FALL MIGRATIONS OF HAWKS AT HAWK MOUNTAIN, PENNSYLVANIA, 1934–1938

BY MAURICE BROUN

THE dramatic development of Hawk Mountain Sanctuary has been scarcely less spectacular than the fascinating migrations of hawks and eagles that occur there. Hawk Mountain, above Drehersville in the Kittatinny Ridge of eastern Pennsylvania, formerly a shambles frequented by ruthless local hunters, is now a Mecca to which bird students and conservationists flock in increasing numbers. The Sanctuary has proved itself a compelling force in furthering an intelligent and enlightened attitude toward the birds of prey. Hawk Mountain Sanctuary was an object lesson whose influence and effectiveness induced the Pennsylvania Game Commission in June 1937, to protect all raptors excepting the *Accipiters*, and to remove the bounty on the Goshawk. In the past few seasons, chiefly in the months of September and October, the Sanctuary has been visited by upwards of 12,000 persons who have registered from thirty-one States and several foreign countries; and among the visitors have been many erstwhile hawk-hunters.

In the summer of 1938 the Hawk Mountain Sanctuary Association was formed. The Sanctuary comprises two square miles of rocky woodland, ranging from 550 feet to 1,506 feet above sea level; it is partly in Schuylkill County and partly in Berks County. The property is administered by a board of seven directors. Mrs. Charles Noel Edge is president of the Association, and to her goes all the credit for having been the originator and guiding spirit of the project. The interesting details of the topography, and of the past history of Hawk Mountain may be read in an earlier report (2). The annual reports of the Emergency Conservation Committee contain brief summaries of the Sanctuary's progress as well as a resumé of each season's migration.

I am indebted to Mrs. Charles N. Edge and to Mr. Earl L. Poole for many valuable suggestions.

In the fall of 1934, as a result of the Sanctuary, the migrations of Falconiformes along the Kittatinny Ridge were observed systematically for the first time. However, owing to the necessity for rigid patrol of the Sanctuary during the early part of that season, observations could not always be made, and the migration data, acquired in approximately 306 hours of observation, were incomplete. Since the second season (1935) uninterrupted daily censuses of the hawk flights have been made, each season's observations covering an average of 575 hours. The accumulated data provide a more nearly accurate picture of the migrations than that published prematurely

for 1934 (2), and also furnish a sounder basis for future statistical comparisons. The numerical status of the birds of prey has evoked so much interest among ornithologists, that it seems desirable to make available the data thus far compiled at Hawk Mountain.

The daily censuses have been made as carefully as possible. On some days, however, the birds fly very high, and it is certain that many pass unseen. The totals presented in the monthly tables cannot be construed, therefore, as being all inclusive of the actual numbers of hawks that have migrated over the Sanctuary, or for that matter over the length of the Kittatinny Ridge. It must be borne in mind, also, that prior to 1937 hawk shooting continued to be practiced vigorously at scattered points along the ridge, well up into New Jersey; the shooting has by no means been abolished in spite of the legal statutes protecting most species. How our totals may be affected is conjectural.

The Kittatinny Ridge (and apparently at times the parallel ridges west of it), are essentially migratory flyways for *Buteos* and eagles, and to a lesser extent for *Accipiters*. The hawks coast on the up-currents of air caused by wind striking against the flanks of the mountain, and these air currents provide the *modus operandi* of the ridge flights. The Cape May flyway, as pointed out by Allen and Peterson, is used by the bulk of the *Accipiters*, falcons, Ospreys and Turkey Vultures which breed in the northeastern part of the country (1). Hence, in the table of seasonal totals the figures for these last-named species are negligible. According to reports from the contiguous ridges, appreciable flights of hawks must occur over them on certain days.

General weather conditions have been correlated with the daily flight conditions. The results are comparable, roughly, with those published for 1934, when, it was found, a certain sequence of flights took place, i. e., days of high-flying hawks were followed by periods of stormy weather, which in turn brought heavier migrations of usually low-flying birds (2). It has been found, however, that during protracted periods of perfect weather the birds fly at every conceivable level! During such weather the hawks often fly exceedingly high during the middle of the day, perhaps taking advantage of thermal currents. Suffice it to say—and this is the only thing predictable about the migrations—the heaviest flights are generally preceded by marked meteorological disturbances in the regions to the north. It will be noted in the monthly charts that in most instances from early September until mid-November an appreciable flight of birds occurs at Hawk Mountain within three days of the inception of low barometric pressure moving across the northern Appalachian region. Where the data indicate poor or mediocre flights after a 'low', it does not necessarily follow that no pronounced migration took place. Rain or heavy mists in northeastern Pennsylvania or north-

ern New Jersey may hold up the migrants, or a shifting wind may steer the hawks along a different route. On September 20, 1937, we recorded only 288 Broad-wings in spite of ideal conditions; yet over a thousand of these *Buteos* were observed by Frederic P. Mangels, over Clifton, New Jersey, a locality considerably distant from the Kittatinny Ridge.

