

# Investigating habitat quality for the Mearns quail through diet preferences: implications for land management

P.I. Alberto Macías Duarte, Ph.D.  
Sonora State University  
Hermosillo, Mexico

Oscar E. López-Bujanda and  
Reina A. Castillo-Gómez  
University of Sonora

Angel B. Montoya  
U.S. Fish and Wildlife Service  
Las Cruces, New Mexico





Wildlife habitat



# Animals exploit resources for growth, survival and reproduction

Abundance & distribution,  
Activity patterns  
Population dynamics



Food availability is an important factor that limit bird populations



**Knowledge of wildlife nutrition  
is central to understanding the  
species' ecology**

**Tools for habitat  
management**

# Montezuma Quail

(Mearns', fool or arlequin quail)

*Cyrtonyx montezumae*

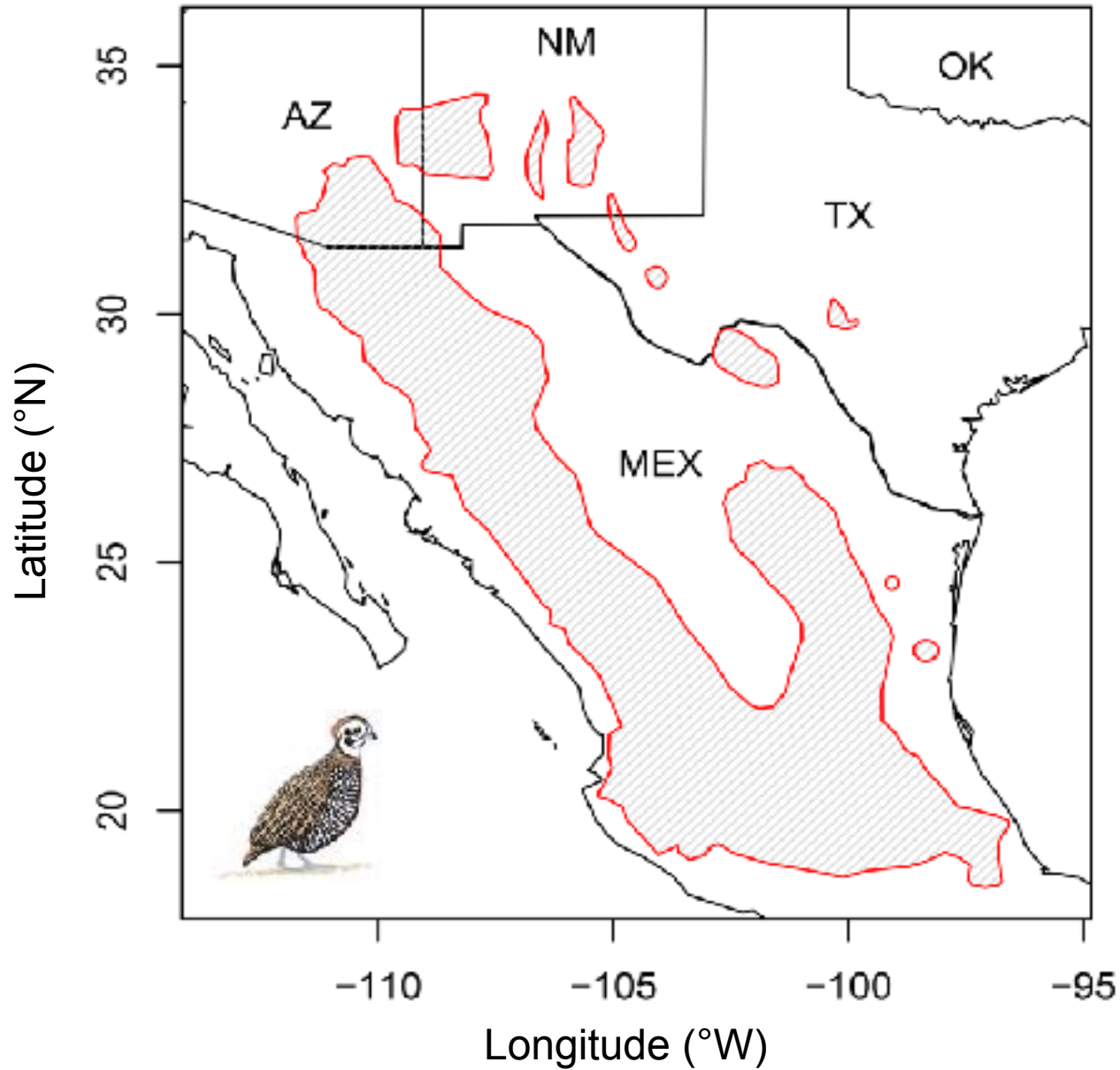




## Popular gamebird in Arizona and New Mexico



# Geographic distribution of Montezuma quail





# Habitat

**Pine - oak forest  
savannas**



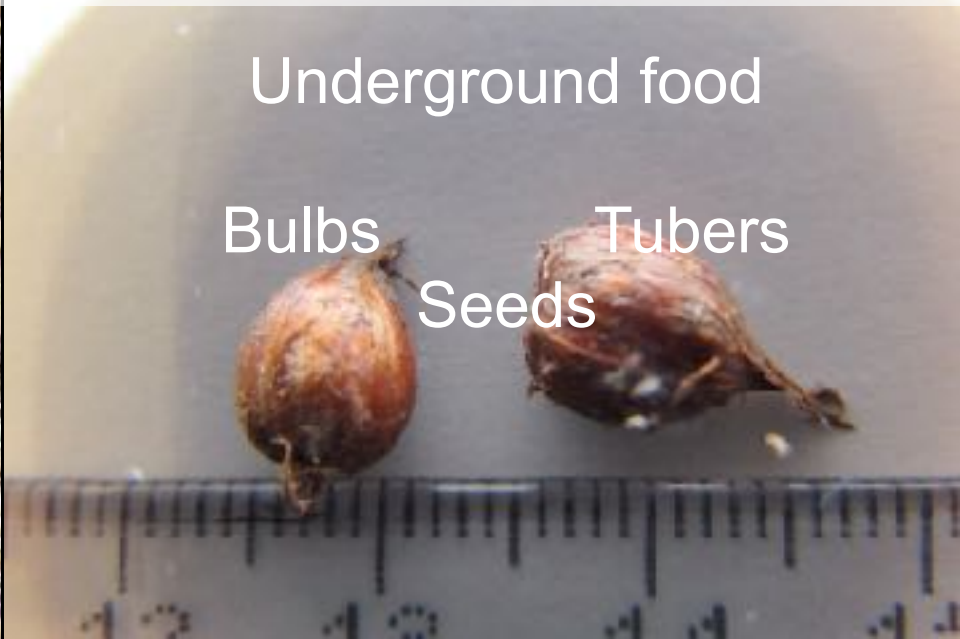
# Foraging behavior and diet of Montezuma Quail

