

**The Allegheny Front Migration Observatory:  
A Long-term Bird Banding Project**

George A. Hall



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### INTRODUCTION

In October 1950 members of the Brooks Bird Club first visited the Allegheny Front in West Virginia to count migrating raptors passing the rock outcrop known as Bear Rocks. In the following years, Club outings or individual visits were a popular feature of the autumn season. In addition to raptors, large numbers of passerines, mostly warblers, were seen flying, also, along the Front (Davis, 1952; Hall, 1955; 1958) on some days.

In the fall of 1957, Ralph K. Bell (Bell, 2005), a bird bander who had witnessed the warbler flight, and the writer in April 1958 (at that time not a bander) independently conceived the idea of operating a banding station in the Bear Rocks area to study the fall migration as a part of the "Operation Recovery" program of the U.S. Fish and Wildlife Service. Bell and Hall got together and made plans for a pilot project that fall.

In September 1958, Bell and a few helpers set up several mist nets in the vicinity of a primitive campground, then known as the old Red Creek cabin site, in the Monongahela National Forest, Tucker County, West Virginia. From this small beginning grew one of the major fall banding stations in the eastern United States, now known as the Allegheny Front Migration Observatory (AFMO). During the long weekend of September 18-21, 1958, 54 birds of 19 species were banded, despite some abominable weather (Bell, 1959). In 1959 a more intensive program was carried out at the campground during an 11-day stay, and on several weekends in September and October, with 432 birds banded (Knight, 1960). Bell and Hall operated a two-man weekend program with occasional helpers for several years. In 1963 when net lanes were first established on the rim of the Allegheny Front escarpment, the number of captures increased markedly, and after 1965, banding in the campground was discontinued. Several other banders began to participate for varying lengths of time, and a number of people were trained to handle birds in the nets.

By the early 1970s, it became possible to operate the station full-time, and gradually the standardized program of operation used today was established. The station opens on or near August 15 and closes about October 15 with occasional days of operation in late October. The history of the project is covered in more detail by Hooker (n.d.) and Pattison (2003). The station has been manned entirely by unpaid volunteers over the years. Fifty banders, some of whom learned the craft at the station, have worked there, some of them for many years (Appendix A). Probably, several hundred additional people have helped in netting, transporting birds, weighing birds, clerking, and

other nonbanding tasks. Some of these volunteers, also, have years of service, and some ultimately became banders.

In the early years of the project the banders might be the only people on the mountain, but in the late 1960s and early 1970s, the region was "discovered" by outdoors enthusiasts and environmentalists. This brought many visitors to the area and, of course, to the banding station. The increase of visitors brought publicity, which extended well beyond the local region, and this publicity attracted still more visitors. A "Visitor's Register" was started in 1978, and through the 2000 season, nearly 34,000 signatures were recorded. Among these visitors have been classes of students from grade school to the college level. Many groups make annual visits to the Observatory. In some years, a "demonstration bander" has lectured on bird banding and demonstrated the procedures to visitors.

From the beginning the expenses of the station were met entirely by the banders, but in recent years the Brooks Bird Club has paid for some of the nets. Contributions from visitors have paid for incidentals, and the U.S. Forest Service has waived the campground fees for two campsites through the season.

The purpose of this monograph is to summarize the work done at this banding station from 1958 through the 2000 season. In those 43 years, 184,773 birds of 119 forms were banded. While the data for most of these years have been published (Appendix B), no long-term summary of the results has been written previously. A five-year summary (Hall, 1964), a descriptive paper (Hall & Bell, 1981), and a series of short papers on migration dates (Hooker, 1985, 1986, 1987, n.d.) and patterns (Hall, 1981) have been published. Bell published several anecdotal, seasonal accounts (Bell 1964, 1965, 1966, 1967, 1968, 1969, 1970, 1971) and a paper on recoveries of banded birds (Bell, 2003).

### THE LOCATION

#### The Mountain

The Allegheny Front, a prominent geographic feature of eastern United States, is a long ridge running in a northeast to southwest direction from its origin in central Pennsylvania to eastern West Virginia. It forms the boundary between the folded Appalachian Mountains in the Ridge and Valley physiographic province and the uplifted Allegheny Plateau, and over some of its length is the continental divide separating the Atlantic (Potomac River) drainage from the Gulf (Ohio River) drainage. The eastern face of the mountain is a steep escarpment rising abruptly

from the valley. From the top of this escarpment, which is frequently marked by large outcrops of Pottsville conglomerate, a broad plateau slopes gently to the west for several miles before reaching the other side of the mountain. The elevation of the summit increases from north to south.

The narrow valley to the east is occupied by a mixture of farm land and patches of deciduous forest. The mature second-growth Oak-Chestnut forest (Braun, 1950) on the lower slopes of the escarpment blends into a Northern Hardwoods forest near the summit. Above 900 m (3,000 ft.), the plateau was originally covered with a nearly pure stand of Red Spruce (*Picea rubens*). At the edge of the escarpment this forest blended into the Northern Hardwoods forest. Most of the original forest was cut in the early part of the Twentieth Century. Widespread and intense fires followed the cutting, and much of the organic portion of the soil was burned. The subsequent low fertility of the soil, combined with the rigor of the winters, produced a regenerated plant cover of stunted spruces, scrubby deciduous trees, and bushes on the plateau. There are extensive areas of blueberries (*Vaccinium* spp.) and other heaths, grasslands, boulder fields, and a few sphagnum bogs. The general aspect near the Observatory resembles some parts of boreal Canada.

Before the lumber operations, a few areas of grasslands, known locally as "sods," were present, and the area near the banding station is known as "Dolly Sods," a name derived from one of these grasslands owned by the Dahle family of German immigrants.

#### The Banding Station

The banding station is located on the rim of the Allegheny Front escarpment in the Monongahela National Forest, Grant County, West Virginia, at latitude 39° 02' North, longitude 79° 18.76' West at an elevation of 1,130 m (3,719 ft.). At this location the top of the escarpment has an elevation of 1,150-1,200 m (3,800-4,000 ft.). The eastern slope drops steeply to the top of some foothills, known as the Fore Knobs, at an elevation of about 850 m (2,800 ft.) and then steeply to 450-500 m (1,500-1,600 ft.). An intermittent stream, flowing west to east, has cut a pronounced ravine in the escarpment, forming a shallow, one-mile-wide "pass" with high points of about 1,200 m (4,000 ft.). This pass interrupts the general southwesterly trend of the escarpment, which curves strongly to the east and then returns to its original direction (Figure 1).

The mist nets used at the banding station are located along the rim of the escarpment or slightly below the edge of the basin formed by the ravine. An assortment of 6 m, 9 m, and 12 m nets, which gives an equivalent of twenty 9 m nets, is used, and all have mesh size of 30 mm, which is most efficient for capturing warblers but will not catch

some larger birds. The nets are arranged in three lines located in a variety of habitats. Most nets are surrounded by scrubby heaths, but some are in spruce groves, some in deciduous trees, and some over rock fields. Over the years the growth of the vegetation at the net lanes has produced a major problem. The rigorous winter conditions had severely limited the growth of the regenerating forest for many years, especially the spruces, but eventually these trees did grow large enough that the birds were flying too high to be netted. It has become necessary, therefore, to cut and trim the vegetation periodically.

### THE MIGRATION

#### The Bird Movement

At the outcrop known as Bear Rocks, about five km north of the AFMO station, many migrating passerine birds can be observed flying in loose "bundles" on a course parallel to the ridge and just below the lip of the escarpment, where they have some protection from the usually strong west winds. It is assumed that the flight continues in this manner until the birds reach the break in the escarpment at the banding station. To continue to follow the ridge line they would have to depart from their southwesterly orientation and fly due east to round the projection of one of the Fore Knobs, which is the western boundary of the pass. Either they are unwilling to do that, or the southwesterly flight direction is so imprinted on them, that they continue in that direction, flying up the ravine and crossing the mountain through the pass. They do this in the face of the strong headwinds as they arrive at the rim of the plateau. Because of these headwinds, many of the birds reaching the top of the pass are flying low enough to be caught in the mist nets, but only a small, but unknown, fraction of the birds flying up the slope are netted. Once at the top, those not caught continue to fly the southwesterly course.

The raptors flying along this mountain are usually high enough to see across the irregularity in the ridge, and many of them pick up the ridge farther south, although some of them may cross the mountain in the pass to the north of the station.

#### The Season

When the station opens in the middle of August, the weather is normally hot and dry, and the few birds caught will be mostly locally breeding species, e.g., Dark-eyed Juncos, Hermit Thrushes, Common Yellowthroats, and one or two other warbler species. Most of these will be birds of the year or hatch year birds (HY), but the catch will include some older, after hatch year birds (AHY), a few of which may have been banded here in earlier years. A few early migrants from the North will be caught. Once the local birds learn to avoid the nets, the daily capture number

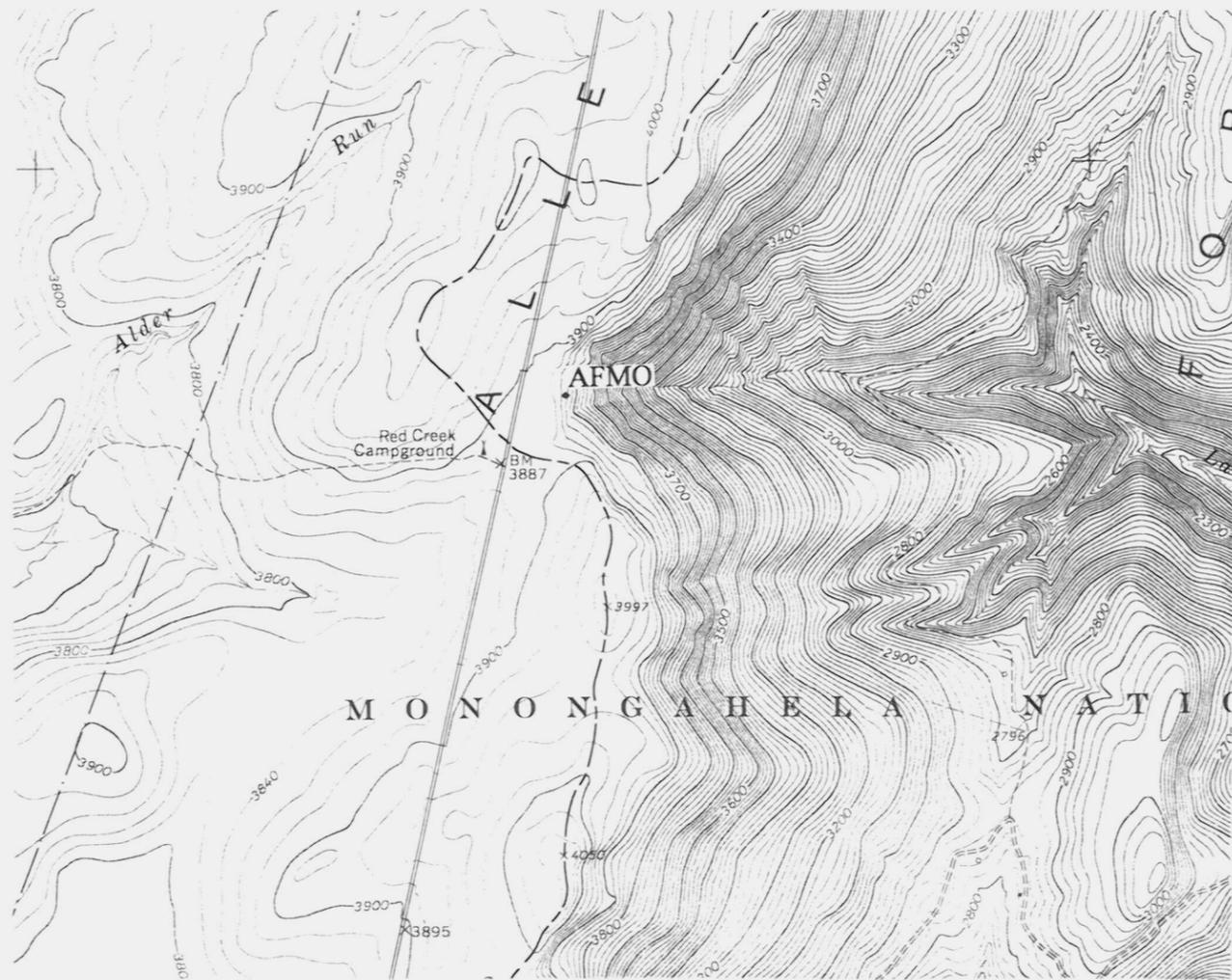


Figure 1. Topographic map (U.S.G.S.) with location of banding station.

will be quite low, often fewer than ten, but occasionally as many as 20-30.

This period of relative inactivity will be broken with the arrival of the first wave of true migrants, which usually occurs a day or two before or after the first of September, and usually lasts about three days. The peak daily banding count will normally be 100-150. This wave will be followed by another period lasting from a week to ten days, during which only small numbers of migrants will be caught. The second big wave will arrive in mid-September and will be followed by a series of waves interrupted by a few days of poor flights. Typically these waves last three to four days: a preliminary day with moderate numbers, a peak day with a high count followed by one or two "echo flight" days with numbers lower than the peak. Figure 2 shows the pattern of a typical year. The series of strong waves continues at least until October 1, with the heaviest flights usually in the last third of September. Occasionally the peak may be a little earlier or, more frequently, will

come near the end of the month. During October, the pattern continues, but the waves are generally not so heavy and the weather is often unfavorable. Over the years there have been many exceptions to the pattern outlined here. This was particularly true during the 1990s when the yearly totals were comparatively low.

The daily banding totals can be quite high at AFMO. Days with 400 captures are fairly common, and in most years, several daily counts will be that high. The highest one-day count was 1,128 birds on September 8, 1985. Fortunately this was on a weekend when five banders and numerous net-tenders were available. There had been 907 captures on the 7th, and on the 9th, 714 birds were banded even though a lack of manpower had caused the nets to be closed early. But the daily numbers are also often very low. In the 1990s the highest daily capture numbers were only about 250. Even in good years there may be days with as few as 10 to 20 birds banded.

