What’s swallowing up the birds? Tracking swallow (family *Hirundinidae*) population declines in Ontario

Introduction

Swallow populations are declining. Like many other aerial insectivores (birds that make a living through capturing insect prey in flight), they have been declining over the past few decades. [insert stats for various species] occurring in North America and Europe. common environmental cause for decline?

There are some broad causes of mortality for all birds (cats, collisions with windows, roads Kociolek et al 2011, noise pollution Leonard et al 2015.), but there is no reason why these should affect swallows more than any other family. So why are swallows more vulnerable than other birds? Long migration crossing many countries from Argentina to Panama to Canada (conservation is an international effort).

This has been concerning many scientists, and these declines have led to a flurry of research on the causes of this decline. As well, these declines have led to many citizen science initiatives that are trying to restore populations through diligent bird surveys, nest monitoring efforts, the preservation of bird habitat, and installation of artificial bird boxes. In Canada, this has led to the recent assignment of Barn Swallows (and Purple Martins) to the species at risk. However, the causes of the decline of swallows and other aerial insectivores remain a real mystery.

In this study, we used route survey data from 1967 to 2016 from the Breeding Bird Survey to ask whether six species of swallows are exhibiting population declines in Ontario as well as at what rate. In addition, we investigated the potential causes of the decline including the impact of local weather and levels of traffic (a proxy for anthropogenic activity).

Methods

Discussion

Limitations of our study:

Routes not consistent year to year

Limitations of studying swallows in general:

Swallows have huge migrations spanning the entire western hemisphere. Typical individuals migrate thousands of kilometres every year. During a typical swallow’s lifetime, it will encounter a variety of habitats, make use of various insect prey, and experience all sorts of local weather events on its breeding grounds, wintering grounds, or migration stops. If food availability, habitat availability, or abiotic factors have anything to do with their decline at any point during their lifespan, this makes it difficult to pinpoint the exact causes of their decline.

Still lots unknown about their exact migration routes and where they stop during migration

Still lots unknown about where they winter and what the quality of that habitat is

Not many studies using trackers yet, motus technology is still pretty new

Hard to test effects of insect populations of swallows – examining stomach contents is pretty hard

Other questions to explore:

Do weather/insect populations/anthropogenic activity on breeding grounds affect breeding success?

Does habitat quality on wintering grounds affect survival rates of swallows? i.e. human disturbance, habitat destruction, use of harmful pesticides. Laws more relaxed in those countries

Does habitat quality on migration affect survival rates of swallows?

Where do swallows migrate? 🡪 use new innovative tracking techniques like motus

With BBS data: Are swallows declining in some regions faster than others? Could use BBS data to measure rates of decline by state/province

It is important to find out the cause of this decline. It is not only a matter of losing these beautiful birds – but they are also an indicator species. We need to get to the bottom of the decline because they may be warning us about something important!

Literature cited

Cox AR, Robertson RJ, Fedy BC, Rendell WB, Bonier F. 2018. Demographic drivers of local population decline in Tree Swallows (*Tachycineta bicolor*) in Ontario, Canada. *The Condor* 120(4): 842-851.

Bellavance V, Bélisle M, Savage J, Pelletier F, Garanta D. 2018. Influence of agricultural intensification on prey availability and nestling diet in Tree Swallows (*Tachycineta bicolor*). *Canadian Journal of Zoology* 96(9): 1053-1065.

Smith AC, Hudson MAR, Downes CM, Francis CM. 2015. Change Points in the Population Trends of Aerial-Insectivorous Birds in North America: Synchronized in Time across Species and Regions. *PLOS ONE* 10(7).

Sicurella B, Musitelli F, Rubolini D, Saino N, Ambrosini R. 2016. Environmental conditions at arrival to the wintering grounds and during spring migration affect population dynamics of barn swallows *Hirundo rustica* breeding in Northern Italy. *Pop Ecol* 58(1): 135-145.

