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# American Kestrels

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## A Guide to Biology and Nest Box Monitoring

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## Contents

Introduction.....	2
Physical Description.....	2
Range .....	3
Habitat .....	4
Food .....	5
Breeding.....	5
Roosting .....	7
Population Decline.....	7
Nest Boxes .....	8
Monitoring.....	10
Starling Prevention .....	12

## Introduction

The American Kestrel is North America's smallest and most colorful falcon, and many adore kestrels for their lovely plumage and big personality. In the 1800s and early 1900s, many referred to American Kestrels as "sparrowhawks," however that common name typically refers to Accipiter hawks. Thus, scientists shifted to using the common name "American Kestrel", because it is a more accurate descriptor and aligns with other small kestrels around the world. The American Kestrel's Latin name, *Falco sparverius*, means "Falcon of sparrows" - a reference to this falcon's habit of occasionally taking small passerines as prey.

## Physical Description

American Kestrels are approximately the size of a jay, with the slender, pointed wings and long tail typical for falcons. They are approximately 9 inches long from beak to tail tip, and their wingspan is about 22 inches. Adults weigh an average of 4.1oz, or 117g. As with most other birds of prey, the female kestrel is larger and heavier than the male. However, with their small size and generally slender bodies, the size dimorphism is not readily apparent unless the pair is viewed right next to each other. Only then do the females appear more robust.

Their flight is buoyant and quick, and kestrels are known for hovering over fields as a hunting technique. Another great behavioral marker is that these birds tend to bob their tail while perching. They will often perch prominently on fence posts and power lines above their favored habitat, making it fairly easy to determine when American Kestrels are around. Confusing kestrels with doves or pigeons can happen, as both have the pointed wings, but the different tail shapes, the bright colors, and the very slender body of the kestrel can assist differentiation in the field. Doves and pigeons also do not bob their tail repeatedly while perching – a very useful behavioral distinction.

Another similar species is the Merlin, which is also a small, slender falcon. However, Merlins typically fly fast and low to the ground, which is less common in kestrels. Merlins also sport much darker and less varied plumage overall.

In comparison to other falcons in the United States, American Kestrels exhibit stark sexual dimorphism in coloration, with the male in particular sporting bright, colorful plumage. Males have slate-blue over the top of their wings, with stark black primaries and secondaries spotted with white. The males' backs are a rufous orange with black barring, and their tail is the same color with one large black band towards the end of the tail, lined with a few strips of white at the edges. The males also have a cleaner, whiter look to their sides, breast, and flanks – their belly is mostly white with black spots, and often a tinge of orange on their breast.



Fig 1. A comparison of a female American Kestrel (left) to a male (right). Smith, Kevin (photographer). 2014

The females are more camouflaged in their appearance, sporting plumage with less stark contrast than the male. Female kestrels are a rufous-brown color overall and heavily-barrred with dark brown across their back and tail. The females' breast and flanks are streaked with brown over a cream base, and appear to be reddish and brownish throughout when viewed from a distance.

Both sexes have two stark black malar stripes on their cheeks, and a blue crown tinged with rufous at the very top. American Kestrels also have two spots on the back of their heads, acting as "false eyes" to fool potential predators into thinking the kestrel will never be caught unwary from behind.

Subspecies of American Kestrels have some regional variation in their plumage, which is most apparent in males. For instance, male kestrels of the subspecies *Falco s. sparverius* exhibit light morphs and dark morphs, with the former almost completely lacking the typical black barring and spots. The South American *Falco s. cinnamominus* display the heaviest spotting and barring in both males and females, and are also the largest subspecies. Although subtle differences like these exist between all 17 American Kestrel subspecies, their unique color pattern still makes them readily identifiable across their entire range.

In South America, potentially confusing species include the Bat Hawk or Pearl Kite, if viewed very briefly in the wild, due to similar size or behavior, but the color of the American Kestrels' plumage, and the falcon shape, is very different from either of those.

## Range

American Kestrels are a generally widespread and adaptable species, found from Alaska all the way down to the southern tip of Argentina. In general, American Kestrels in colder climates tend to migrate to warmer regions for the winter months, while kestrels in sub-tropical and tropical regions are non-migratory. In areas where migrations happen, kestrels are spotted in the thousands during peak migration times at hawk migration watches stationed along major flyways.