Temperature and wind *direction*, at least locally, have no apparent influence on the daily migrations. It is well to bear in mind, however, that the migrating hawks are always seen to best advantage at Hawk Mountain when strong winds strike against the side of the ridge, from *northerly* quarters. It has been suggested by some observers that there is a continuous day-by-day movement, regardless of the weather—the birds simply following the impulse to migrate—but that on pleasant days when the winds are not particularly favorable in creating the proper air currents along the ridge, the birds spread out over the terrain. This presupposes a far greater hawk population than we are aware of. A study of the monthly charts will show many days at Hawk Mountain when ridge flights would appear decidedly unfavorable, so far as wind is concerned, and yet optimum flights have occurred.

Sometimes a day's count is considerably augmented by hawks that evidently have not used the Kittatinny flyway. For example, in the early forenoon of September 16, 1938, groups of Broad-wings came out of the north (at very great height), as though from adjacent ridges, and then proceeded to follow our ridge. On the other hand, there is a tendency for migrants to avoid Hawk Mountain during easterly or southerly winds. Observers at the Sanctuary must occasionally, when the wind is in these directions, strain their vision to the utmost to follow the passage of hawks which leave the ridge to take a short-cut across the valley to a spur of the ridge known as 'The Pinnacle,' some four miles distant. If the birds take this cut too far out they will escape observation altogether. Thus a Golden Eagle observed sixteen miles up the ridge on October 9, 1937—the wind was light south—was not seen at Hawk Mountain. Such instances can be multiplied. The foregoing factors and conditions of the hawk migrations will explain, in part, the widely fluctuating numbers of birds each season.

During September and October, observations are begun about 7.30 a. m. (sometimes earlier), though few hawks venture past the promontories earlier than 8 o'clock. In September, no hawks are seen after 3.30 o'clock except on very good flight days occurring late in the month. A puzzling aspect of the September flights is the invariable appearance of the bulk of a day's migrants between 9 and 11 a. m. Throughout the best part of the season there is usually a lull in the flight during the middle of the day. The flights of October and November are not so uneven. Notable numbers of migrants appear in the afternoons as well as during the forenoons, and on many days

in October the birds migrate until dusk. In November, as the season wanes, the flight duration is from 9.30 or 10 o'clock until 2.30 p. m., never earlier, nor later.

Experiments to measure the speed of flight were made in the fall of 1938, by means of short-wave radio, and by the telegraph system, but both methods failed. Our difficulty with the telegraph was the impossibility of making ground connections, for the terrain is exceedingly rough and rocky. The radio method had various set-backs, chief of which was the perversity of the wind in choosing a southerly quarter each time the trials were made; the oncoming birds, besides, were slow and desultory in movement, and did not stick to the ridge. Further attempts to secure exact data on speed of flight are planned, however, and use will be made of telephone.

In the fall of 1934 I was able to estimate an average speed of 45 miles an hour in Red-tails, by measuring their progress between two points on the ridge. This speed was greatly accelerated on very windy days. An adult Bald Eagle, timed by Mr. Richard H. Pough at Bake Oven Knob on November 10, 1935, passed the Sanctuary twenty minutes later. Assuming this to be the same bird (which from the lateness of the date seems probable), it covered the distance of 16 miles at the rate of 0.8 mile per minute. An adult Golden Eagle, timed by Mr. Pough on October 11, 1936, at Fox Gap in the Kittatinny Ridge, 42 miles northeast of the Sanctuary, was found to make the passage in about 50 minutes—again assuming this to be the same bird—or at a rate of speed almost identical with that of the Bald Eagle.

Assuming an average of six hours of flight on most days (allowing two hours off, from 11 to 1, when there is frequently a lull), and an average hourly speed of 45 miles, it will be seen that the hawks may accomplish 270 or more miles per day easily. Thus, on September 15, 1935, when a pronounced low-pressure area extended over northern New York and New England, the consequent exodus of Broad-wings from that region needed scarcely more than two days to be felt along our section of the ridge, and hence, the impressive totals for the 16th and 17th.

