AUTUMN BIRD MIGRATION AT BAKE OVEN KNOB, PA.

DONALD S. HEINTZELMAN AND THOMAS V. ARMENTANO

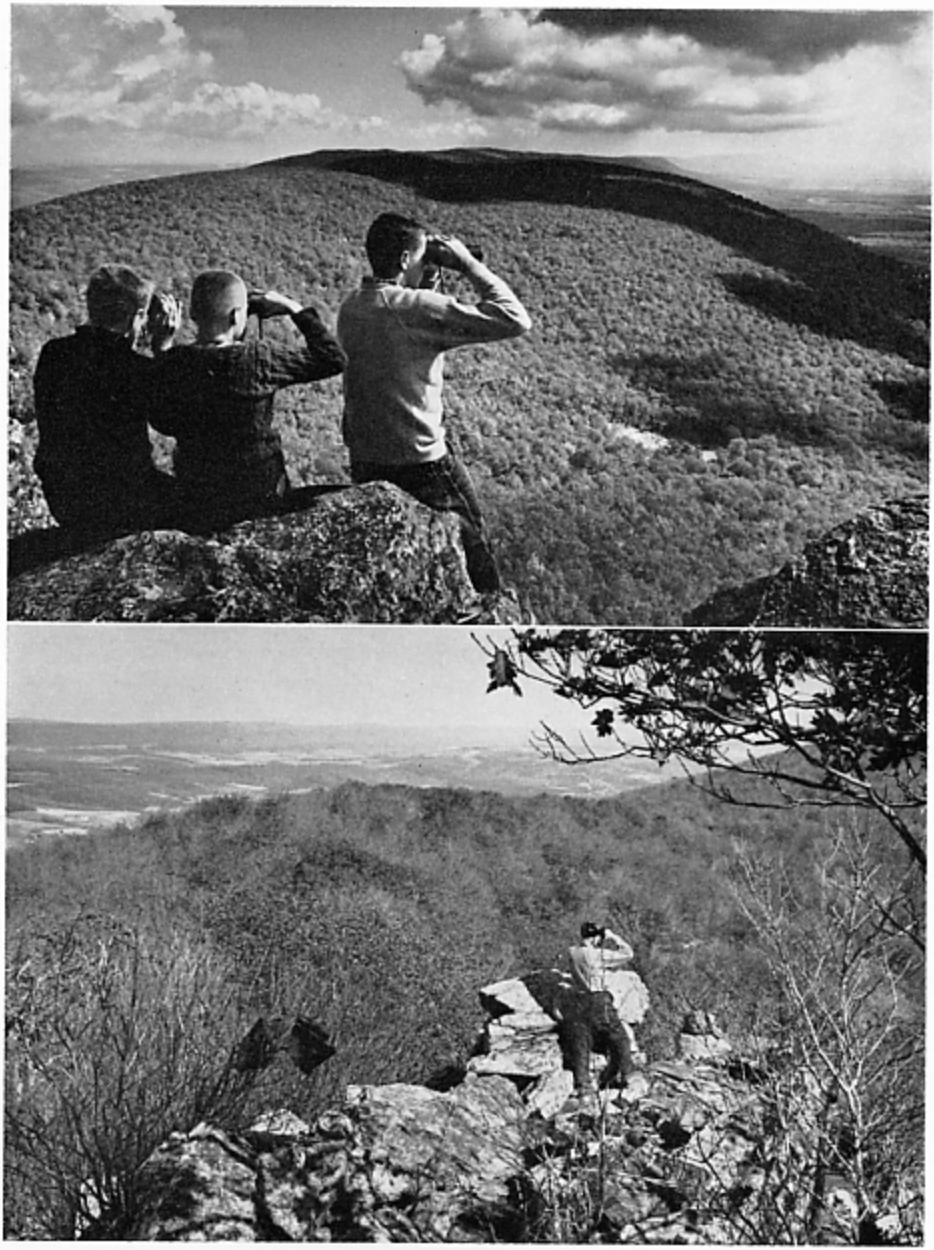
INTRODUCTION

Since the beginning of American ornithology, southeastern Pennsylvania has played an important role in the development of this science. Alexander Wilson did considerable work in and around Philadelphia, a large and important series of specimens has been amassed in the Academy of Natural Sciences of Philadelphia, and several eastern Pennsylvania counties, e.g. Chester and Berks, have been documented by competent ornithologists. In contrast, Lehigh County has been relatively little studied, the only major published work being the preliminary checklist of Trainer and Miller (1956). This is surprising since there are a number of ornithologically interesting locations within the county. Foremost of these during the autumn migration is Bake Oven Knob (hereafter referred to as BOK), a State Game Land owned by the Pennsylvania Game Commission, located on the Kittatinny Ridge about 16 miles east of Hawk Mountain Sanctuary. This mountain forms the northern boundary of Lehigh County and is some 20 miles north of Allentown, the nearest large city. Directions for reaching BOK are printed elsewhere (Heintzelman, 1963a: 154-158).

For convenience, the area covered here includes not only BOK (Figs. 1 & 2), but also a strip of mountaintop extending westward some two miles to another rock promontory called Bear Rocks. A few of our observations were made at the latter location.

The geology of BOK has been studied by Miller (1941: 136-137). Briefly, it reaches an elevation of 1600 feet above mean sea level, about 100 feet above the rest of the mountain crest, is composed of Tuscarora conglomeratic rock, and is the result of differential weathering and erosion. Directly below BOK a large bowl called Bake Oven has been produced similarly.

