American Kestrel Northeast Region
2nd Annual Nest Box Program Report – 2019

Northeast region includes New England & Mid-Atlantic states: VA, VT, RI, PA, NY, NH, NJ, MA, MD, ME, DE, CT

An only-child cuddles with mother

Two guiding quotes for report writing:

How do I know what I think until I see what I say?
E.M. Forster

Don't write what you know but what you want to know.
Anonymous

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I. Introduction

In 1991 Jim Klucsarits, an Alvernia University professor volunteering for Hawk Mountain Sanctuary, handled his first kestrel, was bitten by it, and became infected by what he calls "Kestrel-itis": an essentially incurable disease characterized by much enthusiasm for all things kestrel (Kadaba 2011). Another afflicted individual, Art Gingert of Connecticut, refers to the disease simply as kestrel fever, and to kestrels as OFBs (our favorite birds). Klucsarits, in dealing with the affliction, co-wrote a photo guide detailing how to accurately age American kestrel nestlings (Klucsarits & Rusbuldt 2007) that belongs in every kestrel banding bag as a teaching and reference tool.

Similarly, Paul Karner was introduced to kestrel banding in the late 1970s by a Hawk Mountain Sanctuary intern (Berg 2006) and today is banding and educating as effectively as ever, with 137 nestlings banded in 2019. In northern New York teacher Mark Manske started a kestrel nest box program in 2002: over the past two seasons he banded 510 nestlings. Manske was educated about raptors in Wisconsin by the legendary Dr. Frances Hamerstrom (Manske 2004), who trained her first raptor, a kestrel, at age 12 and was the only female graduate student of the even-more-legendary Aldo Leopold. Thanks to scientists and enthusiasts like these and many others like them, the kestrel has a fighting chance to reverse the decline – estimated as high as 80% -- experienced over the last 60 years in the northeastern states.

American kestrels are often described as charismatic. Like most animals when closely observed, each individual has a unique personality. When opening a nest box full of nestlings, a bander might find one that fights with sharp claws, one watches calmly while leg jewelry is affixed, and others that have their own attitudes. A new classification category might be added after genus/species/subspecies: personality (an infinite array). Or how about a "tribe" category to break out the urban and rural kestrels, or for the migratory vs. non-migratory kestrel clans? The nature vs. nurture (genes vs. environment) discussion gets deep quickly when applied to kestrels. They're intelligent and adaptive as a species and as individuals. But will they be adaptive enough to survive: keeping up with ever-quickening human-induced environmental changes? This year's Annual Report inescapably touches on this question.

II. State totals of kestrel nestlings reaching banding age

The following totals were acquired by contacting kestrel nest box program managers and banders in the ten northeastern states. The 2019 count includes new contacts not included in the 2018 count. Neither count represents all the young kestrels banded in each state. Referencing data from the U.S. Geological Survey's Bird Banding Laboratory (BBL) the total 2018-born and banded kestrels count for the ten states is 2,386. Since this total includes a percentage of non-nestlings, the 1,868 nestlings-banded count from 2018 (includes Tom Sayers CT count) appears to be reasonably inclusive. The 2019 count – with the new contributing contacts – is more inclusive, but the 2019 BBL data – which includes young kestrels captured and banded outside nest boxes – is not yet available for reference.

2018 nestlings-banded count: 1,663* 2019 nestlings-banded count: 1,737*

% increase: 4%*

*These counts and this increase reflect only counts received for both 2018 and 2019. In future years this count will be expanded to include nestlings confirmed to reach banding age, rather than just those banded.

2019 total 10-state count of kestrel nestlings reaching banding age: 2,014

Connecticut: 156 (Tom Sayers count is not in yet; his count in 2018 was 149)
149 by Art Gingert and Mike Dudek includes 137 banded and 12 very likely to have fledged un-banded (down 7 from 2018)
7 by Larry Fischer (up from 1 in 2018)

Delaware: 22 by Jacque Williamson with Brandywine Zoo (up from 15 in 2018)

Maine: 33 banded by Marek Plater (down from 53 in 2018)

Maryland: 49 (40 banded is up from 35 in 2018)
12 by Tom Humphrey
37 by Suzanne Shoemaker includes 28 banded and 9 additional likely reaching banding age (up one from 36 in 2018)

Massachusetts: 55 (up one from 54 in 2018)
13 by Joey Mason (down from 17 in 2018)
9 by Mike Maurer (1st year included in this count)
4 by Grafton Land Trust (down from 5 in 2018)
38 by Kestrel Land Trust (up 11 from 2018)

New Hampshire: 11 (up from 8 in 2018)
11 by former Mark Manske student under his permit (up from 8 in 2018)

New Jersey: 243 (down from 263 in 2018)
12 by Friends of Hopewell Valley Open Space (new program but part of NJDEP's Bill Pitts program)
10 by Raritan Headwaters (new program but part of NJDEP's Bill Pitts program)
70 by Bill Pitts and Steve Eisenhauer in southern NJ (down from 84 in 2018)
104 by Bill Pitts in central and northern NJ (down from 127 in 2018)
47 by John Smallwood in Sussex and Warren Counties (down from 52 in 2018)

New York: 240 (down from 270 in 2018; Smith and Raptor Trust counts not included this year)
240 by Mark Manske: 215 in northern NY and 25 in western NY (down from 270 in 2018)
0 by Zach Smith wasn't able to get to boxes to band this year (down from 25 in 2018)

NY & NJ: The Raptor Trust had 49 kestrels admitted, 43 released or still in rehab (equals 43 in 2018)
45 HY, 4 AHY; 32-NYC, 1-Long Island, 16-NJ; 39 released, 4 still in care as of 12-26-19 (The Raptor Trust is located in NJ but receives most kestrels for rehab from NY)

