City of Austin Balcones Canyonlands Preserve
Cave Invertebrate Species Trends

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Introduction

The Balcones Canyonland Preserve protects many caves containing endangered species, species of concern, as well as other rare cave invertebrate species. The City of Austin and Travis County perform cave faunal surveys on caves managed by each entity. This report covers species trends for ten species found in City of Austin managed caves.

Methods

Faunal surveys are done following the guidelines in *Conducting Presence/Absence Surveys for Endangered Karst Invertebrates in Central Texas* (USFWS 2015). Most caves are surveyed twice a year while some are surveyed annually. The City's cave faunal data for some caves goes back as far as the 60s and 70s. Though this historical data is informative, there is a lot of information missing about how it was collected which makes it difficult to compare to our current data. In 2010 the City and County standardized faunal surveys. A schedule of when each cave would be surveyed was created and all the cave surveys zones were delineated. For this reason, the following analysis ignores data prior to 2010. Some caves were added to the schedule after 2010, and all data is analyzed for these caves. Table 1. shows the ten species and the caves in which faunal surveys are performed. *Texella reyesi* was excluded from this analysis since it was covered in attachment C of the City of Austin Bone Cave Harvestman report (City of Austin, BCP 2020). *Texella reddelli* caves North of the Colorado River we excluded since new genetic work indicates that they are actually *Texella reyesi* (Hedin & Derkarabetian 2020). Counts of *Rhadine persephone* and *Rhadine subterranea* from Pond Party Pit were excluded due to many records only identified to genus. Linear regressions were performed in Excel to identify trends. Trend lines are only shown for significant trends.

	Airmen's Cave	Arrow Cave	Blowing Sink Cave	Broken Arrow Cave	Cave Y	Cortana Cave	Cotterell Cave	District Park Cave	Flint Ridge Cave	Get Down Cave	Jester Estates Cave	Little Bee Creek Cave	Maple Run Cave	Midnight Cave	Millipede Annex Cave	Millipede Cave	Pond Party Pit	Seibert Sink	Slaughter Creek Cave	Spider Cave	Stovepipe Cave	Testudo Tube
Rhadine persephone				X																X	X	X
Rhadine subterranea				X			X															X
Rhadine austinica	X	X	X		X			X	X	X			X	X				X	X			
Tartarocreagris texana											X											
Tartarocreagris attenuata																					X	
Tartarocreagris infernalis							X										X					
Tayshaneta myopica						X					X				X	X						
Texamaurops reddelli																					X	
Texella reddelli												X										
Texella spinoperca	X																	X				

Table 1. Species and Caves covered in this report.

Rhadine persephone

Figure 1. *Rhadine persephone* in Wilcox Cave #1, 11/1/2018, by Colin Strickland.

None of the trends in the four caves with *Rhadine persephone* were significant. Count data for each cave can be seen in Figures 2 through 5.

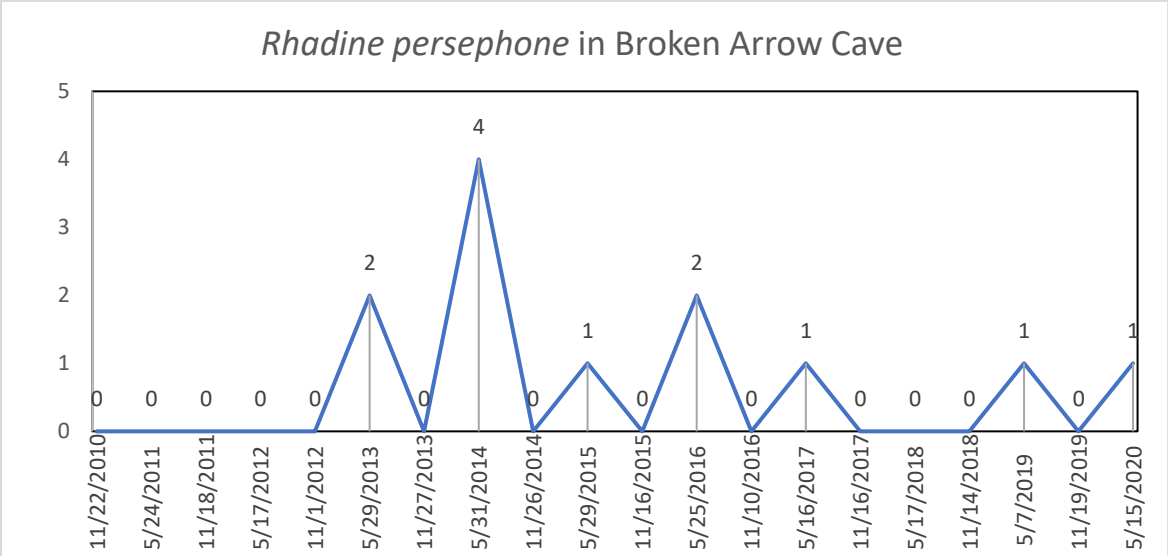

Figure 2. Counts of *Rhadine persephone* in Broken Arrow Cave. No significant trend was found in the number of *Rhadine persephone* observed in Broken Arrow Cave since 11/22/2010, $r(18) = .037$, $p = 0.93$.

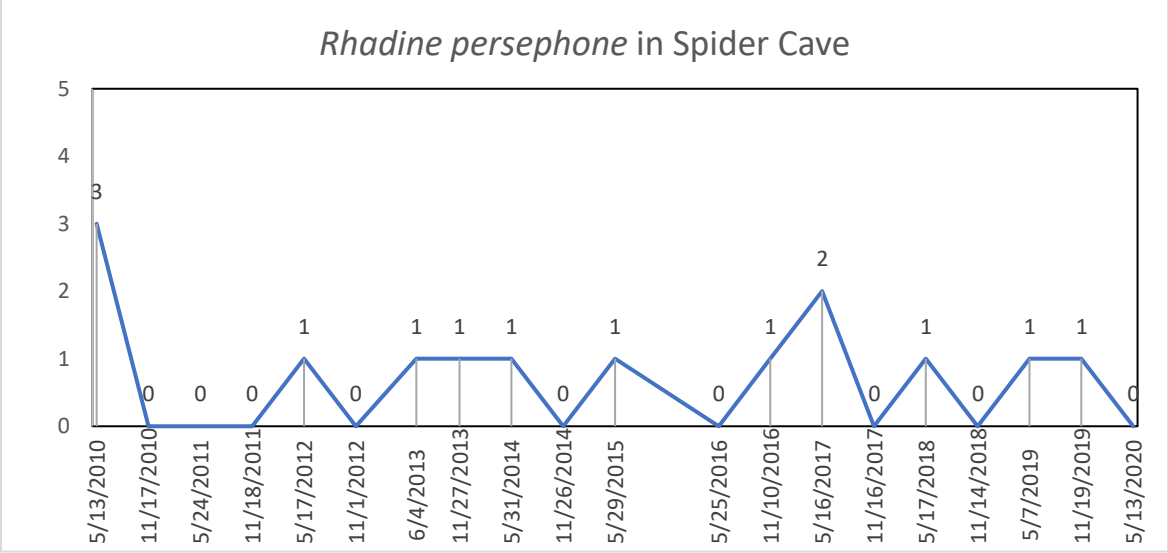

Figure 3. Counts of *Rhadine persephone* in Spider Cave. No significant trend was found in the number of *Rhadine persephone* observed in Spider Cave since 5/13/2010, $r(18) = .11$, $p = 0.65$.

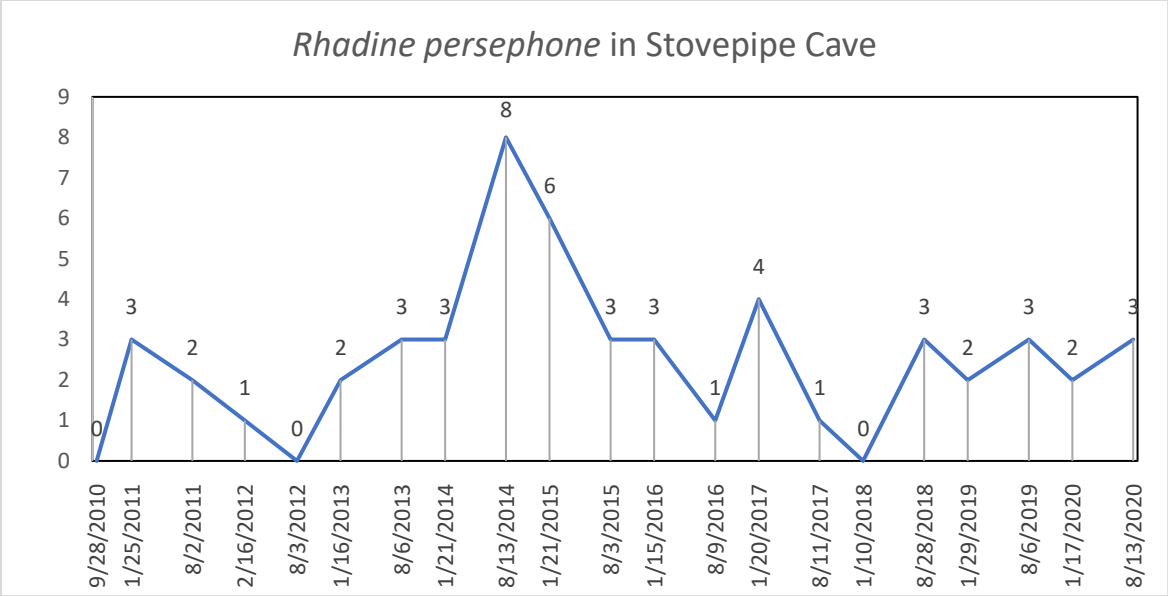

Figure 4. Counts of *Rhadine persephone* in Stovepipe Cave. No significant trend was found in the number of *Rhadine persephone* observed in Stovepipe Cave since 9/28/2010, $r(19) = .090$, $p = 0.70$.

