

Pack Monadnock Raptor Observatory Fall 2019 Final Report



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Introduction

Each year we clamber to the top of this rock, either by foot or by car, to witness the spectacle of raptor migration and collect hourly data on this movement. Here we look out upon the Contoocook Valley to the west and the coastal plains to the east and we pick out specks of these birds, classing them to family and then species. The data is important but there is something more that draws us there, year after year. Perhaps it is the sheer number of Broad-winged Hawks that move by in clouds and squadrons in September? Perhaps it is the chance at seeing one of the few eastern Golden Eagles as it flies past the watch on its way down into the interior eastern United States? Perhaps it is to see a close-up of the many Sharp-shinned Hawks and Merlins that take a swipe at our owl decoy in effort to ward it off? These birds surely put on a show and we find a lot of entertainment in watching them.

But more than just observers of birds we enjoy the camaraderie of others and sharing the science and magic of this migratory spectacle. School groups, scout groups, birding and non-birding clubs, and families all schedule time to visit the Pack Monadnock Raptor Observatory in the fall to learn about raptor migration and perhaps get an opportunity to see up close this spectacle that enraptures us so.

Why Pack Monadnock?

Many raptors migrate long distances to their wintering grounds in Central and South America. In order to conserve energy for the journey, they soar on updrafts created by favorable winds and thermals produced by heat rising from the landscape below. With the wind at their backs, many raptors can travel distances of 250-300 miles in a single day! It is this combination of geography and weather patterns that brings raptors to Pack Monadnock. Because of its high elevation, location along a north-south ridgeline, and prominent views to the north and west, Pack Monadnock has long been known as an excellent vantage point for observing raptor migration.

Site Description

The Pack Monadnock Raptor Observatory (PMRO) is located near the summit of Pack Monadnock (2,290 feet) within Miller State Park in Peterborough, NH. Situated in south-central New Hampshire along the scenic and rugged 22-mile long Wapack Range, the Observatory platform offers spectacular views to the north and west, including Mount Washington, the White Mountains, Crotched Mountain, Mount Kearsarge, Mount Cardigan, North Pack Monadnock, Mount Monadnock, and several summits in Vermont. Able to accommodate large crowds during peak season, the observation platform is wheelchair accessible via a short trail from the parking lot atop the scenic summit. This parking lot can be reached from the 1.5-mile paved auto road that connects to the park's entrance at the base of the mountain from NH 101. For those seeking a less paved route, the observation platform can also be reached from several hiking trails along the mountain. Bad weather notwithstanding, the auto road is generally open through Veterans Day (conditions permitting) while the trails are open to hikers during all seasons.

History and Mission

Like many of New Hampshire's mountains, Pack Monadnock has a long and storied history, including hawk watching. However, it was not until 2005 that it was deemed an official hawk watch site. Founded by NH Audubon under the leadership of Iain MacLeod, with initial funding from the Samuel P. Hunt Foundation, the Monadnock Community Foundation, and the Putnam Foundation, PMRO has since become a fixture of the local community and widely renowned as one of the premier hawk watch locations in New England. Having just completed its 15th season, PMRO is one of at least 87 hawk watches located in the Eastern Flyway, which runs the length of the east coast of North America from New Brunswick, Canada all the way to Alabama. This series of hawk watches all report data to the online database maintained by PMRO's partner organization, the Hawk Migration Association of North America (HMANA): <http://hawkcount.org/>. Further, the observatory, owing to both its longevity and its standardized methodology, is now part of a select analysis through the Raptor Population Index (RPI), a project of HMANA. The set of raptor migration monitoring sites chosen for the RPI analysis is the 'gold standard' for hawk watches, as each contributes key data which are used by conservation biologists to make determinations about global populations of raptors and conservation strategies for them. In this way, PMRO plays a key regional role in this periodic analysis, the most recent of which was completed in 2016. For more information, see <http://rpi-project.org/index.php>.

Since its inception as an official hawk watch, there have been variable start and end dates for this project. From 2005-2011, daily counts were conducted from September 1 through October 31, weather permitting. While this count period encapsulates peak migration for this site in terms of total detections, it fails to capture many of our late-season migrants. This includes a large percentage of our Northern Goshawk, Golden Eagle, Rough-legged Hawk, Red-shouldered Hawk, and Red-tailed Hawk numbers. Thus, despite all its merits, this survey period painted a rather incomplete picture of hawk migration past Pack Monadnock. To remedy this issue, the official count period has been extended twice in recent years to better quantify late-season migration, first to November 15 (2012-2014, 8 years of data now), and more recently to November 20 (2015-present, 5 years of data now).

From 2005-2017, the Observatory was managed and coordinated by New Hampshire Audubon (NHA). In 2018, NHA entered into a new partnership with the Harris Center for Conservation Education in Hancock, NH to provide research and education staffing for this project. Through its research and education efforts, PMRO continues to fulfill the missions of both NHA ("to protect New Hampshire's natural environment for wildlife and for people") and the Harris Center ("to promote understanding and respect for our natural environment through education of all ages, direct protection and exemplary stewardship of the region's natural resources, conservation research, and programs that encourage active participation in the great outdoors").

What We See Here

Located at 41 degrees latitude, PMRO is nearly halfway to the North Pole from the equator. There are several kinds of habitat further north of us which include mixed coniferous and deciduous forest, boreal forest, and tundra. The diversity of birds we see at PMRO reflect these habitats and latitudes. Roughly 15 species of raptors are observed migrating past the PRMO each fall, the majority of these being Broad-winged Hawks, with lesser numbers of Sharp-shinned Hawks and even smaller numbers of all other species. The chart below shows the relative makeup of observations.