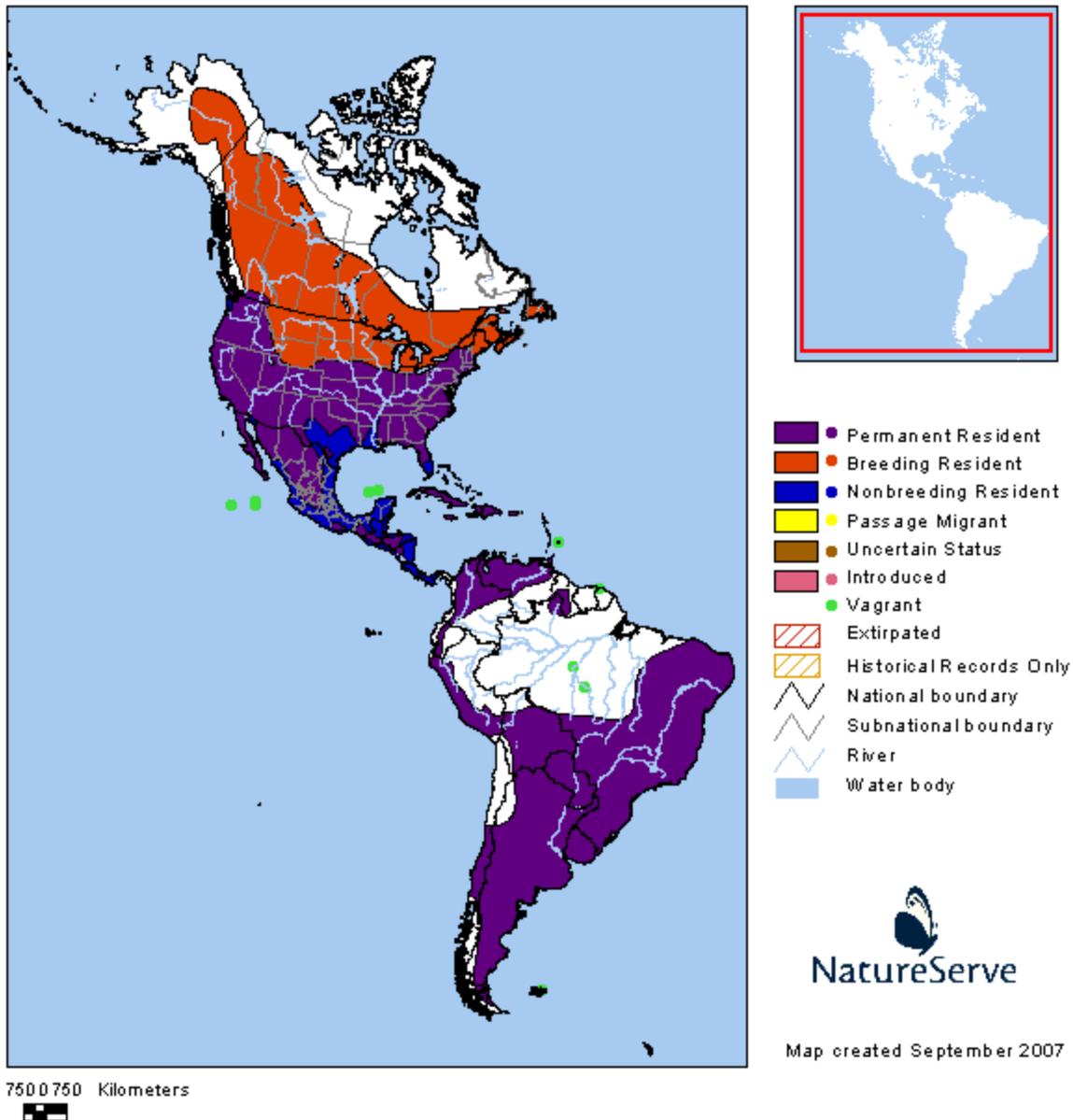


Fig 2. A map detailing the range of the American Kestrel. Range data provided by Infonatura/Natureserve. Ridgely, R. S., T. F. Allnutt, T. Brooks, D. K. McNicol, D. W. Mehlman, B. E. Young, and J. R. Zook. 2005. Digital Distribution Maps of the Birds of the Western Hemisphere, version 2.1. NatureServe, Arlington, Virginia, USA.

