# Community Ecology of Three Caves in Williamson County, Texas:1991-1999

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## Summary

I summarize data from the "Lakeline Study" of three caves near Austin, Texas. We studied the community ecology of Lakeline Cave, Testudo Tube, and Temples of Thor Cave from 1991 to 1999. The study focused on two endangered species: *Rhadine persephone*, the Tooth Cave ground beetle, and *Texella reyesi*, the Bone Cave harvestman, and associated fauna. Studies included temperature and humidity data logging, zone inventories of fauna, cave cricket ecology, and fire ants. A combination of drought during the 1990s, fire ants, and decreased raccoon visitation may have caused a decrease in cave humidity, cave crickets, millipedes, and perhaps *Texella reyesi*. The development of Lakeline Mall isolated Lakeline Cave into a 2.3-acre preserve, which may have contributed to the decrease in raccoons, crickets, and cave fauna there.

## Introduction

This report summarizes ecological data collected in the "Lakeline Study" from three Central Texas cave communities near Austin, Texas. The study focused on two endangered species: *Rhadine persephone*, the Tooth Cave ground beetle, and *Texella reyesi*, the Bone Cave harvestman, and the associated fauna. Studies included temperature and humidity data logging, zone inventories of fauna, cave cricket ecology, and fire ants. Fourteen graphs provide an overview of the data. This serves as an annual report on data gathered by Peter S. Sprouse and Jean Krejca in November, 1998, and February, May, and August, 1999, using methods we started earlier. This also is a review of long-term ecological trends starting with the first studies I conducted in Lakeline Cave in May, 1991. Elliott (1994) summarized data collected through May, 1994.

We studied Lakeline Cave, Testudo Tube, and Temples of Thor Cave (Thor Cave), at first owned by Simon Development Co., Inc., and subsequently deeded to Texas Parks & Wildlife Department (TPWD). The three caves are in preserves set aside as mitigation land for two endangered species that were found in Lakeline Cave during the development of Lakeline Mall.

## Materials and Methods

We continued the quarterly inventory of zones in each cave that we had begun in 1992. According to the original study plan, proposed under the Lakeline Habitat Conservation Plan, the routine studies of Testudo and Thor were discontinued in 1997-98, but TPWD re-instituted them in November, 1998 to provide a longer baseline for interpretation of ecological trends. Cricket "hop" (exit) counts were also repeated at the three caves in May and June, 1999, for the first time since 1993. These hop counts supplemented the in-cave cricket counts, which provide slightly different estimates of cricket populations.

Temperature and humidity readings were taken in each cave as before, but using a Psychrodyne wet-dry bulb thermometer instead of the Atkins digital thermometer used during most of the previous studies.

This report does not summarize the meterological data from the caves, which are available in all the reports written to date. Instead, I have summarized precipitation data for the Austin area, which I obtained from the National Weather Service web site for Austin/San Antonio at http://www.srh.noaa.gov/ewx/. The precipitation data are of interest for interpretation of long-term trends in these caves, providing a

picture of moisture in the ground. Greater evapo-transpiration during the summer can reduce the amount of moisture infiltrating to the caves, but precipitation is still a good indicator of how much water and water vapor is available in the caves a few weeks to a few months after substantial rainfall.

Fire ants were controlled periodically using the hot-water methods developed earlier (Elliott, 1993, 1994).

Data were graphed using the Excel spreadsheet program.

## Results

Drought conditions prevailed in central Texas throughout most of the 1990s, punctuated by a few wet years. Overall, declines in populations of cave crickets in Lakeline Cave occurred since this study began. Thor Cave experienced a decline, while Testudo Tube had a small increase in crickets.

The following graphs (Figures 1 through 8) depict the long-term trends of precipitation, cave humidity, cave crickets, millipedes, and deposition of scats by raccoons. Generally, as precipitation decreased, so did the aforementioned species, although some changes did track the annual precipitation values. Another set of graphs (Figures 9-11) depicts the 1998-1999 trends of crickets, *Rhadine* beetles, and *Texella reyesi* harvestmen in the three study caves. Figures 12-14 examine the long-term trends of these species.

Figure 1 depicts the annual precipitation for the Austin area from 1991 through 1999. The years 1991, 1992, 1994, and 1997 can be considered wet years. The years 1990, 1993, 1996, and 1999 can be considered drought years because they fell below the annual mean of 32 in. of precipitation. The summer of 1998 was a severe drought even though the 1998 total was above average. Droughts can cause substantial declines in cave-dwelling camel crickets, and can result in fewer observations of troglobites, particularly *Cambala* and *Speodesmus* millipedes and *Texella reyesi*, which often prefer near-saturated atmospheres.