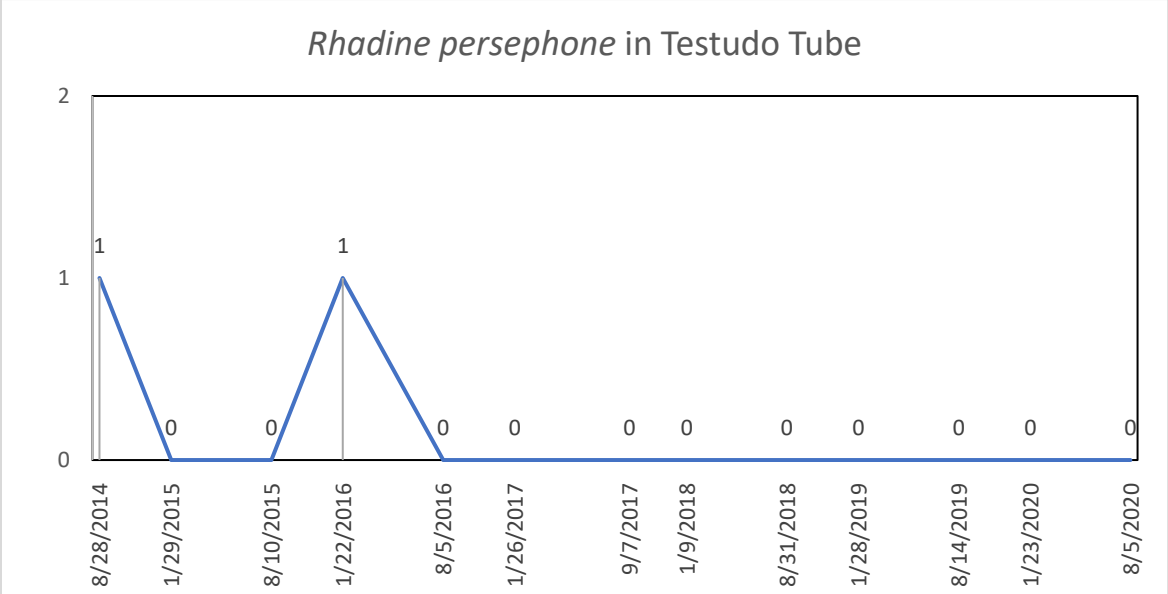

Figure 5. Counts of *Rhadine persephone* in Testudo Tube. No significant trend was found in the number of *Rhadine persephone* observed in Testudo Tube since 8/28/2014, $r(11) = .51$, $p = 0.073$.

Rhadine subterranea

Figure 6. *Rhadine subterranea* in Cotterell Cave, 8/11/2017, by Mark Sanders.

There was a significant increase in the number of *Rhadine subterranea* observed in Cotterell Cave since 9/1/2010 (Figure 7). Neither of the trends in the other two caves with *Rhadine subterranea* were significant (Figures 8 & 9).

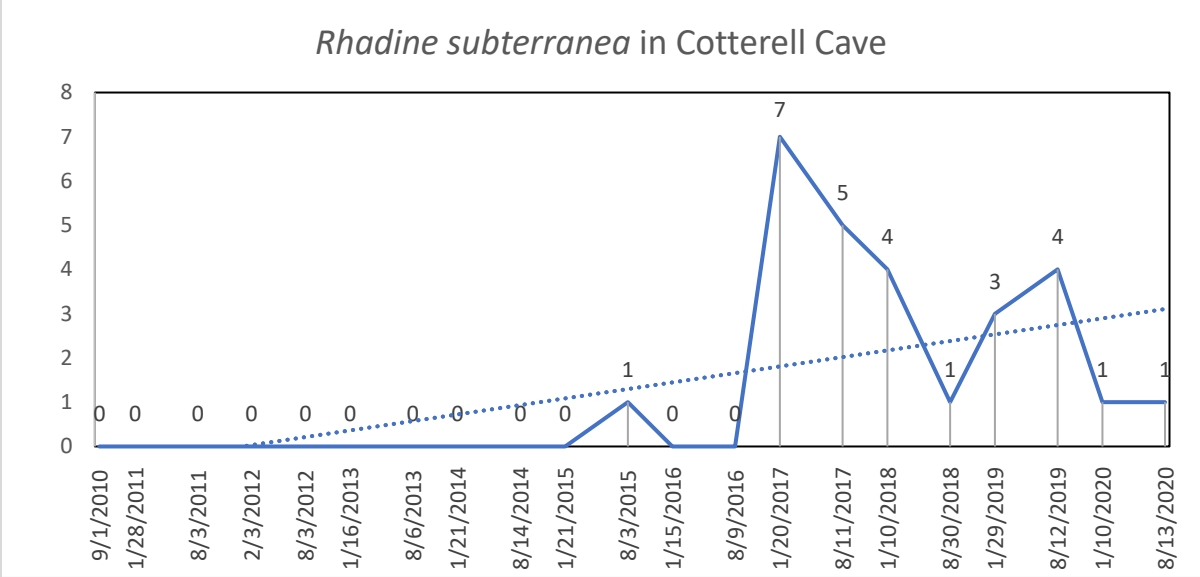

Figure 7. Counts of *Rhadine subterranea* in Cotterell Cave. There was a significant increasing trend in the number of *Rhadine subterranea* observed in Cotterell Cave since 9/1/2010, $r(19) = .54$, $p = 0.013$.

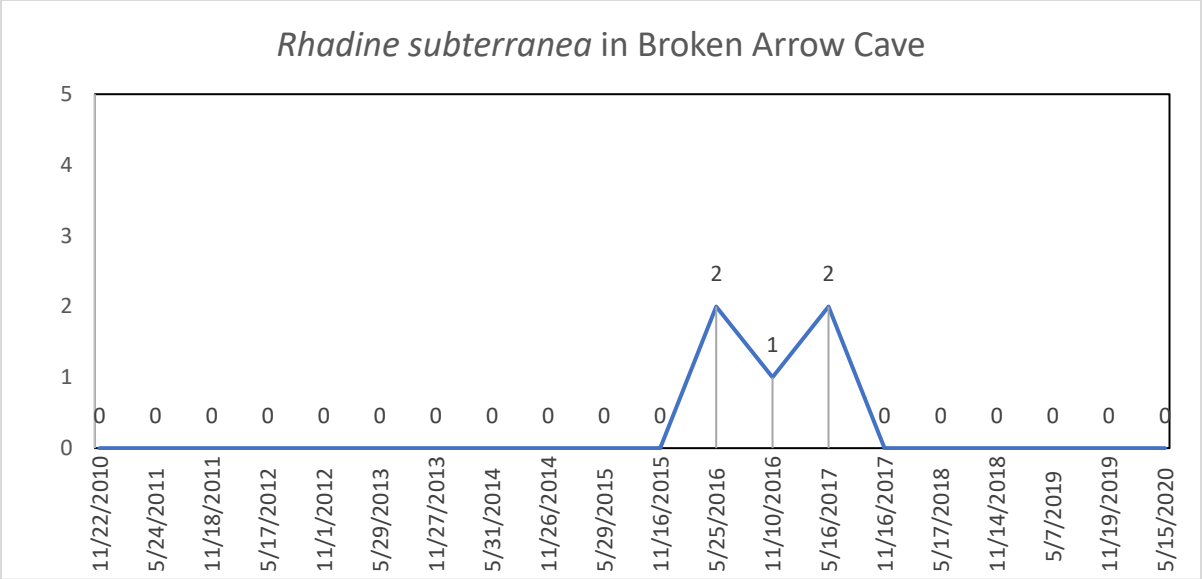

Figure 8. Counts of *Rhadine subterranea* in Broken Arrow Cave. No significant trend was found in the number of *Rhadine subterranea* observed in Broken Arrow Cave since 1/22/2010, $r(18) = .17$, $p = 0.46$.

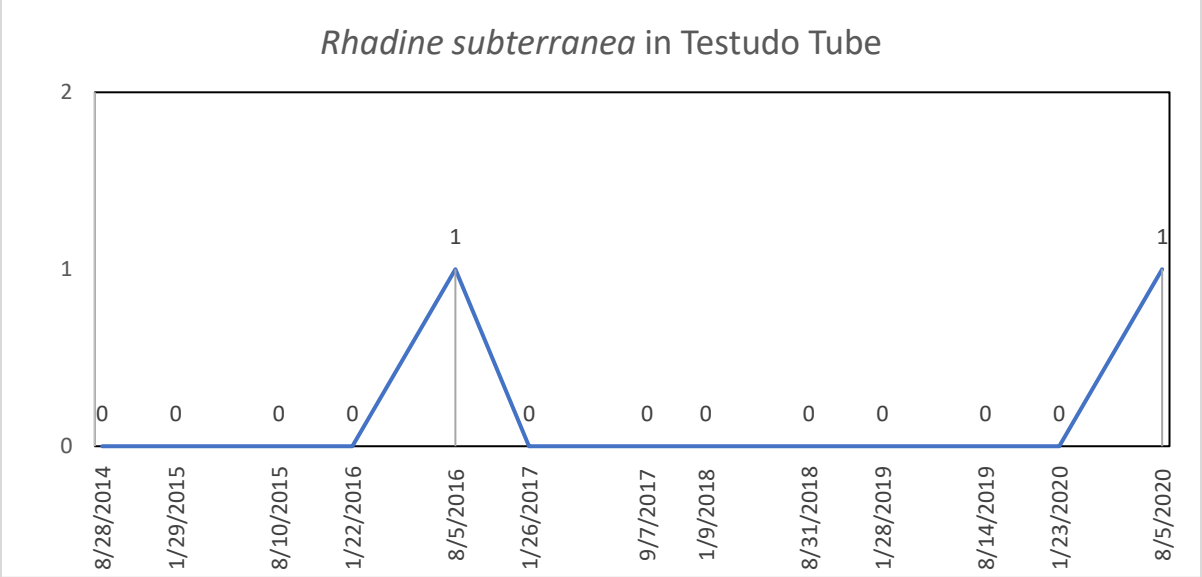

Figure 9. Counts of *Rhadine subterranea* in Testudo Tube. No significant trend was found in the number of *Rhadine subterranea* observed in Testudo Tube since 8/28/2014, $r(11) = .23$, $p = 0.45$.