Pennsylvania: 862 (704 count of banded nestlings from 2018 submitters is up from 552)
62 by Emily Thomas Perlock and Don Watts in NW PA includes 49 banded with 13 additional unbanded young believed to have fledged (up from 35 in 2018)
165 by Dan Mummert and Lauren Ferreri with PA Game Commission in SE PA (no record in 2018 report)
137 by Jere Schade and Paul Karner in Northampton County not including 6 boxes with young fledged before they could be banded (up from 93 in 2018)
134 by Nick Kerlin, Jon Kauffman and Steve Eisenhauer in 3-county area around State College with 4 additional unbanded but photo-confirmed (up from 48 in 2018)
14 by Jim Moffet and Steve Eisenhauer in Reading area includes 5 banded and 9 additional un-banded but photo-confirmed (no record in 2018 report)
80 by J.F. Therrian and James Klucsarits in Berks County area (equal to 80 in 2018)
56 by Nate McKelvie in Harrisburg area (up from 44 in 2018)
217 by Devich Farbotnik in Bucks County (217 also in 2018)
18 by Jere Schade and Steve Benningfield in Bucks County (down from 35 in 2018)

Virginia: 270 (up from 260 in 2018)
270 by Lance & Jill Morrow in Shenandoah Valley (up from 260 in 2018)
Patti Reum reports a successful year with VA boxes she helps monitor but no banding is occurring yet.

III. 10-state Bird Banding Laboratory (BBL) count and Report Goals

BBL processes over a million bands per year from all bird species. Kestrels are included, with each banded bird aged by banders. *Age Determination of American Kestrels: a revised key* (Smallwood 1989) details how to identify Hatch Year (HY) kestrels. Accurate identification of the HY birds supports one of the goals of this Annual Report: to add a complementary kestrel population indicator to the well-established Breeding Bird Survey (BBS), Christmas Bird Count (CBC), Winter Raptor Survey (WRS) and the various raptor migration counts at hawk watch stations. Including 10-state BBL counts of HY birds in this report also provides a cross-reference on the count received from nest box landlords.

Two concerns have arisen – so far – with this goal:

1. Nestlings unable to fly have the official designation of Local (L) until they're capable of sustained flight, when they attain HY status, but only until January 1, when they become After Hatch Year (AHY) or Second Year (SY) birds. The Juvenile (J) designation is now obsolete, although still occasionally used, and some banders don't distinguish between L and HY birds (see: https://www.pwrc.usgs.gov/BBL/manual/age.cfm).
2. Banders are sometimes slow in sending banding records to BBL staff.

The first concern can essentially be resolved by combining the BBL-provided HY and L counts, resulting in a count directly related to the "nestlings reaching banding age" count adopted for the nest box programs. The second concern is more problematic but can be mostly resolved by postponing use of the BBL count for a year, providing extra time for all – hopefully – of the banders to send in their data. However, this means this 2019 Annual Report cannot include a two-year count cross-reference.

The other goals of this Annual Report are:

- to recognize and support the extensive work of individual and program nest box managers (landlords), banders and volunteers
- to provide a forum for information exchange
- to emphasize the value of active management of habitat and nesting options
- public education, especially the need to publicize the kestrel's plight
- to expand the range of nest box landlords (both individual and multiple box programs), and to draft new activists and enthusiasts to replace landlords "aging out"
- to create a report accessible to participating farmers and other landowners who've allowed nest boxes on their property (this report is not written to meet scientific journal standards but is designed for a wider audience: the general public, enthusiasts and scientists)

A 2011 U.S. Fish & Wildlife Service study found 47 million birdwatchers in the U.S., with 80% of these being "around the home" birdwatchers. The number of homes with bird feeders has been calculated at over 50 million. An obvious difficulty is in converting birdwatching to bird preservation actions. Even though many longtime birding enthusiasts concentrate mostly on watching and less on restoration and conservation actions, both serious and many casual birdwatchers recognize the BBL -- established in 1920 -- as a valuable research source. Including the BBL's annual kestrel counts in this report is another step in trying to connect with more people and to hopefully stimulate beneficial actions, even if this simply means financial contributions to organizations doing conservation work. Watching/recording/listing the decline of a species has value, especially when it involves sharing with others and spreading birding enthusiasm, but taking active steps to try to reverse the decline – arguably – has even more importance.

IV. NYC and other urban kestrels

The best urban kestrel story of 2019 is probably the Cleveland pair that nested in the damaged eave of a building where a $11 million renovation job had started. The construction company postponed all work until the kestrel young fledged, installed a live-view camera to document nesting progress, and placed a fabric ledge below the eave opening to prevent nestlings from falling out prematurely (Segall, 2019). Newspaper articles and television coverage resulted.

The New York City kestrel population mostly remains a mystery. With little banding of adults and nestlings, difficult access to nearly all evident nest cavities and ledges, and the complexities of following bird activities amid a maze of buildings, data collection is difficult. Don Davis (pers. com.) reports that some kestrels returned in 2019 and tried to nest in Chinatown, but crows chased them away. Art Gingert revisited the seven kestrel nest boxes that he and Bob DeCandido installed eight years ago in both Manhattan and The Bronx -- sites where kestrels were reported to be nesting -- but no kestrel use was evident. In fact, some of the boxes hadn't been used by any bird species at all.

