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Climate effects on butterfly species richness

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Climate Change Effects on Butterfly Species Richness

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Abstract

- The effects of climate change on the surrounding biodiversity lead scientists to argue an “insect apocalypse” is approaching.
- Butterflies, as poikilothermic animals, meaning their activity is closely controlled by weather, represent a useful indicator to studying climate change.
- Scientists can detect changes in butterfly fecundity which result in changes in distribution and abundance over a short period of time.[1]
- **I hypothesize that as temperatures grow unstable and creep higher in the beginning stages of butterfly lives, population richness will decline.**

Materials and Methods

- The value of undeveloped land has become more crucial to reducing greenhouse gas emissions as the effects of climate change become evident across Massachusetts.[2]

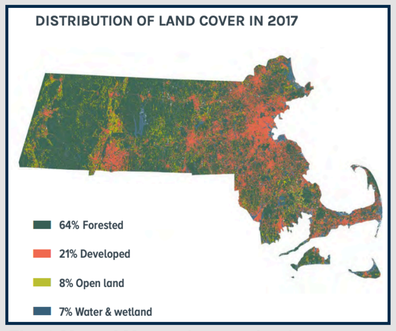

Fig. 1 Map of Massachusetts land cover distribution in 2017. Map: Mass Audubon, 6th Edition of *Losing Ground*.

Fig. 2 Average temperature in Massachusetts from March - June between 1992 - 2021. Graph: NOAA.

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Fig. 3 Eastern tailed blue (*cupido comyntas*). One species in MA affected by climate change. Photo: MassAudubon.org.

- Butterfly data was collected using a study system with support from the Massachusetts Butterfly Club observations from 1992-2018.
- Species were excluded if they underwent a taxonomic shift, realignment, or outbreak of the population during study period to avoid uncharacteristic population behaviors.
- Data was compiled on two life history traits: voltinism and species range relative to Boston, MA.

Results

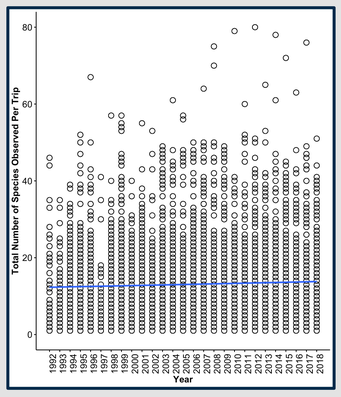

Fig. 4 Butterfly species richness in Massachusetts over a 26-year period.

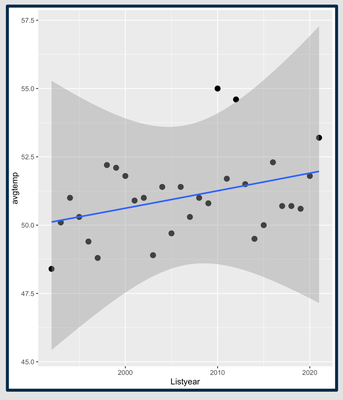

Fig. 5 Mean temperature from 1992 - today during butterfly flight-season (March - June).

Species Richness to Annual Observation

- There is a significant relationship between total number of species observed per trip (X^2 1735.6, df = 1, $p < 0.001$).
- Species observations increase each year with a slope ~ 1.

Average Temperature to Annual Flight Season

- There is a significant correlation to mean temperature over a 30-year timespan (X^2= 0.1799, df = 1, $p > 0.6715$).
- Temperatures are on an incline (slope ~ 1).
- Flight season is moving to different months to adapt with changing temperatures.

Conclusion

- **There is a strong correlation between changes in temperature and changes in species abundance.**
- Species are more likely to increase richness if they are multivoltine (voltinism has a direct effect on flight period trends) and through adaptability, especially in northern temperature climates.
- The number of southern species are increasing while northern species decrease, but abundance is even because species are increasing/decreasing at a similar rate.
- This could also mean that climate change highlights a focus on surrounding biodiversity which forces communities to pay closer attention.
- Butterflies may be able to adjust to climate change if they are able to remove the pressure of anthropogenic changes.

References

1. Roy, D.B., Sparks, T.H. Phenology of British butterflies and climate change. Global Change Biology 6, 407-416 (2000).
2. Ricci, E.H., J. Collins, J. Clarke, P. Dolci, and L. de la Parra. *Losing Ground: Nature’s Value in a Changing Climate.* Massachusetts Audubon Society, Inc., 1-2 (2020).
3. James Michielini, Erik Dopman, Elizabeth Crone. Changes in Flight Period Predict Trends in Abundance of Massachusetts Butterflies. *Authorea.* (2020).

Acknowledgements

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