

## 3.0 Study Components

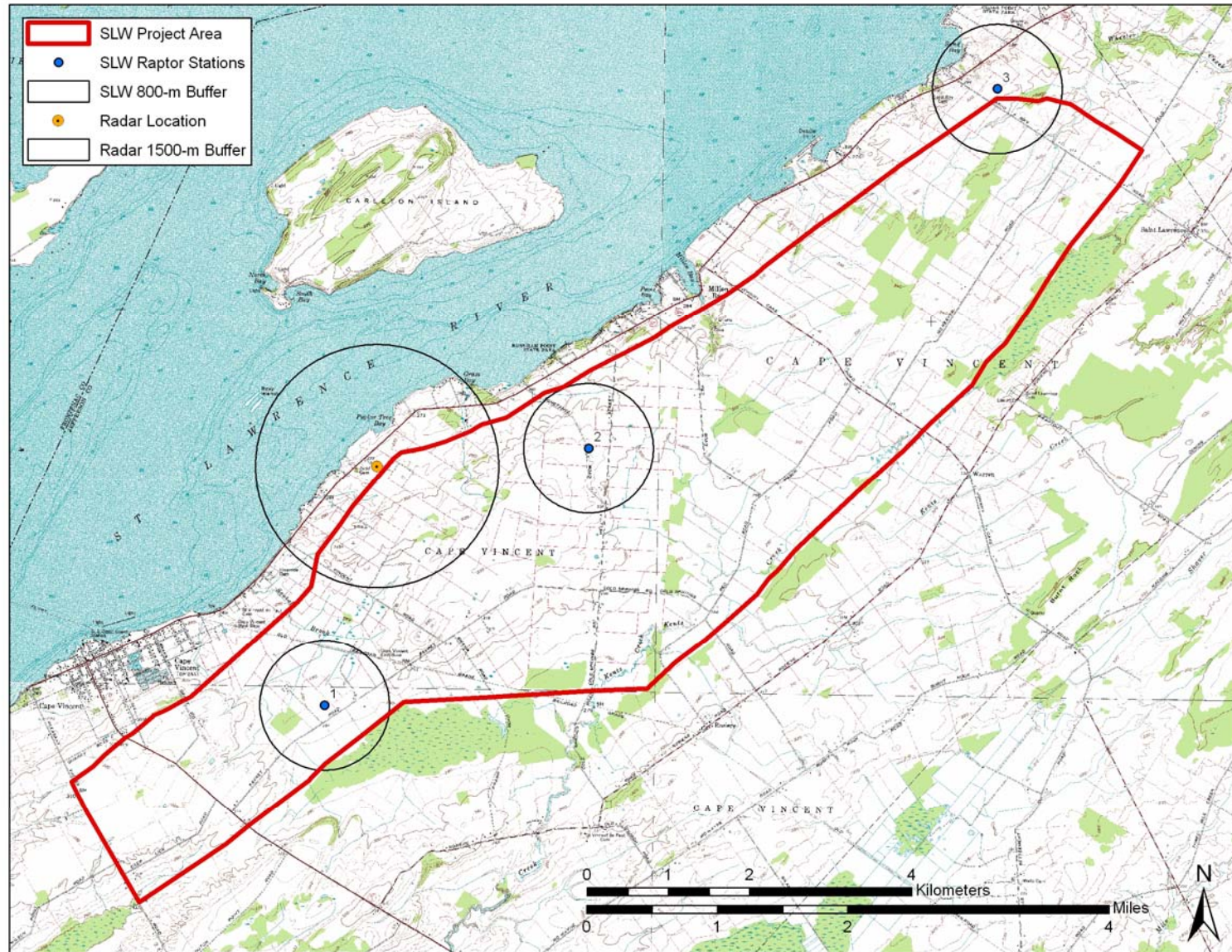
The one-year avian and bat preconstruction study consists of nocturnal marine radar sampling during the spring and fall migration periods; diurnal point count surveys from fixed point locations conducive to observing raptors and other large birds; breeding bird survey point counts; AnaBat sampling for migrating bats during the spring and fall; AnaBat sampling for resident bats, including presence of the Indiana bat, during the summer; winter and early spring waterfowl and raptor surveys; and habitat-focused surveys for federal and state-listed species. This interim report will present the results of the fall season radar sampling, spring/fall raptor migration surveys, breeding bird survey, and migrating and breeding bat surveys.

