Pennsylvania Raptor Migration Summary - Spring 2020

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The 2020 Spring count season started with warmer and wetter than average conditions with some sites noting Turkey Vultures already present in late February. These warm conditions gave way to a cooler and wetter than average Spring. Despite the wet conditions, early and late season migrants produced some record breaking counts in eastern and western Pennsylvania, while counts of early and late season migrants lagged at central Pennsylvania watch sites.

Migration Summary

Eight Pennsylvania Spring watch sites recorded an above-average 38,354 total hawks in 1832 hours during 311 days of counting between 15 February and 6 June for a rate of 21 per hour (Table 1). Spring count hours were 31% above the average annual effort of 1396 hours. Total spring raptors were 46% above the ten-year average of 26,219, primarily driven by an increase in counts of Turkey Vultures and Broad-winged Hawks. The Turkey Vulture total, 19,443, was 26% above the ten-year average of 15,383, and Broad-winged Hawks, totaling 13,113, were 128% above the ten-year average of 5743. However, they were not the only species to enjoy above average counts - Black Vulture, Bald Eagle, Merlin, and Peregrine Falcon all had counts at least 40% above their ten-year averages (Table 1).

Five species had counts below their 10-year averages; Northern Harriers, Golden Eagles, and Red-tailed Hawks were 22%, 19%, and 9% below their 10-year averages, respectively. Only two Northern Goshawks were recorded, below their average of 6.5 and no Rough-legged Hawks were recorded this spring (Table 1). All of these species, with the exception of Golden Eagles, had below average counts in the fall of 2019. However, the above average count of Golden Eagles in Fall 2019 was boosted by the new Bald Eagle Mt. watch site, without which Golden Eagle totals would have been below average.

Site Highlights

Allegheny Front (*Somerset/Bedford*) - Allegheny counters tallied 955 hawks in 344 hours on 61 days from 2/15 to 5/7, a rate of 2.8 hawks per hour (Table 1). The overall count was 14% below the ten-year average, with counts of accipiters notably low - Sharp-shinned and Cooper's Hawks were 34% and 35% below average and there were no Northern Goshawks counted this spring (Table 1). The Red-tailed Hawk total of 144 was the third lowest in the 21-year history of the count and was 38% below the ten-year average of 234. Counts of both Osprey (87) and Golden Eagle (89) were above their ten-year averages of 68.7 and 69.7, respectively (Table 1). A one-day record of seven Peregrine Falcons was recorded 4/29. Although not an abundant migrant, the total count of 12 Peregrines was well above the average of 3.5. April 29 was also the high day for the season with 192 raptors tallied, including 51 Ospreys, the third highest one-day count, 15 Bald Eagles, 26 Sharp-shinned Hawks, and 67 Broad-winged Hawks.

Delaware Nature Society Kite Watch at Bucktoe Preserve (*Chester*) - The fourth year for this late spring watch for kites and shorebirds. Counters tallied 24 hawks in 142 hours on 21 days from 5/17 to 6/6, a rate of 0.2 hawks per hour (Table 1). A high of 9 raptors were tallied 5/29 - one Osprey and 8 Mississippi Kites. Mississippi Kites also were seen 5/19 and 5/31. Overall, a record number of 10 Mississippi Kites was tallied this year at Bucktoe, the only watch site in Pennsylvania to record this species as a migrant.

Hawk Mountain (*Berks/Schuylkill*) - Hawk Mountain counters recorded 1269 hawks in 301 hours on 43 days from 4/1 to 5/15, a rate of 4.2 hawks per hour. Total raptors were 30% above the ten-year average with notably high counts of Turkey Vulture and Broad-winged Hawk. The Turkey Vulture count of 139 was the highest season-long count and 174% above average while the Broad-winged Hawk count of 739 was the second highest ever and 84% above the ten-year average. Counts of both Sharp-shinned Hawks (58) and Red-tailed Hawks (80) were below the ten-year averages of 88.9 and 88.5, respectively. A season high 33 Turkey Vultures, 3 Red-shouldered Hawks, and 14 Red-tailed Hawks were tallied on 4/1 (Table 2). Light NW winds on 5/1 produced the high count of the season with 392 raptors, including season highs of 9 Black Vultures and 359 Broad-winged Hawks, along with 7 Ospreys and 5 Bald Eagles (Table 2). An adult Mississippi Kite was seen flying SW on 5/12 and was not counted.