Figure 2 shows the relative humidity (RH) at mid point in the three caves over the years during May, usually the wettest month in central Texas. No data were collected in 1998, a drought year. RHs did not decline much until 1999, after a severe drought.

Figure 3 show the RH (at mid cave) in the three caves during August, usually a dry month in central Texas. RHs declined since the mid-1990s.

Figure 4 shows the in-cave and exit counts of crickets at Lakeline Cave from 1992 through 1999. Figure 5 shows the exit counts of crickets at Lakeline Cave, Testudo Tube, and Thor Cave in 1993 and 1999. Lakeline had a large decline while Testudo had a slight increase and Thor a moderate decline in crickets.

Figure 6 depicts numbers of *Speodesmus* millipedes in spring, compared to annual precipitation. There was a decrease since the mid-1990s, then an increase in 1999.

Figure 7 shows numbers of *Cambala* millipedes in spring, compared to annual precipitation. There was a decrease since the mid-1990s, then an increase in 1999.

Figure 8 graphs fresh raccoon scats observed yearly from 1993-1999. Two dead raccoons also were seen in Thor Cave. Lakeline and Thor have had decreases in scats since the mid-1990s. The apparent lack of scats in Thor Cave during the mid-1990s probably is misleading, as we did not inventory all parts of the cave, which is larger than the others. For instance, I observed scats and a dead raccoon in the Coral Room of Thor Cave in March, 1993, but we did not usually visit the Coral Room. Only one scat has ever been observed in Testudo Tube.

Figure 9 shows in-cave counts of crickets and *Rhadine* beetles at Lakeline Cave, 1998-1999, using a logarithmic scale. No *Texella reyesi* harvestmen were observed during this period.

Figure 10 depicts the in-cave counts of crickets and *Rhadine* beetles at Testudo Tube, 1998-1999. *Texella reyesi* does not inhabit this cave. The usual pattern observed in this cave continues, with more *R. subterranea* observed than *R. persephone* (Elliott, 1994). There has been a slight increase in cricket numbers here.

Figure 11 shows the in-cave counts of crickets, *Rhadine noctivaga*, and *Texella reyesi* at Thor Cave, 1998-1999. As usual, *T. reyesi* is concentrated around Zone 5, where there is substantial cover (rocks), soil, and high humidity. Depite continued problems with fire ants at this preserve, the cave community continues to be rich in species diversity.

Figure 12 shows the long-term trend of *Texella reyesi* and *Rhadine* beetles at Lakeline Cave, 1992-1999. Cyclical patterns and apparent declines may be caused by drought, fire ants, and other factors. Fewer *R. persephone* were seen recently than before, but the numbers are so low that this could be a random effect. *Texella reyesi* was not observed in 1994 and 1999.

Figure 13 shows the long-term trend of *Rhadine* beetles at Testudo Tube, 1992-1999. No data were collected 1997-1998. There is no obvious decline of *Rhadine* species in this cave.

Figure 14 shows the long-term trend of *Texella reyesi* and *Rhadine noctivaga* at Thor Cave, 1992-1999. There is no obvious decline of these species in this cave. No data were collected 1997-1998.

## Discussion

Cave (camel) crickets have drastically declined in Lakeline Cave since 1993 while they have increased slightly or decreased moderately at the other two caves. Millipedes, which are moisture-loving, also decreased at Lakeline and the other caves during the same period, which was mostly a drought.

If one considers Lakeline Cave an "experimental site," with a 2.3-acre natural area in an enclosure surrounded by a mall development, while the other two caves are "controls," with larger undisturbed areas surrounding them, then one might argue that the declines in Lakeline Cave are due to the mall development and its associated effects. However, all three sites undergo large seasonal and yearly changes caused by precipitation, reproductive cycles, fire ants, and many other factors. All three sites have been affected by fire ants, which we have controlled somewhat by hot-water treatments. Competition between fire ants and cave crickets was documented by Elliott (1994) and other studies I have done at Camp Bullis and SunCity Georgetown.

Lakeline and Thor caves also had apparent decreases in raccoon scats since the mid-1990s. Scats are consumed by cave crickets. Loss of crickets can lead to a loss of *Rhadine* beetles, which feed on cricket eggs and nymphs.

We do not fully understand the food preferences of *Texella reyes* harvestman, but I have observed one feeding on fungus growing on a dead raccoon in Thor Cave (Elliott, 1994). Insofar as Lakeline Cave is a continuing "experiment," it will be interesting to observe if the cricket decline will continue (with some degree of variation), and if the apparent decline in *Texella reyesi* there will continue as well.

