

Swainson's Hawk Migration: Annotated Bibliographies

By: Natasha Kervin

Note on organization: These annotated bibliographies are ordered from foundational articles about migration and Swainson's Hawks to detailed articles on the migration patterns of Swainson's Hawks.

Salewski, V., & Bruderer, B. (2007). The evolution of bird migration – A synthesis. *Naturwissenschaften*, 94(4), 268-279. <https://doi.org/10.1007/s00114-006-0186-y>

Summary:

Bird migration is the process of birds moving between breeding and non-breeding areas on a regular, internally controlled basis. Competition and resource availability have been discussed in previous literature as contributing factors to migration and the diversity of migration from different latitudes.

In this review, the authors sought to determine if migration evolves towards new breeding areas or towards new areas for survival during the non-breeding season. The authors discuss early theories of bird migration presented by previous literature to address their problems and shortcomings. The authors developed a new theory, coined the “dispersal-migration-theory”, to explain how bird migration evolved. According to this theory, migration evolved gradually through the process of selection after long-distance dispersal events. The authors emphasize the importance of considering migration as a process rather than an event. The dispersal-migration theory discusses four main stages for the evolution of migration. Firstly, individuals will disperse to favourable habitats which causes their ranges will expand. Secondly, if individuals reach areas with seasonal variations in crucial resources, there will be an increase in selection for migratory traits. Thirdly, crucial resources will exhibit a gradient of increasing seasonality as the range expands. Fourthly, the number of individuals displaying migration activity will grow over time until almost every individual demonstrates migration behaviour. With this, the authors concluded that a fitness gain from an abundance of resources will result in migration. In addition, the authors suggest that migration evolves away from breeding grounds to areas for survival in the non-breeding season. This review is significant as it proposes a model that explains the evolution of migration as a process of selection for non-breeding areas in order to survive. The authors conclude that future studies are needed to explain the directional movements of birds during migration.

Contribution:

This article describes the evolution of migratory behaviour in birds by proposing a new theory that evades problems in earlier works. The theory provides an insight that the evolution of migration is caused by gradual change through selection and suggests that migration evolves towards new areas for survival during the non-breeding season. This review contradicts previous literature by rejecting earlier explanations for the evolution of migration and suggesting a new theory. This article is included in my literature review because it gives me a better understanding of the migration behaviour of birds.

Robinson, W. D., Bowlin, M. S., Bisson, I., Shamoun-Baranes, J., Thorup, K., Diehl, R. H., Kunz, T. H., Mabey, S., & Winkler, D. W. (2010). Integrating concepts and technologies to advance the study of bird migration. *Frontiers in Ecology and the Environment*, 8(7), 354-361. <https://doi.org/10.1890/080179>

Summary:

Migration is a repeating seasonal movement among favourable habitats that occurs in nearly every animal with wings. It has been shown in previous literature that technology is helping researchers better understand the basic elements of migration. These can include the location of an animal's breeding and non-breeding grounds.

This review sought to investigate the methodological limitations of studying animal migration and the ways in which new technologies have overcome them. The authors examine four major topics in animal migration that are specifically addressed when studying birds. In the subheading “migratory connectivity”, the authors discuss two approaches that allow researchers to connect the breeding, nonbreeding, and migration routes of birds. The first approach includes assigning individuals to their likely regions of origin and the second approach includes performing chemical analyses on isotopes. Additionally, researchers often use satellite transmitters to map migration routes. In the subheading “in-flight behaviour and dynamic spatial demography”, the authors discuss ways in which researchers study in-flight behaviour actively using radio transmitters or passively using radars and thermal images. Weather radar coverage is also used by researchers to track demographic changes. In the subheading “behaviour and ecology movement” the authors discuss how large-scale banding and satellite telemetry can provide insight into the effects of weather on birds and the timing of migration. In addition, a device known as an Emlen funnel can be used to determine the direction of flight. In the subheading “physiological ecology of migration”, the authors discuss how transmitters can be used to measure heart rate, respiration, wingbeat frequency, and blood chemistry during migration. This study is significant as it gives an overview of the various technologies used to study different aspects of bird migration. The authors conclude that future studies should explore the development of smaller and more durable technologies.

Contribution:

This review identified various technologies that researchers use today to study animal migration and gives suggestions on how we can improve these technologies to gain more knowledge on different aspects of animal migration. This article supports previous literature as it discusses technologies that researchers have found useful when studying animal migration in their published works. I included this review in my literature review because it gave me a detailed description of how migratory behaviour is studied, which will help me identify which technologies are useful when studying the migration behaviour of Swainson’s Hawks.

