BGB 2020 Part 1 – Ithaca and NE United States data analysis

Background

Building on the results of our (Lily Twining and Ryan Shipley) PhD research, we want to understand if terrestrial and aquatic emergence phenology has changed over time, and if this affects the reproductive success of different aerial insectivore species differently. Our research showed that in Tree Swallows, multiple measures of reproductive success are more positively associated with aquatic rather than terrestrial insect abundance (Twining et al., 2018). The corroborated an earlier hand-raising study (Twining et al., 2016), where chicks that were provided essential fats (polyunsaturated fatty acids or PUFAs) that mainly come from insects with an aquatic juvenile stage grew more quickly and in overall better condition than those that were not. Aquatic insects tend to emerge earlier than terrestrial species, and another study showed that when adults reproduce too early – they increase the risk of chick mortality due to unexpected poor weather events (Shipley et al., 2020). Thus, parents must balance the benefits of obtaining early emerging, high quality food resources with the intrinsic risk of inclement weather events which often occur unexpectedly early in the year.

Shipley, J. R., Twining, C. W., Taff, C. C., Vitousek, M. N., Flack, A., & Winkler, D. W. (2020). Birds advancing lay dates with warming springs face greater risk of chick mortality. *Proceedings of the National Academy of Sciences*.

Twining, C. W., Brenna, J. T., Lawrence, P., Shipley, J. R., Tollefson, T. N., & Winkler, D. W. (2016). Omega-3 long-chain polyunsaturated fatty acids support aerial insectivore performance more than food quantity. *Proceedings of the National Academy of Sciences*, 201603998.

Twining, C. W., Shipley, J. R., & Winkler, D. W. (2018). Aquatic insects rich in omega‐3 fatty acids drive breeding success in a widespread bird. *Ecology letters*, *21*(12), 1812-1820.

Analysis Plan

I have chosen several bird species that all rely on flying insects to feed their young but vary in their annual reproductive timing, a fall into groups as early, middle, and late breeders. For these groups we have not only reproductive dates but also number of eggs laid, chicks hatched, and chicks fledged. In addition, we have daily insect count and biomass data separated into orders, but also grouped more coarsely into those with aquatic and terrestrial life stages. I believe we can make the general following predictions –

H1 – Insect phenology varies from year to year based on local climatic conditions and synchrony between aquatic and terrestrial emergence varies.

H2 – Terrestrial insect emergence phenology has advanced more than aquatic, and foraging birds are subject to changing compositions of available prey.

H3 – Earlier breeding aerial insectivore species are more likely to be subject to aquatic / terrestrial emergence asynchrony, and it should negatively affect the successful reproduction of young.