I conclude that drought, fire ants, and a decrease in racoon visitation have caused the decline of crickets and millipedes in Lakeline Cave. Development of the mall and isolation of Lakeline Cave may have caused the recent decline in *Texella reyesi,* but the number of observations is so low that it could be a random event. For example, we did not observe *T. reyesi* in Lakeline Cave in 1994, then it "reappeared."

Since North American cave crickets have a pronounced annual life cycle, but troglobites (cave-adapted species) may live for years, we may not see any obvious declines in the troglobitic fauna of Lakeline Cave for years, especially if the preserve remains in its present state (about 2.3 acres). We can reasonably expect the Lakeline Cave community to decline more rapidly if the preserve boundaries are drawn tighter, as planned in the Lakeline Habitat Conservation Plan.

## Acknowledgments

The support of Simon Development and TPWD for this study is gratefully acknowledged. I thank Doug Allen, Peter S. Sprouse, Jean Krejca, Charley Savvas, Allan Cobb, James Reddell, Vernelle Elliott, Lee Sherrod, Brian Keeley, Mike Warton and Associates, and others who participated in the field work. I appreciate the help and administrative skills of Joe Stallsmith, Simon Development Co., Inc., and Peggy Horner, TPWD, in providing the funding for the project.

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Elliott, W.R. 1994. Community ecology of three caves in Williamson County, Texas: A three-year summary. Report to Simon Development Co. Inc., Texas Parks & Wildlife Dept., and U.S. Fish & Wildlife Service. 46 pp.

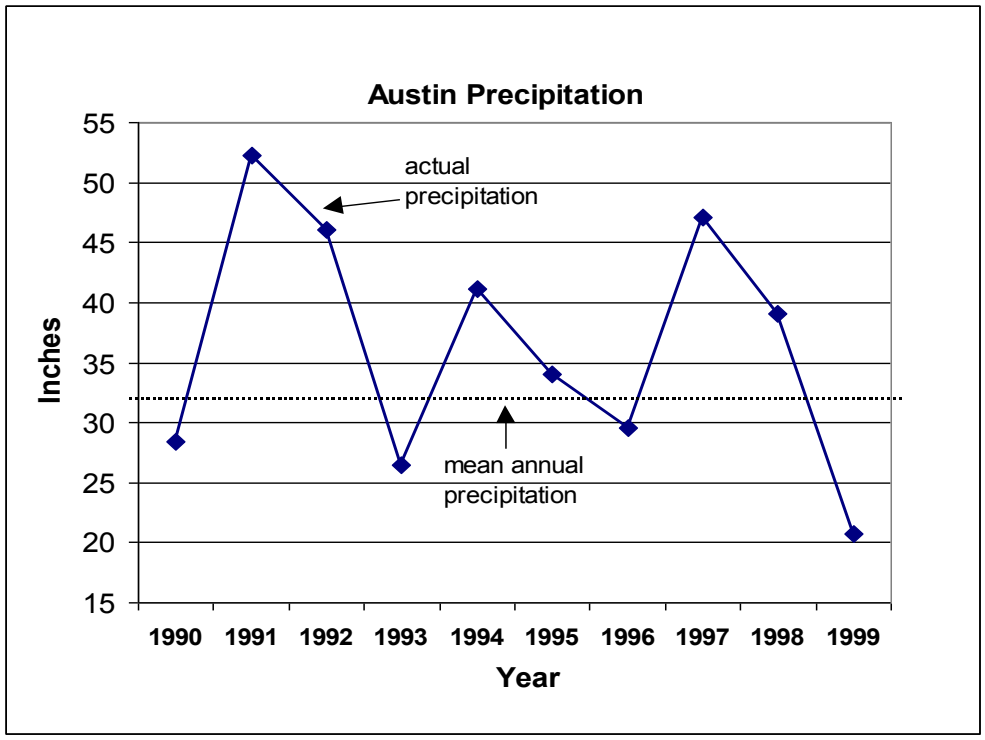



Fig. 1. Precipitation in Austin, Texas, at Camp Mabry, from National Weather Service.