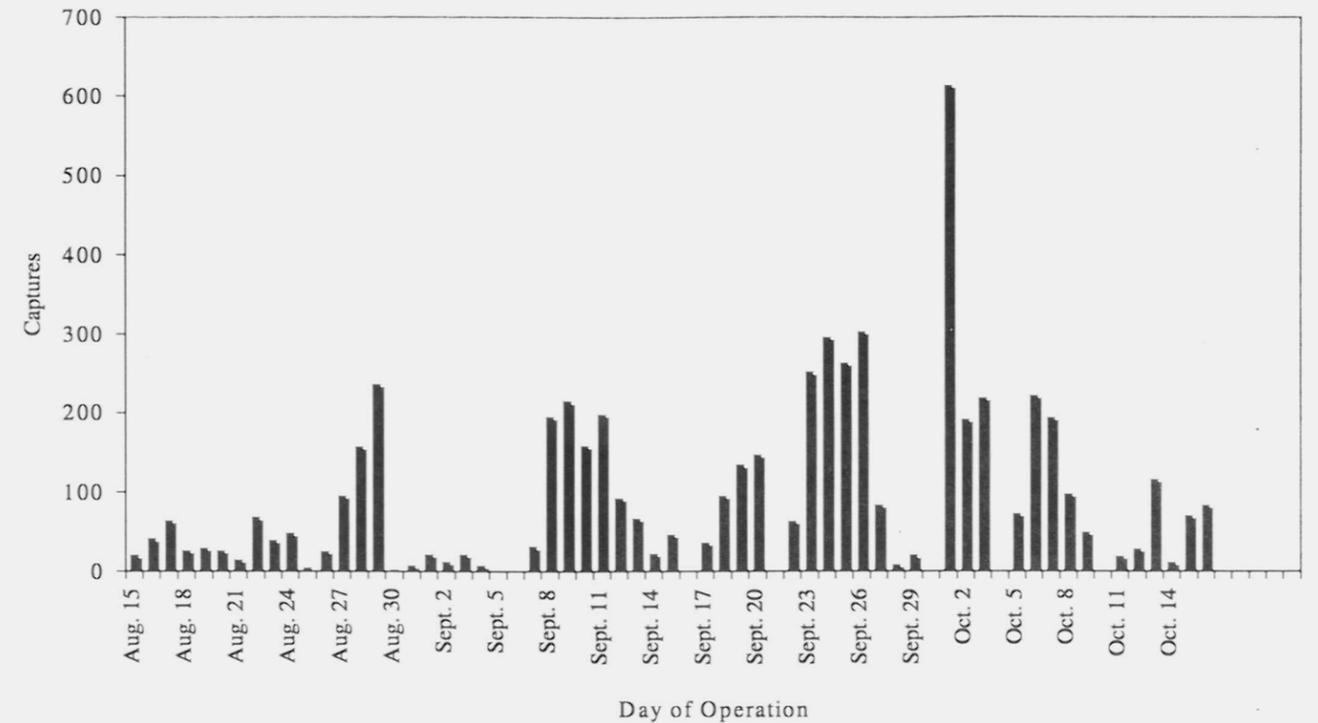


Figure 2. Daily capture numbers for the 1999 season.

#### The Weather and Heavy Count Days

The daily weather patterns are primary factors determining the day's capture numbers, and the cumulative weather pattern for the season is one of the major factors controlling the total number of bandings for the year. The number of birds caught on a given day largely depends upon the weather in the "North," the undefined and only vaguely known location where the migrants start their flight, and the weather at the AFMO station. Favorable weather at both of these locations will occur after an atmospheric LOW when a strong associated cold front has passed through the Northeast. In the North those migrants that are physiologically prepared may initiate a migratory flight if any precipitation connected with the cold front has ceased, the temperature has dropped, and the winds are favorable for their desired flight direction.

At AFMO, a good flight will occur only if the wind is from the northwest quadrant and has been from that direction overnight, and it is not raining. These conditions may be met on the backside of a LOW after any precipitation associated with the front has ceased. Figure 3 shows weather conditions in eastern North America the day before the largest number of bandings made on a single day in AFMO history, September 8, 1985. On several occasions, it has been noted the flight came even when the cold front became occluded before it reached as far south as the Observatory.

If the wind is from any other direction, no flight will

occur, but a few birds that may have spent the night in the immediate area may be caught at dawn. In several years in the mid-1990s, a succession of strong HIGH pressure areas off the Virginia and Carolina capes for most of September resulted in day after day of east winds. Captures at AFMO were few during most of those seasons. It is not known if the birds migrated by some other route under those climatic conditions.

No birds will fly on a rainy day, and a rain shower that starts during the morning flight will stop all movement. If a predawn shower ends and the sky starts to clear by about 8 o'clock, a good flight will sometimes occur on a deferred time schedule. No heavy flight movement will occur when the mountaintop is covered with dense fog, a not uncommon occurrence, although migrating thrushes sometimes land in numbers on foggy mornings.

On several occasions, heavy all-day rains have resulted as a hurricane swept up the east coast. Such events usually resulted in one or two days of closure followed by a big count day. This was especially true in 1999 when two periods of closure due to hurricanes resulted in big days. A third big day in that year came after the station had been closed for a day due to winds that were too strong to carry out netting operations.

The Observatory may experience subfreezing temperatures in the early morning at any time, and snow may occur at any time after mid-September, but this seems to have no effect on the birds.

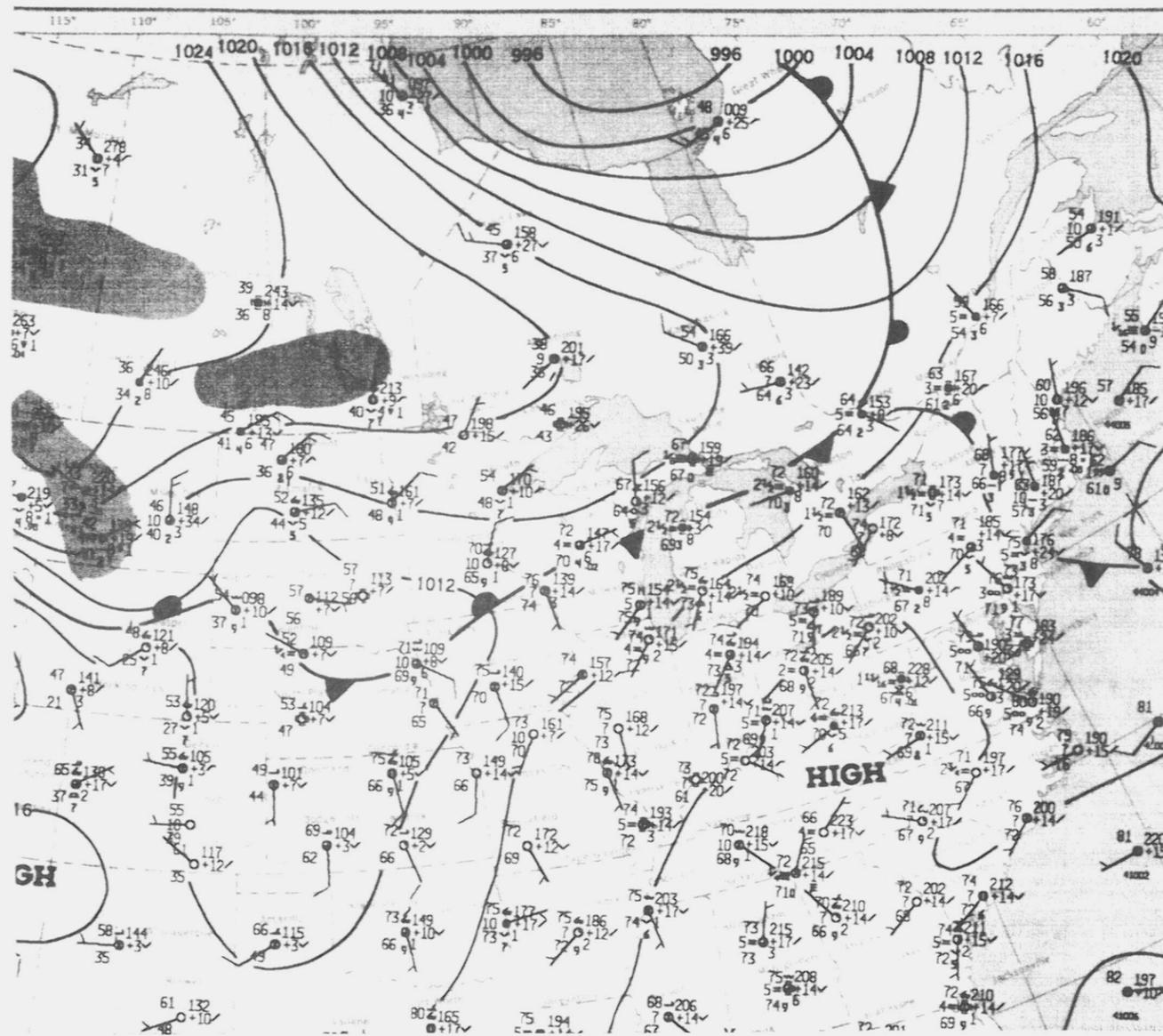


Figure 3. U.S. weather map showing approaching front on Saturday, September 7, 1985.

#### The Day's Flight

That a day is going to have a good flight can often be predicted the night before. If the sky is clear, or nearly so, and the wind is strong out of the northwest quadrant, the prospects for a good flight the next morning are excellent. If these conditions still obtain an hour before sunrise a heavy flight is almost certain. In the early part of the night the characteristic flight calls of migrating warblers may be heard. Before sunrise a few thrush calls may be heard, but these are more prevalent if the mountaintop is covered by a light mist. Oddly enough in view of what is to come, few warbler calls are heard. As the darkness begins to fade, the resident Eastern Towhees and Winter Wrens may call. With the first light, birds will begin to come up the slope

and into the nets. Most of these early birds will be thrushes, especially the Swainson's Thrush, and in mid-September, the thrush count may be high. Some of the grassland sparrows will also be caught early. Usually the only warblers will be Ovenbirds and Common Yellowthroats. In the early part of the season, these Yellowthroats may be residents.

This early flight lasts until the sun makes its appearance above the mountain ridges to the east. There usually follows a lull of perhaps 20 to 30 minutes during which few birds will be caught. Then, suddenly, the warblers will appear. The station personnel jokingly say this occurs at 7:20 EDT. On a day of a really heavy flight, the basin below the station will be filled with warblers flying up the slope

against the strong opposing wind. There is no flock structure, and each bird appears to be independent. A little "bundle" of birds will pass and momentarily no birds will be in view, and then another flight will arrive.

The birds seem to materialize in the basin and fly up the slope of the pass, and having reached the top, they continue to fly to the west, thus crossing the mountain. If the wind is too strong, the birds fly low and occasionally stop in the trees or shrubs. Eventually they will fight their way to the top. If the wind velocity is too low, they fly high over the net lanes, and few will be caught. Thus a large number of captures depends on having a wind of intermediate velocities. Under strong wind conditions, not only will few reach the top, but the nets will be blown taut so that birds bounce off the extended net and are not entangled. The heavy flight will continue until about 10 o'clock if the wind remains strong out of the northwest quadrant. Gradually the numbers dwindle and by noon the flight is usually over.

A small number of stragglers may be caught in the afternoon, but the nets are generally not kept open after 12 o'clock. A shift in the wind, a rain shower, or a blanketing cloud will end the flight. On some days, what was thought to be a weak west wind at first light was really the down-slope draft characteristic of mountains in the early morning. A small flight then may occur at dawn, but as the day warms, the up-slope draft takes over, producing a pseudo east wind, which stops the flight earlier than usual.

The number of birds caught may sometimes border on the fantastic. On one memorable occasion, 60 birds were counted in one 9 m net. Birds kept hitting into the net while the net-tender was trying to remove them, and when the net was finally cleared, it was found that 80 birds had been caught in that one net. On some days when there were too few banders and net-tenders available, the nets had to be closed as early as 8 o'clock.

If the wind is out of the south or east, there will be very few birds flying, and the only catches of the day will be a few local birds caught at dawn.

#### The Fall Flight Direction at AFMO

The species banded fall into three main categories: (1) the thrushes, and a few other species, that end a nocturnal flight by landing shortly after first light; (2) the warblers, which fly in large numbers for three to four hours after sunrise; and (3) diurnal migrants (e.g., Blue Jays and American Robins). The behavior of the warblers strongly indicates that this morning flight is still a part of the migration. Unlike the small flocks of migrant warblers often seen in the lowlands, these birds are not feeding as they move. Their flight is purposeful and direct. Below the level of the escarpment rim, the winds may be tail winds, but once the birds rise to the rim, they are fighting an

opposing wind, and they continue to do so. Once they reach the top they show no signs of stopping to feed, but continue across the plateau for some unknown length of time. According to the received wisdom in textbooks, the members of the Parulidae are nocturnal migrants. How does the morning flight of warblers seen at AFMO fit in with a nocturnal flight plan? Each species has a genetically fixed standard direction (Matthews, 1968) that determines the initial heading the bird will fly when starting its southward flight in the fall. For most of the boreal warblers treated here, this direction is probably within a few degrees on either side of South. The birds have been stimulated to migrate by the passage of a low pressure system and cold front. Strong westerly winds on the backside of the LOW are to some degree tail winds for a bird trying to fly south. The birds are displaced to the east because the realized compass heading is a resultant of the wind direction imposed on the standard direction.

The birds are flying a broad flight path high over the topography of the land below. This flight ends when the birds come down and land in the predawn hours shortly after midnight. (Matthews, 1968). They rest until after the sun is well up, thus accounting for the absence of warbler calls at dawn. After a period of time, they take off and attempt to correct for the eastward displacement. This is done by flying in a direction that is perpendicular to the standard direction. The post dawn takeoff and corrective flight have been observed in the Piedmont area of South Carolina (Gauthreaux, 1978).

The "corrective flight" for the birds in the Allegheny Front region is in a westerly direction and undoubtedly takes place on a broad front. Concentration occurs when the westward flying birds reach the topographic feature of the mountain ridge. "Trapped" on this feature that acts as a "leading line," they turn and follow the ridge southwestwardly to the ravine where they deviate from the leading line and cross the mountain. This corrective flight is analogous to the daytime flights on the Atlantic Coast where birds blown out to sea in the night correct for the displacement at dawn by flying west to land, and then are deflected south by the strong leading line of the ocean/coast interface.

The combination of weather and topography that produce the heavy migrant flights at this station in the autumn are not effective on the northbound flight in the spring. Thus the AFMO project does not have a spring component.

#### THE RESULTS

In 43 years, 184,773 birds of 117 species and two hybrids have been banded (Table 1a-b). The annual total bandings have varied widely (Figure 4). Before 1972, banding was not standardized, and there were gaps in the day-to-day operations. Table 1a shows a major increase in banding totals beginning in 1963, which marks the reloca-

tion of the mist-netting area from the campground to its present location at the rim of the escarpment. From 1972 to the present, the operation has followed a standardized protocol with netting done on every day that had suitable weather. Data analysis was done for 1973-2000 (Table 1b). Table 2 lists the species together with the banding totals and yearly averages. The Wood Warblers (Parulidae) make up 73% of all bandings. Table 3 gives the number of bandings for the ten most common species. These ten, of which eight are warblers, make up 72.5% of the total, and the 20 most numerous species make up 86%.

#### The Migrant Groups

The species banded at AFMO can be divided into four groups (Table 4): long distance migrants (LDM), short distance migrants (SDM), nonmigrants (NM), and unanalyzed species (U).