Digging  
Large and curve claws



Underground food

Bulbs      Tubers  
Seeds



Foraging in coveys

## United States

Bishop, Hungerford (1965)

- Bulbs of *Oxalis* – 64%

Brown (1982)

- Bulbs of *Cyperus* – 56%
- Bulbs of *Oxalis* – 26%

## México

Hernández et al. (2004)

- Bulbs of *Oxalis* – 42%

Zaragoza et al. (2004)

- Bulbs of *Oxalis* – 67%

Férrnandez-López (2015)

- Bulbs of *Oxalis* – 88%

**Montezuma quail is specialist in  
Woodsorrel (*Oxalis*) bulbs**

# Objectives

- **Determine the winter diet composition of Montezuma Quail in southern Arizona, New Mexico**
- **Explain geographic variation in diet composition through environmental and habitat characteristics**

# Scientific collection by hunters

- Crops were obtained from hunted birds from the 2008-2017 hunting seasons in AZ and NM
- Information collected for each crop
  - Coordinates
  - Date
  - Time of hunt
  - Covey size

# Samples



Sub adult male shot by AB Montoya Fabra  
x 10 bird survey at 1520h on 01/02/16.  
Only hunter AB Montoya - Dog - Paloma.  
Location Tierra Blanca FS-522 road  
Casta NF. 0100 135 251 838 mE;  
3638224mN. 5871' Elevation. Contents:  
(Crop full) Crop, heart + wings 1 of 3.



