

Countless Creatures of the Caverns: A Spelunking into Virginia Cave Spider Diversity

Casey Venable and Dr. Marc Milne
March 18, 2023

Caves are islands

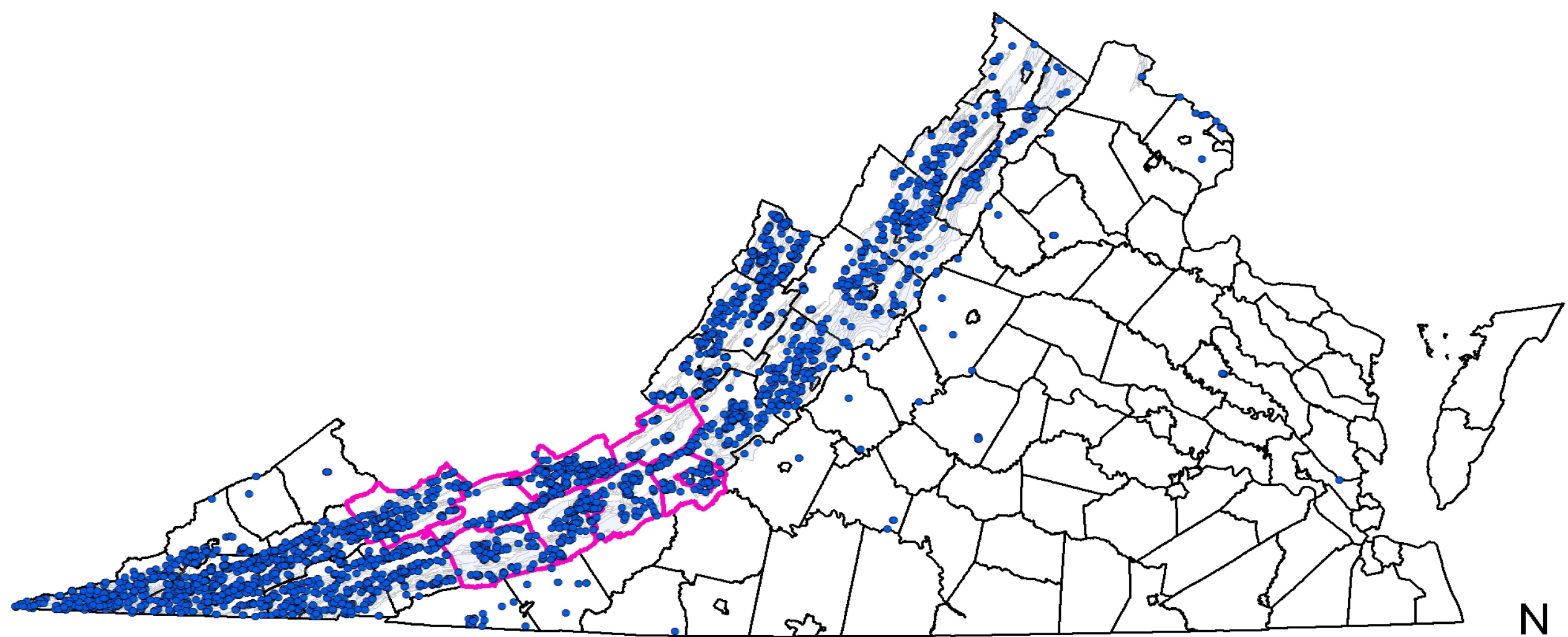
- Caves → allopatric speciation opportunities for geographically-limited species
 - **Short-range endemics**
- Appalachian caves number in the tens-of-thousands (Ex: Tennessee)



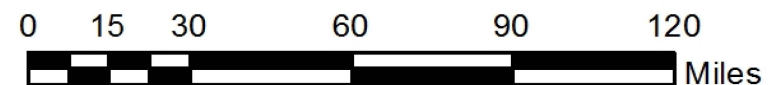


Virginia caves

- 2,900+
- Most are in soluble carbonate rock (e.g., limestone) in Western part of state
- Acidic groundwater + carbonate rock → large cavities
- ~200 cave-limited species, 150 of which are globally rare.



**New River Karst Region of Virginia
with carbonate rocks and caves**





Spiders as cave-dwellers

- Many species live their entire lives in caves → **troglobionts**
 - Some spend part of their lives in caves → **troglophiles**
- Troglobionts often...
 - ...have reduced eyes,
 - ...have reduced pigmentation, and
 - ...are tiny.

Purpose

- Caves hold significant, rare biological fauna that is often threatened by pollution, human encroachment, and vandalism
- Study began in 2018
- Foci:
 - Develop a more accurate **conservation** framework for Virginia's cave and karst
 - Assess the degree to which these resources are currently protected
 - Promote public awareness of the Natural Heritage Cave Resources of Virginia and the importance of their **conservation**.



Methods

~**235** caves across Western Virginia, each sampled once by hand

Identification done via various keys and comparisons to known species.



Example(s) of Taxonomy Process – Cave Spiders

family



Family can be determined by carapace shape, eye pattern, and size and number of claws.

genus



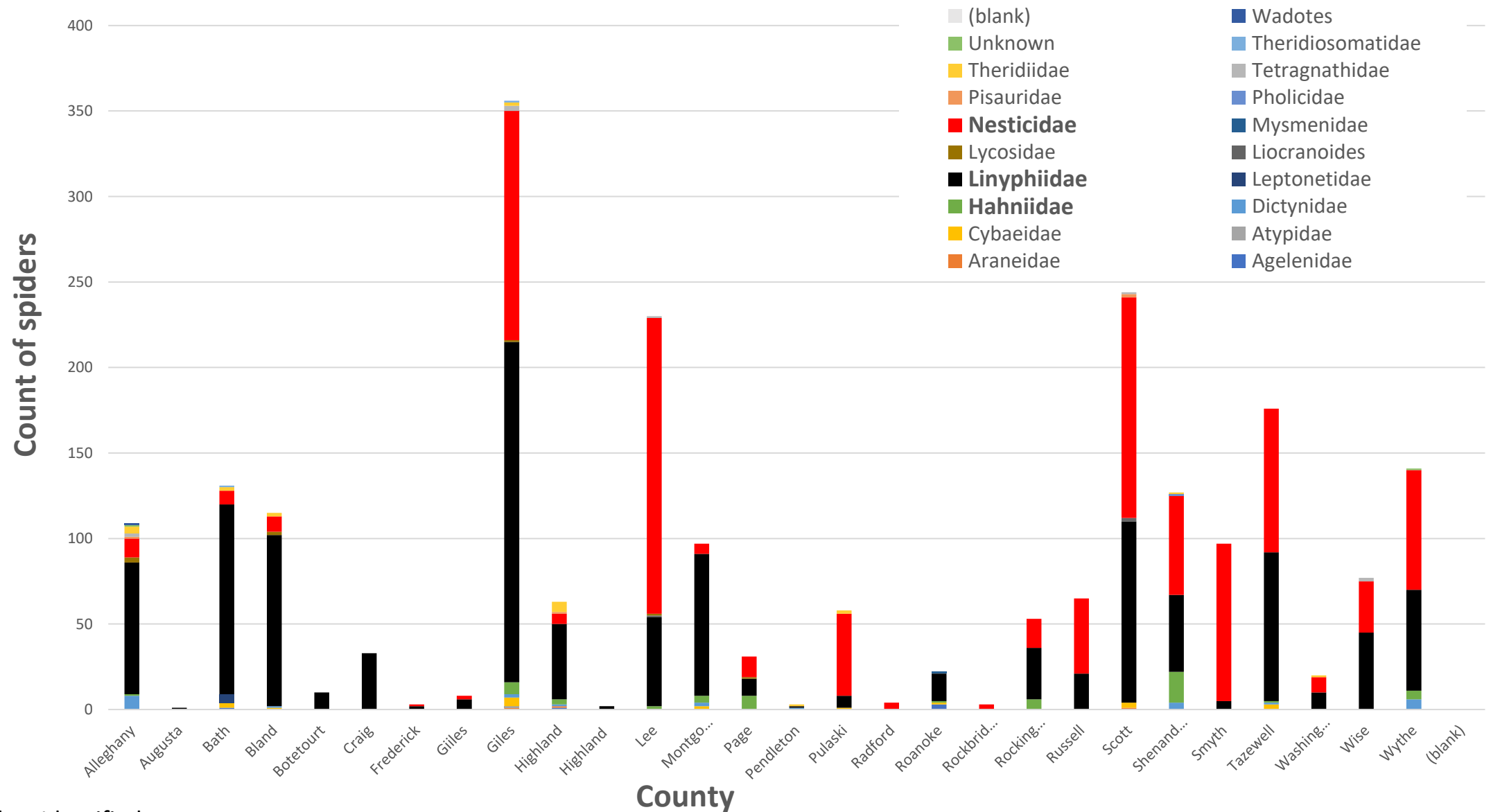
Genus can be determined by observation of abdomen patterning, observation of seta (hairs) and spines on legs, and a presence of a ventral comb.