Rhadine austinica

Figure 10. *Rhadine austinica* in Get Down Cave, 5/20/2019, by Colin Strickland.

There was a significant decrease in the number of *Rhadine austinica* observed in District Park Cave since 11/18/2010 (Figure 11). None of the trends in the other 10 caves with *Rhadine austinica* were significant (Figures 12 through 21).

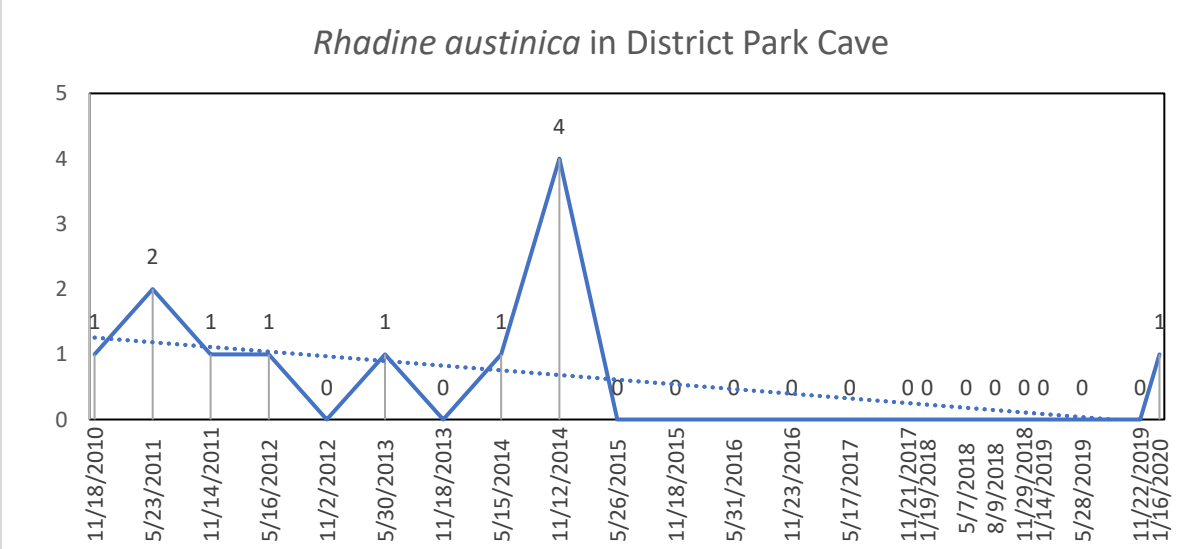

Figure 11. Counts of *Rhadine austinica* in District Park Cave. There was a significant decreasing trend in the number of *Rhadine austinica* observed in District Park Cave since 11/18/2010, $r(21) = .44$, $p = 0.035$.

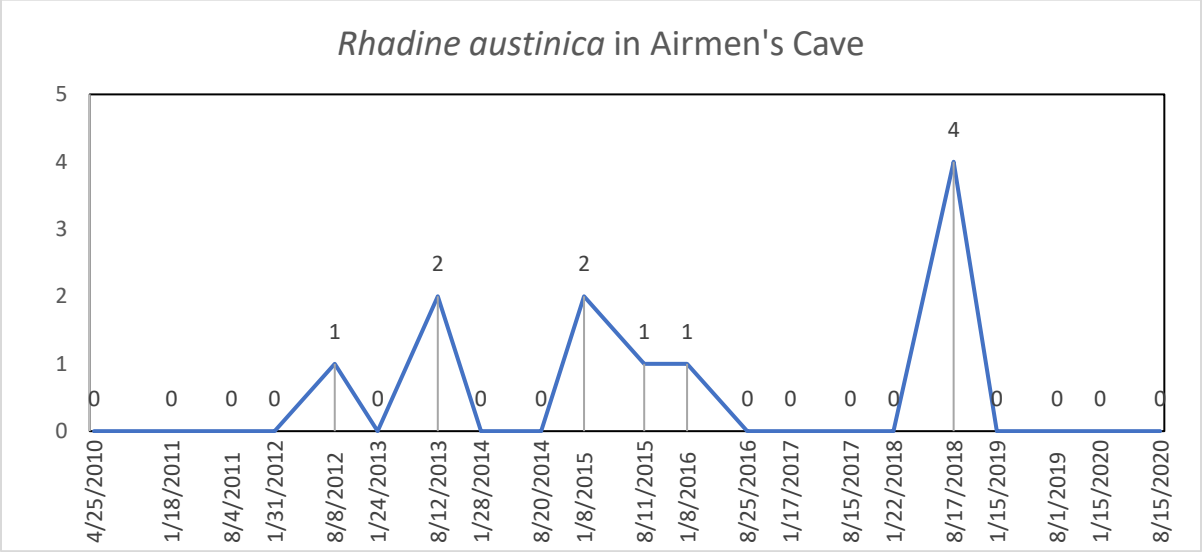

Figure 12. Counts of *Rhadine austinica* in Airmen's Cave. No significant trend was found in the number of *Rhadine austinica* observed in Airmen's Cave since 4/25/2010, $r(19) = .074$, $p = 0.75$.

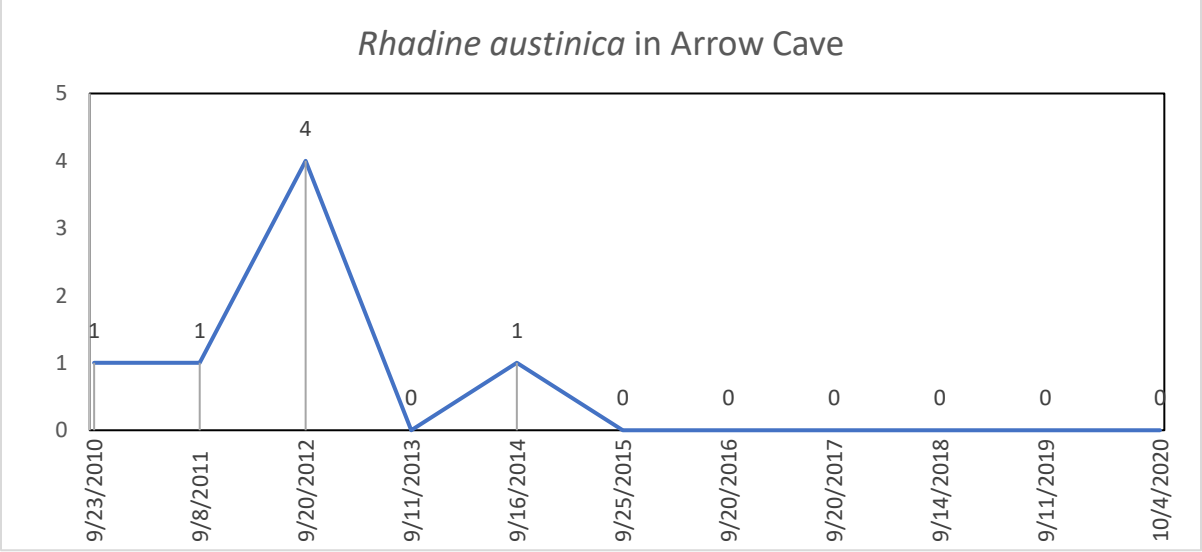

Figure 13. Counts of *Rhadine austinica* in Arrow Cave. No significant trend was found in the number of *Rhadine austinica* observed in Arrow Cave since 9/23/2010, $r(9) = .55$, $p = 0.080$.

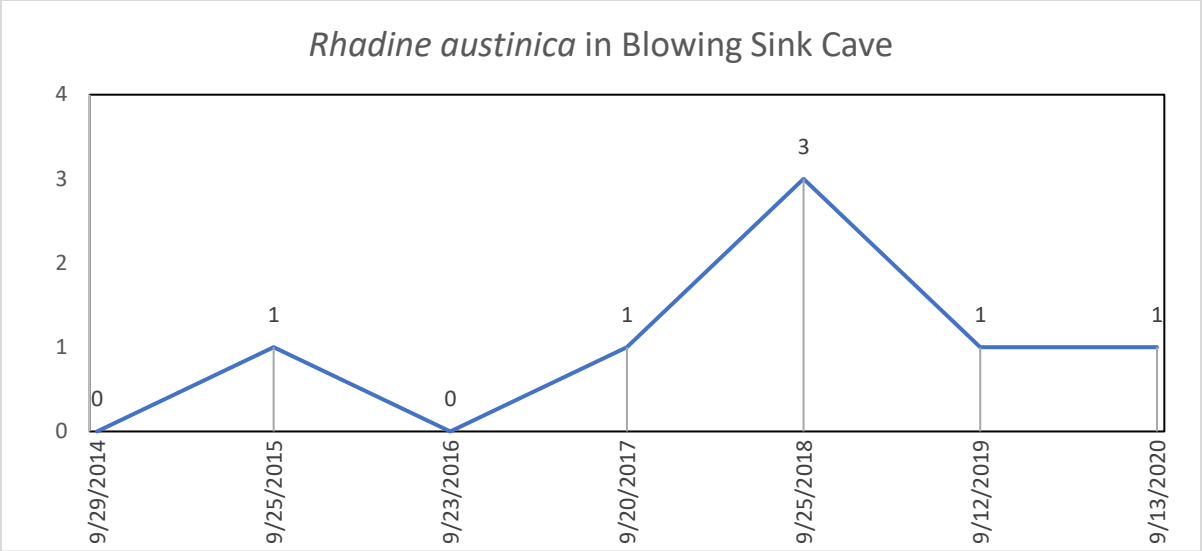

Figure 14. Counts of *Rhadine austinica* in Blowing Sink Cave. No significant trend was found in the number of *Rhadine austinica* observed in Blowing Sink Cave since 9/29/2014, $r(5) = .47$, $p = 0.29$.

