

**SPRING MIGRATIONAL MOVEMENT STUDY OF RAPTORS ON
OTTAWA NATIONAL WILDLIFE REFUGE AND SURROUNDING LAKE ERIE
MARSHES, OHIO**

PROGRESS REPORT-2006

BSBO-ONWR06-2

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INTRODUCTION

_____ A comprehensive study to monitor the movement and dynamics of raptor migration along the southwest shore of Lake Erie was initiated with a pilot season in the spring of 1991. Little is known on raptor migration west of the Allegheny mountains and east of the Rockies. Lake Erie represents a major physical barrier to migrating raptors resulting in measurable concentrations. The combination of the expansive water and the thermals created by the land-water interface result in definable bands of activity.

The wetland habitat that occurs along the shore of Lake Erie is under severe pressure from development and agriculture. The importance of this habitat to raptors for hunting and migration is poorly understood. The marshes hold large small mammal populations from mice to muskrats and extremely large numbers of neotropical passerines can be found during spring migration.

The large avian concentrations, whether it is passerines or raptors, attract many birders from March through May to the marshes. The more raptor migration is understood the more those that appreciate their presence can enjoy them.

The objectives of this study are to monitor long term trends in migrating raptors utilizing the region and to examine for spatial and temporal differences in migration between various age and sex classes of individual species and between species. The study will also allow for environmental education to improve the public's perception of these avian predators.

METHODS AND MATERIALS

_____ A prioritized list of observation points and banding stations was developed to encompass the western basin of Lake Erie (Table 1, Figure 1). The field season commenced 20 February and concluded 20 May depending on weather conditions. Count data were gathered following the guidelines established by the Hawk Migration Assoc. of North America. These consisted of observations from fixed points, making visual counts of passing raptors, and identifying to species where possible. Flight direction, wind direction, wind speed, sky condition, time of observation, and length of observation were collected for each sample period. Data were collected by project personnel and volunteers assisting in the study. Two half-day workshops dealing with raptor identification and data collection were conducted for volunteers in February. Weather data were compiled at the watch sites and from hourly readings by Toledo Edison at the Davis Besse Nuclear Power Station (DBNPS). DBNPS weather data collected from 100 m at

1000 hr was correlated with raptor movements. The 1000 hr weather data were chosen because thermals are usually formed around that time. Observation data were compiled and reported to the Hawk Migration Assoc. of North America.

RESULTS AND DISCUSSION

COUNTS

Raptor counts were conducted on 72 days between 27 February and 11 May in 2006 (Table 2). One hundred and eighty-one individual trips involving 644.9 observation hours and 915 volunteer hours counted 4,418 raptors. The Magee Marsh tower was monitored daily, weather permitting. Other sites were manned when personnel were available. Counts for 2006 (6.85 birds/hr) were 39 percent below 2005 (11.16 birds/hr), and the lowest average per hour for the 16-year study. Much is to be learned about raptor flight paths and their variability along Lake Erie. Weather data were compiled from hourly readings by Toledo Edison at the Davis Besse Nuclear Power Station, and count data were analyzed for correlation with wind direction. In future years, as count data becomes more systematic, migration will be correlated with wind speed, pressure cells, fronts and precipitation as well as wind direction.

In 2006, high count dates again appeared to be positively correlated with southwest quadrant winds (Figure 2). These counts are shown in bold type in Table 2. Southwest winds allow raptors to tack into the wind as they migrate along the western basin. Good movements were also observed on southeast quadrant winds.

It continues to appear that the tower on Magee Marsh Wildlife Area provides a valuable control for the study. Table 3 shows observer hours, raptors observed, and raptors counted per hour for each site utilized. In 2006, County Line, Turtle Creek, SR 590, Maumee Bay State Park, and South Bass Island provided highly productive counts when manned. The tower site average is moderated by the number of days in which there was no migration.

An observation point along the Magee Marsh beach is utilized to better assess falcon movement which is theorized to be heaviest along the lake edge; however, this site was not manned in 2006. The Magee location was chosen over the Ottawa NWR beach due to it being open to the public and an active eagle nest site on Ottawa NWR. The sledding hill at Maumee Bay State Park should be representative of the volume of birds crossing near the mouth of the Maumee river. The Cullen Park site may be useful in actual crossing determination of the birds on the western end of Lake Erie.