Left photo shows female kestrel entering opening to feed her four nestlings. Note netting shelf installed by construction company to minimize chance the young will fall before they're ready to fledge. Right photo shows view from nest: not the typical habitat nest box program managers look for! See following link to access full story: https://www.cleveland.com/news/g66l-2019/05/af6d144ecb7700/feisty-falcons-alter-schedule-for-11-million-renovation-of-ohio-city-apartments-.html (photos by Lisa DeJong/The Plain Dealer)

Art Gingert with American kestrel nest box mounted on old wooden rooftop water tank at Regis High School / East 84th Street, Manhattan - New York City NY - April 2019 - photo by Daniel Gingert

An article *Where Have All the House Sparrows Gone?* (Miller 2019) asks a question unthinkable 50 years go. The Cornell Lab of Ornithology reports house sparrow numbers in North America have declined by 84 percent since 1966. This is welcome news to many humans, but perhaps not for urban kestrels who need them as a year-round food supply. Another bothersome and potential lethal threat was documented as early as 2001 by Marzluff et al: "American Crow populations tend to be densest and increasing most rapidly in urban areas of North America." Combined with other trends, like the increasing loss of urban nooks, crannies, ledges and the proliferation of "clean" new building lines, urban kestrel populations – having thrived in NYC for at least a century and probably far longer – may increasingly look towards their human landlords for assistance. Clarifying what "assistance" means is no easy task.

The Raptor Trust is located in Millington, New Jersey, about 25 miles from New York City. It is the designated rehabilitation destination for kestrels found in NYC, and receives approximately 50% of the NJ wild birds needing rehabilitation. In 2019 it received 49 kestrels. 45 of these were young/fledgling/nestling HY or L birds, and 4 were adults AHY. 39 were released, and 4 were still under care as of 12-26-19. 32 of the kestrels received were from NYC, with one from Long Island and 16 from NJ. The count of 32 from NYC is of particular interest since it is one of the few indicators available for the NYC kestrel population. It might reflect a roughly accurate percentage of the total population, but is more likely equivalent to calculating a city's human population by multiplying from the number of people entering hospital emergency rooms.

In 2019, two of the four kestrels that fledged from a Providence, RI nest near where they nested in a house eave in 2018. Peter Green notes he couldn't locate the nest this year.

In May 2019, Peter Green took this photo of a kestrel on the tallest perch in Providence, RI – 428 feet high

V. Individual source/sink assessments of American kestrel nest boxes

Identification and removal, relocation or modification of sink boxes is important

Kestrel nest box managers regularly source/sink assess individual boxes. If a box is predated, or if one or two undersized nestlings are produced (rather than three to five healthy nestlings), box removal or relocation to better habitat is considered. If an involved predator is identified and a suitable predator prevention system installed, or if loss of a parent is suspected, relocation may be postponed. A lost kestrel clutch, particularly when there is not enough time to re-nest in the same or another nearby box or cavity, equals zero production for the nesting adult pair. The box is a sink that season: a wasted year for a pair that may not live to try again.

Source/sink research on multiple kestrel nests includes a Canadian study: *Effects of agricultural lands on habitat selection and breeding success of American kestrels in a boreal context* (Touihri et al 2019) which concludes: "the probability of nesting site use increased with the amount of agricultural lands. Hatching success decreased with the amount of agricultural lands, whereas the fledging success of kestrels did not vary with the amount of agricultural lands. Both the probabilities of hatching and of fledging increased with the area of young forests." And: "Although fledging success alone does not determine fitness or population dynamics, our results suggest that kestrels nesting in this region at the northern limit of their range may be caught in an ecological trap by extensive agricultural lands."

South of Canada, in the middle latitudes, young forest land is rarely utilized by large numbers of nesting kestrels. However, the southeastern subspecies – *Falco sparverius paulus* – nests in

open pine forests, preferring this habitat over most agricultural land (Smallwood & Collopy 2009). Perhaps this preference is due to more open conifer woodland found in the south, as in parts of Canada, and to prey and hunting perch availability. The source/sink question about both individual and multiple boxes and natural cavities is complex, and influenced by geographic-area, subspecies and intraspecies differences. For example, the smaller non-migratory southeastern subspecies weighs 100 grams, 20% less than *Falco sparverius*, and this lesser body size may facilitate its ability to hunt and subsist on a diet of insects and lizards. Urban kestrels trained to prey on house sparrows might struggle to find food in rural areas.

Intraspecies differences can be particularly intriguing. With the exception of the southeastern subspecies, most American kestrels are believed to migrate, with those farthest north migrating the farthest south, and those in the middle migrating the least or not at all. Are we seeing a development similar to the Canada goose, with distinct migratory populations decreasing in numbers and non-migratory populations increasing? Is the source/sink formula different for nonmigratory kestrels that avoid the dangers inherent in migration? Do they need to fledge fewer young to maintain their population? Do these adults live and breed longer? DeCandido and Allen (2007) note of the NYC kestrel population: "Most, if not all, pairs of American Kestrels do not migrate and remain on territory year-round. Copulations were observed beginning in January, and one female was sitting on eggs by mid-March. In New York City, kestrels can fledge as many as five young, beginning in mid-May. More commonly three young fledge per nest, with some young fledging in mid-July."

Another non-migratory population is in Virginia, where Lance and Jill Morrow manage an extensive kestrel nest box program in their Shenandoah Valley Raptor Study Area (SVRSA). 270 nestlings and numerous adults were banded in 2019, and over 2,000 kestrels banded in 12 years, all within 8 miles of Timberville, VA. Lance notes: "Since we've been doing kestrel research for 12 seasons, we have come to know most of our breeding population of kestrels who appear to be non-migratory. During the past several years we are losing our oldest breeding females who have begun to disappear after being recaptured every year in a box for 7-8 years. We presume they died due to old age. Recently, we started learning more about our birds because they are being captured in another Virginia kestrel nest box program to the east. For the first time, banders are capturing breeding kestrels over there and have already recaptured kestrels that we banded in our study area. This is the first proof that some kestrels are surviving and moving (not really migrating) outside of the SVRSA to breed" (Morrow & Morrow 2019).

