DETERMINATION OF RAPTOR MIGRATORY PATHWAYS OVER A LARGE LANDSCAPE

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Abstract

Each autumn, tens of thousands of raptors pass over Hawk Ridge in Duluth, Minnesota on their southbound migration. Although these numbers indicate that the North Shore of Lake Superior is an important migratory corridor, migratory raptor concentrations along the North Shore beyond Hawk Ridge are unknown. To address this issue, migratory raptor counts were conducted from 24 observation sites located between Knife River and Grand Portage, Minnesota, from mid-August through mid-November 2008. My primary objective is to develop a methodology and experimental design to determine the effects of weather, temporal, and landscape factors on raptor migratory pathways over a large landscape. A total of 4,303 raptors were counted migrating through the region among 14 species. Exploratory analyses suggest migratory raptors concentrate near the shoreline of Lake Superior, particularly midday when winds have a westerly component. Flight height differed between Buteos and Accipiters, with >40% of Buteos observed beyond 100m above the tree canopy and approximately ≥30% Accipiters observed below 100m above the tree canopy. Significant factors ($p<0.05$) were identified using multiple regression analysis for total raptors combined (wind direction, hour, temperature, and antecedent wind; $r^2=0.28$, n=564), Buteos (wind direction, hour, and temperature; $r^2=0.29$, n=564), and Accipiters (hour, temperature, antecedent wind, and wind direction nearly significant with p=0.06; $r^2=0.28$, n=564). With the increasing popularity of wind power, the cumulative impacts on birds are of immediate conservation concern, and it is vital that migratory pathways be identified in detail over large regions to avoid large scale negative effects on migrating birds.

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INTRODUCTION

Each autumn, millions of raptors migrate from their breeding grounds to wintering areas traveling along a number of migration corridors across North America: the Eastern, Prairie, Rocky Mountain, and Intermountain Corridors (Bildstein 2006). Within each of these corridors, raptors may concentrate in several migratory pathways (Goodrich and Smith 2008). Pathways generally follow geographical features such as large bodies of water and ridgelines (Kerlinger 1985, Bildstein 2006) and can be influenced by weather conditions (Titus and Mosher 1982, Hall et al. 1992, Allen et al. 1996). Decades of systematic raptor counts have been kept at sites (including Cape May Point on the Atlantic Coast, Hawk Mountain in the Appalachian Mountains, and Hawk Ridge on the western end of the Great Lakes) located within migration corridors. However, detailed information on the pathways used by migrating raptors surrounding these sites or between these sites is limited. With increasing interest in wind power development, a detailed understanding of migratory pathways is needed. Conflicts between migrating raptors and wind power development such as mortality from collisions with wind turbines, the creation of barriers to migrating raptors, habitat conversion, and habitat fragmentation may be avoided (Johnson et al. 2002, U.S. Fish and Wildlife Service 2003, Smallwood and Thelander 2008).

Corridors used by migrating raptors have been assessed using a number of methods, including annual counts at individual sites along major corridors (McCarty and Bildstien 2005), banding (Henny and Van Velzen 1972), use of hydrogen isotopes to determine the origin of migrating birds (Hobson and Wassnaar 1997, Meehan et al. 2001), and tracking migrating birds using telemetry, satellites, or radar (Kerlinger and Gauthreaux 1985b, Bruderer et al. 1994, McClelland et al. 1994, Alerstam et al. 2006). While these studies provide a good overview of migratory pathways at a broad scale, many are based on observations or recoveries from a low number of sites and include assumptions on where birds are traveling between sites. Radio and satellite telemetry provide detailed information on the paths used by migrating birds. However, these methods rely on a low sample size and the paths taken by individual birds vary within and between years (Martell et al. 2001, Alerstam et al. 2006). There is a need for a method that covers a large geographical area in greater detail while maintaining a large sample size as well as accounting for year to year variation. Niles et al. (1996) used multiple observation points to examine the influence of habitat on migratory raptors. Here I use a series of observation points within a known migratory corridor to gain a more detailed understanding of the pathways used by migratory raptors.

The western tip of Lake Superior is a well known concentration point for migrating raptors. Tens of thousands of raptors are counted annually passing over Hawk Ridge in Duluth, MN, during the fall migration from mid-August through mid-December. While migrating raptors are known to concentrate in the Eastern Corridor along the northwestern shore of Lake Superior (Bildstein 2006), migratory pathways in which raptors concentrate are not well known eastward beyond Hawk Ridge or inland from the shore of Lake Superior. It has been suggested that migrating raptors concentrate at the shore due to topography and weather conditions and then travel southwest along the shoreline prior to reaching Hawk Ridge (Hofslund 1966). However, there is a lack of quantitative data supporting this suggestion.

Several factors contribute to concentrating migrating raptors along the shore of Lake Superior. The Great Lakes to the east and Great Plains to the west are two major barriers that funnel migrating raptors through the region (Hofslund 1966). Shorelines and ridgelines concentrate migrating raptors. The lake presents a barrier that raptors are unwilling to cross (Hofslund 1966, Mueller and Berger 1967, Kerlinger 1985, Allen et al. 1996). The terrain along the North Shore with a series of hills along a large water body is conducive to the formation of thermals and updrafts along the shoreline; raptors rely heavily upon these for soaring flight during migration (Hofslund 1966, Kerlinger and Gauthreaux 1985, Maransky et al. 1997). The distribution of migrating raptors may also be strongly influenced by habitat type, with raptors tending to use habitats similar to those they occupy throughout other parts of the year (Niles et al. 1996). Suitable habitat is necessary for the survival of migrating birds that require stopover sites and foraging areas during migration (Niles et al. 1996, Rodewald and Brittingham 2007). The large tracts of unbroken forest in northern Minnesota provide the necessary habitat for migrating forest species.

Wind patterns concentrate birds during migration; the largest flights at Hawk Ridge are observed when winds have a westerly component (Hofslund 1966). Migrating hawks are concentrated near shorelines by westerly winds as a result of wind drift and will not cross the water once they reach the shore (Mueller and Berger 1967). Large flights are often observed the first couple days after the passage of a cold front. The reasons for this are not fully understood; however, northerly or westerly winds and fair conditions after the passage of a cold front are likely factors (Mueller and Berger 1967; Allen et al. 1996). Cloud cover, inclement weather, and large bodies of water inhibit the formation of thermals that do not form until ground temperatures rise (Hofslund 1966, Kerlinger 1985, Kerlinger and Gauthreaux 1985). Raptors do not migrate in high numbers during periods of rainfall, in part due to lack of thermal formation (Mueller and Berger 1961, Kerlinger and Gauthreaux 1985). As a result, the highest concentrations of migrating hawks are typically observed midday when skies are clear and thermals are strongest (Mueller and Berger 1967, Kerlinger and Gauthreaux 1985).

The topography along the north shore of Lake Superior and combination of weather conditions conducive to concentrating migrating raptors makes the region ideal for examining migratory pathways through the use of multiple observation sites. Migrating raptors use the region extensively during the fall migration (Hofslund 1966, Bildstein 2006). Ridges along the lake make it possible to set up many observation points that provide extensive views of the surrounding landscape. The combination of multiple observation sites and reliable migratory movements provided the opportunity to document the specific pathways used by migrating raptors.

The aim of this study is to determine raptor migratory pathways along the North Shore of Lake Superior. My primary objective is to develop the methodology and experimental design to determine the effects of weather, temporal, and landscape factors on raptor migratory pathways over a large landscape. Subsequent papers will describe the results of these efforts over several years of observation.

METHODS

Study Sites. Migrating raptors were observed from 24 observation sites located between Duluth and Grand Portage, Minnesota from 29 August to 11 November 2008. Observation sites were arranged in eight transects, each containing three sites (Fig. 1). Sites were selected based on the view of the surrounding landscape and proximity to the shore of Lake Superior. Rocky outcroppings on prominent ridge tops, clearcuts, gravel pits, roadsides, U.S. Forest Service fire towers, and other open spaces were used to gain the best view possible. If views of the surrounding landscape were obscured by shrubs or young trees, deer stands were used to elevate observers above the ground.

Within each transect, one site was located within 2 km of Lake Superior, the second between 2 and 8 km, and the third between 8 and 14 km from the shore. As allowed by the terrain, the sites within each transect were arranged perpendicular to the shoreline and spaced evenly as possible. Sites were also positioned to provide a continuous view of the landscape between the three sites from the shore to the site furthest inland. Transects were numbered one through eight beginning with the transect located closest to Duluth, MN, with the eighth located in Grand Portage, MN, near the U.S.-Canada border. Sites were lettered *a* though *c* beginning with the site located closest to the shore of Lake Superior.

Data Collection. Hourly raptor counts were recorded by three observers, one stationed at each of the three sites within a transect each sampling day. All counts were simultaneous with the observers beginning and ending at the same time. Counts began approximately 1 - 1½ hours after sunrise and continued for the next 7 hours. A minimum of 5 hours of data were collected each observation day. Counts were delayed or stopped in inclement weather. Data were not collected in heavy fog (visibility limited to within 1.6 km of observation site) or precipitation heavier than drizzle or mist. Results discussed here included transects that were sampled a minimum of three days in 2008, with transects 1, 3, and 6 sampled four days.

Observers were provided a topographic map of the landscape for approximately 4 km surrounding the observation site. Each hour, observers recorded migrating raptors by placing a dot on the map estimating where the bird was first sighted over the landscape. Prominent ridges and other topographic features were used to estimate this position over the landscape. Observers scanned the sky for migrating birds using 8x42 or 8.5x32 power binoculars. Once spotted, birds were identified to species or as specifically as possible using Swarovski STS-80 HD spotting scopes. Observers were conservative in identifying distant birds to genus or species when light or weather conditions obscured clear views. The number of individuals, bird identification, and estimated flight height were recorded directly on the map along with an arrow indicating flight direction. Flight height was estimated in relation to the canopy and categorized as being below the canopy, canopy to 100m, 100m to 500m, and beyond 500m above the canopy. All data including birds and weather conditions were recorded on a separate map for each hour of observation.

Several precautions were taken to avoid double counting migrating raptors. Transects were grouped into three sets, transects 1 through 3, 4 and 5, and 6 through 8. Sets of transects were sampled in a random order. Within each set, the transect furthest to the west was sampled first, followed by the adjacent transect to the northeast because raptors were moving southwest along the shore on successive days. A delay of a least one day was included when moving to a set of transects closer to the western tip of Lake Superior. Observers were in radio or cell phone contact to avoid double counting raptors visible from multiple sites within a transect. If spotted by multiple observers, raptors were recorded by the observer to first sight the bird. If double counting was suspected and not confirmed while in the field, data sheets were compared at the end of the observation day to discuss any potential overlap in observations.

Weather conditions were recorded at the beginning of each hour of observation (Table 1). If precipitation occurred more than 15 minutes within an hour, the appropriate code was used regardless of the conditions at the beginning of the hour. Wind direction was estimated and recorded; however, this was not always accurate due to the sheltered position of several sites. For more accurate estimates, wind direction was retrieved online from the National Climatic Data Center (NCDC) maintained by the National Oceanic and Atmospheric Administration (NOAA) from the regional airport nearest to each site (NCDC 2009). Data retrieved from the NCDC were used in analysis. Antecedent weather conditions including wind direction and precipitation the days prior to observations were also retrieved online from the NCDC (Table 1).

GIS. All observations were entered into a geographical information system (GIS) using ArcMap, version 9.3 (Environmental Research Systems Institute, Inc. 2008). U.S. Geological Survey digital raster graphic maps were used as a base map to create both the data sheets used in the field and to enter birds into ArcMap. Observations were entered as point features into a shapefile containing all raptors recorded in the fall 2008. A single point was used for each bird or group of birds observed. The site, date, hour, number of individuals (if all birds within a group were of the same type), identification, flight height, and flight direction (in degrees) for each observation were recorded in the attribute table. The coordinates for each raptor observation

(NAD 1983 UTM Zone 15N) were calculated. All weather and temporal (hour and date) data were entered into an additional table in ArcMap.

