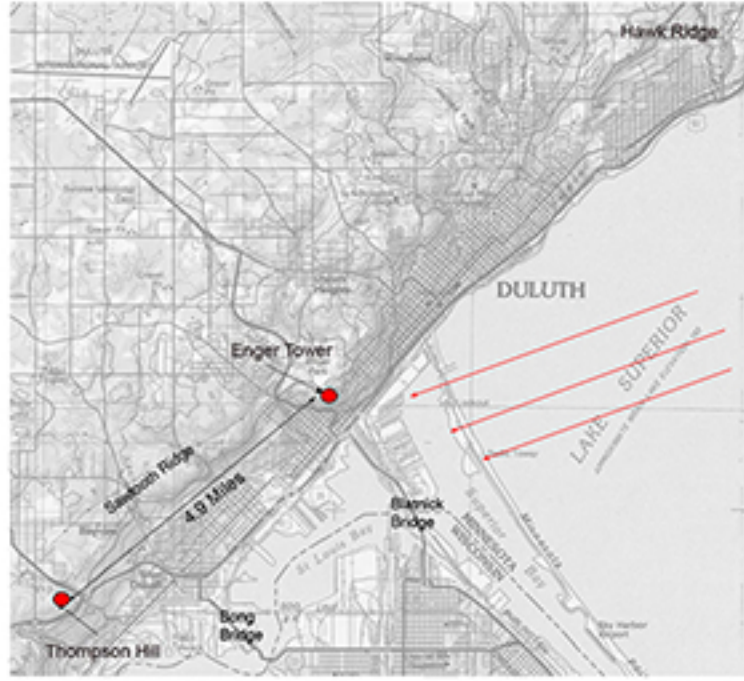


## Background

Since the 1950s, data has been collected regarding the fall migration of raptors at Hawk Ridge in Duluth, Minnesota. It was unknown whether there was similar movement of raptors in the spring. In 1997, in response to this question, a spring migration count was started at Enger Tower in Duluth. Prior to this study no organized spring count had ever been conducted in the Duluth area or anywhere in the state of Minnesota. This represented a significant gap in the understanding of migration in the Duluth area. In 2000, a change in the protocol allowed for a second count site on Thompson Hill to take into account differing effects of weather on flight pathways of migrating raptors.

## Study area



Count locations (Enger Tower, 1997-2005; Thompson Hill, 2000-2005)

- The two sites used are Enger Tower and the Thompson Hill rest area; both are located along the West Skyline Parkway at designated pull offs and allow easy access for all visitors.
- Both sites are approximately 500 feet above Lake Superior.
- The topographical features of both count sites concentrate northbound migrants, which collect along the ridge before continuing north.
- Enger Tower is used on all days except those with Northeast winds (red arrows) which almost always coincides with lake effect breeze conditions.

Lake effect breeze is a phenomenon that occurs when warm air over the land rises faster than cool air over the lake. This creates a vacuum effect as the cold air from the lake is pulled over the land, to replace the void left by the rising warm air; hence, the lake breeze and cooler conditions. This often forces birds westward along the ridge, nearer to the Thompson Hill site.

## Research Objectives and Methods

### Objectives

1. Conduct a survey of previously unknown spring raptor migration and collect baseline data.
2. To further our knowledge of raptors by determining various flight path preferences and migration sequence of some species of raptor by age and or sex.
3. To seek an understanding of the mechanics of migration by studying the effects of various topographical and meteorological factors.
4. Educate the public on the migration of all species of birds.



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### Methods

The survey generally started 1 March and ended 25 May. Inclement weather such as heavy snow, rain, or dense fog prevented surveys. Hours surveyed varied due to weather and flight conditions; attempts were made to cover from 9:00am to 3:00pm.

Weather data was recorded hourly and came from the three recording weather stations: Duluth Airport, Duluth Harbor, and the Superior Airport. Data included temperature, wind direction and speed, barometric pressure and humidity.

Observational data included cloud coverage, visibility, and precipitation. Notes were also recorded on flight characteristics as well as data on age, sex, and plumage if possible. All data was recorded in conformity with the standards set forth by the Hawk Migration Association of North America (HMANA).

When possible, two observers were used to conduct the count. Studies by HawkWatch International have shown two observers are optimal for detecting and counting raptors in an efficient manner.