Jack's Mountain (*Mifflin*) – Jack's Mountain hawk watchers counted 68 raptors in 45 hours over 8 days from 3/2 to 5/19, a rate of 1.5 birds per hour (Table 1). A season high 17 raptors were counted 5/1, including 6 Bald Eagles, one Sharp-shinned Hawk, one Northern Goshawk, 7 Broad-winged Hawks, one Red-tailed Hawk, and one Merlin.

Presque Isle (*Erie*) - Presque Isle counters tallied 30,937 hawks in 183 hours in 52 days from 2/22 to 5/29, a rate of 169 hawks per hour (Table 1). The total count was 40% above the ten-year average, boosted by above average counts of Turkey Vulture (17,779) and Broad-winged Hawk (10,441). Bald Eagle, Merlin, and Peregrine Falcon also were above average (Table 1). Northern Harriers, Cooper's Hawks, and Red-tailed Hawks had below average counts and no Rough-legged Hawks were recorded for the first time in the count's 13-year history (Table 1). A five-day period between 3/25 and 3/29 produced 12,995 Turkey Vultures with a peak of 5505 on 3/26 (Table 2), and an astonishing 3165 counted between 11:00 and 12:00 EST on 3/29. A four-hour window of good weather with warm south-southwest winds produced a surge of 4185 Broad-winged Hawks on 4/30 (Table 2); an extraordinary Broad-wing day considering the ten-year average seasonal count is 4088. A single-day record of 74 Bald Eagles was set 5/24, smashing the old record of 49 and setting a new season total record of 419. On 4/27, counters spotted a Short-eared Owl, the only owl recorded migrating at a Pennsylvania watch site.

Summit Mountain (*Fayette*) – Only the third year of this western Pennsylvania count, Summit Mountain counters recorded an impressive 798 hawks in 20 hours on 4 days from 3/16 to 4/29, a rate of 39.4 hawks per hour (Table 1). The highest one-day count occurred 4/29 with 765 raptors including 43 Ospreys, 7 Bald Eagles, 32 Sharp-shinned Hawks, 599 Broad-winged Hawks, one Golden Eagle, and 3 American Kestrels.

The Land Conservancy for Southern Chester County's Hawk Watch at Bucktoe Creek Preserve (*Chester*) - Bucktoe Creek Preserve counters recorded 2591 hawks in 381 hours on 61 days from 3/1 to 4/30, a rate of 6.8 hawks per hour (Table 1). The Turkey Vulture total of 1282 was much higher than the previous two years with a steady flight through the first half of April, peaking 3/18 with 95 Turkey Vultures (Table 2). A high of 189 raptors were counted 3/30, which included season highs of 45 Black Vultures, 5 Northern Harriers, and 27 Ospreys. The high Broad-winged Hawk count occurred 4/22 with 122 passing over the hawk watch in groups of 2 and 3.

Tussey Mountain (Centre) - Tussey Mountain counters tallied 1712 hawks in 416 hours on 61 days from 2/23 to 4/29, a rate of 4.1 hawks per hour (Table 1). The total count was 15% below the ten-year average. Sharp-shinned Hawks, Cooper's Hawks, and Red-tailed Hawks were all

below their ten-year averages. The Golden Eagle count of 130 was below the average of 178, and the second lowest season total (Table 1). Counts of Ospreys (119) and Bald Eagles (91) both were above their ten-year averages of 95.8 and 57.4, respectively (Table 1). The Table 1 high count of 19 Golden Eagles was recorded 3/12. Mid-April saw an increase in Broad-winged Hawk flights with three days of 100+ Broad-wings, including a peak of 161 on 4/23 (Table 2). Moderate SE winds on 4/29, the last day of the count, produced a season high flight of 239 raptors that included 57 Ospreys, a single-day high of 26 Bald Eagles, and season high counts of Sharp-shinned Hawk (50), American Kestrel (10), and Merlin (5).

