Are Aerial Insectivores Being 'Bugged Out'?

Barn Swallow/Hirondelle rustique Photo: David Hemmings

Special Feature by Jon McCracken

To help identify mechanisms that drive bird population changes, biologists often look for common patterns that occur across entire 'guilds' of bird species. A guild is a grouping of species sharing a common life-history trait, even though the species themselves may not be closely related. There are dozens of guilds that could be classified according to such things as habitat type, food, migration strategy, and nesting strategy. The guild of 'aerial insectivores' – birds that specialize on feeding on flying insects – includes Whip-poor-wills, nighthawks, swifts, swallows, martins, and flycatchers.

Early results from the second Ontario Breeding Bird Atlas indicated some startling declines and even range contractions for this guild. Now that the 2001-2005 Ontario Atlas is complete, the plight of aerial insectivores is gaining increasing attention. The patterns of decline are mirrored very closely by the Breeding Bird Survey, not only in Ontario, but also across much of North America. Early results from the second Maritimes Breeding Bird Atlas and data from the recently completed second New York State Atlas also point to similar patterns.

The magnitude of the declines, especially within the past 20 years or so, is alarming (see Table 1). The proverbial clock may well be ticking down on many common species of aerial insectivores in Canada. In the last two decades alone, populations have fallen by over 70% in the case of Bank Swallow, Common Nighthawk, Chimney Swift, and Barn Swallow, and by over 50% for Cliff Swallow, Olive-sided Flycatcher, Eastern Wood-Pewee, Northern Rough-winged Swallow, Eastern Kingbird, and Purple Martin. Declines have been so severe that Chimney Swift, Common Nighthawk, and Olive-sided Flycatcher were recently designated as nationally Threatened species. Barn Swallow, Bank Swallow, and Eastern Wood-Pewee may not be far behind. For these and other aerial insectivores, the trend signals are getting stronger and more compelling. Some examples of the patterns for species with the strongest declines are presented in Figure 1 (page 6).

Common Nighthawk/Engoulevent d'Amérique Photo: Harold Stiver

Bank Swallow/Hirondelle de rivage Photo: David Hemmings

Evidence suggests that the declines are more pronounced to the north and east. Stronger declines have been detected in Canada than in the U.S., and declines tend to be stronger in eastern North America than in the west. Investigating such geographic patterns may provide insight into the underlying causes.

Some Probable Limiting Factors

The declines are likely influenced by multiple causes, depending on the species being examined. For example, changes in the availability of nest sites helps explain, at least in part, declines of some species. Loss of artificial nesting substrates (open chimneys, wooden barns, gravel rooftops) can be linked to declines of Chimney Swift, Barn Swallow, and probably Common Nighthawk, but this does not appear to explain why declines of these species should be more pronounced in Canada than in the U.S. Moreover, if loss of artificial nesting sites was a primary factor, one would expect that Tree Swallow and Purple Martin populations should be relatively healthy as a result of widespread nest box programs, but they too are declining. Likewise, forest species such as Eastern Wood-Pewee, Olive-sided Flycatcher, Great Crested Flycatcher, and Whip-poor-will, which have no reliance on artificial structures for nesting, are declining nonetheless.

Habitat changes across the landscape also play a role. Several species (swallows, martins, Eastern Kingbird) are strongly associated with open country habitats that have been declining in some parts of eastern Canada, owing to retirement of non-productive farmlands that have since been reverting back to forest. However, once again, this cannot explain population declines of the many species of aerial insectivores that occur in forested habitat.

Eastern Kingbird/Tyran tritri Photo: David Hemmings

Because changes in nest site availability and foraging habitat can only be part of the picture, it is worth examining the one common feature shared by all species in the guild – their reliance on flying insects as an essential food source. No large-scale programs are in place to monitor population levels of aerial insects, and we know t the exceptionally little about their population dynamics or trends. Still, there is growing concern among entomologists and others that aerial insects, including pollinators such as bees, wasps, butterflies, and moths, are in decline. Concern is also being expressed about the status of bat populations, which also specialize on flying insects.