### 3.1 Nocturnal Marine Radar Survey

The overall purpose of the nocturnal marine radar survey is to characterize avian migration over the project area and provide data that can be used to determine the relative magnitude of nocturnal migration over the proposed development area when compared to other sites. The primary objective of the radar study is to collect baseline information on flight direction, passage rates, and flight altitude of nocturnal migrants at a representative sampling location for the proposed development area.

A single radar unit was used for the fall migration season defined as 15 August – 15 October. The radar lab consists of an X-band marine radar, transmitting at 9,410 MHz with power output of 12 kW, mounted on a vehicle. Similar radar labs have been successfully used to monitor nocturnal avian migration and are described in Cooper *et al.* (1991) and Harmata *et al.* (1999). The sampling location was selected based on constraints of the radar (e.g., minimization of ground interference), property ownership, access, and comments from the NYSDEC and USFWS (Figure 3). Based on comments from the NYSDEC and USFWS, the ideal radar sampling point to allow characterization of avian/bat movement along the shoreline, as well as over inland areas, was restricted to those areas approximately 1.5-km from the shoreline. To decrease ground clutter, the unit was positioned in a small hollow so that surrounding topography reflected the lower portion of the main beam, producing a clear picture of sky beyond.

**Figure 3.** Fixed radar location and three migrant raptor survey locations for the St. Lawrence Windpower project area. Buffers around points show extent of survey coverage.



### 3.1.1 Methods

The study period for radar sampling was 63 days during the fall migration season and will be approximately 45 days during the spring. Due to the constraints of marine radar, sampling during some nights was compromised or cancelled due to rain, so the total number of sampled nights was less than the total study period. Nocturnal radar sampling occurred from approximately sunset each night until sunrise the following morning. Each night was broken down into 60-min sampling periods that consisted of:

- 1) one 5-min session to collect weather data and adjust the radar to surveillance (i.e., horizontal) mode,
- 2) one 10-min short-range session (1.5 km range) with the radar in surveillance mode collecting information on migration traffic (passage) rates;
- 3) one 10-min short-range session (1.5 km range) with the radar in surveillance mode collecting information on flight direction and speed of targets, as well as general location of migrants;
- 4) one 5-min break to adjust radar to vertical mode;
- 5) one 10-min short-range session (1.5 km range) in the vertical mode to collect information on migration traffic (passage) rate;
- 6) one 10-min short-range session (1.5 km range) in the vertical mode to collect information on flight altitudes below 1500 m;
- 7) one 5-min short-range session (1.5 km range) in the vertical mode to collect information on the spatial distribution and altitudes of birds along an east-west transect axis; and,
- 8) one 5-min long-range session (3.0 km range) in the vertical mode to collect information on flight altitudes below 3000 m.

The following weather data was collected at the beginning of each hour session: wind speed, wind direction; cloud cover (%); approximate ceiling height (m); approximate visibility (m); precipitation; barometric pressure; air temperature (°C). Noticeable changes in weather conditions, if any, were recorded when the radar unit was adjusted to vertical mode.

The Furuno FAR2117BB radar used in this study has several controls which affect detection and tracking of targets. In order to detect and track small targets, the radar operated under the shortest pulse length setting with the gain control turned up to near the highest setting. Initially, the anti-clutter controls on the radar were turned down to the lowest setting. The anti-sea clutter control was then slowly turned up to about the point where background noise cleared from the screen enough to see small targets. The anti-rain clutter control was kept at the lowest setting. While in the vertical mode, to eliminate ground clutter around the radar generated from second echoes of radar energy bouncing off the van and ground, a blind sector was set so that the radar did not transmit energy when the antennae was pointing towards the ground (from 90° to 270°). The radar trails function was generally set at 30 seconds so that targets could be tracked for long enough to determine direction and speed. Target flight direction was determined by placing the cursor on a target echo within a trail and aligning the offset electronic bearing line (EBL) along the line of target echoes pointing in the direction of travel. Speed was recorded as the distance a

target traveled in 5 seconds (two sweeps of the radar antennae). With the target trails turned on, each sweep of the radar plots a new echo for any given target with each echo persisting on the screen for a set amount of time (e.g., 30 seconds). Speed was determined with the offset variable range marker (VRM) by placing the cursor on a target echo and measuring the distance between that echo and the third echo in line (i.e., the distance traveled in 2 sweeps of the antennae or 5 seconds). Target height was measured with an index line (a tangent on the variable range marker) on the monitor relative to a horizontal line running through the point of origin for the radar.