Conclusions

The Covid-19 pandemic did not deter sites from staffing their lookouts this Spring, as most sites had effort similar to previous years. Several sites were closed to the public and thus had far fewer visitors than previous years. Species counts mirrored those found in Fall 2019 with below average counts at most sites for Sharp-shinned, Cooper's, and Red-tailed Hawks and, for the first time, no Rough-legged Hawks were counted this spring. With a warmer and wetter than average winter, food availability may have been high and species may not have been forced to migrate. A closer look at Christmas Bird Count results could shed some light on whether this could be the case. Above average Osprey and American Kestrel flights are encouraging as both these species have shown long-term declines at eastern watch sites. Counts of Bald Eagles set a new record of 689 eagles counted, shattering last year's record of 483. Who would have thought in 2000, when only 40 Bald Eagles were recorded, that Pennsylvania watch sites would record 17 times that many only 20 years later?

Acknowledgements

Thank you to the site compilers for providing insight and access to their data, particularly Nick Bolgiano and Bob Stewart. Data were downloaded from www.hawkcount.org (accessed June 2020) a site managed by Jason Sodergren, HMANA database manager and the Hawk Migration Association of North America. Regional weather information was gathered from the Northeast Regional Climate Center at Cornell University.

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Table 2. Peak count dates for Turkey Vulture and Broad-winged Hawk at selected Pennsylvania watch sites.

	Turkey Vulture		Broad-winged Hawk	
Site	**Peak Count**	**Date**	**Peak Count**	**Date**
Allegheny Front	28	3/29	134	4/23
Hawk Mountain*	33	4/1	359	5/1
Presque Isle	5505	3/26	4185	4/30
TLC at Bucktoe	95	3/18	112	4/22
Tussey Mountain	12	3/24	161	4/23

