

6.0 THERMAL IMAGING – VERTICALLY POINTING RADAR

Please refer to **Section 5.3** for information on the TI-VPR.

6.1 SURVEY METHODOLOGY

Please refer to **Sections 5.4.3.1** and **5.4.3.2** for information on survey methodology.

6.2 DATA ANALYSIS

Please refer to **Section 5.4.3.3** for information on data analysis. TI-VPR raw data is presented in **Appendix K**.

6.3 OFFSHORE SURVEY RESULTS

6.3.1 *Spring 2008*

6.3.1.1 Target Identification

Data over Grid 7 were gathered from 24 – 26 March 2008 and covered 9:00 PM to 5:00 PM EDT (01:00 to 21:00 UTC). Over this time period only 27 total targets were identified, of which 24 targets were identified as birds (89%) and three as insects, suggesting this was not a high traffic time period, though a weak migration may have occurred (**Table 6-1**). The maximum total targets identified for an hour (12 total targets) occurred from 1:00 AM to 2:00 AM EDT (05:00 to 06:00 UTC), when nine targets were identified as birds and three as insects. There were no foraging bats identified during sampling over Grid 7.

The barge was then moved to Grid 13 for the period 03 – 12 April 2008, with data gathered from 9:00 PM to 8:00 PM (01:00 to 00:00 UTC). During this time a total of 27 targets were identified, of which 21 targets were identified as birds (78%) and six as insects, suggesting that there were minimal traffic rates, though a weak migration may have occurred (**Table 6-2**). The maximum total identified for an hour (18 total targets) occurred from 5:00 AM to 6:00 AM (09:00 to 10:00 UTC), when all targets were identified as birds. There were no foraging bats identified during sampling over Grid 13.

Data collection resumed at Grid 19 for the period 14 – 18 April 2008 and covered from 10:00 PM to 8:00 PM EDT (02:00 to 00:00 UTC). Over this period there were a total of 39 targets identified, of which 24 targets were identified as birds (62%), 12 as insects, and three as foraging bats, suggesting a weak migration may have occurred (**Table 6-3**). The maximum total identified for an hour (9 total targets) occurred from 11:00 PM to 12:00 AM EDT (03:00 to 04:00 UTC), when six targets were identified as birds and three as insects.

At Grid 26 (25 – 30 April 2008) only 21 total targets were identified from 12:00 AM to 8:00 PM EDT (04:00 to 00:00 UTC). Out of the 21 total targets six targets were identified as birds (29%), 12 as insects, and three as foraging bats (**Table 6-4**). This dataset suggests little, if any, bird migration occurred over this time period. The maximum total targets identified for an hour (12 total targets) occurred from 12:00 AM to 1:00 AM EDT (04:00 to 05:00 UTC), when three targets were identified as birds, six as insects, and three as foraging bats.

The data from Grid 23 were collected from 01–07 May 2008. This dataset covered 9:00 PM to 8:00 PM EDT (01:00 to 00:00 UTC) with a total of 783 targets identified, of which 570 targets were identified as birds (73%), 204 as insects, and nine as foraging bats (**Table 6-5**). Most bird targets were identified on the night of 06-07 May, suggesting a strong migration occurred during this time. The maximum total targets identified for an hour (168 total targets) occurred from 2:00 AM to 3:00 AM EDT (06:00 to 07:00 UTC), when 150 targets were identified as birds, 12 as insects, and six as foraging bats.

Grid 17 was the final location for the spring and data were collected from 08-11 May 2008. This dataset covered 9:00 PM to 1:00 PM EDT (01:00 to 17:00 UTC) with a total of 162 targets identified, of which 69

targets were identified as birds (43%), 87 as insects, and six as foraging bats (**Table 6-6**). These data suggest a weak migration took place while sampling at this Grid. The maximum total targets identified for an hour (42 total targets) occurred from 2:00 AM to 3:00 AM EDT (06:00 to 07:00 UTC), when 21 targets were identified as birds and 21 as insects.

Table 6-1. Numbers (TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Grid 7 from 24-26 March 2008.

Hrs (EDT) ¹	Birds	Insects	Foraging Bats	Total Targets	% Birds
9:00 PM	3	0	0	3	100
10:00 PM	0	0	0	0	0
11:00 PM	0	0	0	0	0
12:00 AM	0	0	0	0	0
1:00 AM	9	3	0	12	75
2:00 AM	3	0	0	3	100
3:00 AM	0	0	0	0	0
4:00 AM	0	0	0	0	0
12:00 PM	0	0	0	0	0
1:00 PM	6	0	0	6	100
2:00 PM	3	0	0	3	100
3:00 PM	0	0	0	0	0
4:00 PM	0	0	0	0	0
Total	24	3	0	27	89

¹ Eastern Daylight Time, add 4 hours for UTC.

Table 6-2. Numbers (TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Grid 13 from 03-12 April 2008.

Hrs (EDT) ¹	Birds	Insects	Foraging Bats	Total Targets	% Birds
9:00 PM	0	6	0	6	0
11:00 PM	0	0	0	0	0
12:00 AM	0	0	0	0	0
1:00 AM	0	0	0	0	0
5:00 AM	18	0	0	18	100
6:00 AM	0	0	0	0	0
7:00 AM	0	0	0	0	0
8:00 AM	3	0	0	3	100
11:00 AM	0	0	0	0	0
12:00 PM	0	0	0	0	0
1:00 PM	0	0	0	0	0
2:00 PM	0	0	0	0	0
5:00 PM	0	0	0	0	0
6:00 PM	0	0	0	0	0
7:00 PM	0	0	0	0	0
Total	21	6	0	27	78

¹ Eastern Daylight Time, add 4 hours for UTC.

Table 6-3. Numbers (TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Grid 19 from 14-18 April 2008.

Hrs (EDT) ¹	Birds	Insects	Foraging Bats	Total Targets	% Birds
10:00 PM	0	0	0	0	0
11:00 PM	6	3	0	9	67
12:00 AM	0	0	0	0	0
1:00 AM	3	0	3	6	50
2:00 AM	6	0	0	6	100
3:00 AM	0	0	0	0	0
4:00 AM	0	0	0	0	0
5:00 AM	0	0	0	0	0
6:00 AM	0	0	0	0	0
7:00 AM	0	0	0	0	0
8:00 AM	0	3	0	3	0
9:00 AM	6	0	0	6	100
10:00 AM	0	0	0	0	0
11:00 AM	0	0	0	0	0
12:00 PM	0	3	0	3	0
1:00 PM	0	0	0	0	0
2:00 PM	0	0	0	0	0
3:00 PM	3	3	0	6	50
4:00 PM	0	0	0	0	0
5:00 PM	0	0	0	0	0
6:00 PM	0	0	0	0	0
7:00 PM	0	0	0	0	0
Total	24	12	3	39	62

¹ Eastern Daylight Time, add 4 hours for UTC.

Table 6-4. Numbers (TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Grid 26 from 25-30 April 2008.

Hrs (EDT) ¹	Birds	Insects	Foraging Bats	Total Targets	% Birds
12:00 AM	3	6	3	12	25
1:00 AM	3	6	0	9	33
3:00 AM	0	0	0	0	0
11:00 AM	0	0	0	0	0
12:00 PM	0	0	0	0	0
6:00 PM	0	0	0	0	0
7:00 PM	0	0	0	0	0
Total	6	12	3	21	29

¹ Eastern Daylight Time, add 4 hours for UTC.

Table 6-5. Numbers (TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Grid 23 from 01-07 May 2008.

Hrs (EDT) ¹	Birds	Insects	Foraging Bats	Total Targets	% Birds
9:00 PM	12	0	0	12	100
10:00 PM	72	15	0	87	83
11:00 PM	36	45	0	81	44
12:00 AM	69	36	3	108	64
1:00 AM	63	24	0	87	72
2:00 AM	150	12	6	168	89
3:00 AM	108	15	0	123	88
4:00 AM	36	12	0	48	75
5:00 AM	15	12	0	27	56
7:00 AM	0	3	0	3	0
9:00 AM	3	0	0	3	100
10:00 AM	3	0	0	3	100
11:00 AM	0	3	0	3	0
12:00 PM	0	12	0	12	0
1:00 PM	0	3	0	3	0
2:00 PM	0	0	0	0	0
3:00 PM	0	0	0	0	0
6:00 PM	0	6	0	6	0
7:00 PM	3	6	0	9	33
Total	570	204	9	783	73

¹ Eastern Daylight Time, add 4 hours for UTC.

Table 6-6. Numbers (TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Grid 17 from 08-11 May 2008.

Hrs (EDT) ¹	Birds	Insects	Foraging Bats	Total Targets	% Birds
9:00 PM	6	3	0	9	67
10:00 PM	3	6	3	12	25
11:00 PM	3	12	0	15	20
12:00 AM	6	12	0	18	33
1:00 AM	3	6	0	9	33
2:00 AM	21	21	0	42	50
3:00 AM	3	6	0	9	33
4:00 AM	15	15	3	33	45
5:00 AM	9	3	0	12	75
12:00 PM	0	3	0	3	0
Total	69	87	6	162	43

¹ Eastern Daylight Time, add 4 hours for UTC.

6.3.1.2 TI-VPR Altitudinal Distribution

Over Grid 7 in spring 2008, the TCC of birds in each 15-m (50-ft) altitudinal band showed that 38% (nine of 24 birds) were at altitudes above the RSZ (213+ m [700+ ft], **Table 6-7** and **Figure 6-1**). There were no birds detected below 30 m (100 ft) and 15 birds were detected within 30 to 213 m (100 to 700 ft; i.e., within the RSZ). Occasionally, detections appeared in the VPR and not in the TI and these may represent

insects too high to be detected by the TI but reflective enough to generate an echo on the VPR. CACs adjust for the varying sample size of the TI-VPR field of view at different altitudes. The CAC were similar to the altitude distribution from the TCCs, with 17 birds from 213 to 472 m (700 to 1,549 ft) and 104 birds within the RSZ (14% above the RSZ and 86% within the RSZ).

Grid 13 analyses of the TCC for birds in each altitudinal band showed that 25% (three of 12 birds) were above the RSZ and 75% (nine of 12 birds) were within the RSZ (**Table 6-8** and **Figure 6-2**). Once again no birds were detected below 30 m (100 ft). The CAC were similar to the altitudinal distribution from the TCCs, with 8 birds from 213 to 259 m (700 to 849 ft) and 54 birds within the RSZ (13% above the RSZ and 87% within the RSZ).

Table 6-7. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Grid 7 from 24-26 March 2008.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	0	0
150-199	0	0
200-249	0	0
250-299	6	52
300-349	3	22
350-399	0	0
400-449	3	17
450-499	0	0
500-549	3	13
550-599	0	0
600-649	0	0
650-699	0	0
700-749	0	0
750-799	0	0
800-849	0	0
850-899	0	0
900-949	3	7
950-999	0	0
1000-1049	0	0
1050-1099	0	0
1100-1149	0	0
1150-1199	0	0
1200-1249	3	6
1250-1299	0	0
1300-1349	0	0
1350-1399	0	0
1400-1449	0	0
1450-1499	0	0
1500-1549	3	4
Total	24	121

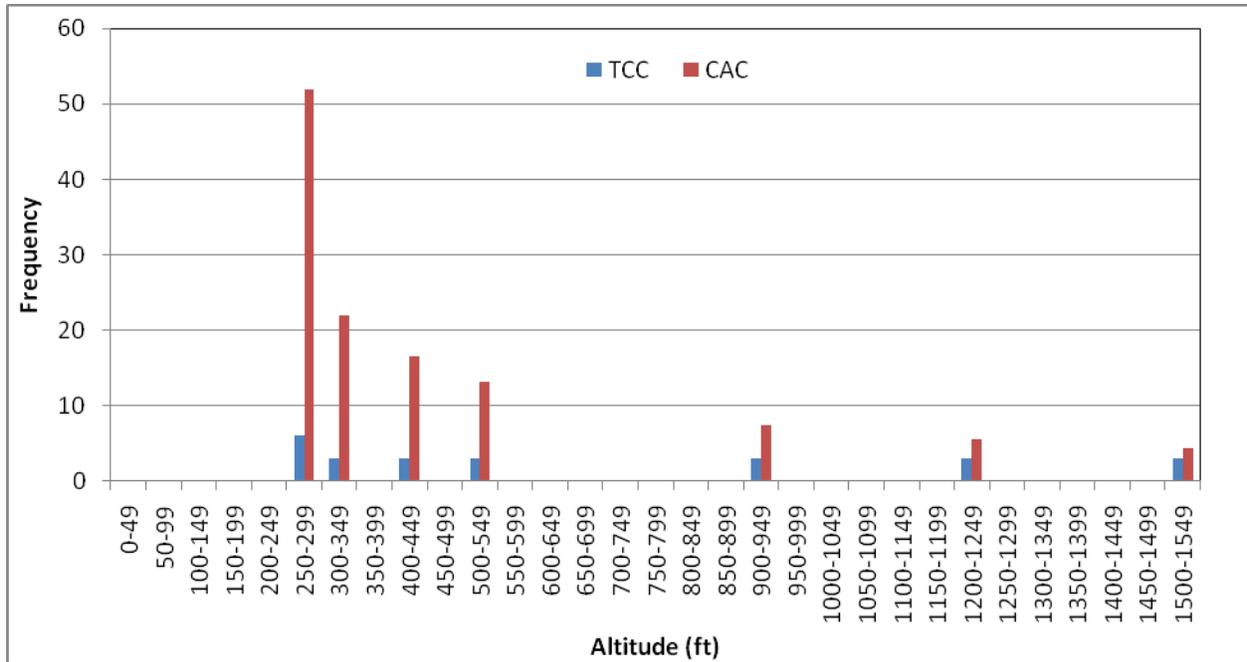


Figure 6-1. Altitudinal distribution of birds (TCC and CAC) aloft over Grid 7 from 24-26 March 2008.

