

Variation of insect diet in two closely-related cavity nesting songbirds

Sebastian Chavez-Ortega¹, Sara Padula, William Anderson, Cori Carver, Kathryn Grabenstein, Scott A. Taylor

Context

In Boulder, Colorado, two related songbird species coexist: the Black-capped Chickadee (*Poecile atricapillus*) and the Mountain Chickadee (*P. gambeli*). Despite their genetic and behavioral similarities, Mountain Chickadees prefer high-elevation dry conifer forests, while Black-capped Chickadees inhabit lower-elevation mixed forests rich in deciduous trees (McCallum et al. 1999; Foote et al. 2010). However, little research has explored how their coexistence affects foraging behavior or if they compete for insect prey for their offspring.

Objective

Analyze and compare the diet (e.g., composition, diversity) of black-capped and mountain chickadee nestlings.

Sampling

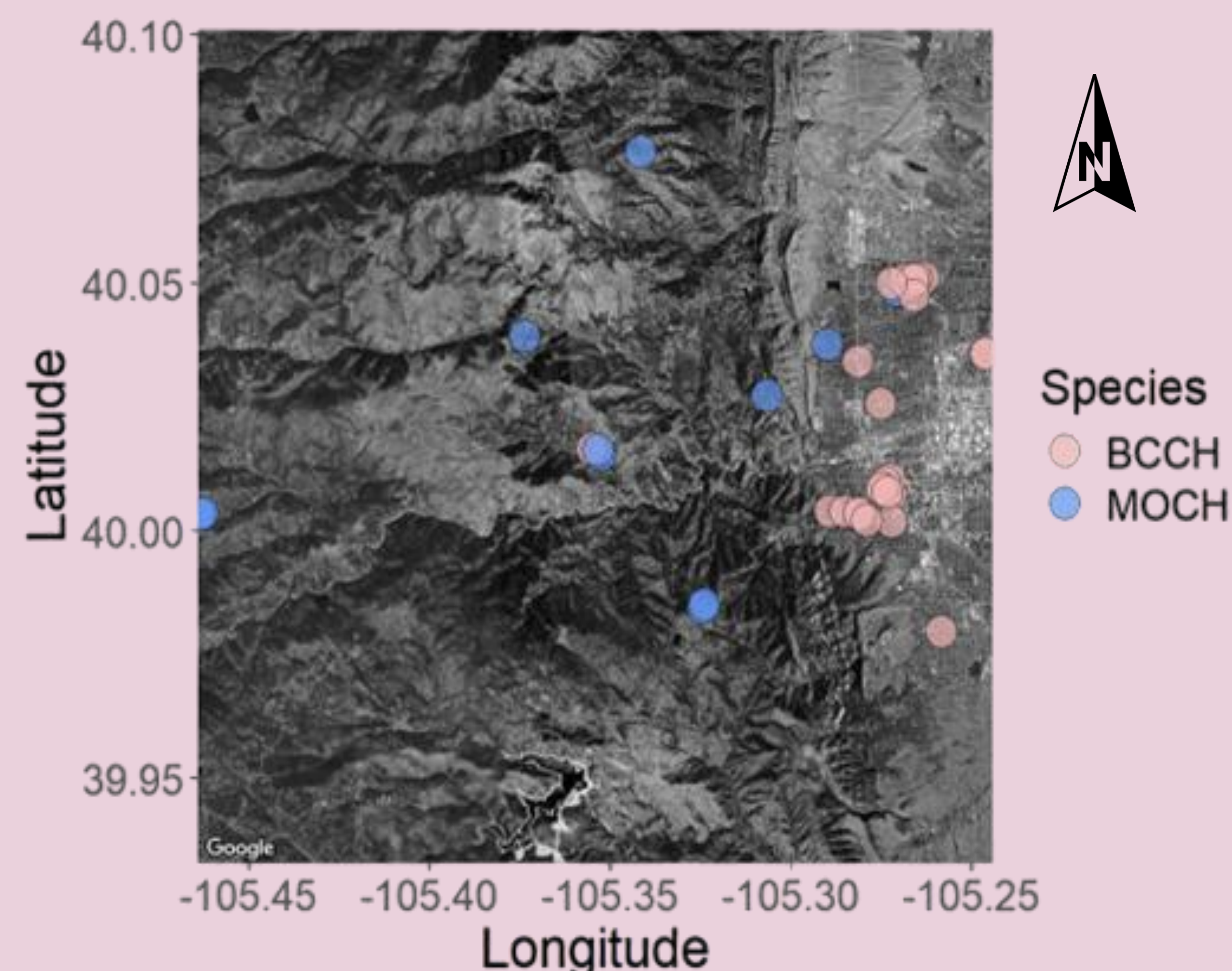
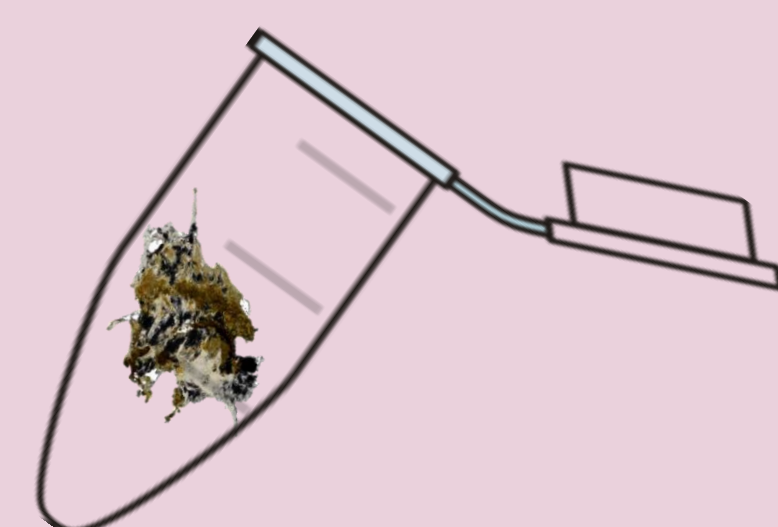


