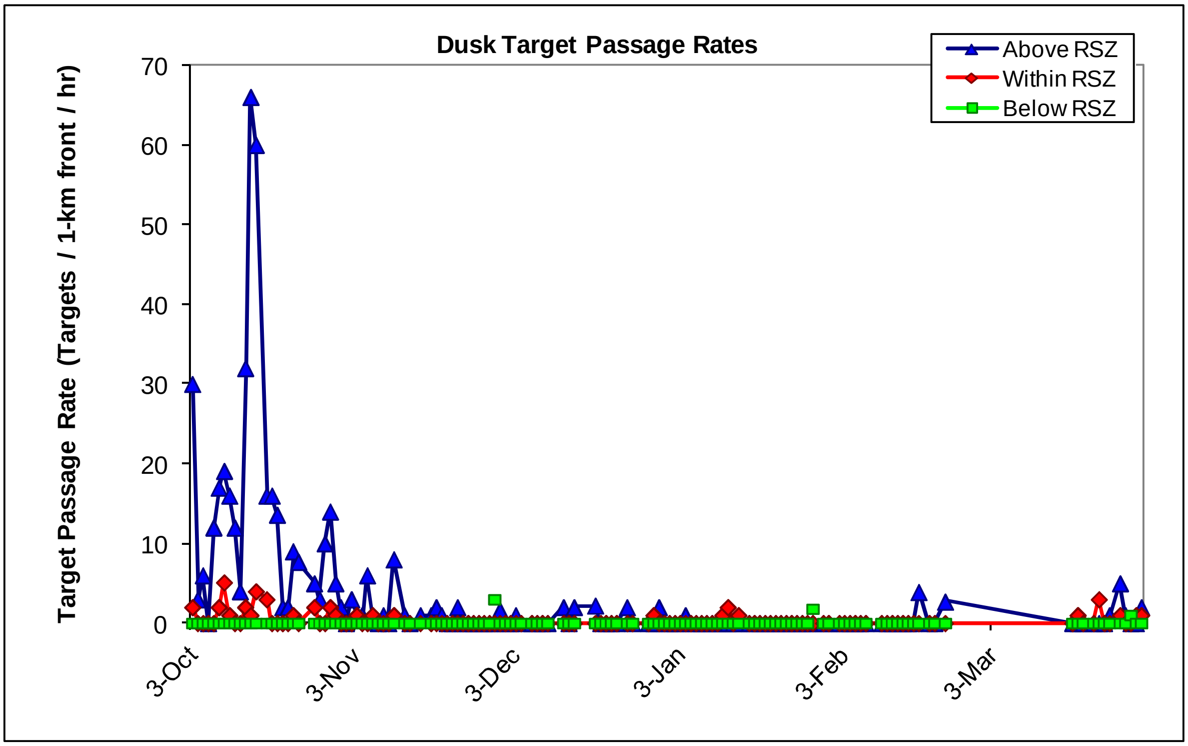

Figure 12-12. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dusks at Site 10 (October 3, 2012 - March 31, 2013).

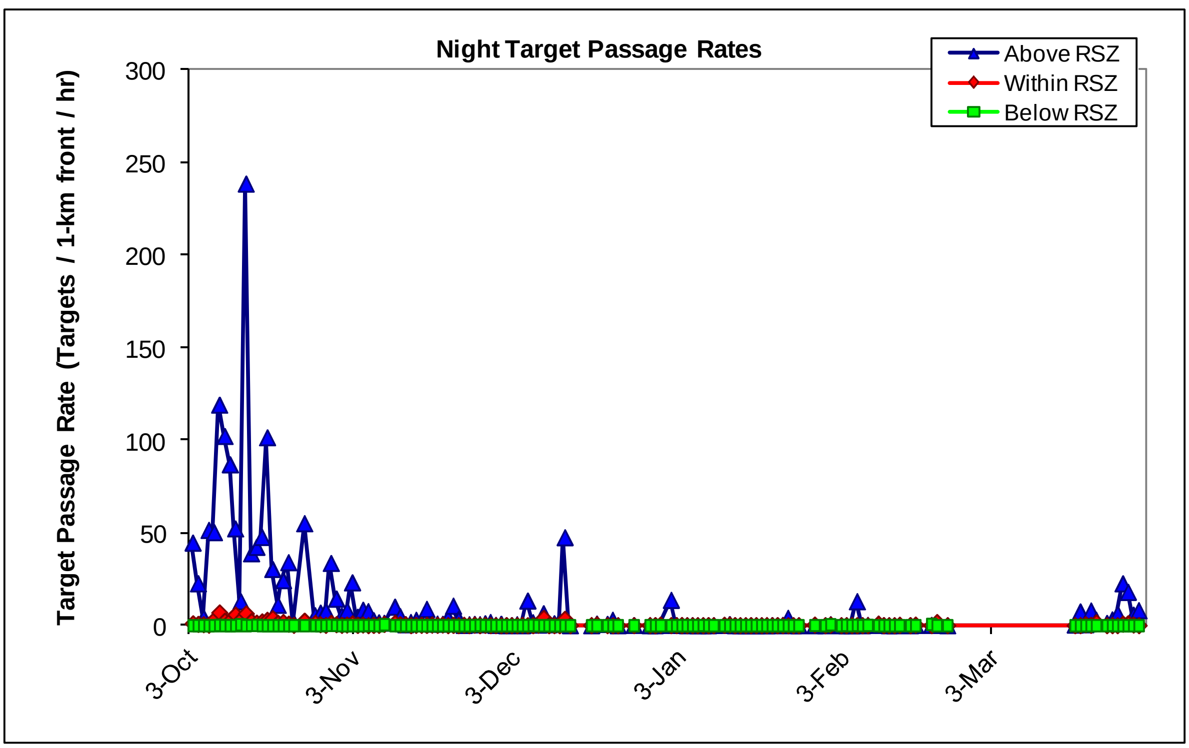

Figure 12-13. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during nights at Site 10 (October 3, 2012 - March 31, 2013).

12.3 Horizontal Radar Data

The Horizontal Surveillance Radar (HSR) was used to determine directional movements of targets during biological periods at Site 10 (October 3, 2012 - March 31, 2013).

12.3.1 Target Directions

Average target directions were calculated for each biological period (Fig. 12-14). Average target directions were also calculated seasonally (comprehensive distribution), with all targets detected at Site 10 (October 3, 2012 - March 31, 2013) combined together by biological period (Fig. 12-15) and hour (Fig. 12-16).

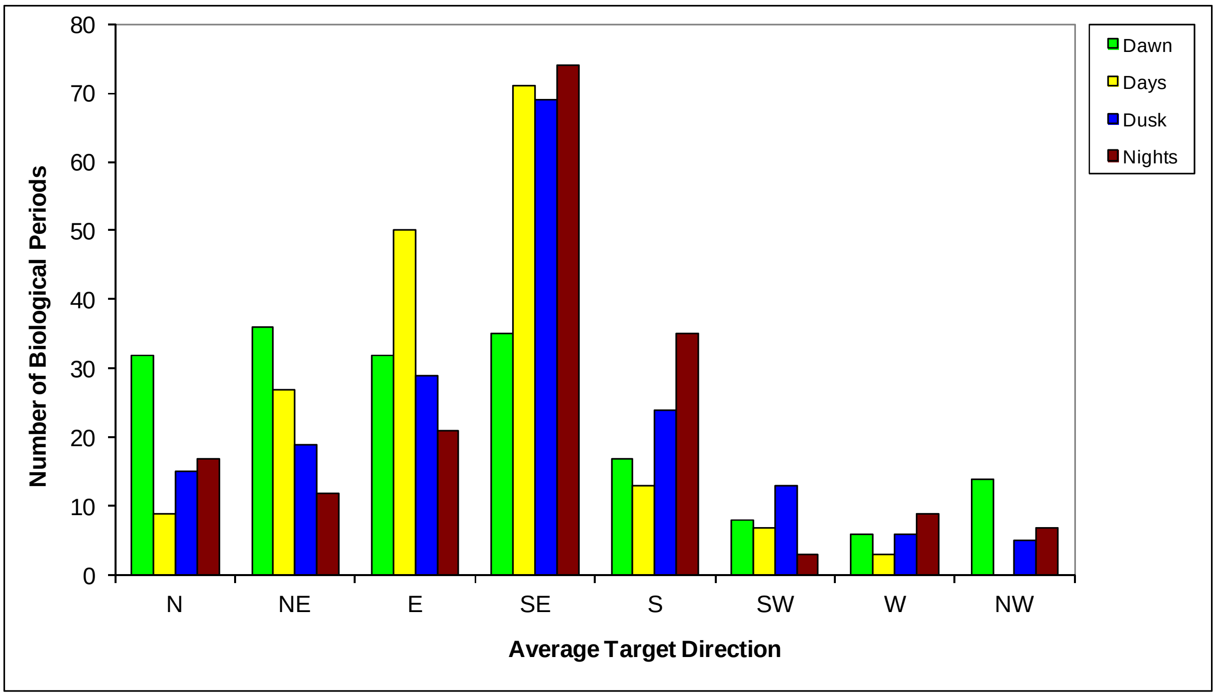

Figure 12-14. Distribution of average target movements among eight directions during dawns, days, dusks, and nights at Site 10 (October 3, 2012 - March 31, 2013).

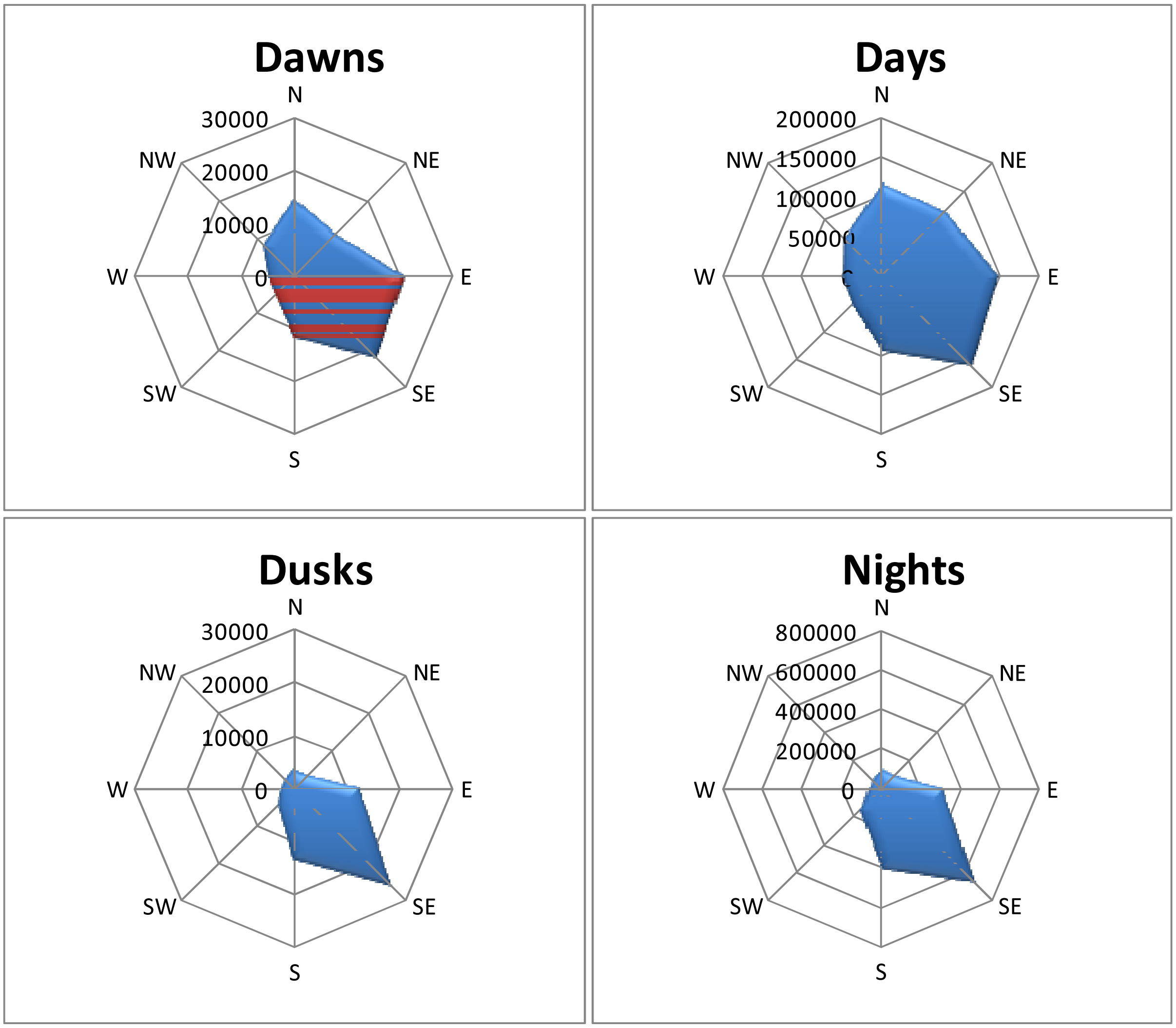

Figure 12-15. Comprehensive distribution of all target's directions during dawns, days, dusks, and nights at Site 10 (October 3, 2012 - March 31, 2013).

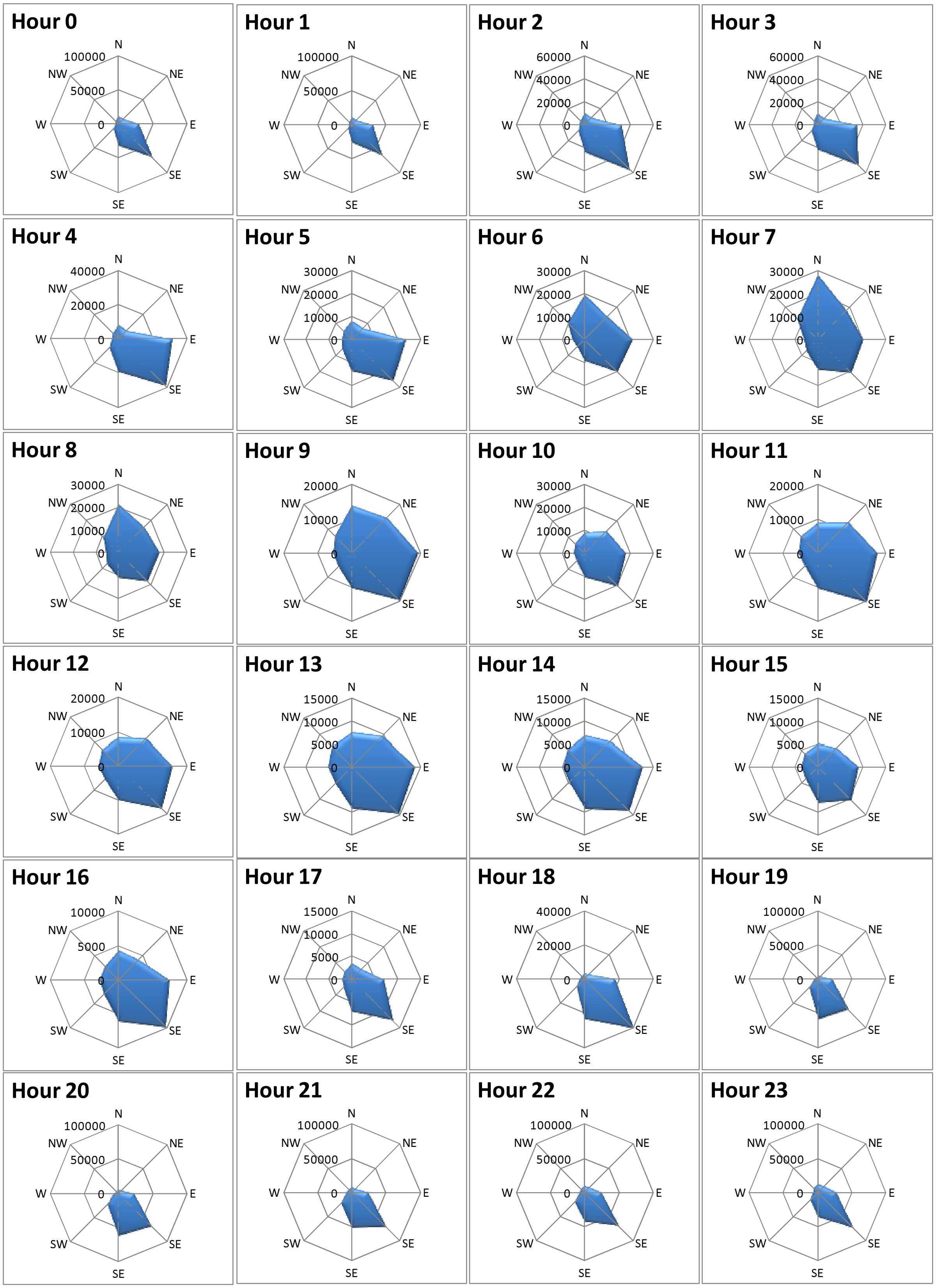

Figure 12-16. Comprehensive distribution of all target's directions by hour at Site 10 (October 3, 2012 - March 31, 2013).