### Habitat Requirements

American Kestrels are an adaptable species in terms of climate, temperatures, and elevation. These little falcons are generally located anywhere in the Western Hemisphere that is not covered in dense forest or in the Arctic Circle. American Kestrels are a species of open country, generally preferring grasslands and shrub lands over anything with tree cover.

Ideal kestrel habitat is composed of ample open space with snags, fence posts, lone bushes or trees, or power wires acting as isolated perches. Kestrels prefer to be able to see their entire territory easily from any one perch, and do not typically appear in areas with dense foliage.

Thus American Kestrels can be found in any of the following: deserts, plains, wooded savannah, marshes, farmland, tree lines and foothills of mountains, clear-cut areas, and even suburban and urban environments.

While wintering, females are seen in more open habitat than males. Some hypothesize this is simply because generally the females arrive at wintering grounds before males do, and thus the females claim the more preferred habitat.

## **Food**

As one could expect from a bird with a wide range like the American Kestrel, this species is varied and adaptable when it comes to diet. The vast majority of prey taken by American Kestrels is medium or large insects. Most kestrels also frequently prey on small mammals, such as voles or mice, and small lizards and snakes. During the nesting season, kestrels also take the nestlings (or rarely, the adults) of smaller birds. Kestrels are also known to occasionally hunt bats, though this is less common than the aforementioned prey items. In arid and subtropical regions, small reptiles can make up the majority of a kestrel's diet.

Kestrels use isolated perches to sit and wait for prey, and they also actively search while flying, kiting, or hovering over fields. Captured prey is then eaten by the kestrel while perching.

## **Breeding**

American Kestrels differ from many other North American falcons in that they prefer to nest in cavities, instead of cliff ledges. Kestrels do not construct their own cavities, however, and thus they are secondary cavity nesters. Kestrels choose a variety of cavity types, including old woodpecker holes, squirrel nests, crevices in barns and building roofs, man-made nest boxes, or other similar structures. American Kestrels do occasionally use old, sheltered bird nests, however this behavior is rare compared to cavity nesting.

It is the male kestrel that claims a nesting territory and identifies potential nest cavities. They prefer cavities that are about eight to thirty feet off the ground, in areas with abundant open space and ample food resources. Cavities in areas with tree cover or other sheltered areas are typically used by species other than American Kestrels.

Males will escort potential mates to cavities within their territories and the female will choose the nest site. Females appear to select males based on their plumage, flight displays, and how ideal their claimed nesting territory and potential nest cavities appear to be. Physical fights between two males and between two females have been witnessed, and such clashes can occur while pairs are competing for nest sites.

Copulation between pairs is frequent and can occur from the time that both birds are at the nest site until the first egg is laid. Not all copulations are fertile, but they affirm the social bond between the male and female for the duration of the nesting season. Similar to most birds of prey, copulation lasts only a brief few seconds.

It is also common to see the male bring gifts of food to the female. She may cache uneaten food in the

nest site (or nearby) if she accepts a gift when she is not hungry. When the female begins to lay eggs, the male will provide the majority of her food.

Females will lay anywhere from 1 to 7 eggs, with 4-5 being the average. One egg is typically laid every other day, and incubation begins in full after the clutch is complete. The male or female may incubate the eggs briefly during the laying period, but incubation becomes a full-time job after the female is done laying eggs entirely.

The female typically performs the majority of the incubation, with the male hunting and bringing her food. The male will assist in incubation, however, and the female can hunt for herself on occasion as well. Both sexes develop a bare brooding patch on their abdomen, which allows the eggs (and young nestlings) direct skin contact for warmth during incubating and brooding. Incubation of the eggs typically takes 27-31 days.

Directly prior to hatching, nestlings will begin to vocalize from within the egg. Then, “pips” will occur in the eggshell, which are holes the nestling pokes in the shell to allow the chick to begin to breathe. Nestlings use a small notch on the top of their beak, called an egg tooth, to chip at the egg shell to break out. After successful hatching, the egg tooth falls off within a couple days.

American Kestrel nestlings are born altricial, meaning blind and helpless. Though they are covered in a fine layer of white down, the down is not sufficient for thermoregulation, so the nestlings rely on the parents to keep warm. Much like with incubation, the female performs most of the brooding, and the male provides most of the food, but the male and female will sometimes swap jobs.