Ecologically, BOK is of considerable interest. Cool temperatures and a partially exposed summit provide a climate decidedly more northern than would be expected at this latitude. Hence floral elements such as *Amelanchier laevis* Wieg., a shadbush, are found in neighboring Northampton County (Schaeffer, 1949: 299) and extend westward along the ridge to BOK in Lehigh County (*fide* Schaeffer). Mountain ash (*Pyrus americana*) is fairly common on the north slope of the ridge, but is lacking on the south side. The shallow, acid soil of the ridge crest supports other trees including black-gum (*Nyssa sylvatica*), scrub oak (*Quercus ilicifolia*), and fire cherry (*Prunus pensylvanica*), along with dense undergrowth of blueberry (*Vaccinium sp.*), sheep laurel (*Kalmia angustifolia*), mountain laurel (*Kalmia latifolia*), and huckleberry (*Gaylussacia* sp.). Along the lower elevations of the ridge and



Figs. 1 and 2. Bake Oven Knob, Lehigh County, Pennsylvania. Top: View looking toward the east from the South Lookout. Photographed on 29 September 1962. Bottom: View looking north from The Point. Photographed on 1 November 1964.

in the valley the sugar maple (*Acer saccharinum*), shagbark hickory (*Carya ovata*), and tulip popular (*Liriodendron tulipifera*) are common.

BOK is characterized by an overlapping of the Alleghanian and the Carolinian life zones. At Bear Rocks a small remnant of the original forest still remains in the form of small pockets of *Rhododendron,* white pine (*Pinus strobus*), and hemlock (*Tsuga canadensis*).

Ornithologically, BOK is particularly attractive since it is right on the summit of the Kittatinny Ridge – a major migration route used by innumerable species of birds ranging from the tiny Ruby-throated Hummingbird (*Archilochus colubris*) to the majestic Golden Eagle (*Aquila chrysaetos*). Two lookouts are suitable as observation points at BOK itself. The South Lookout (Fig. 1) rises above the point where the ridge makes a gentle semi-U-shaped curve and therefore allows the observer a superb view over the whole mountain toward the east. It is especially suitable on days with winds prevailing from the east, southeast, south, and southwest. Under these conditions birds commonly fly very close to the rocks and the observers (Heintzelman, 1963a: 154-158). The alternate lookout, called The Point (Fig. 2), is used when north, northwest, and northeast winds prevail. It is located about two city blocks east of the previously described observation point and is reached by walking along the Appalachian Trail to the east end of a large boulder field. Aside from wind, weather conditions described by Broun (1963) as applying to Hawk Mountain generally apply to BOK hawk migration movements.

Prior to the beginning of our field work in 1961, the full potentialities of BOK were not utilized. This paper summarizes our work to date and lays the groundwork for future BOK-Hawk Mountain hawk migration studies by investigation of the following areas: (1) analysing the hourly components of a select BOK hawk flight, (2) making a number of general comparisons of select BOK-Hawk Mountain flights, (3) comparing yearly BOK-Hawk Mountain hawk migration totals in terms of the numbers of species of birds seen, (4) presenting a preliminary statistical analysis of 1961-1963 Broad-winged Hawk (*Buteo platypterus*) flights, and (5) presenting a new hawk migration hypothesis for Broad-winged Hawks. In addition, we also present an annotated account of the 90 species of birds recorded at BOK in autumn.

The literature pertaining to BOK is sparce, with most available records being gathered by Delaware Valley Ornithological Club members and appearing principally in *Audubon Field Notes* and in *Cassinia*. Heintzelman (1963a; 1963b) recently published short accounts of various aspects of BOK hawk flights. A few of these notes and articles are used in this paper, including some references prior to the limits of the time period covered by our field work (27 August 1961 to 11 Novmber 1961; 7 September 1962 to 23 November 1962; and 3 August 1963 to 24 November 1963). Aside from some Hirundinidae movements which begin in July, this period spans the autumn migration period of almost all birds known to pass over BOK.

One method of gaining knowledge about BOK hawk flights is by making hourly counts of the numbers of a given species passing BOK throughout an entire day. Figure 3 is a graph of this type, plotting the numbers of Red-tailed Hawks (*Buteo jamaicensis*) passing BOK each hour of the normal observation day on 9 November 1963 — a good flight day with partly cloudy skies, a maximum visibility of 20+ miles, a northwest wind at 5 to 20 MPH, and an air temperature at 12:00 noon, EST, of 11° C. Curiously the curve for this flight appears to be bimodal, suggesting the presence of two statistical populations of Red-tails each of which is not entirely separate from the other. An approximation of the so-called "noon-day lull" occurred between 1:30 and 2:29 pm, EST. What happens to the birds during this time is unknown, but we seldom see hawks landing in trees. Is it possible that the birds reach an altitude high enough to escape detection?

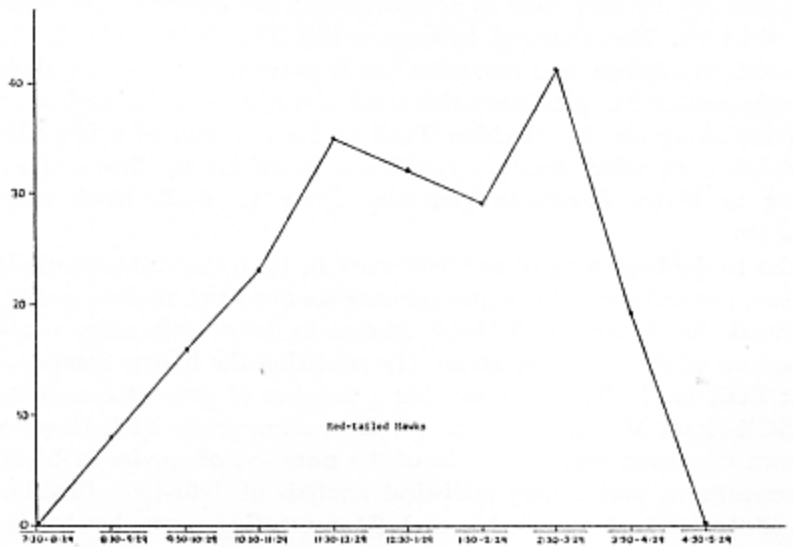


Fig. 3. Graph of the Red-tailed Hawk flight at BOK on 9 November 1963. Numbers of hawks passing per hour are plotted on the ordinate, and time (EST) is plotted on the abscissa.