## Results and Conclusions

YEAR	3-YEAR MEAN (1997-1999)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	TOTAL (2000-2024)	MEAN (2000-2024)	
Observation Hours:	384	454.5	354.75	482.75	336.0	546.5	404.25	283.8	38	570	437.2	190.3	73.5	39.5	62.5	66.5	112.3	29	562.6	515.8	574.5	591	517.5	634.4	605.7	8789.5	351.6		
<b>RAPTOR COUNTS</b>																													
Black Vulture	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Turkey Vulture	608	1081	2209	1678	1037	1741	740	1156	193	1347	1845	651	147	180	930	14	191	0	2498	2765	2584	2541	2142	3213	3938	35970	1439		
Osprey	94	208	271	255	184	227	204	88	6	169	69	36	2	22	53	9	18	0	230	161	167	145	126	106	119	2994	120		
Bald Eagle	1418	2829	2631	2971	2866	3415	2859	2338	1059	4142	4028	1842	1729	886	1225	1167	2393	389	5480	7727	4744	5070	5203	4944	5833	80606	3224		
Northern Harrier	32	56	38	61	47	89	35	32	10	75	62	26	11	17	21	7	23	0	72	63	55	62	84	87	82	1155	46		
Sharp-shinned Hawk	1241	2761	2051	2430	2373	2659	2798	1503	224	2070	1827	803	118	1104	717	199	507	1	2637	2482	1859	1525	1040	1952	2358	39554	1582		
Cooper's Hawk	27	47	54	63	41	37	38	20	3	21	18	24	6	5	14	1	28	0	31	39	40	55	38	38	33	721	29		
Northern Goshawk	3	13	23	24	11	19	10	8	0	4	2	3	2	4	2	2	1	1	6	7	4	6	3	0	1	163	7		
Red-shouldered Hawk	1	4	3	4	3	4	4	2	1	4	3	0	0	0	0	0	4	0	3	4	3	7	3	3	3	64	3		
Broad-winged Hawk	3821	12571	9466	10178	12979	16944	15073	9330	221	7560	4546	1008	0	2641	1561	705	1666	0	17910	13334	6393	5733	7856	7852	11607	184338	7374		
Red-tailed Hawk	1987	6315	5413	7332	5733	7398	2651	2556	1291	3516	2336	1774	850	425	1679	117	1460	0	2985	3724	2871	2542	2145	2460	2276	72870	2915		
Rough-legged Hawk	57	390	195	250	161	407	145	105	93	151	117	47	83	59	175	35	25	12	443	234	213	236	164	324	181	4412	176		
Swainson's Hawk	2	2	4	5	4	3	4	1	0	1	0	0	0	0	0	1	1	0	6	5	5	3	5	3	4	59	2		
Golden Eagle	23	63	66	77	71	127	48	50	23	61	80	54	75	12	19	33	70	1	161	212	171	117	151	115	117	2048	82		
American Kestrel	34	132	82	115	114	131	46	39	2	52	22	20	2	37	35	1	13	0	46	81	50	41	59	91	96	1358	54		
Merlin	11	24	17	16	26	22	10	4	25	14	18	4	3	12	5	11	0	64	41	34	58	35	53	61	592	24			
Peregrine Falcon	5	12	7	7	6	10	7	8	0	19	8	5	3	2	2	2	2	0	22	20	23	12	23	29	34	271	11		
Mississippi Kite	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0		
Ferruginous Hawk	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0		
Gyr Falcon	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0		
Unidentified Accipiter	0	4	8	7	1	0	0	1	0	2	1	5	2	0	0	0	0	0	0	0	0	0	1	0	1	35	1		
Unidentified Buteo	0	11	9	12	0	1	0	0	0	2	1	2	4	0	0	0	0	0	7	3	0	0	0	0	4	2	61	2	
Unidentified Falcon	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	
Unidentified Eagle	0	0	0	1	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	1	6	0	
Unidentified Raptor	0	24	5	3	0	0	0	0	0	47	13	12	1	3	0	0	0	0	2	1	4	11	24	28	184	7			
<b>TOTAL</b>	<b>9365</b>	<b>26547</b>	<b>22554</b>	<b>25491</b>	<b>25648</b>	<b>33238</b>	<b>24684</b>	<b>17247</b>	<b>3130</b>	<b>19269</b>	<b>14992</b>	<b>6331</b>	<b>3043</b>	<b>5400</b>	<b>6445</b>	<b>2298</b>	<b>6414</b>	<b>404</b>	<b>32602</b>	<b>30904</b>	<b>19217</b>	<b>18157</b>	<b>19089</b>	<b>21298</b>	<b>26776</b>	<b>427471</b>	<b>17099</b>		

Table 1. Summary of observation efforts and raptor counts by species: 1997-2024. Totals and means were calculated for before and after the change in count protocol in 2000. From 2000-2024, a total of 427,471 raptors were counted.

20 species of diurnal raptors have been recorded. Notable species recorded include the second state record of Black Vulture (*Coragyps atratus*) and an adult light-morph Ferruginous Hawk (*Buteo regalis*).

The difference in species composition between the spring and fall migration (2000-2005) is shown in Table 2. This suggests that certain species might use alternative migratory pathways in the spring. WSHC is unique in this regard as there are no studies comparing a spring and fall population of birds of the same geographic count area.

Table 2. Comparison of fall flights at Hawk Ridge Bird Observatory to spring flights at West Skyline Hawk Count, 2000-2005. Numbers are in observations per hour.