ANNOTATED LIST OF HAWKS

TURKEY VULTURE, *Cathartes aura septentrionalis*.—Throughout the fall a few 'buzzards' may be seen in the vicinity. Individuals, apparently migrating, show up in the second week of September, on good flight days. Only two noteworthy flights, both in 1935, have been observed: a compact fleet of 145 on November 5, and four days later a group of 35 flew by.

EASTERN GOSHAWK, *Astur a. atricapillus*.—In 1934 when the 'Big Blue Darters' were reported as early as October 10, skepticism was manifest in certain circles. Goshawks may be expected along the ridge even in September. The data include seventeen occurrences of Goshawks during that month, the earliest being an immature on September 15, 1937. An adult and two immatures appeared in the big flight of

September 17, 1936. Dr. Sutton cites a number of occurrences of Goshawks in Pennsylvania in September, 1926 (4).

Immature Goshawks are very few in number: 31 (10.6 per cent) in 1935; 15 (8.4 per cent) in 1936; nine were seen in 1937; only one in 1938.

Goshawk 'invasions' evidently took place during the seasons of 1935 and 1936, yet our total of 177 birds for the latter season seems inconsequential when compared with the number of 537 Goshawks that were received for bounty during the month of November alone, by the Pennsylvania Game Commission.

SHARP-SHINNED HAWK, *Accipiter v. velox.*—Of all the hawks this little *Accipiter* is the most difficult to count by virtue of its small size, and swift, erratic flight. When Hawk Mountain was a shooting paradise these were the birds that tested the gunners' skill and provided the most exciting 'sport.' On days of heavy Sharp-shin flights many must escape observation. The birds will appear momentarily, often darting through the trees, sometimes in pursuit of some small bird, and in a flash they are gone.

The Sharp-shin has the longest and most continuous migration of any of the hawks. They come in small numbers in late August or early September, and they increase notably within three weeks. Nearly all these first-comers are birds of the year. One curious exception stands out—on September 22, 1935, every one of 87 Sharp-shins was an adult! The bulk of the September Sharp-shins *always* come during the afternoon. At Cape May they fly largely in the morning (1)! Early October brings a gradual transition from immature to adult birds, and usually by mid-season immatures are seen very infrequently. It is far from easy to differentiate ages when Sharp-shins are moving in large numbers. However, in 1935 and 1936, strenuous efforts were made to obtain such data and it was found that during the former season exactly 50 per cent of the migrants were immatures, while in 1936 only 12.1 per cent were immatures.

Record Sharp-shin days have occurred as follows: 1935—512 on October 2, and 680 on October 4; 1936—901 on October 19; 1937—900 on October 7, and 734 on October 8.

COOPER'S HAWK, *Accipiter cooperi.*—Closely paralleling the Sharp-shin migration —though on a much smaller scale—is the migration of the Cooper's Hawk. As with the Sharp-shin, the immatures precede the adults, and the latter make up the majority of the migrants. October brings the greatest numbers, with 50 to 75 on a good flight day; a record number of 127 was obtained on October 8, 1937.

The proportion of Cooper's to Sharp-shins is roughly 10 per cent—the same figure that holds at Cape May.

EASTERN RED-TAILED HAWK, *Buteo b. borealis.*—Although a few Red-tails appear along the ridge in September (86 represent the maximum number seen in this month, in 1936), conspicuous movements do not occur before mid-October. These *Buteos* travel singly or in pairs, though it is not unusual to see as many as twenty or thirty in a group.

The Red-tail migration is composed predominantly of adults. Age determination cannot be followed consistently, due to the occasional days when the birds fly too high, or too far out from the ridge. A fairly reliable index of the proportion of adults to immatures may be gained, however, from the following table, in which only those individuals are noted whose plumage could be determined.

	Adults	*Immatures*	*Per cent*
1934	3001	425	14.2
1935	3340	460	13.7
1936	2641	179	6.7
1937	3316	288	8.6
1938	1226	181	14.7

The relative scarcity of Red-tails during the fall of 1938 may be explained, in part, by the unprecedented mildness of much of that season; many of the birds may have failed to migrate, or lack of strong northerly winds failed to produce the customary concentrated ridge flights.

A glance at the table of seasonal totals reveals particularly heavy concentrations of Red-tails during the first and fourth seasons. It may be of interest to examine two fourteen-day periods for those seasons.