We use a similar technique to study the migration of Golden Eagles and Bald Eagles (*Haliaeetus leucocephalus*). The exact time is recorded when each eagle passes BOK, and these times for each species for 1961 to 1963 are plotted in Figure 4. Here the Bald Eagles show a peak movement between 12:00 and 12:59 pm, EST, whereas the Golden Eagles have a movement pattern which almost approaches a trimodal curve indicative of three statistical populations. If these three populations actually exist, they may be separate movements of adult males, adult females, and immatures.

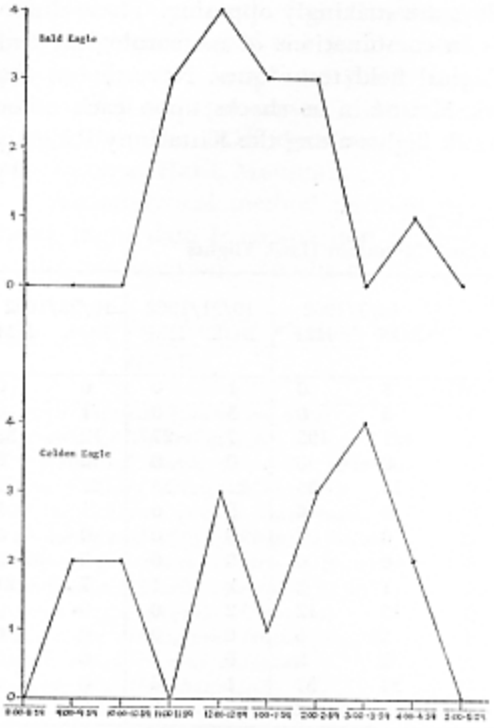


Fig. 4. Graphs of BOK Bald Eagle (upper) and Golden Eagle (lower) migration movements. Numbers of eagles passing per hour are plotted on the ordinate, and time (EST) is plotted on the abscissa.

The easiest method of analyzing BOK-Hawk Mountain hawk flights is a simple direct comparison of our respective species totals for specific days. Tables 1, 2, and 3 list totals for selected flight days for the months of September, October, and November. The totals for some days show rather close

Table 1

Select September 1962 BOK-Hawk Mountain Hawk Flights

SPECIES	9/8/1962		9/16/1962		9/18/1962		9/19/1962	
	BOK	HM	BOK	HM	BOK	HM	BOK	HM
Turkey Vulture (*Cathartes aura*)	5	—	9	—	4	—	0	0
Sharp-shinned Hawk (*Accipiter striatus*)	4	0	8	8	10	8	5	4
Red-tailed Hawk (*Buteo jamaicensis*)	14	0	3	0	4	0	1	0
Broad-winged Hawk (*Buteo platypterus*)	174	119	217	3200	923	896	123	214
Bald Eagle (*Haliaectus leucocephalus*)	0	0	0	4	1	1	0	0
Marsh Hawk (*Circus cyaneus*)	3	1	2	2	4	3	0	3
Osprey (*Pandion haliaetus*)	2	0	16	22	32	38	3	6
Sparrow Hawk (*Falco sparverius*)	1	0	3	1	14	23	0	0
Unidentified Hawks	6	0	4	0	3	0	2	0
TOTALS	209	120	262	3237	995	969	134	227

agreement, whereas totals for other days are strikingly opposing. These differences may be the result of variations in combinations of meteorological and geographical conditions, and in biological field techniques. Nevertheless the possibilities of using BOK and Hawk Mountain as checks upon each other and upon the general movement of hawk flights along the Kittatinny Ridge is obvious.

Table 2

Select October 1962 BOK-Hawk Mountain Hawk Flights

SPECIES	10/7/1962		10/21/1962		10/28/1962	
	BOK	HM	BOK	HM	BOK	HM
Turkey Vulture (*Cathartes aura*)	8	0	1	0	0	0
Goshawk (*Accipiter gentilis*)	6	0	3	0	1	0
Sharp-shinned Hawk (*Accipiter striatus*)	121	195	7	27	12	32
Cooper's Hawk (*Accipiter cooperii*)	8	8	0	0	0	0
Red-tailed Hawk (*Buteo jamaicensis*)	15	33	21	33	47	255
Red-shouldered Hawk (*Buteo lineatus*)	0	6	2	6	1	5
Broad-winged Hawk (*Buteo platypterus*)	0	1	0	0	0	0
Golden Eagle (*Aquila chrysaetos*)	0	0	0	0	0	3
Marsh Hawk (*Circus cyaneus*)	1	2	2	1	7	21
Osprey (*Pandion haliaetus*)	13	12	2	0	0	0
Peregrine Falcon (*Falco peregrinus*)	3	6	0	0	0	0
Pigeon Hawk (*Falco columbarius*)	2	2	0	1	0	0
Sparrow Hawk (*Falco sparverius*)	34	57	1	4	0	0
Unidentified Hawks	9	2	1	0	2	0
TOTALS	220	324	40	72	70	316

Table 3

Select November 1963 BOK-Hawk Mountain Hawk Flights

SPECIES	11/3/1963		11/9/1963		11/16/1963		11/24/1963	
	BOK	HM	BOK	HM	BOK	HM	BOK	HM
Turkey Vulture (*Cathartes aura*)	1	0	5	8	0	0	0	0
Goshawk (*Accipiter gentilis*)	2	3	2	1	2	0	0	3
Sharp-shinned Hawk (*Accipiter striatus*)	3	5	1	9	4	3	0	0
Cooper's Hawk (*Accipiter cooperii*)	0	0	0	3	0	1	0	1
Red-tailed Hawk (*Buteo jamaicensis*)	374	417	203	203	68	106	54	106
Red-shouldered Hawk (*Buteo lineatus*)	8	9	20	20	6	6	0	0
Rough-legged Hawk (*Buteo lagopus*)	3	0	0	1	0	1	2	2
Golden Eagle (*Aquila chrysaetos*)	2	3	5	2	2	0	2	3
Bald Eagle (*Haliaeetus leucocephalus*)	0	0	0	0	0	0	0	1
Marsh Hawk (*Circus cyaneus*)	2	3	4	6	4	4	1	1
Peregrine Falcon (*Falco peregrinus*)	0	0	0	1	0	1	0	0
Pigeon Hawk (*Falco columbarius*)	0	0	1	1	0	0	0	0
Sparrow Hawk (*Falco sparverius*)	1	0	0	3	0	0	0	0
Unidentified Hawks	0	0	5	0	2	0	0	0
TOTALS	396	440	246	258	88	122	59	117

Still another method of comparing BOK-Hawk Mountain hawk migration data is by making direct comparisons between our yearly totals for each species. Table 4 lists these yearly species totals along with the number of observation days per season at both locations. The Hawk Mountain data are higher than the BOK data because there were many more observation days per season at Hawk Mountain.