Data Analysis. Raptors were analyzed in two groups according to flight style, Buteos and Accipiters, to examine any differences in the pathways used by these two groups. Buteos included species that rely primarily on soaring flight, including Red-tailed Hawks (*Buteo jamaicensis*), Broad-winged Hawks (*Buteo platypterus*), and Rough-legged Hawks (*Buteo lagopus*), and Bald Eagles (*Haliaeetus leucocephalus*) and Golden Eagles (*Aquila chrysaetos*). Any unidentified Buteos or Eagles were also included in the Buteos group. Accipiters included Sharp-shined Hawks (*Accipiter striatus*), Cooper's Hawks (*Accipiter cooperii*), Northern Goshawks (*Accipiter gentilis*), and any unidentified Accipiters; species relying on flapping flight with intermittent glides as opposed to soaring. A third overall group included all raptors observed.

Exploratory data analyses and summaries were completed from the 2008 migratory season using SAS version 9.2 (SAS Institute 2002-2007). All data tables were exported from ArcMap into Microsoft Excel prior to being imported into SAS. Once in SAS, the data tables containing all raptor, landscape, and weather data were merged into a single table organized by site, date, and hour. The total number of each species of raptor observed, total Buteos, Accipiters, and overall raptors were calculated for each site each hour of observation. Descriptive statistics were calculated including the means and proportions of raptors observed under various conditions. Hourly raptor totals were log (y+1) transformed for analysis. A multiple regression analysis was calculated to examine the relationship between migrating raptors, weather factors, and time of day using the Mixed procedure (Littell et al. 2002). Random effects included in the model were date(transect) and site. The factor with the highest p-value was eliminated and the models run again until all remaining factors were significant at $p \leq 0.05$.

RESULTS

A total of 4,303 raptors were observed in fall 2008 among 14 species. The highest numbers of raptors observed for an individual species were Bald Eagles, followed by Sharp-shinned Hawks, Broad-winged Hawks, and Red-tailed Hawks. A combined total of 1881 individuals were identified in the genus *Buteo*, representing the majority of raptors observed. *Accipiter* species comprised 772 of the total raptors observed in fall 2008 (Table 2).

Distance from Hawk Ridge. Overall, the most raptors observed per hour occurred at transect 1, and then showed a slight decrease northeastward along the shore away from Hawk Ridge. No consistent decreasing trend in the number of raptors observed at each transect was found. The Buteos were variable, with the most observed from transect 1, followed by transects 6 and 3. Accipiters were observed in the highest numbers mid-way between Duluth and Grand Portage, MN at transects 3, 4, and 5 (Fig. 2).

Distance from Shore. Within each transect, the most raptors were consistently observed from one of the two sites located closest to shore. The most total raptors were observed from site *a* in each transect, with the exception of transects 3 and 8, in which the most were observed from site *b*. A similar pattern was observed in the Buteo group; however differences in the number of birds observed from each site were less pronounced. Within transects 4, 5, and 6, the number of birds was more evenly distributed between the three sites (~28 to38%) as compared to the other groups. The highest numbers remained at site *a*, with the exception of transect 4 where a slightly higher proportion of Buteos (37%) were observed from site *c*. At transect 7, equal proportions of Buteos were observed at sites *a* and *b*. The Accipiter group followed the same pattern as total raptors, with the most observed at site *a* at each transect, with the exception of transects 3 and 8 (Fig. 3).

Flight Height. Raptors were rarely observed flying below the tree canopy, with the exception of the Accipiter group at transect 7. Overall, the most raptors were observed from 100 to 500m and beyond 500m above the tree canopy. Accipiters were more often observed flying at lower altitudes than Buteos. This was particularly evident at the canopy to 100m above canopy range. Approximately ≥ 30% of Accipiters were observed between the canopy to 100m above compared to Buteos (<30%) at each transect. The highest numbers of Buteos (>40%) were observed beyond 100m above the canopy (Fig. 4).

Weather and Temporal Factors. Multiple regression analysis identified significant weather and temporal factors for all three groups. Significant factors ($p<0.05$) for raptors overall were wind direction, hour, temperature, and antecedent wind ($r^2=0.28$, n=564). For the Accipiter group, hour, temperature, and antecedent wind were significant. Wind direction was nearly significant at a $p=0.06$ and was kept in the model for goodness of fit ($r^2=0.28$, n=564). For the Buteo group, significant factors were wind direction, hour, and temperature ($r^2=0.29$, n=564) (Table 3).

When winds were from the Northwest and Southwest, > 12 raptors per hour were observed for raptors overall. Fewer than 5 raptors per hour were observed overall when winds were from the Northeast, Southeast, and South. The Buteos followed the same pattern, with the most observed with winds from the Northwest and fewest with winds from the Northeast, Southeast, and South. Differences between wind directions were smaller for Accipiters than the other groups. The most were observed when winds were from the Southwest and nearly zero with winds from the Northeast, East, and South (Fig. 5a).

Daily raptor counts were highest midday for all three groups. The number of raptors observed increased through the third hour of observation, corresponding to late morning, and then slowly decreased throughout the remainder of the day (Fig. 5b). Over the course of the 2008 fall migration season, the most total raptors and Buteos were observed during the third seasonal interval from mid to late October 2008. Each transect was sampled once per interval, with the exception of the fourth interval in which only transects 1, 3, and 6 were sampled. Overall, the number of raptors steadily increased through the third interval, and then sharply dropped during the fourth from early to mid November. The number of Buteos observed per hour peaked during interval 3 and was steady throughout intervals 1, 2, and 4. Accipiters peaked during the second interval from mid September through mid October, with fewer observed during the first and third intervals and nearly zero during the fourth (Fig. 5c).

DISCUSSION

Distance from Hawk Ridge and Distance from Shore. Data collected during fall 2008 confirmed that thousands of raptors migrate along the north shore of Lake Superior. For all raptors combined, a slight decreasing trend was observed in the number of migrating raptors northeastward along the shore. This was possibly due to the funneling effect toward Hawk Ridge, where birds from the East traveling along the shore in addition to those from the North and West congregate (Hofslund 1966). However consistent decreases were not observed as expected in all three groups. Major flights of Broad-winged Hawks are typically observed at the western tip of Lake Superior. Presumably weather patterns during the peak migration season for Broad-winged Hawks were not amenable in 2008 for a large migration, leading to a lower number of raptors observed closer to Hawk Ridge (Hofslund 1966).

Migrating raptors were most often observed from the sites located closest to Lake Superior, with similar or higher numbers occasionally occurring at inland sites. Raptors migrate in a broad front from their breeding grounds in the north prior to encountering barriers such as the Great Lakes that concentrate them into distinct migratory pathways (Bildstein 2006). Lake Superior is the first major barrier encountered by migrating raptors traveling south from northern

Minnesota and Canada during the fall. As a result, migrating raptors were expected to congregate at the water's edge (Mueller and Berger 1961).

The presence of well defined ridgelines and the proximity of those ridgelines to the shore may contribute to similar or higher numbers of migrating raptors observed at *b* sites versus *a* sites. At transects 3 and 8, where higher proportions of birds were observed from site *b*, site *b* was located either on or overlooking the first major ridge from shore, while site *a* was not located on a ridge. When site *a* was located on the first major ridge from the shore, the most birds were typically observed from site *a* (Fig. 6). Raptors rely on updrafts that form along the ridges running along the shore. Rather than flying directly along the shoreline once they reach the lake, raptors likely follow the ridges closest to shore to take advantage of updrafts (Mueller and Berger 1967).

Flight Height. The most noticeable pattern in flight height was between the Accipiter and Buteo groups, with higher proportions of Accipiters observed flying between the canopy and 100m above versus Buteos (Fig. 4). Niles et al. (1996) found that raptors fly lower over habitats they occupy during the remainder of the year, perhaps for foraging purposes while on migration. The majority of the landscape along the North Shore is forested. Accipiters take advantage of foraging opportunities while migrating over forested areas (Niles et al. 1996). Several species included in the Buteo group including Golden Eagles, Rough-legged Hawks, and Red-tailed Hawks occupy open habitats that are sparse throughout the region and may forage less. Buteos are also more often observed either gaining altitude on thermals or gliding from high altitudes between thermals (Kerlinger and Gauthreax 1985, Kerlinger and Gauthreaux 1985b).

Influence of Wind Direction, Daily Timing, and Seasonality. Raptors migrated in the highest numbers when winds had a westerly component, consistent with observations from Hawk Ridge (Hofslund 1966). Raptors are strongly influenced by the passage of cold fronts, with the most birds observed just after the passage of a front when winds have a westerly component

(Mueller and Berger 1961, Allen et al. 1996). The north shore of Lake Superior in Minnesota is oriented from southwest to northeast. With winds out of the west or northwest, migrating raptors are pushed toward the lake as a result of wind drift, at which point they follow the shore around its western end (Hofslund 1966, Mueller and Berger 1967b). When winds are from the south or east, birds are pushed away from the lakeshore, leading to fewer observations near the shore (Mueller and Berger 1961).

The timing of daily peak flights was consistent with other studies, with the most raptors observed during the middle part of the day (Mueller and Berger 1973, Maransky et al. 1997). Red-tailed, Rough-legged, and Broad-winged Hawks, Bald and Golden Eagles, and Turkey Vultures (*Cathartes aura*) all rely heavily on thermals and updrafts for soaring flight, which are strongest around midday (Kerlinger and Gauthreax 1985, Kerlinger and Gauthreaux 1985b, Maransky et al. 1997). The high number of Turkey Vultures in addition to *Buteo* species included in the overall group was a likely contributor to the higher numbers observed midday (Fig.5). Mueller and Berger (1973) noted Accipiters migrating along Lake Michigan tended to be seen more often in the morning compared to Buteos and Falcons. The tendency of this group to fly earlier in the day may have led to the lack of a distinct midday peak as compared to Buteos and total raptors.

Seasonal peaks were consistent with those recorded at Hawk Ridge (Hofslund 1966). The mid through late October peak in the Buteo group coincided with several late season migrants, including Red-tailed Hawks which typically peak in October, Rough-legged Hawks, and Bald and Golden Eagles which peak mid October through early November. A higher peak around mid September was expected in the Buteo group due to the high numbers of Broad-winged Hawks that typically migrate through the region (Hofslund 1966). Lower than usual numbers of Broad-winged Hawks migrating fall 2008 contributed to the lower mid September peak. Peak Accipiter migration occurred from mid September through mid October, with almost none by late October and November. A similar pattern in seasonal timing has been documented in several studies, and is likely associated with fair weather conditions early in the fall (Mueller and Berger 1967b, Titus and Mosher 1982, Hall et al. 1992).

Future Research. My objective was to establish an experimental design and framework to understand migratory pathways of raptors over a large area encompassing 240 km from Duluth to Grand Portage, MN within 17 km of the shoreline. My results show that it is possible to sample this large area and gain insights on the magnitude of migration and the migratory behavior of raptors. With additional years of data, analyses including all weather and landscape factors will provide a detailed understanding of migratory pathways along the North Shore of Lake Superior.

Visual methods of studying migratory movements are useful where detailed observations or large sample sizes are limited using other methods, as is the case along the North Shore of Lake Superior. The topography of the region limits the use of radar, since the many ridgelines block radar beams. Low resolution makes it difficult to estimate the exact location of migrating raptors. Radar also has limited capabilities in detecting low flying birds, which is of concern with *Accipiter* species. Telemetry studies also have limitations, again due to the topography and low sample sizes relative to the thousands of raptors migrating through the region. Telemetry however may be used in confirming the pathways used by migrating raptors.

These methods can be tailored to any region where a more detailed understanding of the migratory pathways used by raptors is desired. A series of vantage points with a wide view of the landscape is required and can be obtained by using lifts, towers, and other structures as well as the existing terrain. Factors specific to each region such as prevailing weather patterns, the orientation of ridges, shorelines, or other geographical features, and the flight styles of predominant species should be considered (U. S. Fish and Wildlife Service 2003). It is important to note that these methods are not intended to determine the total number of migrating birds but rather to determine their pathways. By examining the relative concentration of birds, heavily used areas can be identified regardless of concentrations outside the region under study. This can be especially useful in planning new wind power developments, considering concentrations may occur in areas not previously known (U. S. Fish and Wildlife Service 2003).

