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THE FULL ANNUAL CYCLE OF THE AMERICAN KESTREL: STATE OF THE KNOWLEDGE, INFORMATION GAPS, AND CONSERVATION NEEDS

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The American Kestrel (*Falco sparverius*) is a relatively common and popular raptor that has often been used as the model species for a variety of scientific studies (e.g., Bird and Bowman 1987). Despite the kestrel's ubiquity, long-term data from the Breeding Bird Survey (BBS), raptor migration counts, and occupancy of nest boxes all suggest that American Kestrel populations are undergoing widespread declines across North America (e.g., McClure et al. 2017, Bird and Smallwood 2023, Oleyar et al. 2023, and references therein). The most severe declines seem to be occurring in populations along the Atlantic coast and the Appalachian Mountains (Farmer and Smith 2009, Bird and Smallwood 2023), although some level of decline seems to have occurred throughout much of North America (Bird and Smallwood 2023, Oleyar et al. 2023). Regional declines in kestrel populations have been reported beginning as early as 1951 (McClure and Schulwitz 2022), and although many potential drivers of decline have been investigated, no clear conclusions have been reached (Bird and Smallwood 2023).

Systematic monitoring of kestrels primarily began in 1966 with the advent of the BBS (Sauer et al. 2020) and these data indicated that the continental decline began in the late 1960s and has steadily continued through 2019. Few systematic monitoring data for raptor populations exist before the 1960s. One exception is relatively standardized counts of migratory raptors at the North Lookout of Hawk Mountain Sanctuary, which began in 1934 (Broun 1948, Therrien et al. 2012). These data display an interesting pattern in that counts of American Kestrels actually increased from 1934 until about 1971 (Bednarz et al. 1990; Fig. 6), after which counts of migrating kestrels at Hawk Mountain significantly declined. We note that these early counts of migrating raptors were most likely not influenced by the effects of global climate change that primarily manifested since 1980 (US Environmental Protection Agency 2023) and could influence kestrel migratory behavior. These early trend data raise the question of whether kestrel populations are really exhibiting a historical decline from pre-European settlement times, or some re-adjustment of population numbers in response to a series of anthropogenic landscape modifications that occurred over the last couple hundred years. For example, much of the Atlantic Flyway along the east coast of North America originally comprised mature eastern deciduous forest that likely provided only limited habitat for American Kestrels. Thus, the current decline that we are witnessing along the Atlantic Coast is at least in part a secondary response explained by conversion of pasture lands to residential developments, intensive row-crop agriculture, or to the reestablishment of forest in the northeastern U.S. (Bednarz et al. 1990). What is the appropriate population of American Kestrels indicative of a healthy ecological community is a matter of continued discussion, but something that could be addressed with the assessment of historical effective population size (Ne) using genetic tools (see Ruegg et al. 2021, Gousy-Leblanc et al. 2023). Nonetheless, the current monitoring data available on American Kestrels clearly demonstrate a widespread decline of this popular common falcon since the 1960s and that prevailing trend is concerning.

Concern for the populations of this falcon that is cherished by birders, ornithologists, conservationists, and others who enjoy this charismatic diminutive predator led to publication of this special issue of the *Journal of Raptor Research* on the American Kestrel. Prior to this special issue, three symposiums on the American Kestrel have been sponsored by the Raptor Research Foundation, Inc. (RRF). The first focused on the basic biology and conservation management of this falcon and was published as a Raptor Research Report in 1987 (Bird and Bowman 1987). At that time, there was only limited concern about the population status of the kestrel. The second symposium was organized in conjunction with the RRF meeting at Fogelsville, Pennsylvania, in 2007 and was largely focused on concerns about emerging data suggesting population declines. Several papers from this symposium were published in a special issue of the *Journal of Raptor Research* in 2009 (e.g., Bird 2009, Farmer and Smith 2009, Smallwood et al. 2009). A third more limited American Kestrel symposium (eight papers) was convened by The Peregrine Fund's American Kestrel Partnership at the RRF conference in 2014 (Corpus Christi, Texas), but no proceedings were produced.