An analytical method perhaps more suitable to BOK-Hawk Mountain hawk flight data is comparison of percentages of species observed each year at the two locations. Results of this approach are presented in Table 5.

Table 4
Bake Oven Knob-Hawk Mountain Autumn Hawk Migration Totals (1961-1963)

SPECIES	Bake Oven Knob*			Hawk Mountain**		
	1961	1962	1963	1961	1962	1963
Turkey Vulture (*Cathartes aura*)	26	47	146	129	——	178
Goshawk (*Accipiter gentilis*)	3	13	7	89	33	28
Sharp-shinned Hawk (*Accipiter striatus*)	71	280	207	1753	2283	1532
Cooper's Hawk (*Accipiter cooperii*)	2	18	8	108	77	73
Red-tailed Hawk (*Buteo jamaicensis*)	129	733	881	2606	2748	3474
Red-shouldered Hawk (*Buteo lineatus*)	26	31	44	333	268	210
Broad-winged Hawk (*Buteo platypterus*)	236	2606	5132	8403	8276	9824
Rough-legged Hawk (*Buteo lagopus*)	3	0	5	36	7	11
Golden Eagle (*Aquila chrysaetos*)	2	4	11	52	40	28
Bald Eagle (*Haliaeetus leucocephalus*)	2	3	10	51	48	30
Marsh Hawk (*Circus cyaneus*)	15	47	56	283	186	178
Osprey (*Pandion haliaetus*)	10	110	59	352	290	190
Peregrine Falcon (*Falco peregrinus*)	0	5	4	23	30	21
Pigeon Hawk (*Falco columbarius*)	0	3	4	13	20	27
Sparrow Hawk (*Falco sparverius*)	16	69	35	470	446	265
Unidentified Hawks	23	60	67	117	110	101
TOTALS	564	4029	6676	14,818	14,862	16,170

* 1961 = 9 observation days
1962 = 20 observation days
1963 = 32 observation days

** 1961 = 76 observation days
1962 = 70 observation days
1963 = 80 observation days

Table 5
Yearly Percentages of Hawks Passing BOK and Hawk Mountain (1961-1963)

SPECIES	BOK			Hawk Mountain		
	1961	1962	1963	1961	1962	1963
Turkey Vulture (*Cathartes aura*)	4.70	1.20	2.20	0.80	——	1.10
Goshawk (*Accipiter gentilis*)	0.50	0.40	0.10	0.60	0.20	0.20
Sharp-shinned Hawk (*Accipiter striatus*)	12.70	6.90	3.10	11.85	15.40	9.50
Cooper's Hawk (*Accipiter cooperii*)	0.30	0.50	0.10	0.70	0.50	0.50
Red-tailed Hawk (*Buteo jamaicensis*)	22.90	18.20	13.30	17.60	18.50	21.50
Red-shouldered Hawk (*Buteo lineatus*)	4.60	0.70	0.60	2.20	1.80	1.30
Broad-winged Hawk (*Buteo platypterus*)	41.90	65.00	77.00	56.90	55.70	60.41
Rough-legged Hawk (*Buteo lagopus*)	0.50	00.00	0.08	0.23	0.04	0.08
Golden Eagle (*Aquila chrysaetos*)	0.30	0.10	0.10	0.35	0.26	0.18
Bald Eagle (*Haliaeetus leucocephalus*)	0.30	0.05	0.10	0.34	0.30	0.19
Marsh Hawk (*Circus cyaneus*)	2.70	1.10	0.80	1.90	1.23	1.10
Osprey (*Pandion haliaetus*)	1.80	2.70	0.90	2.37	1.94	1.20
Peregrine Falcon (*Falco peregrinus*)	0.00	0.10	0.06	0.14	0.20	0.14
Pigeon Hawk (*Falco columbarius*)	0.00	0.05	0.06	0.07	0.11	0.20
Sparrow Hawk (*Falco sparverius*)	2.80	1.60	0.50	3.17	3.10	1.70
Unidentified Hawks	4.00	1.40	1.00	0.78	0.72	0.70

Because of the interesting Broad-winged Hawk flight which occurred in 1963, we calculated the standard error of proportion for Broad-wings passing BOK and Hawk Mountain for 1961, 1962, and 1963. With the Hawk Mountain percentages used as the hypothetical true proportions, all three years show statistically significant differences at both 1% and 5% levels of probability. Some light was shed on why this should be so on 14 September 1963. This was the peak 1963 Broad-wing migration day. Strong northeast winds prevailed until about 3:30 pm, EST, then the wind shifted to the southwest. The result was strikingly apparent. With the wind still in the northeast, the hawks were cutting diagonally across the ridge and by the time they reached BOK, many were far to the south of the mountain. Time and again we discovered large swirling masses of Broad-wings far out over the valley south of BOK. Occasionally, however, a group of Broad-wings passed overhead and then began leaving the ridge to continue on their south-southwest course away from the mountain. But shortly after the wind shift (to the southwest) many birds began passing very close to, or directly over, our observation point. This latter movement continued for the rest of the day. Why? The following hypothesis suggests one possible explanation.