* Site begins count in April

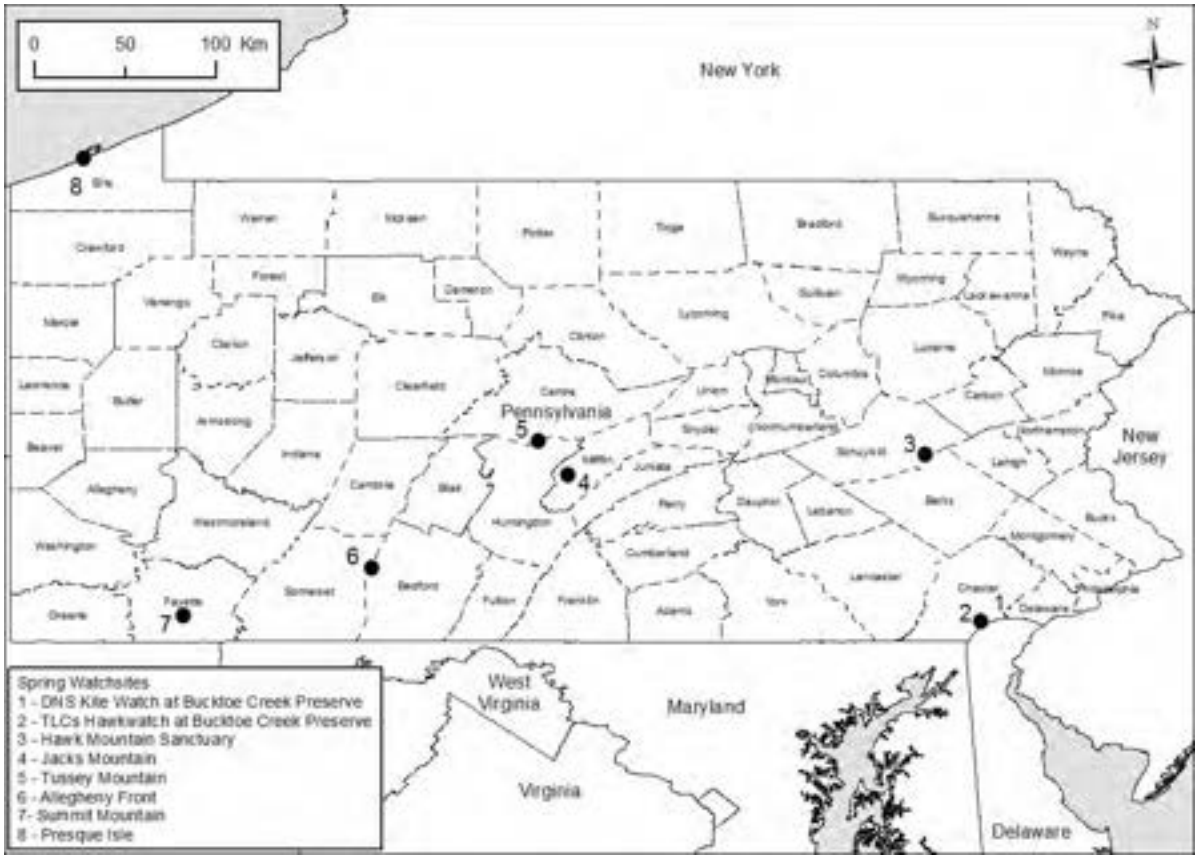

Table 1. Spring 2020 count results for Pennsylvania watchsites.

ALLEGHENY FRONT (*Bedford*) - Bob Stewart, compiler

Month	Days	Hours	BLVU	TUVU	OSPR	BAEA	NOHA	SSHA	COHA	NOGO	RSHA	BWHA	RTHA	RLHA	GOEA	AMKE	MERL	PEFA	MIKI	Unid	Total
February	11	56.75	0	8	0	1	3	0	1	0	0	0	29	0	5	0	0	0	0	4	51
March	25	145.25	10	105	3	8	3	20	19	0	7	0	96	0	81	4	0	3	0	7	366
April	20	114	0	4	77	18	6	41	9	0	4	299	19	0	1	0	4	9	0	21	512
May	5	28	0	0	7	2	1	3	0	0	2	8	0	0	2	0	0	0	0	1	26
Total	**61**	**344**	**10**	**117**	**87**	**29**	**13**	**64**	**29**	**0**	**13**	**307**	**144**	**0**	**89**	**4**	**4**	**12**	**0**	**33**	**955**
Total per hr			0.03	0.34	0.25	0.08	0.04	0.19	0.08	0.00	0.04	0.89	0.42	0.00	0.26	0.01	0.01	0.03	0.00	0.10	2.78
% of flight			1.0	12.3	9.1	3.0	1.4	6.7	3.0	0.0	1.4	32.1	15.1	0.0	9.3	0.4	0.4	1.3	0.0	3.5	100.0
Average last 10 yrs	56.6	351.1	10.5	168.9	68.7	21.3	13.2	96.8	44.5	3.5	27.6	290.7	233.7	0.5	69.7	14.2	3.7	3.5	0.0	40.6	1111.6

DELAWARE NATURE SOCIETY KITE WATCH AT BUCKTOE PRESERVE (Chester) - Larry Lewis, compiler

Month	Days	Hours	BLVU	TUVU	OSPR	BAEA	NOHA	SSHA	COHA	NOGO	RSHA	BWHA	RTHA	RLHA	GOEA	AMKE	MERL	PEFA	MIKI	Unid	Total
May	15	105.75	0	0	10	0	0	1	0	0	0	1	0	0	0	0	0	0	10	0	22
June	6	36	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Total	**21**	**141.75**	**0**	**0**	**12**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**10**	**0**	**24**
Total per hr			0.00	0.00	0.08	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.17
% of flight			0.0	0.0	50.0	0.0	0.0	4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.7	0.0	100.0
Average last 10 yrs																					