Liguori, J. (2011). *Buteos. Hawks at a distance: Identification of migrant raptors* (pp. 59-66). New Jersey, U.S.A.: Princeton University Press. <https://doi.org/10.1515/9781400838264>

Summary:

Swainson's Hawks are large and long birds with pointed wings. They can be observed migrating in groups while soaring or gliding through the air. According to previous literature, the colour of Swainson's Hawks can be used to identify their age.

The author of this book chapter sought to distinguish between adult, subadult, and juvenile plumages as well as light and dark colour morphologies (morphs). This was accomplished by taking multiple photographs of visible Swainson's Hawks from the ground between August 15 and November 30. After taking the photographs, the author would then examine the photo closely to determine the age and colour morph of each individual hawk. Using hundreds of photos, the author distinguished between light morph adults, light morph juveniles, dark morph adults, dark morph juveniles, and subadults. In general, light morph Swainson's Hawks have a white underside with dark flight feathers and pale upper tail coverts – feathers that cover the base of the main tail feather. Dark morph Swainson's Hawks are different in that they have a uniformly dark underside and their topside feathers are a shade darker than the light morphs. Ways to distinguish an adult from a juvenile is that an adult will have a dark head during Spring whereas a juvenile will have a pale head, and juveniles will have paler underwing coverts. Subadults can be distinguished because they have a juvenile underside, a characteristic juvenile pale head in the Spring, adult flight feathers, an adult topside, and symmetrical wings or tail molt in autumn. This book chapter is significant because it gives a detailed description of the light and dark colour morphs and how to distinguish the different ages classes of Swainson's Hawks. Future assessments are needed to determine if Swainson's Hawks migrate depending on their age class or colour.

Contribution:

This book chapter distinguishes the morphology of the two most common plumages as well as the age classes of Swainson's Hawks. This book chapter supports previous findings in that the morphology of Swainson's Hawks can be categorized into light and dark morphs. I included this book chapter in my literature review because being able to distinguish the different types of morphology in Swainson's Hawks can be useful in determining if Swainson's Hawks exhibit colour or age migration patterns.

Campbell, M. L., & Inzunza, E. R. (2017). What does the Swainson's hawk migration phenology tell us about its migration ecology? *Journal of Raptor Research*, 51(4), 451-454. <https://doi.org/10.3356/JRR-16-67.1>

Summary:

This article investigates the causes of the autumn bimodal migration phenology of the Swainson's Hawk in Veracruz, Mexico. The autumn bimodal migration refers to how Swainson's Hawks migrate at two different periods during the autumn season and phenology is the study of cyclic and seasonal natural phenomena. Previous literature suggests that when a bimodal pattern is observed during species migration, it is usually influenced by factors such as different geographic origins, sex, or age class.

The researchers proposed that the bimodal phenology observed in Swainson's Hawk migration is due to age. To explore this hypothesis, technicians photographed flocks of migrating Swainson's Hawks from October 4 to 30 (2015) on two count sites in Chichicaxtle and Cardel, Mexico. Each photograph was enlarged, and the researchers tallied the number of juveniles, adults, and undetermined hawks in each photo based on their plumages. The researchers collected 447 usable photographs and aged 2207 out of 3313 visible individuals. They found that the proportion of juveniles remained constant, but the proportion of adults increased towards the end of the migration period – this was subsequently found to be caused by a small sample size and was deemed not significant. The study also mentions that in the year of the study (2015), the Swainson's Hawk migration did not show the typical bimodal pattern. In the end, this study's results suggest that there is no definitive evidence that the Swainson's Hawk bimodal phenology is due to age. This study is significant because it rules out age class as a factor that could cause the bimodal migration pattern observed in Swainson's Hawks. Future studies are required to determine if there are other factors that reveal Swainson's Hawk differential migration, such as sex or geographic origin, and use different methodologies when exploring these questions.

Contribution:

This article gives insight into whether Swainson's Hawk bimodal migration phenology is due to age. The research advanced the knowledge of Swainson's Hawk migration in discovering that their migration phenology is not due to age class. This study contradicts previous findings in the literature since a unimodal autumn migration pattern was observed. I am including this study in my literature review because it gives me a better understanding of Swainson's Hawk migration behavior in that this species is expected to migrate bimodally in the autumn, and that this pattern is not due to age.