This special issue is largely based on the fourth symposium on this species entitled "The Full Annual Cycle of the American Kestrel: Knowledge Gaps and Conservations Needs" held as part of the 2021 virtual RRF conference hosted by the Peregrine Fund. The idea to hold this fourth symposium emerged during an informal meeting among several active kestrel and raptor researchers including Laurie Goodrich, Julie Heath, and many others during the 2019 RRF conference in Fort Collins, Colorado. Collectively, this impromptu group of raptor researchers proposed that the time was right to review new results and ongoing research, discuss and share ideas, and deliberate the status and the potential drivers of the kestrel decline. Kelsey Biles (University of North Texas), Anjolene Hunt (Boise State University), Jean-François Therrien (Hawk Mountain Sanctuary), and Jim Bednarz (University of North Texas) agreed to organize and implement the symposium at the next RRF conference scheduled for October 2020 in Boise, Idaho. After the Covid-19 pandemic led to the cancellation of that conference and the conversion of the 2021 conference to a virtual-only meeting, the symposium coordinators hosted "The Full Annual Cycle of the American Kestrel: Knowledge Gaps and Conservations Needs" symposium on Zoom on 11 October 2021. Sixteen papers were presented addressing a range of topics related to the full annual cycle including breeding biology, migration, effects of climate change, demography, and wintering ecology. This symposium ended with a discussion session about the kestrel population decline and potential drivers of the decline. The symposium was well attended and generated further interest in addressing the ongoing population change of the American Kestrel and its conservation. Based on the conservation interest in the American Kestrel situation and under the adept direction of Cheryl Dykstra (Editor of the *Journal of Raptor Research*), we solicited and reviewed contributions, involved numerous volunteer referees in the peer-review process, and produced this special issue focused on the biology and conservation of the American Kestrel. Our key objectives with this issue were to summarize current data and the state of the knowledge about American Kestrel science, generate ideas and hypotheses related to the population decline and potential conservation actions, and stimulate the next generation research effort to further understand the causes of the decline and develop conservation measures to ensure the persistence of a healthy and viable American Kestrel population over the long-term.

We feel that we have already met our first two objectives, and are making progress on the third ultimate conservation objective. Clearly, the 2021 symposium and subsequent solicitation of papers published in this special edition have generated much intellectual discussion, debate, and new ideas that are presented in the following collection of papers in this issue. Also, we believe, at least indirectly, the energy and interest generated by the Full Annual Cycle symposium and this published proceedings has led to the U.S. Fish and Wildlife Service (National Raptor Program) sponsoring the Integrated Population Model and Decision Science American Kestrel Workshop in Albuquerque, New Mexico, in February 2023. This workshop included scientists and interested parties concerned about kestrels and involved many of the participants in the Full Annual Cycle symposium and contributors to this issue of the *Journal of Raptor Research*. The Albuquerque workshop organized by Brian Millsap, Kristin Davis, and Abby Lawson continued our vigorous discussions and is currently leading to the development of testable hypotheses related to the demographic decline and conservation management of the American Kestrel. This interest and attention will undoubtedly lead to additional funding that will support the next round of research investigation to answer questions about the decline in kestrels and the development of conservation actions.

Importantly, this special edition on the American Kestrel offers a wealth of current data, information, and ideas that will provide a solid basis for future research investigations. The 22 papers published in this edition cover an array of topics including current population trends, advances in techniques and management, exciting insights into migration biology, new information on nesting biology, habitat relationships, wintering ecology, potential impacts of rodenticides, diseases and maladies, and previously unknown natural history observations. If you are interested in raptor biology and conservation, or an American Kestrel enthusiast, you will be amazed by the findings and insights cover to cover in this issue of the *Journal of Raptor Research*.

For current trend information, make sure to read the commentary by David Bird and John Smallwood (2023), who review recent nest occupancy, BBS, Christmas Bird Count, and selected migration count data. They also review potential drivers of the population declines and offer the hypothesis that increases in Cooper's Hawk (*Accipter cooperii*) populations may be influencing kestrel populations, not by direct predation, but by restricting kestrel distribution by the mere presence of Cooper's Hawks in many habitats. Also, David Oleyar and colleagues (2023) provide a thorough analysis of raptor migration counts from 59 migration watchsites by employing Raptor Population Indices. Their conclusions were similar to those of Bird and Smallwood (2023) that the data show widespread declines may be moderating in recent years. However, these authors caution that recent changes in climate may be altering kestrel migratory behavior resulting in short-stopping or the forgoing of migration, and thus influencing migration counts.