Table 1. Average annual percentage population trends of aerial insectivores in Canada for different time periods according to the Breeding Bird Survey. Values in red represent statistically significant declines; values in green are statistically significant increases. Species are listed in order of greatest long-term decline.

Tableau 1. Pourcentages annuels moyens des variations des populations d'insectivores aériens du Canada au cours de diverses périodes selon les résultats du Relevé des oiseaux nicheurs. Les valeurs en rouge et en vert correspondent respectivement à des diminutions et à des augmentations statistiquement significatives. Les espèces sont présentées par ordre décroissant de diminution à long terme des populations.

Species/Espèces	Long-term Average Annual % Trends/ Pourcentages annuels moyens des variations à long terme (1968-2006)	Recent Average Annual % Trends/ Pourcentages moyens des variations récentes (1986-2006)
Chimney Swift/Martinet ramoneur	-8.4	-7.2
Eastern Wood-Pewee/Pioui de l'Est	-4.7	-4.9
Bank Swallow/Pioui de l'Est	-4.6	-7.5
Common Nighthawk/Engoulevent d'Amérique	-4.4	-7.5
Olive-sided Flycatcher/Moucherolle à côtés olive	-4.0	-5.3
Barn Swallow/Hirondelle rustique	-3.3	-6.1
Whip-poor-will/Engoulevent bois-pourri	-3.3	-0.9
Eastern Kingbird/Tyran tritri	-2.0	-4.3
N. Rough-winged Swallow/Hirondelle à ailes hérissées	-1.8	-5.2
Cliff Swallow/Hirondelle à front blanc	-1.3	-5.7
Purple Martin/Hirondelle noire	-1.3	-4.0
Great Crested Flycatcher/Tyran huppé	-1.2	-2.3
Eastern Phoebe/Moucherolle phébi	-1.0	-1.5
Tree Swallow/Hirondelle bicolore	-0.9	-2.5
Least Flycatcher/Moucherolle tchébec	-0.7	-2.2
Yellow-bellied Flycatcher/Moucherolle à ventre jaune	-0.4	-0.9
Alder Flycatcher/Moucherolle des aulnes	0.0	-1.1
Willow Flycatcher/Moucherolle des saules	2.1	-0.9

The overall abundance of aerial insects may be declining, and at the same time, latitudinal and/or longitudinal shifts may be occurring in the geographic ranges occupied by particular kinds of insects. Or perhaps the peak timing of seasonal emergence of some insects is changing, possibly in response to climate change. There could even be vertical changes happening to some insect populations occupying discrete altitudinal bands of airspace.

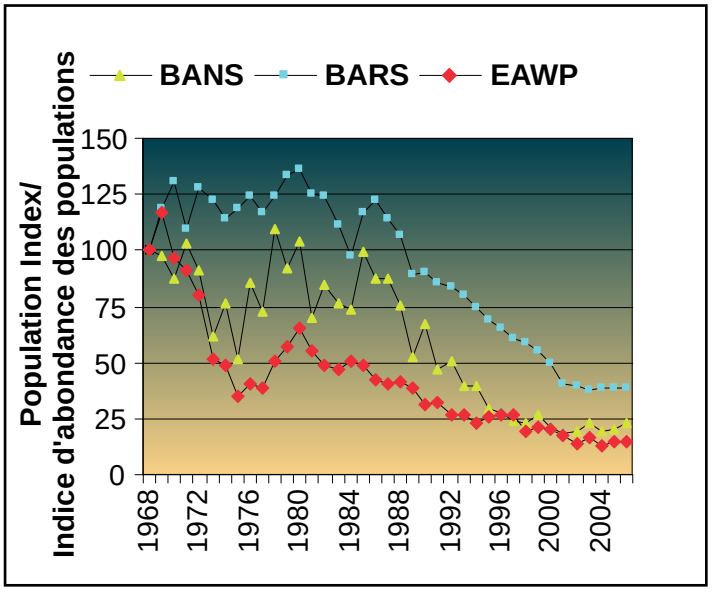
A variety of things could be acting to diminish populations of flying insects, and some more so than others, depending on the species involved. For example, nocturnal species are sensitive to light pollution. Artificial lights at night disrupt insect behaviour, which could result in population level effects. For light-sensitive species, life is too short to spend even a few nights whirling aimlessly around a street lamp.