Bechard, M. J., Sarasola, J. H., & Woodbridge, B. (2006). A re-evaluation of evidence raises questions about the fasting migration hypothesis for Swainson's hawk (*Buteo swainsoni*). *El Hornero*, 21(2), 65-72.

Summary:

Previous literature has found that Swainson's Hawks are long-distance migrants that use techniques such as "stop-and-go" and soaring flight to travel between the pampas (grasslands) of North and South America. During migration, these hawks have been known to change from a carnivore to an insectivore diet, and tend to travel in flocks.

It has been suggested that Swainson's Hawks complete their migration by fasting, therefore, the authors sought to investigate the timing and geographic length of their migration along with changes in body mass prior to departure and after arriving on their breeding and wintering grounds. The authors captured and attached satellite transmitters (PPTs) to 34 breeding females at their nesting sites in North America to determine the length, routes, duration, and speed of migration. Between 1998 and 2001, male and female adult and juvenile hawks were captured and weighed on and between their breeding and non-breeding grounds to estimate fat stores. The study found that the southward and northward migration routes were quite similar in that they were mostly inland and avoided crossing large bodies of water. The data showed that Swainson's Hawks would have large-scale annual changes in body mass where they would lose weight during the breeding season, regain it before migration, lose it midway through migration, and gain it back after arriving in their wintering grounds. The weight of both sexes and age classes of hawks was much higher than predicted by the fasting hypothesis which suggests that they must feed during migration in 'stopover sites' to gain back fat stores. This study was significant as it was found that Swainson's Hawks do not fast during their entire migration. Future studies are needed to document the body mass of Swainson's Hawk's midway through their migration to confirm the use of stopover sites.

Contribution:

This article tested the fasting migration hypothesis in Swainson's Hawks and discovered that these hawks do not fast during their migration. Instead, they will use stopover sites in order to refuel and regain fat stores. This article contradicted previous literature in that it proved that the fasting migration hypothesis does not apply to the migration of Swainson's Hawks. I included this article in my literature review because it gave me insight into how Swainson's Hawks can migrate for long distances from North America to South America.

Littlefield, C. D., & Johnson, D. H. (2013). Migration and habitat preferences of Swainson's hawks at an autumn stopover site in Northwestern Texas. *Journal of Raptor Research*, 47(1), 54-59. <https://doi.org/10.3356/JRR-11-41.1>

Summary:

Swainson's Hawks travel 10,000 kilometers from North America's open fields to South America's agricultural areas during their southward migration in the fall. A number of recent studies indicate that these hawks temporarily stop in areas known as 'stopover sites' on the way to their non-breeding grounds. This usually occurs in September as a result of the desire to forage for food.

The authors sought to investigate the characteristics of a stopover site used by Swainson's Hawks in northwestern Texas. This involved quantifying the adult colour morphologies, number of subadults, and foraging behavior, and documenting the use of foraging habitats. The study area was southwest of Dimmitt, Texas, and comprised of 20 different habitat types, most of which were cultivated. Surveys were collected from this area between 1995 to 1999 from a vehicle that recorded the hunting behaviour, number of subadults, and colour morphs. Using the data collected from the surveys, the authors examined how much habitat the hawks used in relation to the amount of habitat that was available. The authors observed most Swainson's Hawks foraging in black-eyed pea, silage corn, plowed, herbaceous fallow, and harvested seed corn fields. The hawks were also documented using a perch-and-wait method while hunting for prey. In addition, it was found that subadults were more common earlier in the fall and there was an increase in dark morphs as autumn progressed. The authors suggest that this stopover site is likely used by hawks to replenish their fat stores for the remainder of their southward migration. This article is significant as it identified favored habitats, examined the foraging behaviour, and identified the timing of subadults and colour morphologies of Swainson's Hawks during their southward migration. The authors suggest that future studies should examine how depleting underground water sources affect Swainson's Hawk foraging habitats.

Contribution:

This article describes the type of habitats that are favoured by Swainson's Hawks at a common stopover site in northwestern Texas. From the data collected, the authors also observed that light morphs and subadults are more common earlier in the southward migration. This article contradicts previously published literature in that it suggests that these hawks migrate due to age class. I included this article in my literature review because it gave me a better understanding about the migration behaviour of Swainson's hawks, specifically about their habitat preference, colour morphs, age class migration, and hunting behavior.