species



Species can be determined by examining genitalia. For Females I would examine the scape, median septum, epigynal pockets of the epigynum. For identification of males observe the paracymbium, embolus, and other structures on the pedipalps.

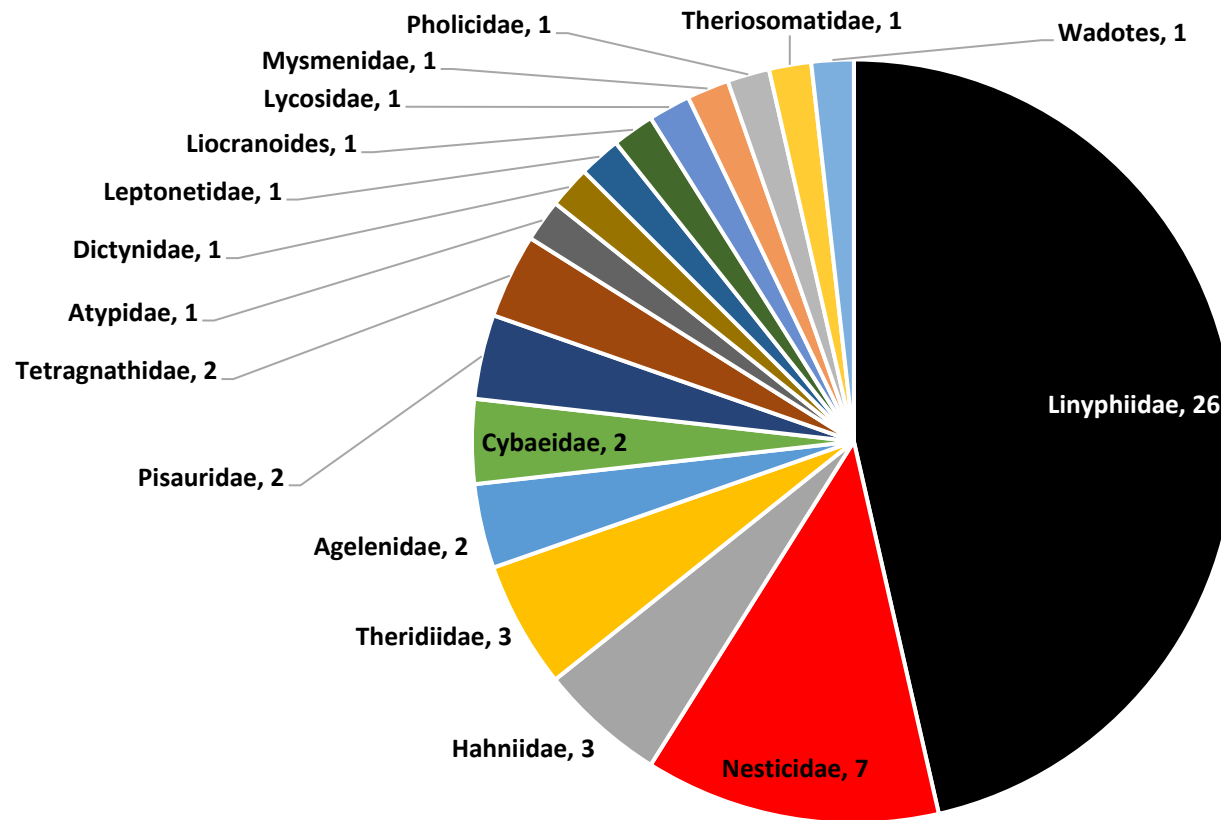
Results: Family Data Count – By County*



235 Caves*
28 Counties
2280 Total Spiders Identified

Results: Species Diversity – All Caves*

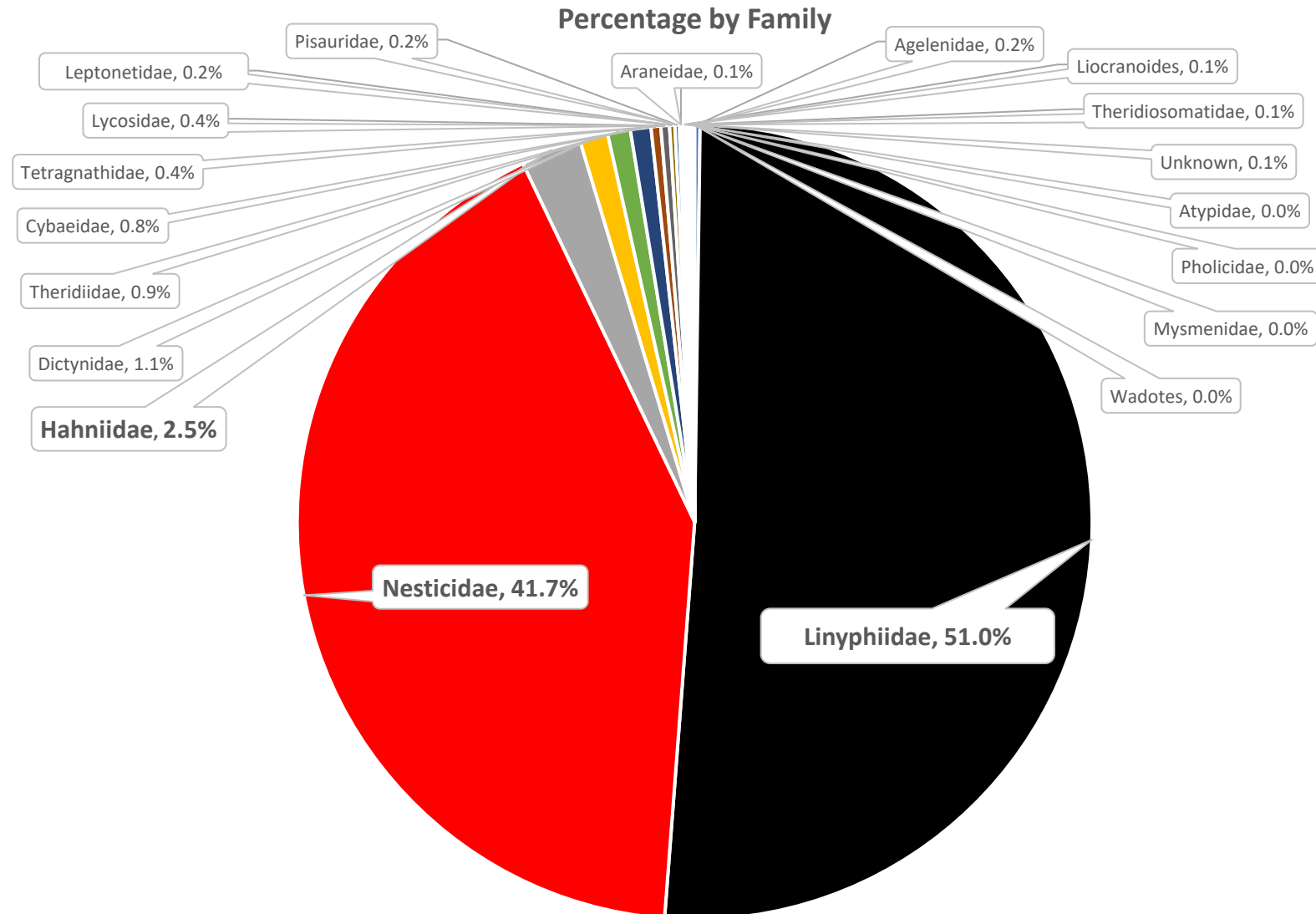
Count of Species within Family



Species	Count
Linyphiidae	26
Nesticidae	7