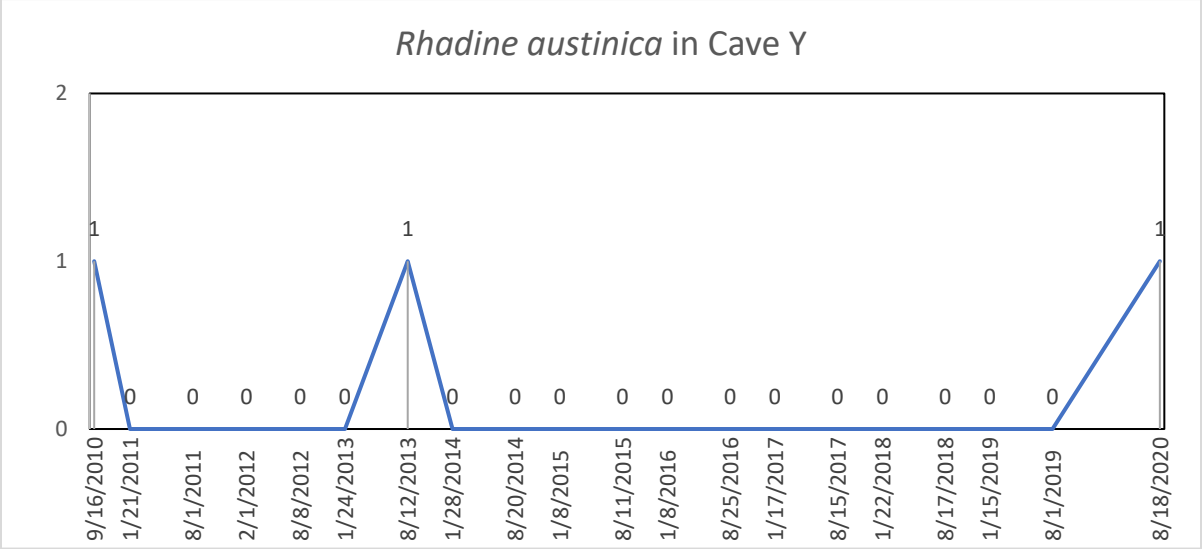

Figure 15. Counts of *Rhadine austinica* in Cave Y. No significant trend was found in the number of *Rhadine austinica* observed in Cave Y since 9/16/2010, $r(18) = .055$, $p = 0.82$.

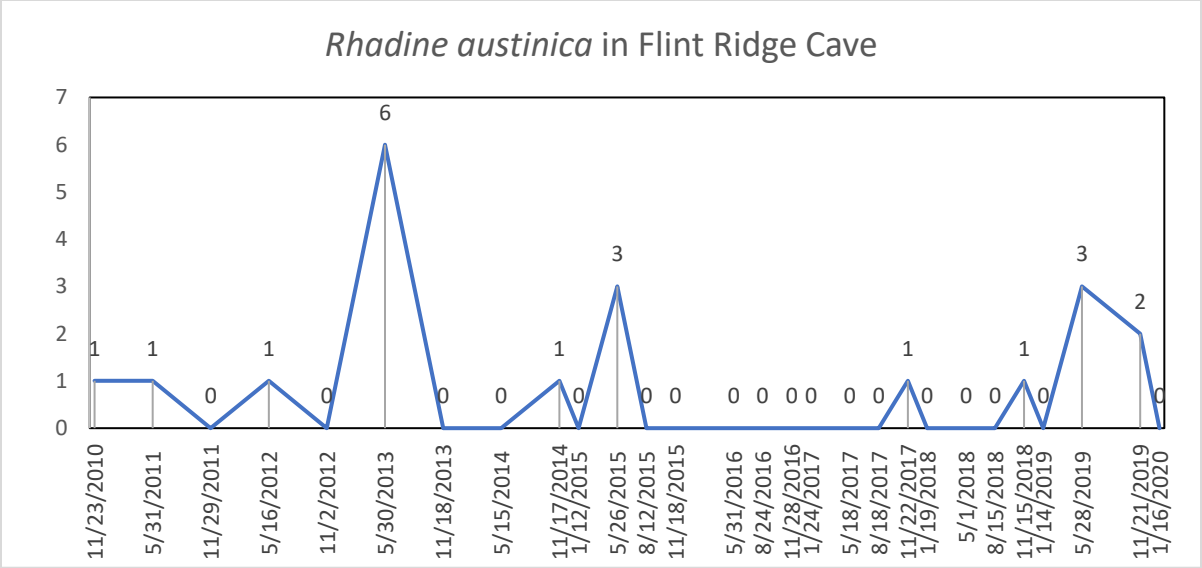

Figure 16. Counts of *Rhadine austinica* in Flint Ridge Cave. No significant trend was found in the number of *Rhadine austinica* observed in Flint Ridge Cave since 11/23/2010, $r(26) = .11$, $p = 0.58$.

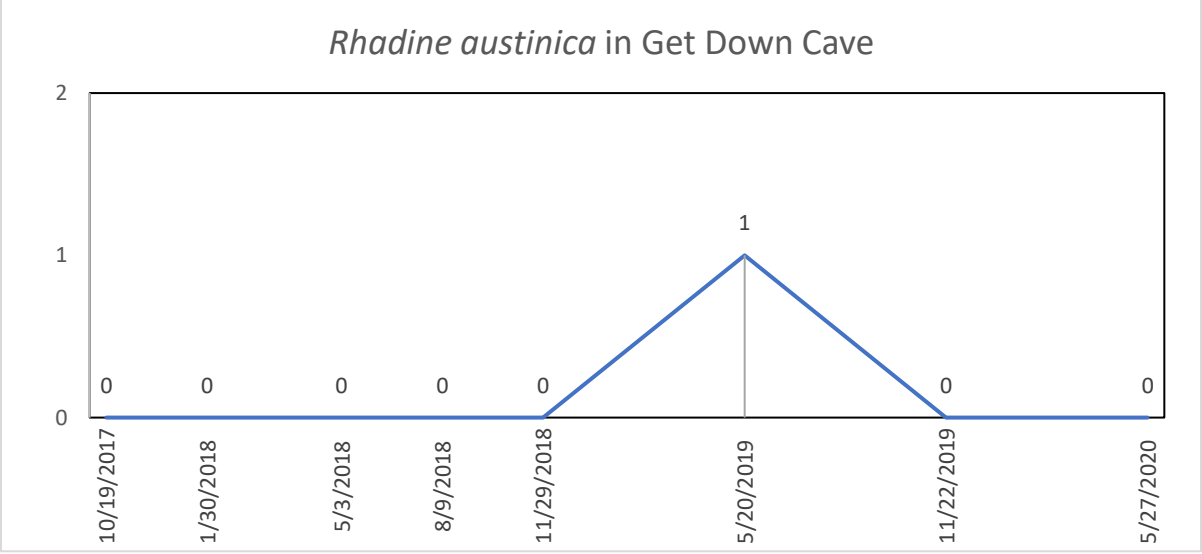

Figure 17. Counts of *Rhadine austinica* in Get Down Cave. No significant trend was found in the number of *Rhadine austinica* observed in Get Down Cave since 10/19/2017, $r(6) = .20$, $p = 0.63$.

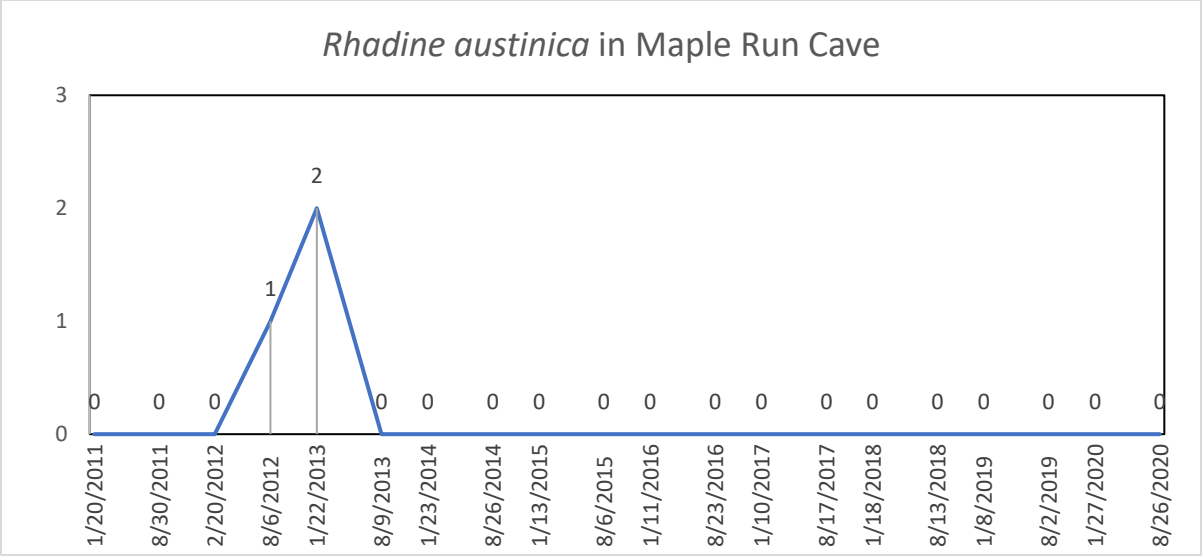

Figure 18. Counts of *Rhadine austinica* in Maple Run Cave. No significant trend was found in the number of *Rhadine austinica* observed in Maple Run Cave since 1/20/2011, $r(18) = .32$, $p = 0.17$.

