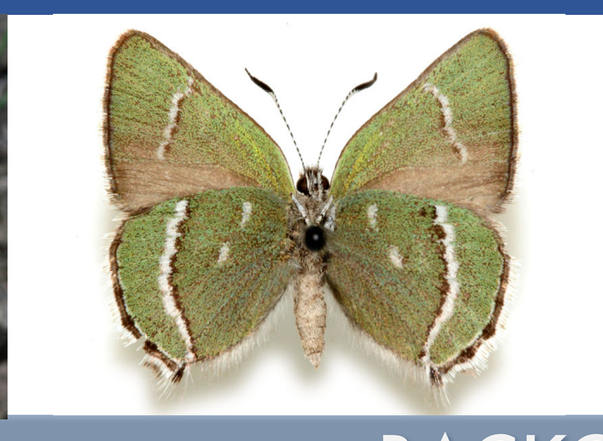
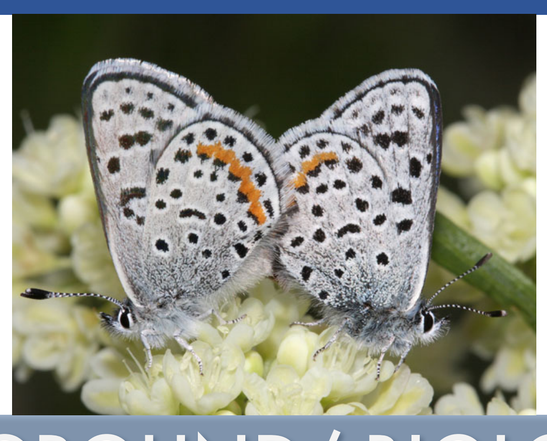
SPATIAL MISMATCH OF BUTTERFLIES & THEIR HOST PLANT

Geena M. Hill
Florida Museum of Natural History, University of Florida, Gainesville, FL

BACKGROUND/ BIOLOGY

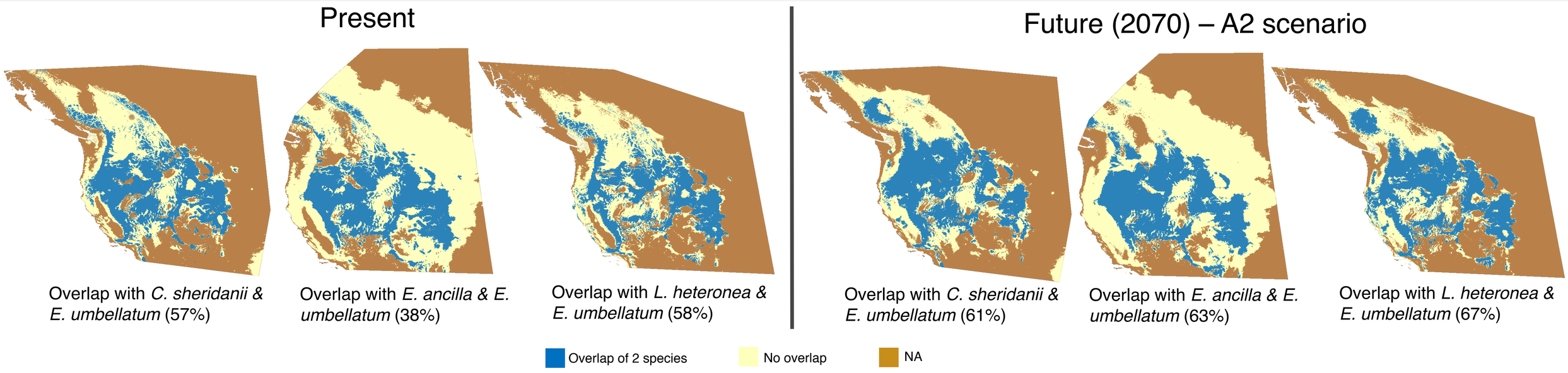
Eriogonum species, or wild buckwheat, are host plants to many moths and butterflies. Several of these Lepidoptera species are monophagous or oligophagous: many feed solely on the genus *Eriogonum*, and some feed on only a single species of *Eriogonum*. *Eriogonum umbellatum*, also known as Sulphur flower, is native to western North America and its range extends across ten states and into British Columbia and Alberta. This plant species is shared and preferred by several univoltine butterfly species. The Green Hairstreak (*Callophrys sheridanii)* flies early in the spring from March to June and will begin feeding on the new growth of *E. umbellatum* as they begin to flush out. As *C. sheridanii* is beginning to pupate and *E. umbellatum* is starting to flower, the Pacific Dotted-Blue (*Euphilotes enoptes)* adults emerge from diapause and lay their eggs on the flowers and their larvae will feed on the flower heads. The eggs of the Blue Copper butterfly (*Lycaena heteronea)* that were laid the previous spring, begin to hatch near the end of the bloom season of *E. umbellatum,* and the caterpillars feed on all parts of the leaves. This system demonstrates a unique situation where multiple butterfly species are utilizing the same host plant within the same space, but at slightly different times. I assessed potential spatial mismatches between the three species of butterflies and their host plant by modeling distribution overlaps at present and future climatic conditions.

METHODS

Host plant and butterfly data: iDigBio, iNaturalist, and GBIF. I designed training regions for all four species in QGIS where the species occurred and where their known range is, as well as additional habitat where the species could disperse. Bioclimatic variables that were used for each species include: altitude, annual mean temperature, mean diurnal range (mean of monthly (max temp–min temp)), isothermality (bio2/bio7)(*100), temperature seasonality (standard deviation *100), mean temperature of wettest quarter, mean temperature of driest quarter, annual precipitation, precipitation of driest month, and precipitation seasonality (coefficient of variation).

MaxEnt features: linear, quadratic, and product features were used. *MaxEnt settings:* random seed, 10 replicates, crossvalidate, clamping, and MESS analysis. Each median model was then thesholded based on the analysis of omission/commission. I calculated the extent of ENM suitable habitat by calculating the area of each cell and recorded the sum in km2. *Future data:* downloaded from CliMond. CSIRO model, A2 scenario, and 10' resolution data were used. Overlap of present and future distributions was calculated in QGIS using raster calculator. Area percentage of overlap was calculated in R for all six models.

RESULTS



DISCUSSION

While individual distributions of two of the butterfly species will shrink over time (*C. sheridanii* by 107445.2521 km^2 and *E. ancilla* by 233736.1954 km^2*)*, the host plant and Blue copper will increase their distributions (*E. umbellatum* by 169396.9424 km^2 and *L. heteronea* by 113257.3904 km^2). Overlap percentages for all species appear to increase over time. From present to 2070, *C. sheridanii* & *E. umbellatum* overlap distributions increase by 4%, *E. ancilla* & *E. umbellatum* increase by 25%, and *L. heteronea* & *E. umbellatum* increase by 9%. All models generated in MaxEnt had generally decent AUC's [area under the curve], although the species with fewer occurrence points (i.e., *E. ancilla)* had less significant results which stresses the need to obtain as many occurrence points as possible. This study shows that co-occurring species do not necessarily react in a similar manner to future climate conditions. It would be useful to research phenology-related questions in the future, especially if species' phenology changes over time and results in the species competing with each other. It should also be emphasized that other essential biotic interactions should be included to provide realistic projections of future species distributions.

ACKNOWLEDGEMENTS

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Image credit: Andrew Warren, Paul Slichter, Todd Stout, Kim Davis, Mike Strangeland, Jim P. Brock

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