Long distance migrants (LDM) are the species that winter south of the of the border of the United States, largely in Latin America. For the purposes of this discussion, the term long distance migrants is equivalent to the term Neotropical or Nearctic migrants of the literature. This group contains most of the warblers, thrushes, fly-

Table 1a-b  
Annual Banding Numbers  
for the Years 1958-1972 and 1973-2000

1a 1958-1972				1b 1973-2000			
Year	Bandings	net-hr	b/100nh	Year	Bandings	net-hr	b/100nh
1958	54	323	16.7	1973	4,743	3,286	144.3
1959	432	2,023	21.4	1974	7,171	2,522	284.3
1960	324	1,492	21.7	1975	3,889	2,231	174.3
1961	579	2,390	24.2	1976	4,940	2,611	189.2
1962	448	1,842	24.3	1977	7,544	3,689	204.5
1963	1,056	3,128	33.8	1978	6,792	3,578	189.8
1964	1,390	2,740	50.7	1979	3,050	3,702	82.4
1965	3,492	4,638	75.3	1980	7,099	4,800	147.9
1966	2,989	2,772	107.8	1981	9,220	4,214	218.8
1967	954	2,112	45.2	1982	6,708	4,702	142.7
1968	2,111	1,879	112.3	1983	9,367	5,598	167.3
1969	1,469	1,469	100.0	1984	5,818	5,133	113.3
1970	2,522	1,660	151.9	1985	8,506	5,156	165.0
1971	977	939	104.0	1986	8,778	5,358	163.8
1972	2,751	1,880	146.3	1987	7,911	4,996	158.3
				1988	6,344	6,087	104.2
Total	21,548	31,287	68.9	1989	4,152	5,870	70.7
Average	1,436.5	2,100.5	68.4	1990	4,991	6,446	77.4
				1991	8,212	7,231	113.6
				1992	3,866	6,875	56.2
				1993	3,979	7,756	49.0
				1994	4,024	6,895	58.4
				1995	3,181	7,586	41.9
				1996	2,002	6,792	29.5
				1997	3,843	7,648	50.2
				1998	8,585	8,549	100.4
				1999	5,662	6,796	83.3
				2000	3,007	6,000	50.1
				Total	163,202	152,107	107.29
				Average	5,828.6	5,432.4	125.2

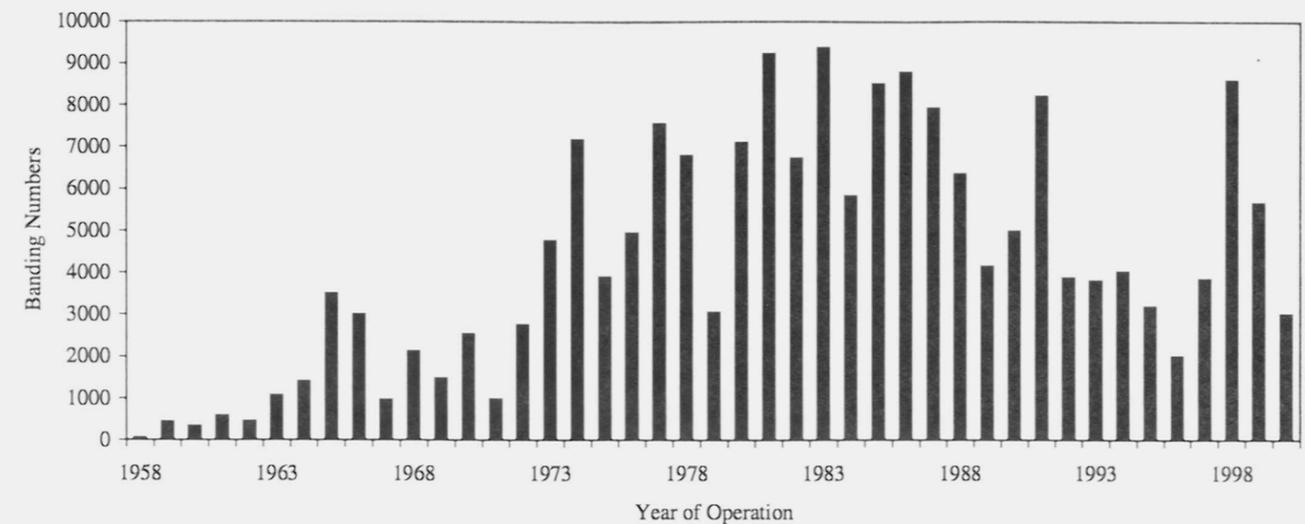


Figure 4. Annual banding numbers versus year of operation.

catchers, and vireos. These species may be further divided into three subgroups: (LDMa) species such as the Blackpoll Warbler whose breeding range is predominantly to the north of West Virginia); (LDMb) species for which West Virginia is located more or less in the latitudinal middle of the breeding range; and (LDMc) species for which West Virginia is at or near the northern limit of the breeding range. Some subgroup (LDMa) species do nest at high elevations in West Virginia, but the majority of the populations breeds to the north.

By considering the numbers of birds available to migrate south past AFMO, one can predict qualitatively the numbers of each of the subgroups. The species of subgroup (LDMa) provide 73% of the total captures and nine of the ten leading species are of this group. Only 9% of the total captures come from species of subgroup (LDMb), and the species of subgroup (LDMc) contribute less than one per cent of the total, since relatively small numbers of this subgroup nest to the north of AFMO.

A few species of each subgroup will have essentially completed their fall migration in this region before the station opens in mid-August. Thus few Mourning Warblers, subgroup (LDMa); Yellow Warblers, subgroup (LDMb); and Louisiana Waterthrushes, subgroup (LDMc), are captured.

The Short Distance Migrants (SDM) are the species for which the majority of the population winters in continental United States. The most numerous of these are late season migrants: Blue Jay, both kinglet species, White-throated Sparrow, Dark-eyed Junco, and American Goldfinch. The annual numbers of these species are greatly dependent on whether the station closes before the peak of the flight occurs.

The Nonmigrants (NM) are species that are permanent

residents in the region of the station. The birds caught are frequently post-breeding wanderers, such as the chickadees, which are often caught in family groups.

The Unanalyzed (U) species are seven species that do not comfortably fit in any of the groups.

Table 2 gives the group assignment for each species. This assignment is often rather arbitrary as some species may fit in more than one category. Thus the Dark-eyed Junco is both a permanent resident and a short-distance migrant.

#### The Source and Destination of the Migrants

Forty-nine birds banded at this station have been recovered elsewhere, and nine birds banded elsewhere have been caught here (Bell, 2003). Of these records, 29 provide information useful in estimating the probable source or destination of the Nearctic migrants.

For 18 records of southbound migrants, 9 come from locations that are northeast of the station, 5 come from locations that are northwest of the station, and 4 come from due north of the station. Of these only two records are of birds known to be on the breeding grounds. Of the 11 records from the south of the station, 6 come from Central America, Mexico, or the Gulf Coast of Texas, and 5 come from the West Indies or Florida.

The numbers of the three "budworm specialists," which at first increased and then decreased in parallel with a new outbreak of the insect in the spruce forests north of Quebec City, also suggest the northeast being the source of most of the birds caught at this station.

It appears that the birds banded at this station come from several places in the North and depart by several routes to the wintering grounds. Their occurrence along the mountain ridge at AFMO is thus a temporary deviation

Table 2  
Number of Bandings by Species for the Periods 1958-2000 and 1973-2000,  
Average Bandings, Range, and Migrant Category

Species	Bandings 1958-1972	Bandings 1973-2000	Avg. Bandings 1958-2000	Range	Migrant Category
Sharp-shinned Hawk	88	79			SDM
Cooper's Hawk	3	2			U
Merlin	6	6			U
American Woodcock	28	15			SDM
Black-billed Cuckoo	16	7			LDMb
Yellow-billed Cuckoo	12	7			LDMb
Eastern Screech-Owl	7	4			NM
Northern Saw-whet Owl	69	49			SDM
Whip-poor-will	17	5			SDM
Ruby-throated Hummingbird	30	1			LDMb
Red-headed Woodpecker	6	3			SDM
Red-bellied Woodpecker	3	2			NM
Yellow-bellied Sapsucker	169	123	4.7	0-16	SDM
Downy Woodpecker	194	138	4.9	0-15	NM
Hairy Woodpecker	18	15			NM
Northern Flicker	44	34			SDM
Olive-sided Flycatcher	2	2			LDMa
Eastern Wood Pewee	156	117	4.5	0-13	LDMb
Yellow-bellied Flycatcher	137	104	3.8	0-14	LDMa
Acadian Flycatcher	25	21			LDMb
"Traill's" Flycatcher	37	32			LDMb
Least Flycatcher	133	83			LDMb
Eastern Phoebe	31	23			SDM
Great Crested Flycatcher	2	2			LDMb
Eastern Kingbird	1	1			LDMb
White-eyed Vireo	16	15			LDMc
Yellow-throated Vireo	49	43			LDMb
Blue-headed Vireo	391	349	3	2-31	LDMa
Warbling Vireo	7	7			LDMb
Philadelphia Vireo	682	541	19.0	1-60	LDMa
Red-eyed Vireo	2,134	1,736	60.4	15-161	LDMb
Blue Jay	3,598	2,865	98.2	2-389	SDM
Carolina Chickadee	7	7			NM
Black-capped Chickadee	794	582	20.3	6-52	NM
Tufted Titmouse	193	127	4.7	0-17	NM
Red-breasted Nuthatch	742	615	22.2	0-114	SDM
White-breasted Nuthatch	131	94	3.5	0-14	NM
Brown Creeper	783	647	22.9	2-85	SDM
Carolina Wren	3				NM
Bewick's Wren	9	6			U
House Wren	53	47			SDM
Winter Wren	437	416	14.3	2-37	SDM
Golden-crowned Kinglet	5,434	5,142	17.8	3-677	SDM
Ruby-crowned Kinglet	3,061	2,783	95.4	30-227	SDM
Blue-gray Gnatcatcher	80	75			LDMc
Veery	341	312	10.8	1-19	LDMa
Gray-cheeked Thrush	597	449	15.8	1-37	LDMa
Swanson's Thrush	12,028	10,043	351.3	109-592	LDMa
Hermit Thrush	930	838	29	2-71	SDM
Wood Thrush	1,162	1,049	35.6	8-110	LDMb

Species	Bandings 1958-1972	Bandings 1973-2000	Avg. Bandings 1958-2000	Range	Migrant Category
American Robin	767	460	16.5	1-43	DM
Varied Thrush	1	1			U
Gray Catbird	686	442	15.4	4-32	SDM
Brown Thrasher	133	59	2.3	0-6	SDM
European Starling	17	9			U
American Pipit	1	1			U
Cedar Waxwing	320	265	9.2	0-25	SDM
Blue-winged Warbler	35	34			LDMb
Golden-winged Warbler	49	43			LDMb
Vermivora hybrids	4	4			
Tennessee Warbler	20,966	19,300	678.3	83-1,948	LDMa
Orange-crowned Warbler	36	311			LDMa
Nashville Warbler	2,254	2,039	70.9	12-182	LDMa
Northern Parula	190	185	6.4	0-27	LDMb
Yellow Warbler	13	11			LDMb
Chestnut-sided Warbler	1,500	1,330	46.3	12-118	LDMa
Magnolia Warbler	7,738	6,960	242.6	74-654	LDMa
Cape May Warbler	15,095	14,043	497.6	46-1,224	LDMa
Black-throated Blue Warbler	21,849	20,033	700.5	243-1,229	LDMa
Yellow Rumped Warbler	755	670	24.4	2-219	LDMa
Black-throated Green Warbler	12,713	11,169	409.5	111-1,089	LDMa
Blackburnian Warbler	8,292	7,310	265.3	2-1,103	LDMa
Yellow-throated Warbler	1	1			LDMc
Pine Warbler	21	20			SDM
Prairie Warbler	29	25			LDMc
Palm Warbler	221	198	6.9	1-16	LDMa
Bay-breasted Warbler	7,384	6,467	235.6	10-386	LDMa
Blackpoll Warbler	22,513	20,185	710.1	156-1,415	LDMa
Cerulean Warbler	22	21			LDMb
Black-and-white Warbler	1,135	1,025	35.5	4-97	LDMb
American Redstart	1,370	1,227	42.8	14-104	LDMb
Worm-eating Warbler	161	155	5.4	0-16	LDMb
Ovenbird	3,538	3,019	105.2	33-245	LDMb
Northern Waterthrush	107	89	3.1	0-14	LDMa
Louisiana Waterthrush	21	21			LDMc
Kentucky Warbler	18	16			LDMc
Connecticut Warbler	304	278	9.6	1-34	LDMa
Mourning Warbler	29	28			LDMa
Common Yellowthroat	4,438	3,927	136.6	34-218	LDMb
Hooded Warbler	347	318	11	4-28	LDMc
Wilson's Warbler	1,078	840	29.8	7-66	LDMa
Canada Warbler	519	432	15	2-46	LDMa
Yellow-breasted Chat	3	0			LDMc
Scarlet Tanager	531	405	14.4	0-30	LDMb
Eastern Towhee	770	479	16.9	6-31	SDM
Chipping Sparrow	58	58			SDM
Field Sparrow	267	246	6.5	0-19	SDM
Vesper Sparrow	40	33			SDM
Savannah Sparrow	142	128	4.5	0-10	SDM
Henslow's Sparrow	2	2			SDM
Fox Sparrow	86	72	2.5	0-16	SDM
Song Sparrow	481	396	13.7	1-25	SDM
Lincoln's Sparrow	290	252	8.5	0-21	SDM
Swamp Sparrow	438	328	11.3	1-26	SDM

Species	Bandings 1958-1972	Bandings 1973-2000	Avg. Bandings 1958-2000	Range	Migrant Category
White-throated Sparrow	1,358	1,009	35.8	7-84	SDM
White-crowned Sparrow	174	123	4.3	0-20	SDM
Dark-eyed Junco	5,194	4,596	159.4	28-521	SDM
Northern Cardinal	9	7			NM
Rose-breasted Grosbeak	1,548	1,207	42.4	10-121	LDMb
Indigo Bunting	113	104	3.6	0-12	LDMb
Rusty Blackbird	7	2			SDM
Common Grackle	1	1			SDM
Brown-headed Cowbird	8	7			SDM
Baltimore Oriole	27	17			LDMb
Purple Finch	291	225	7.9	2-24	SDM
Red Crossbill	1	0			U
Pine Siskin	60	52	1.9	0-24	SDM
American Goldfinch	1,200	828	29.1	5-117	SDM

Table 3  
Ten Most Banded Species

Species	Number
Blackpoll Warbler	22,513
Black-throated Blue Warbler	21,849
Tennessee Warbler	20,966
Cape May Warbler	15,095
Black-throated Green Warbler	12,713
Swainson's Thrush	12,028
Blackburnian Warbler	8,292
Magnolia Warbler	7,738
Bay-breasted Warbler	7,384
Golden-crowned Kinglet	5,434
Total	134,012

Table 4  
Categories of Migrants

Category	Species	Number
Long Distance Migrants (LDM)	58	54,003
LDM (a)	21	135,823
LDM (b)	29	17,665
LDM (c)	8	515
Short Distance Migrants (SDM)	42	29,244
Non-Migrants (NM)	10	1,372
Unanalyzed (U)	7	54

from the main routes. This might be termed the "O'Hare Airport effect" because of the similarity to the passengers at a busy airport who arrive from many directions, associate briefly, and then depart in several directions.

#### Migration Dates and Patterns

The banding season at AFMO can be divided into four periods. From August 15 to the last few days of August or first days of September is a period when only a few migrants are present and most of the captures are from the local nesting population. Chestnut-sided, Canada, and Black-and-white Warblers are migrating, and a substantial fraction of these species will have passed the station by the end of this period.

The second period is the beginning of the heavy migration and extends from the arrival of the first wave of migrants through the first two weeks of September. Most of the major species will be caught, although except for Cape May and Blackburnian Warblers, they will not be in high numbers.

The last two weeks of September and the first few days of October will be the peak of the migration. Numbers of birds and number of species caught will be at the highest. The heavy flight of Blue Jays will occur during this period, as will the peak of the Broad-winged Hawk flight. A few early individuals of the October migrants, both kinglets, White-throated Sparrows, and juncos will appear.

The fourth period, from early October to the closing of the station, is characterized by large numbers of birds of fewer species. The possible onset of winter weather may occur at this time.

Figure 5, adapted from Hooker (n.d.), summarizes the time schedule of some of the common species. As seen qualitatively in Figure 5, the typical pattern is a period of heavy migration preceded and succeeded by periods of lesser numbers, which suggests the bell-shaped curve of a normal distribution. Hall (1981) plotted pooled data from

four years in graphs of banding total number versus date. Most of the graphs approximated a normal distribution (Figure 6, Table 5). The Chestnut-sided and Blackburnian Warblers had curves that were greatly skewed to the right; the Magnolia curve had a broad, ill-defined maximum; and with both the Nashville and Wilson's Warblers, there was no peak, as small numbers of birds were caught throughout the season.