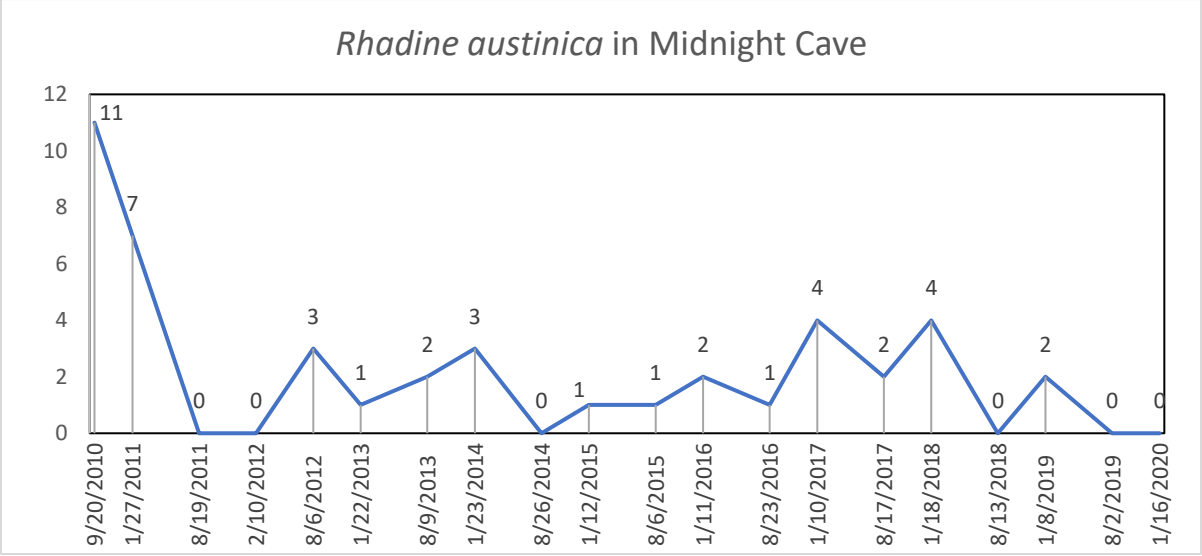

Figure 19. Counts of *Rhadine austinica* in Midnight Cave. No significant trend was found in the number of *Rhadine austinica* observed in Midnight Cave since 9/20/2010, $r(18) = .43$, $p = 0.056$.

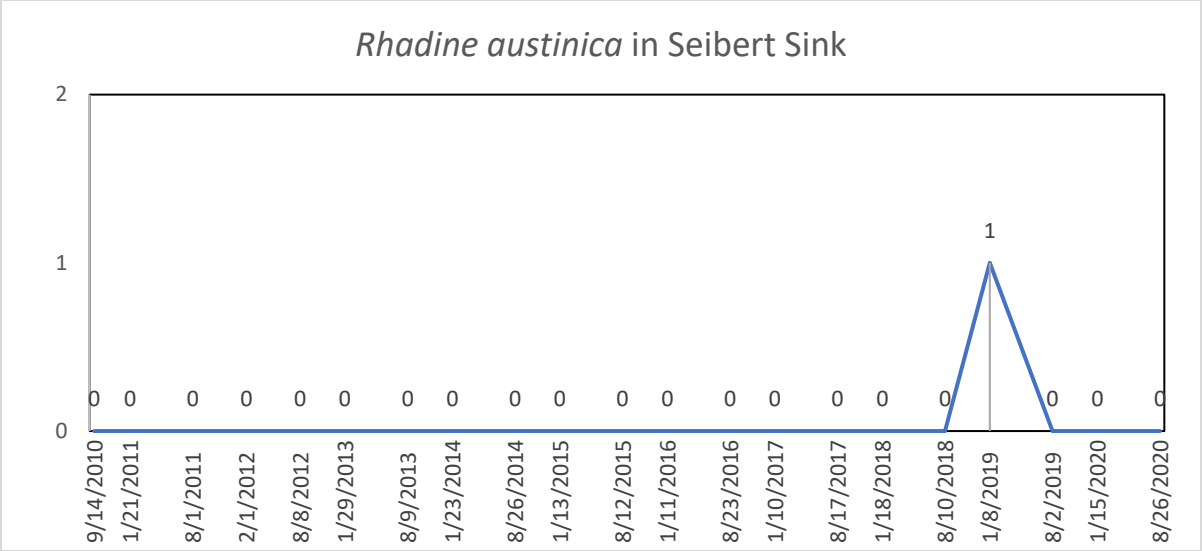

Figure 20. Counts of *Rhadine austinica* in Seibert Sink. No significant trend was found in the number of *Rhadine austinica* observed in Seibert Sink since 9/14/2010, $r(19) = .25$, $p = 0.27$.

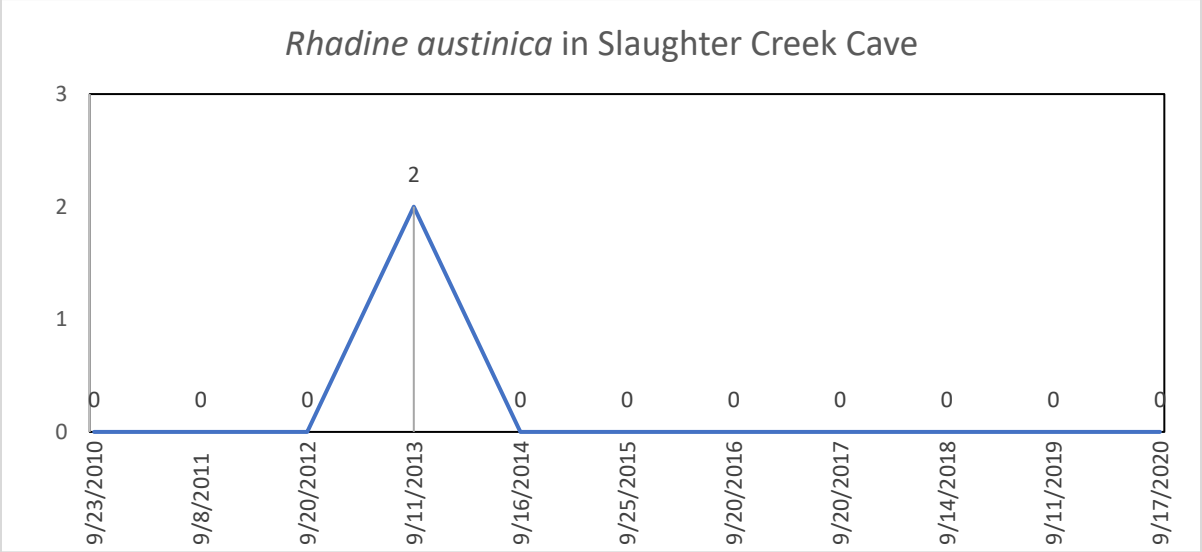

Figure 21. Counts of *Rhadine austinica* in Slaughter Creek Cave. No significant trend was found in the number of *Rhadine austinica* observed in Slaughter Creek Cave since 9/23/2010, $r(9) = .20$, $p = 0.55$.

Tartarocreagris texana

Figure 22. *Tartarocreagris texana* in Jester Estates Cave, 11/17/2020, by Colin Strickland.

No significant trend was found in the number of *Tartarocreagris texana* observed in Jester Estates Cave since 11/17/2010 (Figure 23).

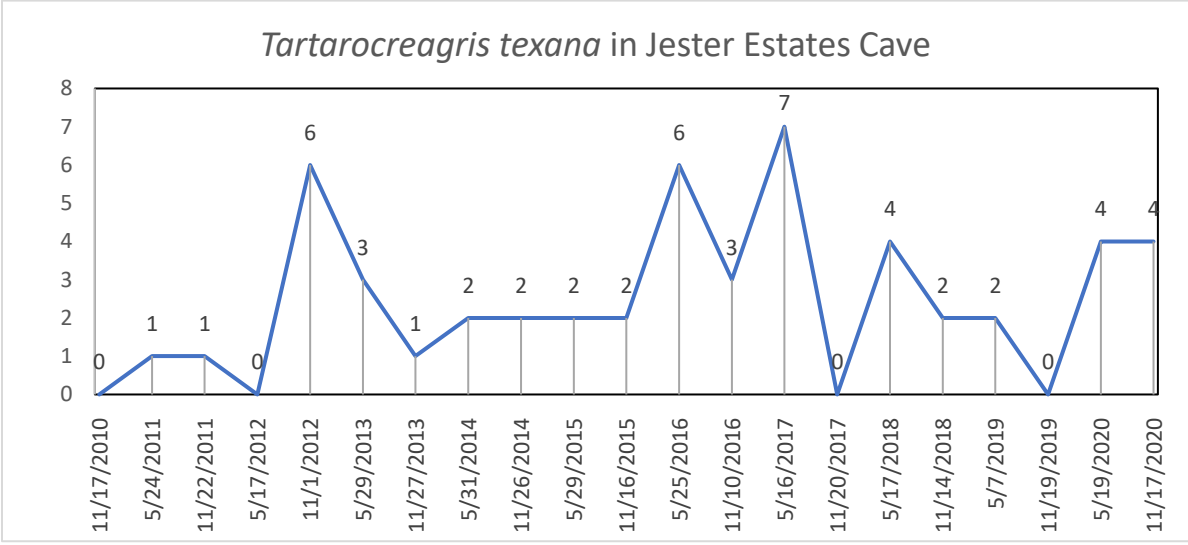

Figure 23. Counts of *Tartarocreagris texana* in Jester Estates Cave. No significant trend was found in the number of *Tartarocreagris texana* observed in Jester Estates Cave since 11/17/2010, $r(19) = .28$, $p = 0.23$.

Tartarocreagris attenuata

Figure 24. *Tartarocreagris attenuata* in Stovepipe Cave, 8/6/2019, by Colin Strickland.

There was a significant increasing trend in the number of *Tartarocreagris attenuata* observed in Stovepipe Cave since 9/28/2010 (Figure 25).