Makeup of Raptor Observations at PMRO

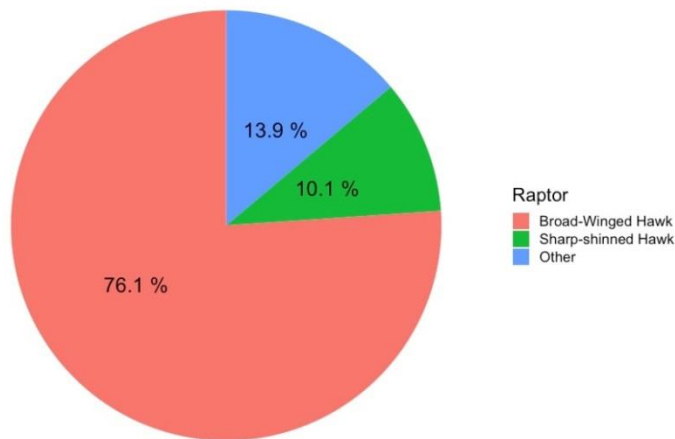


Chart showing the percentage of Broad-winged Hawk and Sharp-shinned Hawk of the total number of observations made from September 1, 2005 to November 20, 2019. "Other" includes all other birds including unidentified birds.

Education and Outreach

With easy access by the Miller State Park auto road, the Raptor Observatory is a destination for school groups and visitors alike. Visitors to the park wander down the path to look at the view to the north, to specifically look at raptors, or because they are curious as to where the path goes. At PMRO, if conditions are right, they get to witness raptor migration up close and personal. This year there were several days during the Broad-winged Hawk migration window as well as several days within the Red-shouldered Hawk window where birds were flying low over the platform, easily viewable without binoculars. This year, a total of 5,707 visitors made their way to the platform and had some sort of interaction with the Raptor Biologist, Harris Center staff or volunteer educators, or interpretation located at the watch. The number of visitors is up from 2018 and ranks second behind the 2017 season's total of 6,258 visitors. The overall trend in visitation is an increase with last year's lower numbers likely due to poor weather.

This year marked the second year of a partnership with the NH AmeriCorps – Student Conservation Association (SCA). An Intern from the SCA, Xandri Clifton, was on hand to help answer visitors' questions on Friday afternoons this season through Columbus Day (October 14th).

Over the season, we saw a total of 10 schools in 15 groups from the surrounding area visit with more than 400 students getting some exposure to the important subject of raptor migration. There were two days where the numbers of students were not collected so a non-exact number of students is more than 400 students interacting with the site. For each of these visits, a staff member or volunteer from the Harris Center served as an on-site naturalist to educate and answer questions from the many young and inquisitive minds.

Below is a list of the visiting school groups that made their way to the observation platform as part of their education experience. If you are an interested parent or educator wishing to make PRMO a part of your students' outdoor education experience, please contact Susie Spikol at spikol@harriscenter.org or call (603) 525-3944 for more details.



Lori Chretien introducing the concept of raptor shape to students from Clark-Wilkens Elementary School in Amherst, NH - Photo by Mark Timmerman.

School Groups

- Antioch University New England Ornithology 101 - Post-graduate (Keene, NH)
- Antrim Elementary School - Grade 3 (Antrim, NH)
- Dublin School, (Dublin, NH)
- Littleton High School (Littleton, MA)
- Mountain Shadows School - Grades 4-6 (Dublin, NH)
- Peterborough Elementary School - Grade 3 (Peterborough, NH)
- Robin's Nest Nature Preschool - (Peterborough, NH)
- Souhegan High School - Grade 9 (Amherst, NH)
- Southside Middle School - Grade 6 (Manchester, NH)
- Clark-Wilkens Elementary School - (Amherst, NH)

Various clubs and organizations such as those listed below make the Observatory a destination. The following did so in 2019:

Organizations

- Appalachian Mountain Club
- Mass Audubon's Drumlin Farm (Lincoln, MA)
- Mass Audubon's Broadmoor (Natick, MA)
- New Hampshire Audubon (Concord, NH)
- Pilgrim Pines Road Scholar (Swanzey, NH)
- HMANA Meetup Group
- Harris Center Young Birder's Club

Events

To complement the education and outreach efforts offered atop Pack Monadnock, several off-site programs were conducted this fall by the Harris Center and NH Audubon, each offering supplemental raptor learning and appreciation experiences to the general public. These informative sessions included lectures, workshops, and presentations on raptor identification, raptor migration, and focused on the importance of hawk watches, in particular, the PMRO.



A Broad-winged Hawk gets a second chance at this year's Raptor Release Day on September 22nd. Photo by Francie Von Mertens.

Each year PMRO holds several events designed to have fun and get to know each other and the local environment around the platform a little better. This year we kicked off the year with International Hawk Migration week held the week of September 14th to 22nd. Events held during this week included *Raptors on Blueberry Ridge* (held at Crotched Mountain), *Raptor Migration in NH: What the Numbers Tell Us* (presentation at the Harris Center), and *Raptor Release Day* on the 22nd.

Another annual tradition at the hawk watch platform is the *Big Sit!* As described on the Big Sit! Website:

"The Big Sit! is an annual, international, noncompetitive birding event hosted by Bird Watcher's Digest and founded by the New Haven (Connecticut) Bird Club. The Big Sit! is like a Big Day or a bird-a-thon in that the object is to tally as many bird species as can be seen or heard within 24 hours. The difference lies in the area limitation from which you may observe. Some people have called it a 'tailgate party for birders.'"

This year, with a forecast set to clear mid-morning, the event was held on Saturday, October 12th. Levi Burford and Katrina Fenton led the 'Packcipiters' and were on the site at 6am hooting and tooting for owls (none observed). The weather didn't clear until mid-afternoon and the team tallied a meager 13 species for the day. Surely, an all-time low!

Similarly, the PMRO was represented in this year's inaugural Antioch Bird Club's *Monadnock Birding Cup* in which a team comprised of Levi Burford, Phil Brown, and Andre Moraes tallied just 14 species during poor weather and migration conditions – however, the team took the title for 1st place in the Big Sit category of this fun birding event.