Source/sink research involving other species – but in kestrel habitat – includes: *Conservation Reserve Program (CRP): Source or Sink Habitat for Grassland Birds in Missouri?* (McCoy et al 1999), which concludes "For red-winged blackbirds (*Agelaius phoeniceus*), CRP fields were consistently a sink habitat (all Ps < 0.001). Based on our evidence, the CRP likely has contributed to the conservation of grasshopper sparrows, field sparrows, and eastern meadowlarks. Although large numbers of dickcissels and red-winged blackbirds nested in CRP fields, there is little evidence that the CRP has contributed to populations of those species." Similarly, most CRP grasslands appear to provide excellent kestrel habitat. But the first years

after a row-crop field is rotated out of production into CRP grassland, the prey base may be sufficient to attract kestrels to nest boxes but not established enough to support reproduction. It may take a while for a sink habitat to progress to a source.

A CRP (actually, CREP) meadow on a hilltop on the Oscar Johnston farm in Petersburg, PA, after five nestlings were banded with help from Johnson's family and friends. Five additional nestlings were banded in a second box 400 yards downslope along a streamside meadow on the same farm. Both boxes were occupied the first year installed.

Individual kestrel nest box source/sink assessments are less complex than multiple box assessments, but are still tricky. If most or all eggs don't hatch in a box, or hatchlings fail to fledge, it may be due to:

- inexperienced first-year parents
- too much nest box visitation or other disturbance during nesting
- extreme weather conditions, such as excessive high temperatures
- loss of one parent
- food shortages
- Inadequate bedding material creating bare floor
- excessive water entering a box
- predation
- inappropriate nest box design, orientation and/or mounting system

Inadequate bedding, often due to removal of all material by starlings, can allow eggs to roll around on the bare floor, making incubation harder and reducing insulation around eggs: resulting in reduced or zero hatching. Quickly replenishing shavings, chips or straw bedding is one solution, which is sometimes done even after eggs are laid by sprinkling shavings around eggs (there is a report of abandonment when eggs were removed and replaced after bedding was placed under them). Carving out a concave bottom in the center of the floor can also help: if bedding is removed the eggs still rest in a hollow. Pea gravel substrate was found in an Ohio study to be preferred by kestrels over boxes with pine shavings (Rude et al 2015). Mixing grass or chopped straw with the chips or shavings seems to help, since starlings build their nests of this material and usually leave it in boxes when they find it. Chopped straw was used in early kestrel nest box studies, and seemed to work fine. Since kestrels successfully nest on starling grass/straw nests, using this same material might be an inexpensive, convenient and effective option.

Inside floor of octagonal box with 4" diameter ¾" deep circular concave area cut in a 1.5" thick wood bottom, providing insurance in case starlings remove all bedding before kestrels take over box. A 6.5" circular saw blade works best for this cut, set at ¾" depth. The thicker bottom insulates eggs better.

This octagonal box looks more like a tree cavity inside, and has a bit less wind-resistance than a 4-side box. Floor is 10"x10", equal to 80 square inches. Front roof slopes to the back, with aluminum drip edges all around. A ventilation slot is along the back top. Front access door swings down with hinge lip cut at water-shedding 45°.

Excessive water in a box requires an evaluation and correction of the box design. Water stains inside the box usually show where water is getting in. Roofs with drip edges and extra overhang over the front hole are common corrections to wet box interiors. Backward sloped roofs help. Nest box design can determine whether a nest box program is a source or sink, regardless of how good the habitat is and how many kestrels are around looking for boxes and cavities. *Nest box design for the study of diurnal raptors and owls is still an overlooked point in ecological, evolutionary and conservation studies: a review* (Lambrecht et al 2011) calls attention to this issue. Just as important as the actual design of the nest box is the mounting system. Generally, pole and post mounts are more successful – and predator resistant – than tree or building mounts. But there are exceptions to this. Higher box mounts are often preferred, but some programs have success with heights as low as 8 feet.

Of great importance is identification of predators, both foreseen and observed. The problem is unless you find a snake curled up in a box or witness a hawk picking off a fledgling, knowing which predator is involved can be a guess which, with experience, becomes an educated guess requiring action: installing an appropriate predator guard in anticipation of a problem or after damage occurs. Box removal or relocation is sometimes the only practical option.

Cooper's hawks are most frequently mentioned when the issue of kestrel predators comes up, but other predators may be more likely. *House wrens can be nasty neighbors* (Shalaway 2011) details how the tiny house wren can be problematic, with its tendency to poke holes in eggs and often carry them from nests. No predator guard exists to keep them out of nest boxes. Unlike most other bird species, the wren population in the U.S. is increasing in many areas. It thrives in shrubby habitats and occupies the broadest latitudinal range of any native passerine in the New World. Keeping boxes away from shrub/brush areas usually eliminates the house wren threat.

A house wren or starling is suspected for this poked egg damage. The involved nest box was mounted 17' up on a utility pole with low brush below it and along the roadway edge, with trees and a residence 100 yards away. This box was relocated after starlings built a nest on top of the kestrel eggs, clearly indicating kestrel abandonment.

Eastern rat snakes – which can grow to 7 feet or more – also predate both eggs and young. Predator guards to keep them out of boxes must be well-designed and often creatively-constructed. Box relocation is often the best option. Rat snake populations are stable in most of the northeast, and may be increasing locally.

This eastern rat snake was found in a NJ kestrel box mounted 18' up on a utility pole next to a roadway along a hayfield. Starling young were in this box a week before this photo. The bulges in the snake's body now show where they likely went. This box was relocated. Black snakes' lifespan is 10 to 15 years, so once found around a nest box it's likely they'll be there in subsequent years. Kestrels, however, do feed on young rat snakes.