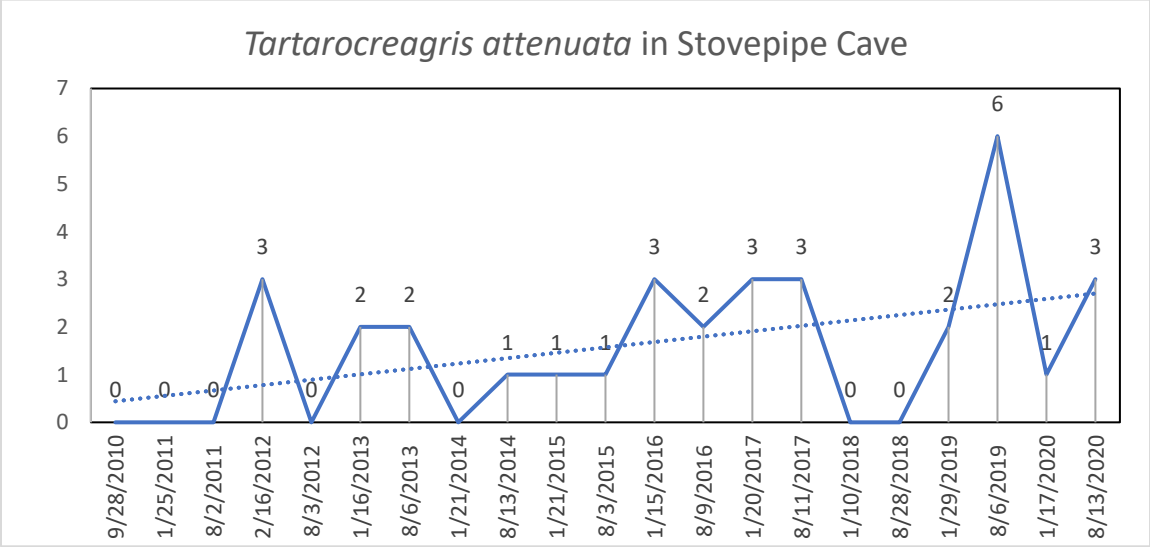

Figure 25. Counts of *Tartarocreagris attenuata* in Stovepipe Cave. There was a significant increasing trend in the number of *Tartarocreagris attenuata* observed in Stovepipe Cave since 9/28/2010, $r(19) = .45$, $p = 0.042$.

Tartarocreagris infernalis

Figure 26. *Tartarocreagris infernalis* in Pond Party Pit, 8/28/2018, by Colin Strickland.

Neither of the trends in the two caves with *Tartarocreagris infernalis* were significant (Figures 27 & 28).

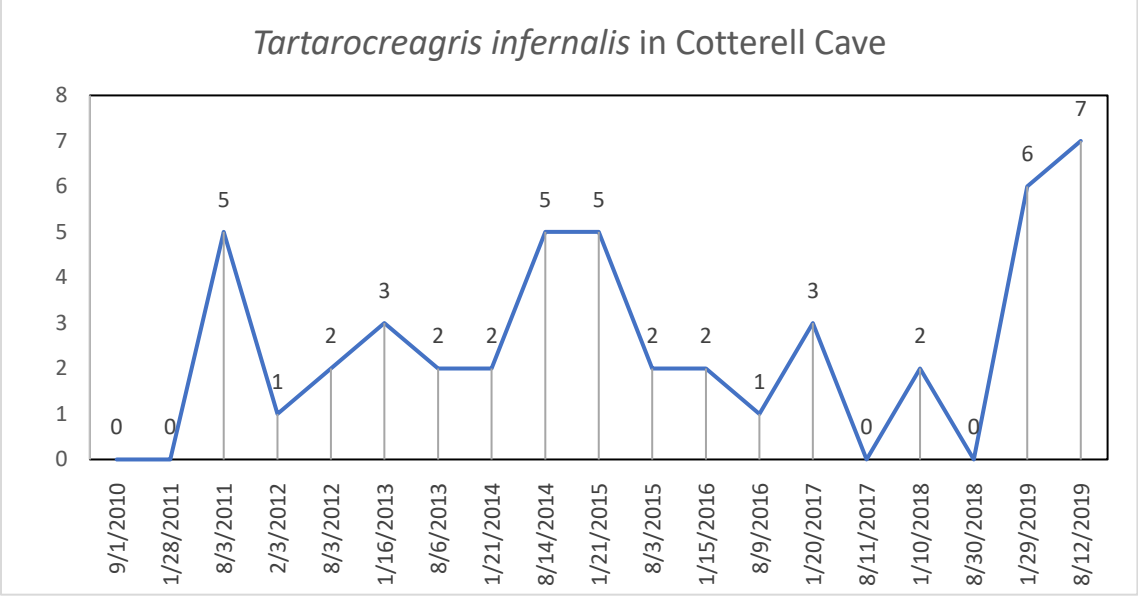

Figure 27. Counts of *Tartarocreagris infernalis* in Cotterell Cave. No significant trend was found in the number of *Tartarocreagris infernalis* observed in Cotterell Cave since 9/1/2010, $r(17) = .30$, $p = 0.21$.

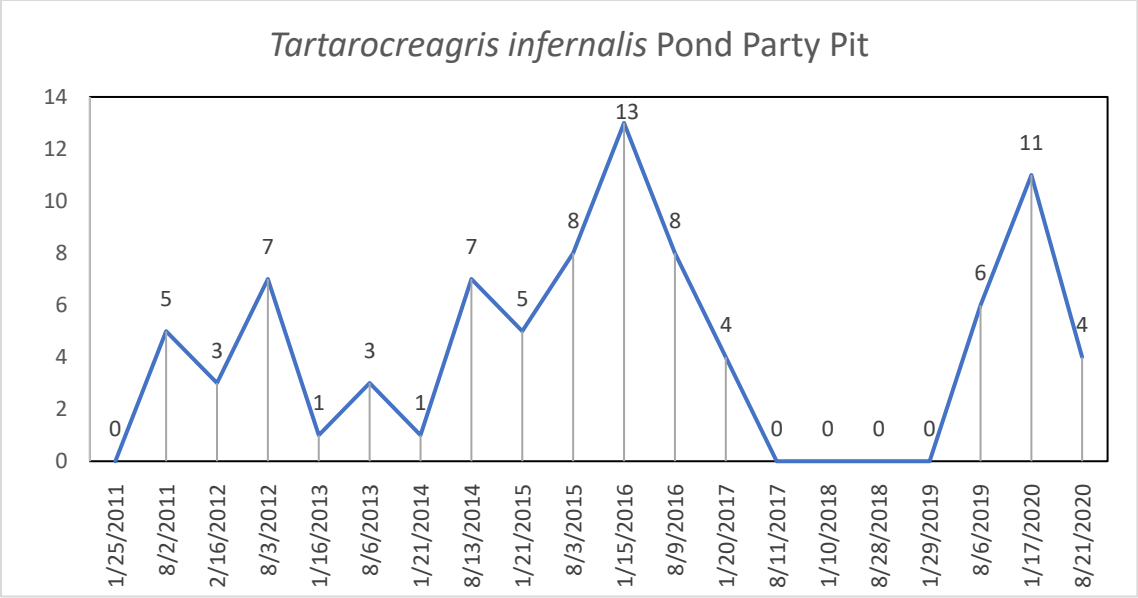

Figure 28. Counts of *Tartarocreagris infernalis* in Pond Party Pit. No significant trend was found in the number of *Tartarocreagris infernalis* observed in Pond Party Pit since 1/25/2011, $r(18) = .097$, $p = 0.68$.

Tayshaneta myopica

Figure 29. *Tayshaneta myopica* in Millipede Annex Cave, 12/5/2019, by Colin Strickland.

There was a significant increasing trend in the number of *Tayshaneta myopica* observed in Cortana Cave since 1/31/2011 (Figure 30). There was a significant decreasing trend in the number of *Tayshaneta myopica* observed in Jester Estates Cave since 11/17/2010 (Figure 31). Neither of the trends in the other two caves with *Tayshaneta myopica* were significant (Figures 32 & 33).

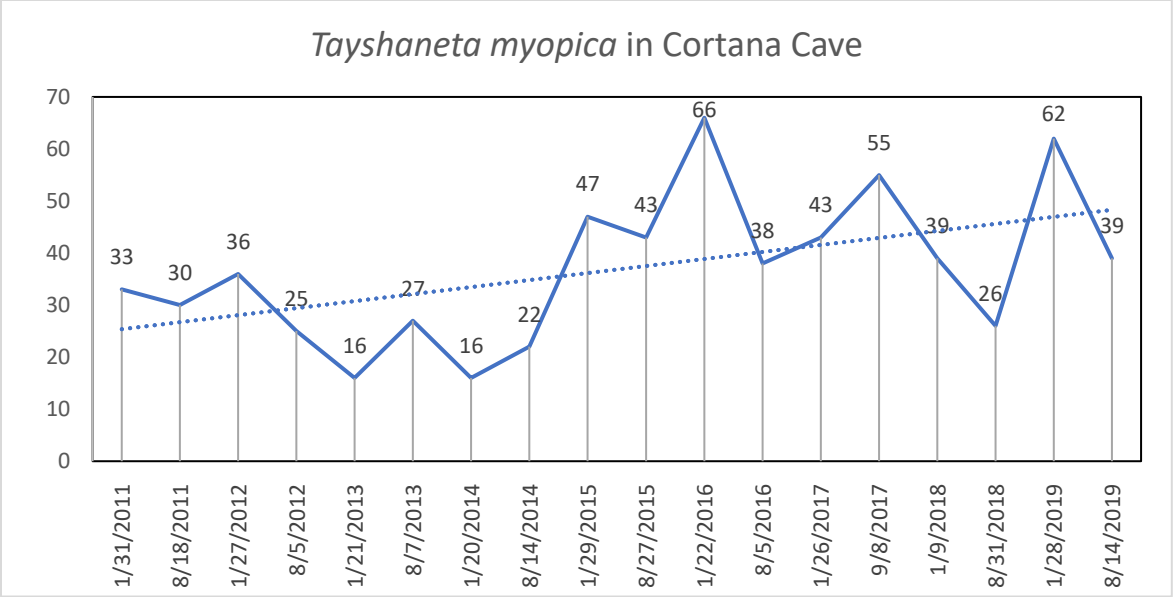

Figure 30. Counts of *Tayshaneta myopica* in Cortana Cave. There was a significant increasing trend in the number of *Tayshaneta myopica* observed in Cortana Cave since 1/31/2011, $r(16) = .50$, $p = 0.034$.