Hahniidae	3
Theridiidae	3
Agelenidae	2
Cybaeidae	2
Pisauridae	2
Tetragnathidae	2
Atypidae	1
Dictynidae	1
Leptonetidae	1
Liocranoides	1
Lycosidae	1
Mysmenidae	1
Pholcidae	1
Theriosomatidae	1
Wadotes	1

235 Caves*
 28 Counties
 2280 Total Spiders Identified

Results: Family Percentage – All Caves*



235 Caves*
 28 Counties
 2280 Total Spiders Identified

Summary of Taxonomy Findings / New Species

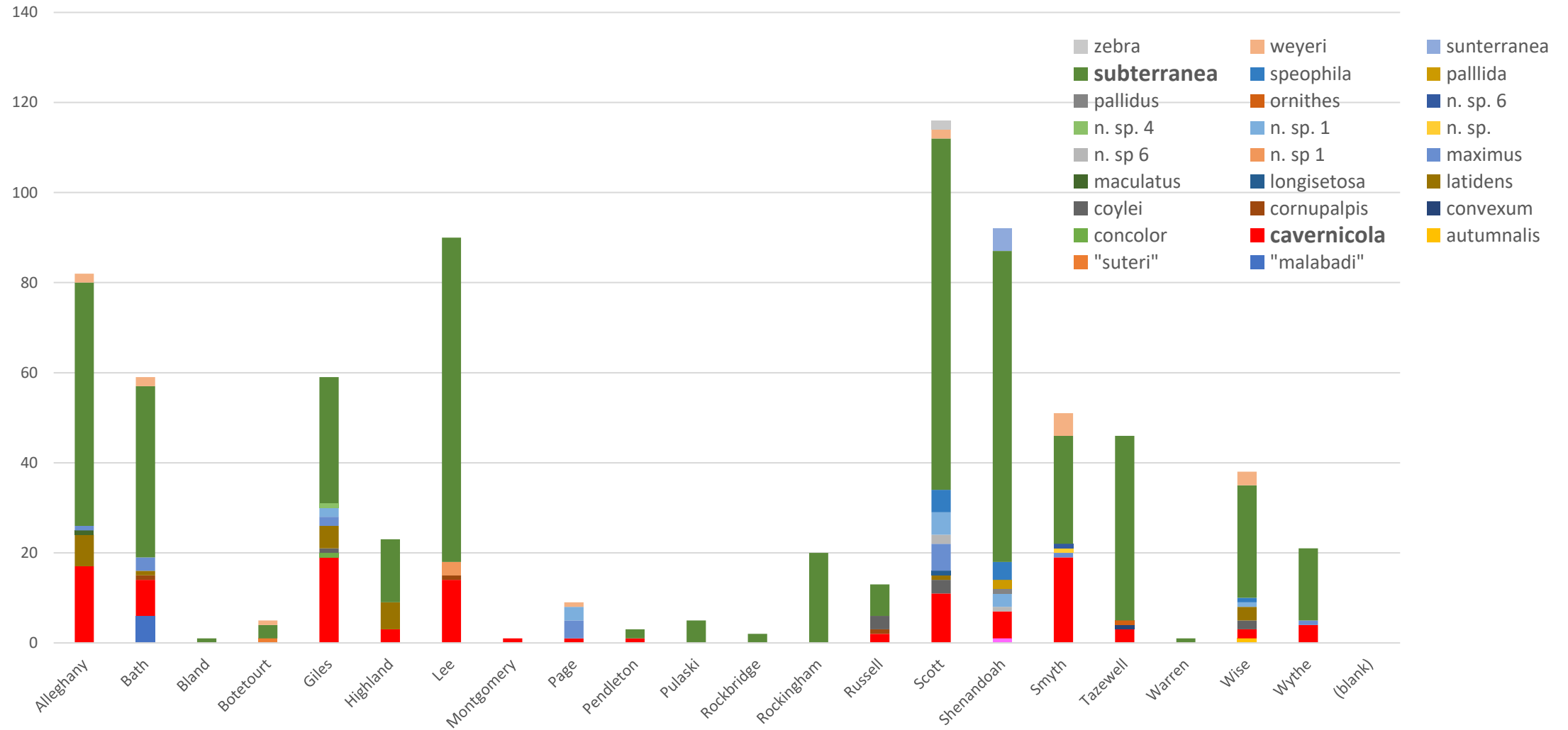
Taxonomy Results
18 Families Identified
40 Genera Identified
56 Species Identified
8 Undescribed (New) Species