The final major event of the year was the annual *Big Soup* competition, held the same day as the October Big Sit! The hot soups helped to soothe the sting of low species count for the day. There was a total of nine soups entered in the contest this year. Competition was fierce, in this, our tenth year. There was a steady stream of visitors willing to subject themselves to the soups and vote on their top three choices. In the end, Levi Burford's 'Wild Mushroom Hungarian' took home first prize while upstart Henry Walters took second place with his inspired 'Wing It!', and Alan Chretien came in third with a Vegi-Chilean Condor soup. Other soups entered included a Butternut Soup deemed "Red-breasted Butternuthatch" brought by Joe from Miller State Park, "Bald Eagle Baitfish Chowder" by Phil Brown, a soup name misrepresenting its taste, "Regurgitated Acorn Squash" by Thom of the SCA. Katrina brought "French-style Pollo-con-vino de Cooper's Hawk", Julie brought "Souper Spicy Ridgeway Tomato", and Van Zimmerman sent a Meat Chili by way of Chuck Carlson.

It was fun to uphold this yearly tradition, and the soups that showed up this year were as good as ever.



The top three entries into the soup contest point to their entry. From left to right: Henry Walters (2nd place) Alan Chretien (3rd place) and Levi Burford (1st place). Photo by Phil Brown.

Methods

Data collection at PRMO has remained largely unchanged over the years. By standardizing the data collection process through a series of established protocols, PMRO has been able to ensure that the data that is collected is of a consistent quality. These protocols have been handed down by each official counter to the next, through the years. The standardization of protocols eliminates unnecessary variables which could impart negative and unforeseen influences on subsequent analyses. What follows is a general accounting of the protocol used for this year's surveys.

An official counter was present daily at the count site from September 1 through November 20, when there is enough visibility to see North Pack Monadnock. The count took place between the hours of 8 a.m. EST and 4 p.m. EST from September 1 through November 2, then from 9 a.m. EST to 3 p.m. EST from November 3 through November 20. On days where the flights were predicted to extend past the regular hours an observer made the effort to be there. While some migrating raptors are undoubtedly first detected with the unaided eye, the use of optics is integral to the project; without them, only a small portion would ever be spotted and correctly identified. Thus, most detected raptors are spotted with the use of 8X or 10X binoculars. Spotting scopes (20X-60X) are also employed and are necessary for scanning distant horizons for "speck birds" that would otherwise slip past undetected. They are also critical for correctly identifying distant migrants, particularly those with challenging IDs (e.g. Accipiters and small falcons).

For this project and others like it, only raptors deemed actively migrating are counted. This important distinction is determined from a variety of factors including known migration periods for a given species at this site, knowledge of the local individuals based on early season viewing, and finally, the behavior of the individual bird or kettle that is being monitored. Nevertheless, this distinction can be tricky, particularly for such species where local, non-migratory individuals are regularly seen throughout parts of the season. Troublesome species in this regard include Turkey Vulture, Sharp-shinned Hawk, Northern Goshawk, Broad-winged Hawk, Red-tailed Hawk, and Merlin. All migratory raptor data is collected on an hourly basis for the duration of the count. This information, along with hourly weather data and a daily summary, is submitted to HawkCount (<https://www.hawkcount.org>), the online hawk watch database for the Hawk Migration Association of North America (HMANA). Copies of this daily report are also submitted to the NH Birds Google Group listserv.

In addition to migrating raptors, daily checklists (including numbers) are kept for other species of birds. This information, along with the raptor total, is then submitted to eBird (<https://ebird.org>), an online database of bird observations that provides scientists, researchers, and amateur naturalists with real-time data about bird distribution and abundance. All checklists are submitted to the 'Miller SP-Pack Monadnock' hotspot (<https://ebird.org/hotspot/L450946>).

The 2019 Season

2019 marks the 15th consecutive season for PMRO. Last year's Raptor Biologist, Chad Witko, passed the baton on to Levi Burford who was hired by the Harris Center to staff the site from September 1st to November 20th. Levi volunteered considerable time in 2018 to get a strong feel for the site and to continue his never-ending work on raptor identification at a distance. This year, while Levi was not on the platform, the count was conducted by veteran counters Henry Walters (Tuesdays), and site founder Iain MacLeod (Mondays). Iain actually got some good days to count this year! When the three official counters were unable to man their post due to scheduling conflicts or illness, the site was covered by the likes of Julie Brown, Phil Brown, Katrina Fenton, and Tom and Janet Delaney.

This year, PMRO was staffed for 557.17 hours of observation time, which ranks in the top third for number of hours per season since the Observatory's inception in 2005. There were six hours of observation time out in August before the season officially kicked off on September 1st. September saw 246.92 hours of observation time with only two days of significantly reduced hours (one day with two hours, one with five hours). There were six additional days in which the count fell short of a complete eight-hour day. October had the toughest weather with only 199.5 hours of observation time recorded this month. The final five days of the month were lost to rain and a low cloud ceiling. November's weather was fairly favorable, considering the generally shortened hours due to less daylight and less favorable migration periods. The 104.75 hours ranks second all-time for hours counted in November behind 2016. However, this season ended somewhat anticlimactically, as the last three days of the season were lost due to rain, snow, or a low cloud deck.

During the 557.17 observation hours, a total of 10,503 migrating raptors were officially counted from the platform. With good weather for the season, we were happy to see our 10,000th bird on October 20th. As evidence from last year, 10,000 birds are not guaranteed each season. While the 2019 numbers were up from the year before, the birds per hour calculation was actually somewhat low. The nature of a hawk watch is that weather is the major factor in overall numbers and our numbers vary from year to year. As was noted in last year's report, the annual variation in numbers is to be expected for a project of this scope. However, by maintaining strict methodology, an understanding of migration patterns at Pack Monadnock, and even regionally, can be ascertained over the long-term.

The 2019 fall season saw higher than average totals (according to the 2016 Raptor Population Index analysis) for Bald Eagle, American Kestrel, Turkey Vulture, and Red-shouldered Hawk. Significant decreases were noted for Northern Goshawk (irregular trend) and Broad-winged Hawks, which largely contributed to the overall deficit in total migrating raptors on the season. The remaining species which are expected at Pack Monadnock on an annual basis remained close to their long-term averages.

Species Accounts

The following accounts give migration details for each species of raptor observed from PMRO this season. Included in this year's format is a reminder of the Raptor Population Index (RPI) analysis generated for the period of 2006-2016 for each species (RPI (2006-2016) from hereon). The next generation of the RPI is planned for 2020. For a full overview of raptor totals at PMRO over the course of the project, please see Table 1 in the Appendix.