All data were exported from Microsoft Access and imported into SAS V.8 for further data processing, quality assurance, and analysis. Additional analyses were performed using Matlab V6.5. To determine passage rates in horizontal mode, the 2-dimensional area represented by the radar image was treated as a 1-dimensional “front” perpendicular to the direction of migration, with length equal to 3 km (the diameter of the surveyed area); all targets counted in the radar image during the sampling period were treated as if they had crossed the front. Based on that assumption, passage rate was calculated as number of targets per kilometer per hour.

Mean flight direction was estimated as  $\bar{\mu} = \tan^{-1}(\bar{y}/\bar{x})$  where  $\bar{y} = \sum_{i=1}^n \cos(\theta_i)/n$ ,  $\bar{x} = \sum_{i=1}^n \sin(\theta_i)/n$ , and  $\theta_i$  was the flight direction for the  $i^{\text{th}}$  observation (Batschelet, 1981).

Dispersion in the data was calculated as  $r = (\bar{x}^2 + \bar{y}^2)^{1/2}$  such that  $0 \leq r \leq 1$ . If all observations had exactly the same direction,  $r = 1$ ; conversely,  $r = 0$  would indicate uniform distribution of directions around the circle.

Mean flight altitude was not adjusted for unequal sampling intensity at different heights or unequal detection probability as a function of distance from the radar unit.

Air speed of targets,  $V_a$ , was calculated as  $V_a = [V_g^2 + V_w^2 - 2V_g V_w \cos(\Delta\theta)]^{1/2}$ , where  $V_g$  = target ground speed,  $V_w$  = wind speed, and  $\Delta\theta$  was the difference between the target flight direction and wind direction. Hourly weather observations made at ground level were used for estimates of wind speed and direction. Wind direction categorized by field observers as ‘N’, ‘NE’, ‘E’, ‘SE’, etc.; were transformed to bearings (0°, 45°, 90°, 135°, etc.) for the calculation of  $\Delta\theta$ . Targets with air speeds less than 6 m/s or greater than 35 m/s were judged not to be migrating birds and were excluded from further analysis.

### 3.1.2 Results

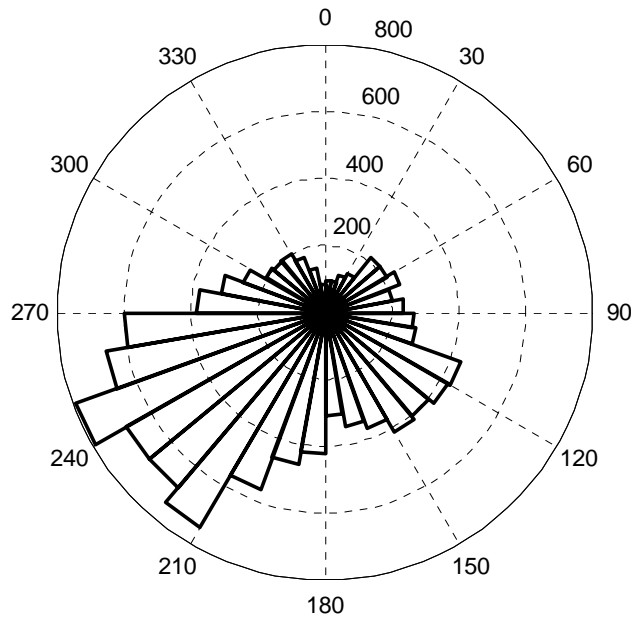
Nocturnal radar surveys were conducted most nights during the 63-day period between August 15 and October 15, 2006. Radar sampling was conducted for approximately 508 hours during the entire study period.