TRANS-MOUNTAIN DRIFT HYPOTHESIS

Study of our data suggests that Broad-winged Hawks are moving southward over a broad front, and not just using the Kittatinny Ridge. Air currents are used over the Kittatinny Ridge as well as over the valley and mountains north of the Kittatinny. With *northeast* winds there is a gradual diagonal drift of Broad-wings, which are notoriously poor fliers in strong winds, across country passing from ridge to ridge but always moving in a general southwestward direction. In other words, birds seen south of BOK drift from the ridge at a point east of BOK, and by the time they reach our position of longitude they are generally far out over the valley to the south of our position — so far so that they are completely missed at Hawk Mountain when they reach a position of longitude equal to that observation point. In a simliar manner, Broad-wings seen at Hawk Mountain were *not* observed at BOK because they were still on the ridges or crossing the valleys to the north of us when at a position of longitude relative to BOK. This process is presented diagrammatically in Figure 5.

Hence the population of Broad-wings observed at BOK is different from the population observed at Hawk Mountain although there is a slight overlapping of the "tails" of the two populations.

On 14 September 1963, two Broad-winged Hawk populations passed BOK and two populations passed Hawk Mountain; 837 Broad-wings were recorded at BOK up to 11:00 am, EST, whereas 3,464 Broad-wings passed Hawk Mountain by 10:00 am, EST, and 3,949 birds passed Hawk Mountain by 12:00 noon, EST. On the other hand, we recorded 2,800 Broad-wings from 11:00 am, EST to 5:10 pm, EST at BOK. Hawk Mountain, however, recorded *no* birds between 12:00 noon, EST and 1:15 pm, EST, and only 1,307 birds

from 12:00 noon, EST to 5:00 pm, EST. (Observers at the Pinnacle, four miles south of Hawk Mountain, recorded an additional 1,540 Broad-wings in the afternoon. These birds, *not seen at Hawk Mountain,* are added to the Hawk Mountain total for 14 September 1963). Table 6 contains the species totals for BOK and for Hawk Mountain for 14 September 1963.

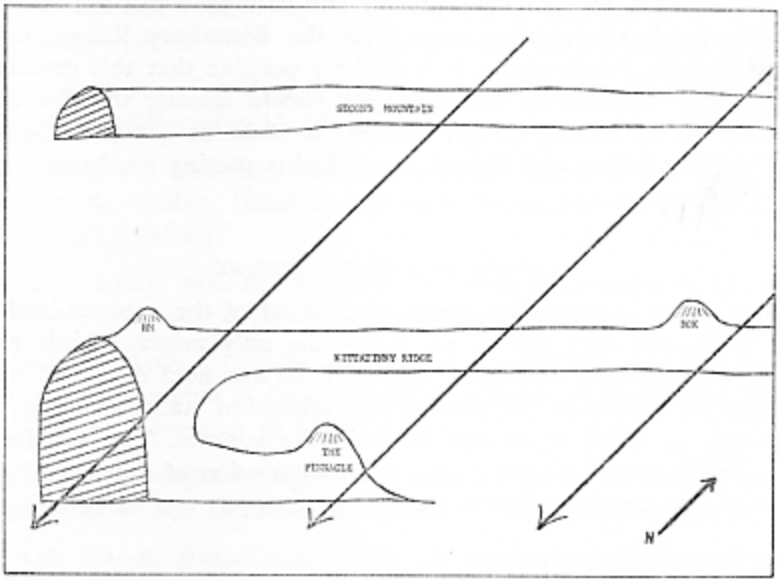


Fig. 5. Diagrammatic representation of the Trans-Mountain Drift postulated for Broad-winged Hawk flights on days with prevailing northeast winds. Arrows show the direction of the hawk flights.

Table 6

BOK-Hawk Mountain Species Totals for 14 September 1963

SPECIES	BOK	Hawk Mountain
Turkey Vulture (*Cathartes aura*)	9	5
Sharp-shinned Hawk (*Accipiter striatus*)	12	3
Cooper's Hawk (*Accipiter cooperii*)	3	1
Red-tailed Hawk (*Buteo jamaicensis*)	13	—
Broad-winged Hawk (*Buteo platypterus*)	3637	6796*
Marsh Hawk (*Circus cyaneus*)	3	5
Osprey (*Pandion haliaetus*)	10	6
Peregrine Falcon (*Falco peregrinus*)	1	0
Sparrow Hawk (*Falco sparverius*)	4	3
Unidentified Hawks	9	—
TOTALS	**3701**	6819

* Includes 1540 Broad-winged Hawks observed at the Pinnacle.

Although the Trans-Mountain Drift Hypothesis may not hold for wind conditions other than from the *northeast,* we do know that many hawks leave the ridge roughly half-way between BOK and Hawk Mountain when winds

from the east and south prevail. Broun (1949: 145) already pointed out that these birds then head for the Pinnacle where they pick up the south spur of the ridge and continue south.

In view of our 14 September 1963 observations at BOK, it now appears that migrant hawks follow movement patterns far more complex than was previously realized. Evidentally southerly and easterly winds are not entirely responsible for hawks cutting away from the Kittatinny Ridge and other northward ridges. Furthermore, it is entirely possible that this gradual drift is not entirely confined to Broad-winged Hawks leaving the Pennsylvania portion of the Kittatinny Ridge. Rather, as Robbins (1956: 211-213) discussed, Virginia flights and indeed many flights passing southward, may be affected similarly.

ANNOTATED SPECIES ACCOUNT

Hawk flights are the most spectacular aspect of the autumn bird migration at BOK, but they are by no means the only migrant birds recorded there. In the following account, compiled from our field data and from the records in the literature, we present the migration status of 90 species of birds known to reside at or pass BOK in the autumn. The standard used to evaluate the status of each species is a modification of that used by Wood (1958: 8-9). For convenience, it is outlined here.