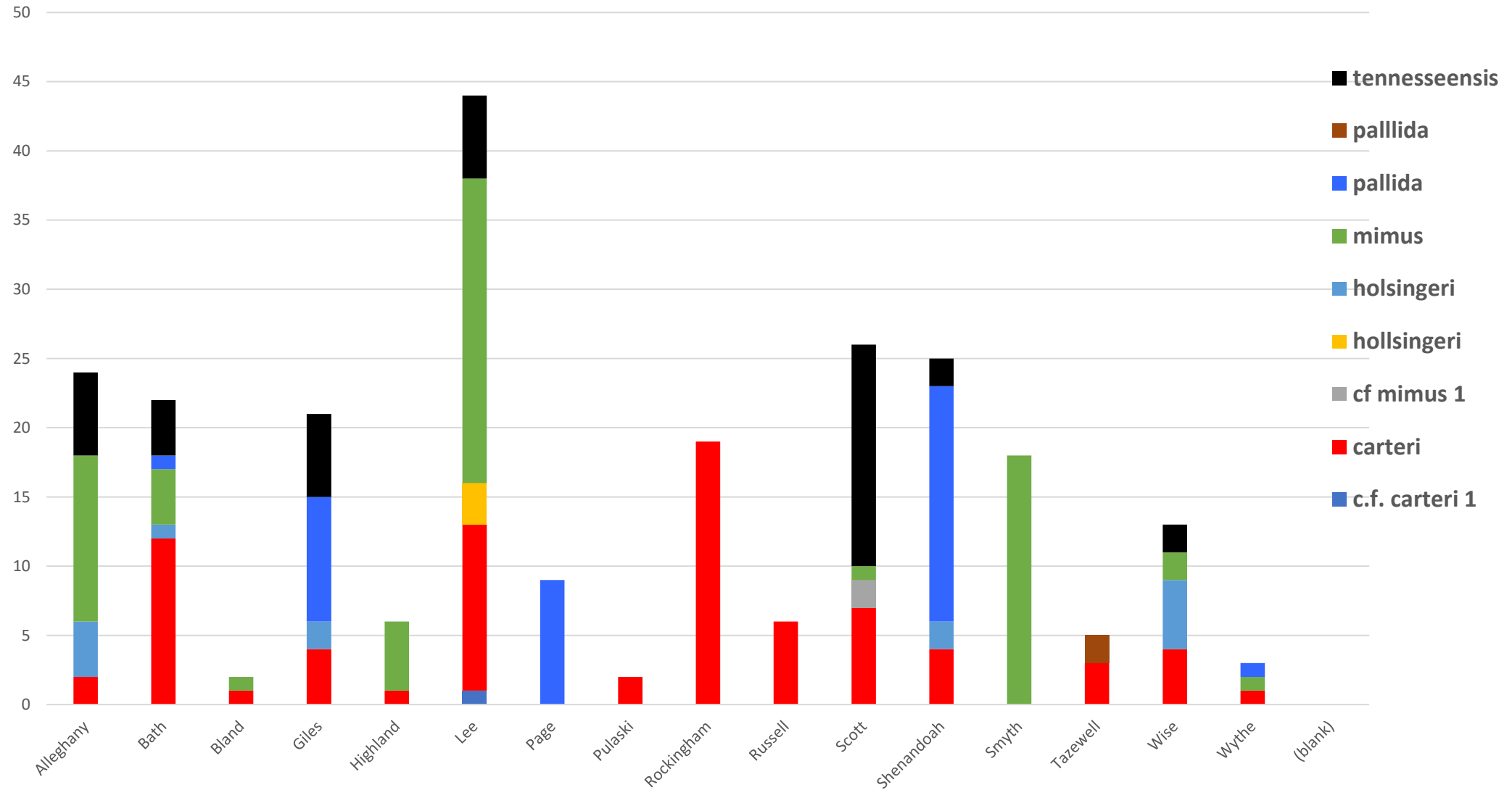


NEW SPECIES IDENTIFIED

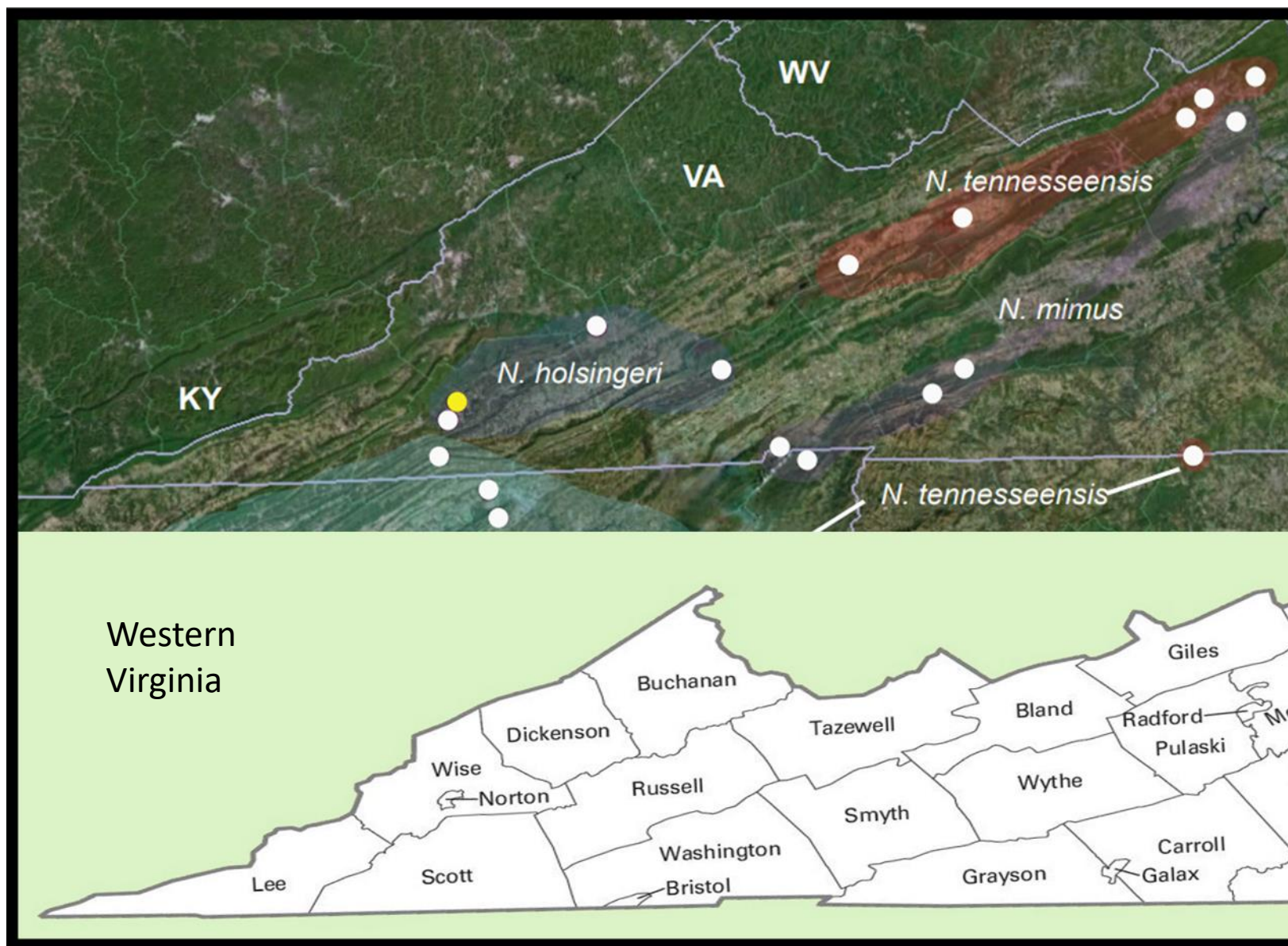
Family	Genus	Unique (New) Species
Hahniidae	Cicurina	cf pallida
Linyphiidae	Agyneta	n. sp. 1
Linyphiidae	Islandiana	n. sp. 4
Linyphiidae	Centromerus	n. sp.
Linyphiidae	Islandiana	n. sp. 6
Linyphiidae	Collinsia	n. sp. 1
Linyphiidae	Tenuiphantes	"malabadi"
Linyphiidae	Gnathonaroides	"suteri"
Linyphiidae	Lepthyphantes	n. sp 1
Nesticidae	Nesticus	cf mimus 1
Nesticidae	Nesticus	c.f. carteri 1