Three additional questions could be asked: (1) What is the ratio of first-year birds (HY) to older birds (AHY)? (2) Do the two age-classes migrate synchronously, and if not, which class comes first? (3) Do males and females migrate synchronously, and if not, which sex comes first? Table 5 summarizes the answers to these questions for 12 warbler species. The fraction of AHY birds is low but is much higher than at banding stations on the East Coast, where the captures are almost 100% HY birds. No difference of timing by sex was found for the three species that can be sexed by banders without error (Black-throated Blue, Cape May, and Blackburnian Warblers). Nine species showed synchronous migration for age-classes. The HY Black-throated Blue and Black-throated Green Warblers migrated before the AHY birds, and the AHY Cape May Warblers migrated before the HY birds (Table 5; Hall, 1981). This analysis was done with data from the late 1970s when banding numbers were high. It would be worthwhile to repeat the analysis with recent data.

#### DISCUSSION

##### Changing Numbers of Migrants

The number of bandings per year has varied greatly (Table 1, Figure 4). A sharp increase after 1964 resulted from transfer of the netting area from the campground to the rim. From 1972 to the present, the station was operated every day from about August 15 to about October 15, except on days of bad weather. The number of nets varied somewhat but was essentially constant. Thus, the period of

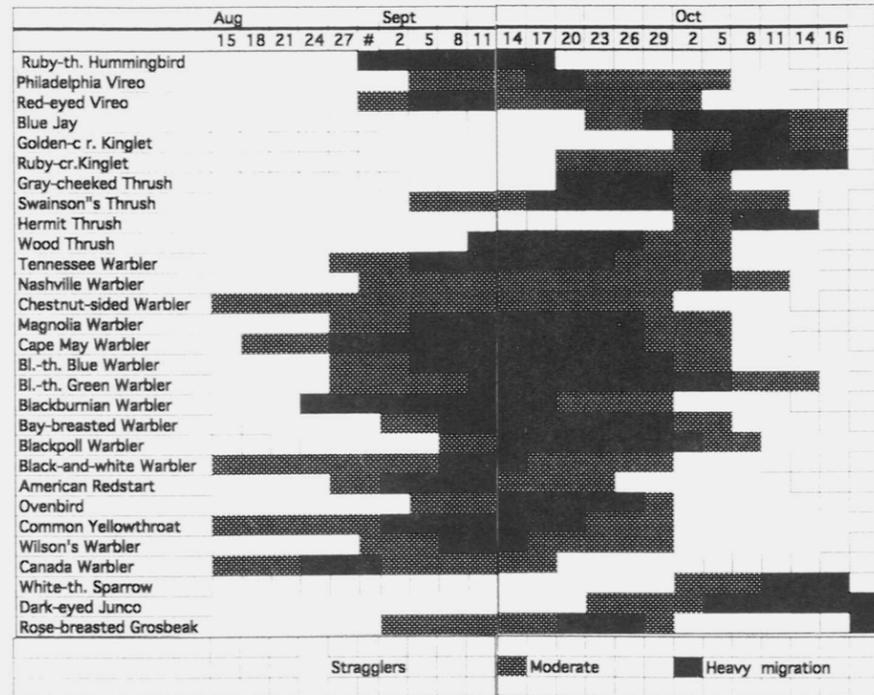


Figure 5. Migration chart for selected species. Adapted from Hooker, n.d.

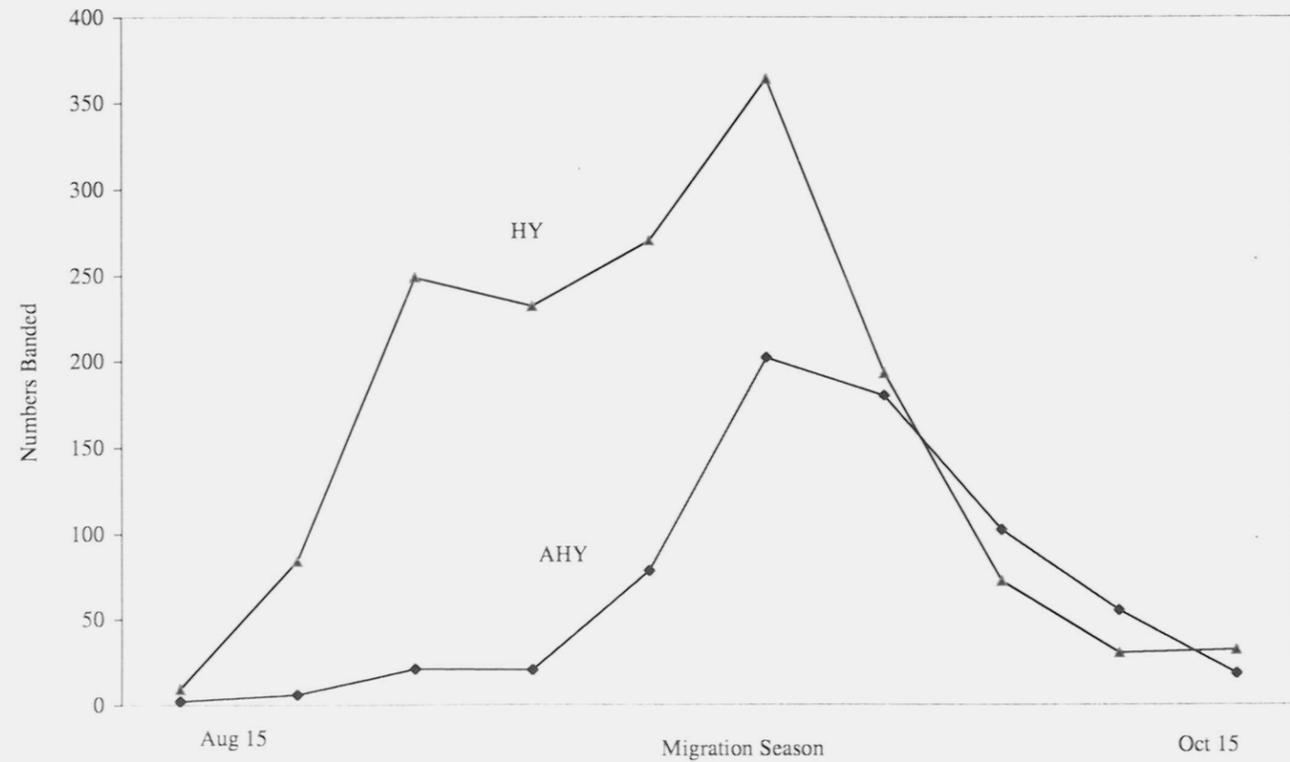


Figure 6. Migration pattern for the Black-throated-Blue Warbler showing different schedule for AHY and HY birds.

Table 5  
Migration Patterns of Warblers

Species	% AHY	Pattern	Timing
Tennessee Warbler	28.7	Normal Distribution	Ages Together
Nashville Warbler	25.6	No Peak	Ages Together
Chestnut-sided Warbler	23.1	Skewed	Ages Together
Magnolia Warbler	35.9	Broad Peak	HY First
Cape May Warbler	33.3	Normal Distribution	AHY First
Black-throated Blue Warbler	31.6	Normal Distribution	HY First
Black-throated Green Warbler	29.5	Normal Distribution	HY First
Blackburnian Warbler	36.7	Skewed	Ages Together
Bay-breasted Warbler	34.8	Normal Distribution	Ages Together
Blackpoll Warbler	48.8	Normal Distribution	Ages Together
Wilson's Warbler	35.6	No Peak	Ages Together
American Redstart	29.1	Skewed	Ages Together

Adapted from Hall (1981)

Table 6  
Average Yearly Capture Number for the Period

	1973-1986	1987-2000
Swainson's Thrush	423.2	294.1
Wood Thrush	42.79	14.8
Nashville Warbler	79.36	66.29
Tennessee Warbler	1019	351
Chestnut-sided Warbler	43.86	54.14
Magnolia Warbler	134.7	234.1
Cape May Warbler	762.9	121.9
Black-throated Blue Warbler	726.4	707.3
Black-throated Green Warbler	425.9	398.7
Blackburnian Warbler	362.4	402.7
Bay-breasted Warbler	354.6	107.3
Blackpoll Warbler	849.1	592.7
Black-and-white Warbler	37.9	35.36
American Redstart	51.57	36.07
Ovenbird	109.4	106.2
Common Yellowthroat	144.5	136
Hooded Warbler	11.43	11.07
Wilson's Warbler	40.07	19.93
Canada Warbler	16.78	13.07
Eastern Towhee	13.57	20.64

1973-2000 is used for a quantitative calculation. For the period of 1973-1989, the number of bandings fluctuated with occasional extremes, both high and low, but exhibited a strong recovery from decreasing trends. In 1989, the number decreased markedly and did not ever recover, although one or two high years did occur. There was a major decrease in numbers starting about 1988-1989, and the average of the yearly averages for the period 1973-1986 is larger than the average of the period 1987-2000. The number of captures per 100 net hours shows the same features.

For a more quantitative treatment, 22 species captured in adequate numbers (and whose migration is essentially complete before the station closes in October) were selected for analysis (Table 6). For the 28 years, 1973-2000, the "Capture Number" (number of bandings) and the "Capture Ratio" (bandings per 100 net-hours) for the 22 species and the yearly total were plotted against the year (Figures 7 and 8). A linear regression trend line was calculated for each (Tables 7 and 8). All of the regressions of Capture Ratio had a negative slope (Table 8), indicating declining numbers, and for 17, the correlation was significant (Table

<sup>1</sup>Statistical and mathematical calculations were done with the aid of George Seidel.

9). Several of the regressions of Capture Number (Table 7) had small positive slopes, but this can well be an artifact of the use of variable numbers of nets giving a variance in net-hours in the early years. Two of the species with nonsignificant trends, Chestnut-sided and Canada Warblers, are early migrants that may have a substantial portion of their flight before the station opens. All five species with nonsignificant trends are captured in comparatively low numbers.

Using the regression parameters for the Capture Ratio (Table 8), the percentage of change per year for each species (Table 9) and the total were calculated. Five species and the total have annual declines of more than 4% per year. Three of these are the "budworm specialists": Tennessee, Cape May, and Bay-breasted Warblers. The numbers of each of these increased from 1964 to 1972 as the operating protocol was developed (e.g., more nets were added). Capture Numbers and Capture Ratios for these species remained high in the late 70s and early 80s; however, a sharp decrease in "budworm specialists" started about 1986, somewhat earlier than other species. Numbers stayed low and there was little recovery by 2000. This can be interpreted to indicate the decline to normal numbers of bird populations that were artificially inflated by a new outbreak of the spruce budworm (*Choriatoneura* spp.) in

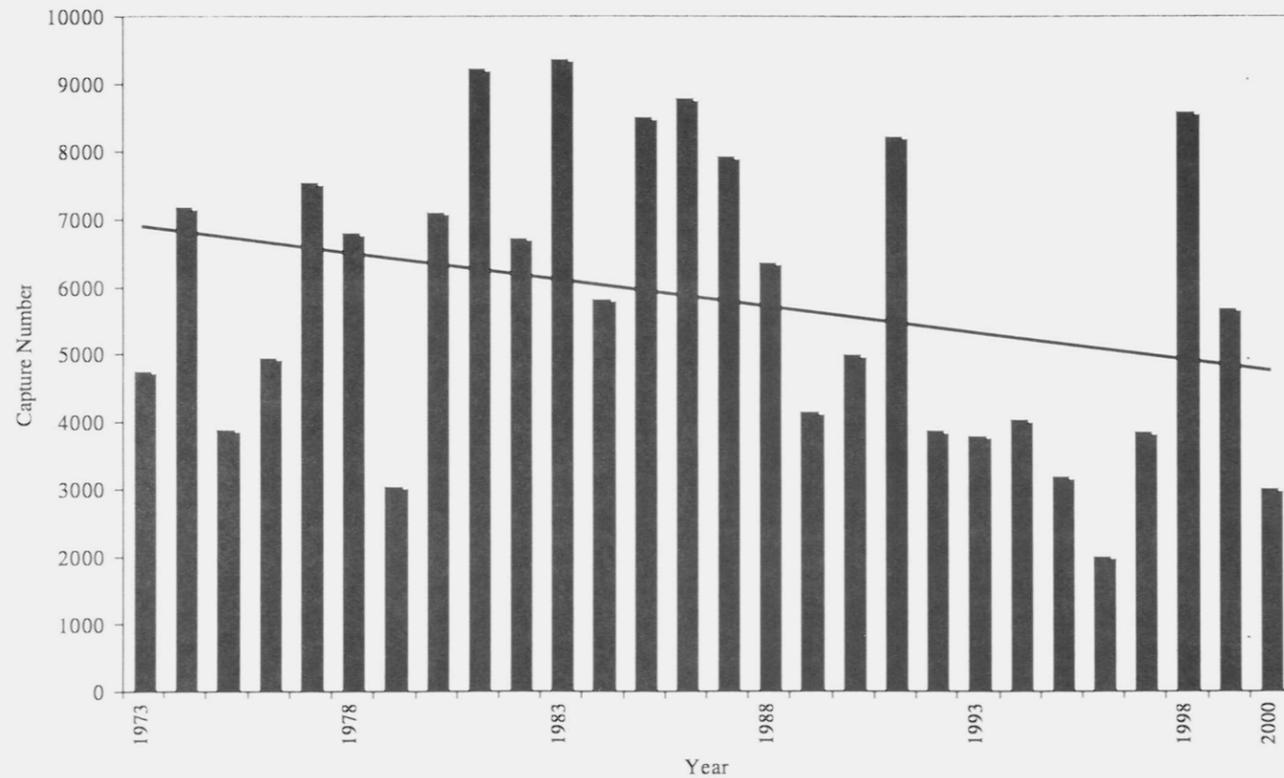


Figure 7. Capture numbers versus year of operation for 1973-2000 showing trend line.

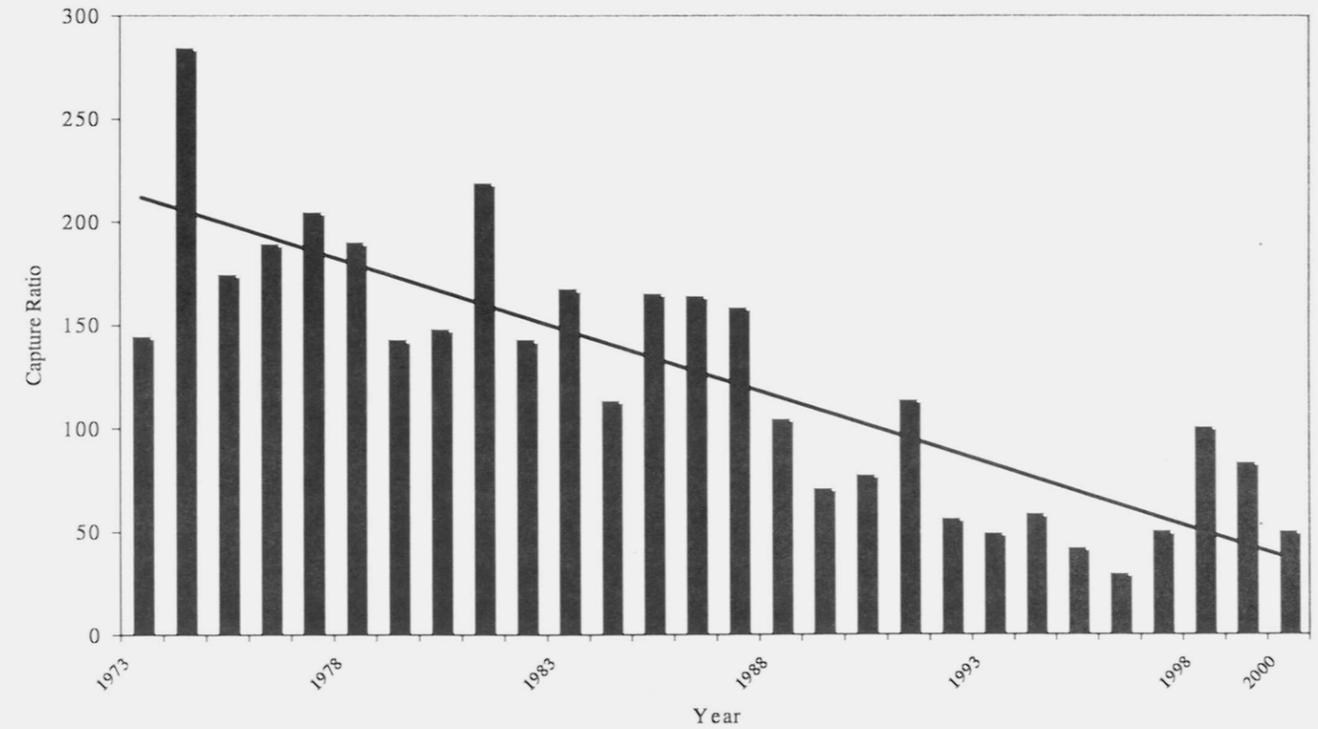


Figure 8. Capture ratio versus year of operation for 1973-2000 showing trend line.