Fig 1. Geographic context of the study. Map of the Boulder Chickadee Study area showing deciduous habitat (right) and coniferous habitat (left). Fecal samples are color-coded by species: pink for Black-capped Chickadees (BCCH), blue for Mountain Chickadees (MOCH).

Data and Sampling:

- **DNA metabarcoding of the CO1 gene** (a method that uses genetic sequence information) was used to identify insect species from bird fecal samples.

- 115 individuals from two different species:
 - 56 Black capped-chickadees
 - 59 Mountain Chickadees



Research Question

When two closely related cavity nesting bird species occupy the same area do they compete for the same insect-rich food sources, or do they adjust their diets to reduce direct competition?

Diet Comparison

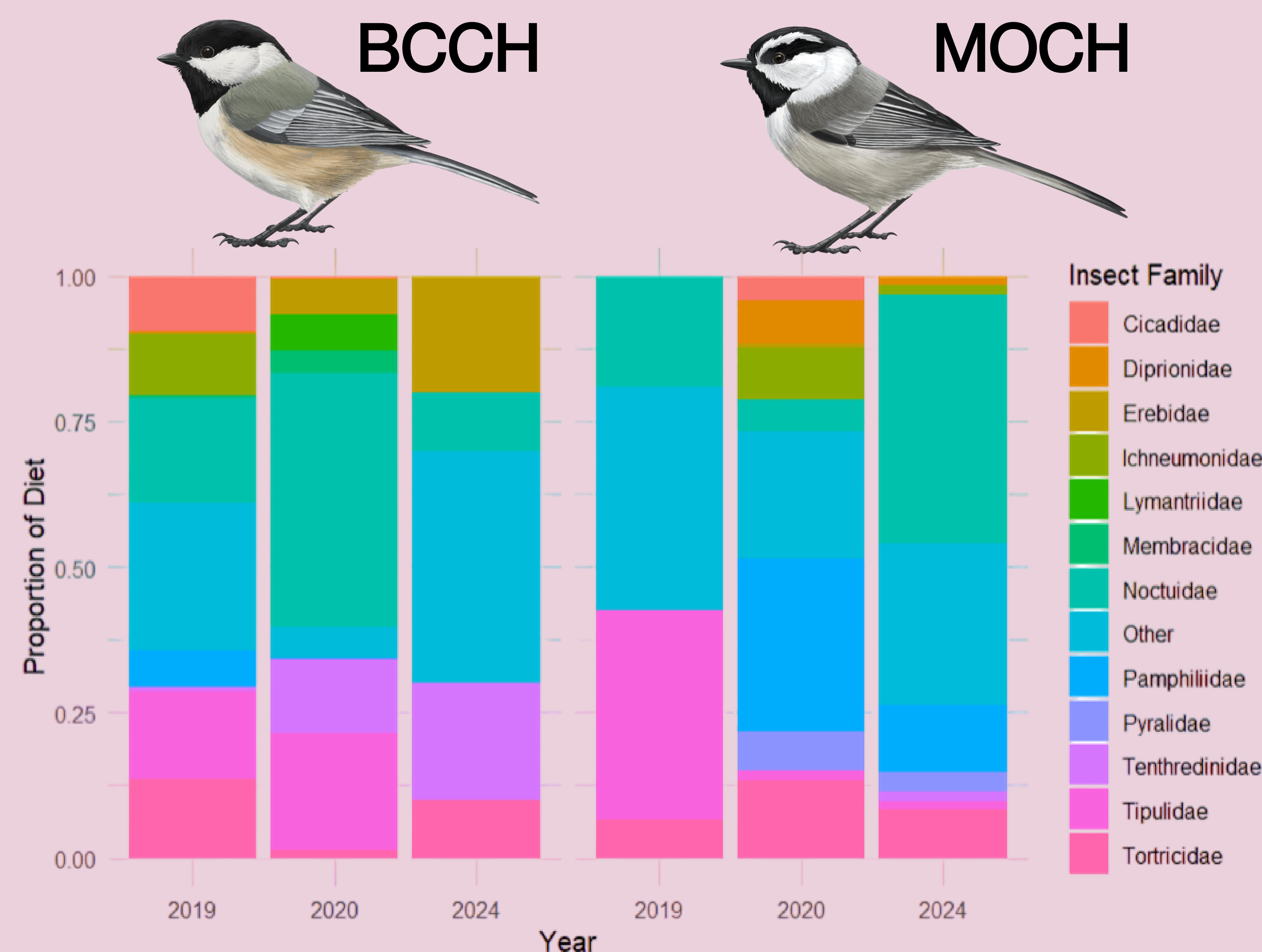


Fig. 2. Chickadee diet composition by insect family . In all years black-capped (BCCH) and mountain chickadee (MOCH) nestling diets differ.