Typically, the male announces himself with vocalizations when arriving after a successful hunt, and the female leaves the nest to take the food from him. This process is referred to as a food exchange. After the food exchange, the female will return to the nest box to tear the prey into ideally-sized chunks and feed the nestlings. The nestlings are very vocal during feeding, and they swallow food chunks whole. As they grow, food demands become higher, and when the chicks are able to thermoregulate on their own, the adult female will join the male in hunting and providing food full-time.

The nestlings grow rapidly—their eyes opening a few days after hatching. Kestrel chicks reach their full adult body size in about 20 days of age. Their feathers are grown in enough to make their first flights around 27-32 days of age. The act of first leaving the nest cavity is called “fledging,” and chicks that have fledged are referred to as “fledglings.” Fledging does not typically mean a graceful or competent flight occurred, however, and fledglings often end up on the ground after their first flights. Fledglings are capable of flying or climbing up to trees or bushes within a couple hours. During this period, the adult male and female will feed and protect the young birds as they make their first forays outside of the nesting cavity.

Fledglings may return to the nest cavity to roost, once they are competent enough in flight to do so. Adult kestrels will continue to watch over and feed fledglings until they are able to hunt reliably on their own, which can take many months. Roving, wandering groups of kestrel families are often spotted during this period with siblings practicing flying by chasing each other or chasing potential prey items. Once the fledglings achieve independence, they will leave their parents.

## Roosting

Roosting is the term used to describe birds using a site for sleeping or resting. Roosting behavior in American Kestrels differs little between the seasons. Kestrels tend to use cavities and sheltered areas to roost including woodland edges, highway signs and power line nooks, pasture areas and farmlands, as well as cavities and holes in cacti and rock cliffs. American Kestrels also use nest boxes to roost as well. The American Kestrel Partnership is interested in how often adult kestrels use nest boxes to roost during the winter, so we encourage partners to report winter roosting behavior if it is noticed.

American Kestrels may change their diet from season to season, but their habitat and roosting requirements remain the same throughout the year, even if they migrate. Thus, American Kestrels winter in habitat much like their breeding habitat - open space, with plenty of small prey.

## Decline

American Kestrels were typically known for being the most abundant bird of prey in areas they inhabit, however an alarming population decrease appears to be occurring across North America. Breeding Bird Survey data show that this population decline is widespread, across a variety of ecological regions.