SPECIES <sup>1</sup>	Mean Fall <sup>2</sup>	Mean Spring <sup>3</sup>	Mean Return Rate <sup>4</sup>
Turkey Vulture	2.1	3.4	157%
Osprey	0.51	0.54	106%
Bald Eagle	4.1	6.9	169%
Northern Harrier	0.7	0.1	18%
Sharp-shinned Hawk	22.1	6.0	27%
Cooper's Hawk	0.2	0.1	48%
Northern Goshawk	1.08	0.04	4%
Red-shouldered Hawk	0.005	0.009	171%
Broad-winged Hawk	93.8	30.4	32%
Swainson's Hawk	0.012	0.009	75%
Red-tailed Hawk	11.8	13.6	115%
Rough-legged Hawk	0.8	0.6	77%
Golden Eagle	0.19	0.17	90%
American Kestrel	3.1	0.2	8%
Merlin	0.23	0.05	21%
Peregrine Falcon	0.09	0.02	21%

Table 3 shows the seasonal timing of migration for all the regularly occurring species at WSHC. The data is based only on the data collected during the 2000-2005 seasons. The table includes first, peak, and last observed with a range from the various years along with average mean date. The table also contains bulk passage (80%) with a range of dates along with medium passage date.

Table 3. Summary of seasonal timing of migration for all regularly-occurring raptors at West Skyline Hawk Count, 2000-2005.

SPECIES <sup>2</sup>	FIRST OBSERVED <sup>3</sup>			PEAK OBSERVED			LAST OBSERVED <sup>3</sup>			BULK PASSAGE <sup>4</sup>		MEDIAN PASSAGE <sup>5</sup>	
	Earliest	Average	Latest	Earliest	Average	Latest	Earliest	Average	Latest	Average	Average		
Turkey Vulture	10-Mar	24-Mar	3-Apr	13-Apr	15-Apr	21-Apr	15-May	18-May	22-May	8-Apr tc 30-Apr	17-Apr		
Osprey	2-Apr	8-Apr	14-Apr	23-Apr	28-Apr	6-May	16-May	20-May	2-Jun	16-Apr tc 5-May	27-Apr		
Bald Eagle	17-Feb	26-Feb	3-Mar	20-Mar	27-Mar	12-Apr	17-May	23-May	2-Jun	14-Mar tc 10-Apr	27-Mar		
Northern Harrier	5-Mar	21-Mar	1-Apr	2-Apr	15-Apr	29-Apr	6-May	16-May	24-May	1-Apr tc 1-May	16-Apr		
Sharp-shinned Hawk	23-Feb	12-Mar	23-Mar	13-Apr	22-Apr	6-May	16-May	23-May	6-Jun	12-Apr tc 6-May	26-Apr		
Cooper's Hawk	18-Feb	10-Mar	25-Mar	7-Apr	21-Apr	8-May	13-May	15-May	17-May	1-Apr tc 5-May	16-Apr		
Northern Goshawk	2-Mar	8-Mar	14-Mar	2-Mar	19-Mar	6-Apr	20-Apr	26-Apr	1-May	14-Mar tc 16-Apr	24-Mar		
Red-shouldered Hawk	23-Mar	30-Mar	10-Apr	25-Mar	3-Apr	13-Apr	26-Mar	8-Apr	16-Apr	30-Mar tc 8-Apr	4-Apr		
Broad-winged Hawk	13-Apr	17-Apr	22-Apr	27-Apr	1-May	6-May	17-May	24-May	8-Jun	24-Apr tc 7-May	1-May		
Swainson's Hawk	12-Apr	19-Apr	2-May	19-Apr	25-Apr	29-Apr	29-Apr	11-May	24-May	19-Apr tc 11-May	30-Apr		
Red-tailed Hawk	2-Mar	12-Mar	22-Mar	26-Mar	5-Apr	13-Apr	17-May	24-May	6-Jun	1-Apr tc 20-Apr	8-Apr		
Rough-legged Hawk	17-Feb	4-Mar	15-Mar	26-Mar	10-Apr	22-Apr	16-May	18-May	20-May	27-Mar tc 28-Apr	14-Apr		
Golden Eagle	18-Feb	2-Mar	9-Mar	4-Mar	16-Mar	24-Mar	3-May	13-May	20-May	12-Mar tc 17-Apr	21-Mar		
American Kestrel	21-Mar	28-Mar	8-Apr	13-Apr	18-Apr	28-Apr	29-Apr	15-May	20-May	12-Apr tc 2-May	22-Apr		
Merlin	9-Mar	24-Mar	8-Apr	18-Apr	27-Apr	11-May	2-May	11-May	18-May	2-Apr tc 5-May	25-Apr		
Peregrine Falcon	9-Mar	31-Mar	28-Apr	14-Apr	3-May	14-May	28-Apr	14-May	24-May	5-Apr tc 12-May	28-Apr		