Alpha Diversity - 2024

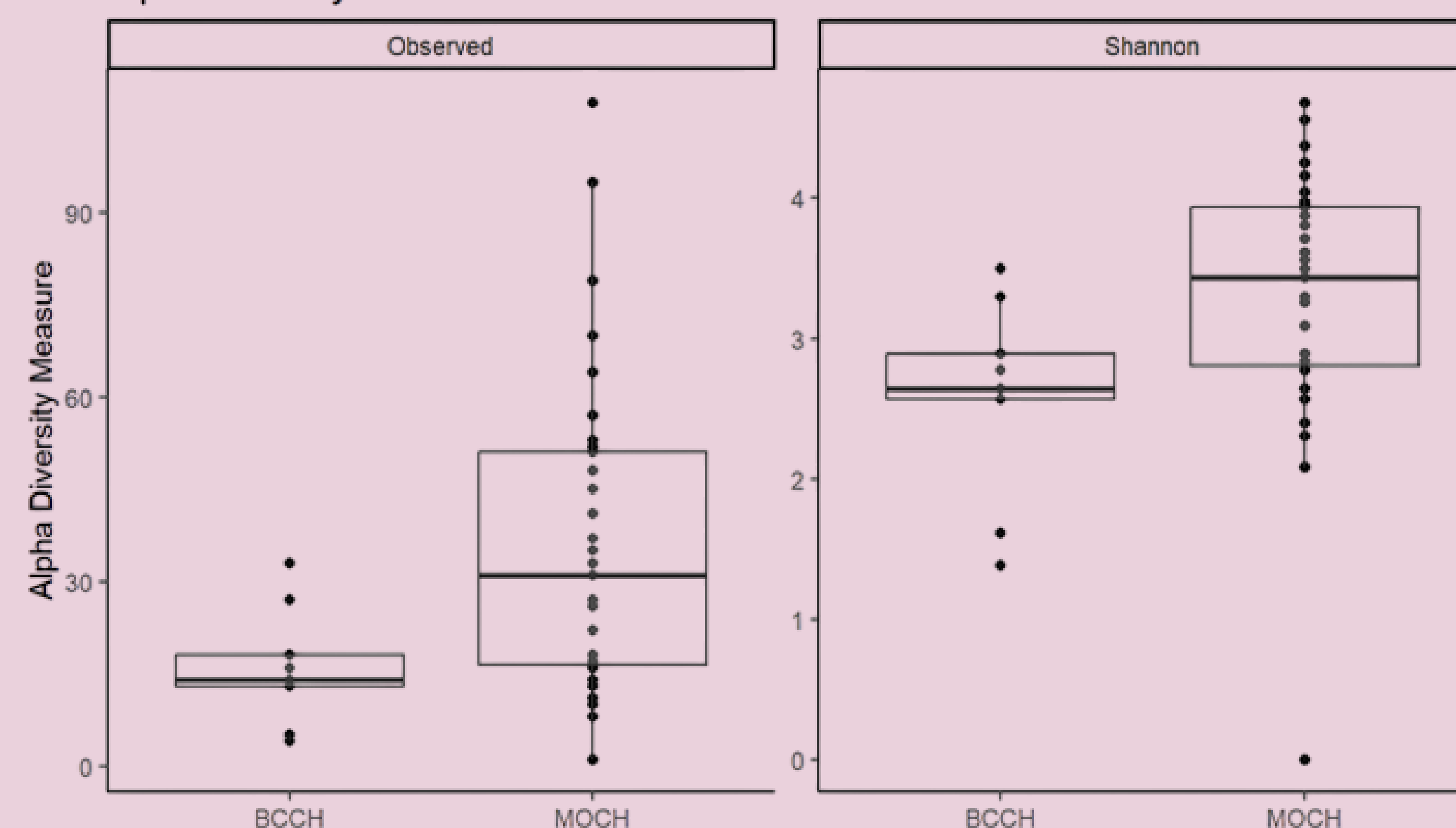


Fig. 3. Mountain chickadee (MOCH) diets contain more diversity than black-capped chickadee (BCCH) diets. Whisker boxplot illustrating the diversity of insect species consumed by both chickadee species, based on fecal samples collected in 2024. Statistical analysis using Bray-Curtis distances revealed increasing dietary differences between black-capped and mountain chickadees over three years, with the strongest in 2024 ($p=0.001$, $R=0.052$).

Discussion

- Across all years, black-capped and mountain chickadee diets differ (Fig. 2).
- In 2024, mountain chickadees ate a wider variety of insects, and their diet was more evenly spread across insect types, than black-capped chickadees (Fig 3), maybe because mountain chickadees are more flexible in what they eat.
- The higher diversity of the mountain chickadee diet may help them avoid direct competition with black-capped chickadees, allowing individuals along the edges of their overlapping ranges to coexist.
- Bray-Curtis dissimilarity analyses revealed increasing dietary differences between black-capped and mountain chickadees over three years, with the strongest in 2024 ($p=0.001$, $R=0.052$).
- Diet variation may, in part, be the outcome of differences in beak morphology between the species (Fig. 4)