#### Flight Direction

Observed flight directions were typically towards the southwest (Figure 4). Mean and dispersion of flight direction were  $\bar{\mu} = 209.2^\circ$  and  $r = 0.34$  ( $n = 12378$  targets). As an indication of the southerly direction of the migration, 71.8% of observations were between 90° and 270°, while

34.5% of observations were between 135° and 225°.

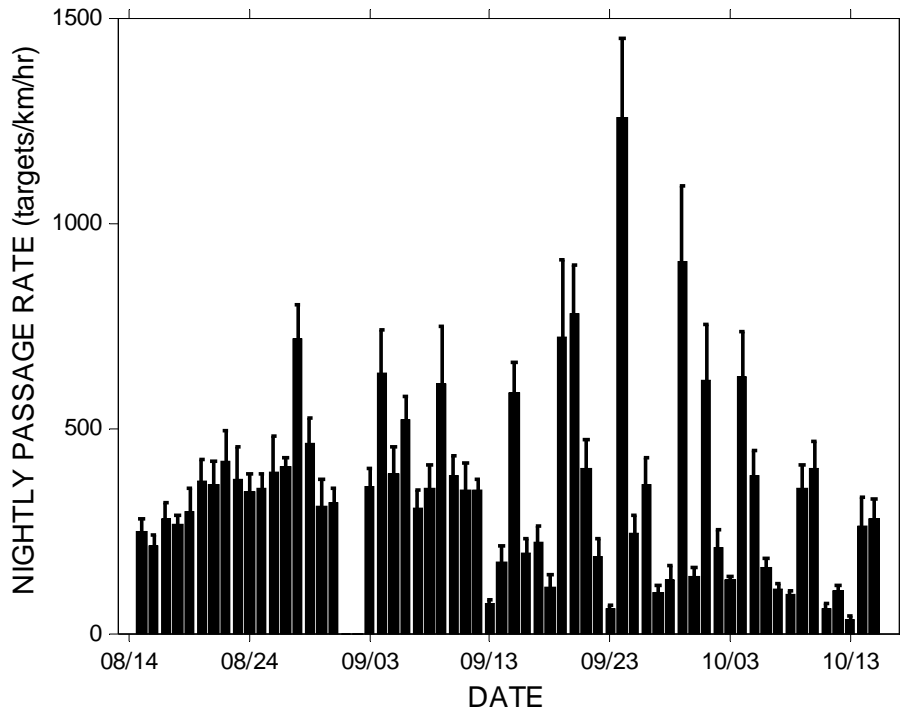
**Figure 4.** Observed fall flight directions in the project area.