HAWK MOUNTAIN (Berks/Schuylkill) - Lansothung Lotha and David Barber, compilers

Month	Days	Hours	BLVU	TUVU	OSPR	BAEA	NOHA	SSHA	COHA	NOGO	RSHA	BWHA	RTHA	RLHA	GOEA	AMKE	MERL	PEFA	MIKI	Unid	Total
April	28	193.8	3	131	34	35	17	41	22	0	10	347	68	0	3	18	6	2	0	27	764
May	15	107.2	9	8	28	13	1	17	12	0	1	392	12	0	0	7	2	0	0	0	505
Total	**43.0**	**301.0**	**12**	**139**	**62**	**48**	**18**	**58**	**34**	**0**	**11**	**739**	**80**	**0**	**3**	**25**	**8**	**2**	**0**	**27**	**1269**
Total per hr			0.04	0.46	0.21	0.16	0.06	0.19	0.11	0.00	0.04	2.46	0.27	0.00	0.01	0.08	0.03	0.01	0.00	0.09	4.22
% of flight			0.9	11.0	4.9	3.8	1.4	4.6	2.7	0.0	0.9	58.2	6.3	0.0	0.2	2.0	0.6	0.2	0.0	2.1	100.0
Average last 10 yrs	42.0	251.0	38.4	50.8	74.3	39.7	22.7	88.9	37.6	0.5	9.3	402.4	88.5	0.3	2.4	22.3	5.9	2.2	0.2	88.6	973.0

JACKS MOUNTAIN (*Mifflin*) - Darrell Smith, compiler

Month	Days	Hours	BLVU	TUVU	OSPR	BAEA	NOHA	SSHA	COHA	NOGO	RSHA	BWHA	RTHA	RLHA	GOEA	AMKE	MERL	PEFA	MIKI	Unid	Total
March	5	26	0	0	0	1	1	1	0	0	2	0	18	0	3	1	1	0	0	2	30
April	2	11.5	0	0	2	1	0	2	0	0	0	6	7	0	2	0	0	0	0	1	21
May	1	7	0	0	0	6	0	1	0	1	0	7	1	0	0	0	1	0	0	0	17
Total	**8**	**44.5**	**0**	**0**	**2**	**8**	**1**	**4**	**0**	**1**	**2**	**13**	**26**	**0**	**5**	**1**	**2**	**0**	**0**	**3**	**68**
Total per hr			0.00	0.00	0.04	0.18	0.02	0.09	0.00	0.02	0.04	0.29	0.58	0.00	0.11	0.02	0.04	0.00	0.00	0.07	1.53
% of flight			0.0	0.0	2.9	11.8	1.5	5.9	0.0	1.5	2.9	19.1	38.2	0.0	7.4	1.5	2.9	0.0	0.0	4.4	100.0
Average last 10 yrs																					

PRESQUE ISLE (*Erie*) - Jerry McWilliams, compiler

Month	Days	Hours	BLVU	TUVU	OSPR	BAEA	NOHA	SSHA	COHA	NOGO	RSHA	BWHA	RTHA	RLHA	GOEA	AMKE	MERL	PEFA	MIKI	Unid	Total
February	3	7	0	34	0	7	1	1	0	0	1	0	20	0	0	0	0	1	0	0	65
March	16	58	0	13592	1	56	17	58	29	1	196	0	267	0	0	75	10	5	0	38	14345
April	18	51.75	0	1536	34	100	25	569	14	0	10	6012	107	0	0	209	10	12	0	15	8654
May	15	66.25	0	2617	58	256	6	342	3	0	1	4429	86	0	1	61	4	2	0	7	7873
Total	**52**	**183**	**0**	**17779**	**93**	**419**	**49**	**970**	**46**	**1**	**208**	**10441**	**480**	**0**	**1**	**345**	**24**	**20**	**0**	**60**	**30937**
Total per hr			0.00	97.15	0.51	2.29	0.27	5.30	0.25	0.01	1.14	57.05	2.62	0.00	0.01	1.89	0.13	0.11	0.00	0.33	169.05
% of flight			0.0	57.5	0.3	1.4	0.2	3.1	0.1	0.0	0.7	33.7	1.6	0.0	0.0	1.1	0.1	0.1	0.0	0.2	100.0
Average last 10 yrs	58	201	1	14787	90	182	82	947	70	1	218	4088	590	16	2	335	15	9	0	40	21429