Linyphiidae species – By County





Distribution of *Nesticus*

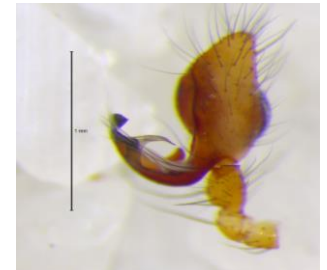


Nesticidae *Nesticus* Spiders



Nesticidae *Nesticus carteri*:
F Habitus view , M Habitus view,
F epigynum, M pedipalp dorsal view

Nesticus carteri female epigynum - VA Broomer
Cave VMNH 11mgs (002)



Nesticidae *Nesticus holsingeri* :
F Habitus view , M Habitus view,
F epigynum, M pedipalp dorsal view

Nesticus holsingeri male habitus - Concrete Tank
Cave VA (002)



Nesticidae *Nesticus tennesseensis* :
F Habitus view , M Habitus view,
F epigynum, M pedipalp dorsal view

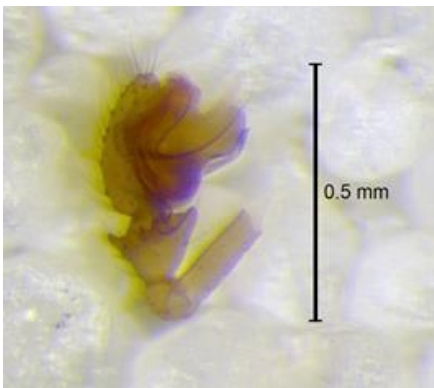
Nesticus tennesseensis female habitus -
Hancock Blowhole Cave VA (002)



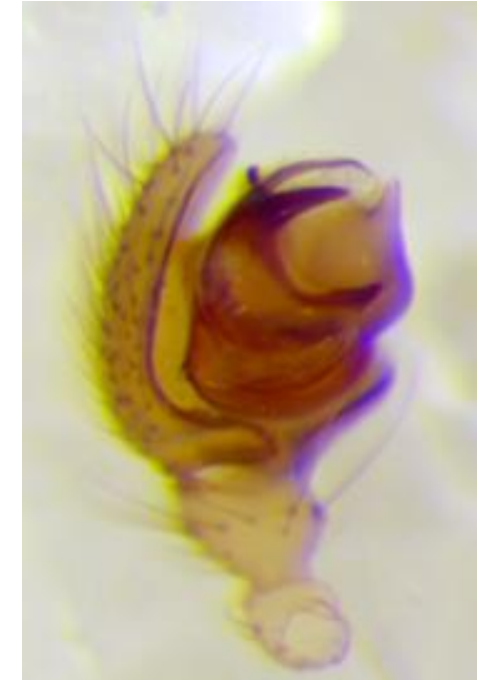
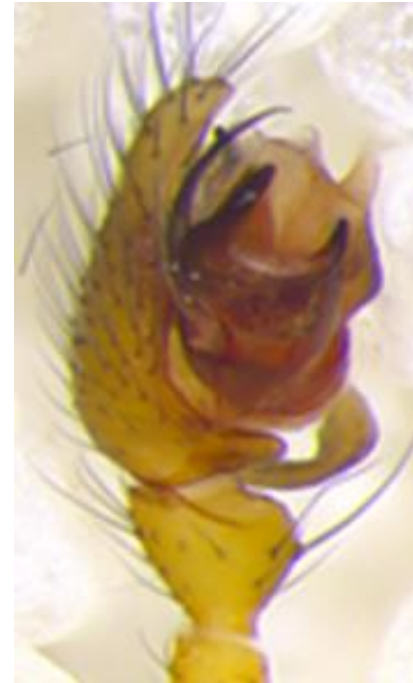
Nesticidae *Nesticus Mimus* :
F Habitus view , M Habitus view, F
epigynum, M pedipalp dorsal view

Nesticus mimus male habitus - Deep Spring
Cave VA (002)

Common Linyphiidae species



Linyphiidae *Phanetta subterranea* habitus view of M and F, epigynum of F, pedipalp of M. This was the most common species found.



Linyphiidae *Porrhomma convexum* habitus view of M and F, epigynum of F, pedipalp of M. could later differentiate from presence of eyes.

Linyphiidae *Porrhomma cavernicola* habitus view of M and F, epigynum of F, pedipalp of M. Notice c shaped embolus

Agyneta n.sp. 1 (Duperre)



Agyneta n. sp. 1 female



Agyneta n. sp. 1 epigynum



Agyneta n. sp. 1 male

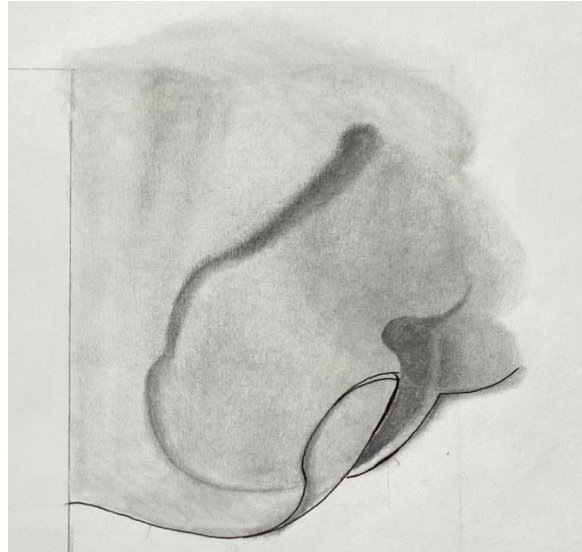


Agyneta n. sp. 1 pedipalp

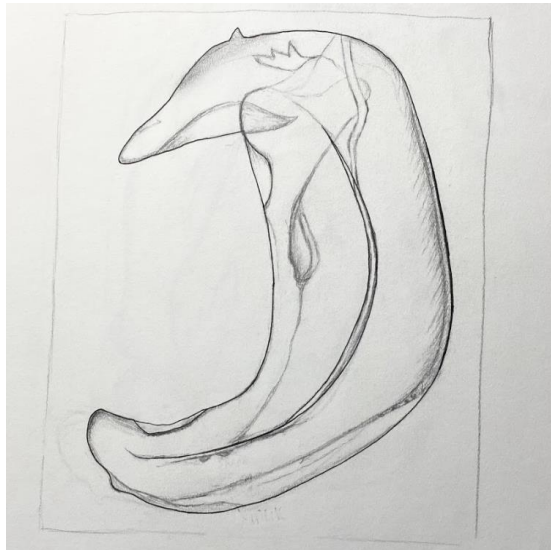
Agyneta n.sp. 1 (Duperre) Drawings



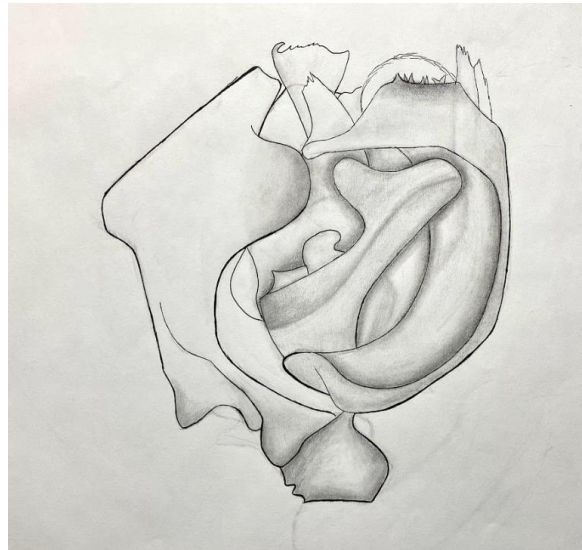
Agyneta (undescribed species #1) male radix