Several sets of guidelines on the construction of new wind power developments have been developed to minimize impacts on birds. A common thread among these guidelines is the importance of identifying potential conflicts and to avoid placing developments in areas highly important to birds, including migratory pathways (U. S. Fish and Wildlife Service 2003, Michigan Department of Labor and Economic Growth 2007, Washington Department of Fish and Wildlife 2009). The results of this and future studies can be used to adhere to these guidelines. Using the methods described here, regional maps of migratory pathways can be produced and used to identify the areas that may be the most sensitive to development. With the increasing popularity of wind power, the cumulative impacts on birds are of immediate conservation concern, considering direct mortality resulting from collisions has been documented at wind farms (Johnson et al. 2002, Smallwood and Thelander 2008). It is vital that migratory pathways be identified in detail over large regions to avoid large scale negative effects on migrating birds.

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Table 1. Weather factors recorded at the beginning of each observation hour in the field and retrieved online from the National Climatic Data Center (NCDC) maintained by NOAA.

Variable	Description
Wind Speed	Estimated wind speed according to the Beaufort wind speed scale.
Wind Direction	Prevailing wind direction retrieved online from the NCDC at time closest to the beginning of the observation hour as recorded at the nearest regional airport. Reclassified as N, NE, E, SE, S, SW, W, and NW.
Temperature	Temperature recorded in degrees Fahrenheit.
Visibility	Estimated distance visible from observation point. Classified as: 1= >2 miles, 2=1 to 2 miles, 3= ½ to 1 mile, 4= ¼ to ½ mile, 5= < ¼ mile.
Sky	Sky cover visible from observation site, including cloud cover and precipitation. Categorized as 0=clear, 1=scattered clouds, 2=broken cloud cover, 3=overcast, 4=fog, 5=drizzle or mist, 6=rain, 7=snow, 8=sleet or ice, 9=precipitation visible in area.
Antecedent Wind	Number of days in which 50% or more of the daylight hours winds did not have a westerly component prior to observation day. Data retrieved from the NCDC.
Antecedent Precipitation	Number of days in which 50% or more of the daylight hours included precipitation heavier than drizzle or mist prior to observation day. Data retrieved from the NCDC.
Hour	Hour (1-7) during each day of observations. Indicates time since sunrise, hour 1=bird sighted between 1 and 2 hours past sunrise, hour 2= between 2 and 3 hours past sunrise, etc.

<u>Table 2.</u> Total of each species observed out of 4,303 raptors fall 2008.

Species	Total
Turkey Vulture (*Cathartes aura*)	107
Osprey (*Pandion haliaetus*)	24
Northern Harrier (*Circus cyaneus*)	22
Sharp-shinned Hawk (*Accipiter striatus*)	539
Cooper's Hawk (*Accipiter cooperii*)	6
Northern Goshawk (*Accipiter gentilis*)	23
Unidentified Accipiter	204
Broad-winged Hawk (*Buteo platypterus*)	375
Red-tailed Hawk (*Buteo jamaicensis*)	370
Rough-legged Hawk (*Buteo lagopus*)	160
Unidentified Buteo	976
Bald Eagle (*Haliaeetus leucocephalus*)	822
Golden Eagle (*Aquila chrysaetos*)	24
Unidentified Eagle	14
American Kestrel (*Falco sparverius*)	87
Merlin (*Falco columbarius*)	19
Peregrine Falcon (*Falco peregrines*)	9
Unidentified Falcon	16
Unidentified Raptor	506

Table 3. Results of multiple regression calculation for weather and temporal factors. Significant ($p \leq 0.05$) weather and temporal (hour = time of day) factors remaining in the model for total raptors overall, Accipiters, and Buteos. Wind direction was left in the model for the Accipiter group for goodness of fit.

Group	Multiple Regression			
	R^2	*N*	Variables Included	*P*
Overall	0.28	564	Hour	<0.01
			Temperature	<0.01
			Antecedent Wind	0.02
			Wind Direction	<0.01
Accipiters	0.28	564	Hour	<0.01
			Temperature	<0.01
			Antecedent Wind	<0.01
			Wind Direction	0.06
Buteos	0.29	564	Hour	<0.01
			Temperature	0.02
			Wind Direction	0.01

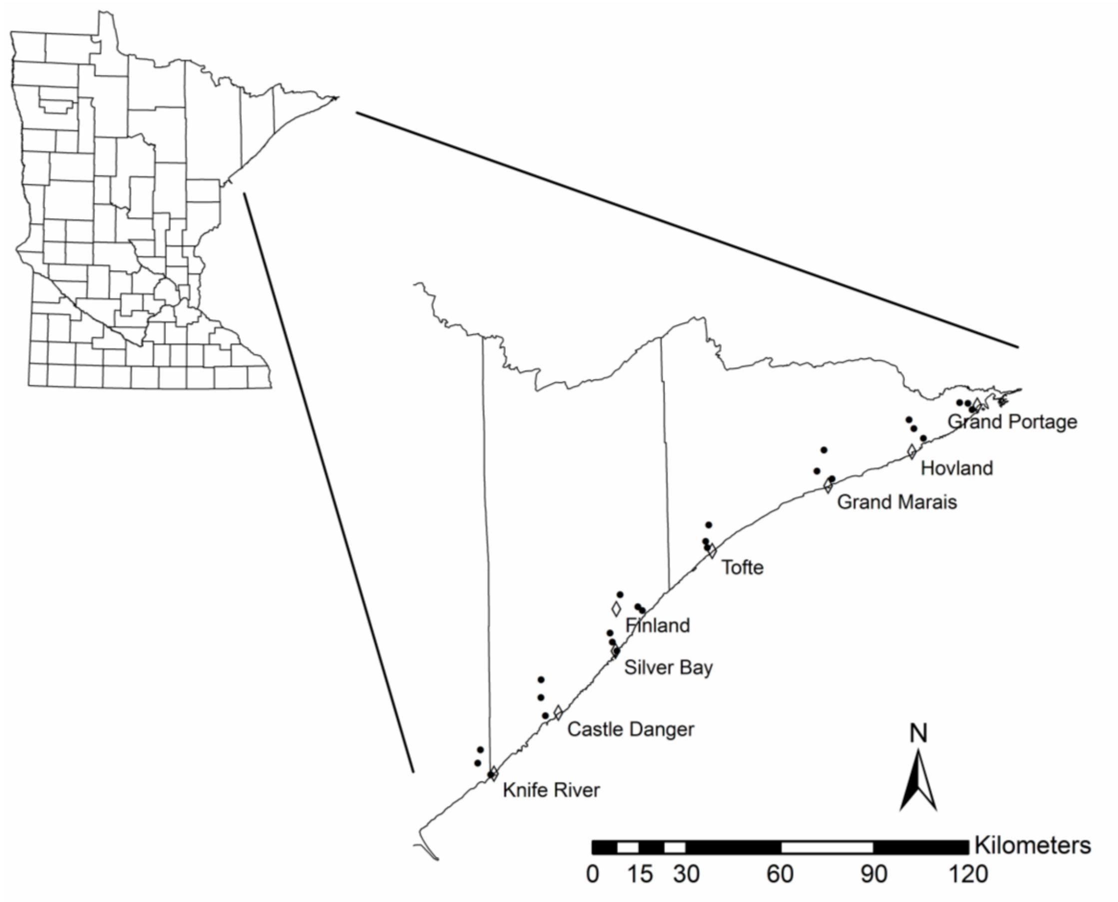


Figure 1. Fall 2008 raptor migration observation sites along Minnesota's North Shore of Lake Superior.

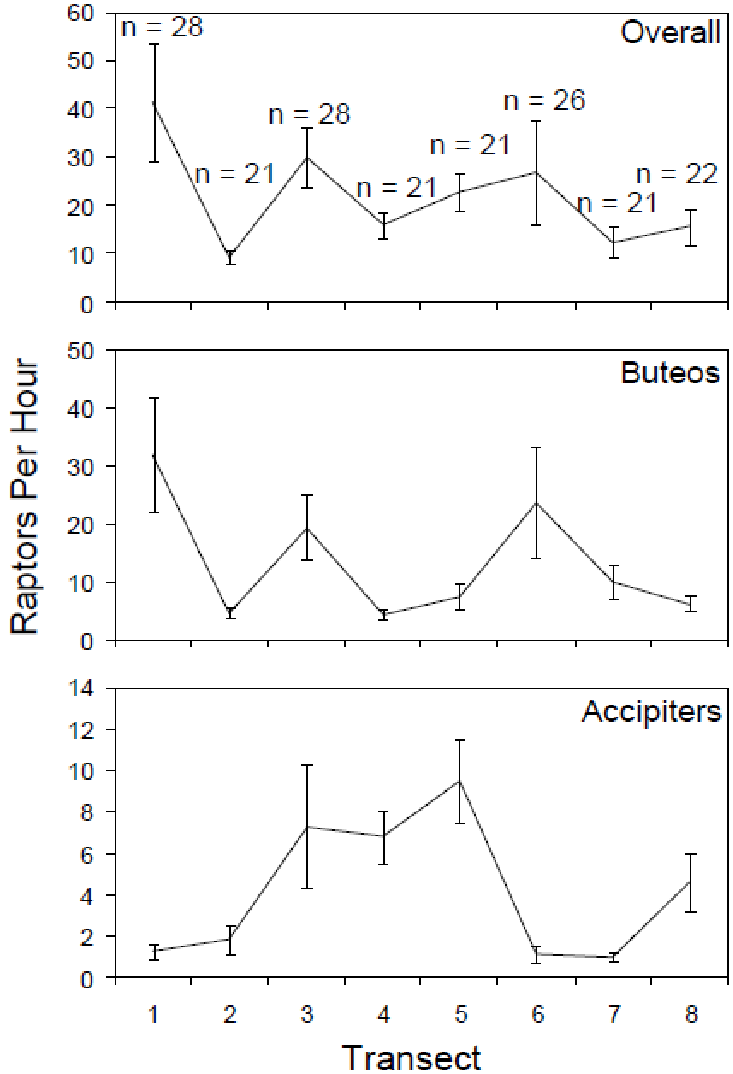


Figure 2. Raptors observed per hour at each transect over the fall 2008 migratory season (mean ± SE).

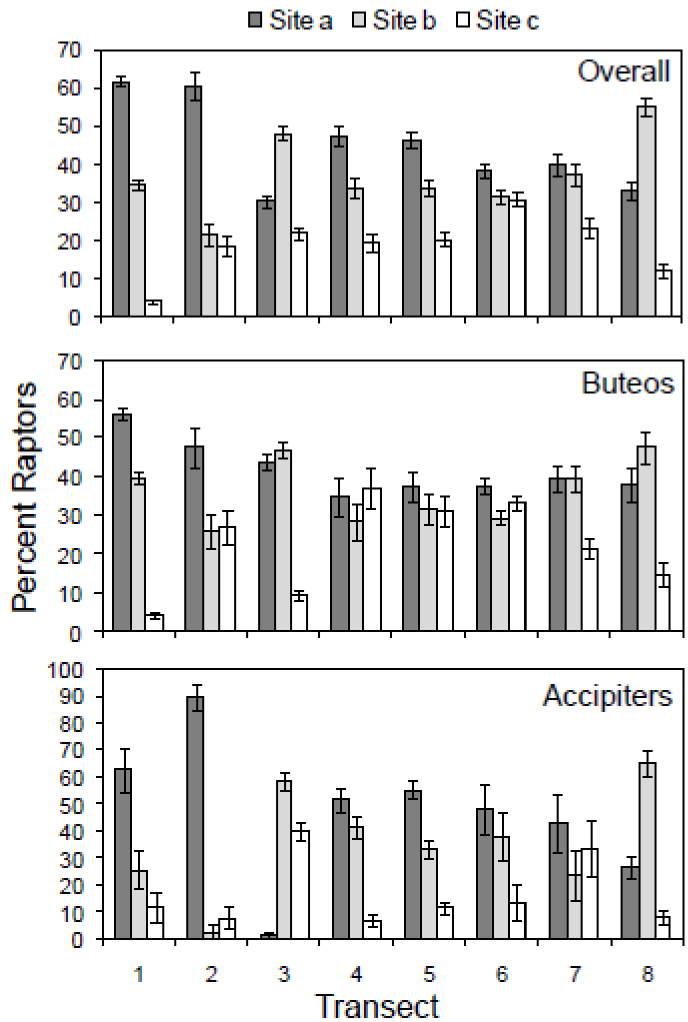


Figure 3. Proportions of raptors observed at each site out of the total observed at each transect (proportion ± SE).