Many kinds of flying insects have an aquatic stage that is very sensitive to changes in aquatic conditions. Marked increases in ultra-violet radiation, large fluctuations in water temperature, increased acidification, marked changes in stream flow, increased water turbidity, and pesticide runoff from surrounding upland areas can have significant deleterious effects on their populations.

Most insects are also sensitive to climatic variation, especially temperature and precipitation extremes. For many species, seasonal patterns of insect emergence or 'hatches' occur within particular climatic thresholds. Even short-term perturbations in climate could significantly affect the seasonal timing of insect availability. If these thresholds shift to earlier or later dates or become less predictable, how will this affect bird species that have evolved to time their life-history schedules to coincide with the expected availability of food resources? If these events become out-of-phase, population level effects on aerial insectivores could be expected.

Of all the factors that could be affecting insect populations, perhaps the most obvious is the exceptionally widespread use of pesticides across the modern agricultural landscape. After all, these agents are specifically designed to control insect populations. It is reasonable to think that their application could have a cumulative population-level effect across broad geographic regions.

All told, there is good reason to suspect that insect populations are changing.



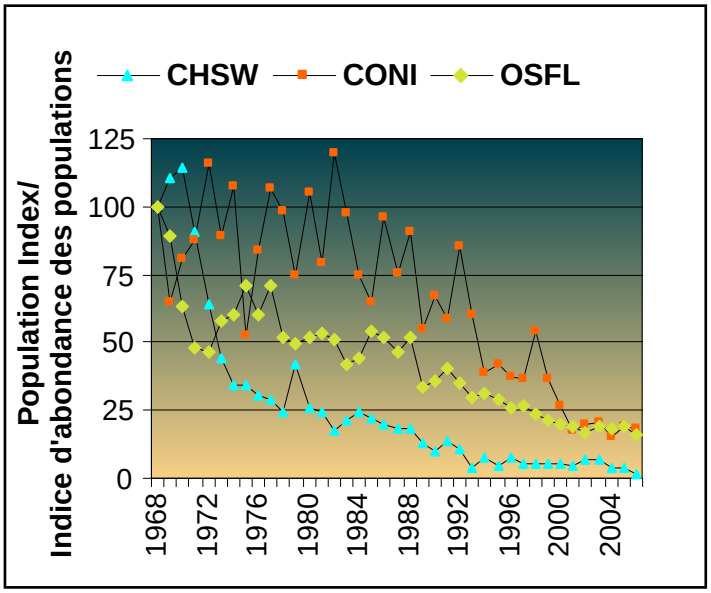


Figure 1. Annual patterns of population change for six species of severely-declining aerial insectivores in Canada, based upon results from the Breeding Bird Survey (1968-2006). Species codes are as follows: CHSW (Chimney Swift); CONI (Common Nighthawk); OSFL (Olive-sided Flycatcher); BANS (Bank Swallow); BARS (Barn Swallow); EAWP (Eastern Wood-Pewee).

Figure 1. Tendances annuelles des variations des populations de six espèces d'insectivores aériens du Canada affichant d'importants déclins selon les résultats du Relevé des oiseaux nicheurs de 1968 à 2006. Les codes correspondant aux espèces sont les suivants : CHSW (Martinet ramoneur), CONI (Engoulevent d'Amérique), OSFL (Moucherolle à côtés olive), BANS (Hirondelle de rivage), BARS (Hirondelle rustique), EAWP (Pioui de l'Est).