	October					November									
	30	31	1	2	3	4	5	6	7	8	9	10	11	12	
1934—	171	148	592	853	308	5	54	243	25	26	34	99	269	426	—3,253 (232.3 per day)
1937—	305	985	620	108	460	77	158	305	150	46	80	114	59	55	—3,522 (251.6 per day)

NORTHERN RED-SHOULDERED HAWK, *Buteo l. lineatus*.—During September of 1935 and 1936 I was much puzzled regarding the exact identification of certain immature plumages of the smaller *Buteos*. Many of these birds were recorded tentatively as Red-shoulders, hence the large recordings of this species in an earlier report (3). Further study has convinced me of my errors in this matter; the questionable *Buteos* have been Broad-wings indubitably. Red-shoulders are actually very infrequent at Hawk Mountain during September (a maximum of 24 was recorded in September 1937), but they appear regularly though in small numbers during October and the first half of November. The migrants are largely adults.

BROAD-WINGED HAWK, *Buteo p. platypterus*.—The data covering five seasons indicate that Broad-wings may be expected at Hawk Mountain in concentrated numbers between September 10 and 26, and that although the Broad-wing has the most restricted migration period of any of the raptors, it nevertheless enjoys supremacy of numbers. In order to convey some picture of the impressive flights of Broad-wings at Hawk Mountain, I can only quote from my field notes some of the outstanding days.

1935, September 17.—"A clear day with light to moderate southeasterly winds. Very soon after my arrival at the lower promontory [at 7.45 a. m.] flock upon flock of small *Buteos* came drifting down the south flank of the ridge. The birds flew very low during the first hour or so of observation; thereafter they were seen at varying levels, sometimes quite high. When the birds reached the 'kettle,' having been strung out along the ridge, they would flock up and ascend gradually on the air currents. Milling round and round over our heads until sufficient altitude was gained, they would depart toward the southwest, again strung out in a long line. As many as 50 or 60 birds at a time were in the air above us; once 80 were counted. Mr. Richard M. May, of Hagerstown, Maryland, arriving in the early forenoon, gave his much-needed help in the counting, . . . the busiest period came between 9 and 11 a. m. The migration began to wane about 3.45 o'clock, and a half hour later it was definitely over. The count of 3,293 hawks included about 3,150 Broad-wings."

1936, September 17.—"Overcast, threatening skies all morning, clearing after 1.30 o'clock; brisk northerly winds most of the day. Small *Buteos* began coming at 8.15

and soon after they were coming thick and fast; I counted 280 between 10.28 and 10.35! The majority passed directly over the ridge within range of shot-gun. [Picture the slaughter in the earlier days!] This flight of low-flying hawks was continuous for five hours. At 12.30 some 150 *Buteos* passed well out over the valley, on the north side of the ridge. Sharp-shins came in numbers after 1.30, as did Ospreys and eagles. At 2.30 I scanned the zenith with my 8-power glasses, just in time to make a hasty count of 200 *Buteos* dashing westward. They were flying so high as to be scarcely visible to the unaided eye. . . After this the birds flew at varying levels, some very low. There was a steady stream of migrants, a few groups notable as follows: 113 birds at 4 o'clock, 170 birds at 4.08, 126 birds at 4.55, 81 at 5.08, 42 at 5.20. The last hawks seen were 2 Ospreys at 5.47. The count for the day was 3,604 hawks: 1 Turkey Vulture, 3 Goshawks, 92 Sharp-shins, 10 Cooper's, 9 Red-tails, 3,400 Broad-wings and perhaps a very few Red-shoulders, 18 Bald Eagles, 2 Golden Eagles, 8 Marsh Hawks, 52 Ospreys, 1 Pigeon and 10 Sparrow Hawks."

The most remarkable migrations of raptors that it has been my privilege to witness at Hawk Mountain, took place between September 22 and 26, 1938, immediately after the hurricane that devastated New England. These five days were preceded locally by five dreary days of continuous rain.

September 22 brought smiling blue skies and moderate westerly winds. Innumerable warblers were in evidence. The day's count of 918 hawks included 885 Broad-wings of which 700 appeared between 9 and 11 a. m.