Table 7  
Regression Parameters for Capture Numbers for the Years 1973-2000

	Slope	Intercept	r squared
Total Bandings	-78.342	6964.5	0.0878
Swainson's Thrush	-8.6708	484.4	0.2743ns
Wood Thrush	0.9428	49.706	0.1485
Nashville Warbler	-0.113	74.46	0.004
Tennessee Warbler	-32.779	1160.7	0.3122
Chestnut-sided Warbler	-0.8429	35.278	0.0768ns
Magnolia Warbler	2.2901	215.37	0.0179
Cape May Warbler	-27.904	906.18	0.3968
Black-throated Blue Warbler	3.2887	669.13	0.0106
Black-throated Green Warbler	-0.3103	407.79	0.0001
Blackburnian Warbler	-5.2356	353.1	0.0523
Bay-breasted Warbler	-13.447	425.95	0.4238
Blackpoll Warbler	-14.083	915.72	0.0644
Black-and-white Warbler	-0.3336	31.77	0.0121ns
American Redstart	-0.7983	55.367	0.0736
Ovenbird	0.3588	102.63	0.0024
Common Yellowthroat	-0.3303	145.04	0.0043
Hooded Warbler	0.1278	9.3868	0.027ns
Wilson's Warbler	-1.0391	44.937	0.2283
Canada Warbler	0.0375	15.459	0.0007ns
Scarlet Tanager	0.2663	18.325	0.0816
Eastern Towhee	0.2489	12.048	0.1802
Rose Breasted Grosbeak	-2.223	75.342	0.3393

Table 8  
Regression Parameters for Capture Ratios for the Years 1973-2000

	Slope (m)	Intercept	r squared
Total Bandings	-6.2231	2128	-0.6678
Swainson's Thrush	-0.4317	14.314	0.5942
Wood Thrush	-0.0493	1.5074	0.4631
Nashville Warbler	-0.0616	2.4079	2.23258
Tennessee Warbler	-1.2013	33.078	0.5964
Chestnut-sided Warbler	-0.0176	1.16779	0.1149
Magnolia Warbler	-0.1392	6.91	0.202
Cape May Warbler	-0.9786	25.14	0.5434
Black-throated Blue Warbler	-0.3549	0.392	0.1716
Black-throated Green Warbler	-0.2964	12.494	0.2159
Blackburnian Warbler	-0.1751	9.688	0.2743
Bay-breasted Warbler	-0.4604	1203	0.6735
Blackpoll Warbler	-9.1324	28.605	0.4683
Black-and-White Warbler	-0.0151	0.175	0.0851
American Redstart	-0.0496	1.64	0.4303
Ovenbird	-0.0733	3.4034	0.2517
Common Yellowthroat	-0.123	4.6849	0.522
Hooded Warbler	-0.0047	0.2878	0.1115
Wilson's Warbler	-0.0517	1.4422	0.5261
Canada Warbler	-0.0098	0.4359	1219
Scarlet Tanager	-0.0188	0.5694	0.5672
Eastern Towhee	-0.0055	0.4038	0.1607
Rose-breasted Grosbeak	-0.825	22.2067	0.6093

the 1970s in the northern area where the birds that pass through the AFMO station breed. The bountiful supply of food led to high production of young, and the autumn numbers of the "specialists" increased. Eventually, the outbreak declined as the spruce trees over a wide area were killed, and with the decline of prey-insects, the number of birds declined, presumably as the production of young decreased as the habitat changed. A similar maximum followed by a sharp decline took place at the Long Point Observatory in Ontario at about the same time (Francis & Hussell, 1998); and at the Powdermill Nature Reserve in Pennsylvania, these species also showed a maximum in the early 1970s (Mulvihill & Leberman, personal communication). The Blackburnian Warbler, not usually considered to be a budworm specialist, also showed a precipitous drop at the same time, but this also indicates that this species also had low production of young after an artificially increased population.

The Wilson's Warbler also had a decline of more than 4% per year. The other warblers had annual declines of 2.1-3.3%. Both the Swainson's and Wood Thrushes had large percentage declines. In contrast, the Hermit Thrush, which was not analyzed, as much of its migration occurs after the

station closes, has had high and increasing numbers in recent years. The only SDM species analyzed, Eastern Towhee, showed a much smaller percentage decline than the LDM species. No other SDM species was handled in numbers large enough to analyze.

At the Long Point Bird Observatory, most of the declining species had annual percentage declines somewhat larger than the ones reported here, and there were positive trends for a few species (Francis & Hussell, 1998)

Rather arbitrarily, the data for the total species and each individual species were divided into two divisions, 1973-1986 and 1987-2000, and individual regressions were calculated for each segment (Figures 9a, 9b, 9c). All regressions for 1987 to 2000, for both Capture Number and Capture Ratio, have negative slopes and are statistically significant.

#### Monitoring Migrant Populations

The awareness of the decline in banding numbers came at the time of greatest concern for the Neotropical migrants (Terborgh, 1989). It was very tempting to attribute the decline in bandings in the 1990s as further evidence of widespread population decline in these species, and band-

Table 9  
Percentage Change per Year  
(Calculated from Table 8)

	% Change/yr	P
Total Bandings	-3.21	P < 0.0001
Swainson's Thrush	-3.6	P < 0.0001
Wood Thrush	-3.67	P < 0.0001
Tennessee Warbler	-4.08	P < 0.0001
Nashville Warbler	-3.24	P > 0.05 ns
Chestnut-sided Warbler	-1.58	P > 0.05 ns
Magnolia Warbler	-2.14	P = 0.0164
Cape May Warbler	-4.29	P < 0.0001
Black-throated Blue Warbler	-2.48	P = 0.0003
Black-throated Green Warbler	-2.59	P = 0.0127
Blackburnian Warbler	-3.3	P = 0.0042
Bay-breasted Warbler	-4.32	P < 0.0001
Blackpoll Warbler	-3.53	P < 0.0001
Black-and-white Warbler	-1.72	P = 0.1320 ns
American Redstart	-3.32	P = 0.0002
Ovenbird	-2.45	P = 0.0065
Common Yellowthroat	-2.86	P < 0.0001
Hooded Warbler	-1.7	P = 0.0825 ns
Wilson's Warbler	-4.02	P < 0.0001
Canada Warbler	-2.38	P = 0.0687 ns
Scarlet Tanager	-3.51	P < 0.0001
Eastern Towhee	-1.4	P = 0.0346
Rose-breasted Grosbeak	-4.2	P > 0.0001

ing of migrants could be used to monitor the populations, particularly those species whose breeding range was largely in the roadless area of northern Canada. However, several factors must be considered. That a major decline was observed for many species at the same time suggests that some character of the AFMO station is at least partially responsible for the decline.

Do the numbers banded for a given species constitute a representative sample of the numbers of that species that fly up the pass? Do the numbers of birds that fly up the pass constitute a representative sample of the population of that species (or at least a localized subpopulation)? There is no hard evidence one way or another for these questions.

Although these questions cannot be answered, an initial assumption can be made that the answers to both questions are constant from year to year. If so, a trend in banding numbers from year to year might measure a population trend. However, there are several other factors peculiar to the AFMO station, all of which can exert a negative effect on the number of captures, that must be considered.

The Breeding Season in the North – The number of

migrants flying south in the fall is driven by the success of the breeding season (and since approximately 70% active success would result in lower than normal numbers of migrants.) Unfortunately, only anecdotal information is available; e.g., in the summer of 2000 the birds in an area in New Hampshire where two birds banded at AFMO have been known to nest, had a successful breeding season (R. T. J. Holmes, personal communication), but that year had the second lowest total bandings at AFMO.

Continental Weather Patterns – A substantial flight of migrants at this station depends upon (1) passage of a cold front in the north and (2) strong winds out of the northwest quadrant. If the high-pressure area, which is normally off the Carolina capes in late summer, locates somewhat north of the normal, the AFMO station will experience light east or southeast winds. No migrants will fly the route over the station under these conditions. In several years in the late 1980s and 1990s, this situation existed and remained static for much of early September. Banding numbers were low. Without west winds to displace the migrants to the east there will be no need for the course correction flight. It is

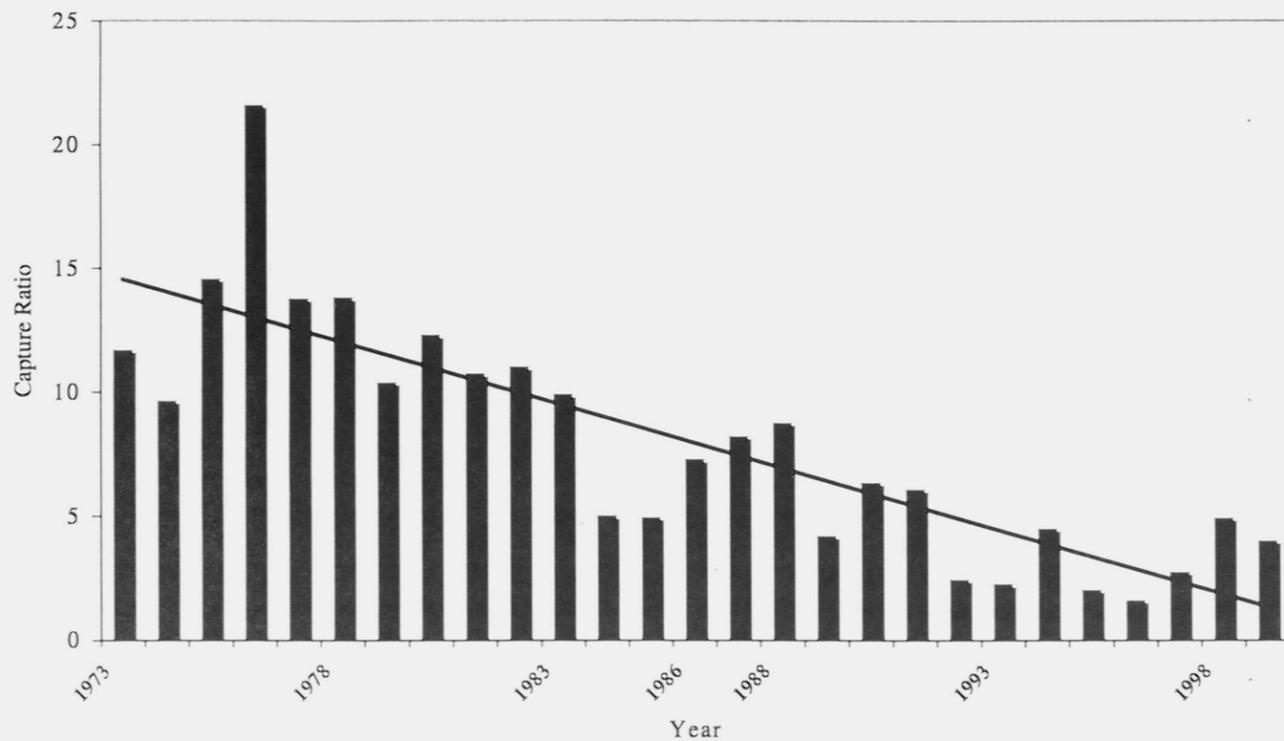


Figure 9a. Example of a single species (Swainson's Thrush) regression for 1973-2000.

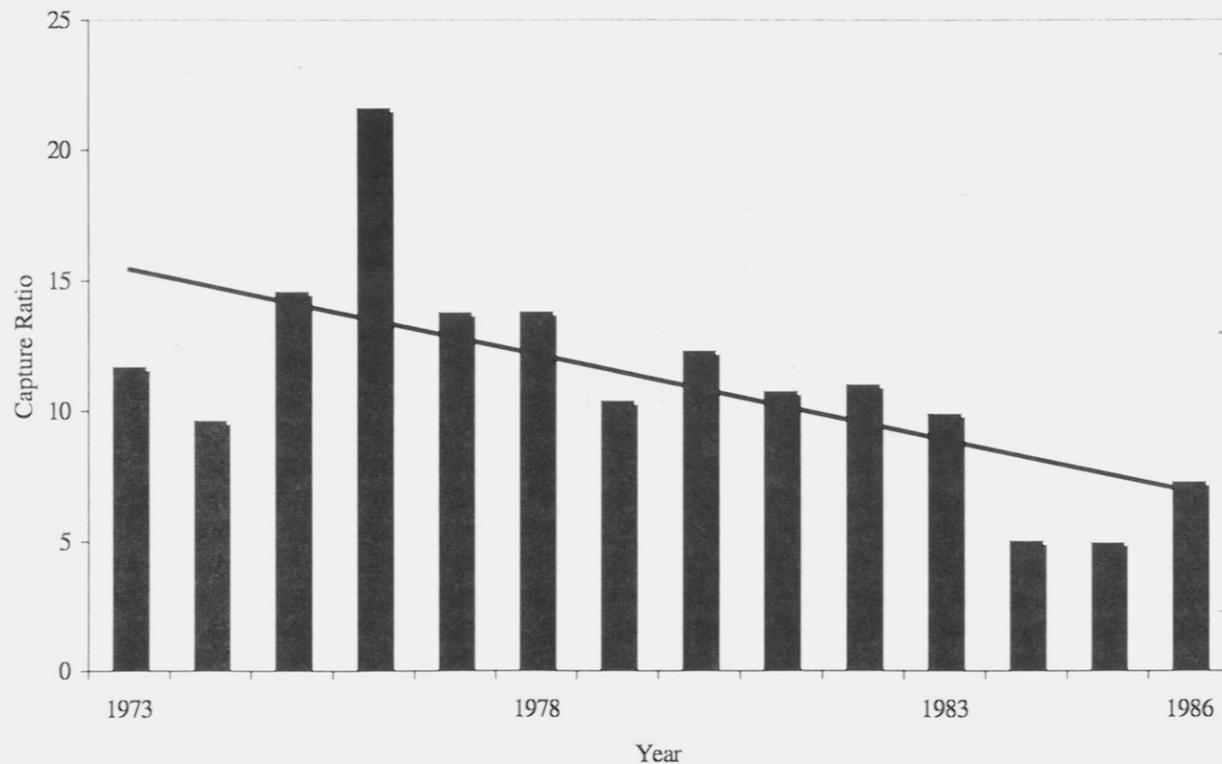


Figure 9b. Example of a single species (Swainson's Thrush) regression for 1973-1986.