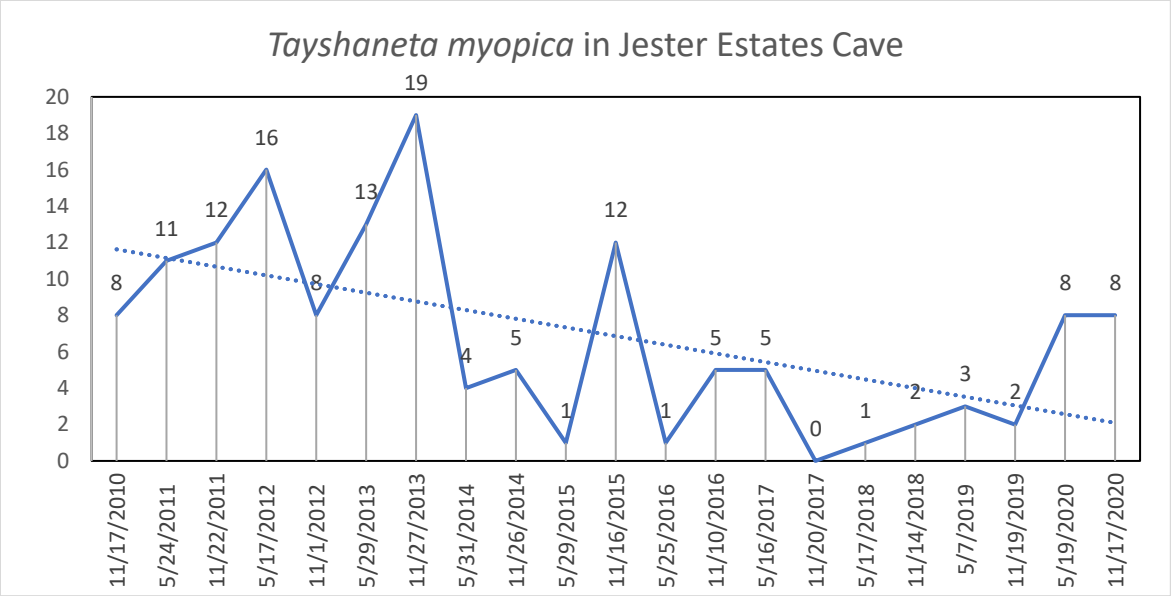

Figure 31. Counts of *Tayshaneta myopica* in Jester Estates Cave. There was a significant decreasing trend in the number of *Tayshaneta myopica* observed in Jester Estates Cave since 11/17/2010, $r(19) = .55$, $p = 0.0095$.

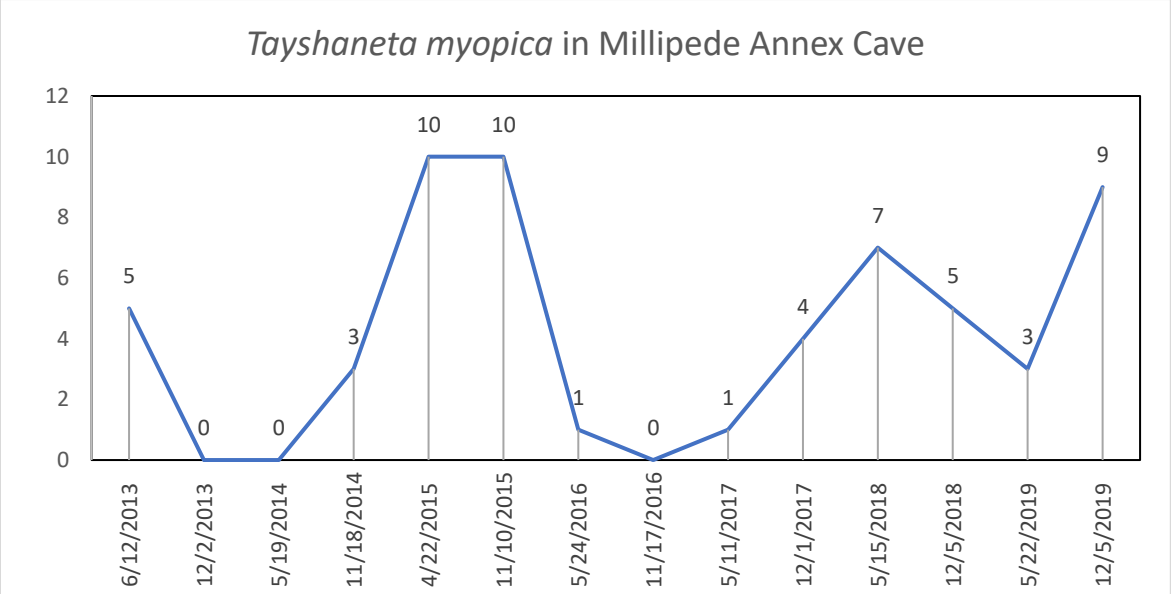

Figure 32. Counts of *Tayshaneta myopica* in Millipede Annex Cave. No significant trend was found in the number of *Tayshaneta myopica* observed in Millipede Annex Cave since 6/12/2013, $r(12) = .25$, $p = 0.40$.

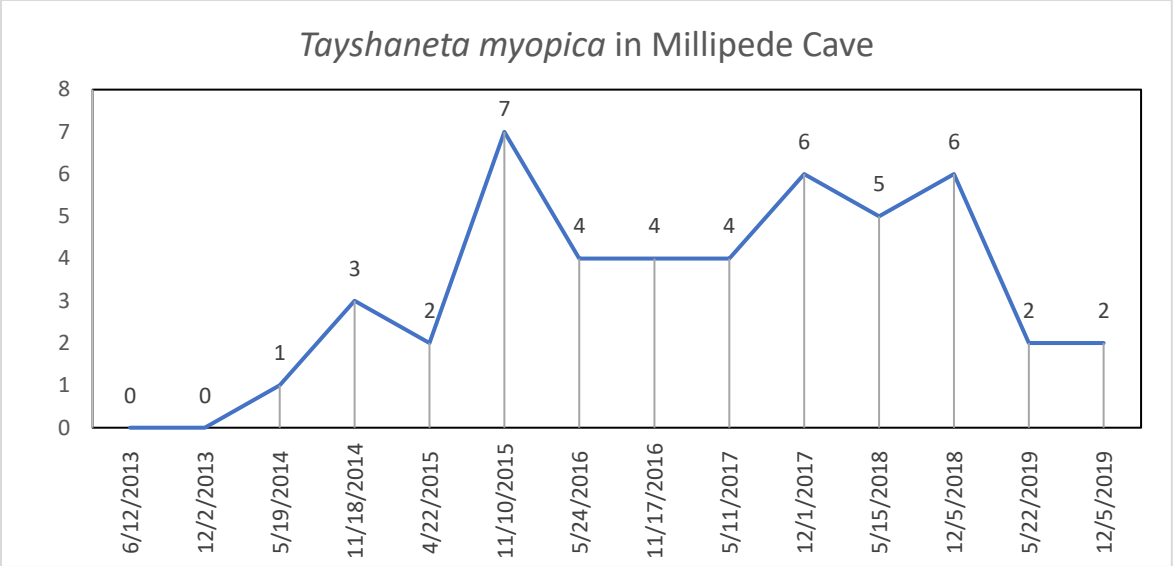

Figure 33. Counts of *Tayshaneta myopica* in Millipede Cave. No significant trend was found in the number of *Tayshaneta myopica* observed in Millipede Cave since 6/12/2013, $r(12) = .48$, $p = 0.081$.

Texamaurops reddelli

Figure 34. *Texamaurops reddelli* in Stovepipe Cave, 8/6/2019, by Piers Hendrie.

No significant trend was found in the number of *Texamaurops reddelli* observed in Stovepipe Cave since 1/25/2011 (Figure 35).

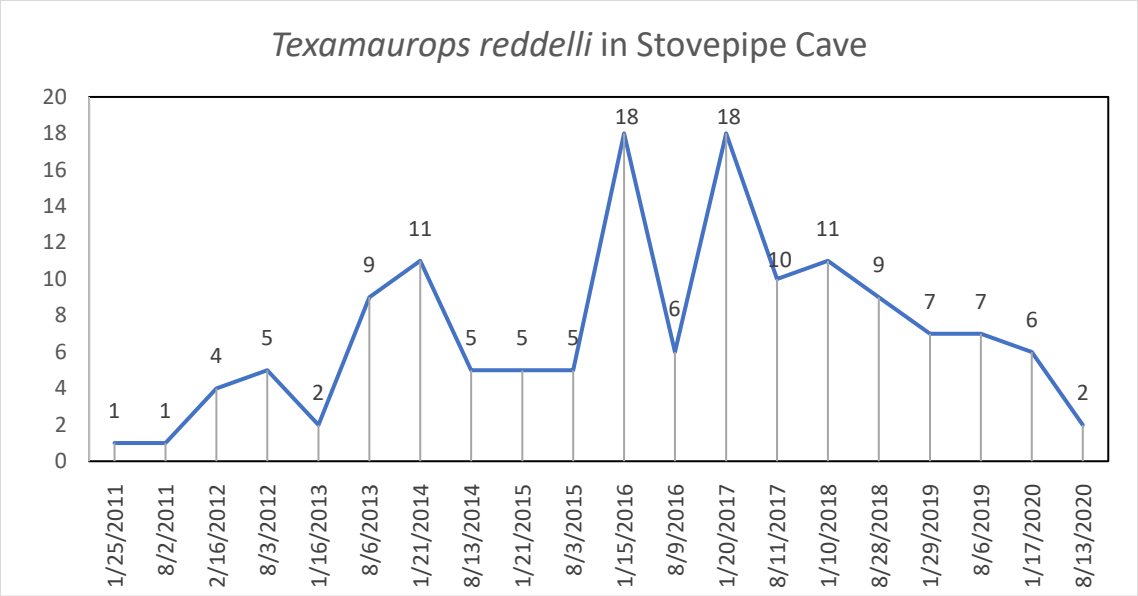

Figure 35. Counts of *Texamaurops reddelli* in Stovepipe Cave. No significant trend was found in the number of *Texamaurops reddelli* observed in Stovepipe Cave since 1/25/2011, $r(18) = .31$, $p = 0.18$.