In terms of monitoring nest boxes, Karl Miller and Jessi Brown (2023) employed dynamic occupancy modeling to design the most efficient sampling strategy to monitor nest box productivity. Their analysis demonstrated that monitoring boxes at approximately monthly intervals was sufficient to accurately estimate occupancy. Further, Chris McClure (2023) conducted a stochastic simulation analysis to evaluate the common practice of relocating nest boxes from poor quality sites to better quality sites. He found that statistically significant increases in vital rates could be produced by simply relocating poorly performing nest boxes. He offered several analytical suggestions on how to estimate unbiased occupancy and vital rates. Finally, concerning management of nest boxes, Jessica Schlarbaum and co-authors (2023) provide an interesting test of several options to control the interference of European Starlings (*Sturnus vulgaris*) with kestrel nest box programs. Specifically, they found the age-old practice of destroying and removing starling nests and eggs has little effect in promoting kestrel use of boxes. More effective management options likely are cracking starling eggs or spraying them with corn oil.

Documenting the full annual migration cycle in American kestrels has been an extremely difficult nut to crack for several reasons, however, several papers in this issue review the challenges, offer improved approaches, and are starting to reveal exciting insights into this aspect of kestrel life history. First, Kelsey Biles and colleagues (2023) evaluate use of leg-loop versus backpack harnesses for attaching devices to track kestrel movements. They concluded that backpack harnesses were most effective and had no adverse effects on the annual return rates of wintering kestrels in Texas. Further, they offer several specific suggestions for using backpack harnesses on kestrels and other small raptors. Mark Martell and team (2023) employed Motus tags to track the dispersal and autumn migration routes of breeding kestrels in Minnesota. They tagged 33 kestrels with Motus tags and subsequently detected 45% of these at various Motus receiving towers and documented dispersal routes, stopover sites, and autumn migratory pathways generally directly south through Iowa and Missouri. Their data demonstrated that the use of the Motus system and transmitters has potential to document the full annual migratory cycle of kestrels, but more receiving stations are necessary. Finally, Anjolene Hunt and co-authors (2023) present an informative study about their attempts to tag kestrels with geolocators and satellite transmitters. Results were limited due to accuracy issues and device unreliability, but they did document one long-distant migration route from Alberta, Canada, to Nicaragua (5945 km). They also reported some interesting findings related to leap-frog migration, the use of stopover sites, and the limitations of current satellite and geolocator technology to document the migration of kestrels.

Several articles in this special edition offer new information related to the nesting biology of kestrels. Emilie Snyder and John Smallwood (2023) analyzed 696 breeding attempts and provided substantial evidence that clutch size, nestling survival, and the number of fledglings produced varied significantly with the age of both parents. The relationship between breeding success and age was most pronounced for males. Marisa Del Corso and John Smallwood (2023) analyzed data from the same New Jersey population between 1996 and 2016 and found that reproductive success was positively related to warmer temperatures during the breeding season and the lack of snowfall during the previous autumn. Allison Cornell and colleagues (2023) conducted a very interesting study that related the role of food quantity and type to the development of nestlings. Although sample sizes were limited, they found that male-biased sex ratio broods were fed more mammals and female-biased sex ratio broods were fed more birds. Also, they found that with food supplementation, kestrel parents reduced their food provisioning efforts. Joseph Kolowski and associates (2023) completed an extensive analysis of factors associated with nest box occupancy and reproductive success in an agricultural landscape in Virginia. Among their fascinating findings were that reproductive success was negatively associated with nearby development and positively associated with the proportion of agricultural lands and pasture within 3 km of the nest sites. Also, the absence of starling activity was related to higher breeding success. Finally, Erica Craig and colleagues (2023) report data from a 20-yr study of a kestrel nest box population in the Alaskan Arctic. Overall, this population exhibited excellent reproductive success, low predation rates, and were not affected by a number of hypothesized factors that may potentially adversely affect kestrel populations at lower latitudes.