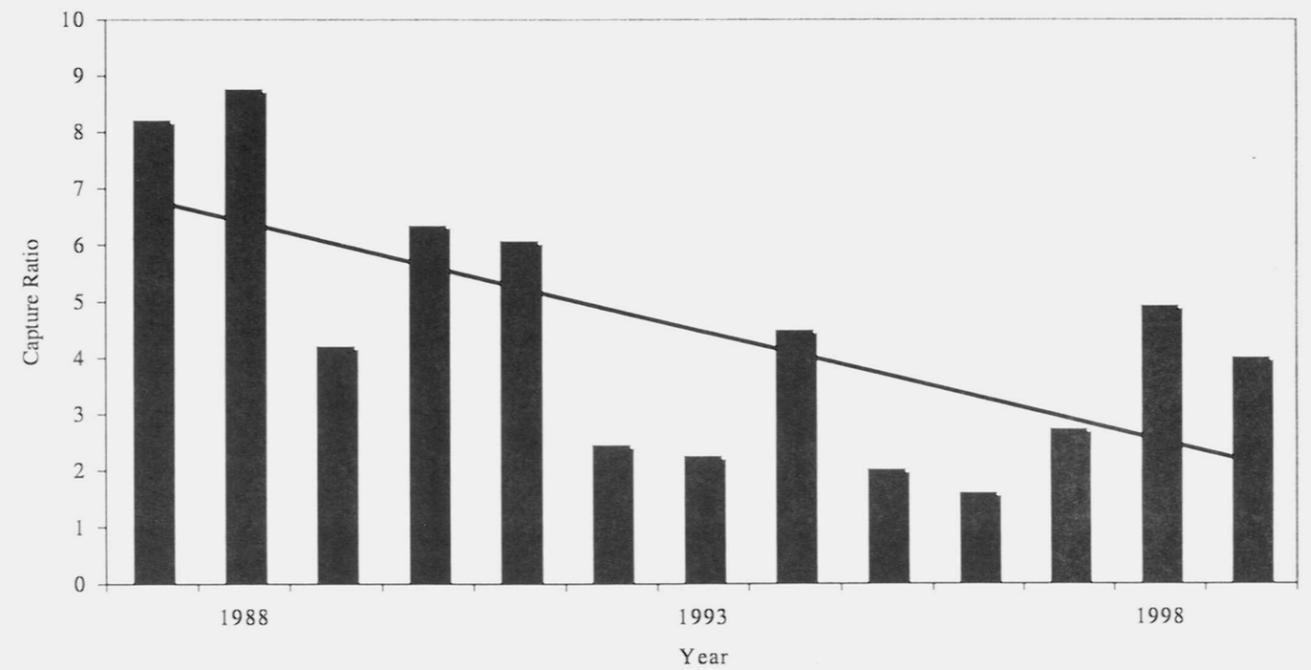


Figure 9c. Example of a single species (Swainson's Thrush) regression for 1987-2000.

not known if the migrants remained in the North or used another route to fly south under these conditions.

Local Weather Conditions – On occasion, the advancing cold front that triggered the departure of the migrants produces rain, or more commonly dense fog (low clouds) on the Allegheny Front. Under these conditions there will be no flight at the Station, and presumably the birds use an alternative route or simply stay put.

The Spruce Budworm Effect – The “Budworm Specialists,” the Tennessee, Cape May, and Bay-breasted Warblers, (both adult and young) account for about 25% of the birds banded, and so the periodic incidence of the Spruce Budworm in the “North” may be a major factor in determining the total number of bandings.

Growth of the Vegetation – As the vegetation, particularly the spruce trees, at the station gradually grew taller, the birds flew higher and so more of them passed over the nets. One productive net was almost wiped out as the spruce trees behind it grew. Over the years several cutting and trimming projects were carried out, but this did not keep up with the growth. (The number of captures at one highly productive net was greatly reduced when an over-enthusiastic cutting crew eliminated too much of its background vegetation.)

If annual banding numbers for a species results from the interaction of these factors with the existing population of the species, it becomes difficult, if not impossible, to tease out any one or two factors as the principal ones in a given year. Furthermore, the assumption that a trend in

banding numbers measures a trend in population is not likely to be valid.

The data of other banding stations agree with AFMO data in concluding that the banding of fall migrants does not track the population of the Neotropical migrants (Faaborg, 2002).

#### BEYOND 2000

Although this account ends with the data of 2000, banding has been carried out for six additional fall migrations, and there is every indication that the station will continue to operate. From the banding results of 43 years, reasonable answers to the questions of Who, What, Where, When, and Why that banding can answer have been obtained. Data from further banding should be applied to answer other questions.

Prior to the 2004 banding season, extensive cutting of the vegetation at the banding site was carried out. The habitat of the station has markedly changed. Has the change been great enough that present and future banding results cannot be fairly compared to previous results?

The climate change produced by global warming will bring about many changes, three of which are changes in floristic nature of the habitat, e.g., ultimate disappearance of spruce, changes in phenological schedules of some bird species, and changes in breeding range. An attempt has been made to answer one of these questions using peak migration dates and temperature for selected migrants (Tyree, 2005). Tyree's results showed weak correlation.

The species of Migrant Group LDMc should extend their breeding range farther north, thus increasing the size of the breeding range and the numbers of this group north of AFMO. The species of Group LDMa might be expected to come south later.

In summer 2004 a more extensive cutting was made, which should, if maintained, return results to previous capture rates.

How will the extensive wind farms that are being built on the Allegheny Front affect the migration at this station? Are some species more vulnerable than others? These and other questions will be best addressed by studying the change in relative numbers between species.

#### SPECIES ACCOUNTS

In the 43 years of station operation, 1958-2000, 117 species have been banded and 45 additional species have been recorded at or near the Observatory. Table 2 lists the following for each species: the total number banded in the 43 years; and the number banded from 1973-2000, which is the basis for the trend calculations; the average in birds banded per year; and, in parentheses, the range is calculated for the 43 years. Data on migration dates are from Hooker (n.d.), and data on migration patterns are from Hall (1981).

**Sharp-shinned Hawk** (*Accipiter striatus*) SDM – Sharp-shinned Hawks are moderately common migrants along the Allegheny Front starting in late September. Hawks caught in the nets are usually attempting to capture small birds tangled in the net, but most of them are able to escape from the small-mesh nets. The maximum year's count was eight. A "Sharpy" banded at Point Pelee Park, Ontario, on September 12, 1968, was captured at AFMO September 26, 1969 (Bell, 2003). One banded at AFMO in 1976 was recaptured in 1978.

**Cooper's Hawk** (*Accipiter cooperi*) U – The Cooper's Hawk, an uncommon migrant at the Observatory, is too large to be caught often in the small-mesh nets used. One was captured in the campground in September 1959. Two have been captured at the present banding site: August 12, 1971 (probably a local resident), and October 15, 1995.

**Merlin** (*Falco columbarius*) U – An uncommon migrant past this station. Two were netted in 1997, and one each in 1980, 1983, 1986, and 1991.

**American Woodcock** (*Scolopax minor*) SDM – The campground has been a congregating area for migrant woodcock, and so captures were frequent in the early years of the project when banding was carried out there, but at the present banding site captures are rare. Woodcocks were known to nest in the campground before it was developed.

**Black-billed Cuckoo** (*Coccyzus erythrophthalmus*) LDMb – Captures from August 27-October 5 with a maximum of three in a season.

**Yellow-billed Cuckoo** (*Coccyzus americanus*) LDMb – Most were caught in the second half of September. Both cuckoo species are uncommon migrants at this station. Fourteen of the 28 captures were before 1972, and only three occurred in the 90s.

**Eastern Screech-Owl** (*Megascops asio*) NM – Three were netted in the early 1960s at the campground site, and three captured during the 90s were decoyed into the nets during nighttime attempts to capture N. Saw-whet Owls.

**Northern Saw-whet Owl** (*Aegolius acadicus*) SDM – In the early years when the nets were open at night migrant saw-whets were occasionally caught, but with the present system of opening the nets just before first light, owl captures are infrequent. The number of captures increased in the mid and late 1990s when some nets were opened at night and recordings of owl calls broadcast. September birds are probably from the small local breeding population and migrants appear in October.

**Whip-poor-will** (*Caprimulgus vociferus*) U – Three were banded in the 1980s and only one in the 1990s. In the early years of the project, Whip-poor-wills were heard calling on most September mornings, but the birds are seldom heard in recent years.

**Ruby-throated Hummingbird** (*Archilochus colubris*) LDMb – Hummingbirds are common migrants, but except for a few in the early years, they are not banded. In 1985 a project of counting the hummingbirds flying through the station area as well as the number released from the nets was started (Hooker, 1990). In the 11 years (1990-2000), 4,738 were counted, averaging 431 per year with limits of 744 and 252. The highest one day count was 154.

**Red-headed Woodpecker** (*Melanerpes erythrocephalus*) SDM – This species is frequently seen flying by the station, often in small groups. The usual flight path does not lead to many captures and none have been banded since 1987.

**Red-bellied Woodpecker** (*Melanerpes carolinus*) NM – Single birds were captured in 1968, 1982, 1990.

**Yellow-bellied Sapsucker** (*Sphyrapicus varius*) SDM – A regular but not very numerous migrant in early October.

**Downy Woodpecker** (*Picoides pubescens*) NM – Apparently moderate numbers of this nonmigrant species engage in postbreeding wandering. Most of the captures have been HY birds.

**Hairy Woodpecker** (*Picoides villosus*) NM – A maximum of two per season.

**Northern Flicker** (*Colaptes auratus*) SDM – Flickers are common migrants past the station, and on a few notable days large numbers flew by. But, as with the Red-headed Woodpecker, the usual flight path does not lead to many captures, and a maximum of four per season have been banded.

**Olive-sided Flycatcher** (*Contopus cooperi*) LDM – There have been a few sightings of this flycatcher perched in the taller spruces, but only two have been captured: September 4, 1982, and September 3, 1995.

**Eastern Wood Pewee** (*Contopus virens*) LDMb – Since 1985 the numbers have been lower than in earlier years.

**Yellow-bellied Flycatcher** (*Empidonax flaviventris*) LDMa – There was a sharp decline in numbers after 1985 but a remarkable increase in 1998.

**Acadian Flycatcher** (*Empidonax vireescens*) LDMb – One or two were banded a year with a maximum of five in 1977.

**"Traill's" Flycatcher** (*Empidonax alnorum/traillii*) LDMb – No attempt has been made to distinguish between the two species involved here. "Traill's" Flycatchers were captured in only 10 of the last 29 years.

**Least Flycatcher** (*Empidonax minimus*) LDMb – Least Flycatchers were more commonly banded in the early years of the project, when banding was done only in the campground. A maximum of 17 were caught in 1961.

**Eastern Phoebe** (*Sayornis phoebe*) SDM – Never more than three were banded a year, and it is missing in many years.

**Great Crested Flycatcher** (*Myiarchus crinitus*) LDMb – There have been only two captures: September 3, 1966, and August 17, 1986.

**Eastern Kingbird** (*Tyrannus tyrannus*) LDMb – The only capture was September 3, 1985.

**White-eyed Vireo** (*Vireo griseus*) LDMc – This southern species apparently does not wander into the region of the station, as only 16 have been banded.

**Yellow-throated Vireo** (*Vireo flavifrons*) LDMb – This vireo is not netted every year, with a maximum of six in a season.

**Blue-headed Vireo** (*Vireo solitarius*) LDMa – Resident Blue-headed Vireos may be netted in August as soon as the station is opened, but the main migration does not occur until the last of September or the first of October. The annual capture numbers are fairly constant with occasional years of high numbers. From 1988 to present there have been a few more captures than in the earlier years.

**Warbling Vireo** (*Vireo gilvus*) LDMb – It is possible that more than seven Warbling Vireos have been banded since some may have been misidentified as the more common Philadelphia Vireo during the press of work on major flight days.

**Philadelphia Vireo** (*Vireo philadelphicus*) LDMa – A few will be netted in early September, but the peak of the migration comes in the third week of September, and a few may be caught in the first few days of October. The number of bandings varies greatly, but no trend was evident until a marked decline occurred from 1989 to 2000.

**Red-eyed Vireo** (*Vireo olivaceus*) LDMb – The migration begins in late August and continues into early October. There is no pronounced peak, and a few birds will be caught daily through September. The earliest birds are predominately HY. The annual numbers show no trend but were slightly lower in the 1990s.

**Blue Jay** (*Cyanocitta cristata*) SDM – A few Blue Jays wander over the station in the early part of the season, but meaningful migration does not start until the third week of September and lasts through the first week of October. The banding numbers do not represent the true magnitude of the flight. Loose flocks, numbering in the hundreds and often in the thousands, pass the station. The number caught depends on the wind direction and the number of people at the station since the jays will alter their flight path to avoid a crowd of people visible at the station. Many Blue Jays will escape from the fine-mesh nets used, although on occasion large-mesh nets have been used at strategic places on the flight route. In a few years essentially no flight occurs, or occurs later than the station is open.

To demonstrate the heavy flight, a program of attempting to count all the flying jays passing through the pass was started in 1990. In ten years (1990-1999) 71,276 jays were counted, giving an average of 7,125 per year with limits of 45 to 18,706. The maximum one-day count was 8,297 on October 3, 1999. These figures are minimum values as many birds pass through hidden by the spruce trees, and often late in the season there are not enough people at the station to make the counts.

**Carolina Chickadee** (*Poecile carolinensis*) NM – The Observatory is a considerable distance from the range of *carolinensis*, and this species does not wander as much as *atricapilla*. Several birds whose identification characters were ambiguous may have been hybrid *carolinensis* x *atricapilla*.

**Black-capped Chickadee** (*Poecile atricapilla*) NM – Chickadees may wander through the station at any time of the season. The capture total is enhanced by the frequent capture of family groups of adults and several young of the year.

**Tufted Titmouse** (*Baeolophus bicolor*) NM – The few titmice banded are postbreeding wanderers from the breeding grounds at lower elevations. As with the chickadees, family groups of four to six have been caught occasionally.

**Red-breasted Nuthatch** (*Sitta canadensis*) SDM – This is an irruptive species for which the annual banding numbers vary widely and are of little use in monitoring the population. Most years will have small numbers, with an occasional year having none and an occasional year having large numbers. The peak of the flight may occur at any time during the season. The three most recent major irruptions were 1981 (peak September 17-October 1), 1985 (peak

August 28-September 10), and 1989 (peak October 4-October 13).

**White-breasted Nuthatch** (*Sitta carolinensis*) NM – The White-breasted Nuthatch is another “permanent resident” given to a certain amount of postbreeding wandering. As such, captures at this station are fortuitous.

**Brown Creeper** (*Certhia americana*) SDM – The Brown Creeper migration begins in the last week of September and continues through October. Stragglers in late August or early September may be from the local breeding population. Although fluctuating greatly, annual numbers showed no trend except for 1974 and 1988 when exceptionally high numbers were netted.

**Carolina Wren** (*Thryothorus ludovicianus*) NM – Another lowland species given to autumnal wandering. The numbers caught parallel the regional population of this species with 4 banded in the 1970s, 1 in the 1980s, and 11 in the 1990s, with a maximum of 5 banded in 1991 and 3 in 1990.