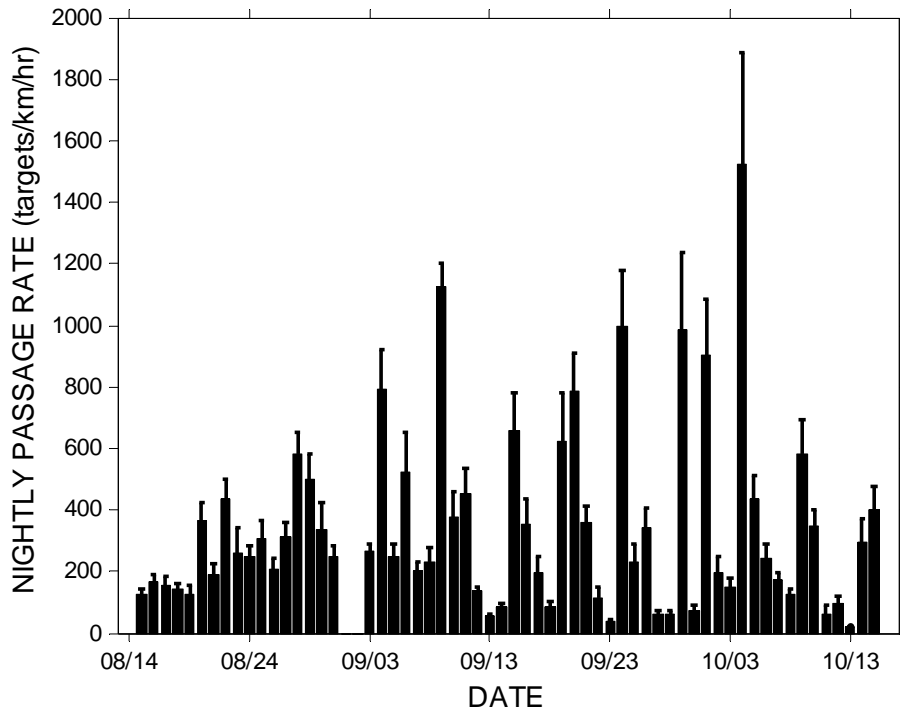
#### Passage Rates

The overall mean passage rate in the horizontal mode was  $345.8 \pm 13.3$  targets/km/hr (mean  $\pm$  SE) ( $n = 506$  sample periods) and in the vertical mode was  $346.2 \pm 17.2$  targets/km/hr (mean  $\pm$  SE) ( $n = 503$  sample periods). Mean nightly passage rate was highly variable in both horizontal mode (Figures 5) and vertical mode (Figure 6). The greatest nightly passage rates occurred in late September and early October. Mean hourly passage rates tended to be low early in the evening, with rapid increases to maximum values just before midnight, followed by progressively declining rates throughout the night (Figures 7 and 8).

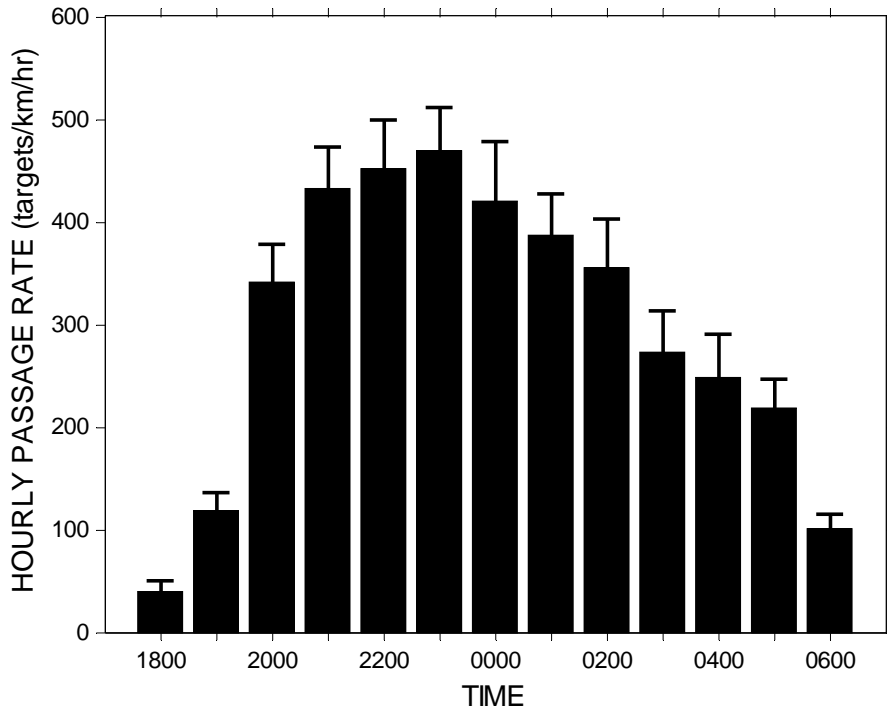
**Figure 5.** Mean + 1 SE nightly passage rates in horizontal mode.