Table 6-8. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Grid 13 from 03-12 April 2008.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	0	0
150-199	0	0
200-249	0	0
250-299	3	26
300-349	0	0
350-399	0	0
400-449	0	0
450-499	3	15
500-549	3	13
550-599	0	0
600-649	0	0
650-699	0	0
700-749	0	0
750-799	0	0
800-849	3	8
Total	12	62

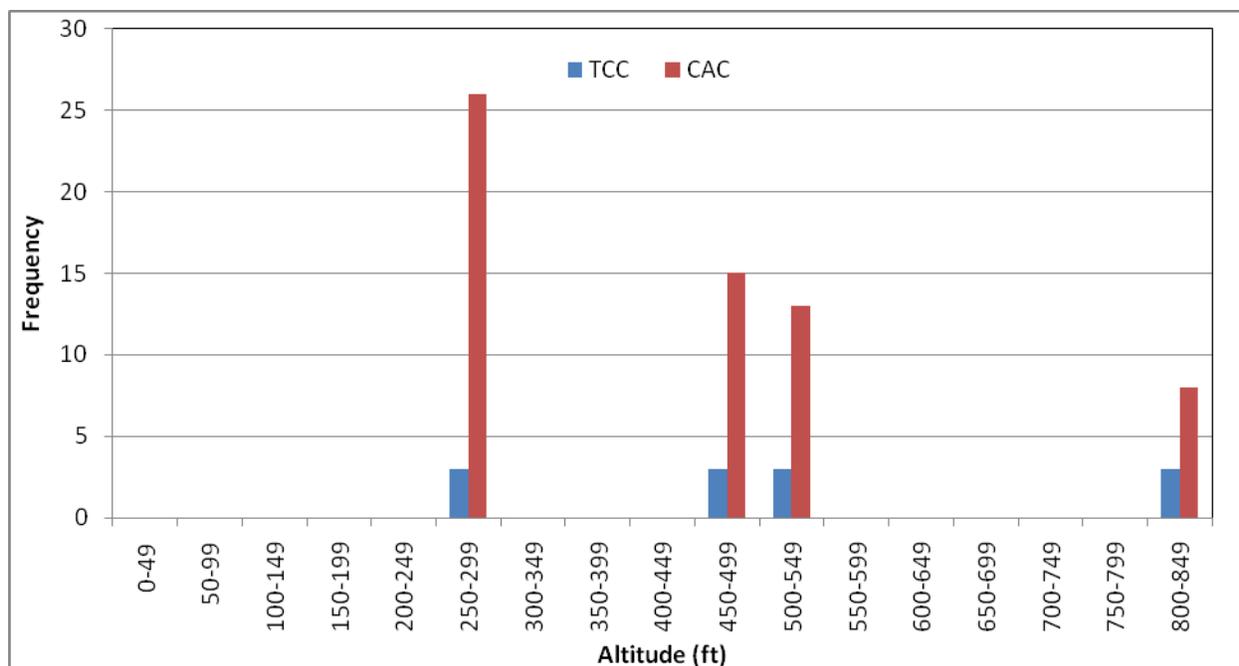


Figure 6-2. Altitudinal distribution of birds (TCC and CAC) aloft over Grid 13 from 03-12 April 2008.

Over Grid 19 the TCC for birds in each altitudinal band showed that 100% (18 birds) were within the RSZ (Table 6-9 and Figure 6-3). There were no birds detected below 30 m (100 ft). The CAC showed 108 birds within the RSZ (100% within the RSZ).

Table 6-9. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Grid 19 from 14-18 April 2008.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	0	0
150-199	0	0
200-249	3	33
250-299	3	26
300-349	0	0
350-399	0	0
400-449	0	0
450-499	3	15
500-549	0	0
550-599	6	24
600-649	0	0
650-699	3	10
Total	18	108

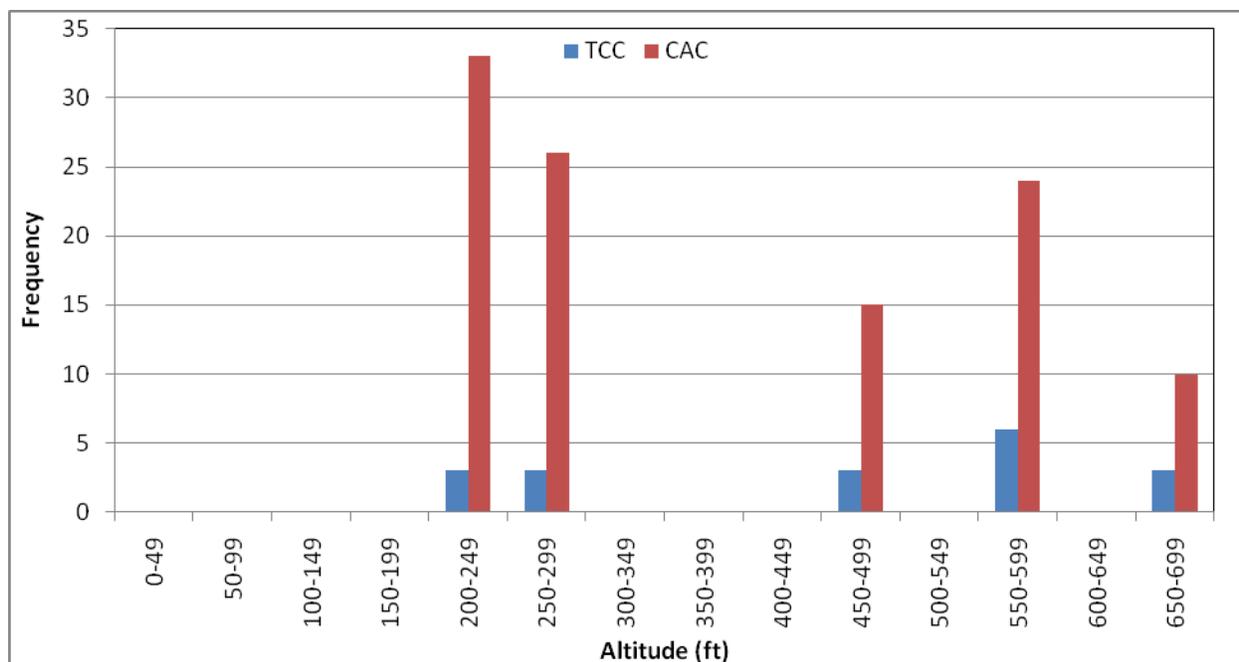


Figure 6-3. Altitudinal distribution of birds (TCC and CAC) aloft over Grid 19 from 14-18 April 2008.

Grid 26 analyses of the TCC for birds in each altitudinal band showed that 50% (3 of 6 birds) were above the RSZ and 50% were detected within the RSZ (Table 6-10 and Figure 6-4). Once again there were no birds detected below 30 m (100 ft). The CAC had a change in altitudinal distribution as compared to the TCCs, with 9 birds from 213 to 244 m (700 to 799 ft) and 33 birds within the RSZ (21% above the RSZ and 79% within the RSZ).

Table 6-10. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Grid 26 from 25-30 April 2008.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	0	0
150-199	0	0
200-249	3	33
250-299	0	0
300-349	0	0
350-399	0	0
400-449	0	0
450-499	0	0
500-549	0	0
550-599	0	0
600-649	0	0
650-699	0	0
700-749	0	0
750-799	3	9
Total	6	42

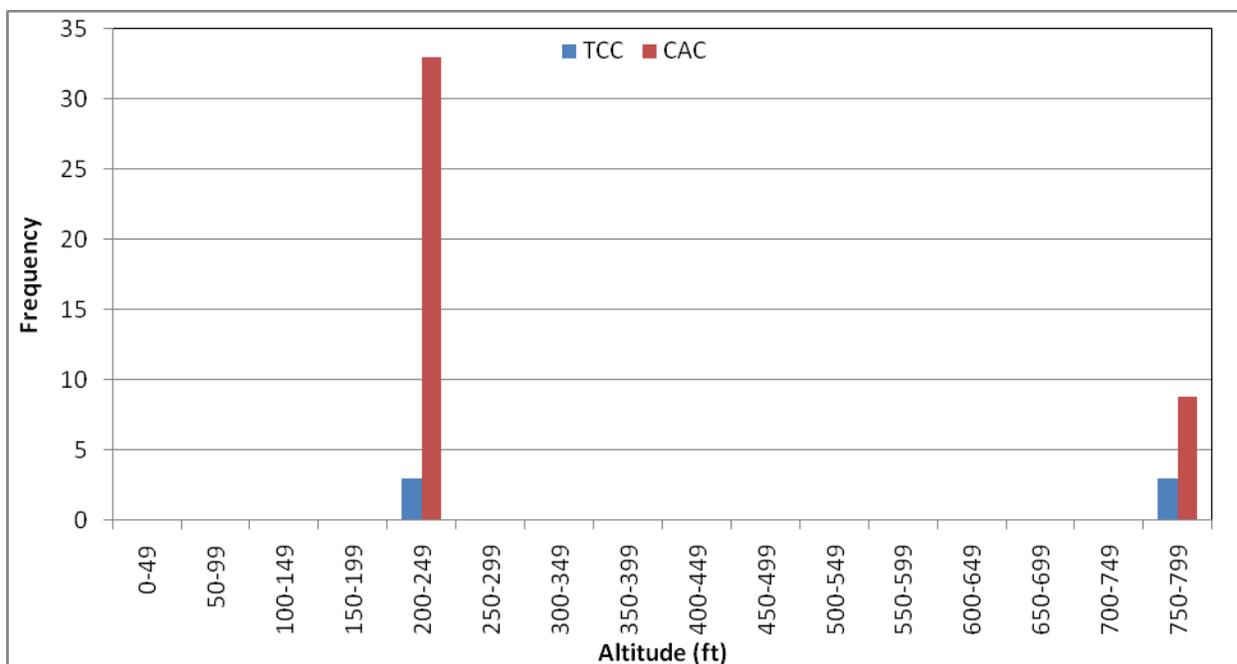


Figure 6-4. Altitudinal distribution of birds (TCC and CAC) aloft over Grid 26 from 25-30 April 2008.

Grid 23 showed the highest totals for birds of the six Grids sampled in spring 2008. The TCC for birds in each altitudinal band showed that 13% (75 of 567 birds) were above the RSZ and 87% (492 of 567 birds) were within the RSZ (**Table 6-11** and **Figure 6-5**). There were no birds detected below 30 m (100 ft). The CAC showed a similar pattern to the TCCs, with 188 birds from 213 to 442 m (700 to 1,449 ft) and 3,594 birds within the RSZ (5% above the RSA and 95% within the RSZ).

