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WHERE HAVE ALL THE SWALLOWS GONE[1]?

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Over the past 40 years, Breeding Bird Surveys (BBS) have documented severe and widespread declines among species of aerial insectivores, i.e., birds that feed in flight on flying insects (Nebel *et al*. 2010, Michel *et al*. 2015, Smith *et al*. 2015). These declines are greater in northeastern North America, including the Maritimes, and for birds that migrate greater distance, i.e., over-wintering in South America (Nebel *et al*. 2010). Interestingly, BBS data also show a common negative change point in population trends that occurred in the mid-1980s; this suggests a large-scale environmental change that is impacting all aerial insectivores (Smith *et al*. 2015). The cause of declines in aerial insectivores is presently unknown. However, two likely drivers are changes in the availability of aerial insects during the breeding season, and/or changes in conditions on the wintering grounds and migration routes (Nebel *et al*. 2010, Shutler *et al*. 2012). To impact populations, these potential drivers must either result in lower reproductive success and/or reduced survival. My work focuses on understanding how these potential drivers are impacting populations of Bank (*Riparia riparia*), Barn (*Hirundo rustica*), Cliff (*Petrochelidon pyrrhonota*) and Tree (*Tachycineta bicolor*) Swallows that breed in the Maritimes (Fig 1).

First, I focused on the relationships between aerial insect abundance and swallow breeding success. Insect abundance when Cliff and Tree Swallows were raising young was higher for pairs that nested earlier in the spring than those that bred later. This raised the possibility that early breeding birds could capitalize on higher insect abundance by raising young that had a larger body mass or higher survival. However, no relationships between nestling body mass or survival and insect abundance was found. Although these results do not support insect abundance as a driver of population declines for

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[1] This article briefly introduces the upcoming talk to be given at the Annual General Meeting of the NSIS, May, 2017.

Fig 1 **1. Just hatched Tree Swallow nestlings. 2. Begging Barn Swallow nestlings. 3. Adult Cliff Swallow in-hand.**

swallows in the Maritimes, it is possible that historical, rather than current, levels of insect abundance have impacted their populations.

Using data largely from the volunteer Maritimes Nest Records Scheme, I then determined if there were changes in the timing of breeding or success of each of the four species since 1960. During this 57-year span, first egg dates for Barn, Cliff and Tree Swallows advanced by 8-10 days, whereas first egg dates for Bank Swallows remained the same. Changes in breeding success varied

Fig 1 (cont'd) 4. Adult Tree Swallow sitting on a nest box.

considerably by species. In recent years, Bank Swallows have lower success and Tree Swallows have slightly higher success. Success for Barn and Cliff Swallows was largely unchanged. These results suggest that insect abundance may be impacting Bank Swallow populations through lower reproductive success, but there is little support for insect abundance driving Barn, Cliff and Tree Swallows population declines in the Maritimes.

Next, I focused on wintering ground conditions as a potential driver of population declines. Wintering regions were identified through a stable isotope analysis from feather samples. I compared individual levels of corticosterone, a stress hormone, between wintering regions to determine if there was a 'hotspot' where swallows were experiencing greater stress. There was no relationship between wintering region and corticosterone levels. This result may be due to the coarse scale of wintering regions, i.e., birds within each region are unlikely to use the whole area. It is also possible that no single wintering region is driving population declines, and that birds wintering in different areas are all experiencing poor conditions. Future work on the potential impact of wintering ground conditions will examine relationships between wintering locations and telomere length (a region of repetitive nucleotide sequences at each end of a chromosome – another indicator of stress), and the survival and subsequent reproductive success of swallows that winter in different areas.

From this research, it appears that there are at least some species-specific drivers of population declines for swallows, and possibly for aerial insectivores in general. For example, of the four species of swallows examined, only Bank Swallows are experiencing reduced breeding success in recent years. Recovery efforts directed at halting population declines will be more challenging if different approaches are required for each species.

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