Along with data on nesting success and habitat associations presented by Kolowski et al. (2023) in Virginia, habitat relationships were also examined by Kristen Linner-Warren and co-authors (2023) in the Southern High Plains of Texas. Based on systematic road transect sampling conducted throughout the year over a 2-yr period, these authors found that kestrels avoided cotton fields and positively selected areas with woodlots or abandoned or occupied houses and barns. Further, kestrels showed some selection toward grazed over un-grazed grasslands. They suggested that siting new wind energy developments in areas under cotton cultivation and avoiding grasslands and woodlots may decrease the risks of collision mortality in kestrels in this part of Texas.

Data collected by Linner-Warren et al. (2023) address habitat relationships in the winter as well as during the breeding period. Carter Couch (2023) describes a compelling study on the location of winter roosts sites in relation to kestrel diurnal territories in Texas. He visually observed birds go to or toward their roosts at dusk and found that 6 of 20 birds (30%) roosted at least 250 m away from their diurnal territories. These limited data suggest the intriguing possibility that kestrel roost sites are limited in Couch's study area and that there are fitness tradeoffs between commuting to a roost site away from the diurnal territory versus staying on a territory and using a less safe roost. Definitely more study is needed on this topic.

Evan Buechley and team (2023) collected and analyzed samples from 98 kestrels and other raptors (dead and live wild birds) in Utah. Of 8 dead kestrels sampled, 75% had evidence of anticoagulant rodenticide exposure. Also, 7 of 12 blood samples (58%) from live adult kestrels had detectable levels anticoagulant rodenticides, while only 1.7% of juveniles tested positive. They concluded that anticoagulant rodenticides be further investigated as a contributing factor in kestrel declines including assessments of nonlethal effects.

Martín Frixione and Ricardo Rodríguez-Estrella (2023) provided a very interesting assessment of the incidence of haemosporidian parasites transferred by biting midges in a wintering population of kestrels on the Baja California Peninsula, Mexico. They found that 42.6% of 54 trapped kestrels were infected with haemosporidians and that the parasite intensity increased with presence of ponds and irrigated agricultural fields and frequency of infected individuals increased through the course of the winter season. Their data suggest that agricultural development in this wintering area facilitates infections by haemosporidians and could be another stressor affecting wintering populations of kestrels.

Jesse Watson and Dave Oleyar (2023) recorded the occurrence of spraddle-leg in 7 of 2241 (0.31%) kestrel nestlings in Utah. Although relatively rare, these nestlings never survive and Watson and Oleyar offer suggestions on how nest boxes can be maintained to avoid the occurrence of spraddle-leg.

From a useful-techniques perspective, John Smallwood and co-authors (2023) provide a short communication discussing the use and misuse of the subterminal black tail band to age female kestrels. Smallwood et al. conclude that a narrow subterminal black tail band is indicative of a juvenile, but relatively wider tail bands are inconclusive for aging. Researchers capturing and aging kestrels should carefully review this paper.

Other shorter contributions in this issue document a series of previous unreported natural history observations. Heather Bullock and coauthors (2023) detailed an interesting observation of a female-female kestrel pairing and mating in Texas. They describe and quantify observations of this pair of marked females repeatedly mating and switching positions for a period of almost 4 wk. Additionally, Valeria Ojeda and Bruno Riovitti (2023) document the first case of a Crested Caracara (*Caracara plancus*) hunting and consuming a fledgling American Kestrel. Finally, Dale Stahlecker (2023) reported the first recorded incident of nesting kestrels preying on nocturnal Ord's kangaroo rats (*Dipodomys ordii*), which might be attributed to drought conditions or the presence of artificial light at night.

All in all, this issue provides fascinating reading about the biology and ecology of American Kestrels with many implications related to the half-century population decline and their long-term conservation. We hope you enjoy and benefit by reading this compendium of articles on the science of American Kestrels. We feel this information benchmark will help launch the next genesis of kestrel research.