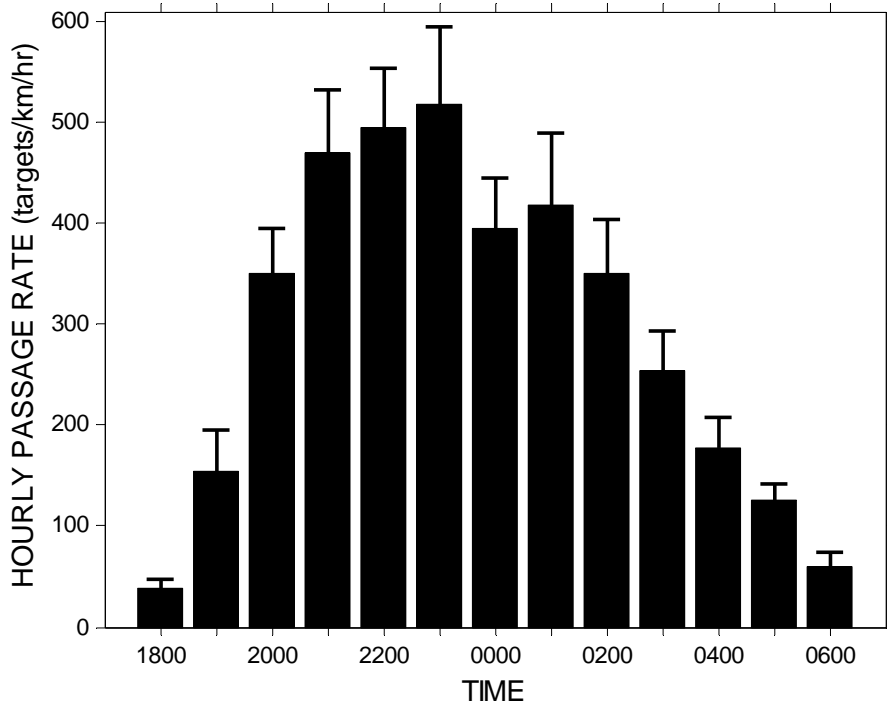
**Figure 6.** Mean + 1 SE nightly passage rates recorded in vertical mode.



**Figure 7.** Mean + 1 SE hourly passage rates recorded in horizontal mode.



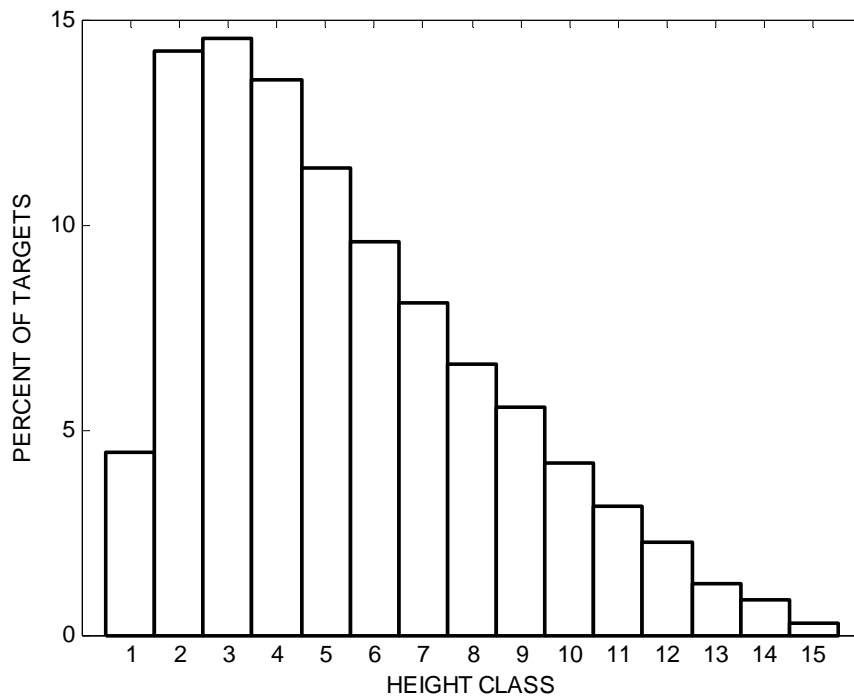
**Figure 8.** Mean  $\pm$  1 SE hourly passage rates recorded in vertical mode.