Regular: Recorded every year.
Irregular: Recorded less than once every year.
Casual: Recorded very infrequently, with only one or two records available.
Abundant: Occurring in such numbers that a competent observer might see more than 500 individuals in a single day.
Very Common: 101 to 500 in a single day.
Common: 26 to 100 in a single day.
Fairly Common: 6 to 25 in a single day.
Uncommon: 1 to 5 in a single day.
Rare: 1 to 5 in a single day and no more than 5 per season.
Very Rare: No more than 1 per season.
Migrant: A species passing through the area or remaining in it for several days.
Permanent Resident: A species recorded in the area during the entire period of this study, e.g. Ruffed Grouse.

COMMON LOON, *Gavia immer*. An irregular migrant, uncommon in October and November; October 7 (1962) to November 3 (1962).

DOUBLE-CRESTED CORMORANT, *Phalacrocorax auritus*. A casual migrant, the only record being three birds observed on October 14, 1962 (Heintzelman, 1963b: 40).

CANADA GOOSE, *Branta canadensis.* A regular migrant, fairly common in late September, very common in October, and common in early November; September 28 (1963) to November 9 (1963).

SNOW GOOSE, *Chen hyperborea.* A casual migrant, very rare in October and November. All records follow:

October 7, 1962.....1 (Heintzelman, 1963b: 40)
November 3, 1963.....1 (*fide* S. Harty and G. Reynard)

PINTAIL, *Dafila acuta.* A casual migrant, the only record being seven birds observed on November 11, 1962 (DSH).

TURKEY VULTURE, *Cathartes aura.* A regular migrant, fairly common in August, September, October, and early November; August 3 (1963) to November 9 (1963).

GOSHAWK, *Accipiter gentilis.* A regular migrant, uncommon in October and November; October 5 (1963) to November 23 (1962).

SHARP-SHINNED HAWK, *Accipiter striatus.* A regular migrant, uncommon in September, common in October and uncommon in November; September 2 (1963) to November 16 (1962).

COOPER'S HAWK, *Accipiter cooperii.* A regular migrant, uncommon from mid-September to late October; September 11 (1963) to October 28 (1963).

RED-TAILED HAWK, *Buteo jamaicensis.* A regular migrant, uncommon in August, fairly common in September and early October, and very common in late October and November; August 3 (1963) to November 24 (1963).

RED-SHOULDERED HAWK, *Buteo lineatus.* A regular migrant, uncommon in October and fairly common in November; October 5 (1963) to November 16 (1963).

BROAD-WINGED HAWK, *Buteo platypterus.* A regular migrant, uncommon in August, very common in early September, abundant in mid- and late September, and uncommon in early October; August 3 (1963) to October 7 (1961).

ROUGH-LEGGED HAWK, *Buteo lagopus.* An irregular migrant, rare in November; November 3 (1961) to November 24 (1963).

GOLDEN EAGLE, *Aquila chrysaetos.* A regular migrant, uncommon in October and November; October 14 (1962) to November 24 (1963).

BALD EAGLE, *Haliaeetus leucocephalus.* A regular migrant, uncommon in late August, September, and October; August 18 (1963) to October 30 (1963).

MARSH HAWK, *Circus cyaneus.* A regular migrant, uncommon in late August, fairly common in September, October and November; August 25 (1963) to November 24 (1963).

Osprey, *Pandion haliaetus.* A regular migrant, rare in August and early September, fairly common in mid-September, uncommon in late September and October, and rare in November; August 17 (1963) to November 11 (1961).

Peregrine Falcon, *Falco peregrinus.* An irregular migrant, rare in September and early October; September 10 (1963) to October 7 (1962).

Pigeon Hawk, *Falco columbarius.* An irregular migrant, rare in September, October and November; September 10 (1963) to November 9 (1963).

Sparrow Hawk, *Falco sparverius.* A regular migrant, fairly common in August, September, and October, and uncommon in November; August 18 (1963) to November 3 (1963).

Ruffed Grouse, *Bonasa umbellus.* Permanent resident, uncommon in August, September, and October; August 31 (1963) to October 14 (1962).

Wild Turkey, *Meleagris gallopavo.* Formerly a permanent resident. Exterminated many years ago, but recently reintroduced by the Pennsylvania Game Commission. All records follow:

October 15, 1961 ..... 2 (DSH)
October 21, 1959 ..... 10 (Poole and Potter, 1960: 21)

Herring Gull, *Larus argentatus.* A regular migrant, rare in October and November; October 15 (1961) to November 16 (1963).

Ring-billed Gull, *Larus delawarensis.* A casual migrant, the only record being four birds observed on November 16, 1963 (DSH).

Mourning Dove, *Zenaidura macroura.* A regular migrant, uncommon in August, September, and October; August 3 (1963) to October 21 (1962).

Nighthawk, *Chordeiles minor.* A regular migrant, rare in August and fairly common in September; August 27 (1961) to September 18 (1962).

Chimney Swift, *Chaetura pelagica.* A regular migrant, fairly common in August and September, and uncommon in early October; August 4 (1963) to October 5 (1963).

Ruby-throated Hummingbird, *Archilochus colubris.* A regular migrant, uncommon in late August and September; August 27 (1961) to September 28 (1963).

Yellow-shafted Flicker, *Colaptes auratus.* A regular migrant, uncommon in August and early September, fairly common in mid-September, and uncommon in late September and early October; August 11 (1963) to October 10 (1962).

Pileated Woodpecker, *Ceophloeus pileatus.* Permanent resident, rare in August, September, October, and November; August 11 (1963) to November 16 (1963).

RED-HEADED WOODPECKER, *Melanerpes erythrocephalus.* An irregular migrant, very rare in mid-September. All records follow:

September 13, 1962 ..... 1 (TVA)
September 14, 1963 ..... 1 (DSH)

HAIRY WOODPECKER, *Dryobates villosus.* An irregular migrant, rare in late August and October. All records follow:

August 22, 1962.....1 (TVA)
October 7, 1961.....1 (DSH)
October 20, 1962.....1 (DSH)

DOWNY WOODPECKER, *Dryobates pubescens.* An irregular migrant, rare in late August, October and November. No September records; August 22 (1962) to November 24 (1963).