Turkey Vulture (*Cathartes aura*)

Season Total: 268

High Count: 49 (October 9)

15-year Mean: 147 15-year Median: 127

Number counted between Nov. 16 and Nov. 20: 0

RPI (2006-2016): +9.53% per year

This year showed a continuation of strong numbers of Turkey Vultures with 268 individuals counted in migration. The 2019 numbers continue to bring up the long-term average (mean). Our biggest day for witnessing Turkey Vulture migration was October 9th when the wind was blowing moderately from the east. Looking at data from all years combined this is a species that will fly on northeast to east winds at the PMRO.

In prior years Turkey Vultures have posed a problem to the counter. How do you know a migrant Turkey Vulture from a non-migrant? This year the Turkey Vultures took it easy on the counter. They wandered back and forth through much of September but on the last day of that month their behavior changed, and they started moving south in droves with purpose. In past years there has been a point in the migration season, when some southern flow causes birds to start moving northward again. With the exception of two birds this was not the case this year.



*There's a Turkey Vulture right there! Actually, that's Francie Von Mertens showing off her best Turkey Vulture dihedral to the Mountain Shadow School.
Photo by Mark Timmerman.*

Osprey (*Pandion haliaetus*)

Season Total: 171

High Count: 12 (September 16)

15-year Mean: 233 15-year Median: 219

RPI (2006-2016): -3.09% per year

No matter how you slice it Osprey numbers are down this year. In fact, this year's total is the lowest number ever recorded for this species. This continued downward slide agrees with trends produced by the RPI analysis generated in 2016, which shows a significant decline in migratory Osprey at PMRO – and at many sites in the Northeast. Unlike last year, we cannot look at poor visibility as a factor in our numbers. Observation hours, dependent on visibility, were fairly high this year. Lastly, it is also interesting to note that Bald Eagle observations surpassed those of Osprey for the first time at PMRO.

Bald Eagle (*Haliaeetus leucocephalus*)

Season Total: 180 *All-time Season High

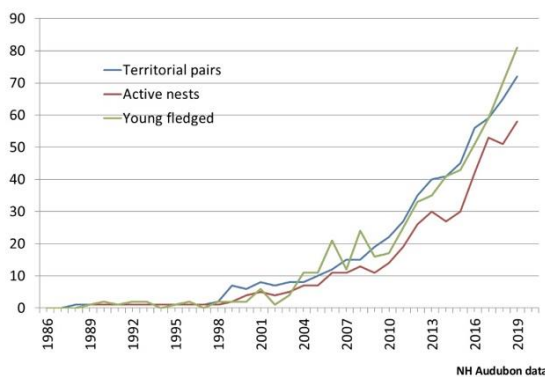
High Count: 12 (September 13)

15-year Mean: 101 15-year Median: 101

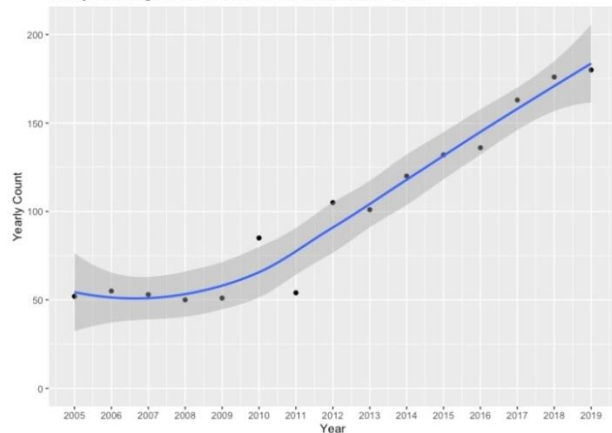
RPI (2006-2016): +9.23% per year

It's obvious from the questions asked at PMRO that Bald Eagles are a source of delight and curiosity for many of the visitors. 2019 was another increase in numbers, continuing the linear increasing trend that has been showing in the data for the last decade. Breeding season population data collected by NH Audubon has been showing a non-linear increase over the same decade. What is interesting is that the *non-linear* population increase in the NH breeding population noted by NH Audubon correlates with a *linear* increase of observations of migrant Bald Eagles at PMRO. But, of course, not all of the Bald Eagles that fly past Pack Monadnock are birds that spent the summer in NH. This raises several questions: What are the populations doing elsewhere? Are more birds remaining on territory north of Pack Monadnock through the winter? Is New Hampshire's population growing at a faster rate than in other states?

New Hampshire Bald Eagle Productivity, 1986-2019



Yearly Bald Eagle Observations at P.M.R.O., 2005-Present



Comparison of statewide breeding season observations from NH Audubon and observations at PMRO.

Northern Harrier (*Circus hudsonius*)

Season Total: 54

High Count: 5 (September 30)

15-year Mean: 84 15-year Median: 87

RPI (2006-2016): -0.79% per year

The 2019 season saw another decrease in migrant numbers of Northern Harrier. This season's 64 individuals is the second lowest yearly count, only ahead of the abbreviated initial 2005 season in which 24 were counted. The downward trend is somewhat perplexing as migration conditions have been favorable for Harrier migration for much of the count season, but the species has seen regional declines. One possible reason for the reduction in migrant numbers is the continuation of the reduction in suitable breeding and hunting habitat (open wetland and hay field) further north of PMRO.

Last year it was noted that the decrease in numbers was a sharp departure from the trend and suggested poor weather was a factor. I'm not sure we can claim poor weather as the reason for this year's decline. All the more reason to support NH Audubon's efforts to monitor breeding populations of this species in the state. In 2020, NH Audubon will be gathering data on presence and breeding of Northern Harriers in an effort to gain a better understanding the state's breeding population.

Sharp-shinned Hawk (*Accipiter striatus*)

Season Total: 1,027

High Count: 79 (September 18)

15-year Mean: 1,133 15-year Median: 1,189

RPI (2006-2016): -1.23% per year

This year's 1,027 count of Sharp-shinned Hawks continues the trend of a slow decrease in migrants at the PMRO. This was the third lowest count after last season (668) and 2005 (520), respectively. This year's decrease supports a slow linear decline shown in our data for the last five years. It also suggests that last year's number was simply an outlier rather than a sudden and drastic population drop, and it can probably be best attributed to the aforementioned poor weather conditions during the fall of 2018.

