

Using Stable Isotopes to Understand the Dynamics of Mexican Free-Tailed Bats

(*Tadarida brasiliensis*) at Bracken Cave, Texas

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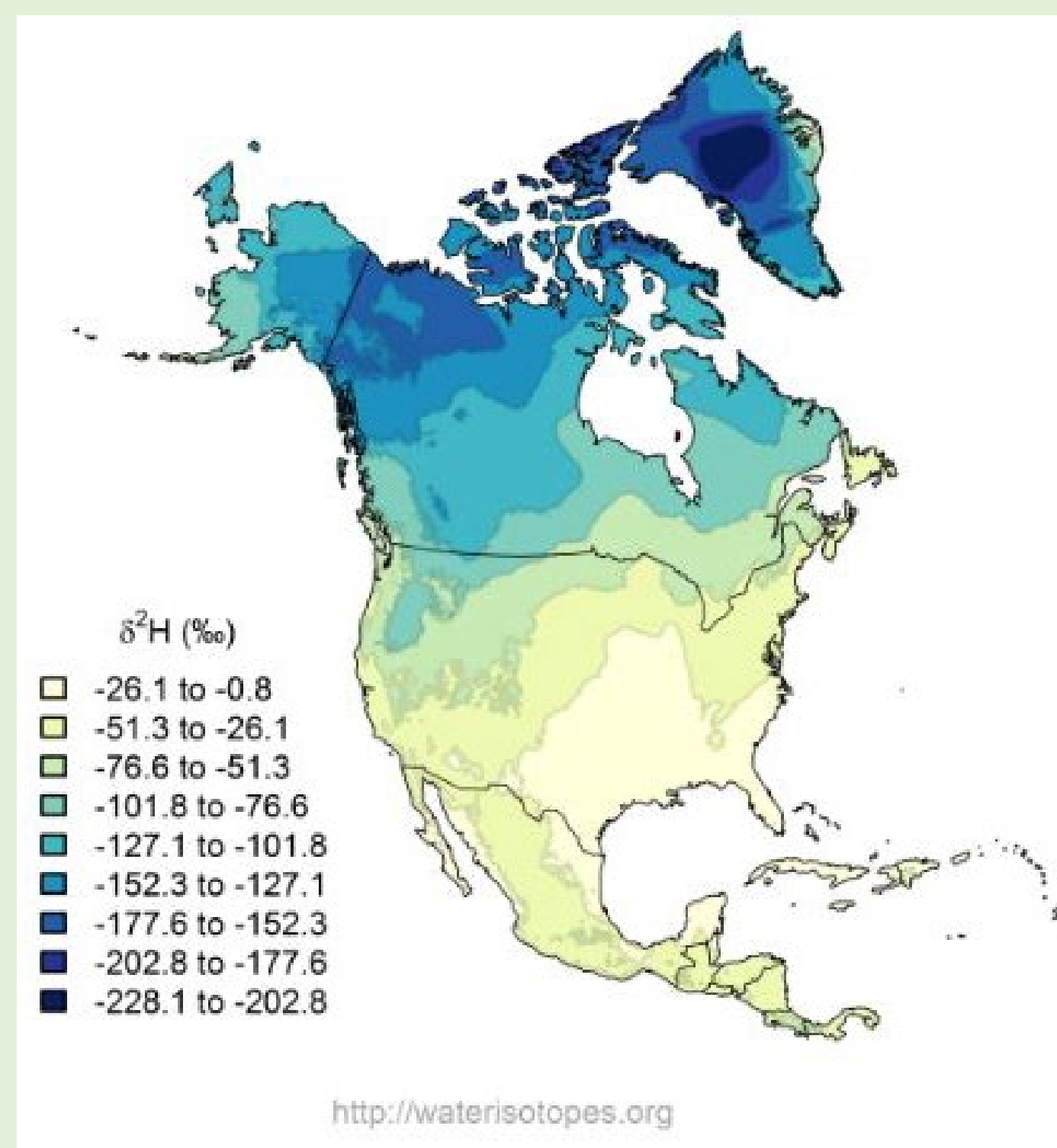


Introduction and Background

- We are investigating the migration dynamics of Mexican free-tailed bats (*Tadarida brasiliensis*, TABR) at Bracken Cave in Texas.
- TABR exhibits a diversity of migration patterns between non-migratory individuals and long-distance migrants.
- Bracken Cave is a summer maternity colony. Only females roost together, give birth in June, and migrate in fall.
- Both males and females are present in the cave in winter and spring; it is unknown if or from where these bats migrate.
- Migration is tracked by analyzing the variation in stable isotope ratios in the fur of these bats.