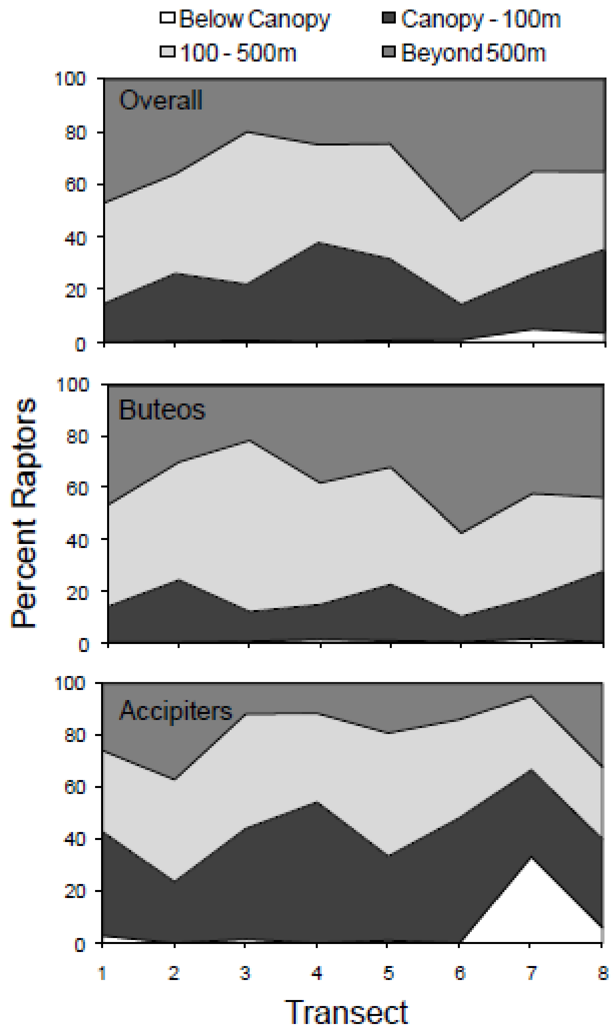
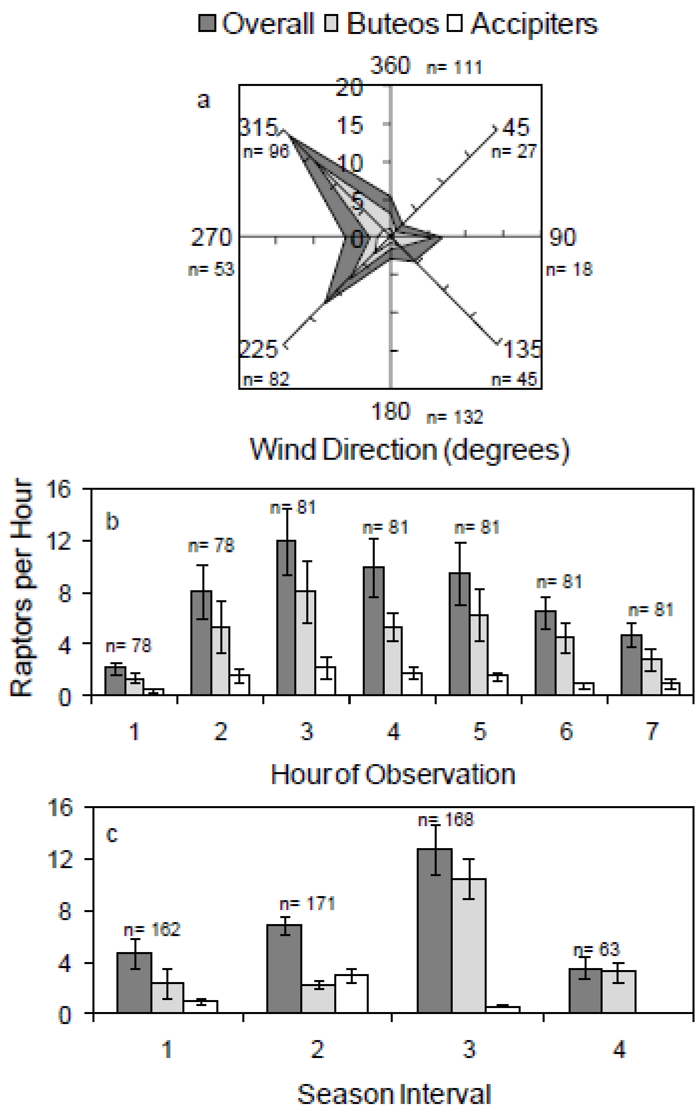


Figure 4. Proportions of raptors observed at each flight height category out of the total observed at each transect.



<u>Figure 5.</u> Raptors observed per hour related to wind direction, time of day, and time during the migratory season (mean ± SE, n=total hours of observation). Hour of observation corresponds to time after sunrise during each observation day; hour 3 approximately late morning, hour 7 mid to late afternoon. Season interval corresponds to time during the migration season, one sampling day at each transect per interval (with the exception of interval 4, in which only transects 1, 3, and 6 were sampled). Interval 1 took place late August through mid September, 2 through mid October, 3 through late October, 4 through mid November 2008

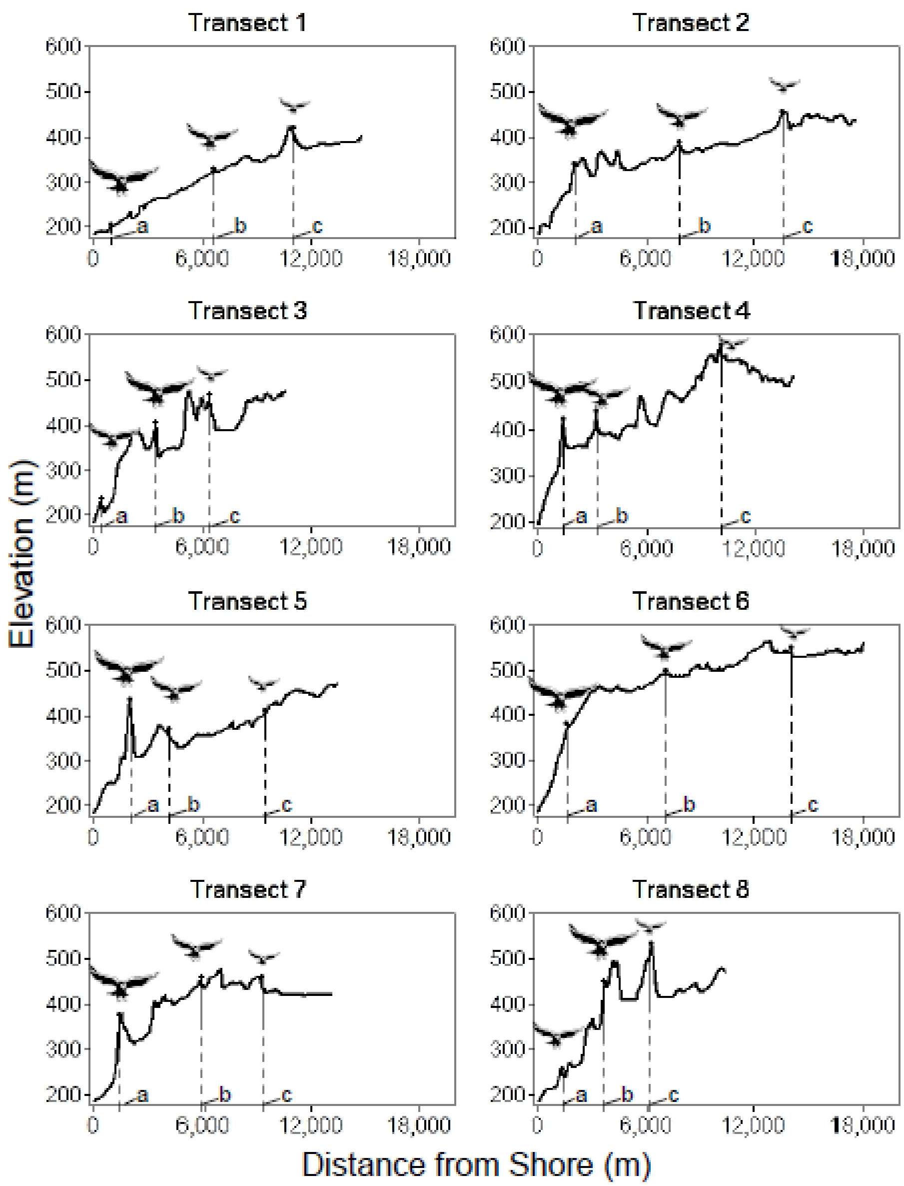


Figure 6. Elevation profile of each transect illustrating changes in elevation, the position of major ridgelines, the position of each observation site, and the proportion of total raptors observed from each site. Sites from which the highest proportions of raptors were observed out of the total for each transect are indicated by large birds. Small birds indicate the lowest proportions.

Appendix 1. Description of raptor migration observation sites. Each site indentified by a number indicating the transect, numbered 1 beginning nearest to Duluth, MN through 8. Letters indicate the site within each transect, beginning closest to the shore of Lake Superior.

Site	Description
1a	Open space. Wayside stop on MN Hwy 61.
1b	Open field near crossroads.
1c	Deer stand on hilltop.
2a	Rocky outcropping on ridge.
2b	Deer stand on roadside bank.
2c	Deer stand overlooking clearcut.
3a	Hilltop overlooking gravel pit.
3b	Rocky outcropping on ridge.
3c	Rocky outcropping on ridge.
4a	Rocky outcropping on ridge.
4b	Rocky outcropping on ridge.
4c	USFS fire tower.
5a	Rocky outcropping on prominent hilltop.
5b	Roadside pull off overlooking Temperance River Valley.
5c	Open field with deer stand.
6a	Overlook on ridge.
6b	Hill in gravel pit.
6c	Roadside with deer stand.
7a	Deck on ridge.
7b	Deer stand in clearcut.
7c	Deer stand on hill overlooking gravel pit.
8a	Hillside overlooking gravel pit.
8b	Rocky outcropping on ridge.
8c	USFS fire tower.

Appendix 2. Regional airport located nearest to each observation site. Weather data on wind direction, antecedent wind, and antecedent precipitation recorded from the regional airports was retrieved online from the National Climatic Data Center maintained by NOAA for use in data analysis.

Transect	Weather Station
1 and 2	Richard B. Helgeson Airport, Two Harbors, MN
3, 4, and 5	Silver Bay Municipal Airport, Silver Bay, MN
6, 7, and 8	Grand Marais/Cook County Airport, Grand Marais, MN

Appendix 3. Total number of raptors, Buteos, and Accipiters observed over the 2008 fall migration season and weather conditions listed by site, date, and hour. Buteos included Red-tailed Hawks, Broad-winged Hawks, Rough-legged Hawks, Bald Eagles, Golden Eagles, and any unidentified Buteos or Eagles. Accipiters included Sharp-shined Hawks, Cooper's Hawks, Northern Goshawks, and any unidentified Accipiters.