Table 6-11. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Grid 23 from 01-07 May 2008.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	9	198
150-199	33	484
200-249	36	396
250-299	72	625
300-349	81	594
350-399	42	266
400-449	60	338
450-499	54	270
500-549	42	182
550-599	36	144
600-649	21	77
650-699	6	20
700-749	9	27
750-799	12	36

Table 6-11 (continued). Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Grid 23 from 01-07 May 2008.

Altitudinal Band (ft)	TCC	CAC
800-849	12	32
850-899	12	32
900-949	6	14
950-999	3	7
1000-1049	3	7
1050-1099	0	0
1100-1149	3	6
1150-1199	3	6
1200-1249	3	6
1250-1299	0	0
1300-1349	6	10
1350-1399	0	0
1400-1449	3	5
Total	567	3782

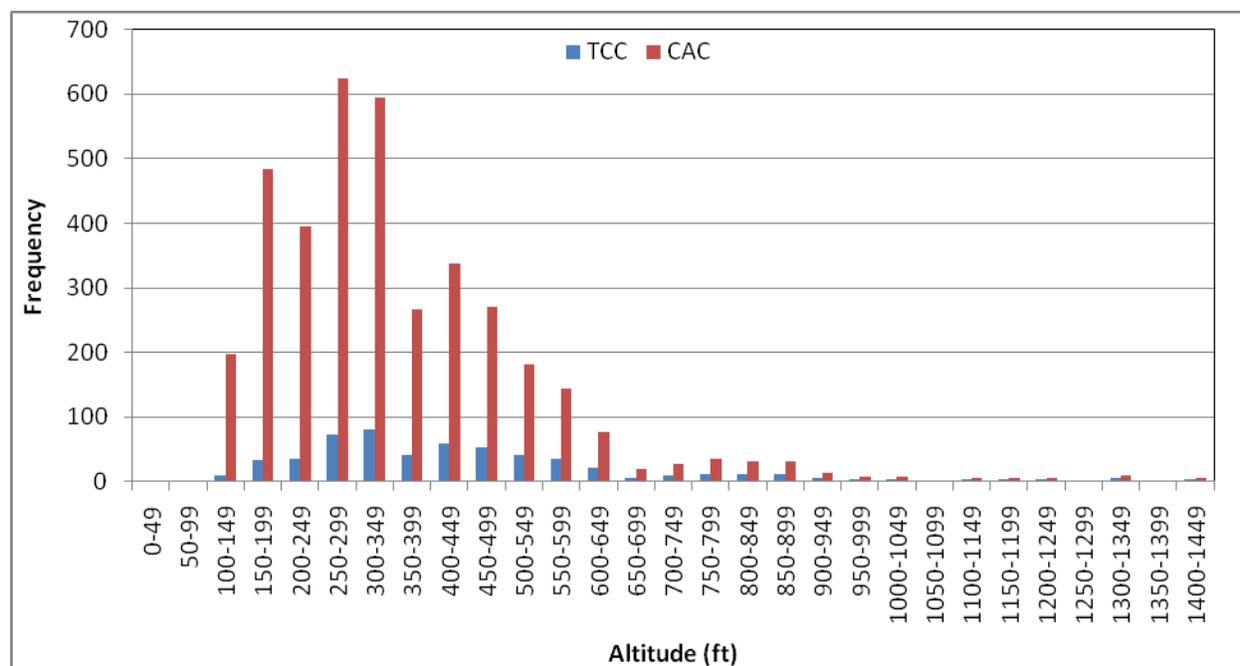


Figure 6-5. Altitudinal distribution of birds (TCC and CAC) aloft over Grid 23 from 01-07 May 2008.

Over Grid 17 the TCC for birds in each altitudinal band showed that 10% (six of 60 birds) were above the RSZ and 90% (54 of 60 birds) were within the RSZ (Table 6-12 and Figure 6-6). There were no birds detected below 30 m (100 ft). The CAC were similar to the TCCs, with nine birds from 213 to 228 m (700 to 749 ft) and 339 birds within the RSZ (3% above the RSZ and 97% within the RSZ).

Table 6-12. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Grid 17 from 08-10 May 2008.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	0	0
150-199	3	44
200-249	0	0
250-299	9	78
300-349	9	66
350-399	0	0
400-449	6	34
450-499	9	45
500-549	6	26
550-599	6	24
600-649	6	22
650-699	0	0
700-749	6	9
Total	60	348

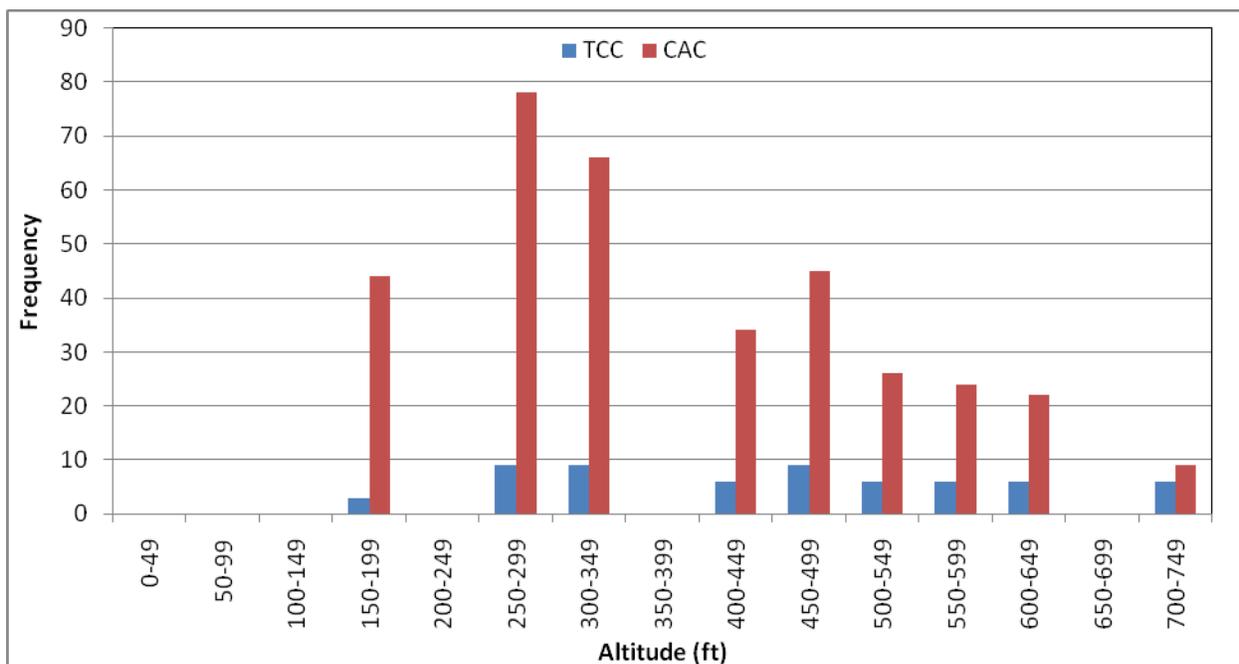


Figure 6-6. Altitudinal distribution of birds (TCC and CAC) aloft over Grid 17 from 08-10 May 2008.

6.3.1.3 TI-VPR Flight Direction

The directional tendencies of birds over all Grids are given in **Table 6-13** and illustrated in **Figure 6-7**. The mean direction for the movements for Grids 7, 13, 19, 23 and 17 ranged from north-northwest (NNW) to ENE (35.42°, 56.88°, 69.37°, 49.12°, and 352.70°, respectively), while Grid 26 showed a mean direction towards the south-southwest (SSW; 188.71°). This anomaly at Grid 26 could be explained by adverse, strong winds (~20 kts from the NW) leading to a reverse migration. Overall, the Grids showed little variability in the mean direction (see length of mean vector **Table 6-13**), with the once exception being Grid 17 as shown by the length of the mean vector (0.31) and circular SD (87.58°).

Table 6-13. Statistical analysis of direction of nightly migrations over Grids 7, 13, 19, 26, 23 and 17 during spring 2008.

3

	Grid 7	Grid 13	Grid 19	Grid 26	Grid 23	Grid 17
Number of Observations	121	71	117	42	3773	354
Mean Vector (μ)	35.42°	56.88°	69.37°	188.71°	49.12°	352.70°
Length of Mean Vector (r)	0.92	0.75	0.77	0.98	0.89	0.31
Median	45°	55°	75°	195°	50°	0°
Concentration	6.44	2.39	2.57	22.17	5.02	0.65
Circular Variance	0.08	0.25	0.23	0.02	0.11	0.69
Circular Standard Deviation	23.58°	43.14°	41.09°	12.31°	27.10°	87.58°
Standard Error of Mean	2.14°	5.07°	3.76°	1.90°	0.44°	6.75°
Rayleigh Test (Z)	102.15	40.28	69.96	40.11	3016.57	34.23
Rayleigh Test (p)	<1E-12	<1E-12	<1E-12	<1E-12	<1E-12	<1E-12
Rao's Spacing Test (U)	339.17	329.65	338.46	342.86	357.90	340.68
Rao's Spacing Test (p)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

6.3.2 Fall 2008

6.3.2.1 Target Identification

Data over Grid 23 were gathered from 01–12 October 2008 and covered 8:00 PM to 7:00 PM EDT (00:00 to 23:00 UTC). During this time a total of 1,252 total targets were identified, of which 985 targets were identified as birds (79%), 243 as insects, and 24 as foraging bats, suggesting some bird migration had taken place over this time period (**Table 6-14**). The maximum total targets identified for an hour (243 total targets) occurred from 7:00 AM to 8:00 AM EDT (11:00 to 12:00 UTC), when all targets were identified as birds.

The barge then moved to Grid 26 and collected data from 13–19 October 2008 and covered 8:00 PM to 6:00 PM EDT (00:00 to 22:00 UTC). During this time a total of 249 targets were identified, of which 192 targets were identified as birds (77%) and 57 as insects, suggesting that some migration occurred (**Table 6-15**). The maximum total targets identified for an hour (57 total targets) occurred from 1:00 AM to 2:00 AM EDT (05:00 to 06:00 UTC), when 51 targets were identified as birds and six as insects. There were no foraging bats identified during sampling over Grid 26.

6.3.2.2 Altitudinal Distribution

Over Grid 23 in fall 2008, the TCC of birds in each 15-m (50-ft) altitudinal band showed that 49% (426 of 861 birds) were at altitudes above the RSZ and 51% (435 of 861 birds) were within the RSZ (Table 6-16 and Figure 6-8). There were no birds detected below 30 m (100 ft). Occasionally, detections appeared in the VPR and not in the TI and these may represent insects too high to be detected by the TI but reflective enough to generate an echo on the VPR. The CAC showed a change in altitudinal distribution from the TCCs, with 943 birds from 213 to 594 m (700 to 1,949 ft) and 3,037 birds within the RSZ (24% above the RSZ and 76% within the RSZ).