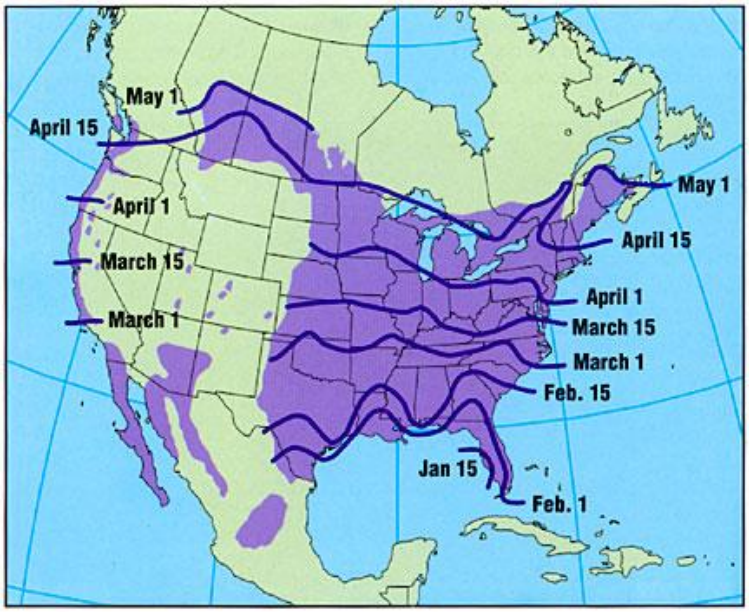
Raccoons can also be a problem. If they gain access to the box front, they can reach in for eggs or young. A good predator guard or a pipe-mount system can eliminate or reduce this threat.

It is undeniable that kestrel nest boxes can be ecological traps: sinks that year-after-year can help hasten a population's decline. An unattended predator-susceptible box in excellent habitat with a good prey base can draw adults to nest there, only to repeatedly lose their young and maybe their own lives to a predator. Individual box attention and modification can change sink boxes to source boxes.

VI. Behavior shifts and other grassland bird interactions

Is the kestrel population in parts of North America exhibiting a nesting behavior shift like that experienced by the purple martin? Answering this question requires a review of the purple martin history which, like the kestrel, once nested only in natural cavities. Hundreds and probably thousands of years ago native Americans began providing martin housing in the form of dried, hollow gourds. In 1831, John James Audubon noted how the colonists adopted this practice: "Almost every country tavern has a martin box on the upper part of its sign-board; and I have observed that the handsomer the box, the better does the inn generally prove to be." Gourds and other human-created houses for martins have been erected in increasing numbers since then. Over time, the success of martins nesting in these houses, paired with the decline of natural cavities, led to a complete behavior shift within the population east of the Rocky Mountains. Only two other North American bird species have undergone a complete shift in nesting behavior: chimney swifts and barn swallows. Today all three of these species nest only on or in man-made structures in the eastern states (Purple Martin Cons. Assoc. 2019).

In western states the purple martin's shift is incomplete. In the Pacific Northwest, where martins once nested primarily in cavities in pilings along rivers and on the coast, they now nest almost entirely in man-made housing. In the remainder of western North America (except for Alberta and Saskatchewan), martins had not accepted nest boxes or gourds until – in the last decade – they started using man-made boxes in California. Although American kestrel nest box programs have a shorter history, in states like Pennsylvania – with at least one program active for 70 years – some kestrels may already be imprinted on nest boxes rather than looking for natural cavities. This imprinting may not be exclusive: one study of the southeastern kestrel found "indications that many juvenile kestrels fledged from nest boxes emigrated to the surrounding natural areas" (Brown & Collopy 2012).



Purple martin range and return migration map showing return dates roughly equal to migratory kestrels'

The apparent kestrel and established martin nesting behavior shifts can create human and bird conflicts, since some landowners like to attract kestrels and other landowners want martins; and both species prefer similar open tree-limited habitats. Predator-prey issues occur, although tolerant coexistence is more common. Bird (2019) details kestrel predation on both martins and barn swallows. But, as with the kestrel/bluebird interaction story described below, it is the exception rather than the rule. When it occurs, nestlings are typically preyed upon rather than adults. Luckily, the newer purple martin gourds and houses tend to have starling-proof entrance holes which minimize or eliminate nestling theft by kestrels.

One potential mitigating factor in assessing kestrel interaction with songbirds is highlighted by Windig (2006) in G*rassland Bird Nest Predation and Artificial Nest Use*, which details small rodent – especially meadow vole – predation on grassland bird eggs. Bobolinks and Savannah sparrows are the two bird species receiving the most attention in this study. Since kestrels often consume lots of meadow voles – and small snakes that eat bird eggs and nestlings – their net effect on grassland songbirds may be positive even if they occasionally prey on songbird nestlings. It should be noted, however, that most research emphasizes meadow voles are herbivores. Even if this is mostly correct, kestrels are indiscriminate in their feeding on all small rodent species, some of which eat bird eggs and nestlings. Where meadow voles live, omnivorous and carnivorous mice and shrew species are also likely present.

The bluebird's story is similar to the purple martin's. Bluebird populations fell in the early 20th century, at least partly due to starling and house sparrows showing up and taking over a limited number of nest holes. But from the 1960s to today, bluebird populations have increased, thanks largely to expanded bluebird box trails, fewer house sparrows and careful management by trail managers: reducing box holes to a size too small for starlings, adding predator guards, regularly maintaining boxes and evicting house sparrows.

In 2019, at the 1,500-acre Cowtown horse and cattle farm near Woodstown, NJ the bluebird and purple martin expert, Allen Jackson, installed six bluebird boxes in an area that had seven successful kestrel nest boxes each of the previous two years. Research on kestrel predation on bluebirds includes instances of predation but also many more examples of co-existence. The success Jackson experienced with these bluebird boxes in 2019 has prompted him to add six more boxes for 2020. His concerns about kestrel predation have lessened (pers. com.).

On the same Cowtown farm in 2018, three state-threatened grassland bird species – kestrel, bobolink and grasshopper sparrow – combined forces to help with permanent preservation of 340 grassland acres. Their shared presence as breeding birds – along with the past and possible future use by upland sandpipers – qualified the acreage for federal Grasslands of Special Significance (GSS) funding. A permanent conservation easement placed on the land now limits the number of grazing animals per acre, sets a bird-friendly timetable for mowing, and prevents conversion to cropland or any use other than grazing and grassland. The GSS program has primarily been utilized in the western states to protect sage grouse habitat. Preservation of the Cowtown grassland is the first time the program has protected land in an eastern state.