## Sexing and aging of Montezuma quail



# Sorting food items in individual crops







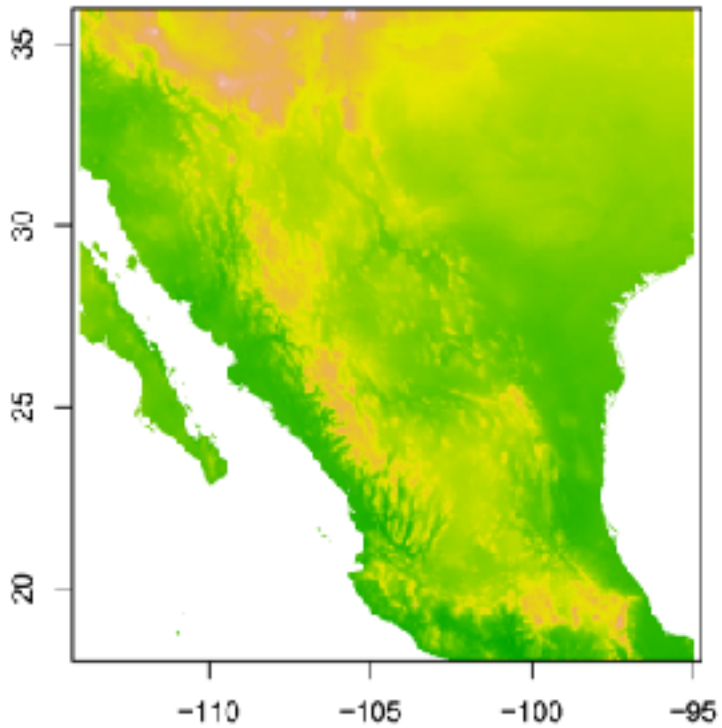
Oscar E. López  
Graduate student



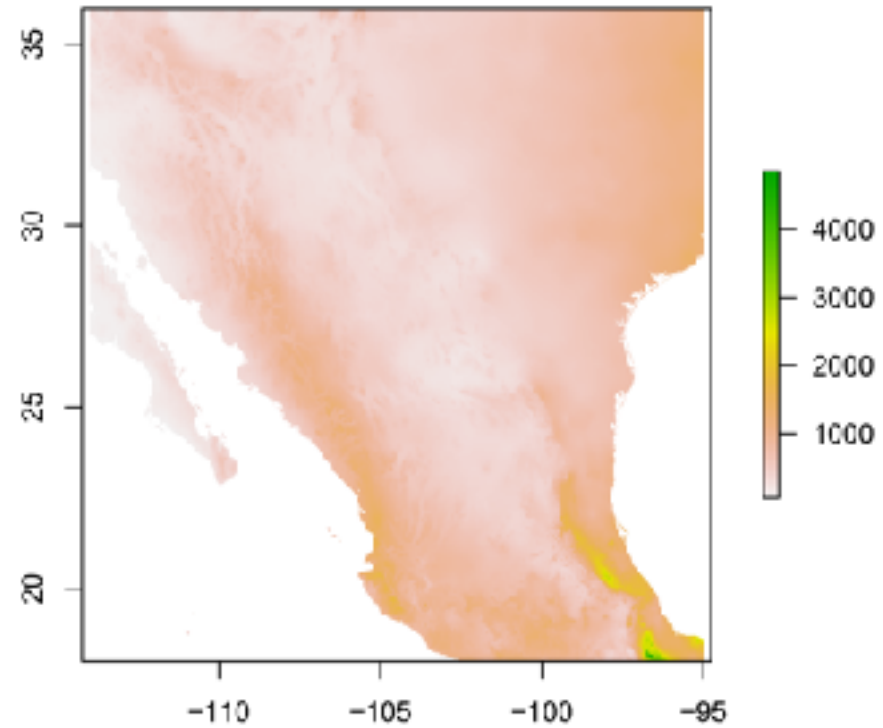


Food items: bulbs, rhizomes, fruits, seeds, bugs



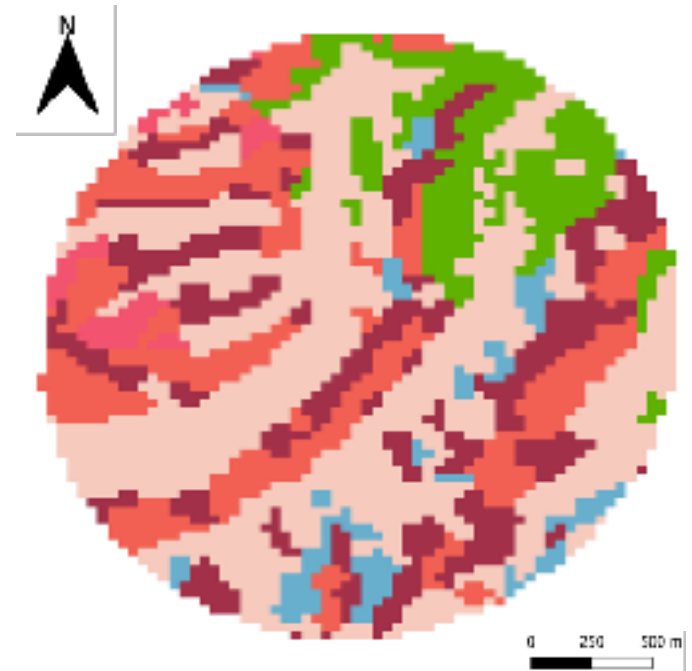
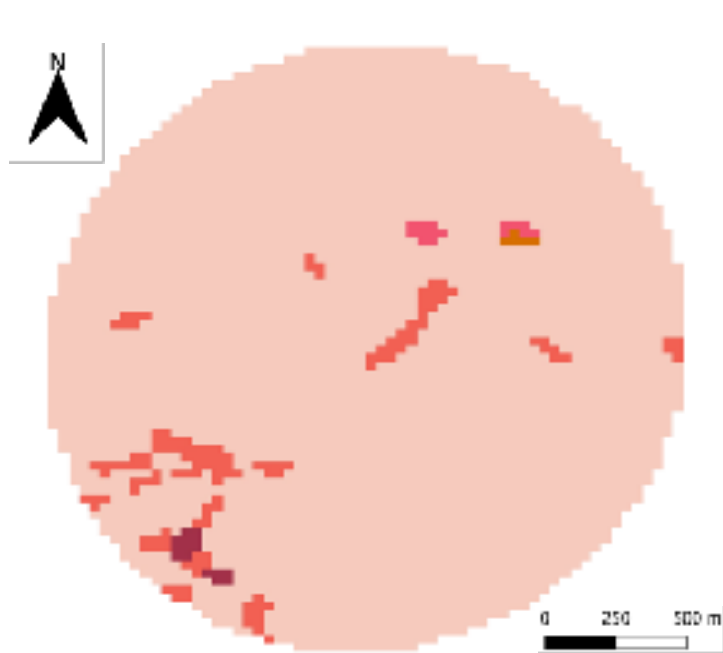


Bioclim1  
Mean annual temperature



Bioclim12  
Annual precipitation

# Effect of vegetation patchiness on Montezuma quail diet



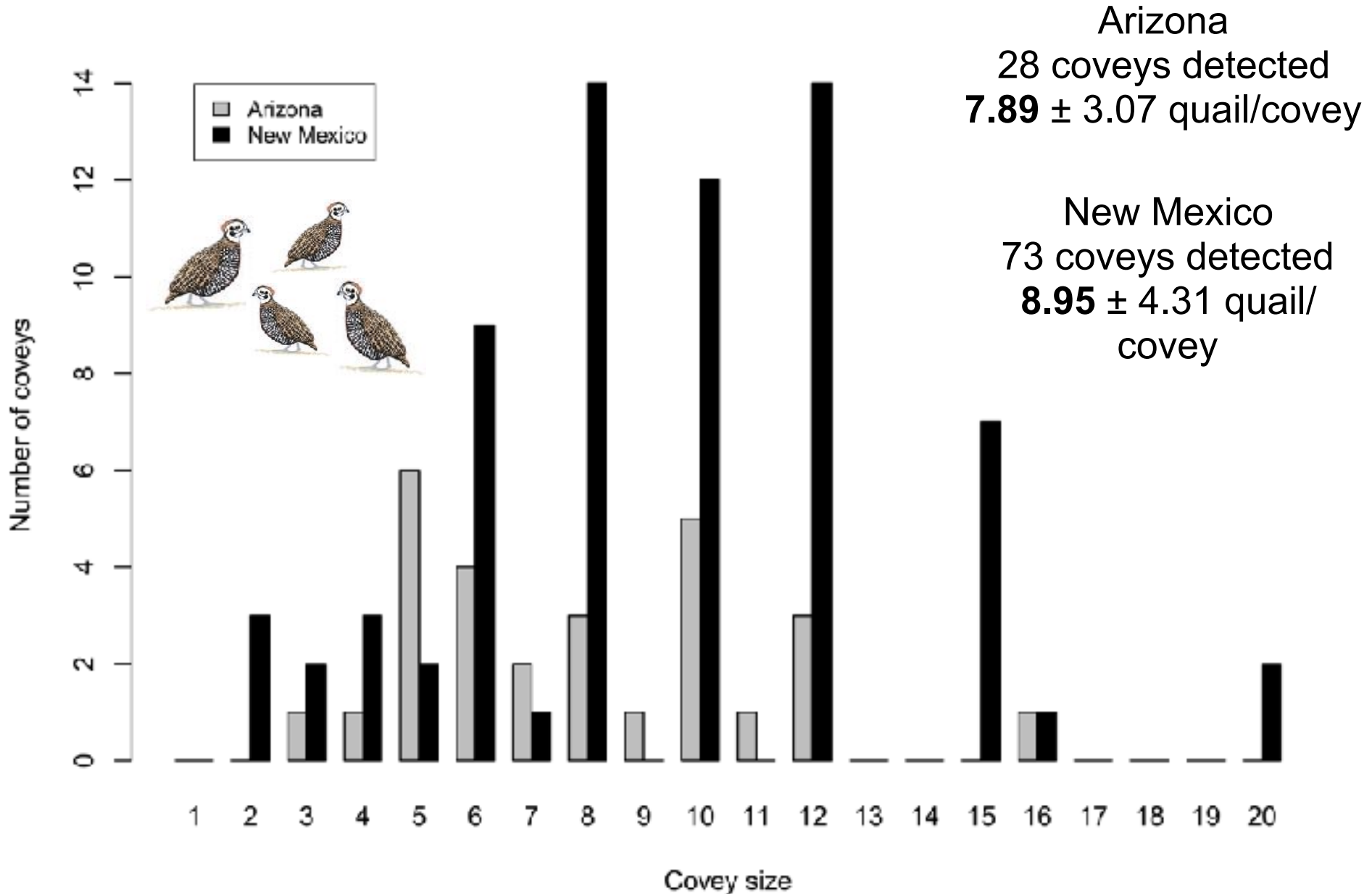
# Results

323 individuals of *Cyrtonyx montezumae* were harvested in the northern limit of its distribution:

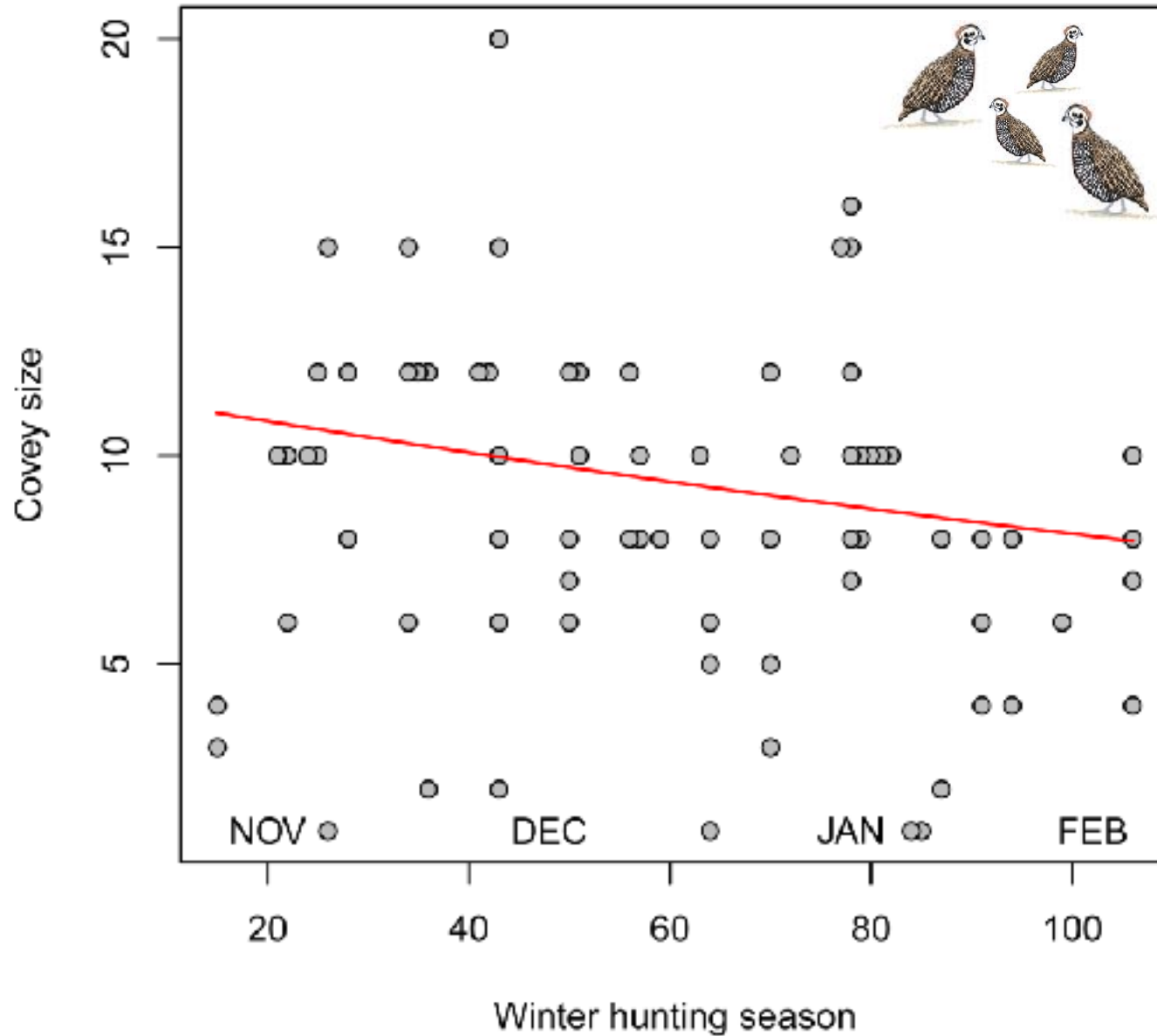
- 176 birds from Arizona (2016-2017)
- 147 birds from New Mexico (2009-2016)



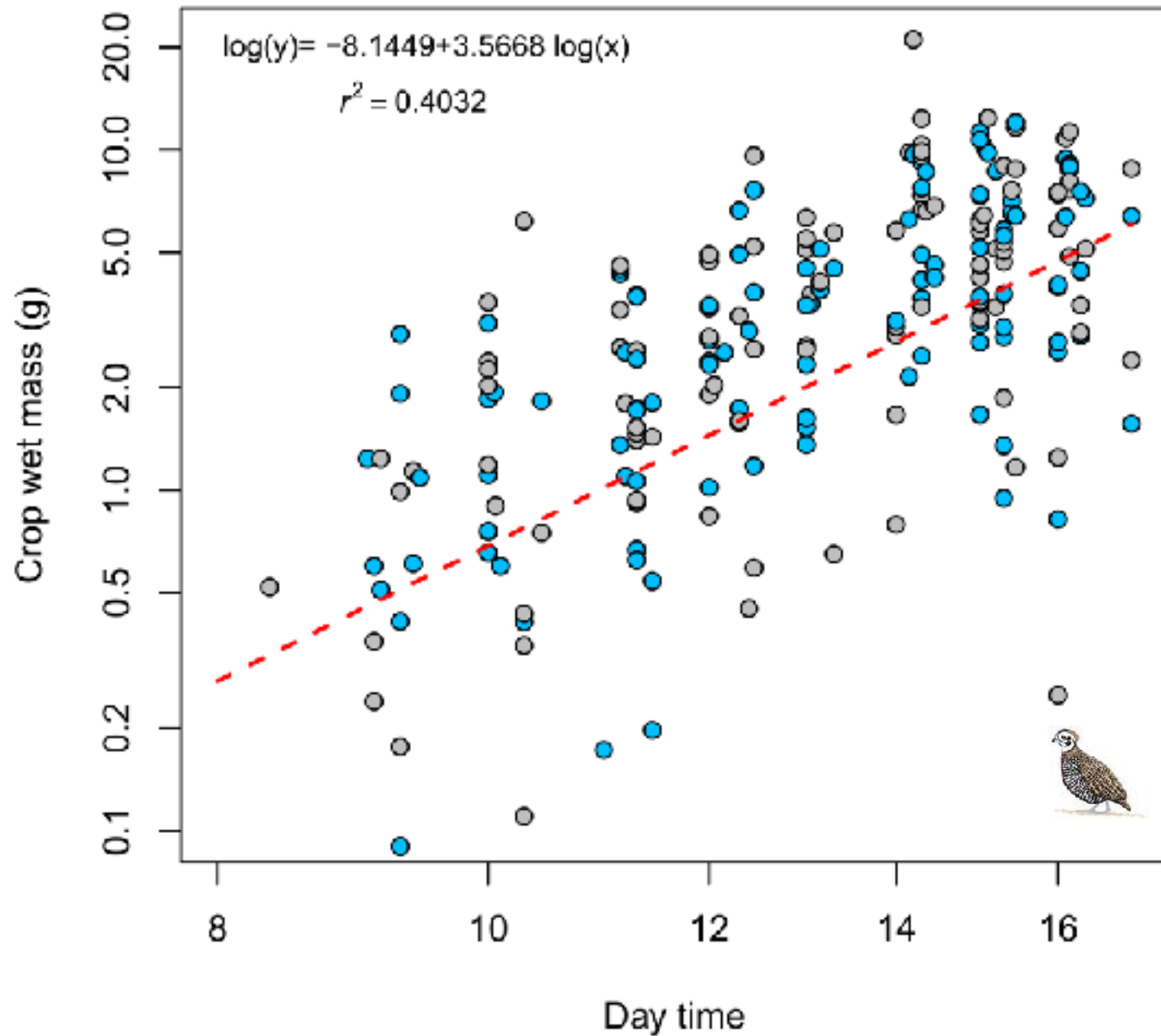
# Foraging groups of Montezuma quail in Arizona and New Mexico