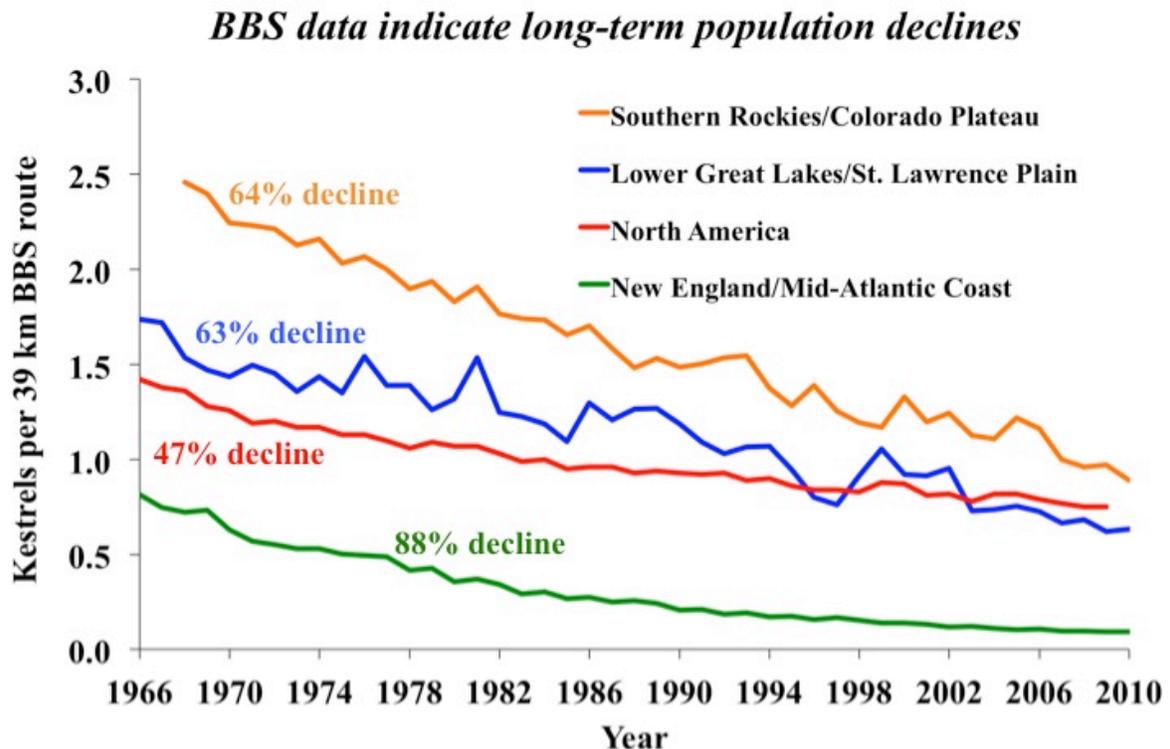


Fig 3. A map derived from Breeding Bird Survey data that displays American Kestrel population declines over time. The Peregrine Fund, 2012. Data provided by The Breeding Bird Survey. <http://kestrel.peregrinefund.org/index.php?action=intro>

Reasons for population declines may include land use change, climate change, depredation by Cooper's Hawks and other birds of prey, competition with European Starlings for nesting cavities, and environmental contaminants such as rodenticides, heavy metals, and brominated flame retardants (used in electronics and textiles). However, researchers do not have sufficient data to understand why these long-term, widespread population declines are occurring.

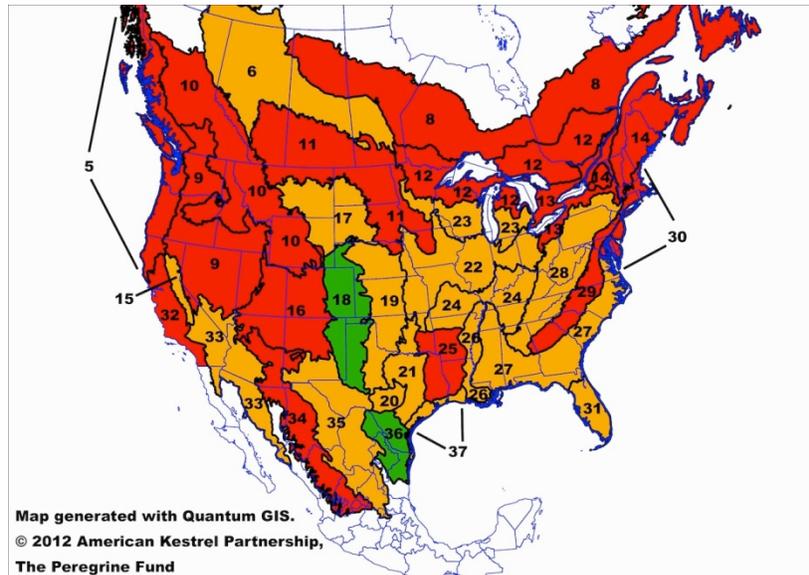


Fig 4. A map detailing American Kestrel population change per [bird conservation region](#) in the continental United States.

Red= Population Decline  
Yellow= No Change  
Green=Population Increase

The Peregrine Fund created the [American Kestrel Partnership](#) in 2012 as a project to research this enigmatic decline. Counts like the Breeding Bird Survey indicate there are fewer breeding kestrels, but they cannot determine where the birds are having trouble in their life cycle. Are adults not returning after winter to breed? Are they dying at high rates during breeding, migration, or overwintering? Are they not breeding as often or failing when they do try to breed? And, critically, how are these demographic processes influenced by land use, environmental contaminants, climate trends, and competing or predatory species?

This unexplained decline is the key mystery that The [American Kestrel Partnership](#) is examining—and to do so, we started a Citizen Science-driven nest box program. Although there are numerous successful nest box programs across North America, they are largely localized and isolated from each other in a research context—making it difficult to draw reliable conclusions on a large scale. In response, the American Kestrel Partnership is coordinating an unprecedented, hemisphere-wide nest box monitoring network and database by supporting existing nest box programs and helping new programs fledge.

### Nest Boxes

When it comes to building [nest boxes](#) for American Kestrels, the first thing to remember is that placing nest boxes without intending to monitor them can be detrimental. Unmonitored nest boxes frequently become habitat for invasive starlings, which is not helpful for American Kestrels. Thus, build and place nest boxes for American Kestrels ONLY if you intend to monitor them.