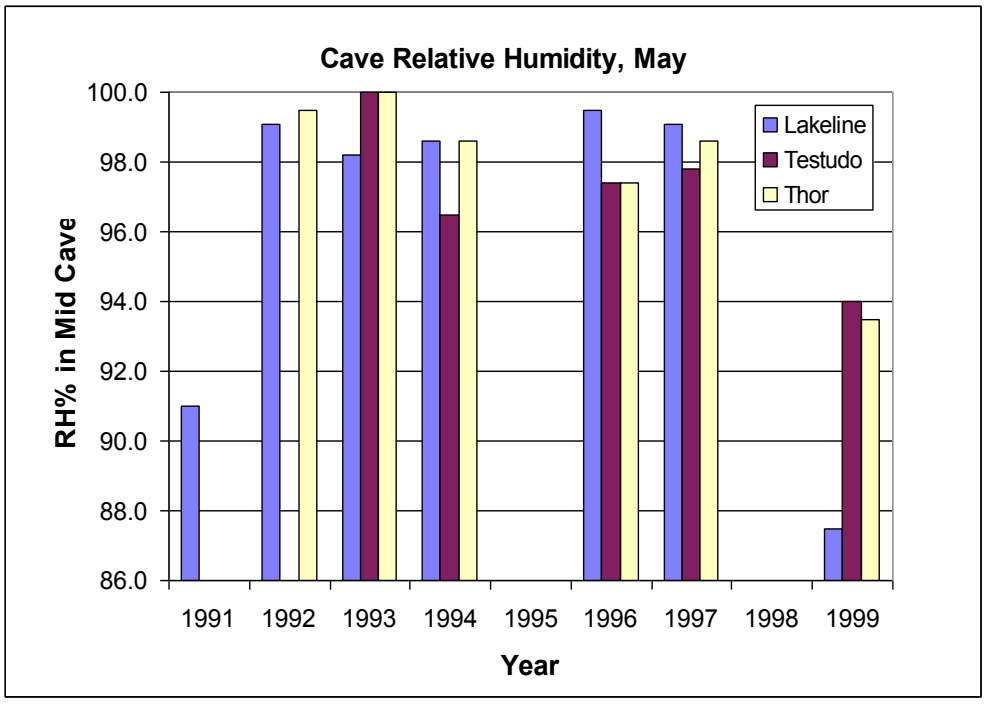



Fig. 2. Relative humidity (at mid cave) in the three caves during May, usually the wettest month in central Texas. RHs were much lower in 1999 after a drought.

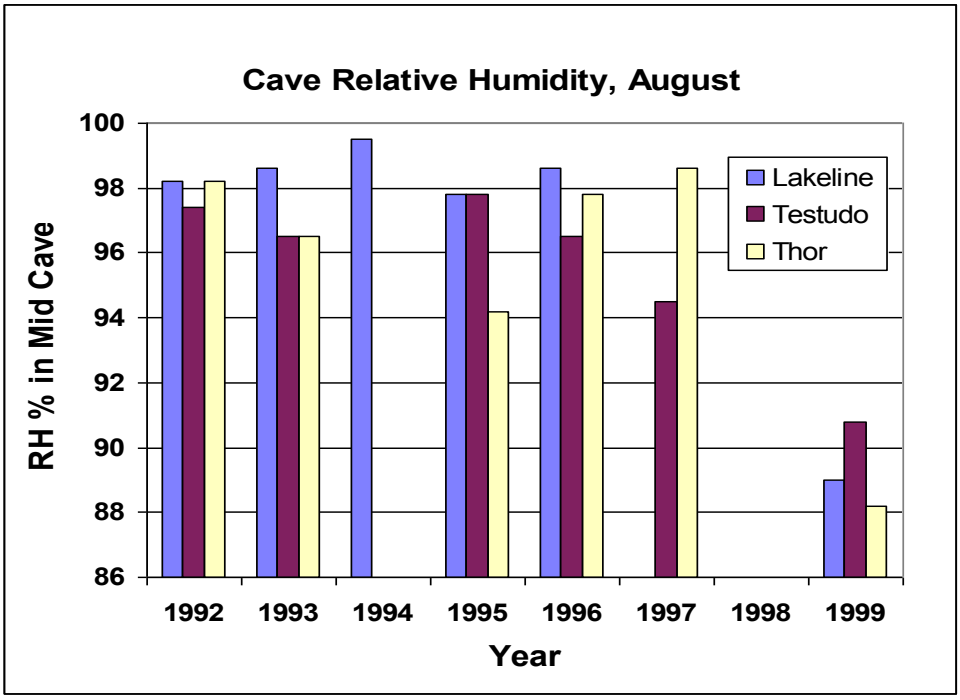



Fig. 3. Relative humidity (at mid cave) in the three caves during August, usually a dry month in central Texas. RHs declined since the mid-1990s.