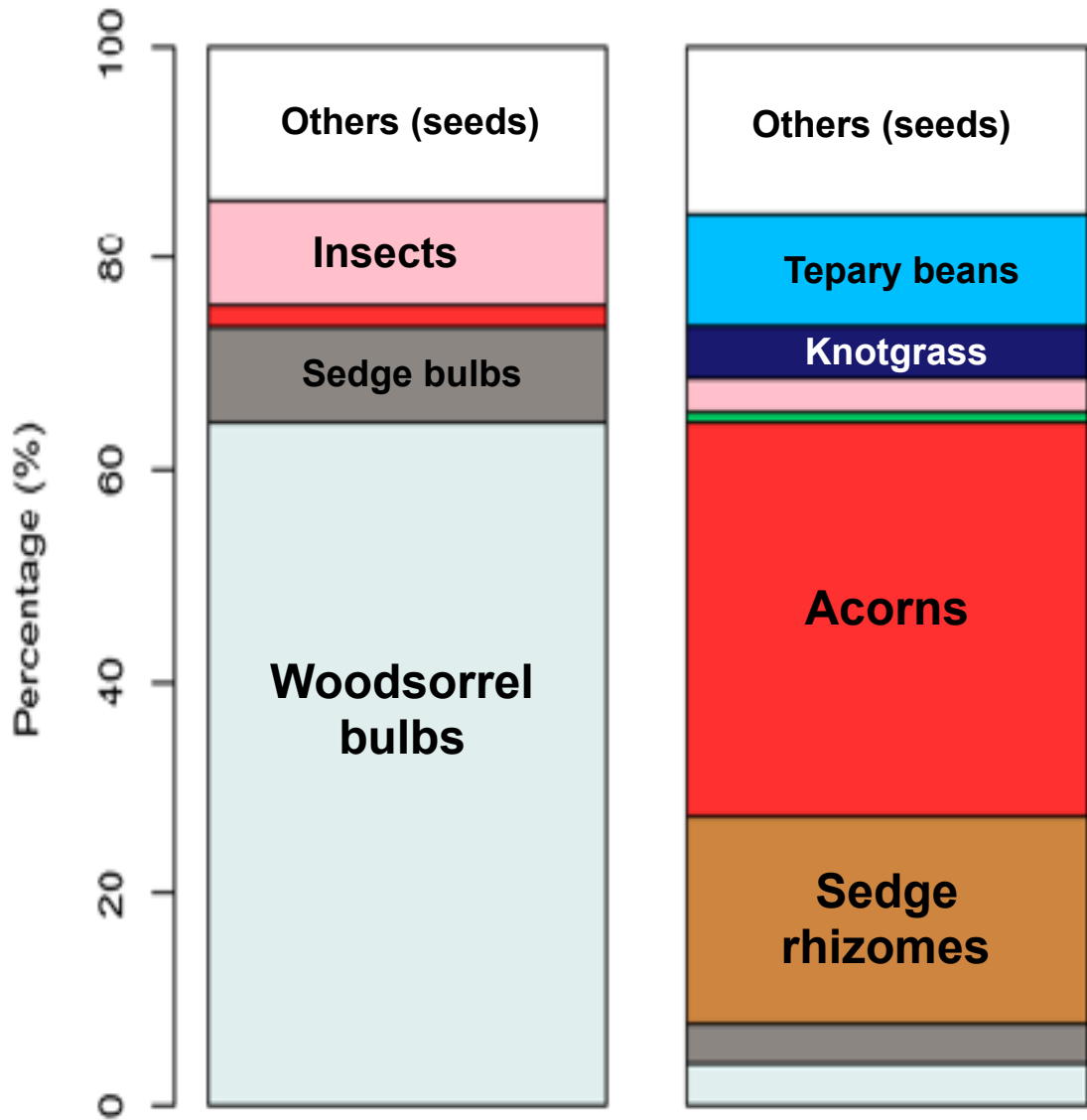
# Covey size decreases during winter



# Daily feeding pattern

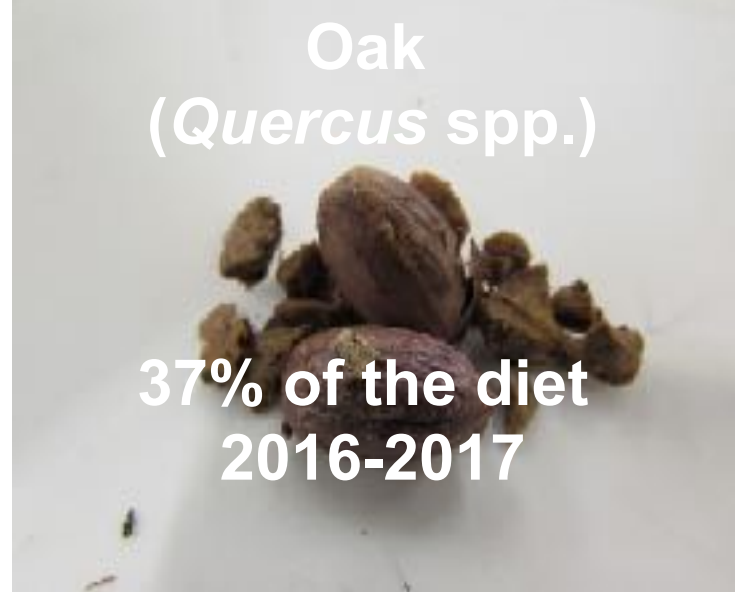






Bishop and Hungerford (1965)

Arizona (16-17)





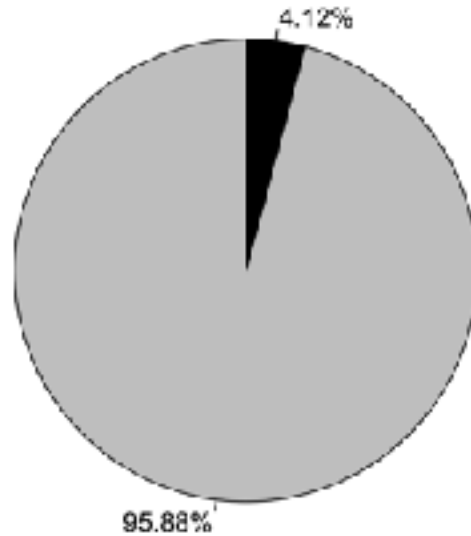
Woodsorrel bulbs  
*Oxalis* spp.