Overview of Stable Isotope Analysis

- Stable isotope ratios vary geographically
- As an example: Deuterium becomes depleted at high latitudes, forming bands across North America
- Metabolic processes capture the isotopic ratios of the location where tissues are formed.
- These signatures are retained in keratin-based tissues, such as fur.
- We can measure isotope ratios in fur to infer the geographic location it was grown.
- Bats molt during summer months and provide a single measurement of where molting occurred.
- Tissues can also become depleted in heavy isotopes due to a phenomenon known as isotope discrimination. This is the result of:
 - Heavier isotopes forming slightly stronger bonds.
 - Heavier isotopes reacting slightly slower in metabolic processes.



Research Question

- Do the seasonal bat populations at Bracken Cave reflect different migratory origins?

Data Collection and Sample Processing

Sample Collection

- TABR were collected from Bracken's Cave by Bat Conservation International in October 2014, January 2015, and April 2015.
- All data collection followed IACUC protocols obtained by BCI.
- Juveniles can no longer be distinguished from adults by winter.

Numbers of Samples Analyzed			
Season	No. Juveniles	No. Adult Females	No. Adult Males
Oct. 2014	23	36	0
Jan. 2015	N/A	34	34
April 2015	N/A	31	35

Sample Processing

- Bat fur was sequentially washed with a dilute soap solution, deionized water, and 2:1 (v/v) chloroform-methanol solution. Samples were then dried in air.
- 350 ± 10 µg of fur was placed in silver capsules for hydrogen isotope analysis.
- Samples were submitted to Cornell University's Stable Isotope Laboratory. Hydrogen isotope ratios are measured with a Thermo Delta V Isotope Ratio Mass Spectrometer.

Data Reporting and Analysis

- Hydrogen isotope ratios are reported relative to the Vienna Standard Mean Ocean Water (VSMOW) ratio,

$$\delta^2\text{H} = \left(\frac{R_{\text{sample}}}{R_{\text{VSMOW}}} - 1 \right) \times 1000\text{‰}$$

- ANOVAs were used to compare measured $\delta^2\text{H}$ values for the individual data sets.