It is also ideal if you research potential nest box programs already in your local area. If there is a kestrel nest box program already going on in your region, it is best to contact those running that project before embarking on one of your own. Overlapping programs can interfere with each other and hinder research, so it is preferable to work with already-established programs. You may contact the American Kestrel Partnership for help in this regard.

If you intend to monitor, and there are no established programs in the area (or you have permission to place more) then there are many local resources that can help get you started. It's a great hands-on educational opportunity for kids, Boy and Girl Scouts, teens, or office co-workers. The data the [American Kestrel Partnership](#) collects are being used for scientific purposes, so it can be a great feeling to contribute to cutting-edge science addressing real-world issues!



Fig 5. A snapshot of kestrel nesting activity within a nest box.

Nest box Blueprints here: <http://hub.peregrinefund.org/node/384>

In regions with potentially very hot climates, such as the southwest US, many people have noted better nest success if they cut an additional ventilation slot in the side of the nest box, as nest boxes tend to get hotter than natural tree cavities in the sun. This is strictly optional, but potentially helpful for those monitoring kestrel boxes in extreme desert climates.

Leaving the nest box bare at the bottom is potentially dangerous for kestrel eggs, so it is recommended that 1-3 inches of some manner of substrate be added to the bottom of nest boxes prior to the breeding season. Any non-toxic wood shaving or bark can serve as a substrate for kestrel nest boxes. A good rule of thumb is to avoid any wood made from pine - pine shavings tend to contain toxic oils. Shavings and bark works just fine, though sawdust can be too fine and is not recommended. Broken hay, pine

needles, and other dry grasses can work as well. Kestrels do not add any substrate on their own, so if you notice that nesting material is being added to a nest box, a different species is building a nest.

Substrates should be cleaned out and replaced each season, as old, used bedding can increase the risk of parasites or disease. However, kestrels will readily nest on top of material from previous seasons.

The best way to attract American Kestrels to a nest box is with ideal placement. Kestrels do take to nest boxes facing in any direction; however they have a preference for nest boxes placed with the entrance facing to the Southeast. A Southeast-facing placement also helps to deter starlings, which prefer a different directional facing for their nests. Ideally, nest boxes should be more than 50 yards away from woodland habitat, to prevent squirrels. American Kestrels prefer areas with plenty of grassy foraging habitat and open space.

When placing more than one kestrel nest box, it is best to space them about a half-mile apart. If there is ample prey and nesting resources available, kestrels will nest in close proximity. One can adjust nest box placements year-to-year in response to use, or lack thereof.

It is also important to keep hazards in mind when placing nest boxes - roads and highways are potentially dangerous for fledgling kestrels, so it is best to face the entry holes away from those hazards. Young children and domesticated animals, such as dogs and cats, can also be a hazard to young fledgling kestrels, so avoid placing nest boxes in close proximity to areas frequently used by unsupervised children or pets.

Many partners also use predator guards when necessary. There are a variety of options that can be used, and what is most effective depends on the predators in the area. It is generally not necessary to place predator guards unless you notice you are losing nests to predation. Nest boxes in nice, open habitat are normally well-protected on their own.

A common anti-snake and anti-mammal predator guard is a simple length of sheet metal wrapped around the nest box pole. This prevents climbing, which is usually how predators would access the nest box. Aerial predators are not normally a concern, due to the small diameter of the entrance hole. However if that becomes a concern, the entrance can be extended with a short tube to help prevent predators from being able to reach all the way inside.

Nest box blueprints can be found here: <http://hub.peregrinefund.org/node/384>

## **Monitoring**

Knowing the timing of the breeding season in your locality can go a long way in getting started with a nest box monitoring program. It is best to begin watching the nest boxes early, to get a feel for when different behaviors begin to occur. For remote or hard-to-access nest boxes, checking the nest boxes during the most crucial stages of the nesting season is the most helpful.

In warm locations of the United States, egg-laying can begin as early as the first week of March. Thus, getting the nest box ready in January is crucial. Courtship behaviors typically begin four weeks before egg-laying starts. Especially at lower latitudes, American Kestrels may occasionally attempt a second nesting later in the year. Continued monitoring can catch those behaviors and allow for more data

collection.

In more temperate areas of the United States, egg-laying typically begins in early April. Warmer springs can mean earlier courtship and egg-laying, while colder springs can move the breeding season back. Keep an eye on nest boxes in March to watch for those initial courtship behaviors.