Insects as 'Aerial Plankton'

Though there is plenty of overlap in diet, each bird species exploits somewhat different food resources in different ways. In the aerial insectivore foraging guild, there are *hawkers*, such as swifts, nighthawks, swallows, and martins, which remain aloft to feed. Then there are *salliers*, such as flycatchers, which typically have a wait-and-see approach to foraging. Within any given zone of air space over any given habitat, the species composition and abundance of insect prey varies with time of day, season, and weather conditions.

It is important to remember that far from our earthbound field of vision, there is a whole airborne 'ocean' of insects flying around above us. Ranging from nearly ground level to heights of several hundred metres, this 'aerial plankton' is a critical food resource for aerial insectivores. Species differences in foraging height could well be an important consideration.

Above about 20 metres, high-flying hawkers, like swifts and nighthawks, feast on high-altitude 'plankton.' Meanwhile, the Purple Martin is a mid-level hawker that forages mostly above 10 metres, but also often enters the air space of the high hawkers. The generalist hawkers (swallows) cruise all air spaces – high, medium, and low. The salliers, likewise, divvy up vertical air space. None of them forage much above about 20 metres, but forest-dwelling species (Olive-sided Flycatcher, Eastern Wood-Pewee, Least Flycatcher, Great Crested Flycatcher) feed mainly at moderate heights of about 5-15 metres. Eastern Kingbird forages within this height range too, but also feeds right down to ground level. Others (Yellow-bellied, Alder, and Willow flycatcher; phoebes) are strictly low-altitude foragers and seldom feed at heights more than three metres.

Interestingly, preliminary examination suggests that species that forage within moderate to high strata are declining most strongly. Those that forage exclusively at heights less than about three metres tend to be faring much better. Amongst the myriad of factors that may be working to reduce populations of aerial foragers, there is merit in thinking vertically as well as laterally.

What the Future Holds

Without solid insights into the mechanisms that are driving population changes, it is difficult to imagine how the current decline of aerial insectivores can be forestalled, let alone reversed. There is also increasing urgency. Although population levels of most of the affected bird species are still sufficiently large enough to allow meaningful scientific studies to be carried out, population trajectories suggest that sample sizes will be much reduced over the next decade or two. To come up with the answers in time, a massive research effort should be considered.

Purple Martin/Hirondelle noire Photo: David Hemmings

If we find compelling evidence that the aerial insectivore guild is indeed being 'bugged out' owing to changes in food supply, there are potentially very large ecological and socio-economic ramifications, particularly if pollinators are part of the picture. All in all, the plight of aerial insectivores is not only food for thought, but a call to action.

Les études révèlent des réductions alarmantes des populations d'insectivores aériens

Le terme « insectivores aériens » désignent les oiseaux qui s'alimentent exclusivement d'insectes en vol. Parmi les oiseaux caractérisés par ces habitudes alimentaires spécialisées, mentionnons les Martinets, les Engoulevents bois-pourri, les Hirondelles et les Moucherolles.

La version de l'Atlas des oiseaux nicheurs de l'Ontario qui vient de paraître fait état de diminutions alarmantes des populations d'insectivores aériens et même du rétrécissement des aires de répartition de ces espèces. Les résultats du Relevé des oiseaux nicheurs dans une grande partie de l'Amérique du Nord, l'atlas de l'état de New York qui vient d'être publié et les résultats préliminaires de la seconde version de l'Atlas des oiseaux nicheurs des Maritimes mettent également en évidence des tendances fortement similaires.

Le Martinet ramoneur, l'Engoulevent d'Amérique et le Moucherolle à côtés olive ont récemment été classés parmi les espèces menacées au Canada. L'Hirondelle rustique et le Pioui de l'Est sont susceptibles d'être classés sous peu dans l'une des catégories d'espèces « en péril ». Dans l'Est du pays, on observe également une diminution des populations de la plupart des autres espèces d'oiseaux s'alimentant en vol (voir le tableau 1, page 5).

Pourquoi ces populations d'insectivores aériens diminuent-elles? Divers facteurs variant selon l'espèce particulière à l'étude sont sans doute à l'origine de cette situation.