Literature Cited

Harmata, A. R., K. M. Podruzny, J. R. Zelenak, and M. L. Morrison. 1999. Using marine surveillance radar to study bird movements and impact assessment. Wildlife Society Bulletin 27:44-52.

Zar, J. H. 1999. Biostatistical Analysis. Fourth edition. Prentice-Hall, Englewood Cliffs, New Jersey, USA.

Appendix A - Abbreviations

AGL – Above Ground Level

HSR – Horizontal Surveillance Radar

km – kilometer

m – meter

mi – mile

nm – Nautical miles (approximately 1.15 miles)

RSZ – Rotor Swept Zone

VSR – Vertical Scanning Radar

Appendix B - Glossary

1-km Front – 0.5 km on either side of the VSR, or 1 km on one side of the VSR, forming a 1-km front through which target passage rates are quantified.

Comprehensive distribution – Frequency distribution of all mean target bearings combined during a season, regardless of date.

Comprehensive mean – Mean of all targets in a time period during an entire season, regardless of the date.

Grand mean – Mean of all period means (e.g. all nights).

Rotor Swept Zone (RSZ) – The 1-km wide band within the 1-km front that encompasses the lowest and highest points swept by a wind turbine's blades. Specific to each project and calculated using the manufacturer's specifications for the wind turbine proposed for the project.

Plot – A single scan of a target.

Target Passage Rate – Number of targets passing through a 1-km wide front during 1 hour. Standardized to an hourly rate using the proportion of minutes radar data was recorded during a given time period.

Target - Object detected by MERLIN Radar and identified by MERLIN software as a biological object (e.g. bird, bat) based on scanned size, speed, and other characteristics.

Track – The entire sequence of plots that make up a target's trail within the radar coverage as long as an object still fits the definition of a target.

TrackPlot – MERLIN program displaying all target or track activity within a specific time period; used for defining time periods of radar data containing rain or other interference.

Tracking – The MERLIN software begins to track a target after it has met the criteria of a biological target for three of four scans. The target continues to be tracked until either the target fails to be detected or to meet the criteria for three of the last four scans.

APPENDIX H

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THE OVERLAND TRAIL RANCH

CHOKECHERRY AND SIERRA MADRE WIND ENERGY PROJECT

CONSERVATION PLAN AND LANDOWNER AGREEMENT

This Conservation Plan and Landowner Agreement (this "Agreement") is entered into as of July 1, 2014 between **POWER COMPANY OF WYOMING LLC** ("PCW") and **THE OVERLAND TRAIL CATTLE COMPANY LLC** ("TOTCO").

Recitals

A. TOTCO owns and operates a large cattle ranching and agricultural operation known as the Overland Trail Ranch (the "Ranch"), which is located south of Rawlins and Sinclair in Carbon County, and headquartered in Saratoga, the Ranch consists of approximately 320,000 acres. The Ranch is in Wyoming's "checkerboard" country, consisting of about half private land and half federal land managed by the Bureau of Land Management ("BLM"), along with a small percentage of state-owned parcels.

B. PCW is developing a wind farm known as the Chokecherry and Sierra Madre Wind Energy Project ("CCSM Project"). The CCSM Project will be located on approximately 125,000 acres of the Ranch. Total permanent land disturbance, however, for the turbines, access roads and related facilities is estimated to be less than 3% of the CCSM Project area. The CCSM Project will generate 2,000-3,000 megawatts of clean, renewable wind energy.

C. PCW and TOTCO have entered into that certain Grant of Easement and Easement Agreement and Restrictive Covenant by and between TOTCO and PCW dated November 30, 2007, as amended (the "Wind Easement"), which allows PCW to use the Ranch lands to construct and operate the CCSM Project.

D. The Ranch provides habitat for a variety of wildlife species. The BLM released a Final Environmental Impact Statement on July 3, 2012, which describes the CCSM Project in detail and analyzes and discloses the impacts of the CCSM Project, including impacts to wildlife species (the "Final EIS") and subsequently issued a Record of Decision for the CCSM Project on October 9, 2012.

E. PCW, TOTCO and Wyoming Game and Fish Department ("WGFD") have entered into a Memorandum of Understanding ("MOU") dated December 10, 2012 to promote and maintain through collaborative efforts the availability and use of high quality habitat to sustain and enhance terrestrial and aquatic wildlife populations on the Ranch in conjunction with various land uses, including the continuation of ranching and agricultural operations as well as development of the wind energy resource through construction and operation of the CCSM Project.

F. The Wildlife Protection Recommendations for Wind Energy Development in Wyoming approved by the Wyoming Game and Fish Commission on November 17, 2010 (the "Wildlife Protection Recommendations") provide for collaboration with the landowner(s) affected by wind energy development to develop a conservation plan for affected private lands incorporating mutually agreed upon goals and practices.

G. The Wildlife Protection Recommendations provide that the conservation plan shall be incorporated into the wind developer's permit application to the Industrial Siting Council ("ISC") and shall become the WGFD "recommendations" under W.S. 35-12-110 (b) and (c) and the WGFD recommendation to any local government entity.

H. The Wildlife Protection Recommendations provide that the parties shall jointly advocate for the ISC to incorporate the conservation plan into the wind developer's permit.

I. The parties desire to enter into a conservation plan for the Overland Trail Ranch pursuant to the Wildlife Protection Recommendations setting forth the mutually agreed upon goals and practices for the Ranch and the CCSM Project, as set forth more fully below.

AGREEMENT

For good and valuable consideration the parties agree that PCW will support TOTCO's management goals and practices in connection with its livestock operations on the Ranch as set out below:

1. **TOTCO Operations.** TOTCO currently manages the Ranch as an active, year round livestock operation. TOTCO's activities include, but are not limited to, raising cattle as a cow/calf and yearling operation, and growing feed for its livestock operations. Range resources within the Ranch consist of intermingled private, state and public lands administered as grazing allotments. The allotments are managed under an intensive rotation system in which grazing is rotated during the growing season among several different pastures within each allotment to provide complete growing season rest for all pastures on alternate years. As a result, water quality in affected streams has improved through soil stabilization, decreased runoff, increased infiltration, and enhanced riparian vegetation health.

2. **TOTCO Management Goals.** TOTCO's goals and practices for managing livestock operations on the Ranch are:

    - **a.** Manage livestock grazing to meet the Wyoming Standards for Healthy Rangelands;
    - **b.** Maintain and/or increase Animal Unit Month (AUM) levels for livestock grazing when feasible, providing that Wyoming Standards for Healthy Rangelands are met;

c. Work closely with BLM to determine the most appropriate methods for achieving the desired plant community, in addition to meeting the Standards for Healthy Rangelands; and

d. Design grazing systems and range improvements to achieve the management goals for livestock grazing and to achieve and maintain healthy rangelands.

For the avoidance of doubt, TOTCO is not obligated to manage the Ranch as set forth in Section 1 or Section 2 above, nor shall such sections otherwise limit TOTCO's complete discretion in the management of the Ranch.

3. **PCW Agreement to Cooperate and Support TOTCO Management Goals.** To the extent consistent with its goals and objectives for developing the CCSM Project and the terms and conditions of the Wind Easement, PCW agrees to cooperate and support TOTCO in meeting TOTCO's goals and objectives for managing livestock operations on the Ranch through the following actions:

a. By implementing a reclamation plan with the objective of emphasizing eventual ecosystem reconstruction to maintain a safe and stable landscape, which means returning the land to a condition approximate to or better than pre-disturbance conditions. Reclamation objectives include initial stabilization goals and long-term reclamation measures to ensure biophysical conditions are maintained in the short term to achieve long-term goals of revegetation and ecosystem reconstruction.

b. By implementing a weed management plan to prevent, mitigate, and control the spread of noxious and/or invasive plant species during construction and operation of the CCSM Project. The goal of weed management in the CCSM Project area will be to minimize the spread of noxious and/or invasive plant species during the construction and operation of the CCSM Project. PCW will assist federal, state, and local agencies' weed control efforts; comply with appropriate agency requirements designed to prevent the spread of noxious and/or invasive plant species; and implement weed control measures on areas of the CCSM Project that are identified to be of special concern. Success standards will be used to assess whether revegetation requirements for the CCSM Project are being met. Part of successful revegetation includes maintaining native or desirable plant communities with minimal undesirable plant species. Success standards and management goals will be designed to be site-specific to each surface-disturbing activity and the surrounding vegetation.

c. By implementing the Applicant Committed Mitigation Measures set forth in Appendix Table C-2 of the Final EIS. Implementing these measures will avoid, minimize and mitigate impacts to grazing operations, wildlife, aquatic resources and other resources within the Ranch.

d. By controlling dust generated by CCSM Project construction activities through implementation of best management practices (BMPs) as listed in Appendix Table C-2 of the Final EIS. Controlling dust will avoid and minimize potential impacts resulting from reduced palatability of livestock forage and serve to maintain livestock health.

4. <u>**Sage-grouse.**</u> Through The Chokecherry and Sierra Madre Wind Energy Project Sage-Grouse Conservation Plan developed by PCW and dated August 2012 (the "Sage-grouse Conservation Plan"), PCW has committed that the CCSM Project will be developed in a way that complements and furthers federal, state and local goals to conserve the greater sage-grouse (*Centrocercus urophasianus*; hereafter sage-grouse). This Conservation Plan promotes sustainable sage-grouse populations and conservation of habitat through environmentally responsible planning and by incorporating the following principles: (1) protection of un-fragmented habitats (PCW's commitment to no development within sage-grouse core population areas [EO 2011-5, Version 3 map]); (2) minimization of habitat loss and fragmentation (CCSM Project long-term footprint is less than 2,000 acres); and (3) management of habitats to maintain, enhance or restore conditions that meet sage-grouse life history needs (implementation of conservation measures). This conservation program will address threats to sage-grouse and will set the standard for the development of renewable resources in an environmentally responsible manner. This will be achieved by implementing science-based conservation measures for sage-grouse that will reduce or eliminate current threats as well as protect, restore and enhance habitat of sage-grouse and other species of interest on the Ranch and within the CCSM Project site. These conservation measures will insure that vital seasonal and year-long habitats on the Ranch are managed responsibly for the benefit of the sage-grouse. These measures will have ancillary benefits to BLM sensitive species and other species including sagebrush obligates, grassland endemics, avian species, big game species and aquatic species (See Appendix 1 to Sage-grouse Conservation Plan).

In addition, the parties have jointly prepared and submitted an application to the U.S. Fish and Wildlife Service (USFWS) for an Enhancement of Survival Permit under Section 10(a)(1)(A) of the Endangered Species Act. The USFWS is currently reviewing the parties draft Candidate Conservation Agreement with Assurances ("CCAA") for sage-grouse, which will be expanded to include a Candidate Conservation Agreement ("CCA"), which will apply to the federal lands within the Ranch.

The parties agree as follows with respect to the Sage-grouse Conservation Plan and any CCAA and CCA ultimately approved by the USFWS:

a. TOTCO agrees to cooperate with PCW so that PCW and its contractors can implement conservation measures outlined in the Sage-grouse Conservation Plan and any CCAA ultimately approved by the USFWS covering lands within the Ranch. The parties acknowledge that such conservation measures may include, but are not limited to, removing and marking fences, water improvement projects and other habitat improvements, reclamation of unnecessary two-track and other roads, and control of noxious and invasive plants.

b. To the extent that the finalized Sage-grouse Conservation Plan and any CCAA approved by the USFWS provide for actions on the Ranch that affect TOTCO's grazing or other agricultural operations, TOTCO agrees to fully implement all such measures as provided for in the Sage-grouse Conservation Plan and/or CCAA. TOTCO and PCW will allocate the cost of implementation of such measures on an equitable basis between them depending on the particular conservation measure involved.

c. TOTCO agrees that where it controls public access to the Ranch, access will not be permitted for the purpose of hunting sage-grouse unless otherwise agreed to by TOTCO, PCW and WGFD.

d. The parties agree to each make available appropriate staff as necessary for implementation of the conservation measures outlined in the Sage-grouse Conservation Plan and any approved CCAA as well as to make available appropriate management level employees as may be needed to attend meetings with the BLM, WGFD, and USFWS or other applicable wildlife agencies with respect to implementation and monitoring of the Sage-grouse Conservation Plan and any approved CCAA.

5. **Mule Deer.** TOTCO and PCW agree to cooperate with WGFD and BLM in developing conservation and mitigation measures related to the Baggs Mule Deer Herd and the Platte Valley Mule Deer Herd. Such measures may include: cooperative research with the University of Wyoming; collaring animals to obtain more information on the herd; and monitoring of the habitat. TOTCO has and will continue to cooperate with the WGFD and the University of Wyoming on pronghorn antelope studies by providing access to the Ranch as requested on a case-by-case basis. The CCSM Project is not expected to have an impact on either the Sierra Madre or the Elk Mountain elk herds because the majority of the high quality elk habitat is located within Sage-Grouse Core Population Areas, where no wind development activities will occur.

6. **Birds and Bats.** PCW is developing an avian and bat protection plan for those species under the jurisdiction of the WGFD as directed by the Wildlife Protection

Recommendations. PCW is working with the USFWS on a Bird and Bat Conservation Strategy ("BBCS") and an Eagle Conservation Plan ("ECP") that address conservation measures that will avoid, minimize and mitigate potential impacts of the CCSM Project on Avian and Bat Trust Species. TOTCO agrees to support PCW in implementation of the BBCS and ECP by providing reasonable access throughout the Ranch for avian and bat surveys and monitoring. TOTCO also agrees to allow PCW access to the Ranch to implement conservation measures required under the USFWS approved BBCS and ECP so long as such conservation measures do not unreasonably interfere with TOTCO's operations and are consistent with TOTCO's livestock management goals and practices as set forth in this Agreement.

7. **Watersheds.** PCW has developed a watershed monitoring plan for the CCSM Project designed to better define current watershed conditions and monitor future conditions of the watersheds. Sites from which channel characteristics and water quality will be monitored are located on TOTCO lands and state and public lands. TOTCO agrees to provide reasonable access to PCW to watershed monitoring sites on the Ranch as currently located or as may be from time to time established or relocated.

8. **Fish.** As set forth in the MOU, TOTCO has agreed to provide access to the Upper Muddy Creek drainage to designated WGFD personnel, or their supervised designees from the BLM or U.S. Forest Service, during the term of the MOU for the purpose of conducting fish surveys, the installation and maintenance of fish migration barriers, and performing mechanical and chemical treatments for habitat enhancement. The goal is to restore native roundtail chub (*Gila robusta*), bluehead sucker (*Catostomus discobolus*), flannelmouth sucker (*Catostomus latipinnis*), mountain sucker (*Catostomus platyrhynchus*), Colorado River cutthroat (*Oncorhynchus clarkii pleuriticus*) and speckled dace (*Rhinichthys osculus*) ("Upper Muddy Creek Fish Species") through improvement and enhancement of habitat.

9. **Reporting and Technical Committee.** Prior to January 31 of each year, PCW will prepare a report summarizing the previous year's wildlife monitoring program and results, and the effectiveness of PCW's wildlife protection measures and best management practices. This report will be distributed to all members of the wildlife technical advisory committee described below.

TOTCO, PCW, and WGFD will form a wildlife technical advisory committee (Wildlife TAC). The Wildlife TAC may include other federal, state or local permitting agencies, such as the Industrial Siting Council or its appointed representative, as required by law. The Wildlife TAC will meet at least annually prior to March 15 to review the prior year's wildlife monitoring results, implementation of wildlife protection measures and best management practices. Based upon prior year's results, the Wildlife TAC may recommend modification, addition or removal of monitoring protocols, wildlife protection measures or best management practices. PCW will consider the Wildlife TAC's recommendations and notify the Wildlife TAC which recommendations it will implement, consistent with PCW's federal permits for the CCSM Project.

The Wildlife TAC will meet each year during CCSM Project construction and for the first three years post-construction. Thereafter, the Wildlife TAC will determine how often to meet, but it shall be at least once every five years. The Wildlife TAC may also modify the schedule for reports to the Wildlife TAC.

10. **Post-Construction Monitoring.** PCW has agreed to post-construction monitoring as set out in Attachment A. TOTCO agrees to support PCW in implementation of its post-construction monitoring commitments by providing reasonable access throughout the Ranch as required for PCW to comply with its commitments.

11. **Reimbursement of Expenses.** Except as expressly provided otherwise in this Agreement, PCW shall reimburse TOTCO for all costs and expenses reasonably and directly incurred by TOTCO in its performance of its obligations under this Agreement.

12. **No Third-party Beneficiaries.** TOTCO and PCW are the only intended beneficiaries of this Agreement and no rights are hereby created for the benefit of any third party, including without limitation any government agency. WGFD is not a party to or an intended beneficiary of this Agreement.

