THE EARLY BIRD GETS THE WORM: THE EFFECTS OF WARMING TEMPERATURES ON MIGRATION TIMING IN AVIAN SPECIES
Humans, birds and other animals share similarities in regards to their anatomy and physiology. In an ever changing world with rising temperatures (ie. global warming), extreme weather and long-term droughts, one question that remains is are animals capable of adapting quick enough? Unfortunately, the effects and fate of global warming on the events and cycles of avian communities remains poorly understood. Over the last century, a global rise in temperature of 0.3–0.6°C has occurred (Houghton et al. 1995, 1996). 2011 even marked the ninth warmest year for global surface temperatures since 1880 (Hansen et al. 1996)(Fig.1). Birds are known to be an indicator species of global warming, as they react to weather and climate changes (Wormworth and Mallon 2006).

A multitude of avian species seem to be responding to the warming temperature trends as observed by Jenni and Kéry (2003) in a study that investigated the variations in timing of autumn migration in birds through Western Europe using a 42-year data set. They found that migratory birds in the south of the Sahara have progressed in recent years, presumably due to the pressures of crossing the Sahel desert before the seasonal dry stage (Jenni and Kéry 2003). When droughts or rising temperatures occur, this puts additional stresses on the birds and the pockets of habitats they depend on, thus causing a physiological response.

Birds have a behaviour response or an annual “body clock” (Elphick 2007) that help them respond to an optimal time to undergo their grand migration journeys. It is still unclear if circannual rhythms are changed by times of rain or unusual temperatures, but the birds’ behaviour may be modified by such factors. For example, during a warm spring season, a bird may breed a week or 10 days earlier than in years when temperatures were normal (Elphick 2007).

The successful spring arrival of migratory birds on their breeding grounds is very important because this is a crucial time for claiming territories and mate selection, which also
directly affects breeding success (DEFRA 2005). Three studies found data that 26-72 percent of migrants’ arrival dates had progressed two weeks sooner compared to the past two to three decades (DEFRA 2005). Additionally, throughout Eurasia more than 24 studies have shown that near the end of the 20th century, with the rise of global warming, birds were arriving on average 3.73 days earlier per decade (Lehikoinen et al. 2004).

A study in 2015 at Delta Marsh, Manitoba looked at a 63-year-old migrant data set where out of 96 species, 27 species significantly altered their arrival date and in conjunction with most other species. Whereas only two species, Greater Yellowlegs (Tringa melanoleuca) and Lesser Yellowlegs (T. flavipes), arrived later over time and were found to have no relation to temperature (Murphy-Klassen et al. 2005). The order Anseriformes (waterfowl species) especially were found to be affected by warming trends, probably due to their habitat in temperate areas where warming is more prominent (Murphy-Klassen et al. 2005). The variation of early arrivals regarding breeding bids showed only slightly higher proportions vs. non-breeding bird orders (Murphy-Klassen et al. 2005)(Table 1). In fact, they found that the trends and early arrival dates demonstrated a correlation that local global warming has influenced several avian species in Manitoba and their spring migration dates (Murphy-Klassen et al. 2005).

For centuries, the arrival of the American Robin (Turdus migratorius) has symbolized the arrival of spring. It can take this bird up to 11 weeks to make their 3,000 mile migration from Iowa to Alaska (Elphick 2007). A study over a 20-year period concluded that T. migratorius arrived 5.4 days earlier at their breeding grounds in Colorado and 7 days earlier in Michigan (Inouye et al. 2000)(Fig. 2). An even more distinct change was during the same period at Delta Marsh, T. migratorius arrived 15.9 days earlier (Murphy-Klassen et al. 2005). Interestingly, T. migratorius showed a trend of early arrival at higher altitudes in Colorado, thus implying that
vegetation characteristics may not to be as important as temperature changes in predicting timing of migration events (Inouye et al. 2000).

Arctic peregrine falcons (Falco peregrinus tundrius) are an endangered species with limited northern breeding distribution, which includes reserves in Alaska, USA (U.S. Fish and Wildlife Services 2006; Bruggeman et al. 2015). Their arrival and apparent survival rates were higher in years that had earlier snowmelt and warmer winters (Bruggeman et al. 2015). Therefore, implying that early migration arrival dates are correlated with rising temperatures, which in turn has helped Arctic peregrines productivity (Bruggeman et al. 2015).

In Australia using a 40-year old data set, a study looked at the arrival dates for 24 bird species and departure dates for 12 species. Birds were found on average to have arrived 3.5 days earlier per decade since 1960, while half of the species actually showed significantly earlier arrivals (Beaumont et al. 2006). These results concluded that there was viable evidence that warming temperatures in the past few decades have affected biological species globally (Beaumont et al. 2006).

Most species, like ourselves, are not sessile beings. We have limbs, fins, wings or other means for locomotion. This therefore suggests that animals are not completely helpless in changing routes or locations when it comes to responding to a change in the environment (ie. warming temperatures). Avian species especially, as just described in this paper, are shown to have been able to cope and adapt to rising temperatures, by modifying their migration dates. The migration-weather relationship is complex, as many other factors play a role. Although, that old saying “The early bird gets the worm” may prove true after all. Birds that respond and adapt to global warming will reach new territories and food supplies faster and more efficiently than others, leading to breeding success. Overall, conflicting trends still exist in the literature for
various spring arrival dates of migratory birds globally and in North America, but more conservation and management is required.

Total word count: 987
References


Table 1. Spring arrival dates from 1939 to 2001 at Delta Marsh, Manitoba. Listed by taxonomic order, breeding status, and migratory distance. Anseriformes includes ducks, geese and swans. Charadriiformes includes medium-large birds such as waders and gulls. Passeriformes includes half of all bird species, the perching birds (from Murphy-Klassen et al. 2005).

<table>
<thead>
<tr>
<th>Category</th>
<th>Anseriformes</th>
<th>Charadriiformes</th>
<th>Passeriformes</th>
<th>Other orders*</th>
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<td></td>
<td>(+) ^b (-) ^c</td>
<td>NS ^d</td>
<td>(+) (-) NS n</td>
<td>(+) (-) NS n</td>
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<tr>
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<td>15.4 23.1 61.5 13</td>
<td>0 15.4 84.6 39</td>
<td>0 21.7 78.3 23</td>
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<td>0.0 20.0 80.0 5</td>
<td>0 17.4 82.6 23</td>
<td>0 37.5 62.5 8</td>
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<td>Nonbreeders</td>
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<td>25.0 25.0 50.0 8</td>
<td>0 12.5 87.5 16</td>
<td>0 13.3 86.7 15</td>
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<td>20.0 10.0 70.0 10</td>
<td>0 11.1 88.9 18</td>
<td>0 0.0 100.0 3</td>
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<td>0.0 66.7 33.3 3</td>
<td>0 19.1 80.9 21</td>
<td>0 25.0 75.0 20</td>
</tr>
</tbody>
</table>

* ^A combination of species from 10 other orders that each contains < 6 species.
^b Represents significant positive trends (later arrival dates).
^c Represents significant negative trends (earlier arrival dates).
^d Indicates nonsignificant trends, both positive and negative.
^e Number of species in each category.
Figures

Fig. 1. Changes in global annual temperatures from 1880-2014 (from Ruedy et al. 2014).
Fig. 2. Two regression lines showcasing the first sightings of American Robin (*Turdus migratorius*) at Rocky Mountain Biological Laboratory, Colorado from 1974 to 1999 (Julian date) (from Inouye et al. 2000).