SUMMIT MOUNTAIN (*Fayette*) - Peter Everett Livengood, compiler

Month	Days	Hours	BLVU	TUVU	OSPR	BAEA	NOHA	SSHA	COHA	NOGO	RSHA	BWHA	RTHA	RLHA	GOEA	AMKE	MERL	PEFA	MIKI	Unid	Total
March	2	6.5	0	24	0	4	0	0	1	0	0	0	3	0	1	0	0	0	0	0	33
April	2	13.75	0	9	43	11	2	38	4	0	0	637	8	0	2	3	2	1	0	5	765
Total	**4**	**20.25**	**0**	**33**	**43**	**15**	**2**	**38**	**5**	**0**	**0**	**637**	**11**	**0**	**3**	**3**	**2**	**1**	**0**	**5**	**798**
Total per hr			0.00	1.63	2.12	0.74	0.10	1.88	0.25	0.00	0.00	31.46	0.54	0.00	0.15	0.15	0.10	0.05	0.00	0.25	39.41
% of flight			0.0	4.1	5.4	1.9	0.3	4.8	0.6	0.0	0.0	79.8	1.4	0.0	0.4	0.4	0.3	0.1	0.0	0.6	100.0
Average last 10 yrs																					

TLC's S. CHESTER COUNTY HAWKWATCH AT STATELINE WOODS PRESERVE (*Chester*) - Larry Lewis, compiler

Month	Days	Hours	BLVU	TUVU	OSPR	BAEA	NOHA	SSHA	COHA	NOGO	RSHA	BWHA	RTHA	RLHA	GOEA	AMKE	MERL	PEFA	MIKI	Unid	Total
March	31	200	207	838	53	47	7	57	34	0	59	0	123	0	0	12	9	0	0	0	1446
April	30	181	119	444	74	30	10	67	31	0	8	270	51	0	0	40	1	0	0	0	1145
Total	**61**	**381**	**326**	**1282**	**127**	**77**	**17**	**124**	**65**	**0**	**67**	**270**	**174**	**0**	**0**	**52**	**10**	**0**	**0**	**0**	**2591**
Total per hr			0.86	3.36	0.33	0.20	0.04	0.33	0.17	0.00	0.18	0.71	0.46	0.00	0.00	0.14	0.03	0.00	0.00	0.00	6.80
% of flight			12.6	49.5	4.9	3.0	0.7	4.8	2.5	0.0	2.6	10.4	6.7	0.0	0.0	2.0	0.4	0.0	0.0	0.0	100.0
Average last 10 yrs																					

TUSSEY MOUNTAIN (*Centre*) - Nick Bolgiano,compiler

Month	Days	Hours	BLVU	TUVU	OSPR	BAEA	NOHA	SSHA	COHA	NOGO	RSHA	BWHA	RTHA	RLHA	GOEA	AMKE	MERL	PEFA	MIKI	Unid	Total
February	6	39.8	0	7	0	0	0	1	0	0	7	0	4	0	3	0	0	0	0	1	23
March	28	187.5	0	55	5	40	4	47	13	0	27	0	176	0	117	23	3	0	0	22	532
April	27	189	0	21	114	51	13	91	8	0	10	705	73	0	10	30	5	0	0	26	1157
Total	**61**	**416.3**	**0**	**83**	**119**	**91**	**17**	**139**	**21**	**0**	**44**	**705**	**253**	**0**	**130**	**53**	**8**	**0**	**0**	**49**	**1712**
Total per hr			0.00	0.20	0.29	0.22	0.04	0.33	0.05	0.00	0.11	1.69	0.61	0.00	0.31	0.13	0.02	0.00	0.00	0.12	4.11
% of flight			0.0	4.8	7.0	5.3	1.0	8.1	1.2	0.0	2.6	41.2	14.8	0.0	7.6	3.1	0.5	0.0	0.0	2.9	100.0
Average last 10 yrs	56.2	403.9	18.0	183.7	95.8	57.4	24.5	178.3	37.2	1.1	44.3	784.2	326.1	2.9	178.3	69.9	6.1	2.0	0.0	28.1	2011.2