13. **Breach and Remedies.** In the event of TOTCO's or PCW's material breach of this Agreement, the other party's sole remedy shall be to require specific performance of the breaching party's obligations under this Agreement. There shall be no other remedy in law or in equity other than specific performance of this Agreement, including a claim for damages of any kind. The parties shall endeavor to settle any dispute, controversy or claim arising out of or relating to this Agreement, or its breach, termination or validity, which has not been resolved by negotiation by the parties, by mediation under the then current Center for Public Resources ("CPR") Model Procedure for Mediation of Business Disputes. The neutral third party will be selected from the CPR Panel of Neutrals, with the assistance of CPR, unless the parties agree otherwise. If the matter has not been resolved within 10 days of the appointment of the neutral third party, then either party may bring an action related to the matter in any state court in Wyoming. PCW's breach of this Agreement shall not give rise to any claim of PCW's breach of (a) the MOU or (b) the Wind Easement.

14. **Covenants Running with Lands.** The provisions of this Agreement shall be covenants running with the Ranch lands and shall be binding upon and inure to the benefit of the successors and assigns of the parties hereto.

15. **No Representations or Warranties.** No representations or warranties of any kind are made by any party to this Agreement.

16. **Entire Agreement; Modification.** This agreement comprises the entire agreement between TOTCO and PCW with regard to the subject matter herein. The agreement shall not be modified, deleted or added to, except in writing signed by an authorized representative of TOTCO and PCW.

17. **Waiver.** The delay or failure of any party to enforce any of its rights under this Agreement shall not constitute a waiver of any such rights, unless such waiver is signed by an authorized representative of the waiving party and delivered to the other party. No custom or practice that may arise between the parties in the course of operating under this Agreement will be construed to waive any party's rights to either ensure the other party's strict performance with the terms and conditions of this Agreement, or to exercise any rights granted to it under this Agreement. Neither party shall be deemed to have waived any right conferred by this Agreement or under any applicable law unless such waiver is set forth in a written document signed by the party to be bound, and delivered to the other party. No express waiver by either party shall be construed as a continuing waiver of any future rights, including as a result of future breaches or defaults or defaults by the other party.

18. **Severability.** If any of the terms of this Agreement are in conflict with any applicable rule, regulation, order or law of a federal, state, county or municipal body, the terms so in conflict shall not apply and the applicable rule, regulation, order or law shall prevail. The provisions of this Agreement shall be deemed severable and the invalidity of any provision hereof shall not affect the validity of the remaining provisions.

19. **Choice of Law.** This Agreement shall be governed by and construed in accordance with the law of the State of Wyoming, excluding its conflict of laws provisions.

20. **Term.** This Agreement shall remain in effect for the life of the CCSM Project, including decommissioning and reclamation.

21. **Execution.** This Agreement may be executed and delivered in one or more counterparts, each of which when executed and delivered shall be an original, and all of which when executed shall constitute one and the same instrument. The exchange of copies of this Agreement and of signature pages by facsimile or by electronic

transmission in .pdf format shall constitute effective execution and delivery of this Agreement as to the parties, and shall be deemed to be their original signatures for all purposes. Any party that delivers an executed counterpart signature page by facsimile or in .pdf format shall promptly thereafter deliver a manually executed counterpart signature page to each of the other parties; provided, however, that the failure to do so shall not affect the validity, enforceability or binding effect of this Agreement.

22. **Recording**. This Agreement shall not be recorded.

[*Signature page follows*]

The Parties have executed this Agreement as of the date first written above.

THE OVERLAND TRAIL CATTLE COMPANY LLC

By: William Miller

Name: William J. Miller
Title: President

POWER COMPANY OF WYOMING LLC

By: ______________________________

Name: Garry L. Miller
Title: Vice President, Land and Environmental Affairs

By its signature below, the Wyoming Game and Fish Department acknowledges that it has reviewed this Agreement and concurs with the terms and conditions applicable to the parties set forth above, and further acknowledges that this Agreement satisfies the applicable requirements of the Wildlife Protection Recommendations.

Wyoming Game and Fish Department

By: ______________________________

Name:
Title:

The Parties have executed this Agreement as of the date first written above.

THE OVERLAND TRAIL CATTLE COMPANY LLC

By: William Miller

Name: William J. Miller
Title: President

POWER COMPANY OF WYOMING LLC

By: ______________________

Name: Garry L. Miller
Title: Vice President, Land and Environmental Affairs

By its signature below, the Wyoming Game and Fish Department acknowledges that it has reviewed this Agreement and concurs with the terms and conditions applicable to the parties set forth above, and further acknowledges that this Agreement satisfies the applicable requirements of the Wildlife Protection Recommendations.

Wyoming Game and Fish Department

By: John Kennedy
Name: John Kennedy
Title: Deputy Director

ATTACHMENT A

Chokecherry and Sierra Madre Wind Energy Project

Wyoming Game and Fish Department Wildlife Protection Recommendations for Wind Energy Development in Wyoming
Implementation of Post-Construction Monitoring Recommendations

Wildlife Resource	Citation[1]	WGFD Recommendations			CCSM Project Implementation
		Survey Type	Survey Objective and Use	WGFD Post-Construction Survey Duration Recommendation	
Bats	App. B, pp. 38 - 44	Habitat Evaluation	The results of habitat evaluations can be used to identify potential roosting and foraging areas for bats within project sites to prioritize surveys. A post-construction habitat evaluation is recommended following development of the project site. Compare pre- and post-construction habitat evaluations to quantify changes in habitats within the project site.	One-time	No sensitive bat habitats were identified in the CCSM Project Site; in addition, the CCSM Project design avoids placing wind turbines near the Bolten Rim, forested areas and reservoirs where bat habitat may exist. The location of the CCSM Project components precludes the need to re-evaluate bat habitat.
		Passive Acoustic	Identify and quantify bat species and relative abundance near the rotor sweep zone. Results can be used to identify bat species presence and describe bat behavior (e.g., spatial and temporal use, etc.) likely to occur near rotor sweep zone.	Three years	Should bat mortality exceed thresholds that will be identified with concurrence from the USFWS[4], the Wildlife TAC will provide recommendations for additional monitoring.[3]
		Carcass Search	Identify and quantify bat species mortality after construction of turbines. The results of post-construction carcass searches are used to estimate mortality rates of bats at wind energy development sites.	Three years	PCW will conduct monitoring for two years post-construction as recommended by the U.S. Fish and Wildlife Service Land-based Wind Energy Guidelines (Wind Energy Guidelines)[5] or as agreed upon with USFWS through concurrence on the BBCS[6] for the CCSM Project. PCW will conduct a third year of post-construction monitoring using protocols agreed upon by the Wildlife TAC.[8]
Passerines and Raptors	App. B, pp. 45 - 48	Fixed-radius 20 minute Point Count Surveys	Detect resident and migrant passerines, and other localized birds.	Three years	PCW will conduct monitoring for two years post-construction as recommended by the Wind Energy Guidelines[5] and Eagle Conservation Plan (ECP) Guidance[7] or as agreed upon with USFWS through concurrence on the BBCS and ECP for the CCSM Project. PCW will conduct a third year of post-construction monitoring using protocols agreed upon by the Wildlife TAC.[8]
		Fixed-radius Day-long Point Count Surveys	Document the species and number of birds observed, their movements and distribution, the proportion of birds occurring within the rotor sweep area, and altitude and orientation of flight during various weather conditions	Three years	PCW will conduct monitoring for two years post-construction as recommended by the Wind Energy Guidelines[5] and ECP Guidance[7] or as agreed upon with USFWS through concurrence on the BBCS and ECP for the CCSM Project. PCW will conduct a third year of post-construction monitoring using protocols agreed upon by the Wildlife TAC.[8]
		Nest Search Surveys	Locate raptor nest structures within suitable habitat	Three years	PCW will conduct monitoring for two years post-construction as recommended by the Wind Energy Guidelines[5] and ECP Guidance[7] or as agreed upon with USFWS through concurrence on the BBCS and ECP for the CCSM Project. PCW will conduct a third year of post-construction monitoring using protocols agreed upon by the Wildlife TAC.[8]

Chokecherry and Sierra Madre Wind Energy Project

Wyoming Game and Fish Department Wildlife Protection Recommendations for Wind Energy Development in Wyoming
Implementation of Post-Construction Monitoring Recommendations

Wildlife Resource	Citation[1]	WGFD Recommendations			CCSM Project Implementation
		Survey Type	Survey Objective and Use	WGFD Post-Construction Survey Duration Recommendation	
Passerines and Raptors	App. B, pp. 45 - 48	Carcass Search and Collection	Estimate annual fatality rates	Three years	PCW will conduct monitoring for two years post-construction as recommended by the Wind Energy Guidelines[5] and ECP Guidance[7] or as agreed upon with USFWS through concurrence on the BBCS and ECP for the CCSM Project. PCW will conduct a third year of post-construction monitoring using protocols agreed upon by the Wildlife TAC.[8]
Sage-Grouse	App. B, pp. 48 - 49	Lek Counts	Collect research response variables to support multi-state industry supported research programs and identify changes in distribution, movements, and habitat use	Three years	PCW will continue to work with BLM and WGFD to perform annual lek counts within the Ranch for five years post-construction.
Big Game	App. B, pp. 49	Telemetry Study	Collect post-development data in support of multi-state industry supported research programs that will help identify any associated impacts	Three years	PCW will continue to coordinate with WGFD on on-going mule deer monitoring for three years post-construction.
Amphibians	App. B, pp. 49 - 51	Incidental Observations[2]	Incidental observations while performing other wildlife surveys will allow for trend data, which could elucidate possible shifts in species assemblages resulting from energy development.	Three years	Incidental observations will be recorded by wildlife biologists during other wildlife surveys
Reptiles	App. B, pp. 52 - 56	Incidental Observations[2]	Incidental observations while performing other wildlife surveys will allow for trend data, which could elucidate possible shifts in species assemblages resulting from energy development.	Three years	Incidental observations will be recorded by wildlife biologists during other wildlife surveys
Aquatics	App B, pp. 57 - 66	Monitor culverts and roads with 5% or greater slopes	The purpose of monitoring culverts and roads with 5% or greater slope is to determine the presence, absence and/or extent of cumulative impacts resulting from changes to the upland surface hydrology, erosion and deposition, to ensure that culverts are functioning as designed and are being maintained and to ensure that the long-term BMPs that were installed are still functioning and are being maintained.	Two years post SWPPP release	PCW will monitor the CCSM Project Site in accordance with the SWPPP, Erosion Control Plan and the Reclamation Plan. The monitoring provisions of the Erosion Control Plan and Reclamation Plan extend at least two years post SWPPP release.

Chokecherry and Sierra Madre Wind Energy Project

Wyoming Game and Fish Department Wildlife Protection Recommendations for Wind Energy Development in Wyoming
Implementation of Post-Construction Monitoring Recommendations

Wildlife Resource	Citation[1]	WGFD Recommendations			CCSM Project Implementation
		Survey Type	Survey Objective and Use	WGFD Post-Construction Survey Duration Recommendation	
Aquatics	App B, pp. 57 - 66	Geomorphological Monitoring	The purpose of geomorphological monitoring activities is to determine the presence, absence and/or extent of cumulative impacts resulting from changes to upland surface hydrology, erosion and deposition and the potential for impacting habitats important to fish, macroinvertebrates, reptiles and amphibians.	Three years from preconstruction survey	PCW will continue watershed monitoring until three years post-construction, in accordance with the Watershed Monitoring Plan for the CCSM Project.

1. Wyoming Game and Fish Commission. 2010. "Wildlife Protection Recommendations for Wind Energy Development in Wyoming." November 17, 2010. http://wgfd.wyo.gov/web2011/Departments/Wildlife/pdfs/WINDENERGY_WILDLIFEPROTECTION0000703.pdf .
2. No occupied or important habitat for Species of the Greatest Conservation Need (SGCN), as identified by the Wyoming Game and Fish Department in the 2010 State Wildlife Action Plan was identified on the CCSM Project Site.
3. USFWS = United States Fish and Wildlife Service.
4. U.S. Fish and Wildlife Service. 2012. "U.S. Fish and Wildlife Service Land-based wind Energy Guidelines" March 23, 2012.
5. BBCS = Bird and Bat conservation Strategy.
6. U.S. Fish and Wildlife Service. 2013. "Eagle Conservation Plan Guidance, Module 1 – Land-based Wind Energy, Version 2" April 2013.
7. The Wildlife Technical Advisory Committee (Wildlife TAC) membership is described in Section 9 of "The Overland Trail Ranch, Chokecherry and Sierra Madre Wind Energy Project Conservation Plan and Landowner Agreement."

APPENDIX I

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Chokecherry and Sierra Madre Wind Energy Project

Applicability of BLM Environmental Constraints, Applicant Committed Measures, Applicant Committed Best Management Practices, and Proposed Mitigation Measures to Migratory Birds and Bats

Phase I Wind Turbine Development

Prepared by

Power Company of Wyoming LLC

555 Seventeenth Street

Suite 2400

Denver, CO 80202

August 2015

TABLE 1. SUMMARY OF BLM ENVIRONMENTAL CONSTRAINTS (ROD TABLE D-1)

Resource Area	Resource Concern	Protection Measure	Application to Jurisdiction[1]			Mitigation Type[2]	Authority/Source	Applicability to Migratory Birds and Bats
			Private Land[3]	State Land	Public Land			
Cultural – Historic Trails	Within either 0.25-mile or the visual horizon (whichever is closer) of a cultural property/ historic trails.	No surface disturbing activities. Management actions resulting in visual elements that diminish the integrity of the property's setting will be managed in accordance with the Wyoming State Protocol and BMPs.	Yes[4]	Yes	Yes	1	2008 Rawlins RMP ROD; Wyoming BLM Mitigation Guidelines; Wind Energy Programmatic EIS ROD Policies and BMPs.	No applicability to migratory birds and bats
Recreation Sites	Within 0.25-mile of developed and undeveloped recreation sites.	Lands closed to operation of public land laws.	Yes[4]	Yes[4]	Yes[4]	1	2008 Rawlins RMP ROD.	No applicability to migratory birds and bats. There are no developed or undeveloped recreation sites within 0.25 mile of the Phase I Wind Turbine Development Site.
Soils – Slopes	Steep slopes >25 percent.	Surface disturbance will be prohibited. No turbines, staging or substations.	Yes[5]	Yes[5]	Yes[5]	1	Wyoming BLM Mitigation Guidelines.	Measure will reduce erosion and soil loss in steep areas maintaining habitats that are used by migratory birds and bats.
Special Management Areas – Designated Areas	Designated areas part of the National Landscape Conservation System (e.g., Continental Divide National Scenic Trail [CDNST]).	Lands will be excluded from wind energy site monitoring and testing and development on lands on which wind energy development is incompatible with specific resource values. (0.25-mile swath centered on the trail)	n/a	Yes[4]	Yes	1	Wind Energy Programmatic EIS ROD Policies and BMPs.	No applicability to migratory birds and bats. The Phase I Wind Turbine Development is not located within 0.25 mile of areas designated as part of the National Landscape Conservation System.
Water – Ephemeral Channels	Within 100 feet from the inner gorge of ephemeral channels.	Avoidance areas for surface-disturbing and disruptive activities and linear crossings. Only those actions within areas that cannot be avoided and that provide protection for the resource identified will be approved.	No[5]	No[5]	Yes[5]	1	2008 Rawlins RMP ROD.	Measure will maintain vegetation and riparian corridors used by migratory birds and bats.
Water – Floodplains	Identified 100-year floodplains.	Surface disturbing activities will be avoided. Only those actions within areas that cannot be avoided and that provide protection for the resource identified will be approved.	No	No	Yes	1	2008 Rawlins RMP ROD.	Measure will maintain vegetation and riparian corridors used by migratory birds and bats.
Water – Perennial Waters, Springs, Wetlands, Riparian	Within 500 feet of perennial waters, springs, and wetland and riparian areas.	Surface disturbing activities will be avoided. Only those actions within areas that cannot be avoided and that provide protection for the resource identified will be approved.	No[4,5]	No[4,5]	Yes[5]	1	2008 Rawlins RMP ROD; Wyoming BLM Mitigation Guidelines; Executive Orders (EOs) 11990 and 11988.	Measure will maintain vegetation, water bodies, and riparian corridors used by migratory birds and bats.
Water – Unstable Areas	Unstable areas (such as landslides, slopes >25 percent, slumps, and areas exhibiting soil creep).	Surface disturbing activities will be avoided. Reclamation practices and BMPs will be applied as appropriate for surface disturbing activities.	No	No	Yes	1	2008 Rawlins RMP ROD.	Measure will reduce erosion and soil loss in steep areas maintaining habitats that are used by migratory birds and bats.