Behavior shifts – sometimes called tradition shifts – are local or can spread to include entire species' populations. *Cultural conformity generates extremely stable traditions in bird song* (Lachlan et al 2018) identifies local and regional bird song differences, much like those found in local and regional human dialects. Aplin et al (2014) found in Europe that wild great tits learn new foraging techniques by observing others in their group, and these new foraging traditions can be sustained for many years. How behavior shifts may apply to American kestrels is a good question. There is no disagreement that the grassland habitat kestrels prefer is on a downward trend in the northeast states. Grassland preservation projects like the Cowtown farm, powerline and road right-of-ways, horse and other livestock grazing land, managed meadows and other grassland areas will always provide some kestrel habitat. However, kestrels' long-term ability to thrive within and beyond these limited habitats may depend on behavior shifts that utilize new habitat, migration, nesting and food options. Human assistance with these shifts may be required. "We're all in this together" is the saying that comes to mind.

Research-based human assistance has been instrumental in bringing back the bald eagle, osprey and peregrine populations. Banning DDT, protecting eagle nest sites, building osprey platforms and peregrine boxes are some of the measures taken. But kestrel populations have continued to drop in the northeast, even as individuals shift their behavior locally to eat wall lizards and nest in rusted building cornices in New York City (Burke et al 2010), and as they utilize nest boxes installed by individuals and groups. One behavior shift that likely has a positive association with nest box programs is migration suspension. This apparent shift – possibly missed or underestimated – deserves more examination. Migration can be dangerous and energy intensive. Staying put – if food and shelter are available and predators few – has advantages. Having attentive human landlords is also helpful.

As noted previously in this report, most of the Shenandoah Valley, VA kestrels in Lance and Jill Morrow's nest box program are non-migratory in an area with an annual average of 24" of snow. Other northeastern programs and individuals report overwintering "resident" kestrels, which may be an accurate assumption, but without a verification system these kestrels may actually be more northern kestrels who "short-stop" their migration. In Woodstown, NJ, which has similar snowfall and temperatures as Shenandoah Valley, Bill Pitts with New Jersey DEP was able to verify one overwintering kestrel by attaching and recovering a geolocator tag. However, unlike the Morrows' VA population, most of the southern NJ kestrels appear to migrate south for the winter. In Pennsylvania, examination of banding data found many kestrels winter close to their breeding territories, with one sample of 92 band recoveries showing 55% of wintering kestrels were within 62 miles of their nesting location (Bolgiano et al 2015).

Another avian species story that seems particularly relevant to the kestrel migration discussion is that of the eastern screech owl. Non-migratory, but extending its range when food is scarce; a user of cavities and nest boxes about the same size as kestrels; with a similar diet in many seasons, but with more of a taste for birds. Screech owl habitat has some overlap with kestrels, but they are drawn to smaller open habitats, forest edges, and prefer the presence of trees for perch-hunting, roosting, cover and nesting. Great-horned and barred owls are their mortal

enemies, like the Cooper's hawk is to the kestrel. The habitat shift these owls have made in many areas over the last 50 to 80 years is a preference for suburban lawns and shade trees, where their two main enemies are scarce and where food is available, especially at bird feeders that attract small night-time rodents and twilight/dawn birds. Screech owl concentrations are now often higher in suburban than in rural areas (Gehlbach 1995; Artuso 2009).

Kestrels occasionally visit bird feeders to prey on birds, but Cooper's hawks may visit so often that kestrels can be the hunter hunted. Kestrels have not yet embraced the suburban environment for breeding. That could change. They may follow the screech owl's lead into this ever-expanding lawn-dominated human habitat, much like the kestrel's behavior shift that likely began 350 years ago onto farmland created by new Americans converting huge areas of forest to open areas. The greatest current hurdle to this move may be the predominance of non-native (insect and bird resistant) shrubs and trees in suburban areas. A pronounced human behavior shift to native plantings would greatly benefit the declining insect and bird populations. This native plant shift is in its infancy. The "meadow lawn" remains outlawed in most communities. However, many individuals and organizations – like the Pennsylvania Land Trust Association -- are trying to change this attitude (see https://conservationtools.org/guides/151-from-lawn-to-meadow).

A rotted electric transmission pole was being replaced when workers noticed the hollow pole had a kestrel nest in it with young (left photo). The company's crew cut out this section of pole and clamped it to the replacement pole (right photo). The kestrel parents returned to feed the young in this transplanted pole section. See American Transmission Co. blog for more details (photos by Pete Chevrette of MJ Electric): https://www.atcllc.com/whats-current/crews-save-family-of-kestrels-by-relocating-nest-to-new-electric-transmission-pole/

VII. Close spacing of boxes

One-half mile is often cited as the recommended minimum spacing of kestrel nest boxes. In northeast Connecticut, Tom Sayers, in an unpublished 2017 kestrel nest box report, detailed his work shortening this distance in good habitat. 40 of his 45 occupied boxes successfully fledged young, with 6 of 8 boxes successful when located within 500 yards of each other. Nagy (1963) set an early standard for close spacing, with 6 successful kestrel boxes on his 320-acre Pennsylvania farm, with the closest pair being only 37 yards apart. Following these examples for the 2019 nesting season, the Shaver's Creek Environmental Center (SCEC) in central Pennsylvania and Natural Lands/NJDEP in southern New Jersey experimented with closer spacing in these kestrel programs. Of 33 successful SCEC boxes, six close-spaced box pairs successfully fledged 30 young, with box pairs spaced 330, 400 and 440 yards apart. None of the Natural Lands/NJDEP close-spaced boxes were successful: the closest successful box pair was 700 yards apart.