Pickerel Creek Wildlife Area has been chosen to assess the movement along the south side of Sandusky Bay. It is thought that this may be a different group of migrants than appear on the Ottawa NWR complex. South Bass Island will identify the potential of island hopping by various species. Ft. Meigs and S.R. 590 sites have been the sole representatives for movements a considerable distance from the lake shore. A continued increase in monitoring will be important in addressing questions concerning these inland flight lines. The balance of the observation sites are designed to fill in and refine the flight paths.

The total raptors counted are shown in Table 4 for accipiters, buteos (Table 5), falcons (Table 6), and Table 7 for miscellaneous species. Individual species totals (N) and peaks by number observed (N) and number per hour follows. To more accurately compare species and for

future year to year comparisons unknown accipiters and buteos were statistically assigned to species. This was done assuming that the unidentified birds were representative of the identified birds for that day or neighboring days. Table 8 shows bird/hour by species during the project history.

1) Turkey Vulture (2,573) Peak: 3 April (502 birds and 177.20 birds/hr). The first observation was 11 March and appeared consistently from mid March into mid-May. It averaged 3.99 individuals per hour of observation in 2006, a decrease of 39 percent from 2005 (6.57 birds/hr) (Table 8). Turkey Vultures were counted on 76% of the count days. Turkey Vultures are almost completely dependent on the thermals to migrate and are normally seen migrating in small kettles. An increase in observation points will better define the area used by this species.

2) Broad-winged Hawk (188) Peak: 13 April (74 and 7.65 birds/hr). Broad-wings are late migrators and were first observed on 11 April. This species depends heavily on thermals and migrates in large kettles. Broad-wings were counted on 27% of the count days. An average of 0.29 individuals per hour was down 82% from 2005 (1.61), and the lowest recorded.

3) Red-tailed Hawk (753) Peak: 9 April (47 birds) and 21 April (3.41 birds/hr). The first observation was 28 February. Red-tails were encountered on 73% of the count days and averaged 0.99 individuals per hour of observation, 15% below 2005's 1.16. Breeding birds continue to be some confusion for observers but should have little effect on overall data.

4) Sharp-shinned Hawk (256) Peak: 13 April (69 birds and 8.13 birds/hr). March 6 was the first observation date for this species and it was consistently seen mid-March into mid-May. The average per observation hour was 0.40 individuals. This was down from the 0.69 in 2004 (-42%). This species, as all accipiters, actively feeds throughout migration, consequently they are not dependent on thermals and have a more general movement. It was observed on 51% of the count days.

5) Red-shouldered Hawk (161) Peak: 24 March (19 birds and 3.17 birds/hr). March 11 was the first observation date. They were consistently recorded from mid-March to mid-April. For 2006, the red-shoulder averaged 0.25 individuals per observer hour. This was 34% below the 0.38 average of 2005. Red-shoulders were observed on 41% of the count days.

6) Cooper's Hawk (132) Peak: 14 April (16 birds and 0.88 birds/hr). The first observation of this species was 4 March. It was consistently seen mid March to early May. It averaged 0.20 individuals per observation hour compared to 0.24 in 2005 (down 17%). It was observed on 61% of the count days.

7) Bald Eagle (265) Peak: 30 March (26 birds) and 10 April (3.2 birds/hr). The migration of the bald eagle is complicated by the resident population of breeding eagles and an increasing number of non-breeders. The first sighting was 27 February and was consistent into late-April. The average per observer hour for 2006 was 0.41, an increase of 86% from 2005 and a record count.

8) Northern Harrier (98) Peak: 29 March (10 birds and 1.09 birds/hr). The harrier is another common wintering bird in the region. The first migrating bird was recorded 27 February. It was consistently recorded until mid-April and was observed on 58% of the count days. The harrier was seen at 0.15 individuals per observer hour compared to 0.13 in 2005.