Site	Date	Hour	Total Raptors	Total Buteos	Total Accipiters	Wind Speed	Wind Direction	Temperature (^{o}F)	Visibility	Sky	Antecedent Wind	Antecedent Precipitation
1a	9/1/2008	1	0	0	0	1	360	63	1	1	0	0
1a	9/1/2008	2	0	0	0	2	180	68	1	2	0	0
1a	9/1/2008	3	1	1	0	2	180	72	1	1	0	0
1a	9/1/2008	4	0	0	0	2	135	77	1	0	0	0
1a	9/1/2008	5	1	1	0	2	135	80	1	0	0	0
1a	9/1/2008	6	0	0	0	2	180	78	1	0	0	0
1a	9/1/2008	7	0	0	0	3	180	78	1	0	0	0
1a	10/3/2008	1	2	0	1	2	360	39	1	0	0	0
1a	10/3/2008	2	4	1	1	1	270	45	1	0	0	0
1a	10/3/2008	3	4	2	1	1	360	48	1	0	0	0
1a	10/3/2008	4	18	11	2	2	270	50	1	0	0	0
1a	10/3/2008	5	14	9	3	1	225	52	1	0	0	0
1a	10/3/2008	6	3	0	0	1	270	55	1	0	0	0
1a	10/3/2008	7	0	0	0	2	315	55	1	0	0	0
1a	10/20/2008	1	19	14	4	3	315	37	1	0	0	0
1a	10/20/2008	2	78	63	2	4	315	42	1	0	0	0
1a	10/20/2008	3	38	38	0	4	315	46	1	0	0	0
1a	10/20/2008	4	164	50	1	4	315	45	1	1	0	0
1a	10/20/2008	5	183	150	4	4	315	49	1	2	0	0
1a	10/20/2008	6	86	81	1	4	315	50	1	2	0	0
1a	10/20/2008	7	23	18	0	4	360	49	1	2	0	0
1a	11/1/2008	1	0	0	0	1	360	38	1	1	0	0
1a	11/1/2008	2	4	4	0	1	360	42	1	1	0	0
1a	11/1/2008	3	13	11	1	1	135	45	1	2	0	0
1a	11/1/2008	4	34	29	1	2	90	42	1	3	0	0

Appendix 3. Continued.

Site	Date	Hour	Total Raptors	Total Buteos	Total Accipiters	Wind Speed	Wind Direction	Temperature (^oF)	Visibility	Sky	Antecedent Wind	Antecedent Precipitation
1a	11/1/2008	5	20	16	0	2	90	45	1	3	0	0
1a	11/1/2008	6	4	4	0	2	90	48	1	3	0	0
1a	11/1/2008	7	2	1	0	2	45	46	1	2	0	0
1b	9/1/2008	1	0	0	0	1	360	70	1	3	0	0
1b	9/1/2008	2	0	0	0	2	180	70	2	3	0	0
1b	9/1/2008	3	2	0	0	3	180	72	2	2	0	0
1b	9/1/2008	4	2	0	0	3	135	78	2	0	0	0
1b	9/1/2008	5	3	1	1	3	135	80	1	0	0	0
1b	9/1/2008	6	1	1	0	3	180	80	2	0	0	0
1b	9/1/2008	7	2	1	0	2	180	85	1	0	0	0
1b	10/3/2008	1	0	0	0	1	360	39	1	0	0	0
1b	10/3/2008	2	2	1	0	1	270	41	1	0	0	0
1b	10/3/2008	3	7	0	0	2	360	45	1	0	0	0
1b	10/3/2008	4	1	1	0	1	270	49	1	0	0	0
1b	10/3/2008	5	1	0	0	1	225	52	1	0	0	0
1b	10/3/2008	6	0	0	0	2	270	55	1	0	0	0
1b	10/3/2008	7	0	0	0	1	315	57	1	0	0	0
1b	10/20/2008	1	23	18	3	4	315	37	1	0	0	0
1b	10/20/2008	2	126	126	0	5	315	41	1	0	0	0
1b	10/20/2008	3	49	48	0	5	315	43	1	0	0	0
1b	10/20/2008	4	22	21	0	4	315	44	1	1	0	0
1b	10/20/2008	5	31	25	1	4	315	47	1	1	0	0
1b	10/20/2008	6	22	16	4	4	315	48	1	1	0	0
1b	10/20/2008	7	14	13	0	5	360	46	1	2	0	0
1b	11/1/2008	1	3	3	0	2	360	38	1	1	0	0
1b	11/1/2008	2	12	11	0	2	360	39	1	1	0	0
1b	11/1/2008	3	38	33	0	2	135	46	1	1	0	0
1b	11/1/2008	4	12	11	0	2	90	45	1	1	0	0

Appendix 3. Continued.

Site	Date	Hour	Total Raptors	Total Buteos	Total Accipiters	Wind Speed	Wind Direction	Temperature (^oF)	Visibility	Sky	Antecedent Wind	Antecedent Precipitation
1b	11/1/2008	5	17	17	0	2	90	47	1	1	0	0
1b	11/1/2008	6	6	6	0	2	90	46	1	1	0	0
1b	11/1/2008	7	3	3	0	2	45	46	1	1	0	0
1c	9/1/2008	1	0	0	0	0	360	67	1	3	0	0
1c	9/1/2008	2	0	0	0	1	180	73	1	2	0	0
1c	9/1/2008	3	0	0	0	2	180	72	1	2	0	0
1c	9/1/2008	4	0	0	0	3	135	75	1	1	0	0
1c	9/1/2008	5	0	0	0	3	135	79	1	0	0	0
1c	9/1/2008	6	0	0	0	3	180	84	1	0	0	0
1c	9/1/2008	7	0	0	0	3	180	83	1	0	0	0
1c	10/3/2008	1	0	0	0	2	360	30	1	0	0	0
1c	10/3/2008	2	0	0	0	2	270	35	1	0	0	0
1c	10/3/2008	3	3	3	0	3	360	39	1	0	0	0
1c	10/3/2008	4	1	1	0	3	270	44	1	0	0	0
1c	10/3/2008	5	1	1	0	3	225	48	1	0	0	0
1c	10/3/2008	6	0	0	0	4	270	48	1	0	0	0
1c	10/3/2008	7	0	0	0	3	315	51	1	0	0	0
1c	10/20/2008	1	8	8	0	3	315	36	1	0	0	0
1c	10/20/2008	2	7	5	2	4	315	40	1	0	0	0
1c	10/20/2008	3	0	0	0	3	315	42	1	0	0	0
1c	10/20/2008	4	5	3	1	4	315	43	1	2	0	0
1c	10/20/2008	5	4	3	0	3	315	48	1	2	0	0
1c	10/20/2008	6	7	7	0	3	315	45	1	2	0	0
1c	10/20/2008	7	2	1	1	3	360	40	1	3	0	0
1c	11/1/2008	1	0	0	0	2	360	38	1	1	0	0
1c	11/1/2008	2	0	0	0	1	360	39	1	1	0	0
1c	11/1/2008	3	0	0	0	1	135	46	1	1	0	0
1c	11/1/2008	4	2	2	0	1	90	45	1	1	0	0

Appendix 3. Continued.

Site	Date	Hour	Total Raptors	Total Buteos	Total Accipiters	Wind Speed	Wind Direction	Temperature (^{o}F)	Visibility	Sky	Antecedent Wind	Antecedent Precipitation
1c	11/1/2008	5	4	3	0	1	90	47	1	1	0	0
1c	11/1/2008	6	0	0	0	1	90	46	1	1	0	0
1c	11/1/2008	7	0	0	0	1	45	46	1	2	0	0
2a	9/3/2008	1	2	0	0	3	270	48	1	1	0	0
2a	9/3/2008	2	9	3	1	3	315	51	1	3	0	0
2a	9/3/2008	3	24	7	13	3	270	55	1	3	0	0
2a	9/3/2008	4	5	1	3	2	270	68	1	3	0	0
2a	9/3/2008	5	11	1	5	2	315	65	1	3	0	0
2a	9/3/2008	6	6	2	1	2	270	72	1	2	0	0
2a	9/3/2008	7	13	3	8	2	360	70	1	2	0	0
2a	10/4/2008	1	0	0	0	1	360	44	1	0	0	0
2a	10/4/2008	2	0	0	0	2	45	47	1	0	0	0
2a	10/4/2008	3	6	4	0	3	90	49	1	0	0	0
2a	10/4/2008	4	10	5	2	3	90	52	1	0	0	0
2a	10/4/2008	5	7	3	1	3	90	53	1	0	0	0
2a	10/4/2008	6	4	2	1	3	135	54	1	0	0	0
2a	10/4/2008	7	1	0	0	3	135	54	1	0	0	0
2a	10/25/2008	1	0	0	0	3	225	44	1	3	4	1
2a	10/25/2008	2	11	10	0	4	225	39	1	3	4	1
2a	10/25/2008	3	0	0	0	5	180	41	1	3	4	1
2a	10/25/2008	4	0	0	0	7	180	45	1	3	4	1
2a	10/25/2008	5	3	2	0	6	180	42	1	3	4	1
2a	10/25/2008	6	3	3	0	6	180	45	1	3	4	1
2a	10/25/2008	7	1	0	0	4	225	50	1	1	4	1
2b	9/3/2008	1	0	0	0	4	270	46	1	2	0	0
2b	9/3/2008	2	0	0	0	4	315	49	1	2	0	0
2b	9/3/2008	3	0	0	0	4	270	56	1	2	0	0
2b	9/3/2008	4	0	0	0	4	270	54	1	2	0	0

Appendix 3. Continued.

Site	Date	Hour	Total Raptors	Total Buteos	Total Accipiters	Wind Speed	Wind Direction	Temperature (^oF)	Visibility	Sky	Antecedent Wind	Antecedent Precipitation
2b	9/3/2008	5	2	2	0	4	315	57	1	2	0	0
2b	9/3/2008	6	5	0	0	3	270	59	1	1	0	0
2b	9/3/2008	7	10	7	0	3	360	61	1	1	0	0
2b	10/4/2008	1	0	0	0	0	360	45	1	0	0	0
2b	10/4/2008	2	5	2	0	0	45	50	1	0	0	0
2b	10/4/2008	3	0	0	0	2	90	52	1	0	0	0
2b	10/4/2008	4	0	0	0	2	90	51	1	0	0	0
2b	10/4/2008	5	0	0	0	2	90	52	1	0	0	0
2b	10/4/2008	6	0	0	0	2	135	53	1	0	0	0
2b	10/4/2008	7	0	0	0	3	135	55	1	0	0	0
2b	10/25/2008	1	2	2	0	3	225	40	1	3	4	1
2b	10/25/2008	2	3	2	0	4	225	40	1	3	4	1
2b	10/25/2008	3	1	1	0	4	180	40	1	3	4	1
2b	10/25/2008	4	2	2	0	3	180	42	1	3	4	1
2b	10/25/2008	5	6	4	0	3	180	42	1	3	4	1
2b	10/25/2008	6	1	1	0	4	180	42	1	2	4	1
2b	10/25/2008	7	4	2	1	4	225	45	1	1	4	1
2c	9/3/2008	1	0	0	0	3	270	46	1	3	0	0
2c	9/3/2008	2	1	0	0	3	315	49	1	3	0	0
2c	9/3/2008	3	1	0	0	2	270	54	1	1	0	0
2c	9/3/2008	4	0	0	0	3	270	56	1	3	0	0
2c	9/3/2008	5	1	0	0	2	315	59	1	1	0	0
2c	9/3/2008	6	0	0	0	2	270	62	1	1	0	0
2c	9/3/2008	7	0	0	0	2	360	65	1	1	0	0
2c	10/4/2008	1	0	0	0	1	360	42	1	0	0	0
2c	10/4/2008	2	6	2	3	1	45	48	1	0	0	0
2c	10/4/2008	3	1	0	0	2	90	51	1	0	0	0
2c	10/4/2008	4	0	0	0	2	90	62	1	0	0	0

Appendix 3. Continued.