The following day, the 23d, produced ideal flight conditions. Only six hawks were seen during the first hour of observation; but 825 were tallied by noon, and the total for the day was 2,062, which included in addition to 1,785 Broad-wings, the following: 187 Sharp-shins, 17 Cooper's, 9 Bald Eagles, 32 Ospreys and 7 Duck Hawks. The birds flew leisurely but in steady numbers, in no very large groups, without any of the customary milling, and the flight continued until 5.20 p. m.

On the third day, the memorable September 24, great numbers of passerine birds rushed past the lookouts. I estimated 100 Flickers, 250 Blue Jays, 400 Cedar Waxwings, countless warblers and finches, and many Chimney Swifts. Only 40 hawks were seen until 9 o'clock, but thereafter they appeared in swarms: 780 between 9 and 10; 1,120 between 10 and 11; 1,260 between 11 and noon; 530 between noon and 1 o'clock; and diminishing numbers until 4 o'clock, but absolutely no hawks after that hour! The heightened noonday passage of hawks was altogether contrary to our usual experience. At one time as many as 436 Broad-wings were seen in a compact flock. Throughout the morning the Broad-wings flew very low, and in a steady stream on *both* sides of the ridge—an unprecedented procedure, and not explicable in view of the light northerly wind which ordinarily keeps the birds on the north side of the ridge. The flight was normal during the afternoon, however. The census would have been utterly impossible had it not been for the assistance of a sharp-eyed observer who tallied every hawk that appeared on one side of the ridge. Upwards of a hundred observers witnessed at least a part of this amazing flight. The day's count follows: 13 Turkey Vultures, 185 Sharp-shins (nearly all after 1.30 p. m.), 18 Cooper's, 4,078 Broad-wings, 3 Red-tails, 4 Bald Eagles, 5 Marsh, 9 Ospreys, 1 Duck, 1 Pigeon and 8 Sparrow Hawks, totalling 4,325 raptors.

On the 25th, a surprising early-morning movement of Broad-wings took place. A total of 493 hawks came through between 7.30 and 9 a. m., 287 between 9 and 10, 202 between 10 and 11, and only 381 hawks went by the rest of the day—200 between 3.30 and 4.30. A total of 1,166 Broad-wings was recorded among 1,363 hawks.

The fifth and last day of these phenomenal flights was bright and warm, as were

the previous days; light southerly breezes prevailed. Another huge wave of small birds appeared. All the Broad-wings flew very high, and there was much milling about. Only 18 came by from 8 to 9 a. m., but 662 were counted during the succeeding hour, and 395 between 10 and 11. The Broad-wing count for the day was 1,492.

In this unparalleled five-day period 10,274 hawks were counted, and of these, 9,406 individuals, or better than nine-tenths, were Broad-wings. I venture to state that many, many years may pass before anything comparable to this is repeated.

AMERICAN ROUGH-LEGGED HAWK, *Buteo lagopus s. johannis.*—Excepting the accidental occurrences of the Gyrfalcons, the Rough-leg has proved to be the rarest hawk at Hawk Mountain. An unusually early migrant was identified on October 6, 1935. The meager records extend from mid-October to early December. The exceedingly mild season of 1938 perhaps explains its total absence at the Sanctuary for that fall, as well as its general scarcity over much of the Northeast.

AMERICAN GOLDEN EAGLE, *Aquila chrysaëtos canadensis.*—The astonishing number of 263 Golden Eagles—50 per cent of the total number of both species of eagles—makes up the record for five seasons. These birds have been identified by scores of persons besides myself. It is rather significant that increasing numbers of bird students and field activity taking place in the past few years, have been coincident with a regular epidemic of these supposedly rare eagles, appearing throughout the Northeast.

Adults and immatures alike appear at regular intervals, usually from early October until the end of the migration. Fifteen records obtain for September, the earliest being that of an adult on September 15, 1935. On a number of days as many as four, five, or six Golden Eagles have been seen, while in 1937, nine were identified on October 31, and seven on November 22. Immatures have averaged 50 per cent of the five-year total.

BALD EAGLE, *Haliaeetus l. leucocephalus.*—Early September brings the majority of each season's Bald Eagles. On a few occasions, impressive numbers have been seen, namely, 33 on September 6, and 10 on the 15th, 1935; 11 on the 11th, 18 on the 17th, 1936; 9 on the 23d, 1938. Immatures have averaged 56 per cent of the five-year total.

MARSH HAWK, *Circus hudsonius.*—The 1934 notes concerning this species were inconclusive. During four full seasons the Marsh Hawk has occurred regularly though in small numbers, throughout the period of migration. At Cape May, according to Allen and Peterson, the Marsh Hawk occurs largely in October (1). The largest number of Marsh Hawks observed in one day was 16 on October 26, 1938.