So, what is happening to the Northeast's Sharp-shinned Hawk population? Is it decreasing or are birds staying to hunt locally through our warming winters?



Two Sharp-shinned Hawks interacting near the PMRO platform. Photo by Andre Moraes.

Cooper's Hawk (*Accipiter cooperii*)

Season Total: 105

High Count: 6 (October 13)

15-year Mean: 144 15-year Median: 145

RPI (2006-2016): -4.61% per year

This year's data continues the downward trend in migrant numbers of Cooper's Hawk that has been occurring since nearly the inception of the Observatory. This was the second lowest year after the 2005 season count of 47. Both the Sharp-shinned Hawk and the Cooper's Hawk have shown similar declines in numbers counted at Pack Monadnock. Observations in the Northeast have also been down overall. Neighboring hawk watches, Putney Mountain and Mount Wachusett, each showed similar declines, and Hawk Mountain and Waggoner's Gap in Pennsylvania showed dramatic declines in these two species. Allegheny Front (also PA) showed a strong increase this year over past years, being somewhat of an outlier. Evidence points to this species 'short-stopping' or becoming less migratory, and more are being recorded further north in winter months.

Northern Goshawk (*Accipiter gentilis*)

Season Total: 9

High Count: 1 (several dates)

15-year Mean: 34 15-year Median: 25

RPI (2006-2016): -5.31% per year

2019 brought another low count year to PMRO for Northern Goshawks. In fact, this season was the lowest tally since the start of the Observatory in 2005. Cyclical in nature with ties to Snowshoe Hare populations further north, Northern Goshawk numbers bounce around from year to year at PMRO. This year marked the third year in a row with a decrease, the longest slump in the observatory's short history. Sites with a more established history of Northern Goshawk observation, like Hawk Ridge in Minnesota, have shown a lot of variance in observations over the last 15 years. This year, Hawk Mountain had lower numbers than usual, so likely this was an off-year. Perhaps next year we will finally see a jump.

Red-shouldered Hawk (*Buteo lineatus*)

Season Total: 181

High Count: 35 (November 2)

15-year Mean: 115 15-year Median: 118

RPI (2006-2016): +2.51% per year

This year we were treated to several days with good flights of close fly-bys from Red-shouldered Hawks. In terms of numbers, Red-shouldered Hawks have seemed to continue their upward climb in numbers.

This year tied the 2017 season (181 observed) for second highest count in the history of the project, behind the 2012 season (209 observed). This is one species whose numbers have risen from the season expansion in 2012 from October 31st to November 15th. With the extension of counting into later November, the count is better suited to tally the complete Red-shouldered Hawk migration window, which may also be trending later in recent years and decades. In terms of data analysis, it may be best to include only years from 2012 onward for the most accurate view of their migration past PMRO.



This transitioning Red-shouldered hawk took a half-hearted swipe at Gina the owl. Photo by Levi Burford.

Broad-winged Hawk (*Buteo platypterus*)

Season Total: 7,840

High Count: 2,435 (September 18)

15-year Mean: 8,568 15-year Median: 7,840

RPI (2006-2016): +7.18% per year

Few things draw people to PMRO as does the Broad-winged Hawk spectacle in September. Broad-wingeds make up two-thirds of the total number of raptors tallied in any given year, and the fact that they come through in a compressed window of time in the middle of September makes their migration relatively easy to plan for. This year, the PMRO recorded two flights of more than 2,000 birds, one day above 1,000 birds, and four days between 250 and 600 birds. In total, 7,840 migrant Broad-winged Hawks were observed at PMRO. This number is slightly below average (median 8,025, mean 8,889) and ranks 7th out of 14 years of data.

Neighboring sites, Putney Mountain and Mount Wachusett, each showed big declines in the numbers of Broad-winged Hawks this year. One possibility for the difference in numbers might be the fact that the PMRO is located on a ridge, and ridge sites exhibit more consistency from year to year as they are less dependent on ideal weather conditions to carry large numbers of birds past the watch site.

Red-tailed Hawk (*Buteo jamaicensis*)

Season Total: 220

High Count: 25 (November 16)

15-year Mean: 331 15-year Median: 341

RPI (2006-2016): **-6.96%** per year

This year the big Red-tailed Hawk flight never seemed to come. Only a handful of non-migrants were observed in September, and the numbers of migrants slowly built to a high of 26 on the 16th of November. It is possible that the Red-tailed flight was later this year than the count window, though this is not supported by data from sites that had extended observation windows like Holiday Beach in Ontario, and Hawk Mountain, Waggoner's Gap, and Allegheny Front in Pennsylvania. Another possible cause of the lowered numbers might be a decrease in populations after last year's squirrel/rodent boom and subsequent die-off. One final possibility is one that has been shown to be a factor elsewhere: 'short-stopping' or staying further north later or drifting southward at a slower rate through the winter.

Rough-legged Hawk (*Buteo lagopus*)

Season Total: 0

High Count: 0

15-year Mean: 0 15-year Median: <1

RPI (2006-2016): N/A (insufficient data)

None were observed this year for the first time since 2011.

Golden Eagle (*Aquila chrysaetos*)

Season Total: 4

High Count: 1 (several days)

15-year Mean: 8 15-year Median: 7

RPI (2006-2016): N/A (insufficient data)

This year saw a lower than average number of observations for one of our favored migrants with only four counted to last year's 22. The data shows that there have not been back-to-back strong flight years in the history of the project. Perhaps just a coincidence, but perhaps we'll know after another 15 years. It is tough to look at the data for numbers of Golden Eagle migrants and pull out trends. The PMRO counts such a small sample of this infrequent NH migrant. Weather plays a much larger role in our observations than for sites in Pennsylvania which seem to get more consistent and higher numbers.