TABLE 1. SUMMARY OF BLM ENVIRONMENTAL CONSTRAINTS (ROD TABLE D-1)

Resource Area	Resource Concern	Protection Measure	Application to Jurisdiction[1]			Mitigation Type[2]	Authority/Source	Applicability to Migratory Birds and Bats
			Private Land[3]	State Land	Public Land			
Water – Wetlands	Wetlands identified on National Wetlands Inventory (NWI) or proper functioning condition (PFC).[6]	No disturbance.	No	No	Yes	1	EOs 11990 and 11988.	Measure will maintain vegetation, water bodies, and riparian corridors used by migratory birds and bats.
Wildlife – Amphibians	Identified 100-year floodplains; within 500 feet of perennial waters, springs, wells, and wetlands; and within 100 feet of the inner gorge of ephemeral channels.	Surface disturbing and disruptive activities will be avoided.	No	No	Yes	1	2008 Rawlins RMP ROD.	Measure will maintain vegetation, water bodies, and riparian corridors used by migratory birds and bats.
Wildlife – Fish	Waterbodies that potentially support fish for a portion of the year.	Design road crossings to simulate natural stream processes.	No	No	Yes	1	2008 Rawlins RMP ROD.	Measure will maintain vegetation, water bodies, and riparian corridors used by migratory birds and bats.
Wildlife – Raptors	825 feet of active raptor nests (ferruginous hawks, 1,200 feet).	Well locations, roads, ancillary facilities, and other surface structures requiring a repeated human presence will not be allowed. Distance may vary depending on factors such as nest activity, species, natural topographic barriers, and line-of-sight distances.	Yes	Yes	Yes	1	2008 Rawlins RMP ROD.	Measure will minimize impacts to active raptor nests.
Wildlife-Columbian Sharp-tailed Grouse	0.25 mile to 1 mile of an occupied or undetermined Columbian sharp-tailed grouse lek.	High-profile structures (e.g., buildings, storage tanks, overhead powerlines, wind turbines, towers, and windmills) would be authorized on a case-by-case basis from one-quarter mile to 1 mile of an occupied greater sage-grouse and sharp-tailed grouse lek.	No	No	Yes	1	2008 Rawlins RMP ROD.	No applicability to migratory birds and bats. Columbian sharp-tailed grouse do not occur within 1-mile of Phase I.
Wildlife – Greater Sage-grouse	Inside Core Areas: 0.60 mile NSU from lek perimeter (includes occupied and undetermined leks). Outside Core Areas: 0.25 mile NSU from lek perimeter (includes occupied and undetermined leks).	Surface disturbing activities or surface occupancy is prohibited or restricted.	Yes	Yes	Yes	1	BLM IM No. WY-2012-019	Measure will minimize impacts to sagebrush habitats that are used by sagebrush obligate bird species and other migratory bird and bat species.

TABLE 1. SUMMARY OF BLM ENVIRONMENTAL CONSTRAINTS (ROD TABLE D-1)

Resource Area	Resource Concern	Protection Measure	Application to Jurisdiction[1]			Mitigation Type[2]	Authority/Source	Applicability to Migratory Birds and Bats
			Private Land[3]	State Land	Public Land			
Wildlife – Greater Sage-grouse	Inside Core Areas.	Limit development to one disturbance location per 640 acres. Cumulative value of one location and existing disturbance to not exceed 5 percent of sagebrush habitat within 640 acres	No	No	Yes	1	BLM IM No. WY-2012-019	PCW has committed to site the CCSM Project outside designated greater sage-grouse core areas (Order 2011-5, Attachment A, Sage-Grouse Core Breeding Areas Version 3). Measure will avoid impacts, including fragmentation, to habitats that are used by sagebrush obligate bird species and other migratory bird and bat species.
Wildlife – Greater Sage-Grouse	0.25-mile to 1 mile of an occupied sage-grouse lek.	High-profile structures (e.g., buildings, storage tanks, overhead power lines, wind turbines, towers, and windmills) will be authorized on a case-by-case basis.	No	No	Yes	1	2008 Rawlins RMP ROD.	No applicability to migratory birds and bats.
Wildlife – Greater Sage-grouse	Inside Core Areas: Within 0.60-mile of the perimeter of an occupied or undetermined greater sage-grouse lek. Outside Core Areas: Within 0.25-mile of the perimeter of an occupied or undetermined greater sage-grouse lek.	Disruptive activities are restricted between 6:00 p.m. and 9:00 a.m. from March 1 to May 20.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD; BLM IM No. WY-2012-019.	Measure will reduce disturbance of nocturnal and crepuscular species across Phase I.
Wildlife – Greater Sage-grouse	Inside Core Areas: In suitable greater sage-grouse nesting and early brood-rearing habitat. Outside Core Areas: In suitable greater sage-grouse nesting and early brood-rearing habitat within 1) mapped habitat important for connectivity, or 2) within 2 miles of any occupied or undetermined lek.	Surface disturbing and/or disruptive activities are prohibited or restricted from March 1 – July 15.	No[7]	No[7]	Yes	2	BLM IM No. WY-2012-019; 2008 Rawlins RMP ROD.	Measure will reduce impacts to migrating and nesting migratory birds and bats that use sagebrush habitat and other associated habitats within Phase I.

TABLE 1. SUMMARY OF BLM ENVIRONMENTAL CONSTRAINTS (ROD TABLE D-1)

Resource Area	Resource Concern	Protection Measure	Application to Jurisdiction[1]			Mitigation Type[2]	Authority/Source	Applicability to Migratory Birds and Bats
			Private Land[3]	State Land	Public Land			
Wildlife – Greater Sage-grouse	Greater sage-grouse delineated winter concentration areas.	Surface disturbing and/or disruptive activities in mapped or modeled greater sage-grouse winter habitats/concentration areas that support Core Area populations, are prohibited or restricted from November 15 – March 14.	No[7]	No[7]	Yes	2	BLM IM No. WY-2012-019; 2008 Rawlins RMP ROD.	No applicability to migratory birds and bats. There are no delineated greater sage-grouse winter concentration areas in the CCSM Project Site.
Wildlife – Columbian Sharp-tailed Grouse	Within 0.25-mile of the perimeter of an occupied or undetermined Columbian sharp-tailed grouse lek.	Surface disturbing activities or occupancy are prohibited. Disruptive activities are prohibited between 6:00 p.m. and 9:00 a.m. from March 1 to May 20.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	No applicability to migratory birds and bats. Columbian sharp-tailed grouse do not occur in CCSM Project Site.
Wildlife – Barn Owl	Within 0.75-mile of barn owl nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited February 1–July 15.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	Barn owls are not known to occur in the CCSM Project Site. In the unlikely event that a barn owl nest is discovered, this measure will reduce impacts to the nest when active.
Wildlife – Big Game	Big game crucial winter range.	Surface disturbing and disruptive activities will not be allowed during the period of November 15 to April 30. Disruptive activities will require the use of BMPs designed to reduce the amount of human presence and activity during the winter months.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD; Wyoming BLM Mitigation Guidelines.	Limited applicability to migratory birds and bats. No bats and very few migratory birds occur in Phase I during winter. However, measure will reduce impacts and disturbance to migratory bird species using Phase I in winter.
Wildlife – Big Game	Big game parturition areas.	Surface disturbing and disruptive activities will not be allowed during the period of May 1 to June 30.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD; Wyoming BLM Mitigation Guidelines.	No applicability. No big game parturition areas occur in Phase I.
Wildlife – Burrowing Owl	Within 0.75-mile of burrowing owl nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited April 15–September 15.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	Measure will minimize impacts to active burrowing owl nests.
Wildlife – Cooper's Hawk	Within 0.75-mile of Cooper's hawk nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited April 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	Measure will minimize impacts to active Cooper's hawk nests.
Wildlife – Ferruginous Hawk	Within 1-mile buffer of ferruginous hawk nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited March 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	No active ferruginous hawk nests have been documented in more than 5 years of monitoring for the CCSM Project. However, measure will minimize impacts to any active ferruginous hawk nests that may occur in the future.

TABLE 1. SUMMARY OF BLM ENVIRONMENTAL CONSTRAINTS (ROD TABLE D-1)

Resource Area	Resource Concern	Protection Measure	Application to Jurisdiction[1]			Mitigation Type[2]	Authority/Source	Applicability to Migratory Birds and Bats
			Private Land[3]	State Land	Public Land			
Wildlife – Golden Eagle	Within 1-mile buffer of golden eagle nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited February 1–July 15.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	PCW's Phase I ECP describes the benefits of the avoidance and minimization measures developed for golden eagles.
Wildlife – Goshawk	Within 0.75-mile of Goshawk nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited April 1–August 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	No active goshawk nests have been documented in more than 5 years of monitoring for the CCSM Project. However, measure will minimize impacts to any active goshawk nests that may occur in the future.
Wildlife – Great-Horned Owl	Within 0.75-mile of great-horned owl nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited February 1–July 15.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	Measure will minimize impacts to active great horned owl nests.
Wildlife – Kestrel	Within 0.75-mile of kestrel nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited April 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	Measure will minimize impacts to active American kestrel nests.
Wildlife – Long-Eared Owl	Within 0.75-mile of long-eared owl nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited March 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	No active long-eared owl nests have been documented in more than 5 years of monitoring for the CCSM Project. However, measure will minimize impacts to any active long-eared owl nests that may occur in the future.
Wildlife – Merlin	Within 0.75-mile of Merlin nests.	Seasonal wildlife stipulation April 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	No active merlin nests have been documented in more than 5 years of monitoring for the CCSM Project. However, measure will minimize impacts to any active merlin nests that may occur in the future.
Wildlife – Mountain Plover	Potential and occupied habitat Mountain plover.	Habitat will be avoided where practical. All surface-disturbing activities will be restricted from April 10 to July 10. Additional protection measures will be applied if this area is later determined to be within occupied habitat. Occupied habitat is defined as areas where broods and adults have been found.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	Measure will minimize impacts to mountain plovers and other migratory bird and bat species that use occupied mountain plover habitats.
Wildlife – Northern Harrier	Within 0.75-mile of northern harrier nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited April 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	Measure will minimize impacts to active northern harrier nests.
Wildlife – Osprey	Within 0.75-mile of osprey nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited April 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	No active osprey nests have been documented in more than 5 years of monitoring for the CCSM Project. However, measure will minimize impacts to any active osprey nests that may occur in the future.

TABLE 1. SUMMARY OF BLM ENVIRONMENTAL CONSTRAINTS (ROD TABLE D-1)

Resource Area	Resource Concern	Protection Measure	Application to Jurisdiction[1]			Mitigation Type[2]	Authority/Source	Applicability to Migratory Birds and Bats
			Private Land[3]	State Land	Public Land			
Wildlife – Peregrine Falcon	Within 0.75-mile of peregrine falcon nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited March 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	No active peregrine falcon nests have been documented in more than 5 years of monitoring for the CCSM Project. However, measure will minimize impacts to any active peregrine falcon nests that may occur in the future.
Wildlife – Prairie Falcon	Within 0.75-mile of prairie falcon nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited April 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	Measure will minimize impacts to active prairie falcon nests.
Wildlife – Raptor	Defined raptor and game bird winter concentration areas.	Activities or surface use will not be allowed from November 15 to April 30.	No[7]	No[7]	Yes	2	Wyoming BLM Mitigation Guidelines.	No applicability to migratory birds and bats. No raptor or game bird winter concentration areas occur in the CCSM Project Site.
Wildlife – Raptor	Raptor nesting habitat.	Activities or surface use will not be allowed from February 1 to July 31.	No[7]	No[7]	Yes	2	Wyoming BLM Mitigation Guidelines.	Measure will minimize impacts to active raptor nests.
Wildlife – Raptors	Within 0.75-mile of other raptor nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited February 1–July 15.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	Measure will minimize impacts to active raptor nests.
Wildlife – Red-Tailed Hawk	Within 0.75-mile of red-tailed hawk nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited February 1–July 15.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	Measure will minimize impacts to active red-tailed hawk nests.
Wildlife – Screech Owl	Within 0.75-mile of screech owl nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited March 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	No active screech owl nests have been documented in more than 5 years of monitoring for the CCSM Project. However, measure will minimize impacts to any active screech owl nests that may occur in the future.
Wildlife – Sharp-Shinned Hawk	Within 0.75-mile of sharp-shinned hawk nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited April 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	Measure will minimize impacts to sharp-shinned hawk nests.
Wildlife – Short-Eared Owl	Within 0.75-mile of short-eared owl nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited March 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	No active short-eared owl nests have been documented in more than 5 years of monitoring for the CCSM Project. However, measure will minimize impacts to any active short-eared owl nests that may occur in the future.
Wildlife – Swainson's Hawk	Within 0.75-mile of Swainson's hawk nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited April 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	Measure will minimize impacts to sharp-shinned hawk nests.
Wildlife – Western Yellow-billed Cuckoo	Within 0.5 mile radius yellow-billed cuckoo nest.	Seasonal wildlife stipulation April 15–August 15.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	No suitable western yellow-billed cuckoo habitat is present within the vicinity of the CCSM Project Site.

TABLE 1. SUMMARY OF BLM ENVIRONMENTAL CONSTRAINTS (ROD TABLE D-1)

Resource Area	Resource Concern	Protection Measure	Application to Jurisdiction[1]			Mitigation Type[2]	Authority/Source	Applicability to Migratory Birds and Bats
			Private Land[3]	State Land	Public Land			

Notes:

[1] Sources of information for application of stipulations for private and state lands include *Applicant Proposed Alternative and BLM Response Letter* (April 23, 2010), *PCW Response and Data on BLM Alternatives* (December 2009), and the *Plan of Development for the Chokecherry and Sierra Madre Wind Energy Project* (January 12, 2012).

[2] 1 = Restriction; 2 = Seasonal.

[3] As indicated in PCW's submittal entitled *Applicant Proposed Alternative and BLM Response Letter* (April 23, 2010).

[4] Applicant imposes more restrictive measures or applies measure to a specific area, see summary table of PCW ACMs.

[5] Per the *PCW Response and Data on BLM Alternatives* (December 2009) footnotes to Alternatives Summaries #18, "No Surface Uses (NSUs), as provided by BLM, were avoided to the extent practicable; however, some NSUs could not be completely avoided in a small number of discreet instances (mainly ephemeral streams, slope, and perennial streams/springs/wetlands/riparian). An example of an exception to the NSUs is where a turbine is located in an area that cannot be accessed without crossing an ephemeral stream. If it is determined that the stream is a Water of the U.S., then a Section 404 permit will be obtained thereby allowing an access road to be constructed. Another example is the slope criteria. The accuracy of the digital terrain model used for this analysis is insufficient for micro-siting. Engineering judgment was used to determine in a limited number of cases that it may be possible to grade a resource road to design criteria."

[6] See Chapter 8.0, Glossary.

[7] Per the *PCW Response and Data on BLM Alternatives* (December 2009) footnotes to Alternatives Summaries #10, "seasonal timing restrictions were not applied to construction activities on private land."

TABLE 2. SUMMARY OF APPLICANT COMMITTED MEASURES (ROD TABLE D-2)

Item	Environmental Resource	Applicant Committed Measure	Applicability to Migratory Birds and Bats
A-1-01	ESA, sensitive species, and other wildlife and fish species	Site-specific surveys and/or monitoring for ESA threatened and endangered species, BLM sensitive species and other wildlife and fish species will take place during each phase of construction. Survey and monitoring approaches will be developed in coordination with USFWS, BLM, and WGFD and will be identified in the site-specific PODs developed for each construction right-of-way grant.	Site-specific survey requirements have identified sensitive habitats and areas of avian use. Data was used to avoid and minimize impacts to migratory birds and bats as documented in Phase I BBCS.
A-1-02	Avian and Bat Species, Golden and Bald Eagles	PCW will develop an Avian Protection Plan (APP), a Bat Protection Plan (BPP) and an Eagle Conservation Strategy (ECS) to identify measures to avoid, minimize, and mitigate project impacts through siting, operations, and monitoring.	The Phase I BBCS identifies measures to avoid, minimize, and mitigate project impacts to migratory birds and bats through siting, operations, and monitoring.
A-1-03	Greater Sage-grouse	PCW will comply with EO 2011-5 and commit to no construction activities within Wyoming's SGCA as they are identified in EO 2011-5 (Core Area Version 3 Map).	PCW has committed to locate the CCSM Project outside designated greater sage-grouse core areas (Order 2011-5, Attachment A, Sage-Grouse Core Breeding Areas Version 3). Measure will avoid impacts, including fragmentation, to habitats that are used by sagebrush obligate bird species and other migratory bird and bat species.
A-1-04	Wildlife Habitat Management Areas	PCW will not construct any facilities within portions of the Red Rim-Grizzly WHMA and Upper Muddy Creek Watershed-Grizzly WHMA that are within the Wyoming Sage-Grouse Core Management Area Version 3 Map (EO 2011-5).	See response to A-1-03.
A-1-05	Mule Deer	PCW will continue to coordinate with WGFD on ongoing mule deer monitoring efforts on the Ranch.	No applicability to migratory birds and bats.