Airola, D. A., Estep, J. A., Krolick, D. E., Anderson, R. L., & Peters, J. R. (2019). Wintering areas and migration characteristics of Swainson's hawks that breed in the central valley of California. *Journal of Raptor Research*, 53(3), 237-252.
<https://doi.org/10.3356/JRR-18-49>

Summary:

Populations of Swainson's Hawks in California's Central Valley are known to forage in open fields near their breeding grounds. Previous literature has found that they tend migrate to Mexico and South America after the breeding season. However, little is known about their migration routes or if they utilize stopover sites during migration.

The authors sought to investigate the migration routes, stopover sites and non-breeding grounds of the Swainson's Hawks from California's Central Valley. Swainson's Hawks were captured near their nesting sites between 2011 to 2015 and were equipped with leg bands and satellite transmitters. The transmitters recorded the locations of the hawks several times a day during the breeding and non-breeding season. It was discovered that the Central Valley Swainson's Hawks would travel to several different non-breeding locations, including Mexico, Central America and South America. Following these hawks over a few years revealed that individuals would return annually to the same non-breeding grounds. In addition, their southward and northward migration routes were fairly consistent. The hawks also varied in their departure and arrival times for the southward migration. They departed their breeding grounds between June and October and arrived to their non-breeding grounds between November and January. The authors were surprised to find that all the Central Valley hawks used at least one stopover site during their southward migration. Because of this, the authors characterized Swainson's Hawk migration as a series of rotating stopovers, with the southern most one being the longest. This article is significant as it described the location of non-breeding grounds, characterized stopover sites, and described the migration routes of the California's Central Valley Swainson's Hawks. The authors suggests that future research should focus on the conservational implications of Swainson's Hawks habitats when considering future land-use decisions.

Contribution:

This article describes the various locations Swainson's Hawks from California's Central Valley migrate to during the non-breeding season. In addition, it was discovered that these hawks will use stopover sites and take fairly consistent routes over the course of their migration. This article supports previously published literatures in that they tend to migrate to Mexico and South America after the breeding season. I included this article in my literature review because it describes the migration characteristics of a specific population of Swainson's Hawks in California.

Kochert, M. N., Fuller, M. R., Schueck, L. S., Bond, L., Bechard, M. J., Woodbridge, B., Holroyd, G. L., Martell, M. S., & Banasch, U. (2011). Migration patterns, use of stopover areas, and austral summer movements of Swainson's hawks. *Ornithological Applications*, 113(1), 89-106. <https://doi.org/10.1525/cond.2011.090243>

Summary:

Previous work has found that Swainson's Hawks migrate between their breeding grounds in North America to their wintering grounds in the grass-covered plains of Argentina. The authors sought to investigate Swainson's Hawk ecology during migration, use of stopover areas, and movements on the grounds of Argentina. 46 adult Swainson's Hawks were radio marked on the nesting grounds in seven U.S. states and two Canadian Provinces. Platform transmitter terminals (PPTs) were attached to each hawk that weighed over 900 grams with a backpack harness. Data was transmitted from July 1995 to September 1998. For the southward migration, the authors found that hawks coming from the east followed one route whereas hawks from the west followed two different routes, and they both converged their routes at east-central Mexico. Swainson's Hawks would depart from August 12 through October 9 and arrive in November and December (42-98 days). For the northward migration, hawks from the east followed similar routes back, whereas hawks from the west had variations in their routes. They would depart from mid-February through March and arrive mid-April through May (51-82 days). Other major findings included that their migration patterns did not differ by locality or sex, most hawks would stop at least once during the southward migration, and they live in clusters on their non-breeding grounds. The authors suggest that the northwards migration was faster than the south, stopover sites are used to refuel and replenish fat reserves and/or molt, and that they forage in flocks in Argentina. This study was significant because the southward and northward migration routes were characterized, the purpose of stopover areas was analyzed, and the activities of these hawks in Argentina were identified. Future studies need to address what these hawks do during stopovers and why only some make prolonged stops.

Contribution:

This article characterized stopovers, and the southward, northward, and wintering movements of the Swainson's Hawk migration. The authors assessed the dates of departure and arrival of the south and north migration and discovered that these hawks' migration patterns do not differ by locality of sex, which has important ecological implications. The author's findings also support previous literature in that Swainson's Hawks migrate between their breeding grounds in North America to their wintering grounds in Argentina. This article was included in my literature review because it describes the patterns of migration in Swainson's Hawks.