American Kestrel (*Falco sparverius*)

Season Total: 185

High Count: 23 (September 30)

15-year Mean: 161 15-year Median: 167

RPI (2006-2016): **-3.33%** per year

Since the 2014 season's low of 112, American Kestrel numbers have been on an increasing trend at PMRO. It is hopeful that trend is indicative of an increasing population of American Kestrels in the Northeast, a species that is listed as 'Special Concern' in NH and many other regional states. This year's total of 185 American Kestrel observations was a little higher than the long-term average. Neighboring hawk watches, Putney Mountain and Mount Wachusett, had average and above average years, respectively. All of this could be a sign that the Northeast population had a good year. Unfortunately, this year's increase in numbers was not shared by Pennsylvania hawk watch sites, suggesting that the possible population increase might be somewhat local to New England.

Merlin (*Falco columbarius*)

Season Total: 64

High Count: 8 (September 15)

15-year Mean: 82 15-year Median: 80

RPI (2006-2016): **+3.81%** per year

With the past two years' declines in Merlin observations, it looks like the trend, at least temporarily, is down. What had been a fairly consistent, slight increase each year has not been supported by this year's observations. Traditionally, Merlins have posed a slight conundrum to the first-year counter due to their migration behavior of buzzing over the ridgetop, often attacking anything in their path. The question as to whether each bird is a migrator or temporary resident is not always easy to answer. This year the methodology has been kept the same as in previous years and only several birds (fewer than five) were counted as residents early in the September. Even if the counter had been mistaken, it would not have been significant enough to change the overall count.



One of our more cooperative Merlins alights next to the watch platform. Photo by Levi Burford.

Peregrine Falcon (*Falco peregrinus*)

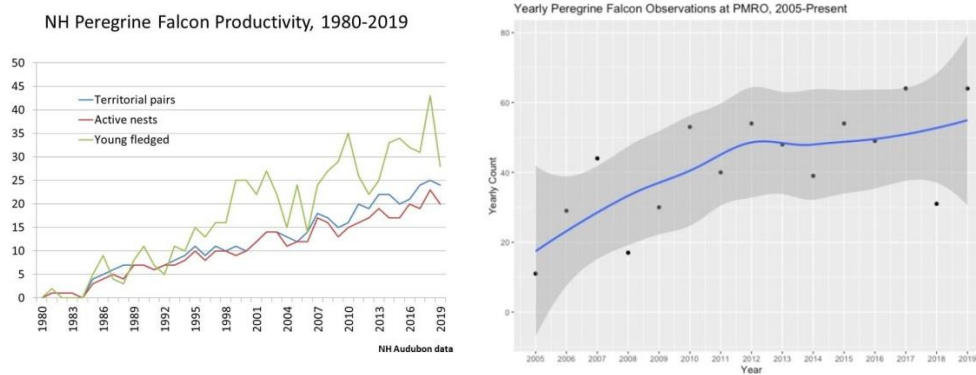
Season Total: 64 *Ties the All-time Season High Count

High Count: 12 (September 15) *Ties the Single Day High Count

15-year Mean: 42 15-year Median: 44

RPI (2006-2016): +5.02% per year

One more Peregrine Falcon. Was that too much to ask for? Twice I asked for it on September 15th when we tied the single day high, and again on October 24th when we recorded our last Peregrine of the year. Either would have given 2019 a record for Peregrine Falcons and neither wish was granted. The raptor gods must've been angry with us. Nevertheless, these numbers bode well for the Eastern population of Peregrines. NH Audubon's data suggests that Peregrines had a tough breeding year in NH. Perhaps the PMRO numbers are indicative that things went okay elsewhere in their range?



Side-by-side comparison of state-wide breeding season observations from NH Audubon and yearly observations at PMRO.



One of this year's many Peregrine Falcons. Photo by Mike Gebu.

Non-raptor Species

Along with raptors, migrating and non-migrating bird and butterfly daily totals were recorded whenever possible. The daily bird checklists have been entered into eBird, as mentioned in Methods. Non-raptor avian highlights from this season included: 35 White-winged Scoter, one Red-bellied Woodpecker (October 3), one Olive-sided Flycatcher (September 5), one Savannah Sparrow (October 5), one Lincoln's Sparrow (September 27), one Rose-breasted Grosbeak (September 13) and one Indigo Bunting (September 5). For a full list of all non-raptor bird species that were observed, please see Table 1 in the Appendix.

Whenever possible, a close eye was kept on non-raptor avian migrant totals as well. Below is a selection of notable species and counts tallied: Canada Goose (4,369), Ruby-throated Hummingbird (30), Common Merganser (31), Double-crested Cormorant (125), Chimney Swift (13), and Common Loon (10). Migrating Monarch Butterflies were also recorded this year, part of a concerted effort since 2007 to track their numbers, migration timing, and phenology. This year's 1,093 Monarch Butterflies were tallied between September 1 and October 26, the last day that a Monarch was detected. This tops last year's count of 828 Monarchs! On September 16, an amazing 129 were recorded. Other butterfly species observed included Painted Lady and at least one dark morph Eastern Tiger Swallowtail that hung around several days. A few young Milk snakes were also observed at times. For mammals, chipmunks were present most days, but many other mammals were not detected this year including red squirrels, voles, or weasels.

Acknowledgements

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Furthermore, many thanks to Phil Brown for coordinating this site and for serving as the primary champion for its continued success. Thank you to Norma Reppucci, Park Manager at Miller State Park, for logistical support a daily updates on summit weather, road conditions, and visiting school groups. Speaking of school groups, a warm-hearted thanks is in order to Susie Spikol for coordinating education and outreach efforts of this project, and to the Harris Center's volunteer educators who helped with programs, in particular, Beth Corwin and Miles Stahmann. Special thanks to Henry Walters and Iain MacLeod for being the official counters on Mondays and Tuesdays, respectively, and to everyone who covered days as needed (see The 2019 Season, above).

And, a very special note of special thanks to Francie and Carl Von Mertens for providing housing to the counter during the field season in addition to good company at the hawk watch, as always.