CRESTED FLYCATCHER, *Myiarchus crinitus.* An irregular migrant, rare in September. All records follow:

September 8, 1962.....1 (TVA)
September 13, 1962.....1 (TVA)

WOOD PEWEE, *Myiochanes virens.* An irregular migrant, uncommon in August and early September; August 4 (1963) to September 13 (1962).

OLIVE-SIDED FLYCATCHER, *Nuttallornis mesoleucus.* A regular migrant, very rare in late August and September. All records follow:

August 27, 1961.....1 (DSH)
September 8, 1963.....1 (DSH)
September 16, 1962.....1 (DSH and TVA)

TREE SWALLOW, *Iridoprocne bicolor.* A regular migrant, common in early and mid-August, and uncommon in late August, September, and early October; August 11 (1963) to October 7 (1962).

ROUGH-WINGED SWALLOW, *Stelgidopteryx ruficollis.* A regular migrant, fairly common in early August, and uncommon in late August and early September; August 4 (1963) to September 8 (1962).

BARN SWALLOW, *Hirundo rustica.* A regular migrant, common in early and mid-August, and uncommon in late August and September; August 3 (1963) to September 18 (1962).

CLIFF SWALLOW, *Petrochelidon pyrrhonota.* An irregular migrant, fairly common from mid-August to early September. All records follow:

August 11, 1963 .....30 (DSH)
September 1, 1963.....15 (DSH)

PURPLE MARTIN, *Progne subis.* A regular migrant, fairly common in early and mid-August, and uncommon in late August and early September; August 3 (1963) to September 7 (1963).

BLUE JAY, *Cyanocitta cristata.* A regular migrant, uncommon from mid-August to mid-September, fairly common from late September to early October, common to very common from early October to mid-October, and uncommon from late October to early November; August 11 (1963) to November 9 (1963).

RAVEN, *Corvus corax.* A casual migrant, rare in late October. Several birds observed on October 22, 1961 (Middleton, 1962: 17) constitute our only record.

COMMON CROW, *Corvus brachyrhynchos.* A regular migrant, uncommon in August, fairly common in September, and common to very common in October and November; August 25 (1963) to November 17 (1962).

BLACK-CAPPED CHICKADEE, *Parus atricapillus.* A permanent resident, fairly common in August, uncommon in September and October, and uncommon to fairly common in November; August 3 (1963) to November 16 (1963).

TUFTED TITMOUSE, *Parus bicolor.* An irregular migrant, uncommon in late August, and rare in early September; August 22 (1962) to September 4 (1962).

WHITE-BREASTED NUTHATCH, *Sitta carolinensis.* An irregular migrant, very rare in early October. All records follow:

October 5, 1963 ..... 1 (DSH)
October 7, 1961 ..... 1 (TVA)

RED-BREASTED NUTHATCH, *Sitta canadensis.* A regular migrant, rare in September and October; September 2 (1961) to October 20 (1962).

BROWN CREEPER, *Certhia familiaris.* A casual migrant, very rare in mid-October. Our only record is one bird seen on October 14, 1962 (DSH).

HOUSE WREN, *Troglodytes aedon.* An irregular migrant, rare in late August, uncommon in September, and rare in mid-October; August 22 (1962) to October 14 (1962).

CAROLINA WREN, *Thryothorus ludovicianus.* An irregular migrant, rare in September; September 8 (1962) to September 18 (1962).

CATBIRD, *Dumetella carolinensis.* A casual migrant, very rare in mid-October. Our single record is a bird seen on October 13, 1963 (DSH).

BROWN THRASHER, *Toxostoma rufum.* A casual migrant, very rare in mid-September. Our single record is a bird seen on September 4, 1963 (TVA).

ROBIN, *Turdus migratorius.* A regular migrant, fairly common in September, fairly common to very common in October, and uncommon in early November; September 13 (1962) to November 9 (1963).

HERMIT THRUSH, *Hylocichla guttatta.* A casual migrant, very rare in late October. Our only record is one bird seen on October 26, 1963 (DSH).

SWAINSON'S THRUSH, *Hylocichla ustulata.* A casual migrant, very rare in late October. Our single record is a bird seen on October 29, 1961 (DSH).

GOLDEN-CROWNED KINGLET, *Regulus satrapa*. A casual migrant, uncommon in mid-October. Our only record is that of six birds observed on October 14, 1962 (DSH).

RUBY-CROWNED KINGLET, *Regulus calendula*. A regular migrant, uncommon in October; October 5 (1963) to October 26 (1963).

CEDAR WAXWING, *Bombycilla cedrorum*. A regular migrant, uncommon in late August, fairly common in September and early October, very common in mid- and late October, and uncommon to fairly common in November; August 18 (1963) to November 16 (1963).

STARLING, *Sturnus vulgaris*. A casual migrant, abundant in early October. Our only record is that of two large flocks numbering over 750 birds observed on October 7, 1961 (DSH).

RED-EYED VIREO, *Vireo olivaceus*. An irregular migrant, rare in late August and early September; August 22 (1962) to September 13 (1963).

WARBLING VIREO, *Vireo gilvus*. A casual migrant, rare in late August. Our only record is that of two birds observed on August 22, 1962 (TVA).

BLACK AND WHITE WARBLER, *Mniotilta varia*. A regular migrant, uncommon in August and September; August 11 (1962) to September 13 (1962).

NASHVILLE WARBLER, *Vermivora ruficapilla*. A casual migrant, rare in early September. Our only record is that of two birds observed on September 8, 1962 (TVA).

MAGNOLIA WARBLER, *Dendroica magnolia*. An irregular migrant, rare in early and mid-September. All records follow:

September 4, 1962.....3 (TVA)
September 13, 1963.....1 (TVA)

CAPE MAY WARBLER, *Dendroica tigrina*. An irregular migrant, rare from mid-September to early October. All records follow:

September 13, 1962.....3 (TVA)
September 14, 1962.....3 (DSH and TVA)
October 7, 1961.....1 (DSH)

BLACK-THROATED BLUE WARBLER, *Dendroica caerulescens*. A regular migrant, uncommon from early September to mid-October; September 4 (1962) to October 13 (1962).