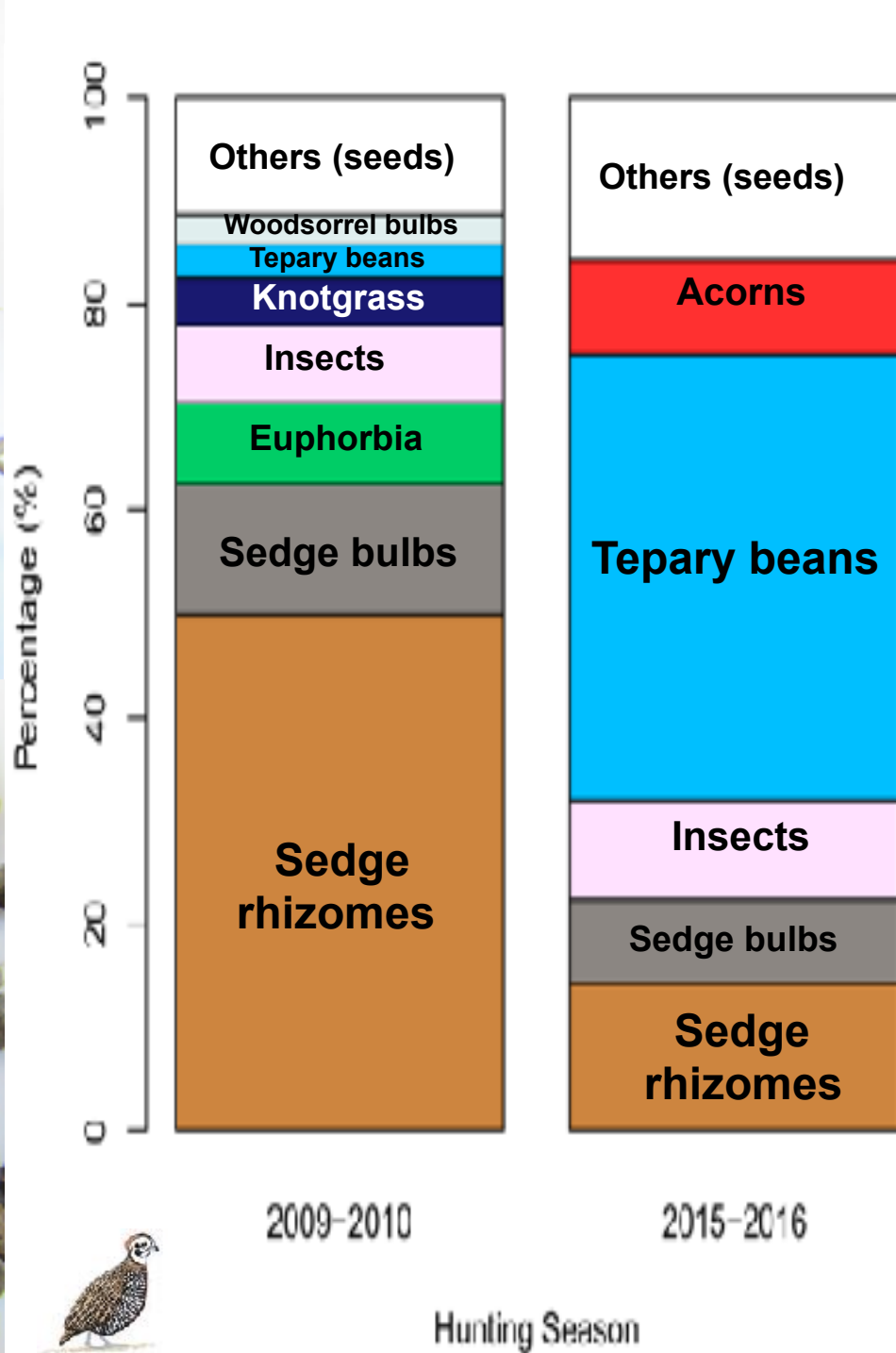
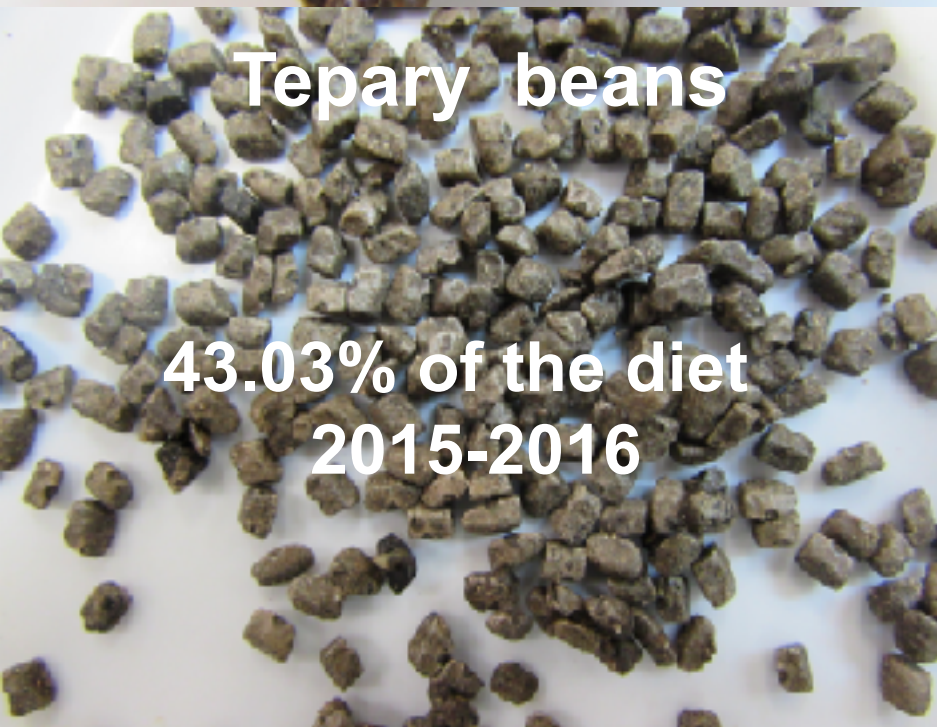