Thanks to all of the volunteers who helped out with the Orchard Hill Pizza Night, including Ian Aldrich, Henry Bernstein, Hunt Dowse, Richard Pendleton, Leah Stahmann, Miles Stahmann, Henry Walters, and

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Finally, the strength of the numbers comes from the number of dedicated volunteers who come out and helps spot and identify the birds. I would like to extend a heart-felt thank you to those below for your diligence and good company through both the good times and the bad:

John Avila, Tom Baillio, Jami Bascom, Julie Brown, Phil Brown, Laurel and Alden Brown, Lois and Brian Burford, Michael Burgess, Wayne Byrnes, Meade Cadot, Chuck Carlson, Glen, Lori, and Alan Chretien, Anne Clauss, Gail Coffey, Jerry Coffey, Jon Creamer, Dot Currier, Ben Davis, Janet Delaney, Tom Delaney, Dan, Mel, and Anna Dipirro, Dan Dubie, Katrina Fenton, Sandy and David Fenton, Miki Foley, Sue Francesco, Mike Gebo, Al Grimstad, Ken Grossweiler, Melanie Haber, Sharon and Scott Harvell, Ben and Robin Haubrich, Pam Hunt, Amanda Kallenbach, Karen Kambol, Peter Kambol, Lisa Kurtz, Lynne Lasalle, Kat Lauer, Jeanne-Marie Maher, Krishna Mangipudi, Howard Mansfield, Patrick Marr, Eric Masterson, Jim McCoy, Steve Mirick, Sy Montgomery, Nancy Moreau, Greg Moore, Andre Moraes, Eric Mueller, Kevin Murphy, Judd Nathan, Cynthia Nichols, Cal and Jeannie Peterka, Don Riley, Kevin Reid, Jason Ruckdeshel, Scott Schwenk, Hillary Siener, Richard Sirull, Kim Snyder, Scott Spangenberg, Susie Spikol, Don Stokes, Lillian Stokes, Harlee Strauss, Kayla Strese, Bob Sweet, Gail Sweet, Diane Temple, Mark Timmerman, Daryl Turek, Tom Warren, Barry Wicklow, Marcia Wilson, Mark Wilson, Chad Witko, Jon Woolf, Susan Wrisley, Logan and Lisa Young, Van Zimmerman, and many more!



Just some of the many Pack faithful. Photo by Andre Moraes

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Appendix

Table I- Numbers and averages for every raptor species recorded over the last 15 years at the Pack Monadnock Raptor Observatory

Year	Obs. Hours	BV	TV	OS	BE	NH	SS	CH	NG	RS	BW	RT	RL	GE	AK	ML	PG	UA	UB	UF	UE	UR	SW	SE
2005	330.25	0	29	219	52	24	520	47	11	23	3978	122	0	5	78	40	11	4	7	5	4	42	0	0
2006	408.25	0	99	257	55	77	1253	213	68	46	7595	407	0	11	201	48	29	7	4	2	1	62	0	0
2007	430	0	121	291	53	121	1288	186	49	112	7776	263	0	5	143	90	44	9	2	3	0	68	0	0
2008	435.75	0	47	256	50	87	1189	162	28	67	6835	254	0	3	183	59	17	5	8	2	2	20	0	0
2009	420.75	0	80	182	51	88	1196	133	25	129	4322	421	0	6	135	56	30	8	14	8	2	77	0	0
2010	627.75	0	145	298	85	115	1248	168	66	109	7606	410	0	10	221	147	53	17	10	5	3	70	0	0
2011	368	0	127	271	54	58	1124	145	21	43	11831	202	0	9	170	68	40	14	6	4	0	69	0	0
2012	600.75	0	164	314	105	91	1388	181	63	209	8848	522	1	7	194	108	54	7	4	2	2	59	1	0
2013	575	0	142	193	101	100	1254	146	25	118	8221	378	1	11	166	89	48	10	2	1	3	20	0	1
2014	497	0	99	213	120	85	1094	126	22	123	11043	348	1	7	112	80	39	5	6	6	2	34	0	0
2015	586.92	0	137	201	132	124	1443	115	48	141	16593	546	1	13	118	120	54	3	5	5	2	42	1	0
2016	527	0	322	242	136	92	1126	163	48	117	10530	294	1	5	167	96	49	6	4	3	2	63	0	0
2017	515.25	0	324	219	163	82	1179	142	16	181	8744	341	2	7	166	106	64	6	6	4	1	51	0	0
2018	455.25	0	98	181	176	64	668	124	11	126	6756	246	2	22	171	58	31	16	18	10	1	63	0	0
2019	557.17	0	268	171	180	54	1027	105	9	181	7840	220	0	4	185	64	64	15	14	4	0	95	0	0
Totals	7335.08	0	2202	3508	1513	1262	16997	2156	510	1725	128518	4974	9	125	2410	1229	627	132	110	64	25	835	2	1
Average	489.00	0	147	234	101	84	1133	144	34	115	8568	332	1	8	161	82	42	9	7	4	2	56	0.1	0

Table 2 - Species Observed from or near the Pack Monadnock Raptor Observatory platform during the 2019 season (eBird 2019)

No.	Species	First	Last	High Count	High Count Date	Total
1	Canada Goose - <i>Branta canadensis</i>	9/15	11/16	1783	10/5	4369
2	White-winged Scoter - <i>Melanitta deglandi</i>	11/13	11/13	35	11/13	35
3	Common Merganser - <i>Mergus merganser</i>	10/8	11/13	15	11/8	31
4	Mourning Dove - <i>Zenaida macroura</i>	10/24	11/8	3	10/24	8
5	Chimney Swift - <i>Chaetura pelagica</i>	8/23	9/22	3	8/23	13
6	Ruby-throated Hummingbird - <i>Archilochus colubris</i>	9/1	9/15	5	9/2	30
7	Ring-billed Gull - <i>Larus delawarensis</i>	10/3	10/13	3	10/13	4
8	Herring Gull - <i>Larus argentatus</i>	9/29	11/17	15	10/13	31
9	Great Black-backed Gull - <i>Larus marinus</i>	11/15	11/15	1	11/15	1
10	Common Loon - <i>Gavia immer</i>	9/13	11/3	4	9/18	10
11	Double-crested Cormorant - <i>Phalacrocorax auritus</i>	9/6	11/16	53	10/13	125
12	Great Blue Heron - <i>Ardea herodias</i>	9/27	11/13	3	9/29	5
13	Belted Kingfisher - <i>Megaceryle alcyon</i>	9/18	9/18	1	9/18	1
14	Red-bellied Woodpecker - <i>Melanerpes carolinus</i>	10/3	10/3	1	10/3	1
15	Downy Woodpecker - <i>Dryobates pubescens</i>	10/14	10/26	1	10/14	2
16	Hairy Woodpecker - <i>Dryobates villosus</i>	10/20	11/2	1	10/20	3
17	Pileated Woodpecker - <i>Dryocopus pileatus</i>	8/23	11/24	2	11/11	16
18	Northern Flicker - <i>Colaptes auratus</i>	9/17	10/25	2	9/27	11
19	Olive-sided Flycatcher - <i>Contopus cooperi</i>	9/5	9/5	1	9/5	1
20	Eastern Phoebe - <i>Sayornis phoebe</i>	9/20	9/20	1	9/20	1
21	Blue-headed Vireo - <i>Vireo solitarius</i>	9/2	10/6	3	10/5	17