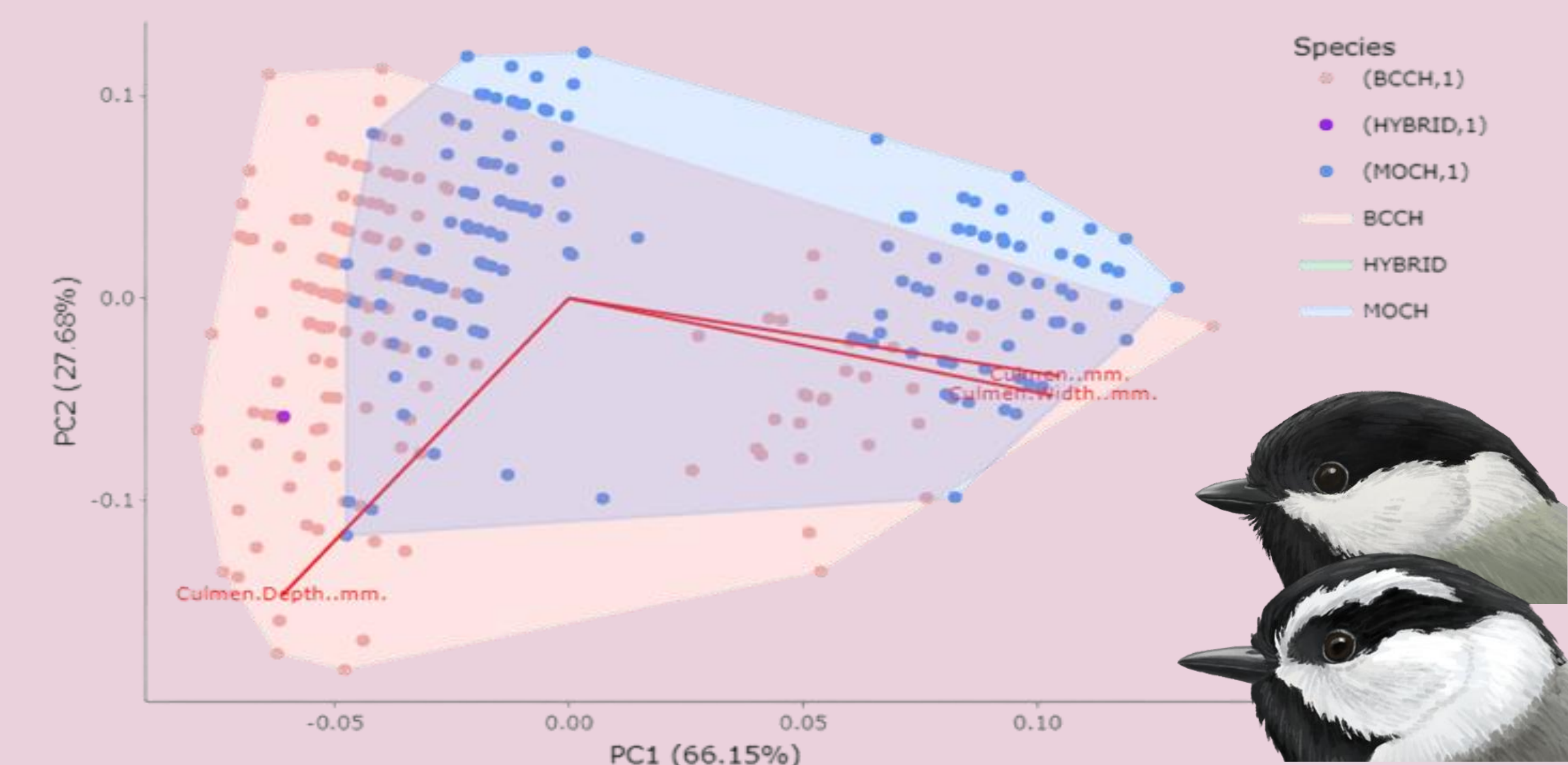


Fig 4. Variation in beak traits between black-capped (BCCH) and mountain (MOCH) chickadees. Principal Component Analysis (PCA) of three beak traits (length, culmen width, and culmen depth). PC1 reflects variation in culmen length and width, while PC2 is driven by culmen depth. Species cluster, indicating distinct beak morphologies.

Conclusion

Across three years, mountain and black-capped chickadee diets were distinct, with mountain chickadees consuming a wider range of prey. This suggests different foraging strategies that may reduce competition and support coexistence. These results offer a foundation for tracking future changes in diet and species interactions over time.

Acknowledgements

This research was supported by the Niwot Ridge LTER program (NWT VIII: NSF DEB-2224439) and Taylor Lab Research Funds.

Literature Cited

McCallum DA, Grundel R, Dahlsten DL. 1999. Mountain chickadee. In: Poole A, Gill F, editors. The birds of North America, No. 453. Philadelphia (PA): Academy of Natural Sciences. p. 1-28.