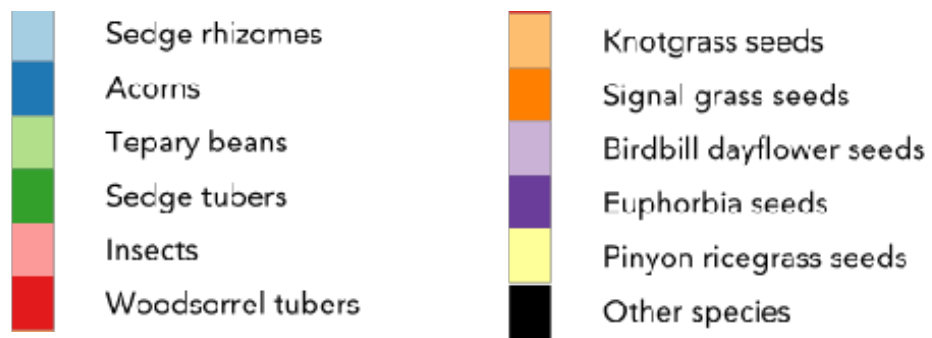
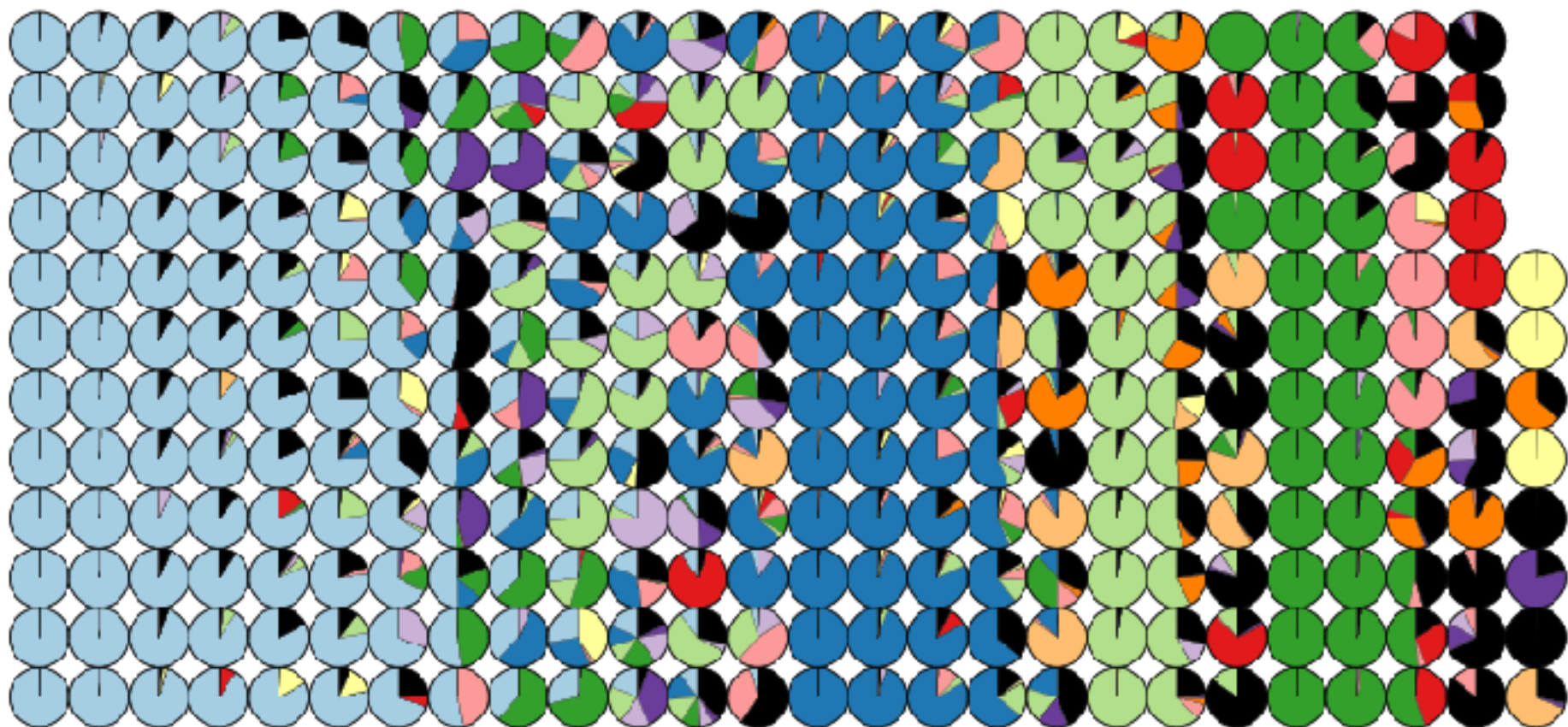
**Bishop y Hungerford (1965)**