Texella reddelli

Figure 36. *Texella reddelli* in Little Bee Creek Cave, 5/16/2019, by Colin Strickland.

No significant trend was found in the number of *Texella reddelli* observed in Little Bee Creek Cave since 5/14/2010 (Figure 37).

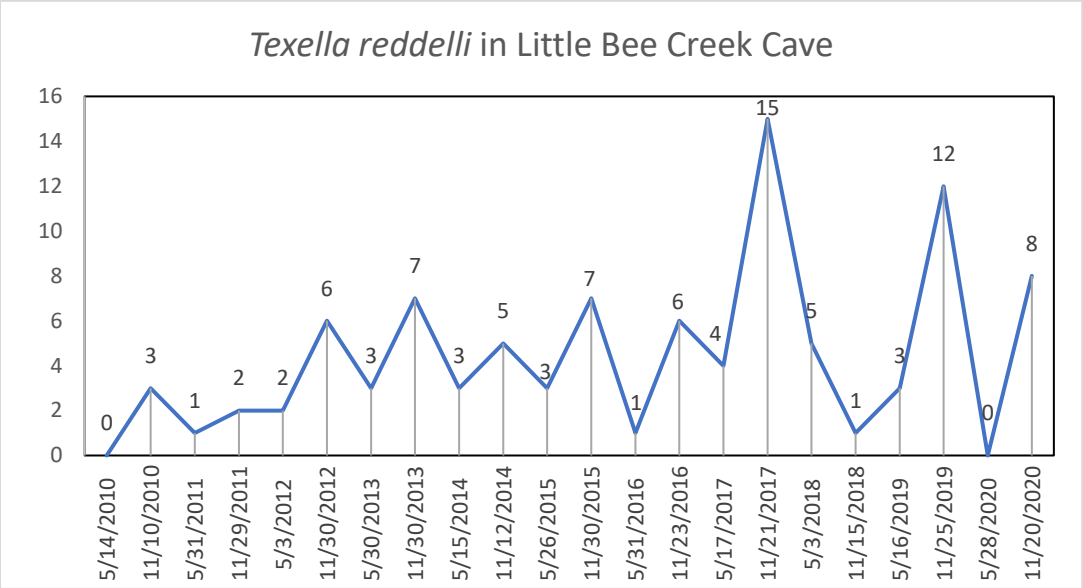

Figure 37. Counts of *Texella reddelli* in Little Bee Creek Cave. No significant trend was found in the number of *Texella reddelli* observed in Little Bee Creek Cave since 5/14/2010, $r(20) = .37$, $p = 0.086$.

Texella spinoperca

Figure 38. *Texella spinoperca* in Jackpot Cave, 8/14/2018, by Colin Strickland.

There was a significant increasing trend in the number of *Texella spinoperca* observed in Airmen's Cave since 1/18/2011 (Figure 39). No significant trend was found in the number of *Texella spinoperca* observed in Seibert Sink since 9/14/2010 (Figure 40).

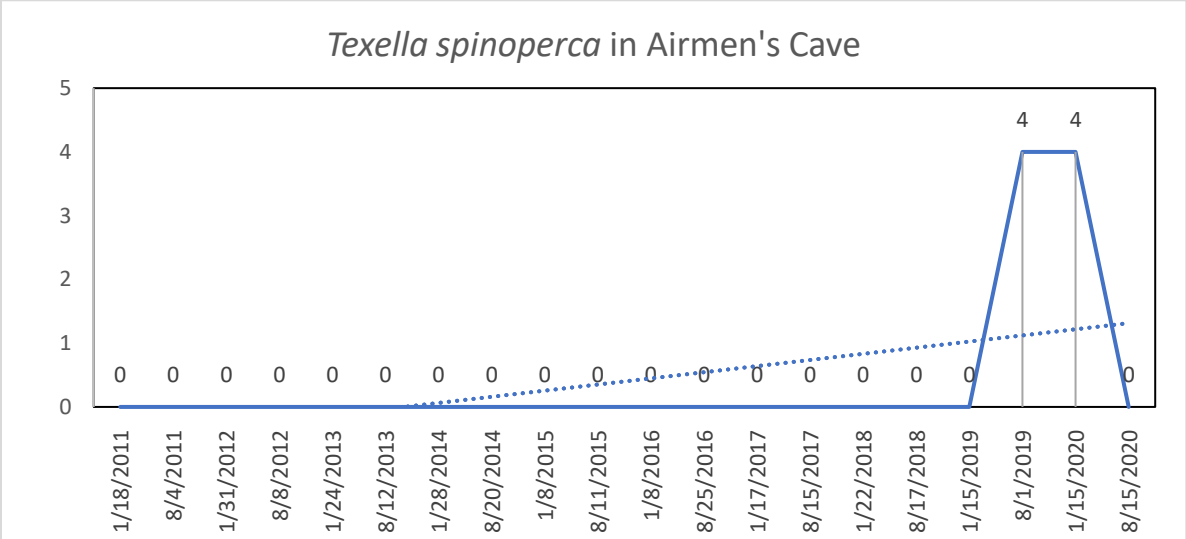

Figure 39. Counts of *Texella spinoperca* in Airmen's Cave. There was a significant increasing trend in the number of *Texella spinoperca* observed in Airmen's Cave since 1/18/2011, $r(18) = .46$, $p = 0.041$.

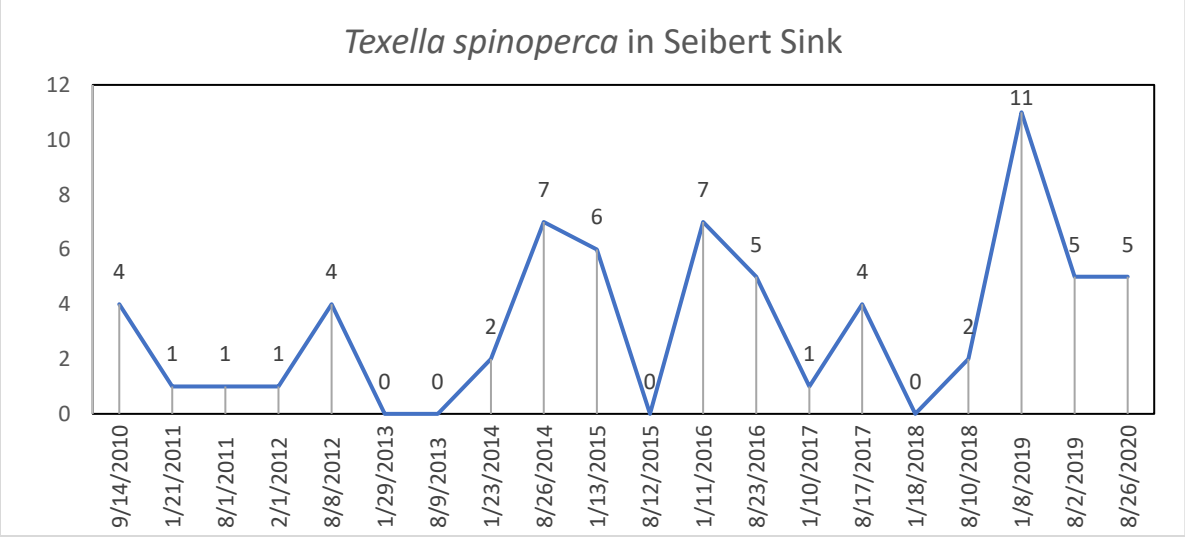

Figure 40. Counts of *Texella spinoperca* in Seibert Sink. No significant trend was found in the number of *Texella spinoperca* observed in Seibert Sink since 9/14/2010, $r(18) = .38$, $p = 0.10$.

Discussion

These species are not observed during every survey, and when observed they are usually found in low numbers. Some species such as *Rhadine austinica*, and *Rhadine subterranea* will only be observed one or two times in a decade of faunal surveys at some caves. *Texella spinoperca* was last observed in Airmen's Cave on 6/23/2008, until the recent sightings on 8/1/2019 and 1/15/2020 (Figure 36). This just reinforces the finding of others that large numbers of surveys are required determine if a species is present at a site. Krejca and Weckerly reported that on the 40th survey of Lakeline Cave in Williamson County a new species of troglobitic pseudoscorpion was found (Krejca &Weckerly 2008).

These species are not always available to be surveyed and are likely still present in the vicinity but in inaccessible mesocaverns or epikarst. Some very long gaps in observations and then high numbers, such as with *Rhadine subterranea* in Cotterell Cave, indicate something else, possibly either very low numbers and then an increase in the population or perhaps an extirpation and then recolonization of the area (Figure 6). Some of the lack of observations is likely due to the certain survey sites being unfavorable to the species. Also, percent of accessible cave surveyed was highly variable between caves. Some smaller caves have surveys zones covering much of the accessible cave such as Spider Cave and Stovepipe Cave, while larger caves like Blowing Sink and Flint Ridge have only a small percentage of the accessible cave in survey zones. If the entirety of these caves were surveyed, no doubt the observations would be more frequent and in higher numbers, but resources for such an effort are limited.

It is interesting that in 33 surveys of Goat Cave no *Rhadine austinica* have ever been observed. They are almost certainly there since they are found in both Maple Run Cave and Blowing Sink Cave which are both nearby. It may be that the accessible area of Goat Cave is too open to the surface due to the large entrance and the lower resulting humidity levels make it unfavorable to troglobites. Similarly, in 14 surveys of Lost Oasis Cave, *Rhadine austinica* was only observed on the first survey in 1985 and not again since. This is most likely because the two survey zones are in the upper level of the cave, and the hard to access lower level is not normally surveyed, but usually during an initial cave survey the entire cave will be searched.

We will continue to monitor these rare species to better understand their strange life histories and population dynamics. We will explore new ways to look at the data and find the hidden patterns.

Acknowledgments

I give thanks to all the surveyors who crawled and searched so many hours to make this data available. And many thanks to the researchers who have done the taxonomic work to identify the many species we find living hidden underground.

Literature Cited

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