An interesting and undeviating sequence of flight has been observed each season: immatures make up nearly all the September migrants, both sexes as well as immatures come in varying numbers during October, while late in the migration the males outnumber the others. The ratio of immatures to adults has varied seasonally from 33.9 per cent to 48.3 per cent.

	1935	*1936*	*1937*	*1938*
Males	60	42	65	55
Females	35	31	23	42
Immatures	52	72	69	84
Indeterminate	6	4	3	8
	153	149	160	189

OSPREY, *Pandion haliaëtus carolinensis.*—The Osprey is seen almost daily during September, and is particularly well represented on heavy flight days, as is evidenced from the numbers of Ospreys cited under the Broad-wing notes. They occur sporadically in October, as late as the 25th. November records include a bird seen on the 14th, in 1935; another on the 6th, 1937.

WHITE GYRFALCON, *Falco rusticolus candicans.*—The records of 1934 remain unique; nothing can be added to the data already presented.

BLACK GYRFALCON, *Falco rusticolus obsoletus.*—A record in addition to those obtained in 1934 is that of a bird observed on October 16, 1936. The day was overcast; only two other hawks were seen, both Marsh Hawks. To quote from my notes: "At 11.20 I was taken by surprise when a huge falcon in very dark plumage pulled up its sails almost directly above me, and perhaps 70 feet away. The bird's underparts were entirely dark, and its head seemed massive; I noted particularly the long, pointed wings. The bird veered a trifle, hesitated, then sailed off towards the south, moving very slowly, and at a distance of a few hundred feet it dropped low over the trees; unmistakably a Black Gyrfalcon."

DUCK HAWK, *Falco peregrinus anatum.*—The Peregrine plays a minor rôle indeed in the hawk migrations. The five-year records show single birds for the most part, on scattered dates from September 4 to November 23. Very unusual, therefore, were such occurrences as eight birds on October 12, 1936, eleven birds on October 7, 1937, and seven on September 23, 1938.

PIGEON HAWK, *Falco c. columbarius.*—Our data for this little falcon differ little from those for the foregoing species. Earliest and latest occurrences fall in 1935—single birds on September 10, and November 9. In October, 1936, four were recorded on the 11th, six on the 12th, and eight on the 17th.

EASTERN SPARROW HAWK, *Falco s. sparverius.*—All the falcons generally dash past the lookouts at express-train speed, but an occasional Sparrow Hawk may be seen loitering above the ridge, plunging at passing *Buteos*, and twice I have seen them beset eagles. Adults far outnumber the immatures, and the proportion of the sexes has averaged about 65 per cent males, 21 per cent females. Fewer than five individuals ordinarily show up in a day, but 16 were recorded on October 4, 1935; 14 on September 28, 1936; 38 on September 26 and 28 on October 7, 1937; and 17 on September 22, 1938.

TABLE OF SEASONAL TOTALS

Species	*1934*	*1935*	*1936*	*1937*	*1938*
1. Turkey Vulture	166	374	87	44	60
2. Eastern Goshawk	123	293	177	49	9
3. Sharp-shinned Hawk	1,913	4,237	4,486	4,817	3,113
4. Cooper's Hawk	333	553	474	492	204
5. Eastern Red-tailed Hawk	5,609	4,024	3,177	4,978	2,230
6. Northern Red-shouldered Hawk	90	181	153	163	143
7. Broad-winged Hawk	2,026	5,459	7,509	4,500	10,761
8. American Rough-legged Hawk	20	9	9	4	—
9. American Golden Eagle	39	66	54	73	31
10. Bald Eagle	52	67	70	38	37
11. Marsh Hawk	105	153	149	160	189
12. Osprey	31	169	205	201	124
13. White Gyrfalcon	2	—	—	—	—

TABLE OF SEASONAL TOTALS—*Continued*

Species	*1934*	*1935*	*1936*	*1937*	*1938*
14. Black Gyrfalcon	2	—	1	—	—
15. Duck Hawk	25	14	36	41	24
16. Pigeon Hawk	19	20	34	10	12
17. Eastern Sparrow Hawk	13	123	102	141	87
Unidentified	208	23	11	8	—
Totals	10,776*	15,766	16,734	15,719	17,024

* Data incomplete; see text.