9) American Kestrel (30) Peak: 13 March and 14 April (4 birds) and 13 March (0.42 birds/hr). This species was first recorded 4 March and was fairly consistent late March through April. This species was seen at 0.05 individuals per observation hour, the same rate as 2005.

10) Osprey (13) Peak: 6 May (2 birds and 0.22 birds/hr). The Osprey was first recorded on 9 April and was fairly consistent through early May. It was seen at 0.02 individuals per observer hour which was an decrease of 50% from 2005 and the lowest recorded.

11) Rough-legged Hawk (31) Peak: 15 March (6 birds and 0.72 birds/hr). The species was first recorded on 27 February. The 0.05 birds per observer hour was the same as 2005's rate. Many Rough-legged Hawks may have passed through to the north before field work began this year. Warm fronts in January and February should have taken many birds north following snow melt.

Other species counted but in low numbers included the Merlin (9), Peregrine Falcon (10), Northern Goshawk (1), and Golden Eagle (7).

EDUCATION

_____ Educational programming was supplied upon request. Three public workshops were given in 2006 to over 80 persons. The workshops were designed to give prospective volunteers background knowledge in raptor movement, identification and guidance in completing field work. A volunteer picnic was held at Carroll Twp. Hall to thank the volunteers for their hours of effort and to discuss future plans.

CONCLUSIONS

The 2006 field season produced valuable data that will add to our understanding of the migrational timing, habitat use, and long-term population trends of migrating raptors. It also allowed us to continue making strides in improvement of count procedures and results. The workshops continue to be a very important and successful tool towards meeting the education objectives of this project.

The prioritized site list appears to be functional for the time being and will be evaluated each year. The study along the south shore of Lake Erie has proven productive to have more than one count site for following the shifts in thermals which the soaring raptors tend to follow. The use of multiple marshes also allows an assessment of broad qualities of wetlands. The protection of this vanishing habitat type can use every additive value identified in Ohio. It is hoped that additional sites can be manned on more days next season, however it will be extremely important that the tower continues to be sampled daily. It will be the means of making daily, yearly and location comparisons.

Because these raptors are so dependent on weather conditions, the past sixteen years have produced some information on movement and timing, but has not been able to address the population trends very well. It is still expected to take several years to approach full implementation of the project.

Study results to date have been utilized for informing the public on where and when to observe migrating hawks. These analyses will also provide guidance for land managers in the Lake Erie marsh region for implementing management schemes for this group of migrating birds.

Table 1. Priority list for observation sites, 2006.

RANK	WATCH SITE LOCATIONS	SITE #
1)	Magee Marsh Tower	1
2)	Turtle Ck. (Lick.-Har.)	3
3)	Magee Beach	5
4)	Pickeral Ck W/A	7
5)	County Line Rd.	14
6)	Maumee Bay St Park	9
7)	S. Bass Island	29
8)	Port Clinton (Fulton St/SR2)	10
9)	SR 590 at Portage River	21
10)	Ft Meigs - Wood Co.	22
11)	Oak Harbor Golf Course	11
12)	SR 579 Golf Course	24
13)	Barrett Rd (Bay Point)	8
14)	Cullen Pk (Toledo)	23
15)	Wildwood Metropark	28
16)	Kelley's Island	13
17)	Metzger Marsh (west)	19
18)	Anchor Pt. Public access	15
19)	Darby Unit (ONWR)	16
20)	Ottawa NWR parking lot	4
21)	Ottawa NWR (pool 2)	17
22)	Toussaint W/A	18
23)	Metzger Marsh (pier)	20

Table 2. Survey counts of raptors and predominant wind direction in the Lake Erie marsh region, 2006.