Turcotte A, Belisle M, Pelletier F, Garant D. 2018. Environmental determinants of haemosporidian parasite prevalence in a declining population of Tree swallows. *Parasitology* 145(7): 961-970.

Imlay TL, Flemming JM, Saldanha S, Wheelwright NT, Leonard ML. 2018. Breeding phenology and performance for four swallows over 57 years: relationships with temperature and precipitation. *Ecosphere* 9(4).

Irons RD, Scurr AH, Rose AP, Hagelin JC, Blake T, Doak DF. 2017. Wind and rain are the primary climate factors driving changing phenology of an aerial insectivore. *Proceedings of the Royal Society B-Biological Sciences* 284(1853).

McArthur SL, McKellar AE, Flood NJ, Reudink MW. Local weather and regional climate influence breeding dynamics of Mountain Bluebirds (*Sialia currucoides*) and Tree Swallows (*Tachycineta bicolor*): a 35-year study. *Canadian Journal of Zoology* 95(4): 271-277.

Stanton RL, Morrissey CA, Clark RG. 2016. Tree Swallow (*Tachycineta bicolor*) foraging responses to agricultural land use and abundance of insect prey. *Canadian Journal of Zoology* 94(9): 637-642.

Paquette SR, Pelletier F, Garant D, Belisle M. 2014. Severe recent decrease of adult body mass in a declining insectivorous bird population. *Proceedings of the Royal Society B-Biological Sciences* 281(1786).

Michel NL, Smith AC, Clark RG, Morrissey CA, Hobson KA. 2016. Differences in spatial synchrony and interspecific concordance inform guild-level population trends for aerial insectivorous birds. *Ecography* 39(8): 774-786.

Sockman J, Courter J. 2018. The Impacts of Temperature, Precipitation, and Growing Degree-Days on First Egg Dates of Eastern Bluebird (Sialia sialis) and Tree Swallow (Tachycineta bicolor) in Ohio. *The American Midland Naturalist* 180(2): 207.

Leonard ML, Horn AG, Oswald KN, McIntyre E. 2015. Effect of ambient noise on parent–offspring interactions in tree swallows*. Animal Behaviour* 109(1): 1-7.

A. V. KOCIOLEK A. P. CLEVENGER C. C. ST. CLAIR D. S. PROPPE. 2011. Effects of Road Networks on Bird Populations.

Weegman MD, Arnold TW, Dawson RD, Winkler DW, Clark RG. Integrated population models reveal local weather conditions are the key drivers of population dynamics in an aerial insectivore. Oecologia 185:119–130.

Saino N, Romano M, Caprioli M, Ambrosini R, Rubolini D, Scandolara C, Romano A. 2012. A ptilochronological study of carry‐over effects of conditions during wintering on breeding performance in the barn swallow *Hirundo rustica*. Journal of Avian Biology