SEPTEMBER

	1935		1936		1937		1938	
	Daily Totals	Wind Conditions	Daily Totals	Wind Conditions	Daily Totals	Wind Conditions	Daily Totals	Wind Conditions
1							31 *	L—NW
2			3 *	L—SE	5	L—W	11	L—N
3			30	L—N	4	L—W	9	L—SE
4	— *	L—SE	48	L—N	17 *	L—W	3	M—NW
5	— *	L—SE	300	M—E	1 *	M—NE	38	M—NW
6	87	B—N	43	L—NW	8	B—E	20	M—E
7	43	L—NW	23	L—W	103	L—NW	8 *	L—E
8	83	L—W	22 *	M—W	110	M—NW	30	M—N
9	3 *	L—SW	87 *	M—NW	208	B—SE	9	B—SE
10	111	B—NW	466	B—SE	40	L—SE	558	M—SE
11	50 *	M—SW	1,228 *	M—SE	1 *	L—SE	53	L—SE
12	14	L—W	10 *	L—W	36 *	L—NW	— *	Rain
13	151	B—E	30	M—SE	—	L—NE	33 *	M—NW
14	1	L—SE	1,006	B—SE	76 *	M—NW	458	B—SE
15	307 *	B—NW	5	M—SE	130 *	M—S	27 *	L—NW
16	729	M—N	767	M—SW	123 *	L—S	220 *	M—N
17	3,293	M—SE	3,604	B—N	250	B—NW	11	B—E
18	97	M—SE	10	B—E	767 *	L—W	—	Rain
19	—	Rain	166 *	B—N	162 *	B—NW	—	Rain
20	73 *	B—N	—	M—E	388 *	B—NW	— *	Rain
21	220	L—SW	230	M—SW	79 *	L—NW	— *	Rain
22	227 *	B—NW	43	L—NW	606	M—SE	918 *	M—W
23	94 *	L—N	176	L—SE	1,532	L—S	2,062 *	B—NW
24	292	M—S	13 *	L—SE	326	L—W	4,325	L—NW
25	310	M—W	101	B—N	179	L—E	1,363	M—NW
26	129	M—W	113	B—SE	299	B—NW	1,606	L—S
27	30	L—W	43 *	M—SW	86	B—E	164	L—SW
28	— *	Rain	158 *	M—NW	1	Rain	10	L—S
29	164 *	B—NW	—	Rain	44	L—N	60 *	M—E
30	436	B—NW	18	B—E	22	B—SE	95	B—E
	6,944		8,743		5,603		12,122	

Legend: *—Indicates low barometric pressure in northern Appalachian regions. L—light. M—moderate. B—brisk. V—variable.

OCTOBER

	1934		1935		1936		1937		1938	
	Daily Totals	Wind Conditions	Daily Totals	Wind Conditions	Daily Totals	Wind Conditions	Daily Totals	Wind Conditions	Daily Totals	Wind Conditions
1	—	—	270 *	M—SW	102 *	B—NW	47 *	L—SE	200	M—NW
2	63	M—SE	688 *	B—NW	107	L—NW	101 *	M—N	111	L—N
3	34	M—SE	265	B—S	160	M—NW	41	B—E	9	B—E
4	3	M—SE	796 *	B—NW	178	L—SE	56	M—SE	4	L—V
5	24	B—E	433 *	B—N	84	L—SW	16	L—E	6	L—V
6	— *	Rain	471	B—NW	17	L—SW	46 *	M—SW	—	Rain
7	107	B—NW	246	B—NW	4	L—SW	1052	B—NW	22	M—N
8	192	B—NW	50	L—S	—	Rain	951	B—NW	217 *	L—NW
9	80	L—SE	115	M—SE	105	M—E	233	L—S	276 *	B—N
10	31 *	B—E	34	M—S	22 *	M—NW	25	L—SE	362	B—NW
11	257	B—NW	23 *	M—W	545 *	M—NW	343	M—NW	32	L—W
12	369 *	B—NW	106	M—W	688	B—NW	194 *	M—W	111	L—W
13	125	B—NW	132	M—W	92	B—SE	217 *	M—NW	42	L—S
14	258 *	B—NW	34 *	L—W	—	Fog	262	B—NW	9	L—SE
15	255	M—NW	192	B—N	—	Rain	844	B—NW	97	L—SE
16	113	L—SE	26	M—E	3 *	M—S	170	M—NW	42	L—SE
17	9	M—SW	45	L—W	115 *	M—NW	141	L—S	149 *	M—NW
18	535	L—NE	34	B—NW	602 *	B—NW	25	M—SE	50	B—SW
19	189	B—NW	236 *	B—NW	1516	M—NW	—	Rain	22 *	L—W
20	51	M—NW	497	M—NW	409	L—W	100	B—NW	— *	Rain
21	82 *	B—SE	178	B—S	273 *	B—SW	73	M—SW	229 *	M—NW
22	121 *	M—NW	13 *	L—W	292 *	M—SW	76	M—S	180	L—SW
23	571 *	B—NE	1 *	L—W	114	M—NE	3	B—NW	60	L—SE
24	10	M—N	251 *	M—NW	413 *	L—N	77	L—NW	— *	Rain
25	182	M—SE	216	M—NW	602	M—S	82	L—SW	529 *	B—NW
26	20	M—N	521	B—NW	148 *	B—NW	68	M—S	251	B—SW
27	28 *	B—N	139	M—SW	49	L—NE	30	M—SE	285 *	B—NW
28	207	B—NW	195	M—S	110	M—S	— *	Rain	304	B—NE
29	260	B—V	52	M—SE	59	M—NW	473 *	B—NW	93 *	M—NE
30	218	M—NW	3	L—SE	162 *	B—NW	421 *	B—NW	260	B—NW
31	176	M—SW	—	Rain	145	L—NW	1158	B—NW	49	L—NW
	4570		6262		7116		7325		3998	