**Arizona (2016-2017)**







*Liorhyssus hyalinus*  
Hemiptera: Rhopalidae



Soil centipede  
Geophilomorpha

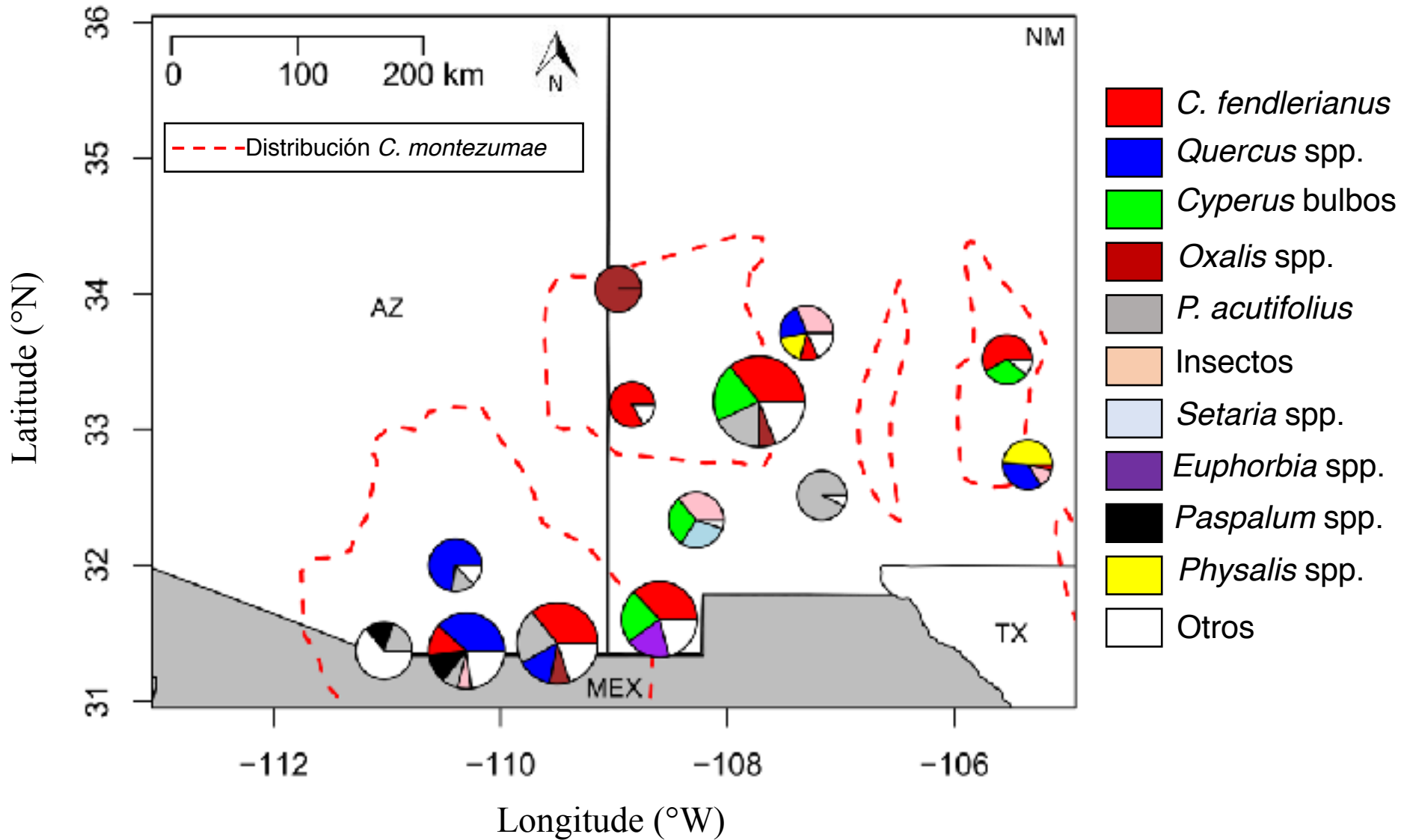


*Melanoplus* spp.  
Orthoptera: Acrididae



*Disonycha glabrata*  
Coleoptera: Chrysomelidae

# Geographic variation in Montezuma quail diet composition



# Effect of environmental and ecological factors on Montezuma quail diet composition

	Explanatory Variables							
	<i>T</i>	<i>P</i>	<i>E</i>	<i>Lat</i>	<i>Lon</i>	<i>H<sub>B</sub></i>	<i>H<sub>L</sub></i>	<i>t</i>
Sedge rhizomes	0	---	0	---	0	+++	++	+++
Acorns	+++	0	+++	+++	---	--	---	+++
Tepary beans	++	0	++	0	--	0	++	++
Sedge bulbs	---	0	--	--	0	0	0	0
Insects	++	--	+	0	0	0	0	0
Woodsorrel bulbs	0	0	0	0	0	0	0	0
Birdbill seeds	0	0	+	0	0	++	0	0
Euphorbia seeds	0	0	0	0	0	+++	-	0



# Conclusions

The composition of winter diet in Montezuma quail is highly variable in time

Montezuma quail is not a specialist on woodsorrel (*Oxalis* spp.) bulbs

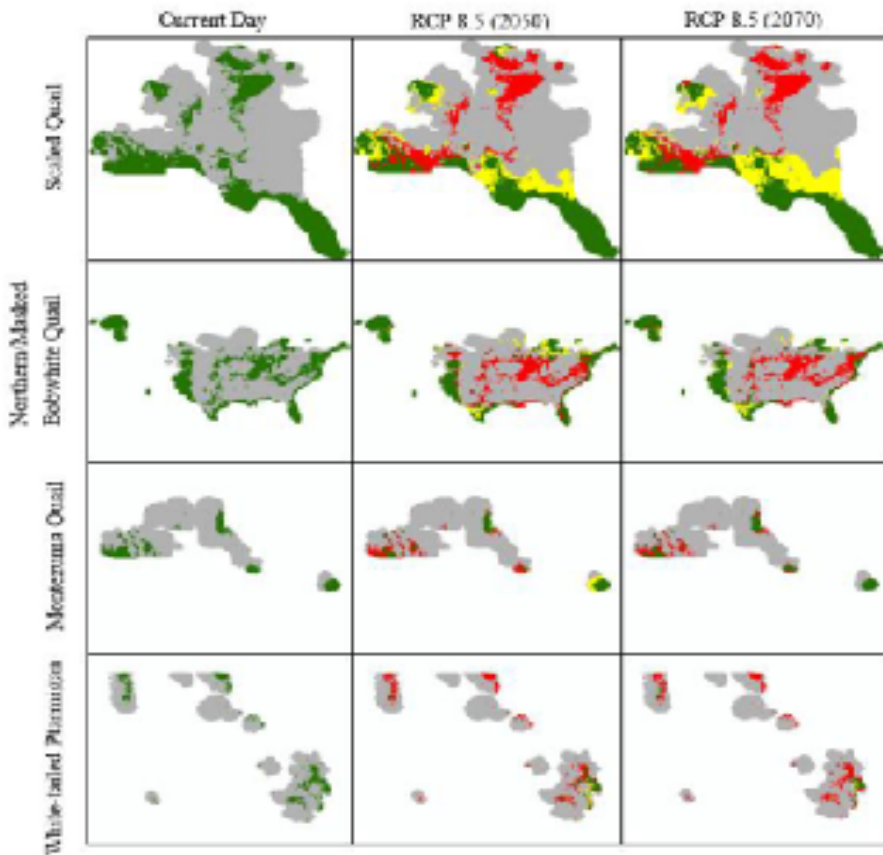
Variation on the diet of Montezuma quail depends on the availability of resources :

Temperature and humidity  
Altitude, latitude and longitude



# Recommendation

The Montezuma quail and others quail species are projected to be highly susceptible to climate change and appeared to be the most concern species in southwest and central United States (Salas et al., 2017)



It is important to continue investigating the ecology of Montezuma quail:

- ✓ Maintain their populations in the northern limit of it's distribution, where it is expected to be more arid in the future.

# Acknowledgements

- Universidad Estatal de Sonora
- Universidad de Sonora
- Arizona Quail Alliance, Inc.
- Southern Arizona Quail Forever
- New Mexico Quail, Inc.
- Timken Foundation
- CONACyT
- Patrick Alexander (Bureau of Land Management)
- Numerous anonymous hunters and guides including: D. Kavannagh and S. Hopkins



# Montezuma quail populations