TABLE 2. SUMMARY OF APPLICANT COMMITTED MEASURES (ROD TABLE D-2)

Item	Environmental Resource	Applicant Committed Measure	Applicability to Migratory Birds and Bats
A-1-06	Colorado River Fishes – bluehead sucker, flannelmouth sucker, roundtail chub, Colorado River cutthroat trout	PCW will continue to work with WGFD and BLM to develop conservation and monitoring strategies for native fish species in the Upper Muddy Creek watershed.	No applicability to migratory birds and bats.
A-1-07	Fish species, amphibian species, other stream obligates; water quality	PCW will monitor watershed and stream conditions throughout the Application Area to document hydrologic conditions and stream channel characteristics (see Appendix F – Watershed Monitoring Plan).	Measure will document any changes to hydrologic conditions and stream channel characteristics that might impact habitats used by migratory birds and bats.
A-1-08	Other wildlife species	PCW will continue to incorporate the outcome of site-specific surveys to microsite infrastructure in order to avoid, minimize, or mitigate impacts to wildlife species.	Site-specific surveys were used to microsite Phase I to avoid, minimize and mitigate impacts to sensitive wildlife species including migratory birds and bats.
A-1-09	Wildlife Stipulations	PCW will adhere to the timing and spatial stipulations and exception processes as they are described in the Project ROD.	Measure benefits migratory birds and bats as documented in this appendix (Appendix I).
A-1-10	Wildlife Stipulations	Timing and spatial stipulations will be used on public lands.	Measure benefits migratory birds and bats as documented in this appendix (Appendix I).
A-1-11	Avian and Bat Monitoring	PCW will develop a project Avian Protection Plan, Bat Protection Plan and Eagle Conservation Strategy that will each describe post-construction monitoring efforts for avian and bat species.	The Phase I BBCS identifies post-construction monitoring and adaptive management processes designed to benefit migratory birds and bats.
A-1-12	Wildlife Monitoring and Survey	PCW will continue to incorporate the outcome of site-specific surveys to microsite infrastructure in order to avoid, minimize, or mitigate impacts to sensitive wildlife species.	Site-specific surveys were used to microsite Phase I to avoid, minimize and mitigate impacts to sensitive wildlife species including migratory birds and bats.

TABLE 2. SUMMARY OF APPLICANT COMMITTED MEASURES (ROD TABLE D-2)

Item	Environmental Resource	Applicant Committed Measure	Applicability to Migratory Birds and Bats
A-1-13	Vegetation	Vegetation datasets developed by PCW will be used during project design to identify sensitive vegetation types for avoidance, minimization or mitigation and to optimize the reclamation plans for each construction phase.	PCW used its vegetation datasets to avoid and minimize impacts, including fragmentation, to sensitive vegetation within Phase I. The reclamation plan for Phase I identifies appropriate BMPs to minimize and mitigate remaining impacts. These measures will benefit migratory birds and bats that use those habitats.
A-1-14	Colorado butterfly plant and Ute ladies'-tresses orchid	Site-specific surveys for both plant species will be completed prior to surface disturbing activities in suitable habitat.	No applicability to migratory birds and bats.
A-1-15	Revegetation and Reclamation	PCW will develop detailed reclamation plans for each of the construction phases and right-of-way grants. These plans will consider site-specific conditions and design considerations to maximize reclamation success.	The reclamation plan for Phase I identifies BMPs to minimize and mitigate vegetation impacts. These measures will benefit migratory birds and bats that use habitats disturbed by Phase I.
A-1-16	Wetland Resources	Facilities would be sited to avoid and/or minimize impacts.	Measure will maintain vegetation, water bodies, and riparian corridors used by migratory birds and bats.
A-1-17	Wetland Resources	Any construction that occurs in or adjacent to wetlands and streams would use BMPs to protect surface water quality and minimize impacts to those resources.	Measure will maintain vegetation, water bodies, and riparian corridors used by migratory birds and bats.
A-1-18	Cultural Resources	Class III inventories of all proposed disturbance areas associated with the site-specific POD will be conducted prior to construction.	No applicability to migratory birds and bats.
A-1-19	Cultural Resources	All cultural resource identification, evaluation, and treatment, including as a result of unexpected discovery at such time that construction has been permitted, will follow the stipulations of the Programmatic Agreement (PA) established for the project.	No applicability to migratory birds and bats.

TABLE 2. SUMMARY OF APPLICANT COMMITTED MEASURES (ROD TABLE D-2)

Item	Environmental Resource	Applicant Committed Measure	Applicability to Migratory Birds and Bats
A-1-20	Paleontological Resources	In the event that fossils are discovered on public lands during construction activities, PCW will suspend work in that area, have an on-call paleontologist review the fossils, and notify the BLM. PCW expects the significance of the discovery and the resulting course of action to be determined within 48 hours of discovery.	No applicability to migratory birds and bats.
A-1-21	Watershed Resources	PCW has implemented a watershed monitoring program to evaluate potential impacts of project construction and operations. PCW commits to continue watershed monitoring efforts for three years post-construction.	Measure will document any changes to hydrologic conditions and stream channel characteristics that may impact habitats used by migratory birds and bats.
A-1-22	Greater Sage-Grouse	PCW will work cooperatively with BLM and WGFD to perform annual lek monitoring within the Ranch in accordance with approved WGFD protocols during pre-construction, construction and for five years post-construction.	No applicability to migratory birds and bats.
A-1-23	Greater Sage-Grouse	PCW will work with BLM and private landowners to identify fences that pose a significant collision risk to sage-grouse. Identified fences will be removed or marked as practicable. To date PCW and TOTCO have removed over 10 miles of fence and have marked an additional 16 miles of fence with reflective bird diverters.	Removing or marking fences will avoid and minimize risks to migratory birds.

TABLE 2. SUMMARY OF APPLICANT COMMITTED MEASURES (ROD TABLE D-2)

Item	Environmental Resource	Applicant Committed Measure	Applicability to Migratory Birds and Bats
A-1-24	Greater Sage-Grouse	PCW will work with BLM and private landowners to evaluate proposed new fences and determine the risk of such fences to sage-grouse. If significant risk exists, new fence construction will be deferred where possible; if fences must be constructed they will be marked with reflective bird diverters.	Proper planning of new fences will avoid and minimize risks to migratory birds.
A-1-25	Avian Species including Bald and golden Eagles and Greater Sage-Grouse	Guy wires on meteorological towers will be marked with reflective bird diverters. To date PCW has marked all guy wires on Project meteorological towers with reflective bird diverters.	Phase I meteorological towers do not include guy wires. This avoids the risk of collision for migratory birds and bats.
A-1-26	Wildlife including Greater Sage-Grouse, Other Avian Species and Small Mammals	PCW will work with private landowners to install metal mesh escape ladders in water tanks that pose a risk to wildlife species. To date, PCW and TOTCO have installed metal mesh escape ramps on many Ranch water tanks.	Water tanks are a known source of mortality for migratory birds. Installation of escape ladders will avoid and minimize this risk.
A-1-27	Wildlife including Greater Sage-Grouse and Bald and Golden Eagles	PCW will work with BLM and private landowners to stabilize and rehabilitate burned areas to promote the biological integrity of the site and limit expansion of invasive species. In 2010 PCW and TOTCO pursued stabilization and recovery of a burned area in the Chokecherry site with an emphasis on rapid recovery and use of the area by sage-grouse and other species.	Rehabilitation of burned areas will restore native vegetation communities, decrease habitat fragmentation, avoid displacement, and maintain habitat for migratory birds and bats.
A-1-28	Wildlife including Greater Sage-Grouse and Bald and Golden Eagles	PCW will work with private landowners and water right owners to pursue water improvement conservation projects to benefit greater sage-grouse and other wildlife species in accordance with all applicable rules and regulations.	Water improvement conservation projects will benefit migratory birds and bats that use those habitats.

TABLE 2. SUMMARY OF APPLICANT COMMITTED MEASURES (ROD TABLE D-2)

Item	Environmental Resource	Applicant Committed Measure	Applicability to Migratory Birds and Bats
A-1-29	Wildlife including Greater Sage-Grouse and Bald and Golden Eagles	PCW will work with private land owners to enhance fallow agricultural fields on the Ranch located east of the North Platte River. Enhancements include vegetation treatments to improve forage and cover for greater sage-grouse.	Restoration of sagebrush and other associated habitats will benefit sagebrush obligate species and other migratory bird and bat species through the reduction of habitat fragmentation.
A-1-30	Wildlife including Greater Sage-Grouse and Bald and Golden Eagles	To minimize habitat fragmentation PCW will work with BLM and private landowners to close unnecessary roadways and reclaim such roads where practicable.	Road closure and reclamation will reduce habitat fragmentation and eliminate vehicle collision risk for migratory birds and bats on those roadways.
A-1-31	Wildlife including Greater Sage-Grouse and Bald and Golden Eagles	PCW will work with BLM and private landowners to control the spread of noxious and invasive plant species.	Noxious weed management will benefit migratory bird and bat species by maintaining habitat functionality and avoiding habitat degradation and species displacement.
A-1-32	Greater Sage-Grouse	PCW will work with private landowners to suspend the hunting of sage-grouse on private lands within the Ranch	Reduction of lead in the environment benefits migratory birds that may ingest or otherwise come in contact with lead.
A-1-33	Greater Sage-Grouse	PCW will cooperate with agencies and private land owners to evaluate and implement predator control techniques to benefit sage-grouse as appropriate.	Reduction of sage-grouse non-avian predators will also decrease predation risks for migratory birds and bats.

TABLE 3. SUMMARY OF APPLICANT COMMITTED MEASURES (ROD TABLE D-2)

Item	Resource Concern	Restriction Distance	Jurisdiction			Applies To					Notes	Applicability to Migratory Birds and Bats
			Private	State	BLM	WTGs	Subs	Roads	Collection	T-Line		
A-2-01	Cultural Historic Trails	1 mile WTGs, 0.25 mile surface of the Overland Trail	Y	Y	Y	Y	Y	No, minimize crossings, cross at right angles			1 mile setback from the center of the Overland Trail as presently mapped (2008 RMP/ROD) in all areas except the following sections, where the BLM's RMP requirement of 0.25 miles were used: T18N R87W S6; T18N R88W S1; T18N R88W S2; T18N R88W S4; T18N R88W S7; T18N R88W S9; T18N R89W S11; T18N R89W S12; T18N R89W S13; T18N R89W S14; and the unmapped Overland Trail alternative route located in T18N R88W S6, T18N R89W S1, T18N R89W S2, T18N R89W S11, and T18N R89W S10.	No applicability to migratory birds and bats.

TABLE 3. SUMMARY OF APPLICANT COMMITTED MEASURES (ROD TABLE D-2)

Item	Resource Concern	Restriction Distance	Jurisdiction			Applies To			Notes	Applicability to Migratory Birds and Bats
			Private	State	BLM	WTGs	Subs	Roads Collection T-Line		
A-2-02	Lands and Realty - City/Town Limits	Structure base 0.5 mile setback	Y	Y	Y	Y	Y	No	Setback only applies to "towers," term not defined in Act; PCW to apply setback to WTGs, overhead collection, and transmission structures based on the height of each structure	No applicability to migratory birds and bats.
A-2-03	Lands and Realty Homes/ Occupied Buildings	Greater of 5.5 times total structure height or 1,000 ft. setback	Y	Y	Y	Y	N	No	Setback only applies to "towers," term not defined in Act; PCW to apply setback to WTGs, overhead collection, and transmission structures based on the height of each structure	No applicability to migratory birds and bats.
A-2-04	Lands and Realty - ROW Setback	5D from ROW boundary	N	N	Y	Y	N	No	Waiver may be granted	No applicability to migratory birds and bats.

TABLE 3. SUMMARY OF APPLICANT COMMITTED MEASURES (ROD TABLE D-2)

Item	Resource Concern	Restriction Distance	Jurisdiction			Applies To			Notes	Applicability to Migratory Birds and Bats
			Private	State	BLM	WTGs	Subs	Roads Collection T-Line		
A-2-05	Lands and Realty - Subdivisions	Greater of 5.5 times total structure height or 1,000 ft. setback	Y	Y	Y	Y	Y	Yes, except underground	Setback applies to all above-ground construction, underground appears permissible within setback	No applicability to migratory birds and bats.
A-2-06	Lands and Realty - WTGs	Tower base 1.1 times total structure height from external property lines	Y	Y	Y	Y	N	No	Setback only applies to "towers," term not defined in Act; PCW to apply setback to WTGs, overhead collection, and transmission structures based on the height of each structure	No applicability to migratory birds and bats.
A-2-07	Lands and Realty - WTGs	Tower base 1.1 times total structure height from any public ROWs	Y	Y	Y	Y	N	No	Setback only applies to "towers," term not defined in Act; PCW to apply setback to WTGs, overhead collection, and transmission structures based on the height of each structure	No applicability to migratory birds and bats.

TABLE 3. SUMMARY OF APPLICANT COMMITTED MEASURES (ROD TABLE D-2)

Item	Resource Concern	Restriction Distance	Jurisdiction			Applies To			Notes	Applicability to Migratory Birds and Bats
			Private	State	BLM	WTGs	Subs	Roads Collection T-Line		
A-2-08	Recreation - Teton Reservoir	1 mile boundary WTGs of Teton Reservoir	Y	Y	Y	Y	N	No	WTG placement would be prohibited within one mile of the Teton Reservoir Recreation Site.	Waterbirds/waterfowl and other migratory birds and bats that use areas within 1-mile of Teton Reservoir benefit from this measure.
A-2-09	Water - North Platte River	1 mile high water mark WTGs of the North Platte River	Y	Y	Y	Y	Y	No, avoid if possible	WTG placement would be prohibited within one mile of the ordinary high water mark of the North Platte River.	Waterbirds/waterfowl and other migratory birds and bats that use the areas within 1-mile of the ordinary high water mark of the North Platte River benefit from this measure.

TABLE 3. SUMMARY OF APPLICANT COMMITTED MEASURES (ROD TABLE D-2)

Item	Resource Concern	Restriction Distance	Jurisdiction			Applies To			Notes	Applicability to Migratory Birds and Bats
			Private	State	BLM	WTGs	Subs	Roads Collection T-Line		
A-2-10	Wildlife - Red Rim Grizzly Wildlife Habitat Area (WHMA)	No development within Red Rim-Grizzly WHMA within the Wyoming Sage-Grouse Core Management Areas Version 3 Map (finalized June 29, 2010)	Y	Y	Y	Y	Y	Yes	The Wyoming Game and Fish Department's (WGFD) Red Rim-Grizzly WHMA is approximately 37,630 acres in total, of which approximately 1,200 acres (3%) lie outside Sage-Grouse Core Management Areas Version 3. The area outside Sage-Grouse Core Management Areas Version 3 is located in the northeast corner of the Grizzly WHMA and is a part of or adjacent to Miller Hill. PCW may locate facilities within this area of the Grizzly WHMA.	Phase I is not located within the Red-Rim Grizzly WHMA. Avoidance of this area benefits the migratory bird and bat species that utilize the WHMA.