DATE	RAPTORS	NUM. OF HOURS	RAPTORS/HOUR* <small>*heavy movements in bold</small>	WIND DIRECTION
Feb. 27	10	9.00	1.11	SW
28	16	12.00	1.33	NNW
Mar. 1	12	8.00	1.50	ENE
2	0	5.83	0.00	NNE
3	4	6.75	0.59	NNW
4	21	10.00	2.10	NW
5	23	12.00	1.92	NE
6	4	8.42	0.48	ENE
7	14	10.83	1.29	N
8	6	5.67	1.06	S
9	7	6.42	1.09	SW
10	6	7.75	0.77	WSW
11	38	9.00	4.22	S
12	61	16.75	3.64	SW
13	52	9.58	5.42	S
14	7	5.58	1.25	WNW
15	36	8.33	4.32	NW
16	113	11.75	9.62	N
17	33	5.85	5.64	ENE
18	19	7.58	2.51	NW
19	89	11.00	8.09	WNW
20	14	5.58	2.51	NNE
21	14	6.00	2.33	NE
22	10	7.92	1.26	NW
23	36	9.20	3.91	N
24	89	6.00	14.83	NNE
25	72	6.33	11.37	N
26	136	14.00	9.71	NNW
27	139	8.42	16.51	S
28	8	8.17	0.98	N
29	152	9.17	16.58	NE
30	189	15.83	11.94	SSW
31	208	8.50	24.47	SSW
Apr. 1	57	7.42	7.68	W
2	75	16.00	4.69	E
3	538	2.83	190.11	S
4	58	6.83	8.49	SW
5	7	6.00	1.17	NNW
6	93	13.67	6.80	SE
7	4	12.42	0.32	SSW
8	24	9.25	2.59	N
9	222	23.25	9.55	SW
Apr. 10	54	6.25	8.64	WSW

Table 2. Survey counts of raptors and predominant wind direction in the Lake Erie marsh region, 2006.

DATE	RAPTORS	NUM. OF HOURS	RAPTORS/HOUR* <small>*heavy movements in bold</small>	WIND DIRECTION
11	132	14.92	8.85	S
12	60	4.42	13.57	SW
13	301	9.67	31.13	SW
14	220	18.25	12.05	SSW
15	97	10.50	9.24	ENE
16	20	13.00	1.54	E
17	26	12.67	2.05	NNE
18	12	11.00	1.09	NE
19	2	6.00	0.33	ENE
20	11	8.83	1.25	E
21	146	12.00	12.17	S
22	109	13.63	8.00	SSW
23	77	9.17	8.40	W
24	22	6.33	3.48	NW
25	0	3.58	0.00	NE
26	43	5.83	7.38	SW
27	No Survey			
28	11	12.25	0.90	NNE
29	No Survey			
30	49	9.00	5.44	SE
May 1	74	6.08	12.17	SE
2	6	2.92	2.05	SW
3	15	6.17	2.43	NW
4	34	6.00	5.67	SW
5	39	6.00	6.50	N
6	61	9.00	6.78	N
7	14	8.00	1.75	S
8	24	6.67	3.60	S
9	22	8.92	2.47	SSE
10	6	6.50	0.92	SSE
11	15	6.00	2.50	SSW
TOTAL	4418	644.90	6.85	

Table 3. Observer hours and count totals for count sites, 2006.

SITE	HOURS OBSERVED	RAPTORS COUNTED	AVERAGE RAPTORS/HR
Tower	415.32	2538	6.11
Turtle Creek	40.33	230	5.70
Ft. Meigs	7.00	10	1.43
Pickeral Creek	7.50	73	9.73
Maumee Bay SP	27.17	359	13.21
County Line	24.58	356	14.48
S.R. 590	54.75	281	5.13
Cullen Park	56.00	207	3.70
Wildwood	2.25	7	2.80
South Bass Is	10.00	357	35.70
TOTAL	644.90	4418	6.85

Table 4. Total accipiter hawks counted in the Lake Erie marsh region, 2006.

DATE	SHARP-SHIN HAWK*	COOPER'S HAWK*	NORTHERN GOSHAWK	UNIDENT. ACCIPITER	TOTAL
Feb. 27					0
28					0
Mar. 1					0
2					0
3					0
4		(1)		1	1
5		3			3
6	1				1
7		1			1
8		1			1
9		1			1
10		1			1
11	1				1
12	1	2			3
13		2			2
14			1		1
15		3			3
16		2			2
17					0
18					0
19	2	3			5
20		1			1
21					0
22					0
23		2			2
24		2			2
25		1 (3)		2	3
26	1	1			2
27	1	2			3
28		1			1
29		(1)		1	1
30	1	1			2
31	10	5			15
Apr. 1	4 (5)	2		1	7
2	4	4			8
3	1 (2)	4 (6)		3	8
4	1				1
5		3			3
Apr. 6		5 (6)		1	6

Table 4. Total accipiter hawks counted in the Lake Erie marsh region, 2006.