2020 TOTALS FOR ALL WATCHSITES

Month	Days	Hours	BLVU	TUVU	OSPR	BAEA	NOHA	SSHA	COHA	NOGO	RSHA	BWHA	RTHA	RLHA	GOEA	AMKE	MERL	PEFA	MIKI	Unid	Total*,**
February	20	103.55	0	49	0	8	4	2	1	0	8	0	53	0	8	0	0	1	0	5	139
March	107	623.25	217	14614	62	156	32	183	96	1	291	0	683	0	202	115	23	8	0	69	16752
April	127	754.8	122	2145	378	246	73	849	88	0	42	8276	333	0	18	300	28	24	0	95	13018
May	51	314.2	9	2625	103	277	8	364	15	1	4	4837	99	0	3	68	7	2	10	8	8443
June	6	36	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Total	**311**	**1831.8**	**348**	**19433**	**543**	**689**	**117**	**1398**	**200**	**2**	**345**	**13113**	**1168**	**0**	**231**	**483**	**58**	**35**	**10**	**177**	**38354**
Total per hr.			0.2	10.6	0.3	0.4	0.1	0.8	0.1	0.0	0.2	7.2	0.6	0.0	0.1	0.3	0.0	0.0	0.0	0.1	20.9
% of flight			0.9	50.7	1.4	1.8	0.3	3.6	0.5	0.0	0.9	34.2	3.0	0.0	0.6	1.3	0.2	0.1	0.0	0.5	100.0
Average last 10 yrs.	**242.4**	**1395.5**	**101.4**	**15383**	**370.4**	**327.8**	**140.3**	**1357**	**208.0**	**6.5**	**309.4**	**5743**	**1280**	**20.0**	**283.7**	**421.8**	**33.1**	**17.0**	**2.4**	**204.6**	**26219**

not necessarily match in priority the phenomena experienced by birds in winter, but it is a useful framework for categorizing what they encounter. The complex interplay of these five factors in the breeding range, on migration, and during winter, requires that each species and discrete population be studied individually to determine causes of decline and appropriate conservation measures. There is still too little data for many species and regions from which to draw conclusions other than many birds are exposed to distinctive threats during winter.

For birds living in a seasonal environment, conservation requires an understanding of when during the annual cycle – whether it is spent in one place or ranges across continents – birds are vulnerable to population losses such as being exposed to distinctive threats during winter. Habitat loss is overwhelmingly the leading cause of bird declines around the world. The highly compressed ranges of birds wintering in the Neotropics, (for some species as little as one-tenth of their breeding range), means that loss of habitat there has a greater impact than comparable losses in North America. Coffee and cacao, when grown under shade trees, can support many migrants through the winter, although few birds are understory and true forest specialists. Mexican grasslands, winter home for many species of the Great Plains, become useless to birds when converted to row crops. Restoring grasslands and rotating cattle so the land is not overgrazed provides good necessary habitat. The loss of wetlands, especially the most extremely productive estuaries where large numbers of shorebirds concentrate on migration, is the most severe threat. Rice fields, salt ponds, and fish ponds can provide alternative habitats for some species. Waterfowl have also declined all over the world from loss of wetlands.

Invasive species compound habitat loss when nonnative plants choke out natural vegetation and animals from elsewhere compete or directly consume wintering birds.