22	Red-eyed Vireo - <i>Vireo olivaceus</i>	9/1	10/6	1	9/1	11
23	Blue Jay - <i>Cyanocitta cristata</i>	9/1	11/14	10	10/3	94
24	American Crow - <i>Corvus brachyrhynchos</i>	9/1	11/17	476	11/2	635
25	Common Raven - <i>Corvus corax</i>	8/23	11/17	45	10/21	403*
26	Black-capped Chickadee - <i>Poecile atricapillus</i>	1/5	11/17	12	9/5	226*
27	Tufted Titmouse - <i>Baeolophus bicolor</i>	9/27	10/26	1	9/27	4
28	Tree Swallow - <i>Tachycineta bicolor</i>	9/1	9/28	4	9/1	11
29	Barn Swallow - <i>Hirundo rustica</i>	9/3	9/3	6	9/3	6
30	Golden-crowned Kinglet - <i>Regulus satrapa</i>	9/1	11/17	3	10/5	40
31	Ruby-crowned Kinglet - <i>Regulus calendula</i>	9/25	10/25	2	10/2	15
32	Red-breasted Nuthatch - <i>Sitta canadensis</i>	8/31	11/17	8	9/21	146*
33	White-breasted Nuthatch - <i>Sitta carolinensis</i>	10/5	10/5	1	10/5	1
34	Brown Creeper - <i>Certhia americana</i>	10/13	11/19	1	10/13	6
35	Winter Wren - <i>Troglodytes hiemalis</i>	9/6	10/13	1	9/6	13*
36	Eastern Bluebird - <i>Sialia sialis</i>	10/14	11/5	4	11/5	6
37	Hermit Thrush - <i>Catharus guttatus</i>	9/29	10/30	2	10/20	8
38	American Robin - <i>Turdus migratorius</i>	9/7	11/19	82	11/13	190
39	Cedar Waxwing - <i>Bombycilla cedrorum</i>	8/23	11/17	9	9/28	52
40	American Pipit - <i>Anthus rubescens</i>	10/5	10/5	1	10/5	1
41	Purple Finch - <i>Haemorhous purpureus</i>	9/1	11/5	1	9/1	4
42	Red Crossbill - <i>Loxia curvirostra</i>	9/2	9/15	5	9/15	6
43	Pine Siskin - <i>Spinus pinus</i>	10/13	11/17	94	11/17	99
44	American Goldfinch - <i>Spinus tristis</i>	9/1	11/17	9	11/17	25
45	Snow Bunting - <i>Plectrophenax nivalis</i>	11/3	11/13	3	11/9	6

46	Fox Sparrow - <i>Passerella iliaca</i>	11/5	11/11	1	11/5	2
47	Dark-eyed Junco - <i>Junco hyemalis</i>	8/23	11/19	130	11/5	715*
48	White-throated Sparrow - <i>Zonotrichia albicollis</i>	9/25	11/14	15	10/6	100*
49	Savannah Sparrow - <i>Passerculus sandwichensis</i>	10/5	10/5	1	10/5	1
50	Song Sparrow - <i>Melospiza melodia</i>	10/19	11/2	1	10/19	6*
51	Lincoln's Sparrow - <i>Melospiza lincolni</i>	9/27	9/27	1	9/27	1
52	Black-and-white Warbler - <i>Mniotilta varia</i>	9/13	9/15	1	9/13	2
53	Nashville Warbler - <i>Leiothlypis ruficapilla</i>	9/13	9/27	1	9/13	1
54	Common Yellowthroat - <i>Geothlypis trichas</i>	9/12	10/2	1	9/12	2
55	American Redstart - <i>Setophaga ruticilla</i>	9/2	9/2	2	9/2	2
56	Cape May Warbler - <i>Setophaga tigrina</i>	9/1	10/2	3	9/5	20
57	Northern Parula - <i>Setophaga americana</i>	9/8	9/28	3	9/13	6
58	Magnolia Warbler - <i>Setophaga magnolia</i>	9/1	9/20	1	9/1	2
59	Blackburnian Warbler - <i>Setophaga fusca</i>	9/8	9/23	1	9/8	2
60	Blackpoll Warbler - <i>Setophaga striata</i>	9/19	10/24	6	9/29	25
61	Black-throated Blue Warbler - <i>Setophaga caerulescens</i>	9/23	9/27	1	9/27	2
62	Pine Warbler - <i>Setophaga pinus</i>	9/10	10/6	1	10/6	2
63	Yellow-rumped Warbler - <i>Setophaga coronata</i>	8/31	11/3	10	9/5	138*
64	Black-throated Green Warbler - <i>Setophaga virens</i>	9/1	9/27	6	9/24	16
65	Scarlet Tanager - <i>Piranga olivacea</i>	9/3	9/3	1	9/3	1
66	Rose-breasted Grosbeak - <i>Pheucticus ludovicianus</i>	9/13	9/13	1	9/13	1
67	Indigo Bunting - <i>Passerina cyanea</i>	9/5	9/5	1	9/5	1

*There is suspicion that individual birds were counted more than once from day to day.