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We greatly appreciated the time and efforts contributed by Kelsey Biles and Anjolene Hunt to organize and host "The Full Annual Cycle of the American Kestrel: Knowledge Gaps and Conservations Needs" symposium that led to the publication of this special issue. Certainly, the completion of this issue could not have happened without the skillful organizing and editing skills of Cheryl Dykstra. We thoroughly appreciated her constant and polite pestering to keep us on task and more or less on schedule! Further, we thank all the authors for their outstanding contributions to kestrel science. Finally, we infinitely appreciated all the referees, many of whom expertly reviewed multiple manuscripts, who helped us and the authors improve the quality of all the papers included in this special edition.

LITERATURE CITED

Bednarz, J. C., D. Klem, L. J. Goodrich, and S. E. Senner (1990). Migration counts at Hawk Mountain, Pennsylvania as indicators of population trends, 1934–1986. The Auk 107:96–109.

Biles, K. S., J. C. Bednarz, S. E. Schulwitz, and J. A. Johnson (2023). Tracking device attachment methods for American Kestrels: Backpack versus leg-loop harnesses. Journal of Raptor Research 57:304–313.

Bird, D. M. (2009). The American Kestrel: From common to scarce. Journal of Raptor Research 43:261–262.

Bird, D. M., and R. Bowman (Editors) (1987). The Ancestral Kestrel. Raptor Research Foundation and Allen Press, Lawrence, KS, USA.

Bird, D. M., and J. A. Smallwood (2023). Evidence of continuing downward trends in American Kestrel populations and recommendations for research into causal factors. Journal of Raptor Research 57:131–145.

Broun, M. (1948). Hawks Aloft: The Story of Hawk Mountain. Stackpole Books, Mechanicsburg, PA, USA.

Buechley, E. R., D. Oleyar, J. L. Watson, J. Bridgeman, S. Volker, D. A. Goldade, C. E. Swift, and B. A. Rattner (2023). Preliminary evidence of anticoagulant rodenticide exposure in American Kestrels (*Falco sparverius*) in the western United States. Journal of Raptor Research 57:264–274.

Bullock, H. E., K. S. Biles, and J. C. Bednarz (2023). Female-female spring fling in American Kestrels: An observation of a female–female pair and copulation behavior. Journal of Raptor Research 57:314–319.

Cornell, A., M. A. Fowler, C. Zimmerman, Z. Khaku, and J.-F. Therrien (2023). The role of food quantity and prey type in nestling development of American Kestrels. Journal of Raptor Research 57:210–219.

Craig, E., T. Craig, and J. McMillan (2023). American Kestrel nesting biology and long-term trends in the Alaskan Arctic: 2002–2021. Journal of Raptor Research 57:238–250.

Crouch, C. G. (2023). Do wintering American Kestrels sleep where they eat? Journal of Raptor Research 57:299–303.

Del Corso, M., and J. A. Smallwood (2023). The effect of local weather conditions on American Kestrel (*Falco sparverius*) reproduction. Journal of Raptor Research 57:201–209.

Farmer, C. J., and J. P. Smith (2009). Migration monitoring indicates widespread declines of American Kestrels (*Falco sparverius*) in North America. Journal of Raptor Research 43:263–273.

Frixione, M. G., and R. Rodríguez-Estrella (2023). Factors influencing prevalence and intensity of Haemosporidian infection in American Kestrels in the nonbreeding season on the Baja California Peninsula, Mexico. Journal of Raptor Research 57:275–290.

Gousy-Leblanc, M., J.-F. Therrien, T. Broquet, D. Rioux, N. Curt Grand Gaudin, N. Tissot, S. Tissot, I. Szabo, L. Wilson, J. T. Evans, V. Bowes, et al. (2023). Long-term population decline of a genetically homogeneous continental-wide top Arctic predator. Ibis. doi: 10.1111/ibi.13199.

Hunt, A. R., J. L. Watson, J. M. Winiarski, R. R. Porter, and J. A. Heath (2023). American Kestrel migration: Insights and challenges from tracking individuals across the annual cycle. Journal of Raptor Research 57:164–175.

Kolowski, J., L. Morrow, and J. Morrow (2023). Factors associated with American Kestrel (*Falco sparverius*) nest box occupancy and reproductive success in an agricultural landscape. Journal of Raptor Research 57:220–237.

Linner-Warren, K., B. D. Bibles, and C. W. Boal (2023). Seasonal abundance and habitat associations of American Kestrels on the Southern High Plains of Texas. Journal of Raptor Research 57:251–263.