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|  | YES | NO(ish) | INCONCLUSIVE |
| Fledgling success | Overwinter survival and fledgling success are most sensitive demographic parameters that contribute to swallow population trends (Cox et al. 2018) | “Our results suggest that in this region [Maritime Canada] poorer breeding performance could contribute to population declines for Bank Swallows but not for the other three species.” (Imlay et al. 2018) |  |
| Decrease in preferred food (due to agriculture on breeding grounds) | Prey selection is altered by agricultural intensification (Bellevance et al. 2018) |  | “Foraging rates (number of nest visits/h) were slightly higher on agricultural sites than at grassland sites, and were positively related to daily insect biomass and nestling age. Tree Swallows, especially males, breeding at agricultural sites spent more time away from the nest box, presumably foraging, resulting in reduced nest attentiveness.” (Stanton et al. 2016). – but there is no evidence here to show that there was actually reduced fledgling success or that foraging rate is a good proxy for food availability |
| Wintering grounds | “critical periods during wintering and migration that may have large impact on population fluctuations of migrant birds” (Sicurella et al. 2016)  Overwinter survival and fledgling success must increase (Cox et al. 2018)  Africa wintering grounds (Saino et al. 2012) |  |  |
| Migration | “critical periods during wintering and migration that may have large impact on population fluctuations of migrant birds” (Sicurella et al. 2016) |  |  |
| Weather | “Tree Swallow reproduction (clutch size, number of nestlings, and number of fledglings) was negatively associated with SOI [Southern Oscillation Index] values, and the number of Tree Swallow nestlings decreased in years of higher rainfall and warmer temperatures. Tree Swallows also showed a marked decline in abundance over the period of the study, consistent with recent range-wide declines.” (McArthur et al. 2017).  “local more than  continental weather drives the population dynamics of this  species and, therefore, demographic synchrony measured at  three sites was limited.” Tree swallow (Weegman et al. 2017) | “On the breeding grounds, warmer winter temperatures for Tree Swallows and less winter precipitation for Barn and Tree Swallows in a given year were associated with earlier breeding, and for Tree Swallows, changes in nestling survival. Otherwise, Barn and Tree Swallow breeding performance was unaffected by winter temperature and precipitation.” (Imlay et al. 2018) | Wind and rain appear to be the primary factors affecting the timing of breeding in Alaska. “Overall, adverse spring climate conditions known to negatively impact foraging success of swallows (wet, windy weather) appear to influence breeding phenology more than variation in temperature” (Irons et al. 2017). However, this tells us nothing about the actual impact on survival/reproduction.  “Tree Swallow first egg dates were later in wetter springs (P < 0.001). Spring temperature did not impact the first egg dales of Tree Swallows (P = 0.89).” (Sockman and Courtier 2018) Same as above. |
| Parasites on breeding grounds |  | Parasites associated with human-modified landscapes have been proposed to contribute to swallow declines (Turcotte et al. 2018), but they occur at such low prevalence that this seems like an unlikely cause |  |

Other

* Swallows appear to have been declining since the 1980s. temporal synchrony in population declines for aerial insectivores (flycatchers, nightjars, swallows, swifts) suggests that there is a likely common environmental factor(s) common affecting population trends for all species in the group (Smith et al. 2015)
* Multiple factors and spatiotemporal synchrony on smaller scales: “The extensive within-species synchrony and limited concordance suggest that population trajectories of these aerial insectivores are responding to large-scale but complex and species-and region-specific environmental conditions (e.g. climate, land use). A single driver of trends for aerial insectivores as a guild appears unlikely.” (Michel et al. 2016)
* Complex factors: “Migratory bird species that feed on air-borne insects are experiencing widespread regional declines, but these remain poorly understood. Agricultural intensification in the breeding range is often regarded as one of the main drivers of these declines. Here, we tested the hypothesis that body mass in breeding individuals should reflect habitat quality in an aerial insectivore, the tree swallow (Tachycineta bicolor), along a gradient of agricultural intensity. Our dataset was collected over 7 years (2005-2011) and included 2918 swallow captures and 1483 broods. Analyses revealed a substantial decline of the population over the course of the study (-19% occupancy rate), mirrored by decreasing body mass. This trend was especially severe in females, representing a total loss of 8% of their mass. Reproductive success was negatively influenced by intensive agriculture, but did not decrease over time. Interestingly, variation in body mass was independent of breeding habitat quality, leading us to suggest that this decline in body mass may result from carry-over effects from non-breeding areas and affect population dynamics through reduced survival. This work contributes to the growing body of evidence suggesting that declines in migratory aerial insectivores are driven by multiple, complex factors requiring better knowledge of year-round habitat use.” (Paquette et al. 2014)
* “A primary concern associated will) changes in nesting phenology is the potential for ecological asynchrony, whereby avian lifecycle events become out of sync with food resources, potentially leading to avian population declines and decreased opportunities for some birds to suppress pests in agroecosystems.” (Sockman and Courter 2018).