Agyneta (undescribed species #1) epigynum



Agyneta (undescribed species #1) embolus



Agyneta (undescribed species #1) pedipalp

Tenuiphantes “malibadi”



Tenuiphantes “malibadi” female



Tenuiphantes “malibadi” epigynum



Tenuiphantes “malibadi” male



Tenuiphantes “malibadi” pedipalp

Lepthyphantes n.sp. 1



Lepthyphantes n. sp. 1 female



Lepthyphantes n. sp. 1 epigynum



Lepthyphantes n. sp. 1 male

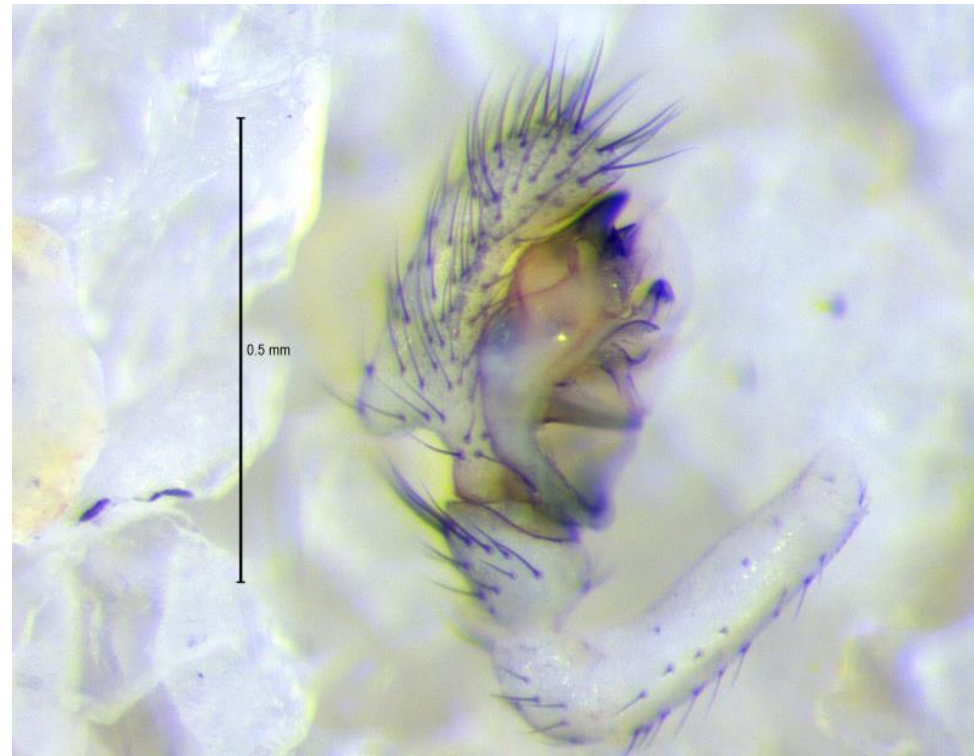


Lepthyphantes n. sp. 1 pedipalp

Centromerus n. sp. 1 → females represent a new species! Where is the female!?



Centromerus n. sp. 1 male



Centromerus n. sp. 1 pedipalp

Islandiana n. sp. 4 → females represent a new species! Where is the male!?



Islandiana (n. sp. 4) female



Islandiana (n. sp. 4) epigynum

Islandiana n. sp. 6 → females represent a new species! Where is the male!?



Islandiana (n. sp. 6) female

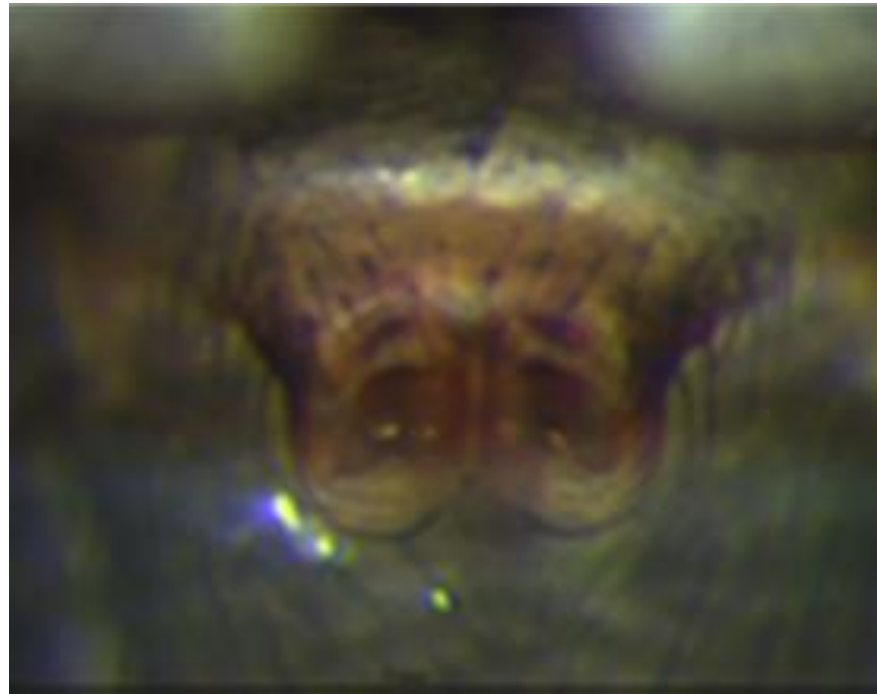


Islandiana (n. sp. 6) epigynum

Oedothorax Maximus female is undescribed,
male is described



Oedothroax maximus female



Oedothorax maximus epigynum

Islandiana speophila → we found the male!
(undescribed)



Islandiana speophila male



Islandiana speophila

(Unknown genus) female; where is the boy!?



(Unknown genus) female



(Unknown genus) epigynum

Conclusions

- The Virginia cave spider fauna is diverse and vastly underexplored
- The project continues with more sampling and identification
- Some undescribed species are currently in the process of being described and published
- Work may lead to conservation regulations for more cave habitats.



A man with a grey beard and a red helmet with a headlamp is looking down at a small green salamander on a rock. The background is dark and blurry, suggesting an underground or cave environment.

Acknowledgements

- Tom Malabad
- Wil Orndorff
- Katarina Kosič Ficco
- Brandon Rhim
- Virginia Department of Conservation and Recreation

The background of the slide is a photograph of a cave interior. The cave walls are covered in various rock formations, including stalactites and stalagmites. The floor is uneven and rocky. Several bright lights are visible, casting a warm glow on the cave's interior. The overall atmosphere is mysterious and ancient.