Legend: *—Indicates low barometric pressure in northern Appalachian regions. L—light. M—moderate. B—brisk. V—variable.

NOVEMBER

	1934		1935		1936		1937		1938	
	Daily Totals	Wind Conditions	Daily Totals	Wind Conditions	Daily Totals	Wind Conditions	Daily Totals	Wind Conditions	Daily Totals	Wind Conditions
1	641 *	B—NW	— *	Rain	53 *	L—NW	639	L—S	53	L—NW
2	1013	B—N	722	B—N	1	L—SW	132 *	M—S	4	L—NW
3	375	M—S	52	L—SE	94 *	B—SW	488 *	B—NW	195	M—SE
4	9 *	Rain	2 *	L—SE	—	Rain	105	L—NW	—	L—E
5	63	L—SW	229 *	M—SE	318 *	B—NW	186	L—S	15	M—S
6	258	B—N	314	B—NW	53	B—SE	342 *	B—NW	2	L—SW
7	27 *	B—W	—	Rain	7	L—E	166	L—NW	3	M—S
8	59	L—W	362 *	B—NW	—	Rain	57	B—S	35	M—SW
9	39	M—NW	175	M—SE	26 *	L—NW	91	B—NW	180	M—NW
10	107 *	L—SE	36	L—SE	72	B—NW	143 *	M—NW	31	L—SW
11	296 *	B—NW	4 *	L—SE	59 *	L—S	67	B—NW	34	L—SW
12	440	B—NW	—	Rain	1	L—SW	60	B—E	16	L—NW
13	4 *	Snow	—	Rain	93	M—N	—	Rain	46	M—SW
14	45	B—NW	66	M—NE	17	L—S	13 *	L—NW	53 *	B—NW
15	63		—	Rain	9 *	B—NW	— *	L—NW	172	M—NW
16	57		8	B—E	19	B—NW	33	L—NW	37	L—NW
17	48		— *	Snow	3 *	B—W	— *	Rain	—	L—NW
18	58		172	B—NW	30	B—NW	84	M—NW	—	Rain
19	20		71	B—SE	—	L—W	—	Snow	— *	Rain
20	13		7 *	L—S	5	M—W	40	B—NW	26	L—NW
21	—	Rain	27 *	L—S	2 *	M—NW	46	B—NW	—	L—NW
22	—	Rain	15 *	M—NW	10	M—NW	53	B—NW	—	L—NW
23	—	Rain	126	B—NW	2	M—NW	31	B—NW	—	Rain
24	74		101	B—N	—	M—NW	2	M—NW	2	B—E
25	8		33	M—N	—	M—NW	—	L—NW		
26	—	Rain	4	M—N			—	L—SE		
27			1	L—S			—	M—SE		
28			—	Rain			—	Rain		
29			1	B—NW			9	B—NW		
30			5	B—NW			4	M—W		
	3717		2533		874		2791		904	

Legend: *—Indicates low barometric pressure in northern Appalachian regions. L—light. M—moderate. B—brisk. V—variable.

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