Manske (2011) reports a nest spacing even closer than Nagy's 37 yards: "Two pairs of kestrels were found to have nested in the same barn at the same time during the 2009 season. One pair used a cavity on the north side of the barn and hunted lands north of the barn and the other used a cavity on the south side of the barn and hunted lands south of the barn."

More research on box spacing is obviously needed. If the habitat is good and the prey base judged adequate to support more than one hungry kestrel family, spacing closer than 500 yards should be considered. Close-spaced boxes give kestrels a choice, provide a hunting perch, potential roost location and a feeding station even if not used for nesting.

VIII. Kestrels (and other bird species) getting smaller for a good reason

Morphological changes in American kestrels at continental migration sites (Ely et al 2018) details the decline in body mass at three sites and reduced wing chord at five of the seven sites surveyed. Food availability, climate change and predation are suggested as possible contributing factors. *Shared morphological consequences of global warming in North American migratory birds* (Weeks et al 2019) found a similar body size loss but an increase in wing length, in examining 70,000 migratory birds from 52 species that died over the past four decades after they collided with buildings in Chicago. The University of Michigan notes of this research completed by their staff: "Several lines of evidence suggest a causal relationship between warming temperatures and the observed declines in avian body size, according to the researchers. The strongest evidence is that – embedded within the long-term trends of declining body size and increasing temperature – there are numerous short-term fluctuations in body size and temperature that appear to be synchronized."

A Comparison of Spring and Fall Migration Weights of American Kestrels (Fischer 2007) is a study that both supports and adds a new dimension to the issue. The study focuses on a single sampling location: Flint Hill in Easton, CT, the only location in Connecticut where large numbers

of migrating kestrels can be seen in the spring. 107 fall males and 77 females and 214 spring males and 384 females were caught, banded and released for a total sample size of 787. Average weights for all birds over a 20-year period showed a decline. But "the data collected show that the average weight for spring migrant males and females is consistently higher than fall migrant males and females." This appears to indicate these kestrels are returning from wintering areas in better health than when they headed south.

A possible explanation is provided by Bergmann's Rule, defined in Encyclopedia Britannica as: "in zoology, the principle correlating external temperature and the ratio of body surface to weight in warm-blooded animals. Birds and mammals in cold regions have been observed to be bulkier than individuals of the same species in warm regions. The principle was proposed by Carl Bergmann, a 19th-century German biologist, to account for an adaptive mechanism to conserve or to radiate body heat, depending on climate." The lighter weight of the southeastern American kestrel subspecies is a good example of this rule. For mammals, one example is the lighter weight of the southern flying squirrel compared to the northern flying squirrel. The weight difference of around 20% between southern and northern flying squirrel species is similar to the difference between *Falco sparverius paulus* and *Falco sparverius*. The southern flying squirrel is pushing the northern species further north along the PA-NY state line as the climate warms.

IX. Airports and kestrels

American kestrels are the second most frequently killed bird species at civil airports, with the mourning dove in first place and the killdeer closely behind the kestrel. More than 4,000 kestrels were struck at airports in the 25-year period 1990-2014. 26 planes were damaged; 72 strikes affected flight operations; and $2 million of damage resulted. These figures must be viewed in comparison to other birds: the kestrel's light weight (average of 4 ounces) ranks it as one of the least risky birds regarding actual damage. Waterfowl strikes were responsible for $234 million of damage in the same period (Dolbeer et al 2014).

Airports pay a lot of attention to wildlife, but most management focuses on bird species that cause more damage and can cause a plane crash (the 2009 Airbus crash into the Hudson River was caused by Canada geese being sucked into the engines, disabling them). Raptor trapping and relocation occurs in some areas (Schafer & Washburn 2016), with more concentration on red-tailed hawks which, although hit half as much as kestrels, cause ten times as much damage to planes. Nevertheless, kestrels will always be drawn to airport grassland. By limiting adjacent nesting opportunities (natural cavities, nest boxes and structure-protected options) kestrel presence can be significantly lessened in the breeding season.

The typical patrol range cited for kestrels nesting in boxes located in good habitat is ½ mile in all directions. It can be more or less, primarily depending on the food supply and the number of mouths to feed. Therefore, a recommended closest distance to an active runway for nest box placement would likely be one mile, with the understanding that this distance should be more if

the habitat around the nest box isn't particularly good, and perhaps a bit less if the habitat around the box is excellent.

A complicating observation is the use of falconry at many airports to reduce bird numbers. A 5-year, $3 million contract was granted by Kennedy Airport in Queens, New York, for Falcon Environmental Services, Inc. to use peregrine falcons to help control birds (Firstenberg 2009). Peregrines and other raptor species are being utilized similarly at a number of airports and landfills in the United States, Canada and abroad. In the summer of 2019, Ocean City, NJ paid a company, East Coast Falcons, $2,100.00 per day to use raptors to scare gulls away from tourist-filled beaches and the boardwalk (see NY Times article at: https://www.nytimes.com/2019/08/15/nyregion/ocean-city-nj-seagulls.html).

Although kestrels, as our smallest falcon, don't strike fear into bird flocks like peregrines, they can reduce bird populations on cherry farms, due more to a threatening presence than actual predation (Shave et al 2018). American kestrels are increasingly used in falconry (PA Falconry & Hawk Trust), usually to help control starlings that, over the past 25 years, have caused almost four times the damage to aircraft as kestrels, even with fewer airplane collisions. Aircraft staff have referred to starlings as "bullets with wings" since their bodies, although lighter than a kestrel's, are more dense. Their tendency to fly in large flocks heightens the damage they can cause. Kestrels, under control of skilled falconers, may someday serve a limited, but more strategic and less-expensive-than-peregrines, role in managing starling flocks at airports.