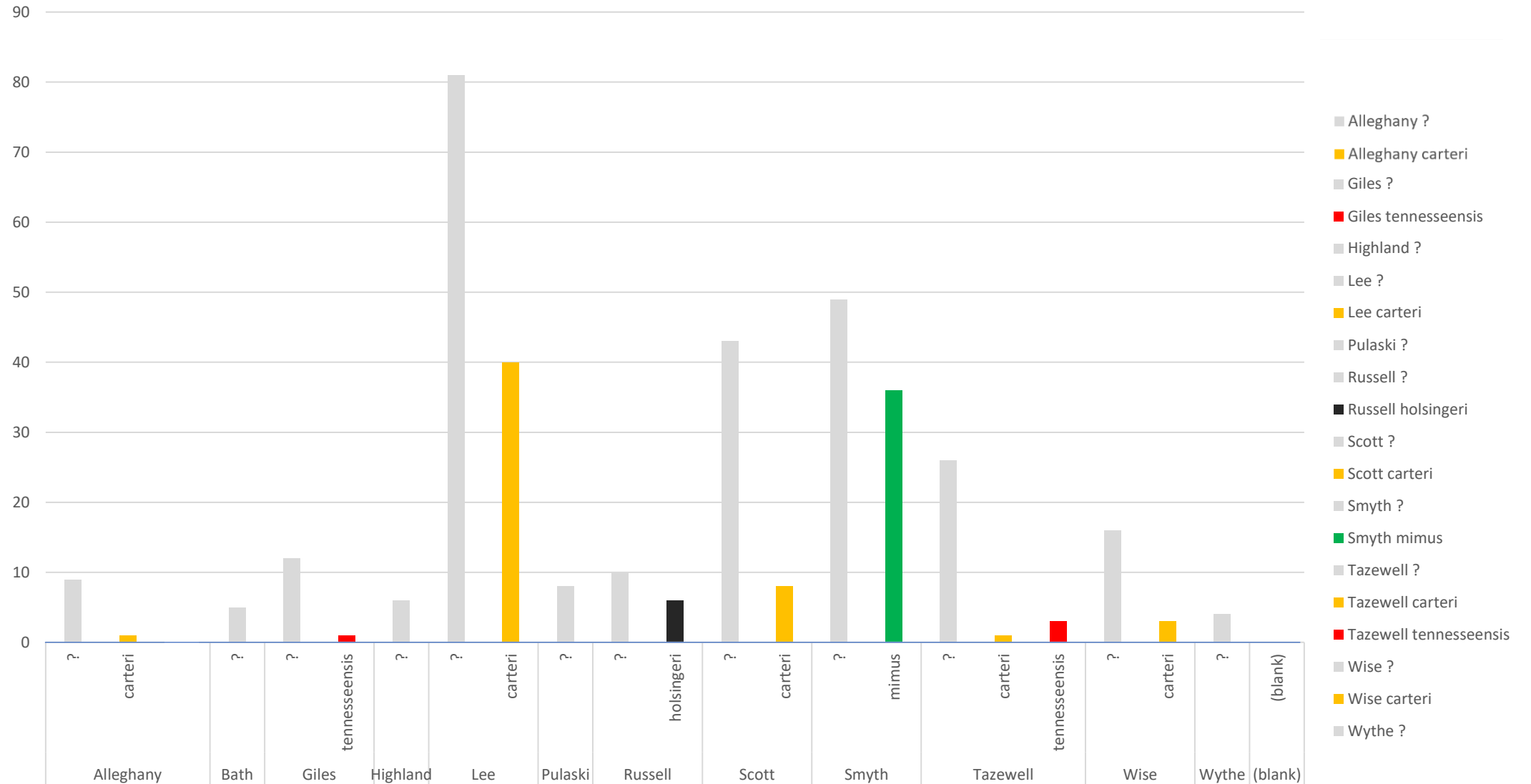
Thank You

Addendum

- Nesticidae (w/Immature Spiders)
- NRV Family Data: (Data Set #1)
- Non-NRV Family Data: (Data Set #2)
- Virginia Family Data: (Data Set #3)
- Spider Photographs

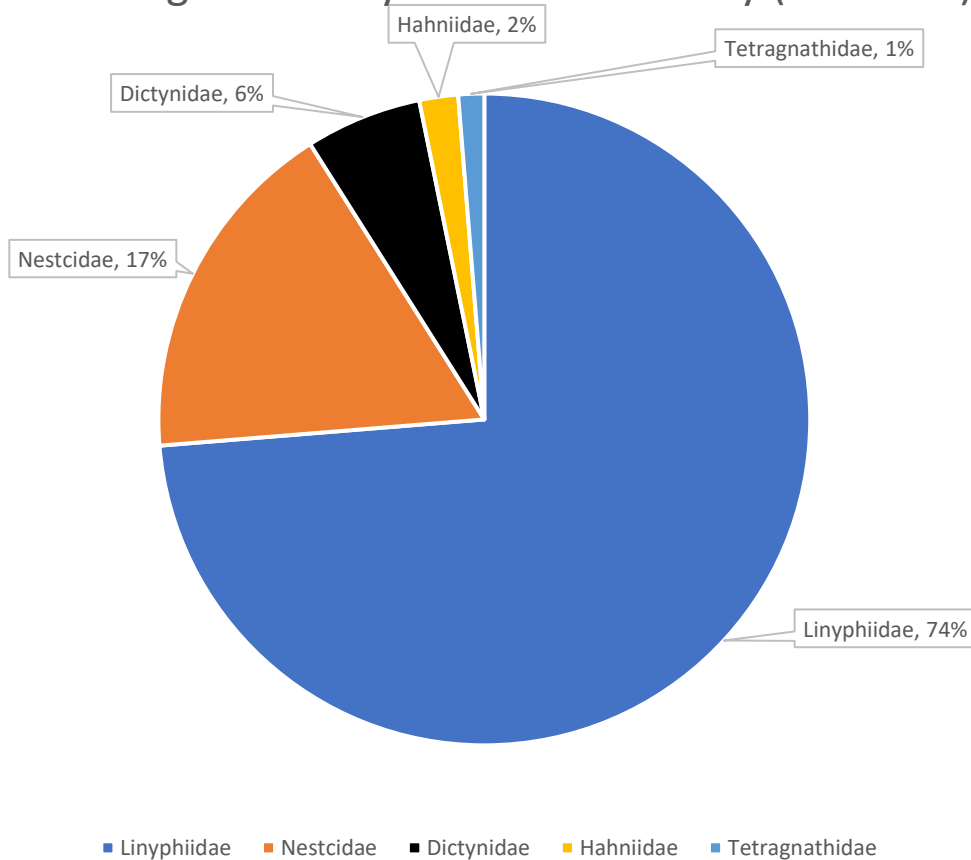
Nesticidae (w/Immature Spiders)

Nesticidae Species Variation by County (All Caves)