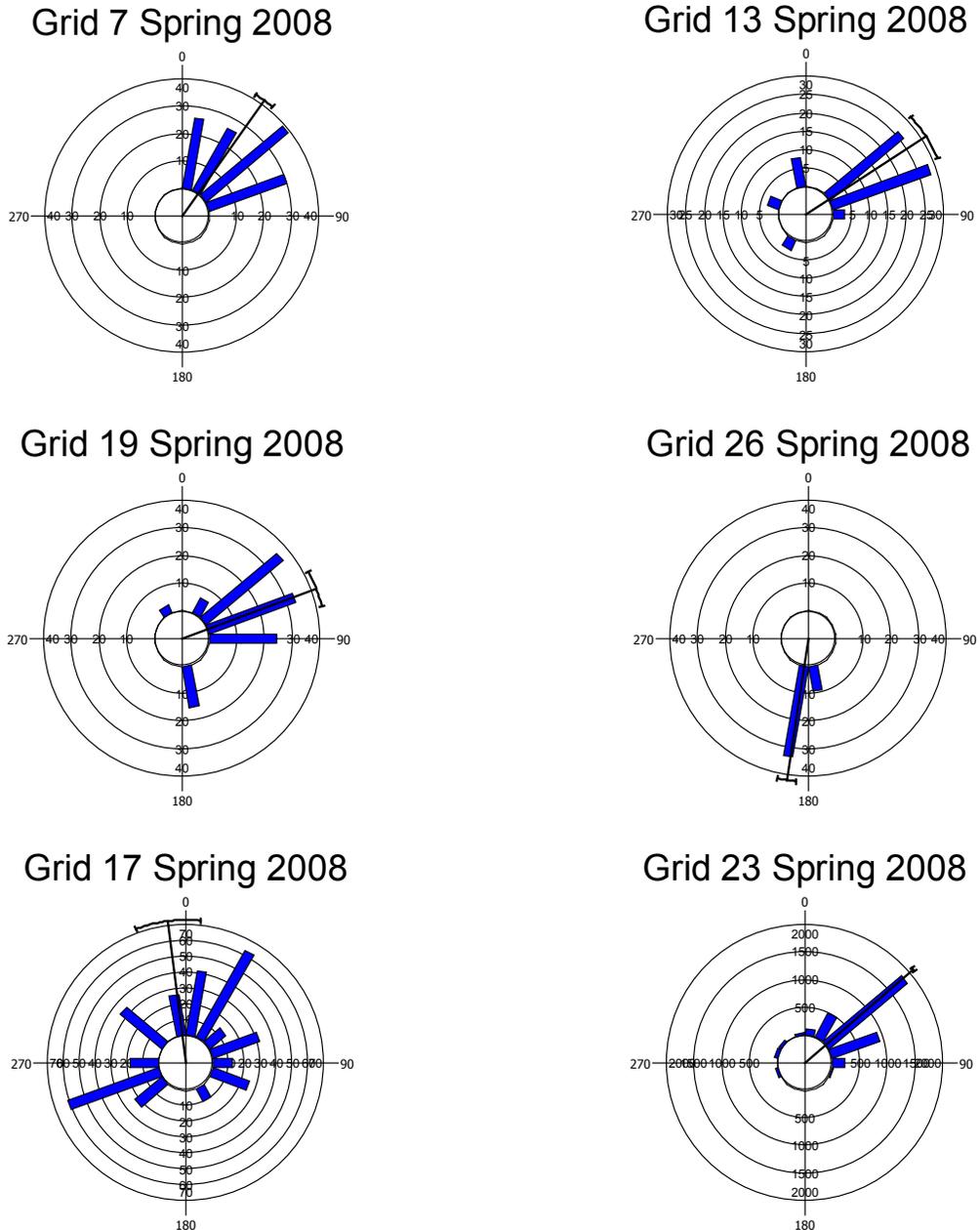


Figure 6-7. Circular diagrams showing the direction of bird movements through the TI-VPR field of view in Grids 7, 13, 19, 26, 23 and 17 for spring 2008. The dark line is the mean angle and the arc at the end shows the 95% confidence limits of the mean.

Table 6-14. Numbers (TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Grid 23 from 01-12 October 2008.

Hrs (EDT) ¹	Birds	Insects	Foraging Bats	Total Targets	% Birds
8:00 PM	6	0	0	6	100
9:00 PM	39	18	3	60	65
10:00 PM	30	3	3	36	83
11:00 PM	0	9	3	12	0
12:00 AM	15	3	9	27	56
1:00 AM	12	21	0	33	36
2:00 AM	45	30	0	75	60
3:00 AM	147	21	0	168	88
4:00 AM	81	30	0	111	73
5:00 AM	99	18	0	117	85
6:00 AM	84	3	0	87	97
7:00 AM	243	0	0	243	100
8:00 AM	105	15	0	120	88
9:00 AM	39	3	0	42	93
10:00 AM	13	0	0	13	100
11:00 AM	3	0	0	3	100
2:00 PM	0	6	0	6	0
3:00 PM	9	21	3	33	27
4:00 PM	12	21	3	36	33
5:00 PM	3	15	0	18	17
6:00 PM	0	6	0	6	0
Total	985	243	24	1252	79

¹ Eastern Daylight Time, add 4 hours for UTC.

Table 6-15. Numbers (TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Grid 26 from 13-19 October 2008.

Hrs (EDT) ¹	Bird	Insects	Foraging Bats	Total Targets	% Birds
8:00 PM	30	0	0	30	100
9:00 PM	0	3	0	3	0
10:00 PM	9	0	0	9	100
11:00 PM	6	9	0	15	40
12:00 AM	48	9	0	57	84
1:00 AM	51	6	0	57	89
2:00 AM	33	0	0	33	100
3:00 AM	9	0	0	9	100
4:00 AM	3	3	0	6	50
5:00 AM	3	9	0	12	25
12:00 PM	0	3	0	3	0
1:00 PM	0	3	0	3	0
2:00 PM	0	3	0	3	0
4:00 PM	0	3	0	3	0
5:00 PM	0	6	0	6	0
Total	192	57	0	249	77

¹ Eastern Daylight Time, add 4 hours for UTC.

Table 6-16. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Grid 23 from 01-12 October 2008.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	0	0
150-199	33	484
200-249	24	264
250-299	39	343
300-349	54	396
350-399	42	264
400-449	9	51
450-499	42	205
500-549	45	498
550-599	33	132
600-649	51	187
650-699	63	213
700-749	12	36
750-799	36	108
800-849	24	64
850-899	48	124
900-949	63	154
950-999	36	83
1000-1049	9	21
1050-1099	9	18
1100-1149	12	24
1150-1199	27	52
1200-1249	108	198
1250-1299	3	5
1300-1349	0	0
1350-1399	3	5
1400-1449	3	5
1450-1499	0	0
1500-1549	27	39
1550-1599	0	0
1600-1649	0	0
1650-1699	0	0
1700-1749	0	0
1750-1799	0	0
1800-1849	3	4
1850-1899	0	0
1900-1949	3	3
Total	861	3980

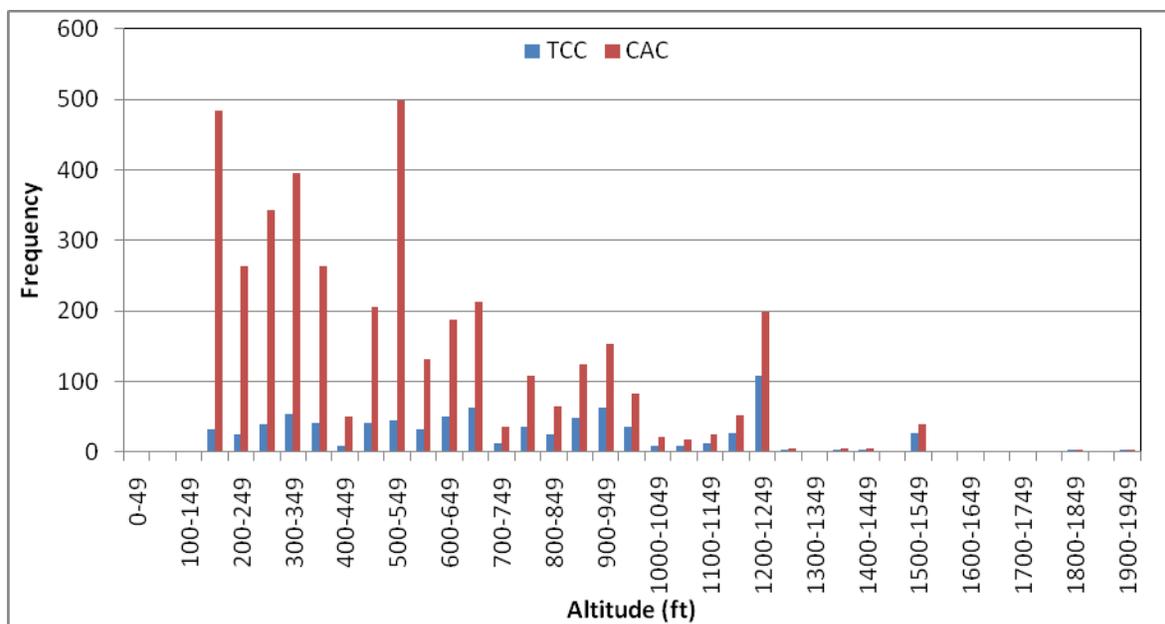


Figure 6-8. Altitudinal distribution of birds (TCC and CAC) aloft over Grid 23 from 01-12 October 2008.

Grid 26 analyses of the TCC for birds in each altitudinal band showed that 49% (93 of 189 birds) were above the RSZ and 51% (96 of 189 birds) were within the RSZ (Table 6-17 and Figure 6-9). Once again no birds were detected below 30 m (100 ft). The CAC showed a change in altitudinal distribution from the TCCs, with 181 birds from 213 to 655 m (700 to 2,149 ft) and 576 birds within the RSZ (24% above the RSZ and 76% within the RSZ).

Table 6-17. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Grid 26 from 13-19 October 2008.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	0	0
150-199	9	132
200-249	3	33
250-299	3	26
300-349	18	132
350-399	3	19
400-449	0	0
450-499	6	30
500-549	6	26
550-599	9	36
600-649	36	132
650-699	3	10
700-749	0	0
750-799	9	27
800-849	9	24
850-899	6	16

Table 6-17 (continued). Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Grid 26 from 13-19 October 2008.

Altitudinal Band (ft)	TCC	CAC
900-949	18	42
950-999	6	14
1000-1049	0	0
1050-1049	0	0
1100-1149	0	0
1150-1199	9	18
1200-1249	0	0
1250-1299	0	0
1300-1349	0	0
1350-1399	0	0
1400-1449	0	0
1450-1499	0	0
1500-1549	3	4
1550-1599	0	0
1600-1649	0	0
1650-1699	0	0
1700-1749	0	0
1750-1799	6	8
1800-1849	0	0
1850-1899	0	0
1900-1949	0	0
1950-1999	0	0
2000-2049	0	0
2050-2099	0	0
2100-2149	27	28
Total	189	757

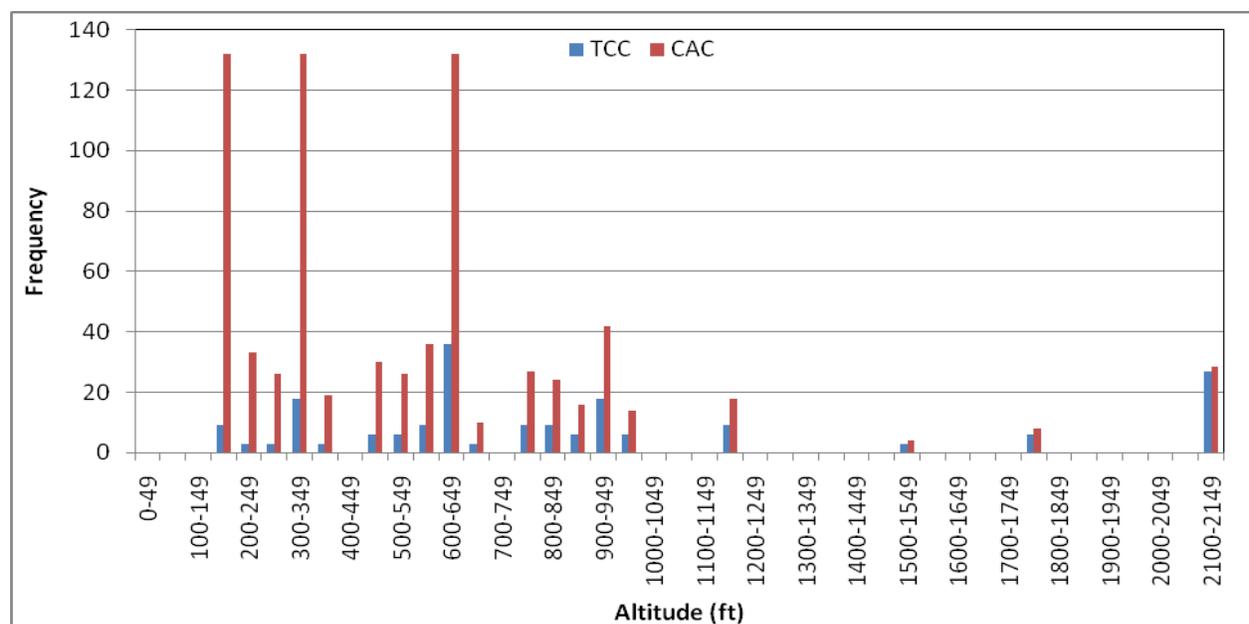


Figure 6-9. Altitudinal distribution of birds (TCC and CAC) aloft over Grid 26 from 13-19 October 2008.

6.3.2.3 Flight Direction

The directional tendencies of birds over Grids 23 and 26 are given in **Table 6-18** and illustrated in **Figure 6-10**. The mean direction for the movements for Grids 23 and 26 were towards the SW (246.17° and 254.51°, respectively). The Grids showed little variability in the mean direction as illustrated by the length of the mean vector (0.75 and 0.72, respectively) and circular SD (43.87° and 46.50°, respectively).