TABLE 3. SUMMARY OF APPLICANT COMMITTED MEASURES (ROD TABLE D-2)

Item	Resource Concern	Restriction Distance	Jurisdiction			Applies To					Notes	Applicability to Migratory Birds and Bats
			Private	State	BLM	WTGs	Subs	Roads	Collection	T-Line		
A-2-11	Wildlife-Sage-Grouse Core Breeding Area	No facilities within the Wyoming Sage-Grouse Core Management Area Version 3 Map (finalized June 29, 2010)	Y	Y	Y	Y	Y	Yes			No construction of any facilities (WTGs, roads, transmission lines, collector lines, substations, staging areas, etc.) in Wyoming's Sage-Grouse Core Management Areas Version 3 (finalized June 29, 2010).	PCW has committed to site the CCSM Project outside designated greater sage-grouse core areas (Order 2011-5, Attachment A, Sage-Grouse Core Breeding Areas Version 3). Measure will avoid impacts, including fragmentation, to habitats that are used by sagebrush obligate bird species and other migratory bird and bat species.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-01	Air – Dust Control	Water would be applied twice per day, or as deemed necessary by the Environmental Inspector, to all disturbed surfaces (i.e., exposed, dry, and unfrozen) during construction. During operation, dust control would occur twice per day in those areas where vehicular traffic exceeds normal operational needs. If, for example, heavy equipment is brought on site for maintenance or if vehicular traffic exceeds a few vehicles per day, additional dust control watering would be initiated.	Dust control measures decrease impacts to vegetation and benefit migratory birds and bats.
A-3-02	Air – Dust Control	Magnesium chloride may be applied, if necessary, for adequate dust suppression. These treatments would occur on an as-needed basis, depending on weather conditions and the amount of traffic on the road.	Dust control measures decrease impacts to vegetation and benefit migratory birds and bats.
A-3-03	Air – Dust Control	The driving surface of all roads constructed for project access would be surfaced with gravel to further reduce potential dust emissions.	Dust control measures decrease impacts to vegetation and benefit migratory birds and bats.
A-3-04	Air – Dust Control	Dust abatement techniques would be used on unpaved, unvegetated surfaces to minimize airborne dust. Dust abatement techniques would be employed on construction materials and stockpiled soils if they are a source of fugitive dust. Dust abatement techniques would be used before and during surface clearing, excavation, or blasting activities.	Dust control measures decrease impacts to vegetation and benefit migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-05	Air – Dust Control	Speed limits (e.g., 25 miles per hour [mph] [40 kilometers per hour [km/h]) would be posted along all access roads and enforced during construction and maintenance activities and enforced to reduce airborne fugitive dust.	Dust control measures decrease impacts to vegetation and benefit migratory birds and bats. Controlling vehicle speeds will also minimize risks associated with vehicle collision.
A-3-06	Air – Vehicle Emissions	All construction equipment would be maintained in good working condition and would contain appropriate pollution control devices to minimize trace gas emissions.	No direct benefit to migratory birds or bats.
A-3-07	Cultural and Paleontological Resources	Unexpected discovery of cultural or paleontological resources during construction would be brought to the attention of the responsible BLM authorized officer immediately. Work would be halted in the vicinity of the find to avoid further disturbance to the resources while they are being evaluated and appropriate mitigation measures are being developed.	No applicability to migratory birds and bats
A-3-08	General – Decommissioning	Prior to the termination of the right-of-way authorization, a decommissioning plan would be developed and approved by the BLM. The decommissioning plan would include a decommissioning impact analysis, site reclamation plan and monitoring program. All management plans, BMPs, and stipulations developed for the construction phase would be applied to similar activities during the decommissioning phase as agreed to between BLM and PCW.	Development of a decommissioning plan using the decommissioning BMPs described in the Phase I BBCS will minimize risks to migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-09	General – Decommissioning	All turbines and ancillary (above-ground) structures would be removed from the site.	Removal of above-ground structures and reclamation of disturbed areas will benefit migratory birds and bats by returning habitat values. Removing above-ground structures will also remove collision risk for migratory birds and bats.
A-3-10	General – Avoidance of sensitive areas	PCW would work with the BLM to mitigate for environmentally sensitive areas. Marshy soils, drainage bottoms, and riparian areas would be avoided to the extent practicable.	Mitigation of environmentally sensitive areas will benefit the migratory bird and bat species that use those areas.
A-3-11	General – Electrical Lines	All underground electrical collector lines would be buried in a manner that minimizes additional surface disturbance (e.g., along roads or other paths of surface disturbance when possible).	Minimizing surface disturbance will benefit migratory birds and bats by retaining habitat value.
A-3-12	General – Environmental Compliance	An Environmental Compliance Plan (ECP) would be developed and implemented to monitor implementation of mitigation measures during project construction. An Environmental Inspector would be on-site to oversee the implementation of the Project ECP.	Implementation of the Environmental Compliance Plan will ensure compliance with the measures described in the Phase I BBCS that benefit migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-13	General – Maintenance	The transmission lines would be inspected two times per year by ground or aerial patrols, and maintenance would be performed as necessary. Substation maintenance activities would include routine, scheduled equipment maintenance and grounds keeping. Once reclamation is complete and vegetation is stable, noxious weed surveys of the Project areas would be conducted on a regular basis. Inspection of the Project access roads and internal resource roads would include weed monitoring and treatment, as outlined in the Weed Management Plan.	Maintenance of transmission lines will ensure compliance with APLIC standards and reduce risks to migratory bird species. Noxious weed management will benefit migratory bird and bat species by maintaining habitat functionality.
A-3-14	General – Maintenance	Inoperative turbines would be repaired, replaced or removed in a timely manner.	No applicability to migratory birds and bats.
A-3-15	General – Mitigation Measures	All control and mitigation measures established for the Project in the POD and the resource-specific management plans that are part of the POD would be maintained and implemented throughout the operational phase, as appropriate. These control and mitigation measures would be reviewed and revised, as needed, based on the mutual agreement of PCW and BLM, to address changing conditions or requirements within the Project area, throughout the operational phase. This dynamic approach would help ensure that impacts from operations are kept to a minimum.	Implementation of the control and mitigation measures in the POD as well as an adaptive management process will benefit migratory birds and bats to the extent the measures apply to migratory birds and bats.
A-3-16	General – Project Disturbance	The number and size/length of roads, temporary fences, lay-down areas, and borrow areas would be minimized.	Minimization of the project footprint has resulted in reduction of habitat impacts and fragmentation which benefits migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-17	General – Project Footprint	The area disturbed by construction-related activities (i.e., footprint) would be kept to a minimum.	Minimization of the project footprint has resulted in reduction in habitat impacts and fragmentation which benefits migratory birds and bats.
A-3-18	General – Project Footprint	The area disturbed by operational-related activities (i.e., footprint) would be kept to a minimum.	Minimization of the project footprint has resulted in reduction in habitat impacts and fragmentation which benefits migratory birds and bats.
A-3-19	Geology – Seismic Considerations	All structures will be built to appropriate seismic requirements for the local geology.	No applicability to migratory birds and bats.
A-3-20	Hazardous Materials – SPCC Plan	A Spill Prevention, Control, and Countermeasures (SPCC) Plan would be implemented during the construction and operation phases of Project. The SPCC would define procedures to be used in the event of an accidental spill from vehicles or other equipment.	Application of the SPCC will reduce potential impacts by preventing migratory bird and bat contact with spilled materials. The SPCC also reduces potential impacts to migratory bird and bat habitat that might be impacted in the unlikely event of an accidental discharge.
A-3-21	Hazardous Materials – Accidental Release	In the event of an accidental release of hazardous materials to the environment, the operator would document the event, including a root cause analysis, appropriate corrective actions taken, and a characterization of the resulting environmental or health and safety impacts. Documentation of the event would be provided to the BLM authorized officer and other federal and state agencies, as required.	See response to item A-3-20.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-22	Hazardous Materials – ESA	A Phase I Environmental Site Assessment would be required prior to the purchase of a property and would be conducted by a trained and experienced environmental professional. If the Phase I Environmental Site Assessment identifies potential hazardous substances, a Phase II Environmental Site Assessment is usually conducted to confirm the presence and extent of contamination.	No applicability to migratory birds and bats.
A-3-23	Hazardous Materials – Handling	Pursuant to the Project's Hazardous Materials Management Plan, all personnel handling hazardous materials would be trained appropriately on the dangers o, and safety precautions to be taken, when working with hazardous materials. Any hazardous materials used on-site would be documented and properly labeled. Material Safety Data Sheets (MSDS) and proper handling procedures would be located on-site. In the event a significant chemical spill occurs, personnel should evacuate the immediate area (as required) and report the release. The Emergency Response Team would be called to the area to assess the extent of the emergency and would determine appropriate response actions based on the Emergency Response Plan.	No applicability to migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-24	Hazardous Materials – Secondary Containment	Secondary containment would be provided for all on-site hazardous materials and waste storage, including fuel. In particular, fuel storage (for construction vehicles and equipment) would be a temporary activity occurring only for as long as is needed to support construction activities.	No applicability to migratory birds and bats.
A-3-25	Hazardous Materials – Storage, Handling, and Disposal	Safety measures would be implemented in accordance with Occupational Safety and Health Administration (OSHA) standards and operator requirements. Petroleum products (e.g., lubricating oils and greases) and items such as touch-up paint and fiberglass blade repair materials would be stored on-site for maintenance operations. All such wastes/substances would be handled, stored in a secured location, and disposed of in accordance with applicable federal, state, and local regulations.	No applicability to migratory birds and bats.
A-3-26	Health and Safety – Crane Operation	Crane safety training would be conducted to ensure riggers and ground workers understand the hazards of working around mobile cranes and that they watch for signs of problems at all times, especially if power lines are nearby. Standard operating procedures would be developed and implemented for safely lifting loads. A written engineered lift plan for all critical lifts would be developed and followed.	No applicability to migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-27	Health and Safety – Crane Operation	Crane operators would take the following steps to protect themselves and other workers when operating mobile cranes on the Project Sites: 1) the minimum clearance between power lines and the crane or load would be 10 ft. for lines rated 50-kV or below; 2) for lines over 50-kV, the minimum clearance would be 10 ft. plus 0.4 foot for each 1-kV over 50-kV; 3) operation of a crane outside of design limitations, manufacturer's specifications, or without the load charts would be prohibited; 4) cranes would be operated only when wind velocities are under the maximum speeds stipulated for safe operation (these velocities are generally stated in the manufacturer's specifications); 5) cranes would be inspected daily prior to each use, monthly, and annually, and the records of these inspections would be available on the machine; 6) rigging equipment would be inspected daily; 7) all operators of mobile cranes would have, and be familiar with, the additional requirements in the ANSI standard; 8) the latch in the hook throat opening would never be tied back; and 9) employees would not be suspended from the cranes and the use of cranes for suspended personnel platforms would be avoided.	No applicability to migratory birds and bats.
A-3-28	Health and Safety – Crane Operation	Meteorological stations would monitor wind speeds on the job site to support safe crane operating standards.	No applicability to migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-29	Lands and Realty – Foreign Lines, Monuments, and Markers	All foreign lines would be marked. Monuments and markers (i.e., General Land Surveys and BLM Cadastral Survey Corners, reference corners, U.S. Coastal and Geodetic benchmarks) would be protected during the construction and operational phases of the Project. In the event that a monument or marker is disturbed, the employee would report the incident in writing to the Authorized Officer. PCW, in consultation with the BLM or other appropriate agency, would be responsible for re-surveying and replacing any markers that are disturbed.	No applicability to migratory birds and bats.
A-3-30	Noise – Blasting and Noisy Activity	If blasting or other noisy activities are required during the construction period, nearby residents would be notified in advance.	No applicability to migratory birds and bats.
A-3-31	Noise – Construction Equipment	All equipment would have sound-control devices no less effective than those provided on the original equipment. All construction equipment used would be adequately muffled and maintained.	Noise control will minimize impacts to migratory birds and bats by reducing potential disturbance and displacement of individuals.
A-3-32	Noise – Construction Equipment	All stationary construction equipment (i.e., compressors and generators) would be located as far as practicable from nearby residences.	No applicability to migratory birds and bats.
A-3-33	Noise – Road Use	Road use specifications designed to keep traffic to a minimum would be implemented to the maximum extent practical.	Minimizing traffic will reduce collision risk, noise, and potential displacement of migratory birds and bats.
A-3-34	Noise – Turbine Noise	All WTGs would be properly maintained to prevent excessive noise.	Noise control will minimize impacts to migratory birds and bats by reducing potential disturbance and displacement of individuals.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-35	Public Health and Safety – Construction Practices	A Project Health and Safety Plan would be implemented in accordance with OSHA standards. Hard hat requirements and "authorized personnel only" signs would be posted at the entrance to the main access points during construction. Permanent signs would be posted at gates on the main access roads. Safety signs (e.g., speed limits, steep grades, etc.) would be placed along the main access roads in accordance with local, state, and federal regulations. Safety signing would be posted on all transformers, at high-voltage facilities, along roads, and around towers (if necessary) in conformance with applicable state and federal regulations.	No applicability to migratory birds and bats

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-36	Public Health and Safety – Construction Practices	A comprehensive and continuous occupational Injury and Illness Prevention Program (IIPP) would be implemented and enforce a code of safe practices (CSP) for all employees. A designated field safety person would be responsible for on-site management and administration of the IIPP and CSP. Occupational safety and health matters would be communicated to employees by written documentation, staff meetings, formal and informal training, weekly safety meetings, and posted information. Communication from employees to supervisors or safety representatives about unsafe or unhealthy conditions would be encouraged and may be verbal or written. Results of investigations of any employee safety suggestion or report of hazard would be distributed to all employees affected by the hazard or posted, as appropriate.	No applicability to migratory birds and bats.
A-3-37	Public Health and Safety – Construction Practices	Each supervisor would conduct an inspection to identify unsafe working conditions and practices, as follows: 1) weekly in all areas; 2) whenever new substances, procedures, or equipment that may represent a new safety or health hazard are introduced to the job site; and 3) whenever a supervisor is made aware of a new or previously unrecognized hazard. A hazard checklist or hazard assessment form would be used to document inspections. Employees may not enter a hazard area without appropriate protective equipment, training, and prior specific approval by the IIPP and CSP administrator.	No applicability to migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-38	Public Health and Safety – Fire Management	Fire control would be provided pursuant to the Project's Fire Safety Plan.	Fire control measures will reduce risk to migratory birds and bats including habitat loss and fragmentation, displacement of individuals, and other indirect impacts.
A-3-39	Public Health and Safety – Fire Management	Fire prevention standards would be followed to reduce the risk of a fire, in accordance with 36 CFR 261 and the Wyoming Interagency Fire Restriction Plan. All hot work that is to occur on site would be done in accordance with OSHA Regulation 29 CFR 1910.252(a).	Fire control measures will reduce risk to migratory birds and bats including habitat loss and fragmentation, displacement of individuals, and other indirect impacts.
A-3-40	Reclamation	All areas of disturbed soil would be reclaimed using weed-free native grasses, forbs, and shrubs. Reclamation activities would be undertaken as early as possible on disturbed areas not required for operation.	Reclamation using native species will maintain habitat function for migratory birds and bats.
A-3-41	Reclamation – Roadways	Access roads would be regraded, the topsoil replaced, and all disturbed areas would be re-vegetated. Any roadway damage due to the transport of the heavy equipment would be repaired on the public roadways upon the completion of Project construction and decommissioning.	Re-vegetation will decrease the size and duration of disturbed surfaces, decrease fragmentation, decrease risk for displacement of individuals, and maintain habitat function for migratory birds and bats.
A-3-42	Reclamation – Topsoil	Topsoil from all decommissioning activities would be salvaged and reapplied during final reclamation.	Topsoil salvage will increase reclamation success and benefit migratory birds and bats per item A-3-41
A-3-43	Reclamation – Vegetation	All areas of disturbed soil would be reclaimed using weed-free native shrubs, grasses, and forbs. The vegetation cover, composition, and diversity would be restored to values commensurate with the ecological setting.	Reclamation using weed-free native species will maintain habitat function for migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-44	Recreation – Public Access	Temporary fencing would be installed around staging areas and storage yards during construction to limit public access. Public access to open excavations would be limited by either installation of locked gates at public access points, or utilization of other approved means of limiting public access.	No applicability to migratory birds and bats.
A-3-45	Recreation – Public Access	Permanent fencing would be installed and maintained around electrical substations, and turbine tower access doors would be locked to limit public access during operations.	No applicability to migratory birds and bats.
A-3-46	Roads – General Design	DELETED[1]	
A-3-47	Roads – General Design	Access roads and on-site roads would be surfaced with aggregate materials, wherever appropriate.	No applicability to migratory birds and bats.
A-3-48	Roads – General Design	Access roads would be located to follow natural contours where possible and minimize side hill cuts.	Minimizing side hill cuts and following natural contours will reduce erosion risk and associated impacts to habitats used by migratory birds and bats.
A-3-49	Roads – General Design	DELETED[1]	
A-3-50	Roads – General Design	Roads would be located upwind from WTG rows, where possible, such that drifting caused by towers or transformers is not likely to accumulate on roads.	No applicability to migratory birds and bats.