Woodbridge, B., Finley, K. K., & Seager, S. T. (1995). An investigation of the Swainson's hawk in Argentina. *Journal of Raptor Research*. 29(3), 202-204.

Summary:

Previous literature has found that Swainson's Hawks migrate to Argentina and other parts of South America after the breeding season in North America. In spite of this, little is known about the Swainson's Hawk distribution in their non-breeding grounds.

The authors sought to identify the southward migration routes of Swainson's Hawks, locate important non-breeding ground destinations, and study habitat relationships during the non-breeding season. In July 1994, two adult female Swainson's Hawks were captured at their nesting grounds in California and were fitted with satellite transmitters. In 1995, a study area with a mixture of pasture and cultivated crops were established in Argentina where many transmissions occurred. Within this area, surveys were conducted to record the location and behaviour of Swainson's hawk flocks, roost sites, and habitat. The authors found that both hawks flew from California into Arizona, through the Gulf of Mexico and Central America, and made a beeline to Brazil before crossing into Argentina. The roost sites in Argentina were in the grooves of eucalyptus trees on the edge of fields and consisted of 35-7000 individuals. Foraging groups were made of 50-1000 individuals. It was observed that most of these hawks ate grasshoppers while foraging. The authors observed that many Swainson's Hawks were found deceased after consuming a pesticide that was sprayed one month prior in nearby fields. Pesticide contamination is predicted to negatively impact Swainson's Hawks significantly in the future. At the end of the study, the authors concluded that the northern La Pampa province of Argentina is an important non-breeding season location for Swainson's Hawks to aggregate. This study is significant as it describes important features of Swainson's Hawks in their non-breeding grounds. The authors suggest that further research should focus on the development and implementation of effective conservation strategies for Swainson's Hawks.

Contribution:

This article describes the migration journey of Swainson's Hawks from California to Argentina and discovered that the province of La Pampa, Argentina was an important non-breeding season destination. This article supports previous literature in that Swainson's Hawks spend their non-breeding season in Argentina and they like to roost near open agricultural fields. I included this article in my literature review because it described important non-breeding ground characteristics of Swainson's Hawks and introduced an important cause of Swainson's Hawk mortality.

Fuller, M. R., Seegar, W. S., & Schueck, L. S. (1998). Routes and travel rates of migrating Peregrine falcons *Falco peregrinus* and Swainson's hawks *Buteo swainsoni* in the Western Hemisphere. *Journal of Avian Biology*, 29(4), 433-440. <https://doi.org/10.2307/3677162>

Summary:

Previous literature has found similarities between the Swainson's Hawk's and the Peregrine Falcon's migration patterns. For example, both large birds will migrate between North America and South America and utilize the use of stopover sites.

In this article, the authors sought to obtain location estimates of Swainson's Hawks and Peregrine Falcons in order to map migration routes and estimate distances and rates of travel. Between 1993 and 1997, individual birds were captured within their breeding range or along their migration routes across North America. They were radio-marked with satellite transmitters that were attached with a backpack harness. Rates, time, and distance traveled were collected using the Argos satellite system and were compared between the two species of birds. The study found that the southward and northward migration routes of Swainson's hawks were entirely inland whereas Peregrine Falcons were both coastal and inland. While observing the data from the full migration, it was found that both birds started and finished their migration at slower rates than was traveled during the middle portion of their migration. In addition, Peregrine Falcons were found to begin their migration at a faster rate than Swainson's Hawks. However, it was found that Swainson's Hawks would increase their speed to match that of the Peregrine Falcons in the middle of the migration. It was observed from the complete migration map of the location estimates that Peregrine Falcons followed a wide range of routes to South America while Swainson's Hawks would follow a broad range of routes that eventually converged together. This study was significant as it compared the migration movements and patterns of Swainson's Hawks and Peregrine Falcons. The authors suggest that future studies are needed to document the migratory movements of hatchling year birds to describe the Swainson's Hawk's and Peregrine Falcon's optimal migration patterns.

Contribution:

This article described the similarities and differences between the migration patterns of Swainson's Hawks and Peregrine Falcons. Overall, this article supports the findings in previous literature in that Swainson's Hawks and Peregrine Falcons both travel from North America to South America after the breeding season. I included this article in my literature review because I was able to compare the migration patterns and characteristics of Swainson's Hawks to a species of large migratory bird that has a similar migratory route.