Table 6-18. Statistical analysis of direction of nightly migrations over Grids 23 and 26 during fall 2008.

	Grid 23	Grid 26
Number of Observations	3,734	757
Mean Vector (μ)	246.17°	254.51°
Length of Mean Vector (r)	0.75	0.72
Median	250°	245°
Concentration	2.33	2.13
Circular Variance	0.25	0.28
Circular Standard Deviation	43.87°	46.50°
Standard Error of Mean	0.71°	1.68°
Rayleigh Test (Z)	2077.88	391.83
Rayleigh Test (p)	<1E-12	<1E-12
Rao's Spacing Test (U)	355.18	347.16
Rao's Spacing Test (p)	<0.01	<0.01

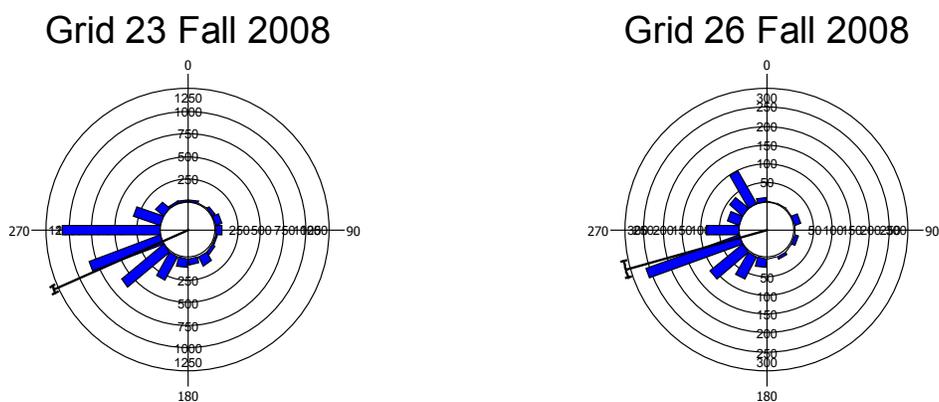


Figure 6-10. Circular diagrams showing the direction of bird movements through the TI-VPR field of view in Grids 23 and 26 for fall 2008. The dark line is the mean angle and the arc at the end shows the 95% confidence limits of the mean.

6.3.3 Spring 2009

6.3.3.1 Target Identification

Data over Grid 16 were gathered on the night of 11 May 2009 and covered 8:00 PM to 8:00 AM EDT (00:00 to 12:00 UTC). Over this time period 96 total targets were identified, of which 39 targets were identified as birds (41%) and 57 as insects (**Table 6-19**). This suggests that a weak bird migration occurred during this evening. The maximum total targets identified for an hour (27 total targets) occurred from 10:00 PM to 11:00 PM EDT (02:00 to 03:00 UTC), when 21 targets were identified as birds and six as insects. There were no foraging bats identified during sampling at Grid 16.

The barge was then moved to Grid 22 and for the night of 12 May 2009 and covered 8:00 PM to 3:00 AM EDT (00:00 to 07:00 UTC). During this time a total of 57 targets were identified, of which 39 targets were identified as birds (68%) and 18 as insects, suggesting a weak migration had occurred (**Table 6-20**). The maximum total targets identified for an hour was 15 total targets and this occurred multiple times at 10:00 to 11:00 PM, 11:00 PM to 12:00 AM and 1:00 AM to 2:00 AM EDT (02:00 to 03:00, 03:00 to 04:00 and 05:00 to 06:00 UTC, respectively). During these times the total birds identified were six, 15, and nine, respectively, while the total insects identified were nine, zero, and six, respectively. There were no foraging bats identified during sampling at Grid 22.

Table 6-19. Numbers (TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Grid 16 on 11 May 2009.

Hrs (EDT) ¹	Birds	Insects	Foraging Bats	Total Targets	% Birds
8:00 PM	3	0	0	3	100
9:00 PM	0	3	0	3	0
10:00 PM	21	6	0	27	78
11:00 PM	15	9	0	24	63
12:00 AM	0	6	0	6	0
1:00 AM	0	9	0	9	0
2:00 AM	0	9	0	9	0
3:00 AM	0	6	0	6	0
4:00 AM	0	6	0	6	0
5:00 AM	0	0	0	0	0
6:00 AM	0	0	0	0	0
7:00 AM	0	3	0	3	0
Total	39	57	0	96	41

¹ Eastern Daylight Time, add 4 hours for UTC.

Table 6-20. Numbers (TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Grid 22 on 12 May 2009.

Hrs (EDT) ¹	Birds	Insects	Foraging Bats	Total Targets	% Birds
8:00 PM	0	0	0	0	0
9:00 PM	0	0	0	0	0
10:00 PM	6	9	0	15	40
11:00 PM	15	0	0	15	100
12:00 AM	9	3	0	12	75
1:00 AM	9	6	0	15	60
2:00 AM	0	0	0	0	0
Total	39	18	0	57	68

¹ Eastern Daylight Time, add 4 hours for UTC.

6.3.3.2 Altitudinal Distribution

Over Grid 16 in spring 2009, the TCC of birds in each 15-m (50-ft) altitudinal band showed that 8% (three of 36 birds) were above the RSZ and 92% (33 of 36 birds) were within the RSZ (**Table 6-21** and **Figure 6-11**). There were no birds detected below 30 m (100 ft). As seen at other sites there were detections that appeared in the VPR and not in the TI which may represent insects too high to be detected by the TI but reflective enough to generate an echo on the VPR. The CAC was similar to the TCCs, with 8 birds from 213 to 274 m (700 to 899 ft) and 214 birds within the RSZ (4% above the RSZ and 96% within the RSZ).

Grid 22 analyses of the TCC for birds in each altitudinal band showed that 15% (6 of 39 birds) were above the RSZ and 85% (33 of 39 birds) were within the RSZ (**Table 6-22** and **Figure 6-12**). Once again no birds were detected below 30 m (100 ft). The CAC was similar to the TCCs, with 15 birds from 213 to 335 m (700 to 1,099 ft) and 231 birds within the RSZ (6% above the RSZ and 94% within the RSZ).

6.3.3.3 Flight Direction

The directional tendencies of birds over Grids 16 and 22 are given in **Table 6-23** and illustrated in **Figure 6-13**. The mean direction for the movements for Grids 16 and 22 were towards the north-northeast (NNE; 17.463° and 23.753°, respectively). The Grids showed little variability in the mean direction as illustrated by the length of the mean vector (0.99 and 0.97, respectively) and circular SD (10.41° and 13.10°, respectively).

Table 6-21. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Grid 16 on 11 May 2009.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	0	0
150-199	0	0
200-249	0	0
250-299	6	52
300-349	12	88
350-399	3	19
400-449	6	34
450-499	0	0
500-549	0	0
550-599	0	0
600-649	3	11
650-699	3	10
700-749	0	0
750-799	0	0
800-849	0	0
850-899	3	8
Total	36	222

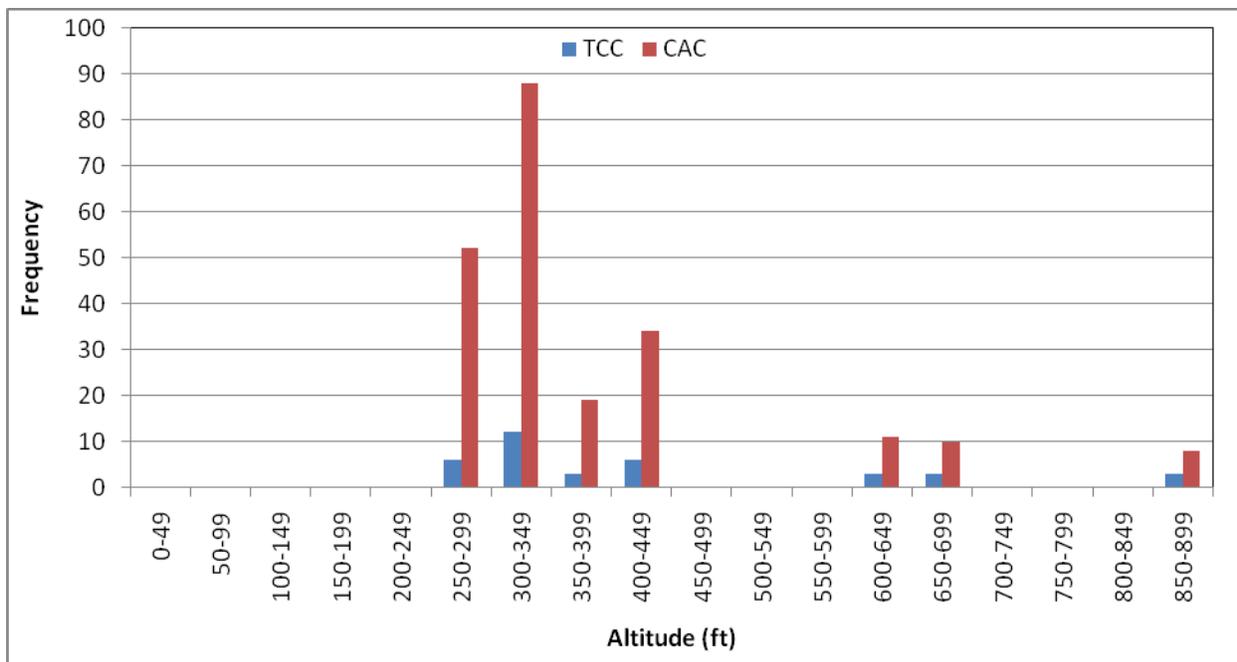


Figure 6-11. Altitudinal distribution of birds (TCC and CAC) aloft over Grid 16 on 11 May 2009.

Table 6-22. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPB samples over Grid 22 on 12 May 2009.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	0	0
150-199	3	44
200-249	0	0
250-299	6	52
300-349	9	66
350-399	0	0
400-449	6	34
450-499	0	0
500-549	3	13
550-599	3	12
600-649	0	0
650-699	3	10
700-749	0	0
750-799	3	9
800-849	0	0
850-899	0	0
900-949	0	0
950-999	0	0
1000-1049	0	0
1050-1099	3	6
Total	39	246

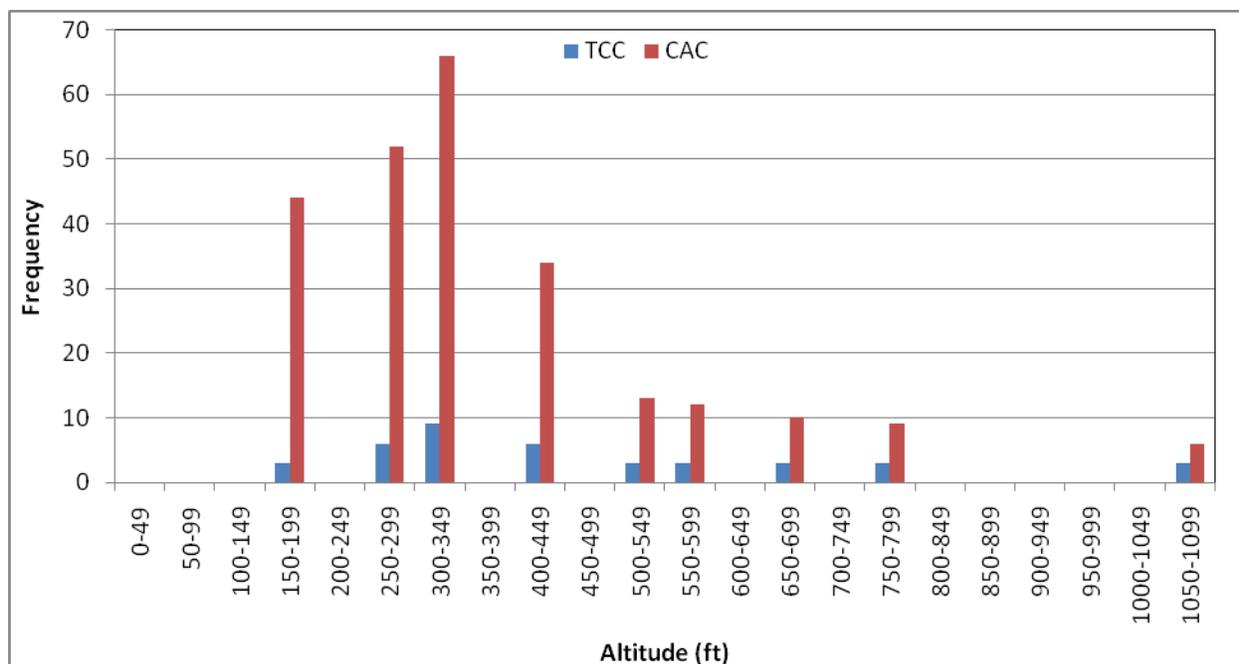
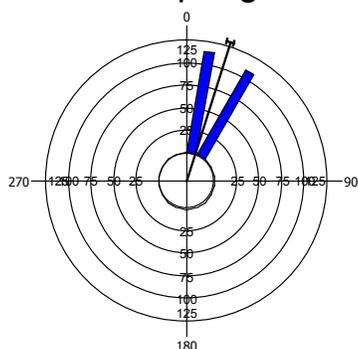


Figure 6-12. Altitudinal distribution of birds (TCC and CAC) aloft over Grid 22 on 12 May 2009.