### Flight Altitudes

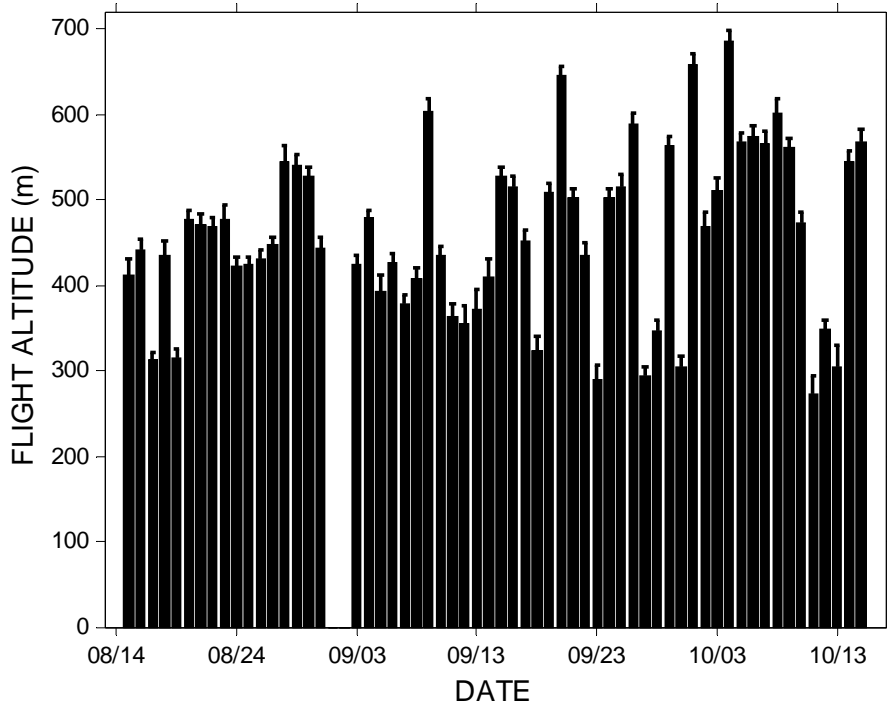
For sampling at the 1.5-km range in vertical mode, mean flight altitude was  $490.4 \pm 1.7$  m (mean  $\pm$  SE) ( $n = 30749$  targets) above radar level (arl)<sup>1</sup>. Approximately 7.7% of targets had flight altitudes less than 125 m (the zone of risk posed by turbines) at the Cape Vincent site. Most targets were observed at altitudes below 500 m (Figure 6). The highest percentage of targets occurred between 201 and 300 m arl. Nightly mean flight altitudes were variable throughout the study period and ranged from approximately 275 m to 685 m arl (Figure 7). In contrast, hourly mean flight altitudes were relatively constant (typically in the 450–500 m range) (Figure 8) and close to the overall mean flight altitude for the study period. For sampling periods at the 3-km range in vertical mode, 3.1% of targets (558 of 18059) had flight altitudes greater than 1500 m.

**Figure 9.** Frequency histogram of targets by height class, sampling at 1.5-km range. Height class 1 represents altitudes 0-100 m, class 2 represents altitudes 100-200 m, etc.

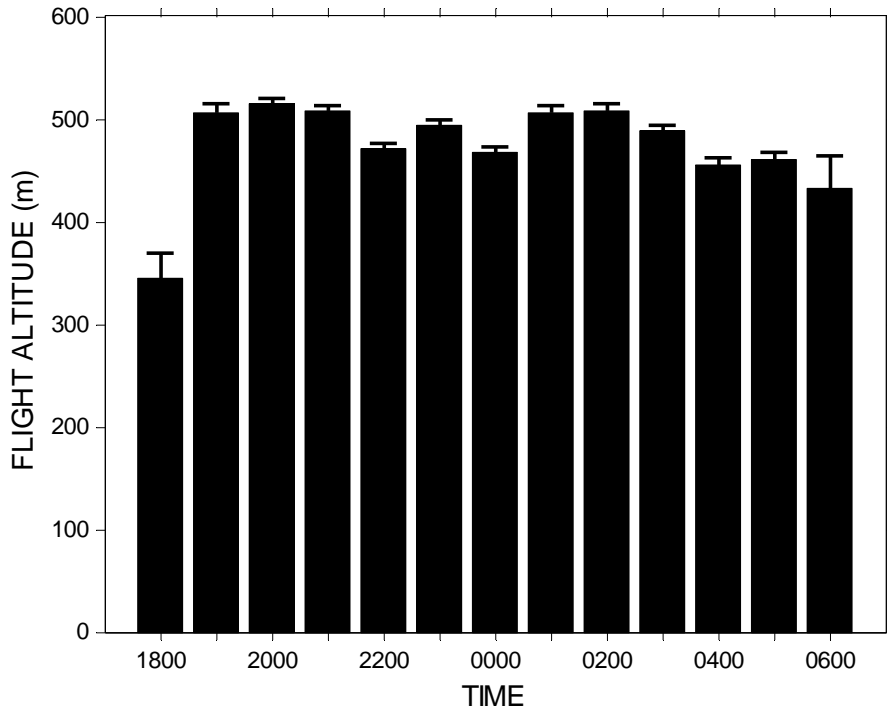


<sup>1</sup> Target altitude was measured in relation to a horizontal line running through the point of origin for the radar and thus termed above radar level. Height above ground level (agl) is highly variable depending on the topography directly below any given target and not measurable with the radar.