**Bewick's Wren** (*Thryomanes bewickii*) U – Single birds were caught almost annually in the mid-1970s, but none were caught since 1978.

**House Wren** (*Troglodytes aedon*) SDM – One or two have been caught in each of 27 of the 43 years of operation.

**Winter Wren** (*Troglodytes troglodytes*) SDM – At least one Winter Wren breeding territory is in the station area, and early in the season the beautiful Winter Wren song is heard in the early mornings. First year birds of this local population are netted in the first days of operation, but the migration does not begin until about October 1 and will continue through the month. A few birds are caught each year, but occasionally there will be an unusually heavy influx. The numbers caught in the 90s are at a somewhat higher level than earlier. This trend has also been detected at the Powdermill banding station in Westmoreland County, Pennsylvania (R. Leberman & R. Mulvihill, personal communication).

**Golden-crowned Kinglet** (*Regulus satrapa*) SDM – A few Golden-crowned Kinglets, presumably from the West Virginia breeding population, will be banded as early as September 1, but the migration does not begin until the last few days of September or early October. Capture numbers increase quickly to a peak in mid-October, and on some days tremendous flights will occur. The total annual capture will depend in large part on the weather and on the closing date of the station as usually kinglets are still migrating when the station closes.

Since about 1988 the yearly number of captures of both kinglet species have been higher than they were earlier. This is in part due to increased kinglet populations as they replaced the declining warbler populations in the North, and in part due to the later closing dates for the station.

**Ruby-crowned Kinglet** (*Regulus calendula*) SDM – While the Ruby-crowned Kinglet is not known to nest in West Virginia, the few stragglers that are netted in early September suggest that there may be a small breeding population in the higher mountains. The migration may begin with a few birds in late September, but the main flight occurs in the second week of October and later. Often substantial numbers are still coming through when the station closes. Yearly numbers increased through the 1980s and have continued to be high with occasional poor years.

**Blue-gray Gnatcatcher** (*Poliophtila caerulea*) LDMc – This is a southern species whose migration barely touches the elevation of the station.

**Veery** (*Catharus fuscescens*) LDMa – The fall migration of the Veery apparently begins before the station opens in mid-August, and it is essentially over by the third week in September. There is no prominent peak of migration. Prior to 1982 the yearly average was about six, but after 1983 this average has been 14.

**Gray-cheeked Thrush** (*Catharus minimus*) LDMa – A late migrant, the Gray-cheeked Thrush flight does not start until the third week in September, and lasts until the second week of October. Annual capture numbers have varied within wide limits, but no trend was evident until the early 90s. From 1993 to 1997 numbers were very low, but some recovery was made in 1998.

**Bicknell's Thrush** (*Catharus bicknelli*) – Hypothetical – Over the years at least two “Gray-cheeked Thrushes” have been noted as possible *bicknelli* based solely on small wing measurements.

**Swainson's Thrush** (*Catharus ustulatus*) LDMa – The Swainson's Thrush, the most common thrush captured at AFMO, is almost exclusively a September bird. A few will be caught in late August and somewhat more will be banded in early October, but the peak comes in the third week of September. Numbers started to decline in the early 1980s and reached a low point in the late 1990s.

**Hermit Thrush** (*Catharus guttatus*) SDM – Hermit Thrushes nest in the spruce groves at the station, and during August and early September many of this local population will be captured. Most will be HY birds, some apparently very recently fledged. The migratory flight does not begin until the last week of September, and numbers increase rapidly through early October. In some years the station is closed before the peak is reached.

Annual numbers were low, but steady until about 1988, when a marked increase in numbers banded occurred, giving a positive trend for the 1990s. This increase paralleled the increase in the breeding population in the West Virginia mountains (personal observation).

**Wood Thrush** (*Hylocichla ustulata*) LDMb – A few, probably from nearby breeding populations, are captured in late August and early September, but the migratory flight does

not start until mid-September and peaks in the fourth week of September. In the early years of the project, there was no trend in the annual capture numbers, but since 1990 there has been a downward trend.

**American Robin** (*Turdus migratorius*) SDM – On occasion large flocks of robins will be seen flying over the station. Most of these birds will be too high to be netted, and the highest numbers are in late October or November after the station is closed. The capture data for robins is thus little related to the status of the species or the timing of the flight.

**Varied Thrush** (*Ixoreus naevius*) U – One banded September 29, 1993, was the first record of the species for West Virginia (Ward, 1995).

**Gray Catbird** (*Dumetella carolinensis*) SDM – Catbirds may nest in the brushy areas of the station, and early in the season they call at first light. Captures occur throughout the season with late stragglers to mid-October. Annual numbers fluctuate widely but no long-term trend is evident.

**Brown Thrasher** (*Toxostoma rufum*) SDM – When banding was carried out in the campground, thrashers were not uncommonly caught, but after the transfer of operations to the present location at the edge of the escarpment, the species was not captured as often. The thrasher is capable of escaping from the fine-mesh nets used.

**European Starling** (*Sturnus vulgaris*) U – During the period of operation very few starlings fly over the station, and few of these are low enough to be netted.

**American Pipit** (*Anthus rubescens*) U – The only banding was one on September 28, 1973. During the fall migration period pipits are occasionally seen in the open grassy areas between the banding station and Bear Rocks.

**Cedar Waxwing** (*Bombycilla cedrorum*) SDM – Flocks of varying size fly over the station throughout the season. Many of these flocks are evidently wandering and will be seen again and again. Only occasionally will birds fly low enough to be caught, although station personnel often attempt to startle the birds into flying low. This attempt is sometimes effective. No attempt has been made to count these birds, but the season's total would be in the thousands, and on several occasions it has been clear that several thousand went by in one day.

**Blue-winged Warbler** (*Vermivora pinus*) LDMb – Not netted in every year with a maximum of five in 1998. Most records are in the first half of September.

**Golden-winged Warbler** (*Vermivora chrysoptera*) LDMb – Maximum of eight in 1983. Most records are in late August or early September. In the early years of the project, there was a small breeding population on the mountain, but these birds usually had migrated earlier than the station opening.

**Vermivora Hybrids** – Single “Brewster's” Warblers were banded on September 9, 1983, September 23, 1986, and September 2, 1987; and a “Lawrence's” Warbler was banded on September 24, 1993.

**Tennessee Warbler** (*Vermivora peregrina*) LDMa – There are a few in the last week of August, but general arrival in numbers is not until September 1. The peak is in the third week of September with a few records as late as October 10. The migration pattern is a normal distribution with age-classes together.

This is one of the “spruce-budworm specialists,” and annual numbers fluctuate widely. Large numbers were caught in the 70s and early 80s but a statistically significant decline occurred in the 1983-92 period. A modest recovery took place in the mid-90s.

**Orange-crowned Warbler** (*Vermivora celata*) LDMa – Not banded in every year, with a maximum of four in 1989. Almost all records are in early October.

**Nashville Warbler** (*Vermivora ruficapilla*) LDMa – Small numbers are netted steadily from September 1 to early October. There is no pronounced peak although numbers are somewhat larger late in the season. The age-classes migrate together. The number of captures has shown a small nonsignificant decline over the years.

**Northern Parula** (*Parula americana*) LDMb – Not captured in every year. There are records from late August to early October.

**Yellow Warbler** (*Dendroica petechia*) LDMb – A maximum of three banded in 1998. The migration of Yellow Warblers at this latitude is essentially complete before the usual opening date of the station.

**Chestnut-sided Warbler** (*Dendroica pensylvanica*) LDMa – The southbound migration has usually started before the station is open, and a few are captured in the last week of September with occasional stragglers in October. The pattern of migration is slightly skewed to the right and the age-classes come together.

The number of captures showed a slight nonsignificant decline over the period 1973-92. A slight positive trend in the 90s may be an artifact of the large number handled in the 1998 season. A Chestnut-sided Warbler banded in 1983 was recaptured in 1987 and two were captured in the year after banding.

**Magnolia Warbler** (*Dendroica magnolia*) LDMa – The few Magnolia Warblers captured in August are mostly local breeders. The migration starts in the first week of September with low but steady daily numbers, and is essentially over by October 1. The pattern has a broad low peak, with the HY birds preceding the AHY birds.

The annual number of captures was steady in the 1970s and early 1980s, but a sharp decline took place from 1983 to 1992. A good recovery in numbers has occurred since 1993.

There have been 13 locally banded Magnolia Warblers recaptured in later years as follows: five, one year after banding; four, two years after; one, three years after; two, four years after; and one, five years after banding. Many of these have been captured in the August period. No Magnolia Warblers banded at this station have been recovered

elsewhere, but in 1998 one was caught just two days after it had been banded near Coudersport, Pennsylvania (Bell, 2003).

**Cape May Warbler** (*Dendroica tigrina*) LDMa – The fall flight of Cape May Warblers begins in the last week of August, peaks in the first third of September, and gradually decreases until late September. A few stragglers, mostly HY females, may be caught in early October. The pattern of migration is a normal distribution. Males and females migrate together, but AHY birds migrate earlier than HYS, unlike most other species.

The trend in the annual counts demonstrates the “Spruce Budworm Effect.” Before 1970 rather few Cape Mays were banded. Numbers then increased steadily as a major outbreak of the budworm occurred in northern Canada, until about 1983 when a major decline started as the infestation burned itself out.

**Black-throated Blue Warbler** (*Dendroica caerulescens*) LDMa – The Black-throated Blue Warbler is one of the three species banded in the largest numbers at this station, and in some years it is the leading species. The migration starts with a few pioneers in late August and builds up to a peak in the third week of September. Moderate numbers are still coming through in early October, and the AHY birds may peak in early October. The separation of HY and AHY birds is so pronounced that it is rare to see a AHY birds before the last ten days of September. Both age groups show a normal distribution pattern, and there is no apparent difference in the schedules of males and females. Only a few of the birds have had plumage characteristics suggestive of the Southern Appalachian race, *cairnsi*, which is the local breeding form.

Only one Black-throated Blue has been recaptured at the station in a year after banding. Two birds banded at AFMO have been recovered at the Hubbard Brook Research area of Dartmouth College in New Hampshire, both in the second breeding season after fall banding. One of these was known to have nested at that location (R. T. Holmes, personal communication).

**Yellow-rumped Warbler** (*Dendroica coronata*) SDM – A few migrants arrive in late September, and the flight builds up in October with the largest numbers after the station has been closed. Thus the numbers banded have been low, but a maximum of 219 was banded in 1989, when the station remained open to October 16.

In the late 1970s and early 1980s a small breeding population was established on the Allegheny Front mountain as well as in other parts of the West Virginia highlands, and as a result there have been a few August bandings in recent years.

**Black-throated Green Warbler** (*Dendroica virens*) LDMa – The few birds caught in late August are most probably of the local breeding population. The main migration starts about September 1 and peaks in the last week

of September, although sometimes the AHY birds may peak in early October. The HY birds come before the AHYs although the separation is not so pronounced as in the Black-throated Blues.

This species has maintained its position as the fifth most abundant species. There has been a slight but significant decrease in numbers through the years. There are occasional years in which unusually large numbers are captured. No Black-throated Green Warblers have been captured in years subsequent to banding nor have any been recovered elsewhere.

**Blackburnian Warbler** (*Dendroica fusca*) LDMa – The Blackburnian Warbler is an early migrant whose migration pattern illustrates the wave phenomenon. The pattern is skewed strongly to the left and in some cases the maximum daily count is obtained on the first or second day of the flight. This wave usually occurs in the last week of August with numbers dropping off thereafter. Only a few stragglers will be caught after the third week of September and most of these will be HY females, although overall the HY and AHY birds come at the same time and no difference is observed in the timing of the sexes.

In almost every year this station bands more Blackburnian Warblers than any other banding station, and for several years in the mid-80s the AFMO station banded more than 50% of the Blackburnians banded in North America. The annual totals reached a peak about 1985 and then declined drastically with very low numbers in the 90s.

**Yellow-throated Warbler** (*Dendroica dominica*) LDMc – Only one banded: August 24, 1993.

**Pine Warbler** (*Dendroica pinus*) SDM – An uncommon migrant with a maximum of four in 1986.

**Prairie Warbler** (*Dendroica discolor*) LDMc – In the early years of the project there was a breeding population on the mountain top, but these birds usually departed before the station was open. Only two Prairie Warblers have been netted in the 1990s.

**Palm Warbler** (*Dendroica palmarum*) LDMa – A few will appear in the last week of September, but most are captured in October. Most of these birds are of the subspecies *palmarum*, the “Western” Palm Warbler, but the “Yellow” Palm Warbler *D. p. hypochrysea* is occasionally caught.

**Bay-breasted Warbler** (*Dendroica castanea*) LDMa – The migration is almost entirely in September with only a few in August and October. The pattern is a normal distribution with a peak in the third week of September. The age-classes migrate on the same schedule.

The Bay-breasted Warbler is the least common of the three “Budworm Specialists.” Prior to 1970 number of captures was small, but a peak was reached about 1983. Since then numbers have shown a significant decline, and in the late 1990s they have been very low.

**Blackpoll Warbler** (*Dendroica striata*) LDMa – Each year the Blackpoll Warbler is the first or second most numerous species. The first migrants arrive about the first week of September, and the flight continues through early October. The pattern is a normal distribution with the peak in the last week of September. The age-classes migrate synchronously.

The large number of birds captured here is noteworthy since the AFMO station is at or near the southern limit in continental North America of the complex migratory route of the Blackpoll (Baird, 1999). Annual numbers have varied within wide limits but the trend since the mid-80s has been downward, hitting a low point in the mid-1990s.

**Cerulean Warbler** (*Dendroica cerulea*) LDMb – A maximum of four in 1973: the latest banded in 1991.

**Black-and-white Warbler** (*Mniotilta varia*) LDMb – The migration of Black-and-white Warblers usually starts before the Station is open, and small numbers of birds are caught through late August to mid-October. Daily numbers are small and no peak is evident.

**American Redstart** (*Setophaga ruticilla*) LDMb – The first migrants arrive in late August. No pronounced peak occurs, but the pattern is skewed towards the early dates with low numbers in late September and very few in October. Capture numbers are small, but marked declines occurred in the early 1980s and again in the early 1990s.

**Worm-eating Warbler** (*Helmitheros vermivorum*) LDMb – First bandings are as early as the station is open in August, and most are gone by mid-September with a few records as late as September 29. Numbers vary widely, but there was no trend apparent until a slight positive trend appeared in the late 1990s.

**Ovenbird** (*Seiurus aurocapilla*) LDMb – A few, possibly local birds, will be banded in late August, but the main migration is in September with a peak in the second half of the month. Ovenbirds do not follow the daily time schedule of the other warblers and most are caught with the thrushes at first light. The numbers caught vary widely from year to year, but no trend was evident until a small decline in the early 1990s.

**Northern Waterthrush** (*Seiurus noveboracensis*) LDMa – An early migrant with most bandings in August, although a few have been caught as late as early October.

**Louisiana Waterthrush** (*Seiurus motacilla*) LDMc – One of the earliest migrants, with most resident birds having departed before the station is open. None were caught in the early years of the project, but in the late 1980s and early 1990s, it was caught nearly every year with the maximum seasonal count being three.

**Kentucky Warbler** (*Oporornis formosus*) LDMc – A maximum of five was banded in 1987 and four in 1998.

**Connecticut Warbler** (*Oporornis agilis*) LDMa – Bandings are almost entirely in September with the great-

est number occurring in mid-month. Annual numbers vary widely, but no trend was evident until the 1980s when a slight decline was observed.