DATE	SHARP-SHIN HAWK*	COOPER'S HAWK*	NORTHERN GOSHAWK	UNIDENT. ACCIPTER	TOTAL
7		(1)		1	1
8					0
9	11	5			16
10		1 (2)		1	2
11	7 (8)	2		1	10
12	6	7			13
13	69	4			73
14	30	16			46
15	7 (8)	9 (10)		2	18
16	1				1
17		1			1
18					0
19					0
20	4	1			5
21	19	6			25
22	3 (4)	2		1	6
23	42	7			49
24	(2)			2	2
25					0
26		3			3
27	No Survey				
28	3 (4)			1	4
29	No Survey				
30	5				5
May 1	1				1
2					0
3		1			1
4	7				7
5	1	1			2
6		2			2
7					0
8	(2)			2	2
9					0
10	(1)			1	1
11	1				1
TOTAL	245 (256)	122 (132)	1	21	389

* Numbers in () include statistically assigned unknowns.

Table 5. Total buteo hawks counted in the Lake Erie marsh region, 2006.

DATE	RED-SHOUL. HAWK	BROAD- WING HAWK	RED-TAIL HAWK	ROUGH-LEG HAWK	UNIDENT. BUTEO	TOTAL
Feb. 27				1		1
28			13	1		14
Mar. 1			6			6
2						0
3			4			4
4			7 (13)		6	13
5			8 (15)	1 (2)	8	17
6						0
7			9			9
8			1			1
9			2			2
10			2			2
11	3 (4)		19 (23)		5	27
12	(3)		17 (37)		23	40
13	13 (14)		8 (9)		2	23
14	2 (3)				1	3
15	6		4	6		16
16	1		13	4		18
17			12 (14)		2	14
18			3 (6)		3	6
19	5 (8)		4 (7)		6	15
20						0
21						0
22	1		6			7
23	1 (2)		10 (11)	1	2	14
24	18 (19)		16		1	35
25	1 (2)		5 (7)		3	9
26	6 (3)		13 (19)		9	28
27	14 (17)		21 (25)	2	7	44
28						0
29	2 (3)		5 (8)		4	11
30	1 (2)		24 (29)		6	31
31	7		17	4		28
1			3 (5)		2	5
2	9 (12)		4 (5)		4	17
3	7 (9)		9 (12)		5	21
Apr. 4			3			3
5	1			3		1
6	9 (13)		16 (22)	2 (3)	11	38
7						0
8						0
9	3 (4)		44 (47)		4	51
10	2 (3)		13 (17)	2 (3)	6	23

Table 5. Total buteo hawks counted in the Lake Erie marsh region, 2006.

DATE	RED-SHOUL. HAWK	BROAD- WING HAWK	RED-TAIL HAWK	ROUGH-LEG HAWK	UNIDENT. BUTEO	TOTAL
11	1	4 (6)	24 (33)	1	11	41
12		1	10 (11)		1	12
13	6	73 (74)	23	0	1	103
14	4 (5)	9 (10)	20 (22)	2	4	39
15		(3)	3 (7)		7	10
16		7				7
17						0
18						0
19			1			1
20		(1)	(1)		2	2
21		26	40 (41)		1	67
22		26 (39)	1		13	40
23	1 (3)	(2)	2 (6)		8	11
24		(1)	9 (10)		2	11
25						0
26		(1)	9 (10)	1	2	12
27	No Survey					
28						0
29	No Survey					
30		2 (7)	4 (10)		11	17
May 1	1		13 (15)		2	16
2						0
3		2	3			5
4		2	1			3
5						0
6		(2)	1 (2)		3	4
7		(1)	4 (5)		2	6
8	1	1 (2)	4 (6)		3	9
9	1		2			3
10						0
11		1				1
TOTAL	127 (161)	154 (188)	515 (637)	28 (31)	193	1017

* Numbers in () include statistically assigned unknowns.