Table 6-23. Statistical analysis of direction of nightly migrations over Grids 16 and 22 during spring 2009.

	Grid 16	Grid 22
Number of Observations	222	246
Mean Vector (μ)	17.463°	23.753°
Length of Mean Vector (r)	0.99	0.97
Median	10°	20°
Concentration	30.796	19.644
Circular Variance	0.016	0.026
Circular Standard Deviation	10.41°	13.10°
Standard Error of Mean	0.70°	0.84°
Rayleigh Test (Z)	214.79	233.473
Rayleigh Test (p)	<1E-12	<1E-12
Rao's Spacing Test (U)	350.27	348.293
Rao's Spacing Test (p)	<0.01	<0.01

Grid 16 Spring 2009



Grid 22 Spring 2009

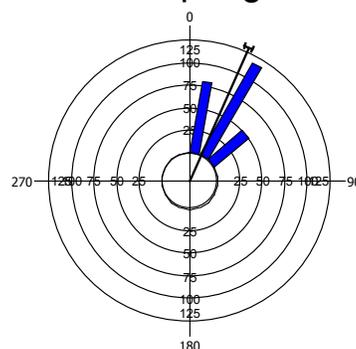


Figure 6-13. Circular diagrams showing the direction of bird movements through the TI-VPR field of view in Grids 16 and 22 for spring 2009. The dark line is the mean angle and the arc at the end shows the 95% confidence limits of the mean.

6.4 ONSHORE SURVEY RESULTS

6.4.1 Fall 2008

6.4.1.1 Target Identification

Data over SIC, New Jersey, were collected from 08–15 December 2008 and covered 9:00 PM to 4:00 PM Eastern Standard Time (EST [02:00 to 21:00 UTC]). Over this time period 285 total targets were recorded, of which 270 targets were identified as birds (95%), nine as insects, and six as foraging bats (Table 6-24), suggesting some bird migration occurred over this period of time. The maximum total targets identified for an hour (57 total targets) occurred from 9:00 PM to 10:00 PM EST (02:00 to 03:00 UTC), when all targets were identified as birds.

Table 6-24. Numbers (TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Sea Isle City, New Jersey, from 08-15 December 2008.

Hrs (EST) ¹	Birds	Insects	Foraging Bats	Total Targets	% Birds
9:00 PM	57	0	0	57	100
10:00 PM	51	3	0	54	94
11:00 PM	33	0	0	33	100
12:00 AM	18	0	6	24	75
1:00 AM	3	0	0	3	100
2:00 AM	12	0	0	12	100
3:00 AM	6	0	0	6	100
7:00 AM	24	0	0	24	100
8:00 AM	9	0	0	9	100
9:00 AM	12	0	0	12	100
10:00 AM	15	0	0	15	100
11:00 AM	6	0	0	6	100
1:00 PM	3	0	0	3	100
2:00 PM	12	3	0	15	80
3:00 PM	9	3	0	12	75
Total	270	9	6	285	95

¹ Eastern Standard Time, add 5 hours for UTC.

6.4.1.2 Altitudinal Distribution

Over SIC, New Jersey, in fall 2008, the TCC of birds in each altitudinal band showed that 27% (66 of 243 birds) were at altitudes above the RSZ and 73% (177 of 243 birds) were within the RSZ (**Table 6-25** and **Figure 6-14**). There were no birds detected below 30 m (100 ft). While sampling over SIC there were detections that appeared in the VPR and not in the TI, which may represent insects too high to be detected by the TI but reflective enough to generate an echo on the VPR. The CAC was similar to the TCCs, with 142 birds from 213 to 625 m (700 to 2,049 ft) and 1,289 birds within the RSZ (10% above the RSZ and 90% within the RSZ).

Table 6-25. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Sea Isle City, New Jersey, from 08-15 December 2008.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	3	66
150-199	15	220
200-249	15	165
250-299	15	130
300-349	51	374
350-399	3	19
400-449	6	34
450-499	9	45
500-549	15	65
550-599	24	96
600-649	15	55
650-699	6	20
700-749	6	18
750-799	0	0
800-849	3	8
850-899	15	39
900-949	3	7
950-999	6	14
1000-1049	0	0
1050-1099	9	18
1100-1149	3	6
1150-1199	0	0
1200-1249	0	0
1250-1299	0	0
1300-1349	15	25
1350-1399	0	0
1400-1449	0	0
1450-1499	0	0
1500-1549	3	4
1550-1599	0	0
1600-1649	0	0
1650-1699	0	0
1700-1749	0	0
1750-1799	0	0
1800-1849	0	0
1850-1899	0	0

Table 6-25 (continued). Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VRP samples over Sea Isle City, New Jersey, from 08-15 December 2008.

Altitudinal Band (ft)	TCC	CAC
1900-1949	0	0
1950-1999	0	0
2000-2049	3	3
Total	243	1431

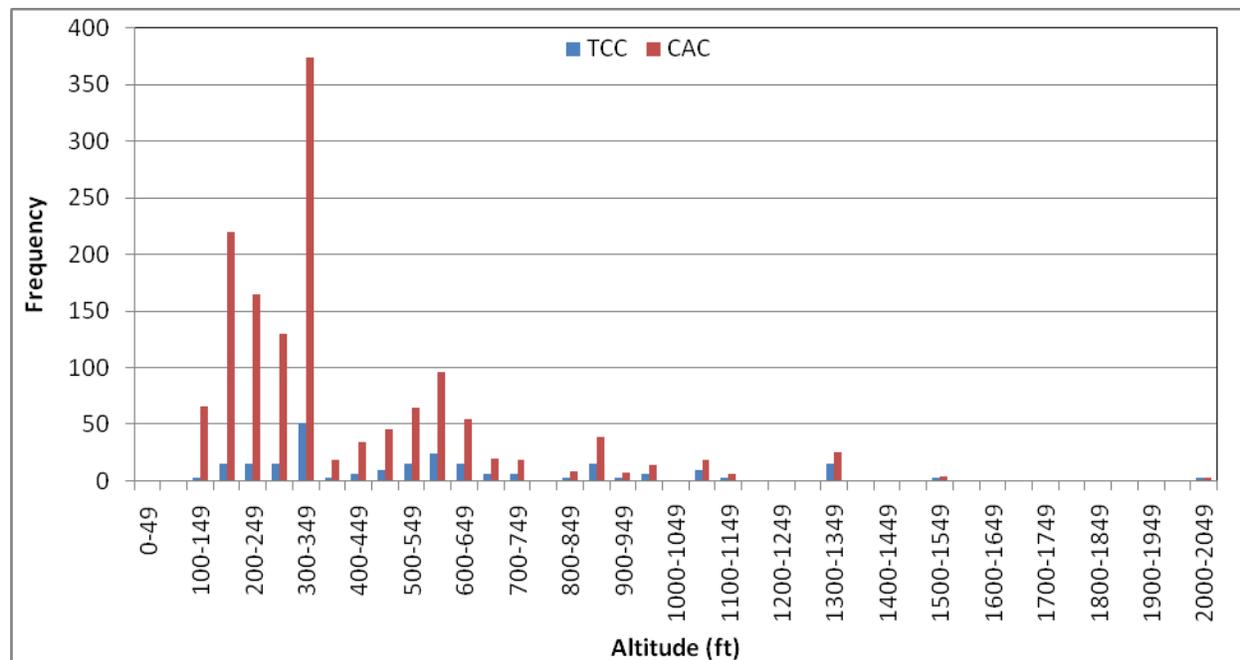


Figure 6-14. Altitudinal distribution of birds (TCC and CAC) aloft over Sea Isle City, New Jersey, from 08-15 December 2008.

6.4.1.3 Flight Direction

The directional tendencies of birds over SIC, New Jersey, are given in **Table 6-26** and illustrated in **Figure 6-15**. The mean direction for movements over SIC was towards the SSW (189.19°). The site showed some variability in the mean direction as illustrated by the length of the mean vector (0.62) and circular SD (56.42°).

6.4.2 Spring 2009

6.4.2.1 Target Identification

Data over IBSP, New Jersey, were collected from 21 – 22 and 27 March 2009 and covered the hours from 12:00 PM to 4:00 PM EDT (16:00 to 20:00 UTC). Over this time period 54 targets were identified, of which 21 targets were identified as birds (39%) and 33 as insects (**Table 6-27**), suggesting that little, if any, bird migration occurred over this period of time. The maximum total targets identified for an hour (42 total targets) occurred from 1:00 PM to 2:00 PM EDT (17:00 to 18:00 UTC), when 18 targets were identified as birds and 24 as insects. There were no foraging bats identified during sampling over IBSP.

Table 6-26. Statistical analysis of direction of nightly migrations over Sea Isle City, New Jersey, during fall 2008.

	Sea Isle City
Number of Observations	1402
Mean Vector (μ)	189.19°
Length of Mean Vector (r)	0.62
Median	180°
Concentration	1.58
Circular Variance	0.38
Circular Standard Deviation	56.42°
Standard Error of Mean	1.55°
Rayleigh Test (Z)	531.74
Rayleigh Test (p)	<1E-12
Rao's Spacing Test (U)	352.55
Rao's Spacing Test (p)	<0.01

Sea Isle City Fall 2008

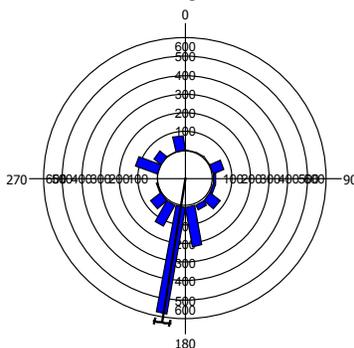


Figure 6-15. Circular diagram showing the direction of bird movements through the TI-VPR field of view over Sea Isle City, New Jersey, for fall 2008. The dark line is the mean angle and the arc at the end shows the 95% confidence limits of the mean.

Table 6-27. Numbers (TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Island Beach State Park, New Jersey, from 21-22 and 27 March 2009.

Hrs (EDT) ¹	Birds	Insects	Foraging Bats	Total Targets	% Birds
12:00 PM	0	0	0	0	0
1:00 PM	18	24	0	42	43
2:00 PM	0	3	0	3	0
3:00 PM	3	6	0	9	33
Total	21	33	0	54	39

¹ Eastern Daylight Time, add 4 hours for UTC.

6.4.2.2 Altitudinal Distribution

Over IBSP, New Jersey, in spring 2009, the TCC of birds in each altitudinal band showed that 100% (21 birds) were at altitudes above the RSZ (**Table 6-28** and **Figure 6-16**). There were no birds detected below 30 m (100 ft). Occasionally, detections appeared in the VPR and not in the TI and these may represent insects too high to be detected by the TI but reflective enough to generate an echo on the VPR. The CAC showed the same distribution found in the TCCs, with all birds (32 total) at altitudes above the RSZ from 213 to 640 m (700 to 2,099 ft).