Relocation of birds is not always successful. A study *The evaluation of translocation as a management tool for American kestrels in an airport setting* by the Wildlife Services National Wildlife Research Center is scheduled to conclude December, 2020. Preliminary findings show a 5% return rate for kestrels. One example pertinent to nest box programs is a kestrel trapped, banded and relocated 15 miles away from the University Park Airport in State College, PA. The kestrel returned and was killed by a plane (Petrie 2018). Coincidentally, a central PA nest box program included in this report has two unoccupied kestrel boxes on a beef cattle farm located ¾ and one mile from this airport. The closer box is scheduled to be removed this winter as a result of the concerns noted above.

In this photo taken by Debbie Beer in January at Phila. International Airport, a female kestrel on a barbed wire fence has an orange left leg band which, according to Bill Pitts of NJDEP, may indicate it was relocated from the airport by USDA-APHIS but has found its way back

X. Habitat loss/gain

Kestrel habitats are receding, expanding, being enhanced and created (the bad, the good and the possible). Exploring habitat trends is important.

In the Northeast and elsewhere, pasture – if not overgrazed – provides some of the best kestrel habitat; but in many areas there is less pasture acreage each year that passes. Small dairy farms are disappearing; and all-size dairy farms typically now graze cows outside less or not at all. Many small dairy farms have switched to raising beef cattle, so the rate of grazing land loss is reduced. For example, the state of Missouri lost 27,000 dairy cows from 2009 to 2019, but added 67,000 beef cows over the same period (Missouri Farmer 2019). Similar trends are seen in some northeastern farm areas, and a demand for more grass-fed beef helps maintain and create pasture. But the long-term predictions for dairy and beef farm pasture aren't very optimistic. Kestrels cannot rely on the acreage remaining stable or expanding.

Horse pastures are on a different trend. In Pennsylvania, approximately 793,000 acres are used for horse-related purposes, and 30.5% of the state's households have horse enthusiasts (Smarsh 2018). Although Pennsylvania may not represent all northeastern states, it is clear the region's horse pasture trend is generally more positive than that for other livestock. Getting more kestrel boxes up on any significant areas of pasture – particularly when it is close to hayfields, mowed utility right-of-ways, wet ditches or other rough grass areas – is a worthwhile goal, regardless of the animals being grazed there.

Away from the rural setting, some interesting possibilities may be opening up with the suburban/urban interface habitat. Hogg (2013) in *Habitat Associations of Birds of Prey in Urban Business Park* conducted occupancy surveys (McKenzie et al 2006) for raptors in business parks in the St. Louis metropolitan area. As one of the five raptors studied, kestrels were detected in 37 of the 155 survey points, placing them second behind the red-tailed hawk in detections. They were the most common raptor in the more open parts of the study area, and were often observed in pairs or, later in the season, with fledglings, suggesting nesting. The probability of their occupancy was found to increase 12% with each 10% increase in grass cover. Hogg notes: "Conservation of raptor species in business parks is an attainable goal and one likely to resonate with people who work in such environments. I spoke with several business site managers or owners who expressed pleasure with the prospect of raptors at their site or told me about sightings that they or their employees had made on the site."

The distinction Hogg (2013) makes between grass and lawn is important. Referencing Borman et al (2001): grass is defined as areas of either wild-growing, unmaintained or seldom-maintained grass, as distinguished from lawns regularly mowed, watered and chemically-treated. For people promoting kestrel habitat, changing public perception about the habitat value and cost savings associated with less frequent mowing of grassy areas vs. lawn can be difficult. However, there are sources available to help.

The Wildlife Habitat Council (https://www.wildlifehc.org/) has been assisting businesses for over 30 years with biodiversity and other conservation concerns. It specializes in work with large corporations and has ongoing projects in eight of the ten northeastern states. Their website lists a state-by-state project count as follows: VA-28, PA-24, NY-17, NJ-11, MD-10, DE-5, CT-1, MA-1. Some corporations have multiple projects in different states, and they appreciate the good publicity received for the partnership conservation work. Reviewing the project and partner lists on the Council's website is enlightening.

One Council partner with multiple projects of particular interest to kestrel enthusiasts is Waste Management, an international company that manages numerous nation-wide landfills. Many abandoned and active sanitary landfills have excellent grassland habitat for kestrels, and requirements are usually in place for long-term maintenance as grassland, to protect the landfill cap from tree root penetration. The Natural Lands/NJDEP southern NJ nest box program installed two kestrel boxes on a large abandoned landfill in January, 2019. The landfill manager was very interested in any natural rodent control, and a kestrel hovering overhead during the installation was a good omen of possible spring success. In PA, Paul Karner received good press

coverage in *Five baby falcons live in Northampton County landfill* (Lewis, 2016) for kestrels he banded at this Waste Management landfill. In MA, 15 young kestrels were banded on a large landfill in Plymouth County in 2018.

Federal and state funding and technical support is also available to enhance and create kestrel habitat. U.S. Department of Agriculture (USDA) CRP and CREP are the programs that, historically and presently, can produce the most habitat. Unlike most riparian buffer protection programs, which require tree plantings, CRP and CREP (the "E" stands for enhanced payments) usually result in managed grassland habitat, with 10-year management contracts (often renewable) as the standard agreement. The U.S. Fish and Wildlife Service Partners Program is another important federal source, particularly with the assistance they provide with establishment of warm season grass meadows, a kestrel favorite.

State governments that help with conservation projects include Virginia's Corporate Habitat Program (https://www.dgif.virginia.gov/wildlife/habitat/corporate/). The first qualified habitat improvement their website lists is "convert high-maintenance lawn areas to native warm-season grass meadows". New York State lists a Habitat Conservation Assistance Program (https://www.dec.ny.gov/animals/112821.html) that protected over 4,300 acres of prime grassland habitat. State and federal programs often have geographic priority areas and funding availability windows, so it can be frustrating trying to get projects approved and funded, but grassland protection and creation are priorities of many programs, so this option is often worth exploring.

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