Of all invasive species, house cats (including feral ones) are the most destructive, killing an estimated 1.3-4.0 billion birds annually in the United States alone. Birds may be especially vulnerable in winter when amphibians, reptiles, and small mammals on which cats also prey are less available. Pollutants such as pesticides, oil, aquatic and marine debris (especially plastics) can travel far from their source and, if consumed, moved up the food chain-food web thereby affecting sequence of birds and other life. Wetlands probably receive and absorb more pollutants than any other habitat, exposing wintering birds from Whooping Crane to waterfowl and shorebirds, to endocrine disrupters, neurotoxins, and other chemicals that result in abnormal behavior and reduced survival. Many pesticides now banned in the U.S. and other developed countries are still widely used in tropical regions where many birds winter. Birds that concentrate at the edges of agricultural areas are especially vulnerable. Residue of spills from oil wells and ships at sea remains for decades. It can coat feathers or be ingested either directly or through food that wintering seabirds consume. Similarly, seabirds mistake pieces of plastic and other debris for food and may choke or starve as their stomach fill with it. Finally, waterfowl consume lead shot in wetlands and on agriculture lands which can sicken and kill them.

The global growth of the human population, with increasing requirements for food, other resources, and space; and production of more forms of debris, is ultimately responsible for all the conservation issues that affect birds and natural ecosystems. The increase of leisure and affluence is sending more people to recreation sites that until recently were undisturbed habitats of wintering birds. Demand for more energy has led to the construction of wind turbines and oil and gas rigs at sea and on terrestrial habitats where birds have no experience with tall vertical structures and how to avoid them. Finally, some birds are overharvested, either through deliberate hunting of wintering waterfowl or incidentally as by-catch in various types of oceanic fishing gear from nets to long-lines of baited hooks that especially attract variable albatrosses, shearwaters, petrels, and alcids. Impacts of climate change have already affected the distributions and populations of birds, and these are likely to increase as changes in temperature, rainfall, ocean currents, and other factors accelerate in this century. Since each element of every ecosystem will respond differently, new communities will be formed that may be more advantageous or challenging for their members. Migratory species, which depend on more sites over the course of the year, will be exposed to more changes, but their mobility may enable them to adapt while species of limited distribution may be squeezed into a shrinking range of suitable habitat.

The world is now undergoing a global modification that affects every ecosystem and all its inhabitants, even those remote from the sources of the problem. Atmospheric levels of carbon dioxide and methane excel natural levels of the last 650,000 years. In fact, the Earth's climate warmed by 0.3-0.6 degrees C, surface sea temperatures are now, on average, 0.3 degrees C higher, and seas have risen an average 10-20 cm. Global warming is altering the nature of winter itself and birds are responding. In addition to evolving new migratory timetables and winter ranges, some birds have also shown physical responses to climate change. More than 100 species in eastern North America now weigh less on average than a few decades ago. Smaller body size is associated with warmer temperatures. Sexual selection as well as survival pressure may also influence the rapid evolution of new traits fostered by changing winter climate, since this is the season when many species molt into the plumage they will display during the following breeding season.

In conclusion, current prediction of future rates of climate change impacts, including greater temperature increases at high latitudes, shrinkage of sea ice, sea-level rise, increase in hot extremes, heat waves, heavy precipitation, and droughts with precipitation generally decreasing in most subtropical land regions can be linked to potential avian extinction rates.

Tropical birds are most vulnerable but some analyses pinpoint the risks birds face in each season, especially identifying loss of winter habitat. The projected decrease in rainfall in subtropical regions will have widespread effects on bird wintering at these latitudes. Sea-level rise will reduce coastal estuaries and wetlands on which waterfowl and shorebirds depend. Warmer sea-surface temperatures change the distribution and reduce the productivity of the food change on which seabirds depend. Research from high latitudes in all oceans has illustrated that changes in winter production have more impact on seabird's survival than summer changes. In addition, the anticipated increase in extreme events such as hurricanes, winter storms, floods, droughts, and massive forest fires, will affect the winter range and survival of many species.

This phenomenal book will be a foundational scientific publication long into the future. Comfortable to read, filled with elegant black and white line drawings by artist Margaret La Farge, it is a trove of up to date climatic, ornithological, and ecological data that should be of vital use to students, scientists, conservationists, and birders alike. It is definitely one of the 'top ten' natural history books of the decade.

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