Table 6-28. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Sea Isle City, New Jersey, from 21-22 and 27 March 2009.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	0	0
150-199	0	0
200-249	0	0
250-299	0	0
300-349	0	0
350-399	0	0
400-449	0	0
450-499	0	0
500-549	0	0
550-599	0	0
600-649	0	0
650-699	0	0
700-749	0	0
750-799	0	0
800-849	0	0
850-899	0	0
900-949	0	0
950-999	0	0
1000-1049	0	0
1050-1099	0	0
1100-1149	0	0
1150-1199	3	6
1200-1249	3	6
1250-1299	0	0
1300-1349	0	0
1350-1399	0	0
1400-1449	3	5
1450-1499	0	0
1500-1549	3	4
1550-1599	0	0
1600-1649	0	0
1650-1699	3	4
1700-1749	0	0
1750-1799	3	4
1800-1849	0	0
1850-1899	0	0
1900-1949	0	0

Table 6-28 (continued). Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Sea Isle City, New Jersey, from 21-22 and 27 March 2009.

Altitudinal Band (ft)	TCC	CAC
1950-1999	0	0
2000-2049	0	0
2050-2099	3	3
Total	21	32

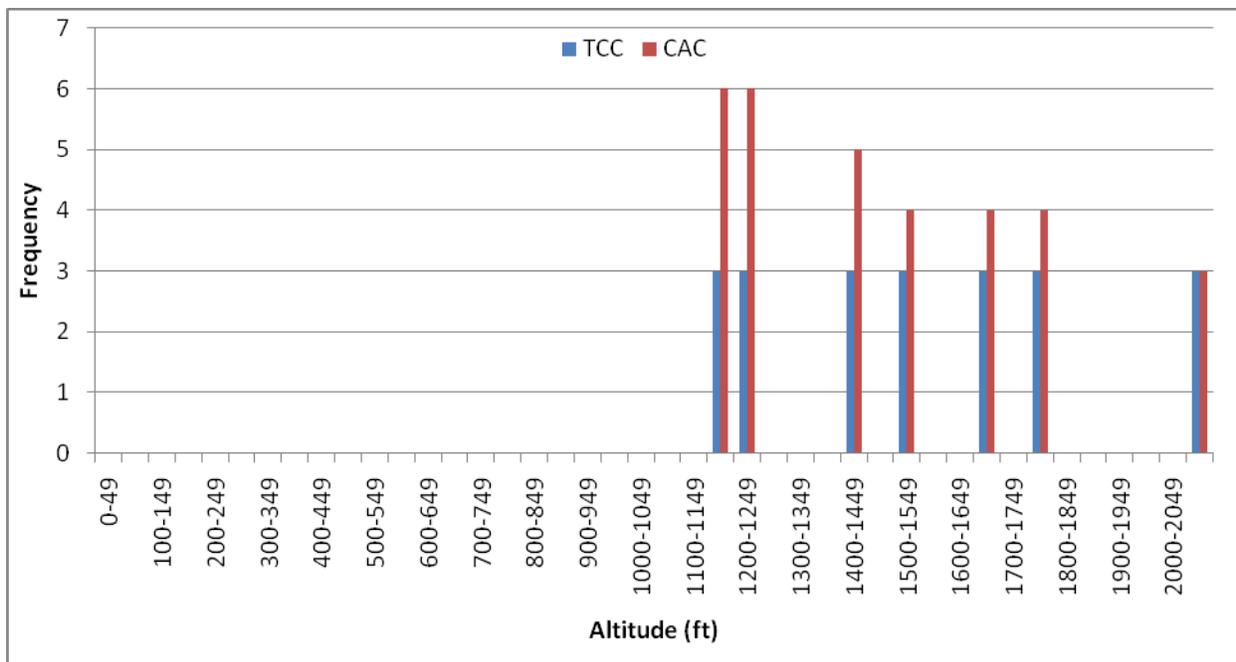


Figure 6-16. Altitudinal distribution of birds (TCC and CAC) aloft over Island Beach State Park, New Jersey, from 21-22 and 27 March 2009.

6.4.2.3 Flight Direction

The directional tendencies of birds over IBSP, New Jersey, are given in **Table 6-29** and illustrated in **Figure 6-17**. The mean direction for movement over IBSP was towards the NE (41.14°). This site showed little variability in the mean direction as illustrated by the length of the mean vector (0.77) and circular SD (41.60°).

6.4.3 Fall 2009

6.4.3.1 Target Identification

Data over IBSP, New Jersey, were collected on the night of 19 September 2009 and covered the hours from 7:00 PM to 11:00 PM EDT (23:00 to 03:00 UTC). Over this time period 219 total targets were identified, of which 144 targets were identified as birds (66%), 69 as insects, and six as foraging bats (**Table 6-30**). This suggests some bird migration occurred on this evening, though the numbers suggest a weak movement. The maximum total targets identified for an hour (93 total targets) occurred from 9:00 to 10:00 PM EDT (01:00 to 02:00 UTC), when 66 targets were identified as birds and 27 as insects.

Table 6-29. Statistical analysis of direction of nightly migrations over Island Beach State Park, New Jersey, during spring 2009.

	Island Beach State Park
Number of Observations	32
Mean Vector (μ)	41.14°
Length of Mean Vector (r)	0.77
Median	30°
Concentration	2.52
Circular Variance	0.23
Circular Standard Deviation	41.60°
Standard Error of Mean	7.27°
Rayleigh Test (Z)	18.89
Rayleigh Test (p)	5.10E-09
Rao's Spacing Test (U)	292.5
Rao's Spacing Test (p)	<0.01

Island Beach State Park Spring 2009

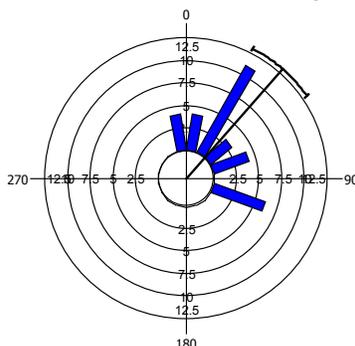


Figure 6-17. Circular diagram showing the direction of bird movements through the TI-VPR field of view over Island Beach State Park, New Jersey, for spring 2009. The dark line is the mean angle and the arc at the end shows the 95% confidence limits of the mean.

Data over BB, New Jersey, were collected on the night of 20 October 2009 and covered the hours from 8:00 PM to 10:00 PM EDT (00:00 to 02:00 UTC). Over this time period 138 total targets were identified, of which 39 targets were identified as birds (28%) and 99 as insects (**Table 6-31**). These data, though limited, suggest that little, if any, migration occurred during these times. The maximum total targets identified for an hour (111 total targets) occurred from 9:00 PM to 10:00 PM (01:00 to 02:00 UTC; 111 total targets), when 24 targets were identified as birds and 87 as insects. There were no foraging bats identified during sampling over BB.

Data over SIC, New Jersey, were collected on 03, 06, and 08 November 2009 and covered the hours from 3:00 PM to 10:00 PM EST (20:00 to 03:00 UTC). Over this time period 1,133 total targets were identified, of which 738 targets were identified as birds (65%) and 395 as insects (**Table 6-32**), suggesting some migration had taken place during these sample times. The maximum total targets identified for an hour (333 total targets) occurred from 8:00 PM to 9:00 PM EST (01:00 to 02:00 UTC),

when 270 targets were identified as birds and 63 as insects. There were no foraging bats identified during sampling over SIC.

Table 6-30. Numbers (TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Island Beach State Park, New Jersey, on 19 September 2009.

Hrs (EDT) ¹	Birds	Insects	Foraging Bats	Total Targets	% Birds
7:00 PM	9	24	3	36	25
8:00 PM	45	15	3	63	71
9:00 PM	66	27	0	93	71
10:00 PM	24	3	0	27	89
Total	144	69	6	219	66

¹ Eastern Daylight Time, add 4 hours for UTC.

Table 6-31. Numbers (time corrected count; TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Brigantine Beach, New Jersey, on 20 October 2009.

Hrs (EDT) ¹	Birds	Insects	Foraging Bats	Total Targets	% Birds
8:00 PM	15	12	0	27	56
9:00 PM	24	87	0	111	22
Total	39	99	0	138	28

¹ Eastern Daylight Time, add 4 hours for UTC.

Table 6-32. Numbers (time corrected count; TCC) of birds, insects, and foraging bats observed in TI-VPR samples over Sea Isle City, New Jersey, on 03, 06, and 08 November 2009.

Hrs (EST) ¹	Birds	Insects	Foraging Bats	Total Targets	% Birds
3:00 PM	9	81	0	90	10
4:00 PM	6	53	0	59	10
5:00 PM	9	12	0	21	43
6:00 PM	132	102	0	234	56
7:00 PM	183	84	0	267	69
8:00 PM	270	63	0	333	81
9:00 PM	129	0	0	129	100
Total	738	395	0	1133	65

¹ Eastern Standard Time, add 5 hours for UTC.

6.4.3.2 Altitudinal Distribution

Over IBSP, New Jersey, in fall 2009, the TCC of birds in each altitudinal band showed that 53% (72 of 135 birds) were at altitudes above the RSZ and 47% (63 of 135 birds) were within the RSZ (**Table 6-33** and **Figure 6-18**). There were no birds detected below 30 m (100 ft). As seen at other sites there were detections that appeared in the VPR and not in the TI which may represent insects too high to be detected by the TI but reflective enough to generate an echo on the VPR. The CAC showed a change in altitudinal distribution from the TCCs, with 153 birds from 213 to 670 m (700 to 2,199 ft) and 385 birds within the RSZ (28% above the RSZ and 72% within the RSZ).

Table 6-33. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Island Beach State Park, New Jersey, on 19 September 2009.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	0	0
150-199	3	44
200-249	3	33
250-299	3	26
300-349	15	110
350-399	6	38
400-449	0	0
450-499	3	15
500-549	12	53
550-599	6	24
600-649	6	22
650-699	6	20
700-749	0	0
750-799	3	9
800-849	6	17
850-899	15	39
900-949	0	0
950-999	12	28
1000-1049	3	7
1050-1099	3	6
1100-1149	6	12
1150-1199	0	0
1200-1249	9	17
1250-1299	0	0
1300-1349	0	0
1350-1399	0	0
1400-1449	0	0
1450-1499	0	0
1500-1549	0	0
1550-1599	3	4
1600-1649	0	0
1650-1699	0	0
1700-1749	3	4
1750-1799	0	0
1800-1849	0	0
1850-1899	3	4
1900-1949	0	0
1950-1999	0	0
2000-2049	3	3
2050-2099	0	0
2100-2149	0	0
2150-2199	3	3
Total	135	538

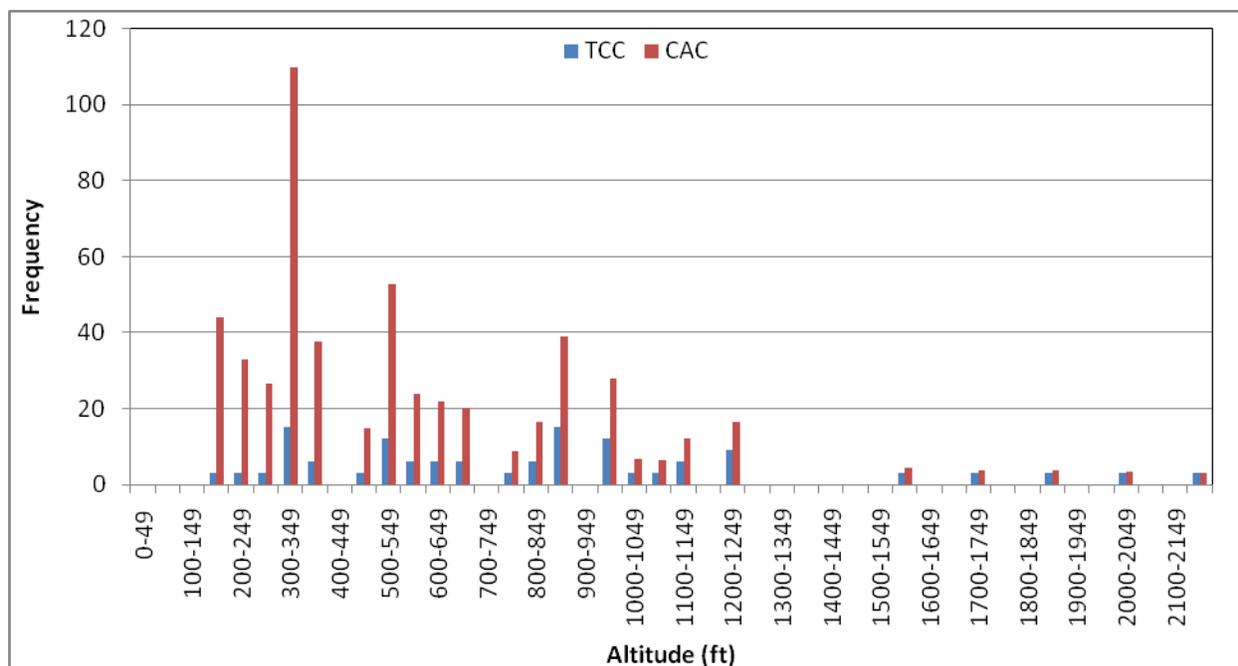


Figure 6-18. Altitudinal distribution of birds (TCC and CAC) aloft over Island Beach State Park, New Jersey, on 19 September 2009.