Site	Date	Hour	Total Raptors	Total Buteos	Total Accipiters	Wind Speed	Wind Direction	Temperature (^oF)	Visibility	Sky	Antecedent Wind	Antecedent Precipitation
2c	10/4/2008	5	1	1	0	2	90	55	1	0	0	0
2c	10/4/2008	6	0	0	0	2	135	55	1	0	0	0
2c	10/4/2008	7	0	0	0	2	135	55	1	0	0	0
2c	10/25/2008	1	1	1	0	4	225	37	1	3	4	1
2c	10/25/2008	2	1	1	0	4	225	37	1	3	4	1
2c	10/25/2008	3	4	4	0	4	180	39	1	3	4	1
2c	10/25/2008	4	3	2	0	3	180	44	1	2	4	1
2c	10/25/2008	5	5	5	0	4	180	43	1	3	4	1
2c	10/25/2008	6	3	3	0	4	180	44	1	2	4	1
2c	10/25/2008	7	7	7	0	5	225	46	1	1	4	1
3a	9/6/2008	1	2	0	0	0	360	55	1	3	0	0
3a	9/6/2008	2	3	1	2	1	360	56	1	3	0	0
3a	9/6/2008	3	2	0	0	1	360	58	1	3	0	0
3a	9/6/2008	4	1	1	0	2	135	62	1	2	0	0
3a	9/6/2008	5	0	0	0	2	135	64	1	2	0	0
3a	9/6/2008	6	1	0	0	2	135	69	1	1	0	0
3a	9/6/2008	7	0	0	0	2	135	63	1	2	0	0
3a	10/8/2008	1	0	0	0	1	360	50	1	3	4	2
3a	10/8/2008	2	0	0	0	2	225	52	1	2	4	2
3a	10/8/2008	3	3	1	0	2	225	55	1	2	4	2
3a	10/8/2008	4	5	3	0	2	225	62	1	2	4	2
3a	10/8/2008	5	2	1	0	3	180	60	1	1	4	2
3a	10/8/2008	6	4	3	0	3	180	60	1	2	4	2
3a	10/8/2008	7	1	1	0	3	180	62	1	1	4	2
3a	10/27/2008	1	17	17	0	3	315	32	1	7	0	0
3a	10/27/2008	2	78	78	0	2	315	36	1	1	0	0
3a	10/27/2008	3	28	26	1	3	315	36	1	2	0	0
3a	10/27/2008	4	27	26	0	3	315	36	1	9	0	0

<u>Appendix 3.</u> Continued.

Site	Date	Hour	Total Raptors	Total Buteos	Total Accipiters	Wind Speed	Wind Direction	Temperature (^oF)	Visibility	Sky	Antecedent Wind	Antecedent Precipitation
3a	10/27/2008	5	20	19	0	4	270	36	1	9	0	0
3a	10/27/2008	6	29	29	0	3	315	36	1	2	0	0
3a	10/27/2008	7	28	27	0	4	315	34	1	9	0	0
3a	11/10/2008	1	0	0	0	1	315	30	1	1	0	0
3a	11/10/2008	2	1	1	0	1	270	27	1	1	0	0
3a	11/10/2008	3	0	0	0	2	270	37	1	1	0	0
3a	11/10/2008	4	2	2	0	1	315	38	1	1	0	0
3a	11/10/2008	5	0	0	0	1	315	40	1	1	0	0
3a	11/10/2008	6	0	0	0	1	270	42	1	1	0	0
3a	11/10/2008	7	0	0	0	1	270	43	1	1	0	0
3b	9/6/2008	1	0	0	0	1	360	50	1	3	2	0
3b	9/6/2008	2	1	0	1	1	360	52	1	2	2	0
3b	9/6/2008	3	11	4	1	1	360	56	1	2	2	0
3b	9/6/2008	4	6	0	1	3	135	58	1	2	2	0
3b	9/6/2008	5	1	0	0	3	135	61	1	2	2	0
3b	9/6/2008	6	1	0	1	3	135	64	1	9	2	0
3b	9/6/2008	7	1	0	0	2	135	60	1	6	2	0
3b	10/8/2008	1	4	0	4	2	360	46	1	2	5	2
3b	10/8/2008	2	25	0	25	3	225	48	1	2	5	2
3b	10/8/2008	3	61	1	59	3	270	46	1	1	5	2
3b	10/8/2008	4	20	0	17	4	225	51	1	1	5	2
3b	10/8/2008	5	9	1	5	5	180	53	1	1	5	2
3b	10/8/2008	6	2	1	0	2	180	55	1	2	5	2
3b	10/8/2008	7	1	1	0	1	180	57	1	1	5	2
3b	10/27/2008	1	20	20	0	5	315	30	1	7	0	0
3b	10/27/2008	2	32	28	0	6	315	30	1	2	0	0
3b	10/27/2008	3	32	27	3	6	315	35	1	7	0	0
3b	10/27/2008	4	31	28	0	5	315	35	1	7	0	0

Appendix 3. Continued.

Site	Date	Hour	Total Raptors	Total Buteos	Total Accipiters	Wind Speed	Wind Direction	Temperature (^oF)	Visibility	Sky	Antecedent Wind	Antecedent Precipitation
3b	10/27/2008	5	31	31	0	7	270	35	1	7	0	0
3b	10/27/2008	6	34	33	1	7	315	35	1	3	0	0
3b	10/27/2008	7	52	50	2	7	315	35	1	7	0	0
3b	11/10/2008	1	4	4	0	4	315	21	1	1	0	0
3b	11/10/2008	2	3	3	0	4	270	21	1	1	0	0
3b	11/10/2008	3	2	2	0	4	270	22	1	1	0	0
3b	11/10/2008	4	5	5	0	5	315	24	1	0	0	0
3b	11/10/2008	5	5	5	0	4	315	26	1	0	0	0
3b	11/10/2008	6	9	9	0	4	270	26	1	0	0	0
3b	11/10/2008	7	1	1	0	4	270	27	1	0	0	0
3c	9/6/2008	1	0	0	0	0	360	55	1	3	2	0
3c	9/6/2008	2	0	0	0	0	360	58	1	3	2	0
3c	9/6/2008	3	14	4	6	2	360	59	1	3	2	0
3c	9/6/2008	4	20	5	6	1	135	60	1	3	2	0
3c	9/6/2008	5	5	3	2	2	135	60	1	3	2	0
3c	9/6/2008	6	7	1	4	1	135	62	1	2	2	0
3c	9/6/2008	7	5	0	2	1	135	60	1	2	2	0
3c	10/8/2008	1	1	0	1	3	360	43	1	1	5	2
3c	10/8/2008	2	13	0	10	3	225	44	1	1	5	2
3c	10/8/2008	3	19	1	15	5	225	48	1	1	5	2
3c	10/8/2008	4	15	1	13	5	225	51	1	1	5	2
3c	10/8/2008	5	13	1	12	5	180	54	1	1	5	2
3c	10/8/2008	6	10	0	10	5	180	55	1	1	5	2
3c	10/8/2008	7	1	1	0	4	180	55	1	1	5	2
3c	10/27/2008	1	3	1	0	4	315	29	3	7	0	0
3c	10/27/2008	2	6	5	0	4	315	36	1	2	0	0
3c	10/27/2008	3	8	4	0	4	315	33	1	7	0	0
3c	10/27/2008	4	11	7	0	3	315	37	1	7	0	0

Appendix 3. Continued.

Site	Date	Hour	Total Raptors	Total Buteos	Total Accipiters	Wind Speed	Wind Direction	Temperature (°F)	Visibility	Sky	Antecedent Wind	Antecedent Precipitation
3c	10/27/2008	5	14	9	0	4	270	37	1	7	0	0
3c	10/27/2008	6	10	2	0	4	315	38	1	7	0	0
3c	10/27/2008	7	4	2	0	5	315	41	1	3	0	0
3c	11/10/2008	1	0	0	0	2	315	26	1	1	0	0
3c	11/10/2008	2	1	1	0	2	270	30	1	1	0	0
3c	11/10/2008	3	0	0	0	2	270	32	1	1	0	0
3c	11/10/2008	4	2	2	0	3	315	35	1	1	0	0
3c	11/10/2008	5	0	0	0	3	315	35	1	1	0	0
3c	11/10/2008	6	1	1	0	2	270	40	1	0	0	0
3c	11/10/2008	7	0	0	0	2	270	39	1	0	0	0
4a	9/8/2008	1	5	0	4	1	315	55	1	1	0	0
4a	9/8/2008	2	27	5	16	2	270	55	1	1	0	0
4a	9/8/2008	3	12	1	8	2	270	53	1	2	0	0
4a	9/8/2008	4	24	8	5	1	360	59	1	2	0	0
4a	9/8/2008	5	13	5	0	1	270	59	1	3	0	0
4a	9/8/2008	6	1	0	0	1	360	55	1	9	0	0
4a	9/8/2008	7	0	0	0	1	135	60	1	5	0	0
4a	9/24/2008	1	3	0	3	4	225	49	1	0	4	1
4a	9/24/2008	2	9	0	7	5	270	52	1	0	4	1
4a	9/24/2008	3	7	1	3	4	225	57	1	0	4	1
4a	9/24/2008	4	6	3	3	5	225	59	1	0	4	1
4a	9/24/2008	5	8	1	5	6	270	60	1	1	4	1
4a	9/24/2008	6	14	1	8	6	270	60	1	1	4	1
4a	9/24/2008	7	15	3	8	6	225	66	1	1	4	1
4a	10/11/2008	1	0	0	0	3	45	53	1	3	0	1
4a	10/11/2008	2	5	1	2	4	45	54	2	3	0	1
4a	10/11/2008	3	5	1	2	3	45	52	1	3	0	1
4a	10/11/2008	4	1	1	0	4	45	55	1	3	0	1

Appendix 3. Continued.

Site	Date	Hour	Total Raptors	Total Buteos	Total Accipiters	Wind Speed	Wind Direction	Temperature (°F)	Visibility	Sky	Antecedent Wind	Antecedent Precipitation
4a	10/11/2008	5	0	0	0	3	45	60	1	3	0	1
4a	10/11/2008	6	1	1	0	3	45	58	1	3	0	1
4a	10/11/2008	7	1	0	0	5	45	50	1	3	0	1
4b	9/8/2008	1	0	0	0	3	315	55	1	1	0	0
4b	9/8/2008	2	1	0	0	3	270	55	1	1	0	0
4b	9/8/2008	3	0	0	0	3	270	53	1	2	0	0
4b	9/8/2008	4	9	5	3	1	360	59	1	3	0	0
4b	9/8/2008	5	5	1	3	1	270	59	1	3	0	0
4b	9/8/2008	6	2	1	0	2	360	55	1	3	0	0
4b	9/8/2008	7	1	1	0	1	135	60	1	6	0	0
4b	9/24/2008	1	3	0	3	4	225	49	1	0	4	1
4b	9/24/2008	2	4	2	2	5	270	52	1	0	4	1
4b	9/24/2008	3	13	1	8	4	225	57	1	0	4	1
4b	9/24/2008	4	16	2	13	5	225	59	1	0	4	1
4b	9/24/2008	5	27	1	15	6	270	59	1	1	4	1
4b	9/24/2008	6	15	9	3	6	270	60	1	2	4	1
4b	9/24/2008	7	8	1	6	4	225	66	1	2	4	1
4b	10/11/2008	1	4	1	2	2	45	50	1	3	0	1
4b	10/11/2008	2	1	0	1	2	45	52	1	3	0	1
4b	10/11/2008	3	2	1	0	2	45	52	1	2	0	1
4b	10/11/2008	4	1	0	0	2	45	52	1	3	0	1
4b	10/11/2008	5	0	0	0	1	45	60	1	3	0	1
4b	10/11/2008	6	0	0	0	1	45	56	1	3	0	1
4b	10/11/2008	7	0	0	0	2	45	55	1	3	0	1
4c	9/8/2008	1	0	0	0	5	315	44	1	1	0	0
4c	9/8/2008	2	2	1	0	6	270	46	1	1	0	0
4c	9/8/2008	3	4	1	0	5	270	45	1	1	0	0
4c	9/8/2008	4	0	0	0	4	360	46	1	2	0	0

Appendix 3. Continued.