[1] Power Company of Wyoming (PCW). 2012. Memorandum from G. Miller (PCW) to P. Murdock (BLM) dated April 10, 2012.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-51	Roads – General Design	Roads are designed in accordance with the BLM Gold Book (BLM 2007a) design criteria as well as the BLM Manual 9113: Roads (BLM 1985).	No applicability to migratory birds and bats.
A-3-52	Roads – General Design	Existing roads would be used, but only if in safe and environmentally sound locations. If new roads are necessary, they would be designed and constructed to the appropriate BLM road design standards where practical and be no higher than necessary to accommodate their intended functions (e.g., traffic volume and weight of vehicles).	Use of existing roads, when possible, will decrease fragmentation, displacement of individuals, and surface disturbance in habitats used by migratory birds and bats.
A-3-53	Roads – General Design	Final roadway alignments will include erosion control measures to stabilize steeper slopes and to prevent loss of soil. These measures will include hay bales, shallow swales and ditches, rock/rip rap embankments, and culvert outlet protection. Final alignments will be ground-verified using BLM Rawlins Field Office knowledge of potentially problematic areas for road construction and/or maintenance.	Measure will reduce erosion and soil loss in steep areas maintaining habitats that are used by migratory birds and bats.
A-3-54	Roads – General Design	Where road intersection improvements are required to accommodate extra-long vehicles, potential upgrades could include placement of relocating signs, placement of temporary paving, and use of flaggers, as needed. All intersection improvements would be restored to their original condition upon the completion of construction.	No applicability to migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-55	Roads – General Design	Where road-cattle guard intersection improvements are required to accommodate overweight vehicles, potential road profile upgrades may be required to allow travel safely over the cattle guards. All damaged cattle guards would be replaced upon the completion of construction.	No applicability to migratory birds and bats.
A-3-56	Roads – General Design	All existing roads that would be used as primary access locations to the Project area would need to be upgraded to accommodate the anticipated extra traffic generated by the Project. Most of these roads are county roads or two-track roads that would need to be widened to accommodate the construction traffic. All necessary federal, state, and local permits would be obtained to complete this work prior to construction.	No applicability to migratory birds and bats.
A-3-57	Roads – General Design	During the course of construction, if excessive wear and tear to the existing roadway surface is evident, these road surfaces would be restored to their original condition upon the completion of construction. Where necessary, consultation with the UPRR would be required to change the roadway profile at specific at-grade railroad crossings to smooth the existing hump for low-profile vehicles; consultation with various utility companies would be required to elevate the risk of oversized vehicles in relation to low-hanging power lines.	No applicability to migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-58	Roads – General Design	Due to crest and sag vertical curves in the roadway profile, select locations would require re-grading prior to hauling extra-long loads. Any grades greater than 10 percent would require assist vehicles on-hand for the large tractor-trailers hauling WTG components. Any grades greater than 7 percent would require assist vehicles on-hand. These locations would be verified during the final design process. In addition, any construction site with grades ranging from 5 to 7 percent on non-paved roadways would require an assist vehicle on stand-by during adverse weather or road conditions.	No applicability to migratory birds and bats.
A-3-59	Roads – General Use	Traffic would be restricted to the roads developed for the Project. Use of other unimproved roads would be restricted to emergency situations. Signs would be placed along construction roads to identify speed limits, travel restrictions, and other standard traffic control information.	Control of traffic and speeds will reduce collision risks to migratory birds and avoid displacement of individuals sensitive to traffic-related impacts.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-60	Roads – Maintenance	Most road maintenance would be performed on an as-needed basis. The frequency and type of maintenance that would be required would be determined by routine inspections. The inspections would be performed on a regular basis and following snowmelt or heavy or prolonged rainfall. Inspections would identify maintenance needs for reduction of ruts and holes, maintenance of crowns and outslopes to keep water off the road, replacement of surfacing materials, clearing of sediment blocking ditches and culverts, maintenance of interim reclamation, and noxious weed control.	No applicability to migratory birds and bats.
A-3-61	Roads – Maintenance	All roads would be maintained in a safe and environmentally responsible manner.	No applicability to migratory birds and bats.
A-3-62	Roads – Operation Access	Project operation would require the use of the new roads for equipment and personnel to reach the WTGs. In addition, an access road that runs adjacent to each WTG site and the project substations would be used.	No applicability to migratory birds and bats.
A-3-63	Roads – Operation Access	Internal resource roads would be located within the project boundaries and would provide access to each WTG. All internal resource roads would be surfaced with gravel. As part of routine maintenance activities, internal resource roads would be maintained in a condition that allows for continued access to the WTGs.	No applicability to migratory birds and bats.
A-3-64	Roads – Reclamation	Abandoned roads and roads that are no longer needed would be recontoured and revegetated.	Measure will reduce surface disturbance and fragmentation in habitats used by migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-65	Soils and Geology –Slopes	Operators would identify unstable slopes and local factors that can induce slope instability. Operators also would avoid creating excessive slopes during excavation and blasting operations. Special construction techniques would be used where applicable in areas of steep slopes, erodible soil, and stream channel crossings.	Measure will reduce impacts to soils, increase reclamation success, and maintain habitats that are used by migratory birds and bats.
A-3-66	Soils – Erosion Control	Erosion control measures would be employed as described in the Master Reclamation Plan	Measure will reduce impacts to soils, increase reclamation success, and maintain habitats that are used by migratory birds and bats.
A-3-67	Soils – Erosion Control	Permanent erosion control devices would be installed during project construction and may include, but are not limited to, waterbars, roadside ditches with subsurface culverts, berms, trash racks on culverts, energy-dissipating structures, mulches, and establishment of permanent vegetation. Erosion controls that comply with county, state, and federal standards would be applied. Practices such as jute netting, silt fences, and check dams would be applied near disturbed areas. The Environmental Inspector would monitor construction to ensure that erosion control devices are functioning properly.	Measure will reduce impacts to soils, increase reclamation success, and maintain habitats that are used by migratory birds and bats.
A-3-68	Soils – Erosion Control	Final roadway alignments would include erosion control measures to stabilize steeper slopes and to prevent loss of soil. These measures would include hay bales, shallow swales and ditches, rock/rip rap embankments, and culvert outlet protection.	Measure will reduce impacts to soils, increase reclamation success, and maintain habitats that are used by migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-69	Soils – Erosion Control	If, during operation, it is determined that snow accumulation causes significant accelerated erosion, appropriate mitigation measures (e.g., snow fence construction) would be developed and implemented.	Measure will reduce impacts to soils, increase reclamation success, and maintain habitats that are used by migratory birds and bats.
A-3-70	Soils – Excavation and Blasting Activities	Foundations and trenches would be backfilled with originally excavated material as much as possible. Excess excavation materials would be disposed of only in approved areas or, if suitable, stockpiled for use in reclamation activities.	No applicability to migratory birds and bats.
A-3-71	Soils – Excavation and Blasting Activities	Borrow material would be obtained only from authorized and permitted sites. Existing sites would be used in preference to new sites when possible.	No applicability to migratory birds and bats.
A-3-72	Soils – Topsoil Handling	Topsoil from all excavations and construction activities would be salvaged and reapplied during reclamation.	Topsoil salvage will increase reclamation success and benefit migratory birds and bats per item A-3-41.
A-3-73	Soils – Topsoil Handling	Topsoil material suitable for site reclamation would be removed in conjunction with clearing and grading and reserved in local stockpiles. Topsoil storage areas would generally be located within staging areas and alongside roadways during construction.	Topsoil salvage will increase reclamation success and benefit migratory birds and bats per item A-3-41.
A-3-74	Soils – Wet Soils During Construction	Construction activities would be suspended when soils are wet. Construction would resume when soils become dry enough to support construction equipment. The Environmental Inspector (EI) would determine when conditions are too wet to continue.	Measure will reduce impacts to soils, increase reclamation success, and maintain habitats that are used by migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-75	Transportation – Traffic Considerations	To minimize impacts on local commuters, consideration would be given to limiting construction vehicles traveling on public roadways during the morning and late afternoon commute time. Consideration would also be given to opportunities for busing of construction workers to the job site to reduce traffic volumes.	No applicability to migratory birds and bats.
A-3-76	Transportation – Transportation Planning	Ongoing ground transportation planning would be conducted to evaluate road use, minimize traffic volume, and ensure that roads are maintained adequately to minimize associated impacts.	Ongoing transportation management will reduce traffic-related disturbance and potential collision risk to migratory birds.
A-3-77	Transportation – Transportation Planning	Following the finalization of site access locations and proposed roadways, a Traffic Management Plan would be developed for traffic both on and off-site. The Traffic Management Plan would discuss flagging guidelines on and off site, specifics of auxiliary lanes if needed, requirements for signage during construction of the project, passing zone and striping details for the existing public roadways, and other details specific to the individual approved access locations leading to and from, and on, the Project area.	Ongoing traffic management will reduce traffic-related disturbance and potential collision risk to migratory birds.
A-3-78	Vegetation – Noxious Weed	Noxious weed surveys would be conducted to evaluate the presence and aerial extent of noxious weed and invasive species populations within the Project area. Preventative management measures would be applied as warranted pursuant to the Project's Weed Management Plan.	Noxious weed management will benefit migratory bird and bat species by maintaining habitat functionality.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-79	Visual Resources	Operators would reduce visual impacts during construction by clearly delineating construction boundaries and minimizing areas of surface disturbance; preserving vegetation to the greatest extent possible; utilizing undulating surface disturbance edges; stripping, salvaging and replacing topsoil; contoured grading; controlling erosion; using dust suppression techniques as required; and restoring exposed soils as closely as possible to their original contour and vegetation.	No applicability to migratory birds and bats.
A-3-80	Visual Resources	Operators would monitor and maintain visual mitigation measures for the approved project in accordance with a visual monitoring and compliance plan. The operator would maintain revegetated surfaces until a self-sustaining stand of vegetation is reestablished and visually adapted to the undisturbed surrounding vegetation.	No applicability to migratory birds and bats.
A-3-81	Waste Management – Disposal	Wastes would be properly containerized and removed periodically for disposal at appropriate off-site permitted disposal facilities.	Measure will maintain habitats that are used by migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-82	Waste Management – Wastewater	Any wastewater generated in association with temporary, portable sanitary facilities would be periodically removed by a licensed hauler and introduced into an existing municipal sewage treatment facility or otherwise disposed of in accordance with applicable state and local laws and regulations. Temporary, portable sanitary facilities provided for construction crews would be adequate to support expected on-site personnel and would be removed at completion of construction activities.	No applicability to migratory birds and bats.
A-3-83	Water – SWPPP	The Project's SWPPP would be implemented in accordance with the Wyoming Department of Environmental Quality (WDEQ) requirements to obtain National Pollutant Discharge Elimination System (NPDES) compliance under Wyoming's NPDES permit WYR10-0000. The SWPPP would describe site-specific erosion control and stream crossing measures that would be implemented during the construction and operation phases of the Project. The Environmental Inspector would direct activities to ensure compliance with the SWPPP.	Measure will reduce impacts to soils and water quality, increase reclamation success, and maintain habitats that are used by migratory birds and bats.
A-3-84	Water – Excavation and Blasting Activities	DELETED[2]	

[2] Power Company of Wyoming (PCW). 2012. Memorandum from G. Miller (PCW) to P. Murdock (BLM) dated April 10, 2012.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-85	Water – Excavation and Blasting Activities	Operators would avoid creating hydrologic conduits between two aquifers during foundation excavation and other activities.	No applicability to migratory birds and bats.
A-3-86	Water – Road Design	DELETED[2]	
A-3-87	Water – Road Drainage	Whenever possible, existing drainage systems would not be altered, especially in sensitive areas such as erodible soils or steep slopes. Potential soil erosion would be controlled at culvert outlets with appropriate structures. Catch basins, roadway ditches, and culverts would be cleaned and maintained regularly.	Measure will reduce impacts to soils, vegetation, and water quality; increase reclamation success; and maintain habitats that are used by migratory birds and bats.
A-3-88	Water – Road Locations	Roads would be located away from drainage bottoms and avoid wetlands, if practicable.	Measure will reduce impacts to soils, vegetation, and water quality; maintain habitats that are used by migratory birds and bats; and avoid vehicle collision risk in these areas.
A-3-89	Water – Stream Crossings	Access roads would be located to minimize stream crossings. All structures crossing streams would be located and constructed so that they do not decrease channel stability or increase water velocity. Operators would obtain all applicable federal and state permits.	Measure will reduce impacts to soils, vegetation, and water quality; maintain habitats that are used by migratory birds and bats; and avoid vehicle collision risk in these areas.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-90	Water – Waterbodies and Wetlands	Waters of the U.S., including wetlands, will be avoided to the maximum extent practicable. Where these features cannot be completely avoided, impacts will be minimized through design modification, as necessary. Facilities (e.g., turbines, substations, staging areas) would be sited to avoid and/or minimize impacts; however, where impacts are anticipated (e.g., use of Project roads), minimization measures would be employed to minimize impacts (e.g., use of culverts to maintain downstream flow/drainage).	Measure will maintain vegetation, water bodies, and riparian corridors used by migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-91	Water – Waterbodies and Wetlands	All impacts would be the minimum necessary to accomplish the Project, would be mitigated, and the appropriate Section 404 permit would be obtained from the U.S. Army Corps of Engineers (USACE) Wyoming Regulatory Office prior to the start of construction. To complete the Section 404 permit, a delineation of all Waters of the U.S. (WUS), including wetlands, would be performed by qualified wetland scientists to obtain current site-specific data regarding the location and extent of aquatic features within the Project area. Current resource mapping (e.g., U.S. Geological Survey (USGS) topographic maps, U.S. Fish and Wildlife Service (USFWS) NWI maps, Federal Emergency Management Agency (FEMA) floodplain maps, Natural Resources Conservation Service (NRCS) soils data, etc.) would be used to guide this future delineation effort. All aquatic features delineated in the field would be recorded using Global Positioning System (GPS) with sub-meter accuracy.	Measure will maintain vegetation, water bodies, and riparian corridors used by migratory birds and bats.
A-3-92	Water – Waterbodies and Wetlands	Any construction that occurs in or adjacent to wetlands and streams would use Applicant Committed BMPs listed in Appendix A to protect surface water quality and to minimize impacts to those resources.	Measure will maintain vegetation, water bodies, and riparian corridors used by migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-93	Wildlife – Department of the Interior (DOI) Wind Turbine Guidelines	Although strictly voluntary on non-federal lands, PCW will review the DOI Wind Turbine Guidelines Advisory Committee Wind Turbine Guidelines (anticipated in late summer 2010) once they are finalized with the intention of complying with them as applicable and appropriate and to the extent they do not conflict with any requirements set out by the BLM in its ROD, any agreements entered into between PCW and the USFWS, or other controlling laws, permits, or regulations.	The measures in the Phase I BBCS incorporate the measures recommended in the current USFWS Wind Energy Guidelines.
A-3-94	Wildlife – Disturbance and Harassment	All employees, contractors, and site visitors would be instructed to avoid harassment and disturbance of wildlife, especially during reproductive (e.g., courtship and nesting) seasons. During construction, pets would not be permitted on site; during operation, pets would be controlled to avoid harassment and disturbance to wildlife.	Measures to reduce impacts to migratory birds and bats will be included in employee training as described in the Phase I BBCS.
A-3-95	Wildlife – Excavation and Blasting Activities	Explosives would be used only within specified times and at specified distances from sensitive wildlife or streams and lakes, as established by the BLM or other federal and state agencies.	Use of explosives per agency guidance and measures described in the Phase I BBCS will reduce risk to migratory birds and bats.
A-3-96	Wildlife – Habitat Restoration	In accordance with the habitat restoration plan, restoration would be undertaken as soon as practical after completion of construction activities to reduce the amount of habitat converted at any one time and to speed up the recovery to natural habitats.	Reclamation and revegetation will minimize the amount and duration of surface disturbance which will benefit the migratory birds and bats using the habitats in Phase I.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-97	Wildlife – Vehicle Collisions	Project personnel and contractors would be instructed and required to adhere to speed limits commensurate with road types, traffic volumes, vehicle types, and site-specific conditions, to ensure safe and efficient traffic flow and to reduce wildlife collisions and disturbance and airborne dust.	Employee training and controlling vehicle speed will minimize risks to migratory birds and bats from vehicle collisions.
A-3-98	Wildlife – Yellow-billed Cuckoo	Yellow-billed cuckoo habitat (i.e., riparian areas) would be avoided to the maximum extent possible.	Yellow-billed cuckoo habitat does not occur in the vicinity of the CCSM Project. Minimization of impacts in riparian areas will maintain habitats used by other migratory birds and bats.

TABLE 5. PROPOSED MITIGATION MEASURES (ROD TABLE D-4)

Resource	Code	Proposed Mitigation Measure	Applicability to Migratory Birds and Bats
General	GEN-1	Phased Construction Sequencing. Limit surface disturbance to areas where turbines would be constructed within 12 months with a goal to mitigate impacts from surface disturbance to wildlife, soils, water, and vegetation (e.g., weeds). Four ROW grants would be issued for the project: 1) internal haul road; 2) transmission line between the two sites; 3) Sierra Madre development; and 4) Chokecherry development.	This measure minimizes impacts to migratory birds and bats by minimizing habitat fragmentation and ensuring that undisturbed habitats are available in areas adjacent to Phase I for use by any individuals displaced during construction.
	GEN-2	Off-site Compensatory Mitigation. Off-site compensatory mitigation may be considered through future consultations between the BLM, Cooperating Agencies, and PCW if mitigation measures established through the project-wide EIS are later determined to not be adequate.	Off-site compensatory mitigation is addressed in the Phase I BBCS.
Air		No additional mitigation measures proposed.	
Cultural	CR-1	To minimize unauthorized collecting of archaeological material or vandalism to known archaeological sites, PCW and its contractors, and all construction personnel, shall attend mandatory training and be educated on the significance of cultural resources and the relevant federal regulations intended to protect them.	No applicability to migratory birds and bats.
	CR-2	Additional mitigation measures will be included in the Programmatic Agreement, which will be developed in coordination with the BLM, SHPO, ACHP, PCW; Indian tribes; and other interested parties.	No applicability to migratory birds and bats.

TABLE 5. PROPOSED MITIGATION MEASURES (ROD TABLE D-4)

Resource	Code	Proposed Mitigation Measure	Applicability to Migratory Birds and Bats
Geology and Mineral Resources		No additional mitigation measures proposed.	
Land Use		No additional mitigation measures proposed.	
Paleontology	PALEO-1	If any vertebrate fossils or scientifically important fossils are discovered during construction operations on federal lands, the permittee shall cease activities immediately and notify the BLM so the agency can determine the significance of the discovery. The BLM shall evaluate or have evaluated such discoveries and shall notify PCW what action shall be taken with respect to such discoveries. Additionally, PCW also would contract with a qualified paleontologist approved by the BLM who shall be on call during all construction periods and available to travel to the site within 24 hours following notice of a discovery, and that the on-call paleontologist shall consult with the BLM to reach agreement on the significance of the discovery within 24 hours following arrival at the site by the on-call paleontologist. The BLM will then promptly notify PCW as to what actions shall be taken.	No applicability to migratory birds and bats.