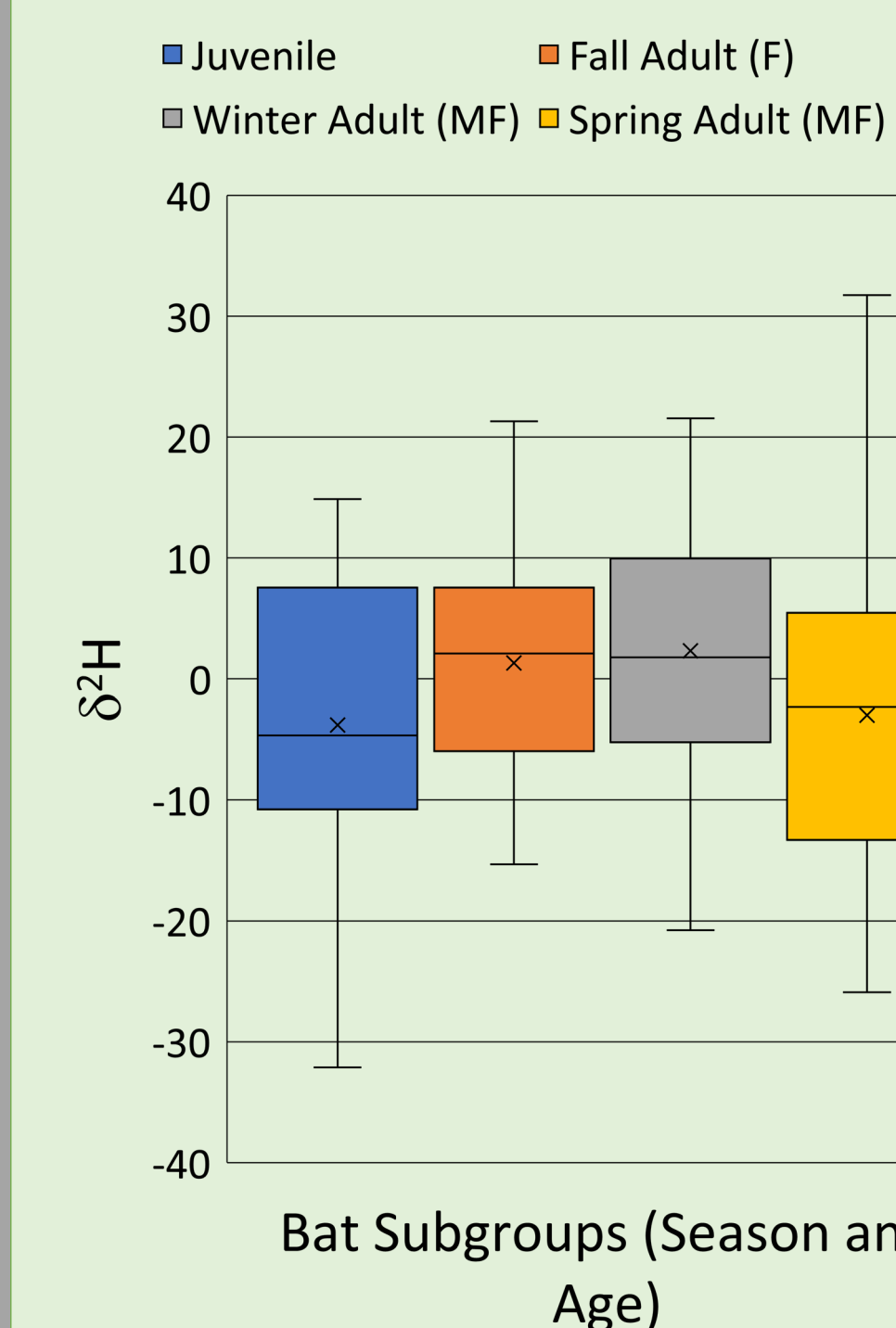
Results

- We first tested whether or not subgroups for each season may be grouped together.
 - Differences are not significant between groups.
 - Juveniles and adult females were expected to differ due to isotope discrimination between mother and young, although the difference did not reach significance, likely due in part to data not being mother-young pairs.

Comparison of Subgroups within a Season			
	Fall Juveniles vs. Adult Females	Winter Adult Males vs. Females	Spring Adult Males vs. Females
Number	23 (J) 36 (A F)	34 (F) 34 (M)	31 (F) 35 (M)
F Score	3.7491	0.001354	0.082825
P-Value	0.0578	0.970757	0.774435

- We next analyzed TABR $\delta^2\text{H}$ values across each season.
- The uncorrected average $\delta^2\text{H}$ for fall bats (1.63‰) is similar to the local precipitation $\delta^2\text{H}$ for Bracken Cave during the summer months when TABR molt (July = 0‰ and August = 6‰).

Comparison of Adults across Seasons			
	All Adults Fall and Winter	Adult Female Fall, Winter, and Spring	Adult Male Winter and Spring
Number	36 (F) 68 (W)	36 (F) 34 (W) 31 (S)	34 (W) 35 (S)
F Score	0.2526	1.9405	4.1378
P Value	0.6163	0.1491	0.04599



- There are no significant differences between fall and winter adults, suggesting winter bats are individuals that did not migrate.
- Seasonal values among females did not differ, which suggests females may return to the cave.
- Winter and spring values for males are significantly different, suggesting an influx of new migrants to the cave.

Acknowledgements

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