Site	Date	Hour	Total Raptors	Total Buteos	Total Accipiters	Wind Speed	Wind Direction	Temperature (^oF)	Visibility	Sky	Antecedent Wind	Antecedent Precipitation
4c	9/8/2008	5	2	2	0	3	270	47	1	2	0	0
4c	9/8/2008	6	3	1	1	3	360	50	1	9	0	0
4c	9/8/2008	7	3	1	1	2	135	51	1	9	0	0
4c	9/24/2008	1	0	0	0	6	225	48	1	0	4	1
4c	9/24/2008	2	2	0	0	6	270	50	1	0	4	1
4c	9/24/2008	3	1	0	0	6	225	52	1	0	4	1
4c	9/24/2008	4	1	0	0	6	225	55	1	6	4	1
4c	9/24/2008	5	7	7	0	7	270	60	1	2	4	1
4c	9/24/2008	6	11	5	1	1	270	60	1	2	4	1
4c	9/24/2008	7	2	0	1	7	225	61	1	2	4	1
4c	10/11/2008	1	1	0	0	6	45	42	1	9	0	1
4c	10/11/2008	2	3	1	2	5	45	44	1	3	0	1
4c	10/11/2008	3	6	5	1	5	45	46	1	2	0	1
4c	10/11/2008	4	4	3	1	4	45	47	1	3	0	1
4c	10/11/2008	5	3	1	0	4	45	48	1	3	0	1
4c	10/11/2008	6	5	4	0	3	45	50	1	9	0	1
4c	10/11/2008	7	4	2	2	4	45	46	1	6	0	1
5a	9/9/2008	1	0	0	0	1	360	47	1	2	0	0
5a	9/9/2008	2	8	0	3	1	360	48	1	3	0	0
5a	9/9/2008	3	4	0	1	2	225	49	1	1	0	0
5a	9/9/2008	4	1	0	1	3	225	53	1	1	0	0
5a	9/9/2008	5	4	0	0	3	135	54	1	1	0	0
5a	9/9/2008	6	0	0	0	4	180	57	1	1	0	0
5a	9/9/2008	7	0	0	0	4	180	55	1	2	0	0
5a	9/25/2008	1	3	0	3	1	360	50	1	3	0	0
5a	9/25/2008	2	19	0	12	1	360	50	1	9	0	0
5a	9/25/2008	3	21	13	3	1	360	52	1	3	0	0
5a	9/25/2008	4	30	5	19	2	360	60	1	2	0	0

Appendix 3. Continued.

Site	Date	Hour	Total Raptors	Total Buteos	Total Accipiters	Wind Speed	Wind Direction	Temperature (^oF)	Visibility	Sky	Antecedent Wind	Antecedent Precipitation
5a	9/25/2008	5	18	1	15	2	135	60	1	3	0	0
5a	9/25/2008	6	10	0	4	2	135	60	1	3	0	0
5a	9/25/2008	7	26	0	20	2	180	58	1	3	0	0
5a	10/16/2008	1	1	0	1	2	270	37	1	2	0	0
5a	10/16/2008	2	11	2	8	2	360	41	1	2	0	0
5a	10/16/2008	3	8	4	3	3	360	40	1	3	0	0
5a	10/16/2008	4	13	3	7	3	315	40	1	3	0	0
5a	10/16/2008	5	12	3	8	3	180	41	1	3	0	0
5a	10/16/2008	6	14	11	3	3	225	43	1	3	0	0
5a	10/16/2008	7	19	16	0	3	270	44	1	9	0	0
5b	9/9/2008	1	2	0	0	1	360	48	1	2	0	0
5b	9/9/2008	2	3	1	0	1	360	52	1	2	0	0
5b	9/9/2008	3	12	1	2	1	225	55	1	1	0	0
5b	9/9/2008	4	7	0	5	2	225	60	1	2	0	0
5b	9/9/2008	5	16	4	9	2	135	55	1	2	0	0
5b	9/9/2008	6	2	1	0	2	180	62	1	2	0	0
5b	9/9/2008	7	3	0	1	2	180	61	1	2	0	0
5b	9/25/2008	1	1	0	1	1	360	42	1	9	0	0
5b	9/25/2008	2	2	0	0	1	360	44	1	6	0	0
5b	9/25/2008	3	22	11	9	1	360	47	1	9	0	0
5b	9/25/2008	4	28	8	13	3	360	58	1	2	0	0
5b	9/25/2008	5	15	4	10	3	135	62	1	2	0	0
5b	9/25/2008	6	6	2	3	3	135	62	1	2	0	0
5b	9/25/2008	7	5	1	2	2	180	60	1	2	0	0
5b	10/16/2008	1	1	1	0	0	270	34	1	2	0	0
5b	10/16/2008	2	0	0	0	0	360	38	1	3	0	0
5b	10/16/2008	3	1	1	0	0	360	41	1	3	0	0
5b	10/16/2008	4	1	1	0	1	315	42	1	3	0	0

Appendix 3. Continued.

Site	Date	Hour	Total Raptors	Total Buteos	Total Accipiters	Wind Speed	Wind Direction	Temperature (^oF)	Visibility	Sky	Antecedent Wind	Antecedent Precipitation
5b	10/16/2008	5	19	7	7	1	180	44	1	3	0	0
5b	10/16/2008	6	12	6	2	1	225	44	1	3	0	0
5b	10/16/2008	7	3	0	2	1	270	45	1	3	0	0
5c	9/9/2008	1	0	0	0	1	360	46	1	2	0	0
5c	9/9/2008	2	0	0	0	1	360	47	1	1	0	0
5c	9/9/2008	3	5	2	3	3	225	56	1	1	0	0
5c	9/9/2008	4	5	2	2	4	225	55	1	1	0	0
5c	9/9/2008	5	1	0	0	3	135	58	1	1	0	0
5c	9/9/2008	6	0	0	0	3	180	58	1	1	0	0
5c	9/9/2008	7	0	0	0	4	180	60	1	1	0	0
5c	9/25/2008	1	0	0	0	0	360	43	1	3	0	0
5c	9/25/2008	2	2	0	2	0	360	45	1	3	0	0
5c	9/25/2008	3	3	1	1	0	360	51	1	3	0	0
5c	9/25/2008	4	4	1	2	3	360	63	1	2	0	0
5c	9/25/2008	5	9	3	4	4	135	62	1	2	0	0
5c	9/25/2008	6	2	0	1	2	135	63	1	1	0	0
5c	9/25/2008	7	0	0	0	2	180	64	1	2	0	0
5c	10/16/2008	1	0	0	0	0	270	39	1	3	0	0
5c	10/16/2008	2	2	0	2	1	360	40	1	3	0	0
5c	10/16/2008	3	6	1	2	1	360	41	1	3	0	0
5c	10/16/2008	4	9	3	1	1	315	43	1	3	0	0
5c	10/16/2008	5	12	6	2	1	180	45	1	3	0	0
5c	10/16/2008	6	17	16	0	1	225	45	1	3	0	0
5c	10/16/2008	7	20	13	1	1	270	50	1	3	0	0
6a	9/15/2008	3	16	3	5	2	225	58	1	2	2	0
6a	9/15/2008	4	3	0	2	3	360	58	1	2	2	0
6a	9/15/2008	5	2	0	0	3	180	58	1	3	2	0
6a	9/15/2008	6	4	2	1	3	180	58	1	3	2	0

Appendix 3. Continued.

Site	Date	Hour	Total Raptors	Total Buteos	Total Accipiters	Wind Speed	Wind Direction	Temperature (°F)	Visibility	Sky	Antecedent Wind	Antecedent Precipitation
6a	9/15/2008	7	2	2	0	3	180	62	1	3	2	0
6a	10/17/2008	1	1	1	0	1	360	42	1	3	0	0
6a	10/17/2008	2	2	1	0	0	360	41	1	3	0	0
6a	10/17/2008	3	3	2	1	0	360	42	1	3	0	0
6a	10/17/2008	4	7	3	3	0	360	45	1	3	0	0
6a	10/17/2008	5	12	6	1	0	360	48	1	3	0	0
6a	10/17/2008	6	2	2	0	1	360	47	1	3	0	0
6a	10/17/2008	7	1	1	0	1	180	50	1	3	0	0
6a	10/28/2008	1	1	1	0	1	270	29	1	3	0	0
6a	10/28/2008	2	13	13	0	2	270	29	1	3	0	0
6a	10/28/2008	3	31	30	0	2	315	32	1	3	0	0
6a	10/28/2008	4	47	46	0	2	315	33	1	3	0	0
6a	10/28/2008	5	51	50	1	2	225	38	1	1	0	0
6a	10/28/2008	6	35	35	0	3	270	42	1	1	0	0
6a	10/28/2008	7	25	25	0	4	315	40	1	1	0	0
6a	11/11/2008	1	0	0	0	2	360	25	1	3	0	0
6a	11/11/2008	2	3	3	0	2	360	25	1	3	0	0
6a	11/11/2008	3	1	1	0	3	135	25	1	3	0	0
6a	11/11/2008	4	3	3	0	2	360	30	1	3	0	0
6a	11/11/2008	5	0	0	0	2	360	28	1	3	0	0
6a	11/11/2008	6	1	1	0	2	135	28	1	3	0	0
6a	11/11/2008	7	0	0	0	2	180	29	1	3	0	0
6b	9/15/2008	3	98	80	1	3	225	50	1	1	2	0
6b	9/15/2008	4	6	1	3	3	360	56	1	2	2	0
6b	9/15/2008	5	3	0	2	4	180	51	1	2	2	0
6b	9/15/2008	6	0	0	0	4	180	56	1	2	2	0
6b	9/15/2008	7	0	0	0	4	180	55	1	2	2	0
6b	10/17/2008	1	1	1	0	1	360	39	1	9	0	0

Appendix 3. Continued.

Site	Date	Hour	Total Raptors	Total Buteos	Total Accipiters	Wind Speed	Wind Direction	Temperature (^oF)	Visibility	Sky	Antecedent Wind	Antecedent Precipitation
6b	10/17/2008	2	0	0	0	1	360	39	1	3	0	0
6b	10/17/2008	3	0	0	0	1	360	39	1	3	0	0
6b	10/17/2008	4	19	17	2	1	360	45	1	3	0	0
6b	10/17/2008	5	35	32	2	1	360	50	1	3	0	0
6b	10/17/2008	6	10	9	0	1	360	45	1	3	0	0
6b	10/17/2008	7	3	1	0	1	180	45	1	3	0	0
6b	10/28/2008	1	1	1	0	1	270	28	1	3	0	0
6b	10/28/2008	2	2	2	0	1	270	28	1	3	0	0
6b	10/28/2008	3	16	13	1	2	315	29	1	3	0	0
6b	10/28/2008	4	7	7	0	1	315	30	1	3	0	0
6b	10/28/2008	5	9	9	0	2	225	34	1	1	0	0
6b	10/28/2008	6	0	0	0	3	270	36	1	2	0	0
6b	10/28/2008	7	2	1	0	3	315	40	1	1	0	0
6b	11/11/2008	1	0	0	0	1	360	20	1	2	0	0
6b	11/11/2008	2	3	3	0	1	360	24	1	3	0	0
6b	11/11/2008	3	2	2	0	3	135	26	1	3	0	0
6b	11/11/2008	4	0	0	0	2	360	27	1	3	0	0
6b	11/11/2008	5	1	1	0	2	360	27	1	3	0	0
6b	11/11/2008	6	0	0	0	2	135	26	1	3	0	0
6b	11/11/2008	7	0	0	0	2	180	26	1	3	0	0
6c	9/15/2008	3	162	162	0	2	225	50	1	3	2	0
6c	9/15/2008	4	20	17	1	3	360	52	1	2	2	0
6c	9/15/2008	5	7	6	0	5	180	54	1	3	2	0
6c	9/15/2008	6	0	0	0	6	180	54	1	3	2	0
6c	9/15/2008	7	0	0	0	4	180	54	1	3	2	0
6c	10/17/2008	1	2	2	0	0	360	36	1	3	0	0
6c	10/17/2008	2	0	0	0	0	360	35	1	3	0	0
6c	10/17/2008	3	0	0	0	0	360	37	1	3	0	0

Appendix 3. Continued.