TABLE 5. PROPOSED MITIGATION MEASURES (ROD TABLE D-4)

Resource	Code	Proposed Mitigation Measure	Applicability to Migratory Birds and Bats
	PALEO-2	Any fossils recovered during the assessment of paleontological resources will be prepared in accordance with standard professional paleontological techniques. The fossils will be curated in a BLM-approved facility. A report on the findings and significance of the salvage program, including a list of the recovered fossils, will be prepared following completion of the program. A copy of this report will accompany the fossils, and a copy will be submitted to the Wyoming Museum, University of Wyoming.	No applicability to migratory birds and bats.
Range	RANGE-1	Coordinate construction schedules and ranching operations to allow sequencing of pasture use to the extent practicable within the Pine Grove/Bolten allotment and other affected allotments (Cottonwood Draw, Middlewood Hill, Grizzly, McCarty Canyon, and Sage Creek) in a manner to minimize conflicts between grazing and construction activities.	No applicability to migratory birds and bats.
Recreation		No additional mitigation measures proposed.	
Socioeconomics		No additional mitigation measures proposed.	
Soils	SOIL-1	Road fabric, or equivalent base stabilization as determined by the BLM, will be applied where roads cross sensitive soils (wet, severely erodible soils, and soils with low soil strength).	Measure will reduce impacts to soils, vegetation, and water quality and maintain habitats that are used by migratory birds and bats.

TABLE 5. PROPOSED MITIGATION MEASURES (ROD TABLE D-4)

Resource	Code	Proposed Mitigation Measure	Applicability to Migratory Birds and Bats
	SOIL-2	Excess subsoil excavated from tower foundations will not be used as topsoil or spread on top of topsoil without further laboratory testing of the subsoil physical and chemical characteristics, and agency approval. PCW will identify the acceptable disposal method for excess subsoil in the final reclamation plan.	Use of native topsoil or subsoils that have the appropriate physical and chemical characteristics will increase reclamation success and benefit migratory birds and bats.
	SOIL-3	Areas identified as having limited reclamation potential (as defined in the Rawlins Instruction Memorandum No. WYD-03-2011-002) will be avoided during construction unless an acceptable site-specific reclamation plan is approved by the BLM.	Reclamation and revegetation following the Phase I reclamation plan will minimize the amount and duration of surface disturbance which will benefit the migratory birds and bats using these habitats.
	SOIL-4	To reduce impacts related to road density in the Application Area, roads that are no longer needed will be effectively reclaimed.	This measure would reduce surface disturbance and fragmentation in habitats used by migratory birds and bats.
	SOIL-5	PCW will be required to submit a snow removal plan as part of the ROW grant application. The snow removal plan will include measures to ensure protection of soil and water resources.	No applicability to migratory birds and bats.
	SOIL-6	Drainages, vegetated sand dunes, salt flats, steep slopes, and gullied areas will be avoided for towers, laydown areas, facilities, and roads (to the extent possible). Towers, laydown areas, and other facilities will be re-located to areas of generally stable soils. These avoidances shall be taken into consideration during site specific analyses.	Measure will reduce impacts to soils, vegetation, and water quality; increase reclamation success; and maintain habitats that are used by migratory birds and bats.

TABLE 5. PROPOSED MITIGATION MEASURES (ROD TABLE D-4)

Resource	Code	Proposed Mitigation Measure	Applicability to Migratory Birds and Bats
Transportation	TRANS-1	To the extent that all governmental entities are willing to participate, PCW shall participate in a coordinated transportation planning process with the BLM, WYDOT, Carbon County, the Town of Sinclair and the City of Rawlins, to identify and develop measures to avoid, manage or mitigate transportation impacts of construction. The BLM shall coordinate with affected local governments to solicit input from the Sinclair Refinery, the CIG compressor station, affected grazing operators, and other major property owners (including the operator of the truck stop just north of I-80 Exit 221) in the affected area. The group shall meet prior to and during the construction phase of the project and in the initial year of project operations, as needed.	No applicability to migratory birds and bats.
	TRANS-2	PCW shall develop measures to inform and update Carbon County residents and travelers on I-80 near Sinclair and WY 71 about potential delays during peak months and especially during peak hours. In coordination with WYDOT, electronic signage shall be used near I-80 Exit 221 to encourage I-80 travelers to use alternate access to Sinclair during peak hours.	No applicability to migratory birds and bats.

TABLE 5. PROPOSED MITIGATION MEASURES (ROD TABLE D-4)

Resource	Code	Proposed Mitigation Measure	Applicability to Migratory Birds and Bats
	TRANS-3	PCW shall coordinate with WYDOT to identify measures to control traffic and enhance traffic flows in the vicinity of I-80 Exit 221 during shift changes and at times when oversized vehicles will be crossing the bridge over I-80, and along WY 71 within the City of Rawlins if the WY 71/CR 407 (Sage Creek Road) workforce commuting option is selected.	No applicability to migratory birds and bats.
	TRANS-4	PCW shall implement incentives for carpooling and/ or other workforce transportation measures to reduce traffic and congestion during shift changes.	No applicability to migratory birds and bats.
Vegetation	VEG-1	Survey and mark the disturbance boundary to minimize unintentional surface disturbance. Actively monitor construction to ensure construction and staff stays within the defined limits.	This measure will ensure that the project footprint is minimized reducing impacts and fragmentation in habitats used by migratory birds and bats.
	VEG-2	Salvage vegetative debris and redistribute to reclaimed surface areas in order to reduce erosion and preserve native organic material and seed sources.	Measure will reduce impacts to soils, vegetation, and water quality; increase reclamation success; and maintain habitats that are used by migratory birds and bats.
	VEG-3	In areas where excavating soil is not necessary, such as temporary laydown areas or temporary access roads, avoid disturbing native soil and root zones where possible to preserve soil structure and soil biology and improve the success for reclamation.	Measure will reduce impacts to soils, vegetation, and water quality; increase reclamation success; and maintain habitats that are used by migratory birds and bats.

TABLE 5. PROPOSED MITIGATION MEASURES (ROD TABLE D-4)

Resource	Code	Proposed Mitigation Measure	Applicability to Migratory Birds and Bats
Visual	VR-1	Monopole and H-frame transmission structures and overhead collector line structures would be treated to have a muted, darker color than conventional galvanized steel or laminated wood to reduce color contrasts. The recommended paint color for transmission structures is Shadow Gray from the BLM Standard Environmental Colors Chart CC-00 or an equivalent color. Steel pole equivalents used in the installation of the overhead electric collector lines should be finished with paint or a self-weathering finish that will harmonize with colors of the surrounding landscape (i.e., approximate the color of wood when used with wood overhead collector lines). When not used with wood poles, the recommended paint color for powerline structures is Shadow Gray from the BLM Standard Environmental Colors Chart CC-00. Conductors would have a non-reflective finish.	No applicability to migratory birds and bats.
	VR-2	Place vegetative debris on cut-and-fill slopes to vary texture and color of cut-and-fills until vegetation has been re-established.	Measure will reduce impacts to soils, vegetation, and water quality; increase reclamation success; and decrease fragmentation in habitats that are used by migratory birds and bats.
	VR-3	Lighting for ancillary facilities shall be motion-activated and shielded downward to limit night lighting impacts beyond the site.	Measure will reduce impacts to nocturnal and night-migrating birds and bats. Measure will also ensure that unnecessary artificial light sources do not attract insect activity and associated migratory bird or bat foraging.

TABLE 5. PROPOSED MITIGATION MEASURES (ROD TABLE D-4)

Resource	Code	Proposed Mitigation Measure	Applicability to Migratory Birds and Bats
	VR-4	Audio Visual Warning System (AVWS) for aircraft detection and warning may be required to reduce day and night lighting impacts from WTGs if technologies become available that are approved by FAA, are proven reliable at the scale of CCSM, and BLM determines that systems are cost effective.	No applicability to migratory birds and bats
	VR-5	Substation components and fencing would be Shadow Gray from the BLM Standard Environmental Colors Chart CC-00 or a similar color in a dark gray color range. Color mitigation would not be required on facilities that are treated in accordance with safety and engineering concerns.	No applicability to migratory birds and bats

TABLE 5. PROPOSED MITIGATION MEASURES (ROD TABLE D-4)

Resource	Code	Proposed Mitigation Measure	Applicability to Migratory Birds and Bats
Wetlands	WET-1	Conduct on-site delineations of all waters of the U.S., including wetlands and waterbodies within the Alternative Development Area prior to construction. The surveys would be performed and documented by qualified wetland scientists to determine the types and spatial extent of site-specific wetland and riparian features. Current resource mapping (e.g., USGS topographic maps, USFWS NWI maps, FEMA floodplain maps, AECOM wetland and riparian data, NRCS soils data, etc.) would be used to guide this future delineation effort. All features would be recorded using a GPS unit with sub-meter accuracy, in addition to photographic and written documentation of each feature according to standardized USACE delineation data requirements and any additional BLM data requirements. Subsequent NEPA tiering would include the site-specific waters of the U.S. delineation results.	Phase I wetland information was used to minimize impacts in wetland and riparian areas resulting in decreased habitat fragmentation, maintenance of native vegetation, and conservation of water bodies and riparian corridors used by migratory birds and bats.
Water	WR-1	Stream water quality monitoring sites will be identified by the BLM. Stream monitoring shall continue through construction, operation, and decommissioning of the project by PCW to monitor for changes in water quality.	The watershed monitoring program will document any changes to hydrologic conditions and stream channel characteristics that may impact habitats used by migratory birds and bats.
	WR-2	PCW will be required to submit the site-specific SWPPP as part of the ROW grant application for approval by the BLM.	Measure will reduce impacts to soils and water quality, increase reclamation success, and maintain habitats that are used by migratory birds and bats.

TABLE 5. PROPOSED MITIGATION MEASURES (ROD TABLE D-4)

Resource	Code	Proposed Mitigation Measure	Applicability to Migratory Birds and Bats
Wildlife and Fisheries	WFM-1	Workers, with the exception of security personnel, will not be allowed to possess firearms during work activities and will attend mandatory training (provided by WGFD) on wildlife regulations and ways to reduce disturbance to wildlife.	Removal of firearms from the CCSM Project Site will ensure that unauthorized take of migratory birds by employees or contractors does not occur.
	WFM-2	Snow fences, if used, will be limited to segments of one-quarter mile or less. In addition, escape openings will be provided along roads, every one-quarter mile or less, to facilitate exit of big game animals from snowplowed roads.	No applicability to migratory birds and bats.
	WFM-3	If measured bat mortality is determined to be above levels of concern for the project (as presented in section 4.14 of the EIS), measures appropriate to avoid, minimize, and mitigate impacts to bat species will be identified in the Bat Protection Plan for the Project. Thresholds of impacts to bats and appropriate responses to exceeding such impact thresholds will be determined by BLM in coordination with the WGFD, and if appropriate, the USFWS, as part of the conservation, avoidance, minimization and mitigation measures identified in the Bat Protection Plan.	The Phase I BBCS serves as the Bat Protection Plan described in WFM-3 and identifies measures to avoid, minimize, and mitigate impacts to bat species.
	WFM-4	Instream construction (stream crossings and stream construction activities) will occur during the low flow period (July 15 to September 30).	Measure will reduce impacts to soils and water quality, increase reclamation success, and maintain habitats that are used by migratory birds and bats. In addition, this measure results in disturbance of these areas after the nesting season or late in the nesting season when impacts to migratory birds will be minimized.

TABLE 5. PROPOSED MITIGATION MEASURES (ROD TABLE D-4)

Resource	Code	Proposed Mitigation Measure	Applicability to Migratory Birds and Bats
Special Status Species	SSS-1	Prior to construction activities in suitable pygmy rabbit habitat, presence/absence surveys would be conducted following appropriate protocols. Areas within 0.25 mile of proposed disturbance that show characteristics of pygmy rabbit habitat will be surveyed in accordance with the Interagency Pygmy Rabbit Working Group Survey Protocols (Ulmschneider et al. 2004). If the surveys conclude that the pygmy rabbits occur, the "Habitat Preservation and Restoration" conservation measures will apply (Keinath and McGee 2004).	No applicability to migratory birds and bats.

TABLE 5. PROPOSED MITIGATION MEASURES (ROD TABLE D-4)

Resource	Code	Proposed Mitigation Measure	Applicability to Migratory Birds and Bats
	SSS-2	Prior to construction activities in suitable Wyoming pocket gopher habitat, presence/absence surveys will be conducted following appropriate protocols. If active Wyoming pocket gopher mounds are identified by the presence/absence survey, the proposed surface disturbing activities will avoid the active pocket gopher mounds by 75 m (BLM 2009f). However, if PCW does not wish to avoid the active pocket gopher mounds by 75 m, classification surveys (via live capture) must be completed to identify the pocket gopher to the species level responsible for the mounds. If the results conclude that the Wyoming pocket gopher is responsible for the mounds, the “Occupied Wyoming Pocket Gopher Habitat Protection Measures” will apply (BLM 2009f). If the results conclude that the associated species is a Northern pocket gopher, then the proposed surface disturbance may proceed without mitigation. If the classification survey fails to conclusively identify the associated pocket gopher to the species level, then it will be assumed that the species is a Wyoming pocket gopher and the “Occupied Wyoming Pocket Gopher Habitat Protection Measures” will apply (BLM 2009f).	No applicability to migratory birds and bats.

TABLE 5. PROPOSED MITIGATION MEASURES (ROD TABLE D-4)

Resource	Code	Proposed Mitigation Measure	Applicability to Migratory Birds and Bats
	SSS-3	To protect potential mountain plover habitat, prior to any surface disturbance, a presence/absence survey for active mountain plover nests will be conducted in all potential habitat within the area proposed for surface disturbance. Surveys are to be performed by a wildlife biologist familiar with mountain plover and their associated habitat. If evidence of mountain plovers is found during the preconstruction survey, then additional stipulations may apply (BLM 2009a).	Measure will minimize impacts to mountain plovers and other migratory bird and bat species that use occupied mountain plover habitats.
Noise	N-1	USEPA guidance stipulates the threshold for residential noise impacts resulting from construction activities, including blasting, is reached at 55 dB(A) at 1,600 feet (USEPA 1974). When a residence is within 1,600 feet of construction activities, construction activities exceeding 55 dB(A) would only be allowed to occur between the hours of 7 a.m. and 10 p.m., and on weekdays.	Measure will reduce disturbance migratory birds and bats that occur within these areas.
	N-2	Whenever feasible, multiple construction activities (e.g., blasting and earthmoving) shall be scheduled to occur concurrently to minimize the length of time residences within 1,600 feet may be affected.	Measure will reduce disturbance migratory birds and bats that occur within these areas.

TABLE 6. PROPOSED APPLICANT COMMITTED MEASURES FOR THE DEADMAN CREEK SOUTH LEK

Resource	Code	Proposed Measure	Applicability to Migratory Birds and Bats
Special Status Species	DCS-01	PCW will conduct all construction activities within 0.25 mile of the Deadman Creek South lek before March 1st or after May 20th.	Measure will minimize impacts to sagebrush habitats surrounding leks that are used by sagebrush obligate bird species and other migratory bird and bat species.
	DCS-02	PCW will conduct all non-critical operation and maintenance activities within 0.25 mile of the Deadman Creek South lek before March 1st or after May 20th. Critical operation and maintenance activities may include but are not limited to road, culvert, and erosion control repair; disabled vehicle repair or removal; and application of dust suppression.	Measure will minimize impacts to sagebrush habitats surrounding leks that are used by sagebrush obligate bird species and other migratory bird and bat species.
	DCS-03	PCW will conduct all non-critical construction, operation and maintenance activities that require use of the road located within 0.25 mile of the Deadman Creek South lek before March 1st or after May 20th. Critical construction, operation and maintenance activities may include but are not limited to unscheduled maintenance of wind turbines and electrical components; road, culvert, and erosion control repair; disabled vehicle repair or removal; and application of dust suppression.	Measure will minimize impacts to sagebrush habitats surrounding leks that are used by sagebrush obligate bird species and other migratory bird and bat species.

TABLE 6. PROPOSED APPLICANT COMMITTED MEASURES FOR THE DEADMAN CREEK SOUTH LEK

	DCS-04	During the period from March 1st to May 20th, PCW will conduct all critical, non-emergency, construction, operation and maintenance activities located within 0.25 mile of the Deadman Creek South lek or that require use of the road located within 0.25 mile of the Deadman Creek South lek between the hours of 9:00 am and 6:00 pm. Critical construction, operation and maintenance activities may include but are not limited to unscheduled maintenance of wind turbines and electrical components; road, culvert, and erosion control repair; disabled vehicle repair or removal; and application of dust suppression.	Measure will minimize impacts to sagebrush habitats surrounding leks that are used by sagebrush obligate bird species and other migratory bird and bat species.