MYRTLE WARBLER, *Dendroica coronata*. A regular migrant, uncommon from mid-August to mid-October; August 18 (1963) to October 13 (1963).

BLACK-THROATED GREEN WARBLER, *Dendroica virens*. A regular migrant, uncommon to fairly common in September, and uncommon in October; September 8 (1963) to October 13 (1963).

BLACKBURNIAN WARBLER, *Dendroica fusca*. An irregular migrant, rare from late August to mid-September. All records follow:

August 22, 1962.....1 (TVA)
August 27, 1963.....3 (TVA)
September 13, 1962.....2 (TVA)

CHESTNUT-SIDED WARBLER, *Dendroica pensylvanica*. A casual migrant, rare in late August. Our only record is that of two birds observed on August 22, 1962 (TVA).

BLACKPOLL WARBLER, *Dendroica striata*. A casual migrant, very rare in early September. Our single record is one bird observed on September 8, 1962 (TVA).

OVENBIRD, *Seiurus aurocapillus*. A regular migrant, rare from mid-August to mid-September. All records follow:

August 17, 1963.....1 (DSH)
September 2, 1961.....1 (DSH)
September 13, 1962.....2 (TVA)

YELLOWTHROAT, *Geothlypis trichas*. A casual migrant, very rare in mid-September. Our single record is one bird seen on September 16, 1963 (DSH and TVA).

AMERICAN REDSTART, *Setophaga ruticilla*. An irregular migrant, rare in early September. All records follow:

September 4, 1962.....1 (TVA)
September 13, 1962.....1 (TVA)

REDWINGED BLACKBIRD, *Agelaius phoeniceus*. A casual migrant, fairly common in mid-October. Our single record is that of 10+ birds observed on October 14, 1962 (DSH).

BALTIMORE ORIOLE, *Icterus galbula*. A casual migrant, very rare in late August. Our single record is one bird observed on August 27, 1961 (DSH).

COMMON GRACKLE, *Quiscalus quiscula*. An irregular migrant, abundant from mid-October to late October, and uncommon in early November; October 13 (1962) to November 9 (1963).

SCARLET TANAGER, *Piranga olivacea*. An irregular migrant, rare from late August to early September. All records follow:

August 22, 1962.....2 (TVA)
August 27, 1963.....1 (TVA)
September 8, 1962.....3 (TVA)

ROSE-BREASTED GROSBEAK, *Pheucticus ludovicianus*. A casual migrant, very rare in mid-September. Our single record is one bird observed on September 15, 1962 (DSH and TVA).

EVENING GROSBEAK, *Hesperiphona vespertina*. An irregular migrant, fairly common to common in November; November 3 (1963) to November 23 1962).

PURPLE FINCH, *Carpodacus purpureus*. A regular migrant, uncommon in September and October, and fairly common in early November; September 8 (1963) to November 23 (1963).

PINE SISKIN, *Spinus pinus*. An irregular migrant, common from mid-November to late November. All records follow:

November 16, 1963 ..... 64 (DSH)
November 23, 1962 ..... 25 (DSH)
November 24, 1963 ..... 40+ (DSH)

AMERICAN GOLDFINCH, *Spinus tristis*. A regular migrant, uncommon in August and September, NO OCTOBER RECORDS, and fairly common in November; August 11 (1963) to November 16 (1963).

RED CROSSBILL, *Loxia curvirostra*. A casual migrant, rare in mid-November. Our only record is that of three birds observed on November 16, 1963 (DSH).

WHITE-WINGED CROSSBILL, *Loxia leucoptera*. A casual migrant, very rare in late November. Our only record is that of one bird observed on November 24, 1963 (DSH).

RUFOUS-SIDED TOWHEE, *Pipilo erythrophthalmus*. A resident, uncommon to fairly common in August, September, and early October; August 3 (1963) to October 7 (1961).

SLATE-COLORED JUNCO, *Junco hyemalis*. A resident during autumn and winter, uncommon in late September, and uncommon to fairly common during October and November; September 20 (1963) to November 24 (1963).

WHITE-THROATED SPARROW, *Zonotrichia albicollis*. A regular migrant, very rare in mid-October. All records follow:

October 7, 1961 ..... 1 (DSH)
October 13, 1962 ..... 1 (TVA)
October 13, 1963 ..... 1 (DSH)

SNOW BUNTING, *Plectrophenax nivalis*. A casual migrant, the only record being one bird observed on November 16, 1963 (DSH).

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SUMMARY

Little ornithological work has been done in Lehigh County, Pennsylvania. During the autumns of 1961 to 1963, at Bake Oven Knob, bird migration observations were made. BOK is located on the Kittatinny Ridge 20 miles north of Allentown, Pennsylvania, and 16 miles east of Hawk Mountain Sanctuary. Its geology resulted from differential weathering and erosion. It reaches an elevation of 1600 feet. BOK ecology is characterized by an overlapping of the Alleghanian and the Carolinian life zones. The Red-tailed Hawk flight for 9 November 1963 produced a bimodal curve. Bald Eagles show one peak movement. Golden Eagles produced a trimodal movement curve. Direct comparisons of select BOK-Hawk Mountain hawk flights vary in agreement. Yearly hawk totals for Hawk Mountain are higher than similar totals for BOK. Yearly percentages of passing hawks for Hawk Mountain and for BOK vary in agreement. The difference in the number of Broad-winged Hawks passing BOK and Hawk Mountain during 1961-1963 was statistically significant. Our Trans-Mountain Drift Hypothesis partially explains this by postulating that Broad-wings fly diagonally across the Kittatinny Ridge and more northern mountains on northeast winds. An annotated account gives the autumn migration status of 90 species of birds observed at BOK.

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326 South 16th Street, Allentown, Pennsylvania

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