Table 6. Total falcons counted in the Lake Erie marsh region, 2006.

DATE	AMER. KESTREL*	MERLIN	PEREGRINE FALCON	UNIDENT. FALCON	TOTAL
Feb. 27					0
28					0
Mar. 1					0
2					0
3					0
4					0
5					0
6					0
7					0
8					0
9	1	1			2
10					0
11	1				1
12	2	2			4
13	4				4
14		1			1
15					0
16					0
17					0
18					0
19	1		1		2
20					0
21					0
22					0
23					0
24					0
25	(1)			1	1
26					0
27	1				1
28					0
29	(1)			1	1
30					0
31	1				1
Apr. 1					0
2					0
3	2				2
4		1	1		2
5					0
6					0
7	1	1			2
8	(1)			1	1
9	1		2		3
10					0

Table 6. Total falcons counted in the Lake Erie marsh region, 2006.

DATE	AMER. KESTREL*	MERLIN	PEREGRINE FALCON	UNIDENT. FALCON	TOTAL
Apr. 11	2				2
12		2	1		3
13					0
14	4	1	1		6
15	1				1
16					0
17	1				1
18					0
19					0
20					0
21					0
22					0
23					0
24					0
25					0
26			2		2
27	No Survey				
28					0
29	No Survey				
30					0
May 1	2				2
2					0
3					0
4					0
5			1		1
6					0
7			1		1
8					0
9					0
10	1				1
11					0
TOTAL	27 (30)	9	10	3	49

Table 7. Total vultures, ospreys, eagles, harriers and unidentified raptors counted in the Lake Erie marsh region, 2006.

DATE	TURKEY VULTURE	OSPREY	BALD EAGLE	GOLDEN EAGLE	NO. HARRIER	UNIDENT. RAPTOR	TOTAL
Feb. 27			6		3		9
28					2		2
Mar. 1			4		2		6
2							0
3							0
4			1		3	1	5
5			1		2		3
6			3				3
7			2		2		4
8			3		1		4
9			1		1		2
10			2		1		3
11	3		3		3		9
12	4		7		3		14
13	19		3		1		23
14			1		1		2
15	10		5		1	1	17
16	91		1		1		93
17	18		1				19
18	10		1		2		13
19	60		6		1		67
20	4		8		1		13
21	13		1				14
22			2		1		3
23	17		2		1		20
24	49				3		52
25	54		3		2		59
26	100		2		4		106
27	66		22		3		91
28	2		5				7
29	125		4		10		139
30	125		26	1	4		156
31	154		7		3		164
Apr. 1	44				1		45
2	46		2		2		50
3	502		5				507
4	46		5	1			52
5			3				3
6	38		8	2	1		49

Table 7. Total vultures, ospreys, eagles, harriers and unidentified raptors counted in the Lake Erie marsh region, 2006.

DATE	TURKEY VULTURE	OSPREY	BALD EAGLE	GOLDEN EAGLE	NO. HARRIER	UNIDENT. RAPTOR	TOTAL
Apr. 7					1		1
8	21		2				23
9	140	1	9		2		152
10	6	1	20		2		29
11	64		7		8		79
12	29	1	1	1			32
13	113	1	8		3		125
14	114	1	6		7	1	129
15	66	1	1				68
16	11	1					12
17	18		6				24
18	11		1				12
19			1				1
20	2		1	1			4
21	52		1		1		54
22	61		2				63
23	2		12		3		17
24	3	1	4	1			9
25							0
26	14		12				26
27	No Survey						
28	5	1			1		7
29	No Survey						
30	25		2				27
May 1	43		12				55
2	5	1					6
3	9						9
4	23				1		24
5	34	1			1		36
6	50	2			2	1	55
7	7						7
8	13						13
9	16		1			2	19
10	3					1	4
11	13						13
TOTAL	2573	13	265	7	98	7	2963

Table 8. Birds per hour of observation of major species and total raptors, 1991 - 2006.