Martell, M. S., A. A. Archer, A. Burnette, M. Lee, F. Nicoletti and K. A. L. Hall (2023). Using the Motus system to track post-breeding dispersal of American Kestrels nesting in Minnesota, USA. Journal of Raptor Research 57:154–163.

McClure, C. J. W. (2023). Relocating nest boxes from poor quality sites can bias inference into population dynamics. Journal of Raptor Research 57:185–192.

McClure, C. J. W., and S. E. Schulwitz (2022). Historical accounts provide inference into population dynamics of American Kestrels (*Falco sparverius*) in the northeastern USA. Journal of Raptor Research 56:89–94.

McClure, C. J. W., S. E. Schulwitz, R. Van Buskirk, B. P. Pauli, and J. A. Heath (2017). Commentary: Research recommendations for understanding the decline of American Kestrels (*Falco sparverius*) across much of North America. Journal of Raptor Research 51:455–464.

Miller, K. E., and J. L. Brown (2023). Maximizing nest box monitoring effort to detect American Kestrel site occupancy. Journal of Raptor Research 57:176–184.

Ojeda, V., and B. Riovitti (2023). Intraguild predation of an American Kestrel fledgling by Crested Caracaras in northern Patagonia, Argentina. Journal of Raptor Research 57:328–329.

Oleyar, D., L. J. Goodrich, D. Ethier, D. Brandes, R. Smith, J. Brown, and J. Sodergren (2023). Thirty years of migration and winter count data indicate regional differences in population trajectories for American Kestrels in North America. Journal of Raptor Research 57:146–153.

Ruegg, K. C., M. Brinkmeyer, C. M. Bossu, R. A. Bay, E. C. Anderson, C. W. Boal, R. D. Dawson, A. Eschenbauch, C. J. W. McClure, K. E. Miller, L. Morrow, et al. (2021). The American Kestrel (*Falco sparverius*) genoscape: Implications for monitoring, management, and subspecies boundaries. Ornithology 138:1–14. DOI: 10.1093/auk/ukaa051.

Sauer, J. R., W. A. Link, and J. E. Hines (2020). The North American Breeding Bird Survey, analysis and results 1966–2019. USGS Patuxent Wildlife Research Center, Laurel, MD, USA. https://www.mbr-pwrc.usgs.gov/bbs/reglist19v3.html.

Schlarbaum, J. N., J. M. Hull, and S. M. Kross (2023). Management of European Starlings in an American Kestrel nest box program. Journal of Raptor Research 57:291–298.

Smallwood, J. A., M. F. Causey, D. H. Mossop, J. R. Klucsarits, B. Robertson, S. Robertson, J. Mason, M. J. Maurer, R. J. Melvin, R. D. Dawson, G. R. Bortolotti, et al. (2009). Why are American Kestrel (*Falco sparverius*) populations declining in North America? Evidence from nest-box programs. Journal of Raptor Research 43:274–282.

Smallwood, J. A., T. E. Ely, and C. E. Hallett (2023). The use, and misuse, of the subterminal black tail band to age female American Kestrels. Journal of Raptor Research 57:320–324.

Snyder, E. R., and J. A. Smallwood (2023). Reproductive success increases with age in American Kestrels, especially in males. Journal of Raptor Research 57:193–200.

Stahlecker, D. W. (2023). Largely nocturnal kangaroo rats preyed upon by diurnal American Kestrels in New Mexico. Journal of Raptor Research 57:330–332.

US Environmental Protection Agency (2023). Climate change indicators: U.S. and global temperature. US Environmental Protection Agency. https://www.epa.gov/climate-indicators/climate-change-indicators-us-and-global-temperature.

Therrien, J.-F., L. J. Goodrich, D. R. Barber, and K. L. Bildstein (2012). A long-term database on raptor migration at Hawk Mountain Sanctuary, northeastern United States. Ecology 93:1979. doi: 10.1890/12-0353.1.

Watson, J. L., and D. Oleyar (2023). Documenting occurrence and rates of spraddle-leg in American Kestrel nestlings within a nest box monitoring network. Journal of Raptor Research 57:325–327.