In the coldest areas of American Kestrel range, such as in Canada or high-elevation mountain areas, egg-laying typically begins in mid-to-late April. Again, this can vary based on regional temperatures for that year.

American Kestrel males arrive to nesting areas first and establish the territory. Then, the male will attempt to attract a female to the nest box and nesting territory. These nesting territories and pair bonds are established about three to four weeks before the first eggs are laid.

When monitoring for courtship behavior, keep an eye out from a distance for frequent entry and exit of nest boxes, the male bringing food to the nest box or to a waiting female, or copulation. Kestrels copulate frequently before eggs are laid, and they may continue to copulate after egg-laying begins.

To maximize the benefit of your monitoring data to The American Kestrel Partnership's research, it is best to check the nest box at least twice - once when there are eggs, and then again within 30 days of that first check. The first check should be made when you strongly suspect there are eggs.

American Kestrels are resilient to stress and are unlikely to abandon the nest once the eggs are laid. Approach the nest box quietly and peek inside quickly. Do not touch the eggs. Count the number present, note the presence of any adults, and quietly move on as quickly as possible. Any adult kestrels that fled will return to tend to the eggs shortly.

Once eggs are found, return to check that same nest box within 30 days. If there are still eggs on the second check, then return within 30 days of that second check. This timing pattern guarantees at least one check when there are eggs and one check when there should be nestlings present.

Documenting nestlings is essentially the same as documenting the eggs - do so quickly and quietly to minimize stress. Open the nest box carefully to ensure that no nestlings fall out or exit the nest box prematurely. Count the number present and determine the age, if possible. Taking a few quick photos can help with this, as you can then compare the photos with our [nestling aging guide](#) that is found on the [American Kestrel Partnership website](#).

If you are a licensed bander, or are using the services of a licensed bander, it is best to band the nestlings when they are approximately 20-25 days old. This is when their tarsi are adult-sized and won't grow any larger but before the nestlings are ready to fledge. Do not band or touch the nestlings unless you have a federal permit to do so.

American Kestrels will fledge and leave the nest box when they are about 27-35 days old with some variation outside of that. Fledglings may return to the nest box after fledging to roost, preen, or nap, but do not fear if they disappear from the area. Adult kestrels continue to care for, protect, and feed fledglings until they are fully proficient in hunting and feeding themselves.

Even if the kestrel family vacates the area, it is best to leave the nest box out to provide fall and winter

roost site. Both adults and fledglings may roost in the nest box throughout the year.

Nest box monitoring data obtained should be entered in the American Kestrel Partnership database online. Full instructions on becoming a Partner and entering your data can be found online here: <http://kestrel.peregrinefund.org/index.php?action=be-partner>

## **Starling Prevention**

European Starlings are an invasive pest species, and nest competition with starlings is one of the hypotheses for why American Kestrels are declining. As a non-native invasive species, they are not protected under the Migratory Bird Treaty Act.

If starling activity is noted in nest boxes intended for American Kestrels, it is ideal to remove and dispose of starling nest materials and eggs. It is most effective to trap the adult bird in the nest box, but removing nesting attempts is helpful as well. One can also trap European Starlings using inside-the-box traps or bait traps, as long as they carry no risk of harming native species.

If it is preferred to relocate the adult starling, it must be done at least three miles away, and the adult bird must be released in similar, preferred habitat. Otherwise, the relocation may not be successful and the starling may return.

If you are uncomfortable with removing starlings or their nests, you can also shake the starling eggs roughly for about sixty seconds, which addles them and renders them a failure. Then you can leave them in the nest box so that the adult female bird continues to use reproductive energy while having no hatching success. This method also prevents that same starling from taking over a different nest box or potentially preventing the starling from trying again, although this also prevents an American Kestrel from using the nest box.

Other cavity-nesting birds, such as Screech Owls or Bluebirds, may use the nest box. These are federally-protected native species, so they must be left alone. It is illegal to destroy the adult birds, nests, or eggs of native bird species. If you suspect European Starling activity in your nest box, be sure of your bird ID before you remove the nest or adult bird.

Non-kestrel species are more likely to use kestrel nest boxes if the placement is not ideal for American Kestrels. Placing nest boxes too close to woodland, tree cover, or areas with little open space makes it more likely that a different species would use the nest box instead. Ideal nest placement and European Starling management is the best way to attract American Kestrels to your nest box.

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