La disponibilité des lieux de nidification et les changements dans les habitats sont des causes possibles, quoique ces phénomènes n'expliquent que partiellement les enjeux. Le déclin des populations de Martinets ramoneurs, d'Hirondelles rustiques et d'Engoulevents d'Amérique est peut-être dû à la perte de structures artificielles servant à la nidification (cheminées ouvertes, granges en bois, toits en gravier). Certaines espèces (l'Hirondelle et le Tyran tritri) sont étroitement associées aux habitats en terrain dégagé, dont le nombre diminue dans certaines parties de l'Est canadien.

La disponibilité de la nourriture représente un facteur limitatif majeur. Même si tous les insectivores aériens s'alimentent d'insectes en vol, il n'existe cependant aucun programme généralisé visant à surveiller l'effectif ou la dynamique des populations de ces proies. On s'inquiète de plus en plus du fait que le nombre d'insectes aériens, dont celui des pollinisateurs comme les abeilles, les guêpes, les papillons de jour et de nuit ainsi que des milliers d'autres diminuent. En outre, l'état des populations de chauves-souris, qui se nourrissent aussi d'insectes aériens, suscite aussi des préoccupations grandissantes.

Tree Swallow/Hirondelle bicolore Photo: David Hemmings

Divers facteurs sont susceptibles d'intervenir dans la réduction des populations de ces insectes. Durant la nuit, bon nombre d'espèces d'insectes aériens nocturnes sont sensibles à la pollution lumineuse dans les milieux dominés par l'être humain. Les changements climatiques, en particulier en ce qui concerne la température et les précipitations, peuvent influer sur le nombre d'insectes aériens disponibles et le moment de leur disponibilité. Les nombreux insectes aériens dont le cycle de vie est caractérisé par un stade aquatique risquent d'être perturbés par les changements dans les milieux humides. Enfin, l'emploi à grande échelle de pesticides a des effets généralisés sur l'effectif des populations d'insectes aériens.

Il existe un véritable « océan » d'insectes dans l'atmosphère au-dessus de nous. Ces couches de « plancton aérien », dont la hauteur peut atteindre jusqu'à plusieurs centaines de mètres, représentent une source de nourriture essentielle de nombreux insectivores aériens. Parmi ces derniers, diverses espèces affectionnent des hauteurs particulières. Le type, la taille et l'abondance des espèces d'insectes proies diffèrent selon l'habitat et la hauteur fréquentée dans l'atmosphère. Chaque espèce d'insectivores aériens exploite des couches distinctes, bien qu'on observe des chevauchements. D'après les résultats préliminaires, la hauteur à laquelle se fait la quête de nourriture constitue un facteur important. Les déclins les plus marqués sont observés chez les espèces s'alimentant d'insectes à des hauteurs modérées à élevées alors que les populations se nourrissant exclusivement à des hauteurs inférieures à environ trois mètres (Moucherolle phébi, Moucherolle à ventre jaune, Moucherolle des aulnes et Moucherolle des saules) tendent à nettement mieux se porter.

Des études scientifiques probantes doivent être amorcées dans les meilleurs délais afin d'empêcher toute diminution supplémentaire des populations d'insectivores aériens et de veiller à leur rétablissement. Toutes ces espèces sont encore assez nombreuses pour permettre d'en prélever des échantillons représentatifs. Toutefois, si le rythme actuel du déclin se maintient, la taille des échantillons diminuera de façon considérable au cours des dix à vingt prochaines années. Il faut donc agir sans plus tarder. La situation exige un programme de recherche de très grande envergure. Nous pourrions tout d'abord mettre à profit les atlas, les Relevés des oiseaux nicheurs et les dossiers de surveillance des oiseaux migrateurs auxquelles nous avons déjà accès, lesquels constituent en soi d'immenses bases de données.

Si l'on se rend compte que le déclin des populations d'insectivores aériens est dû à la disponibilité réduite des proies, il faudra alors se pencher sur les graves ramifications écologiques et socio-économiques que cela entraînera, tout particulièrement si les pollinisateurs sont atteints. Il s'agit certes d'un défi qui donne à réfléchir.