**Mourning Warbler** (*Oporornis philadelphia*) LDMa – This species nests in the region, but by mid-August, when the station opens, the local birds have departed, and the migrants from the north apparently fly a different route so only a few stragglers are caught.

**Common Yellowthroat** (*Geothlypis trichas*) LDMb – This species does not follow the typical “warbler flight pattern.” The areas around the station covered with low vegetation seem to be favorite night roosts for Yellowthroats, and the first captures of the day will include several but few will be caught later in the morning. During August a number of local birds will be caught, but the migration does not start until about September 1. The peak will be reached by September 15, and captures will decline after that. Although many Yellowthroats are caught as repeats in the season of banding, indicating that the area is a congregation point, there have been few returns in later years and there are no distant recoveries.

**Hooded Warbler** (*Wilsonia citrina*) LDMc – The Hooded Warbler has been caught as early as August 14 and as late as October 4, but the majority migrate through in the first half of September. No peak is evident. The number of captures in the years 1980 to 1989 was higher than before and after that period.

**Wilson's Warbler** (*Wilsonia pusilla*) LDMa – The Wilson's Warbler migration starts in late August and is over by October 1 with a few stragglers in early October. There is no peak of migration and the flight usually consists of one to three birds every day. There has been a steady downward trend in capture numbers since 1986 and the capture numbers since 1986. The capture ratio has declined at a rate of 4.0% per year, but this was not statistically significant.

A Wilson's Warbler banded in the autumn of 1974 at Charleston, West Virginia, by AFMO bander, C. Katholi, was captured at AFMO in September 1975.

**Canada Warbler** (*Wilsonia canadensis*) LDMa – The Canada Warbler is another early migrant, and the southbound flight will have started before the station is open. The peak of migration will be in the last week of August with a few stragglers to late September. As with some other early migrants, the migration pattern is greatly skewed to the right. Numbers have never been large, but the period 1980-1989 showed a slight peak in captures.

**Yellow-breasted Chat** (*Icteria virens*) LDM – Single birds were banded in the campground in 1960 and 1962, and in the present location in 1970. In the past chats were uncommon breeding birds on the mountain, but they have not been reported recently.

**Scarlet Tanager** (*Piranga olivacea*) LDMb – A regu-

lar migrant in small numbers, the peak of the Scarlet Tanager flight is in mid-September with occasional early birds in August and very few in October. The annual capture number has varied, but the capture ratio has declined by 3.5% per year.

**Eastern Towhee** (*Pipilo erythrophthalmus*) SDM – There is a local population of towhees in the shrub areas of the station, and early morning calls are heard in August and early September. A few of these local birds will be caught as soon as the station is open, and a few birds have been caught in years after banding. Migrants begin to arrive in the last week of September, and the flight continues into October with captures as late as mid-October.

The number of bandings since 1988 has averaged slightly higher than the earlier average but no trend is noticeable. A towhee banded in September 1964 was found dead near Wheaton, Maryland, in the spring of 1965.

**Chipping Sparrow** (*Spizella passerina*) SDM – In the early years this sparrow was a very rare migrant, but numbers have increased since the late 1980s.

**Field Sparrow** (*Spizella pusilla*) SDM – Small numbers are caught throughout the banding season. Numbers were low in the early years but increased in 1986-88 and declined steadily since then.

**Vesper Sparrow** (*Pooecetes gramineus*) SDM – The Vesper Sparrow is a grassland bird, seemingly far out of habitat at this station, but a few are caught in late August or the first half of September. Almost always these are caught at first light with the thrushes.

**Savannah Sparrow** (*Passerculus sandwichensis*) SDM – This species is another out-of-habitat grassland sparrow, most of which are caught in the very early morning.

**Henslow's Sparrow** (*Ammodramus henslowii*) SDM – Another grassland sparrow, this one with two bandings: August 28, 1989, and October 15, 1996.

**Fox Sparrow** (*Passerella iliaca*) SDM – The Fox Sparrow is a very late migrant for which the peak of migration may occur after the station is closed. Earliest arrival is in the first week of October.

**Song Sparrow** (*Melospiza melodia*) SDM – Small numbers of Song Sparrows are captured throughout the season. In the 1970s annual captures were about six birds per year. From 1981 to the 1990s, the number increased to 23, then after 1991, it decreased to 13.

**Lincoln's Sparrow** (*Melospiza lincolni*) SDM – Small numbers of Lincoln's Sparrows begin to move through the region in mid-September and are still moving when the station closes in mid-October. Annual capture numbers have increased slightly since the early 1980s.

**Swamp Sparrow** (*Melospiza georgiana*) SDM – There is a breeding population of Swamp Sparrows on the mountain, and wandering juveniles are caught in August. When

banding was done in the campground, particularly near the spring, Swamp Sparrows were more commonly caught. Migrants are first noted in late September and the flight continues beyond the station closing.

**White-throated Sparrow** (*Zonotrichia albicollis*) SDM – A few White-throated Sparrows arrive in the last week of September, but the main migration begins in the first days of October and peaks in mid-October. On several occasions newly arrived white-throateds were noted as abundant in the shrubby growth along the path to the banding station at dawn, but only a few were captured that day. As with some of the other sparrows, the annual captures in the 1990s were slightly above those of earlier years.

**White-crowned Sparrow** (*Zonotrichia leucophrys*) SDM – White-crowned Sparrows do not arrive until mid-October, and the peak of their migration may be after the station is closed.

**Dark-eyed Junco** (*Junco hyemalis*) SDM – The junco is the most abundant breeding bird on the mountain. Molt-ing adults or fledglings are netted in August as soon as the station opens. A few birds banded in previous years are caught. These birds are all of the Appalachian subspecies, *J. h. carolinensis*, identifiable by their bluish bills, larger size, and different coloration of plumage. The first "northern" juncos, *Junco h. hyemalis* with pink bills, arrive in early October. Numbers rapidly build up, and the highest numbers will be obtained in the last few days of the banding operation. Observations have shown that the heavy junco movement continues into November. The migrant northern birds are joined by the roving bands of "Carolina" birds, which do not migrate. As with other sparrows, juncos increased in numbers in the 1990s.

**Northern Cardinal** (*Cardinalis cardinalis*) NM – Cardinals are rare wanderers at this elevation.

**Rose-breasted Grosbeak** (*Pheucticus ludovicianus*) LDMb – The Rose-breasted Grosbeak is a daytime migrant at AFMO as small flocks are sometimes seen flying along the mountain ridge, and most of the captures are made late in the morning. Captures, possibly of local birds, are made as soon as the station is open in mid-August, but the peak will be in the third week of September with stragglers coming as late as the second or third week of October. The numbers dropped off markedly in the 1990s, being only about one third of the earlier values.

**Indigo Bunting** (*Passerina cyanea*) LDMb – The Indigo Bunting must use a different migratory route as quite small numbers are caught.

**Rusty Blackbird** (*Euphagus carolinus*) SDM – Only seven have been banded, but on a few occasions in October, flocks of these and other blackbirds have been seen flying high over the station.

**Common Grackle** (*Quiscalus quiscula*) SDM – One

banding occurred September 22, 1986.

**Brown-headed Cowbird** (*Molothrus ater*) SDM – A maximum of four were banded in 1983.

**Baltimore Oriole** (*Icterus galbula*) LDMb – As with other icterids, the Baltimore Oriole does not use this flyway, and so it is only a casual visitant.

**Purple Finch** (*Carpodacus purpureus*) SDM – This species nests on the mountain, and HY birds are frequently caught in August. The station is generally closed before the main migration from the north occurs.

**Red Crossbill** (*Loxia curvirostra*) U – Although crossbills have been seen flying over on many occasions, just one bird, on September 3, 1966, has ever been netted. Small flocks were seen almost daily through the 2000 banding season.

**Pine Siskin** (*Carduelis pinus*) SDM – There may be an occasional breeding population of siskins on this mountain where they are heard flying over more frequently than they are caught.

**American Goldfinch** (*Carduelis tristis*) SDM – Goldfinches in flocks of varying size fly over the station almost daily throughout the season, but the highest numbers are in mid-September. Because of the erratic nature of the flight, it is not possible to know whether given flocks make repeated passages over the station. The flight is too high to lead to many net captures. Since 1990, daily counts of "flyover" goldfinches have been made. In the first ten years a total of 30,646 birds were counted, giving an average of 3,065 per year with extremes of 1,379-4,788. The maximum daily count was 569 on September 20, 1995.

#### ADDITIONAL SPECIES (NOT BANDED)

The Hawk Watch

Bear Rocks, three miles north of the AFMO station, has been the major observation point for observing the autumnal hawk flight since about 1949. However, in some wind conditions a substantial flight can develop at the Observatory. This flight has not been intensively monitored, but in recent years some counting has been done after the noon closing of the banding. Two flight routes are observed. Many birds cross the mountain, more or less on the same path as the small birds, but some higher flying birds continue to follow the main ridge line. A record count of 6,960 hawks was made on September 19, 1995 (Ritter, 1996).

Species observed are Black Vulture (*Coragyps atratus*), Turkey Vulture (*Cathartes aura*), Osprey (*Pandion haliaetus*), Bald Eagle (*Haliaeetus leucocephalus*), Northern Harrier (*Circus cyaneus*), Northern Goshawk (*Accipiter gentilis*), Red-shouldered Hawk (*Buteo lineatus*), Broad-winged Hawk (*Buteo platypterus*), Red-tailed Hawk (*Buteo jamaicensis*), Rough-legged Hawk (*Buteo lagopus*),

Golden Eagle (*Aquila chrysaetos*), and Peregrine Falcon (*Falco peregrinus*).

Several other species have been seen flying over the station or along the mountain ridge. A few species, marked with (\*) have been identified in or near the campground.

Other species seen flying over are Snow Goose (*Chen caerulescens*), Canada Goose (*Branta canadensis*), American Black Duck (*Anas rubripes*), \*Green-winged Teal (*Anas crecca*), \*Ruffed Grouse (*Bonasa umbellus*), Double-crested Cormorant (*Phalacrocorax auritus*), Great Blue Heron (*Ardea herodias*), Sandhill Crane (*Grus canadensis*), \*American Golden-Plover (*Pluvialis dominica*), Killdeer (*Charadrius vociferus*), Greater Yellowlegs (*Tringa melanoleuca*), Great Horned Owl (*Bubo virginianus*), Barred Owl (*Strix varia*), Long-eared Owl (*Asio otus*), Common Nighthawk (*Chordeiles minor*) (several major evening flights observed), Chimney Swift (*Chaetura brachyrhynchos*), Common Raven (*Corvus corax*), \*Horned Lark (*Eremophila alpestris*), Purple Martin (*Progne subis*), Tree Swallow (*Tachycineta bicolor*), Cliff Swallow (*Petrochelidon pyrrhonota*), Barn Swallow (*Hirundo rustica*), Eastern Bluebird (*Sialia sialis*), Snow Bunting (*Plectrophenax nivalis*), Bobolink (*Dolichonyx orizivorus*), Pine Grosbeak (*Pinicola enucleator*), Common Redpoll (*Carduelis flammea*), Evening Grosbeak (*Coccothraustes vespertinus*).

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Ralph K. Bell discovered the "rim" banding site and established the first net-lanes there. He had the responsibility of seeing that an adequate number of banders were present each day, and to that end, he has trained a number of people, including the writer, in netting and banding technique.

APPENDIX A

PARTICIPATING BANDERS, 1958-2000

Gloria Aiken, Lynn Barnhart, Barbara Bilsborough, Ralph Bell, Robert Dean, \*Art Dunnell, Susan Edmonds, Walter Fye, Elizabeth Gatewood, LeJay Graffious, George Hall, Kenneth Heselton, Susan Heselton, Patricia Hogan, Robert Hogan, Steven Huy, Joseph ImBrogno, John Jones, \*Constance Katholi, Gordon Knight, \*Maxine Kiff, \*Jack Linehan, Cleo Mayfield, \*George Mayfield, Carol McCullough, Frederick McCullough, \*Clark Miller, John Morgan, \*Janice Musser, Avis Newell, \*Eph Olliver, \*Thomas Olsen, Joan Pattison, Frances Pope, Elizabeth Ritter, Randolph Ritter, Janet Shaffer, Anne Shreve, Julie Simpson, David Skinner, Constance Skipper, Harry Slack, Trudy Smith, \*Jo Lane Stern, Sally Thayer, Judith Ward, John Willetts, \*Cora Williams, \*Leon Wilson, Charles Ziegenfus.

FULL-TIME NONBANDERS

\*Genevieve Findley, \*John Findley, Kathleen Finnegan, \*Michael Finnegan, \*Harriett Hooker, \*Melvin Hooker, Joleene Minear, and \*Ivareen Pierce.  
(\*Deceased)

APPENDIX B

ANNUAL REPORTS

After the preliminary year of 1958, full data for the years 1959-2000 have been collected. Summaries of most of these data sets have been published in *The Redstart*. The reports vary as to the amount of detail given, and most of them are not cited in the Literature Cited section of this monograph. Reports for 1959 through 1966 are as follows:

1958	Bell, 1959
1959	Knight, 1960
1960	Hall, G. A. (1961). <i>The Redstart</i> , 27(2), 69-72
1961	Hall, G. A. (1962). <i>The Redstart</i> , 28(2), 63-67
1962	Hall, G. A. (1963). <i>The Redstart</i> , 29(2), 72-75
1963	Appendix to Hall, 1964
1964-1966	Hall, 1967

The summaries for the years 1967-1974 were never published although copies were distributed. Some data are given in anecdotal accounts by R. K. Bell under the title "A Bird Bander's Diary" in the September-October issue of *EBBA News* for 1964, 1965, 1966, 1967, 1968, 1969, 1970, and 1971.

From 1975 to the present the author published a full report:

1975	<i>The Redstart</i> , 43(4), 120-123 (1976)
1976	<i>The Redstart</i> , 44(3), 97-100 (1977)
1977	<i>The Redstart</i> , 45(3), 120-123 (1978)
1978	<i>The Redstart</i> , 46(2), 84-90 (1979)

1979	<i>The Redstart</i> , 47(2), 94-97 (1980)
1980	<i>The Redstart</i> , 48(2), 68-71 (1981)
1981	<i>The Redstart</i> , 49(3), 99-102 (1982)
1982	<i>The Redstart</i> , 50(2), 58-63 (1983)
1983	<i>The Redstart</i> , 51(2), 70-73 (1984)
1984	<i>The Redstart</i> , 52(2), 58-61 (1985)
1985	<i>The Redstart</i> , 53(2), 92-95 (1986)
1986	<i>The Redstart</i> , 54(2), 49-52 (1987)
1987	<i>The Redstart</i> , 55(2), 60-63 (1988)
1988	<i>The Redstart</i> , 56(2), 41-44 (1989)
1989	<i>The Redstart</i> , 57(2), 46-49 (1990)
1990	<i>The Redstart</i> , 58(2), 63-66 (1991)
1991	<i>The Redstart</i> , 59(2), 49-53 (1992)
1992	<i>The Redstart</i> , 60(2), 48-52 (1993)
1993	<i>The Redstart</i> , 61(2), 60-64 (1994)
1994	<i>The Redstart</i> , 62(2), 62-66 (1995)
1995	<i>The Redstart</i> , 63(2), 49-53 (1996)
1996	<i>The Redstart</i> , 64(2), 59-63 (1997)
1997	<i>The Redstart</i> , 65(2), 49-53 (1998)
1998	<i>The Redstart</i> , 66(2), 52-57 (1999)
1999	<i>The Redstart</i> , 67(2), 48-52 (2000)
2000	<i>The Redstart</i> , 68(2), 53-57 (2001)

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