SPEC	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991
TUVU	3.99	6.57	7.97	9.48	6.33	3.91	3.64	5.73	10.06	6.46	4.17	3.38	5.36	4.11	3.55	2.76
OSPR	0.02	0.04	0.09	0.05	0.07	0.08	0.03	0.03	0.04	0.03	0.16	0.03	0.04	0.11	0.09	0.05
BAEA	0.41	0.22	0.39	0.21	0.19	0.15	0.16	0.16	0.22	0.16	0.12	0.09	0.10	0.11	0.12	0.02
NOHA	0.15	0.13	0.33	0.19	0.15	0.19	0.13	0.19	0.13	0.14	0.33	0.16	0.23	0.24	0.28	0.54
SSHA	0.40	0.69	2.20	1.06	1.32	1.22	0.55	0.54	0.93	1.03	1.66	0.52	0.97	1.07	1.12	1.81
COHA	0.20	0.24	0.61	0.38	0.26	0.21	0.16	0.30	0.23	0.24	0.26	0.17	0.43	0.32	0.52	0.91
RSHA	0.25	0.38	1.17	0.77	0.71	0.38	0.51	0.76	0.57	0.16	0.44	0.41	0.50	1.07	0.79	0.32
BWHA	0.29	1.61	5.78	1.43	3.45	2.30	1.04	0.17	1.39	0.51	1.17	0.75	1.10	2.71	1.92	1.47
RTHA	0.99	1.16	2.52	2.25	1.62	1.01	1.09	1.85	2.11	1.90	1.89	1.24	2.41	2.01	2.07	1.63
RLHA	0.05	0.05	0.07	0.05	0.03	0.05	0.07	0.16	0.03	0.05	0.27	0.06	0.08	0.10	0.35	0.06
AMKE	0.05	0.05	0.18	0.13	0.09	0.11	0.09	0.11	0.12	0.10	0.14	0.11	0.10	0.11	0.17	0.30
Total hrs	644.9	647.3	608.1	781.1	886.9	980.2	938.0	876.1	924.48	987.30	1029.7	1064.2	1209.3	611.25	575.92	392.25
Total raptors	4418	7224	13003	12519	12580	9493	7096	8875	14720	10789	11051	7517	14067	7642	6362	3931
Total raptors/Hr	6.85	11.16	21.38	16.03	14.18	9.68	7.56	10.13	15.92	10.93	10.73	7.06	11.63	12.5	11.05	10.02

Figure 1. Raptor count locations by site #.