Site	Date	Hour	Total Raptors	Total Buteos	Total Accipiters	Wind Speed	Wind Direction	Temperature (°F)	Visibility	Sky	Antecedent Wind	Antecedent Precipitation
6c	10/17/2008	4	5	3	1	1	360	41	1	3	0	0
6c	10/17/2008	5	13	10	2	1	360	43	1	2	0	0
6c	10/17/2008	6	0	0	0	1	360	44	1	3	0	0
6c	10/17/2008	7	1	0	0	3	180	41	1	3	0	0
6c	10/28/2008	1	0	0	0	2	270	29	1	3	0	0
6c	10/28/2008	2	0	0	0	3	270	30	1	3	0	0
6c	10/28/2008	3	0	0	0	3	315	30	1	3	0	0
6c	10/28/2008	4	0	0	0	3	315	30	1	3	0	0
6c	10/28/2008	5	0	0	0	2	225	38	1	2	0	0
6c	10/28/2008	6	1	1	0	2	270	38	1	2	0	0
6c	10/28/2008	7	0	0	0	4	315	38	1	2	0	0
6c	11/11/2008	1	1	1	0	0	360	21	1	3	0	0
6c	11/11/2008	2	0	0	0	1	360	25	1	3	0	0
6c	11/11/2008	3	0	0	0	1	135	27	1	3	0	0
6c	11/11/2008	4	2	2	0	2	360	27	1	3	0	0
6c	11/11/2008	5	0	0	0	1	360	27	1	3	0	0
6c	11/11/2008	6	0	0	0	2	135	27	1	3	0	0
6c	11/11/2008	7	0	0	0	1	180	27	1	3	0	0
7a	9/16/2008	1	3	0	1	2	270	49	1	2	0	0
7a	9/16/2008	2	0	0	0	2	270	57	1	2	0	0
7a	9/16/2008	3	2	0	1	2	180	60	1	2	0	0
7a	9/16/2008	4	1	0	1	3	180	54	1	3	0	0
7a	9/16/2008	5	1	0	0	3	180	55	1	2	0	0
7a	9/16/2008	6	4	2	1	5	180	64	1	0	0	0
7a	9/16/2008	7	1	0	1	5	180	64	1	0	0	0
7a	10/18/2008	1	2	0	0	2	180	43	1	3	0	0
7a	10/18/2008	2	1	0	0	1	180	45	1	3	0	0
7a	10/18/2008	3	2	2	0	1	180	50	1	3	0	0

Appendix 3. Continued.

Site	Date	Hour	Total Raptors	Total Buteos	Total Accipiters	Wind Speed	Wind Direction	Temperature (°F)	Visibility	Sky	Antecedent Wind	Antecedent Precipitation
7a	10/18/2008	4	6	3	2	2	180	55	1	1	0	0
7a	10/18/2008	5	1	0	0	3	180	57	1	4	0	0
7a	10/18/2008	6	3	3	0	3	180	57	1	0	0	0
7a	10/18/2008	7	2	2	0	3	180	50	1	0	0	0
7a	10/29/2008	1	9	9	0	2	360	30	1	1	0	0
7a	10/29/2008	2	18	16	0	2	315	40	1	1	0	0
7a	10/29/2008	3	36	34	2	2	360	40	1	2	0	0
7a	10/29/2008	4	7	7	0	2	360	43	1	2	0	0
7a	10/29/2008	5	2	2	0	1	180	40	1	1	0	0
7a	10/29/2008	6	2	2	0	2	225	40	1	2	0	0
7a	10/29/2008	7	0	0	0	2	180	40	1	3	0	0
7b	9/16/2008	1	1	0	0	0	270	50	1	3	0	0
7b	9/16/2008	2	0	0	0	0	270	55	1	3	0	0
7b	9/16/2008	3	1	0	0	1	180	58	1	3	0	0
7b	9/16/2008	4	0	0	0	1	180	56	1	3	0	0
7b	9/16/2008	5	2	2	0	1	180	58	1	2	0	0
7b	9/16/2008	6	2	0	1	4	180	64	1	0	0	0
7b	9/16/2008	7	0	0	0	7	180	62	1	0	0	0
7b	10/18/2008	1	0	0	0	1	180	39	1	2	0	0
7b	10/18/2008	2	1	1	0	2	180	41	1	3	0	0
7b	10/18/2008	3	0	0	0	3	180	40	1	3	0	0
7b	10/18/2008	4	14	11	0	3	180	48	1	2	0	0
7b	10/18/2008	5	3	2	1	4	180	45	1	2	0	0
7b	10/18/2008	6	3	2	0	3	180	47	1	1	0	0
7b	10/18/2008	7	1	0	0	4	180	50	1	3	0	0
7b	10/29/2008	1	3	3	0	4	360	25	1	1	0	0
7b	10/29/2008	2	8	8	0	5	315	29	1	1	0	0
7b	10/29/2008	3	22	21	1	5	360	29	1	1	0	0

Appendix 3. Continued.

Site	Date	Hour	Total Raptors	Total Buteos	Total Accipiters	Wind Speed	Wind Direction	Temperature (°F)	Visibility	Sky	Antecedent Wind	Antecedent Precipitation
7b	10/29/2008	4	16	16	0	4	360	34	1	1	0	0
7b	10/29/2008	5	5	4	1	3	180	38	1	1	0	0
7b	10/29/2008	6	10	9	1	3	225	40	1	1	0	0
7b	10/29/2008	7	4	3	0	4	180	37	1	2	0	0
7c	9/16/2008	1	0	0	0	1	270	50	1	3	0	0
7c	9/16/2008	2	3	0	2	1	270	55	1	3	0	0
7c	9/16/2008	3	0	0	0	3	180	58	1	3	0	0
7c	9/16/2008	4	1	0	1	1	180	56	1	3	0	0
7c	9/16/2008	5	0	0	0	2	180	58	1	2	0	0
7c	9/16/2008	6	1	0	0	5	180	64	1	1	0	0
7c	9/16/2008	7	4	2	1	5	180	62	1	0	0	0
7c	10/18/2008	1	0	0	0	3	180	38	1	2	0	0
7c	10/18/2008	2	2	0	2	3	180	40	1	2	0	0
7c	10/18/2008	3	11	8	1	3	180	42	1	2	0	0
7c	10/18/2008	4	14	13	0	4	180	44	1	1	0	0
7c	10/18/2008	5	9	8	0	4	180	46	1	1	0	0
7c	10/18/2008	6	6	6	0	5	180	47	1	1	0	0
7c	10/18/2008	7	1	0	0	5	180	46	1	2	0	0
7c	10/29/2008	1	0	0	0	1	360	25	1	0	0	0
7c	10/29/2008	2	5	5	0	3	315	29	1	1	0	0
7c	10/29/2008	3	1	1	0	3	360	29	1	1	0	0
7c	10/29/2008	4	2	2	0	3	360	34	1	2	0	0
7c	10/29/2008	5	0	0	0	1	180	38	1	1	0	0
7c	10/29/2008	6	0	0	0	2	225	40	1	1	0	0
7c	10/29/2008	7	0	0	0	2	180	37	1	2	0	0
8a	8/29/2008	1	0	0	0	1	270	58	1	1	0	0
8a	8/29/2008	2	1	0	0	1	270	60	1	1	0	0
8a	8/29/2008	3	1	0	1	0	360	65	1	1	0	0

Appendix 3. Continued.

Site	Date	Hour	Total Raptors	Total Buteos	Total Accipiters	Wind Speed	Wind Direction	Temperature (°F)	Visibility	Sky	Antecedent Wind	Antecedent Precipitation
8a	8/29/2008	4	0	0	0	1	225	65	1	2	0	0
8a	8/29/2008	5	2	0	1	1	180	65	1	2	0	0
8a	8/29/2008	6	7	3	3	1	180	65	1	3	0	0
8a	8/29/2008	7	7	2	2	1	180	65	1	2	0	0
8a	9/17/2008	1	4	0	3	0	315	54	1	0	0	0
8a	9/17/2008	2	14	0	5	0	315	60	1	0	0	0
8a	9/17/2008	3	5	4	0	1	315	59	1	0	0	0
8a	9/17/2008	4	5	4	0	3	315	59	1	2	0	0
8a	9/17/2008	5	11	9	2	4	315	60	1	1	0	0
8a	9/17/2008	6	17	1	7	3	315	62	1	1	0	0
8a	9/17/2008	7	9	1	2	3	315	59	1	1	0	0
8a	9/17/2008	8	1	0	0	3	315	61	1	1	0	0
8a	10/30/2008	1	1	1	0	7	180	41	1	0	0	0
8a	10/30/2008	2	6	6	0	6	180	45	1	0	0	0
8a	10/30/2008	3	6	5	1	6	180	47	1	0	0	0
8a	10/30/2008	4	6	6	0	4	180	48	1	0	0	0
8a	10/30/2008	5	5	4	0	5	180	51	1	0	0	0
8a	10/30/2008	6	3	3	0	5	180	54	1	0	0	0
8a	10/30/2008	7	2	2	0	6	180	56	1	0	0	0
8b	8/29/2008	1	0	0	0	5	270	56	1	1	0	0
8b	8/29/2008	2	1	1	0	3	270	64	1	0	0	0
8b	8/29/2008	3	0	0	0	3	360	66	1	1	0	0
8b	8/29/2008	4	0	0	0	4	225	67	1	2	0	0
8b	8/29/2008	5	0	0	0	3	180	64	1	2	0	0
8b	8/29/2008	6	4	3	0	4	180	70	1	1	0	0
8b	8/29/2008	7	0	0	0	5	180	68	1	1	0	0
8b	9/17/2008	1	2	0	1	1	315	54	1	1	0	0
8b	9/17/2008	2	16	2	11	1	315	68	1	0	0	0

Appendix 3. Continued.

Site	Date	Hour	Total Raptors	Total Buteos	Total Accipiters	Wind Speed	Wind Direction	Temperature (°F)	Visibility	Sky	Antecedent Wind	Antecedent Precipitation
8b	9/17/2008	3	44	17	17	1	315	65	1	0	0	0
8b	9/17/2008	4	19	2	3	2	315	68	1	2	0	0
8b	9/17/2008	5	12	5	2	2	315	75	1	1	0	0
8b	9/17/2008	6	29	14	7	2	315	72	1	2	0	0
8b	9/17/2008	7	29	8	14	2	315	70	1	2	0	0
8b	9/17/2008	8	26	7	11	1	315	68	1	1	0	0
8b	10/30/2008	1	0	0	0	7	180	43	1	0	0	0
8b	10/30/2008	2	0	0	0	5	180	48	1	0	0	0
8b	10/30/2008	3	3	2	0	5	180	51	1	0	0	0
8b	10/30/2008	4	1	1	0	4	180	54	1	0	0	0
8b	10/30/2008	5	2	2	0	4	180	54	1	0	0	0
8b	10/30/2008	6	0	0	0	4	180	58	1	0	0	0
8b	10/30/2008	7	0	0	0	6	180	60	1	0	0	0
8c	8/29/2008	1	0	0	0	5	270	55	1	1	0	0
8c	8/29/2008	2	0	0	0	3	270	60	1	0	0	0
8c	8/29/2008	3	1	0	0	4	360	62	1	1	0	0
8c	8/29/2008	4	2	0	1	4	225	64	1	2	0	0
8c	8/29/2008	5	0	0	0	3	180	63	1	3	0	0
8c	8/29/2008	6	8	4	0	3	180	69	1	2	0	0
8c	8/29/2008	7	0	0	0	6	180	70	1	1	0	0
8c	9/17/2008	1	0	0	0	4	315	48	1	0	0	0
8c	9/17/2008	2	2	2	0	3	315	49	1	0	0	0
8c	9/17/2008	3	4	3	1	4	315	52	1	1	0	0
8c	9/17/2008	4	4	3	0	5	315	54	1	1	0	0
8c	9/17/2008	5	0	0	0	5	315	55	1	1	0	0
8c	9/17/2008	6	4	0	2	5	315	56	1	1	0	0
8c	9/17/2008	7	5	1	3	5	315	56	1	1	0	0
8c	9/17/2008	8	4	1	1	4	315	56	1	1	0	0

Appendix 3. Continued.

Site	Date	Hour	Total Raptors	Total Buteos	Total Accipiters	Wind Speed	Wind Direction	Temperature (°F)	Visibility	Sky	Antecedent Wind	Antecedent Precipitation
8c	10/30/2008	1	1	1	0	7	180	45	1	4	0	0
8c	10/30/2008	2	1	0	0	8	180	50	1	1	0	0
8c	10/30/2008	3	1	1	0	7	180	55	1	0	0	0
8c	10/30/2008	4	4	4	0	7	180	52	1	0	0	0
8c	10/30/2008	5	0	0	0	7	180	54	1	0	0	0
8c	10/30/2008	6	0	0	0	7	180	55	1	0	0	0
8c	10/30/2008	7	0	0	0	7	180	58	1	0	0	0