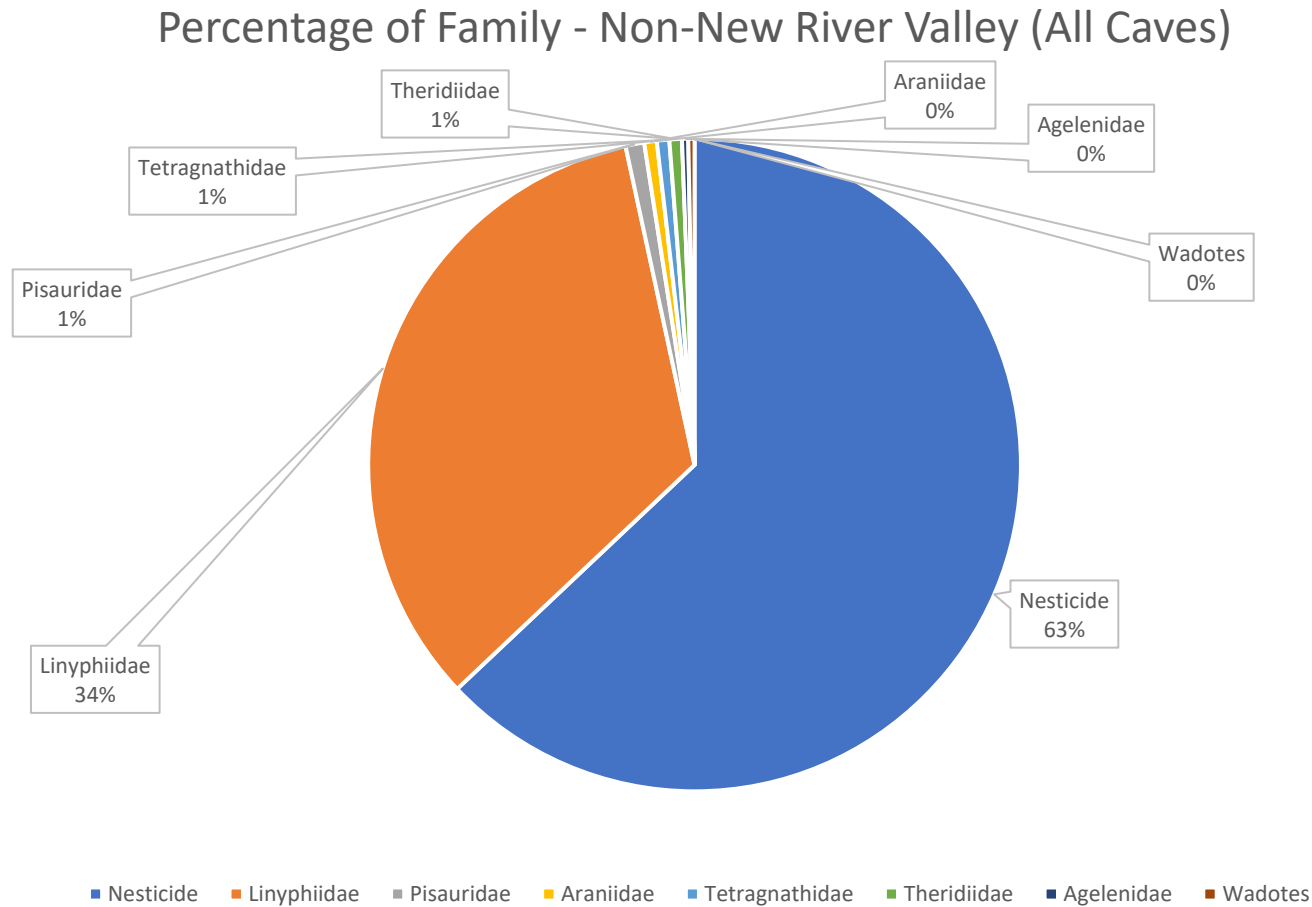
NRV Data – All Caves (Data #1)

Percentage of Family - New River Valley (All Caves)



FAMILY	COUNT	%
Linyphiidae	115	74%
Nestcidae	27	17%
Dictynidae	9	6%
Hahniidae	3	2%
Tetragnathidae	2	1%
Total	156	

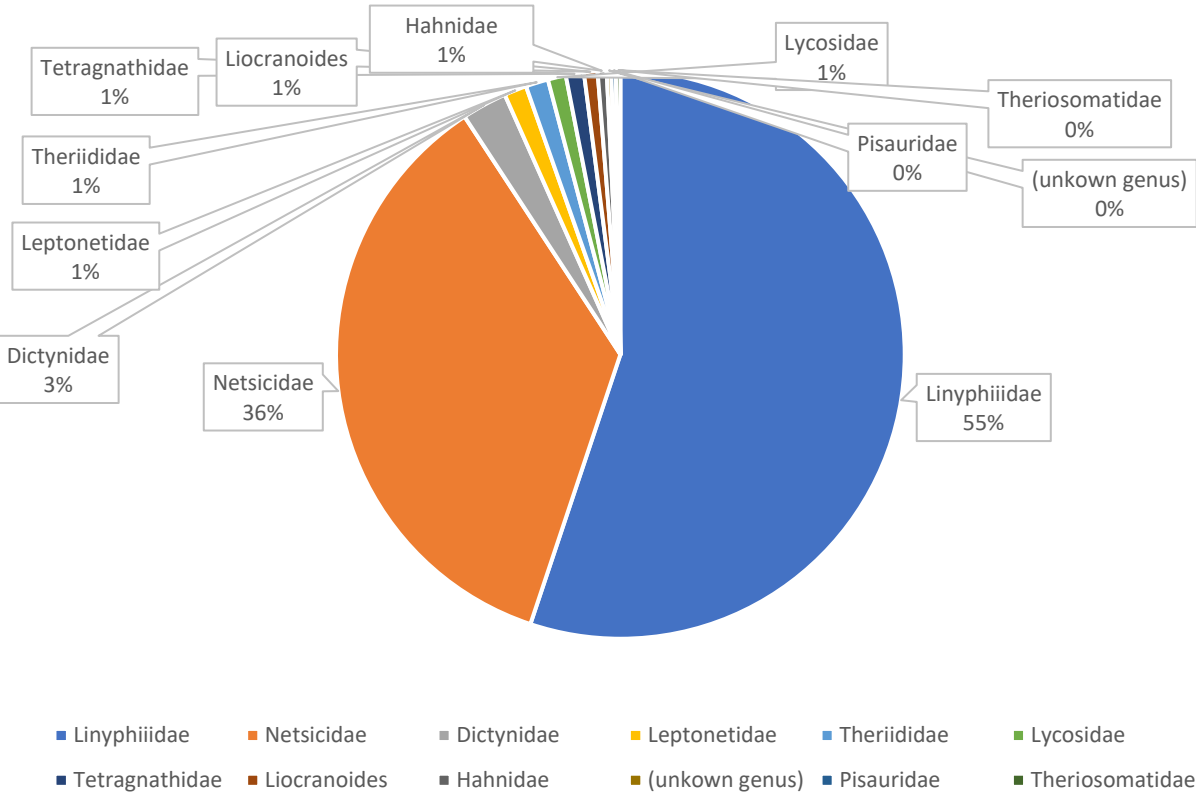
Non-NRV Areas (Data #2)



Family	Count	%
Nesticidae	204	63%
Linyphiidae	109	34%
Pisauridae	3	1%
Araniidae	2	1%
Tetragnathidae	2	1%
Theridiidae	2	1%
Agelenidae	1	0%
Wadotes	1	0%
	324	

Virginia Data #3

Percentage of Family – Virginia (Data #3) All Caves



Family	Count	%
Linyphiidae	215	55%
Netscidae	139	36%
Dictynidae	10	3%
Leptonetidae	5	1%
Theriididae	5	1%
Lycosidae	4	1%
Tetragnathidae	4	1%
Liocranoides	3	1%
Hahnidae	2	1%
(unkown genus)	1	0%
Pisauridae	1	0%
Theriosomatidae	1	0%