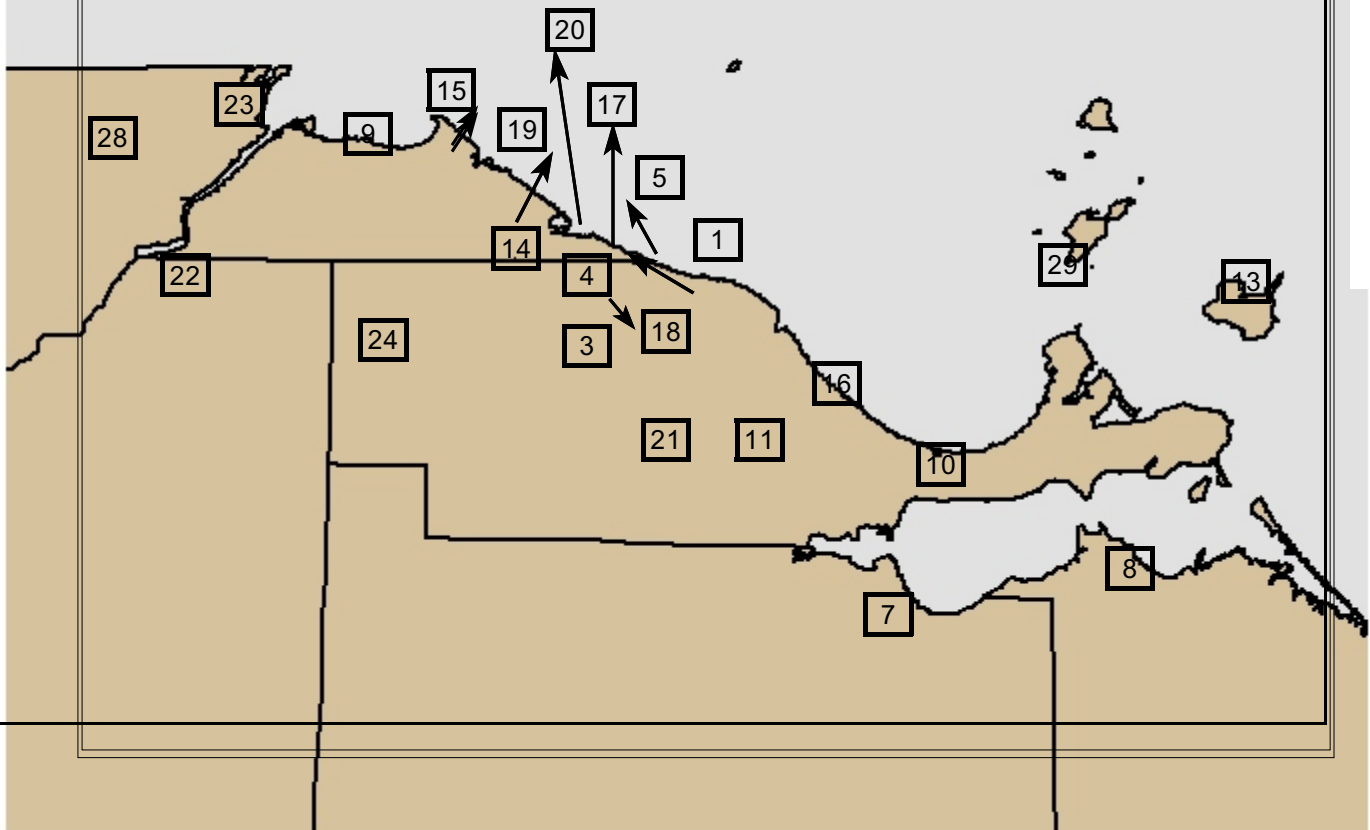
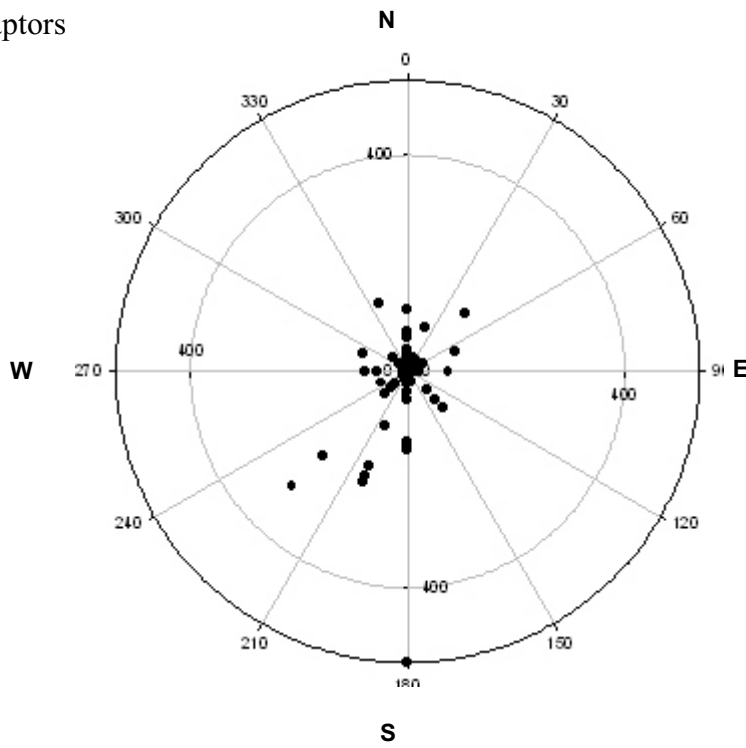


Figure 2. Effect of wind direction on 2006 raptor counts: (a) total raptors observed by wind direction, and (b) raptors per hour by wind direction.

(a) Total raptors



(b) Raptors per hour