The TCC for birds in each altitudinal band over BB, New Jersey, showed that 75% (27 of 36 birds) were above the RSZ and 25% (nine of 36 birds) were within the RSZ (Table 6-34 and Figure 6-19). Once again no birds were detected below 30 m (100 ft). The CAC showed a change in altitudinal distribution from the TCCs, with 58 birds from 213 to 503 m (700 to 1,649 ft) and 58 birds within the RSZ (50% above the RSZ and 50% within the RSZ).

The TCC for birds in each altitudinal band over SIC, New Jersey, showed that 73% (492 of 675 birds) were above the RSZ and 27% (183 of 675 birds) were within the RSZ (Table 6-35 and Figure 6-20). Once again no birds were detected below 30 m (100 ft). The CAC showed a change in altitudinal distribution from the TCCs, with 926 birds from 213 to 685 m (700 to 2,249 ft) and 1,178 birds within the RSZ (44% above the RSZ and 56% within the RSZ).

Table 6-34. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Brigantine Beach, New Jersey, on 20 October 2009.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	0	0
150-199	0	0
200-249	0	0
250-299	0	0
300-349	3	22
350-399	3	19
400-449	3	17
450-499	0	0
500-549	0	0

Table 6-34 (continued). Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Brigantine Beach, New Jersey, on 20 October 2009.

Altitudinal Band (ft)	TCC	CAC
550-599	0	0
600-649	0	0
650-699	0	0
700-749	0	0
750-799	0	0
800-849	3	8
850-899	3	8
900-949	3	7
950-999	6	14
1000-1049	0	0
1050-1099	3	6
1100-1149	0	0
1150-1199	3	6
1200-1249	0	0
1250-1299	0	0
1300-1349	0	0
1350-1399	0	0
1400-1449	0	0
1450-1499	3	5
1500-1549	0	0
1550-1599	0	0
1600-1649	3	4
Total	36	116

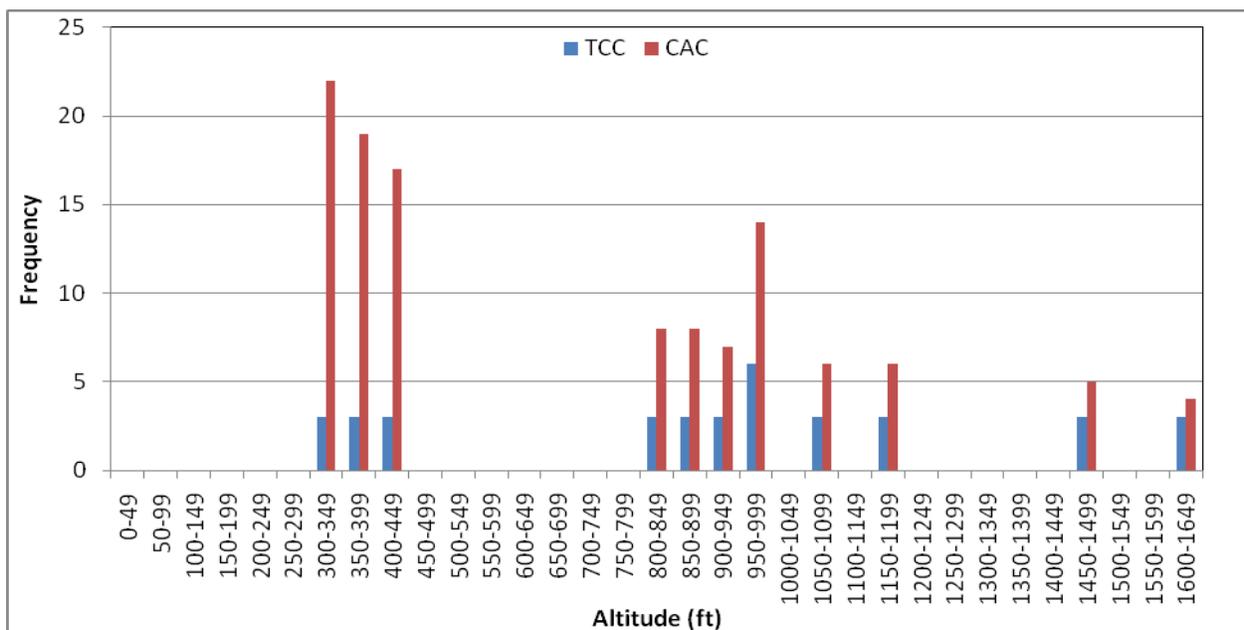


Figure 6-19. Altitudinal distribution of birds (TCC and CAC) aloft over Brigantine Beach, New Jersey, on 20 October 2009.

Table 6-35. Numbers of birds (TCC and CAC) within 50-ft (15-m) altitudinal bands for TI-VPR samples over Sea Isle City, New Jersey, on 03, 06, and 08 November 2009.

Altitudinal Band (ft)	TCC	CAC
0-49	0	0
50-99	0	0
100-149	0	0
150-199	3	44
200-249	15	165
250-299	39	341
300-349	27	198
350-399	21	133
400-449	0	0
450-499	9	44
500-549	9	39
550-599	12	48
600-649	18	66
650-699	30	100
700-749	24	73
750-799	27	81
800-849	21	56
850-899	18	48
900-949	36	94
950-999	18	42
1000-1049	3	7
1050-1099	15	30
1100-1149	12	24
1150-1199	21	42
1200-1249	27	53
1250-1299	21	35
1300-1349	12	20
1350-1399	27	45
1400-1449	18	30
1450-1499	24	40
1500-1549	15	20
1550-1599	12	16
1600-1649	12	16
1650-1699	15	20
1700-1749	21	28
1750-1799	18	24
1800-1849	15	20
1850-1899	6	8
1900-1949	15	15
1950-1999	3	3
2000-2049	9	9
2050-2099	3	3
2100-2149	15	15
2150-2199	0	0
2200-2249	9	9
Total	675	2104

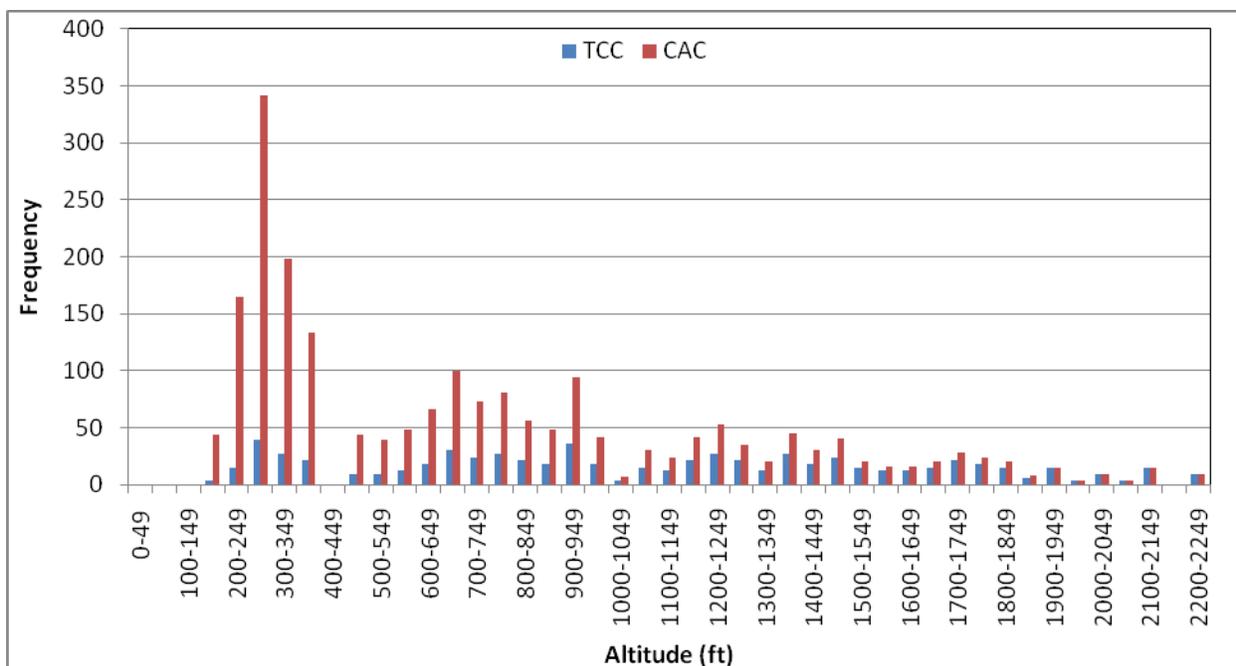


Figure 6-20. Altitudinal distribution of birds (TCC and CAC) aloft over Sea Isle City, New Jersey, on 03, 06, and 08 November 2009.

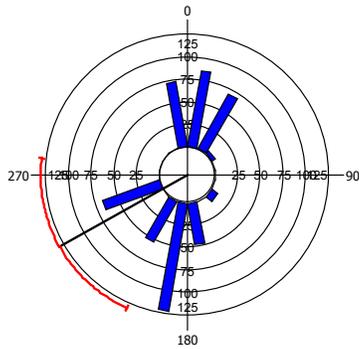
6.4.3.3 Flight Direction

The directional tendencies of birds over IBSP, BB, and SIC, New Jersey, are given in **Table 6-36** and illustrated in **Figure 6-21**. The mean directions for the movements over these onshore sites ranged from SW to SE (240.50°, 164.84°, and 196.53°, respectively). These sites showed some variability in the mean directions as illustrated by the length of the mean vectors (0.10, 0.24, and 0.63, respectively) and circular SD (124.15°, 96.82°, and 55.01°, respectively), with the most variability being shown at IBSP.

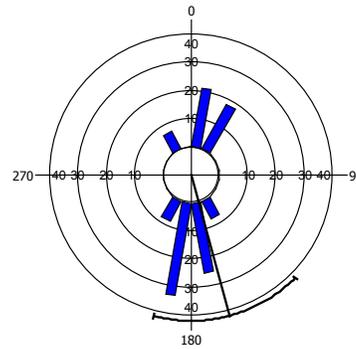
Table 6-36. Statistical analysis of direction of nightly migrations over Island Beach State Park, Brigantine Beach, and Sea Isle City, New Jersey, during fall 2009.

	Island Beach State Park	Brigantine Beach	Sea Isle City
Number of Observations	524	119	2,152
Mean Vector (μ)	240.50°	164.84°	196.53°
Length of Mean Vector (r)	0.10	0.24	0.63
Median	250°	175°	205°
Concentration	0.19	0.49	1.64
Circular Variance	0.90	0.76	0.37
Circular Standard Deviation	124.15°	96.82°	55.01°
Standard Error of Mean	18.47°	15.26°	1.21°
Rayleigh Test (Z)	4.79	6.85	855.98
Rayleigh Test (p)	0.01	0.00	<1E-12
Rao's Spacing Test (U)	344.89	323.70	354.31
Rao's Spacing Test (p)	<0.01	<0.01	<0.01

Island Beach State Park Fall 2009



Brigantine Beach Fall 2009



Sea Isle City Fall 2009

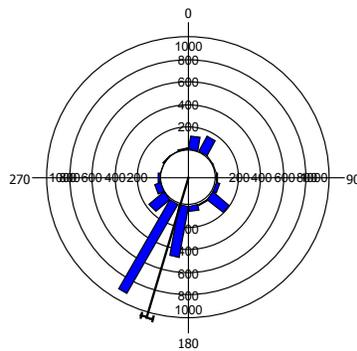


Figure 6-21. Circular diagrams showing the direction of bird movements through the TI-VPR field of view over Island Beach State Park, Brigantine Beach and Sea Isle Beach for fall 2009. The dark line is the mean angle and the arc at the end shows the 95% confidence limits of the mean.