**Figure 10.** Mean + 1 SE nightly flight altitude sampling at 1.5 km range.



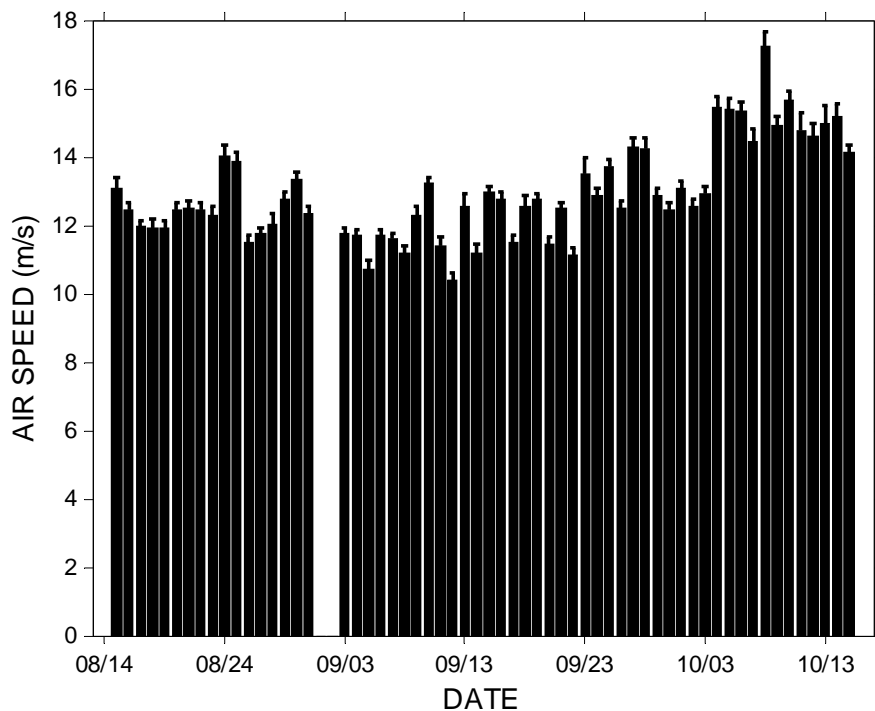
**Figure 11.** Mean + 1 SE hourly flight altitude sampling at 1.5-km range.



### Target Speed

Air speed of targets was calculated by adjusting for wind speed and direction (see Methods above). Of 12190 targets, approximately 1% (120 targets) were moving very slow (< 6 m/s) and one target was moving at high speed (> 35m/s). After excluding very slow and very fast targets, overall mean target air speed was  $12.95 \pm 0.03$  m/s (mean  $\pm$  SE) ( $n = 12069$  targets). Nightly mean target air speed varied from approximately 10 to 17 m/s (Figure 12). Because the percentage of targets moving slow was so small, no further adjustment to the data set was warranted.

**Figure 12.** Mean + 1 SE nightly target air speed.



### **3.2 Raptor Migration Surveys**

The objective of the raptor migration surveys is to estimate the spatial and temporal use of the sites by migrant raptors, other diurnal migrants (e.g., waterfowl, corvids), and other large birds. Point counts using variable circular plots (Reynolds *et al.* 1980, Bibby *et al.* 1992) were conducted within the project area according to methods used by the Hawk Migration Association of North America (HMANA) with observers continuously scanning the sky and surrounding areas for raptors in the survey area. Three permanent stations were designated for diurnal surveys (Figure 3). All large birds and flocks detected during the point counts were recorded, but the emphasis of the surveys was locating and counting raptors within approximately 800-m (0.5 mi) of each point. The timing of surveys was determined in consultation with the NYSDEC