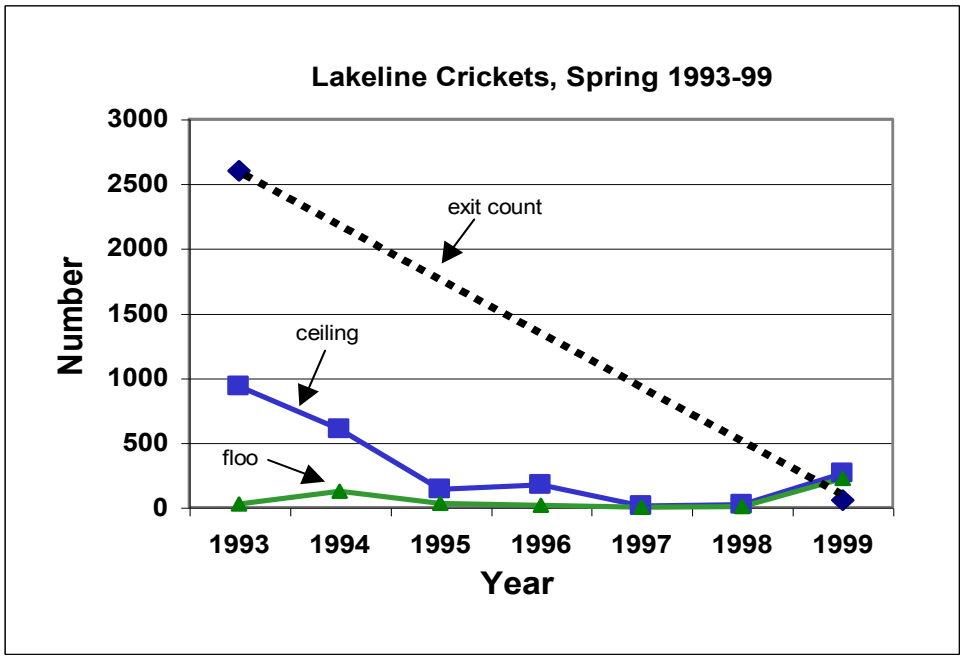



Fig. 4. In-cave and exit counts of crickets at Lakeline Cave. There has been a large decline since 1993.

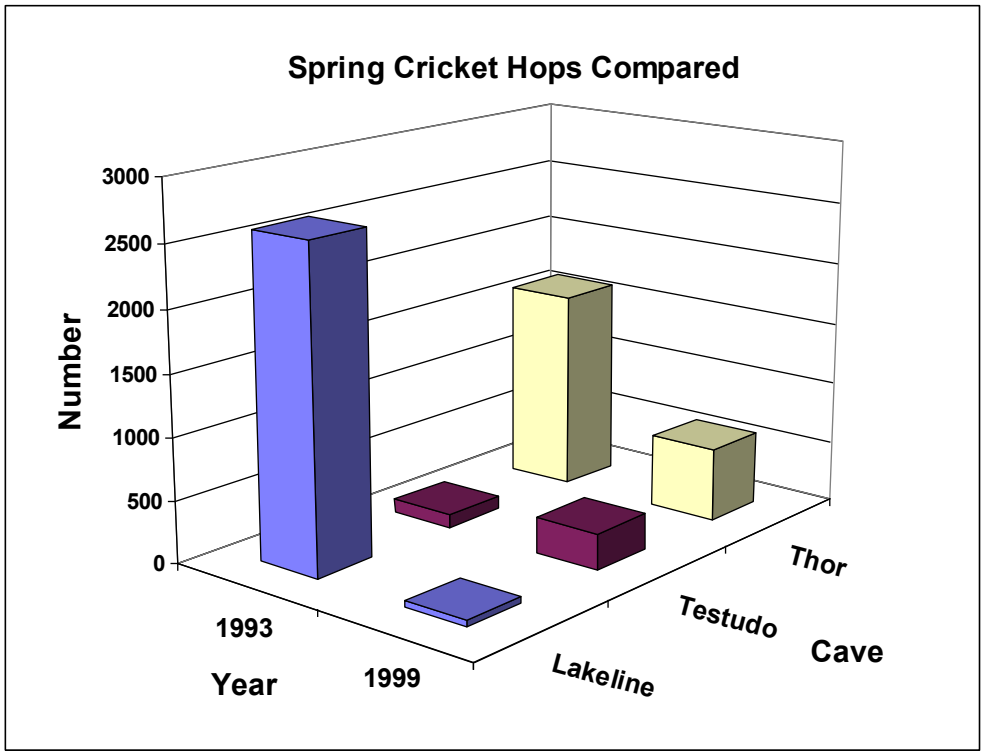



Fig. 5. Exit counts of crickets at Lakeline Cave, Testudo Tube, and Thor Cave. Lakeline had a large decline while Testudo had a slight increase and Thor a moderate decline.

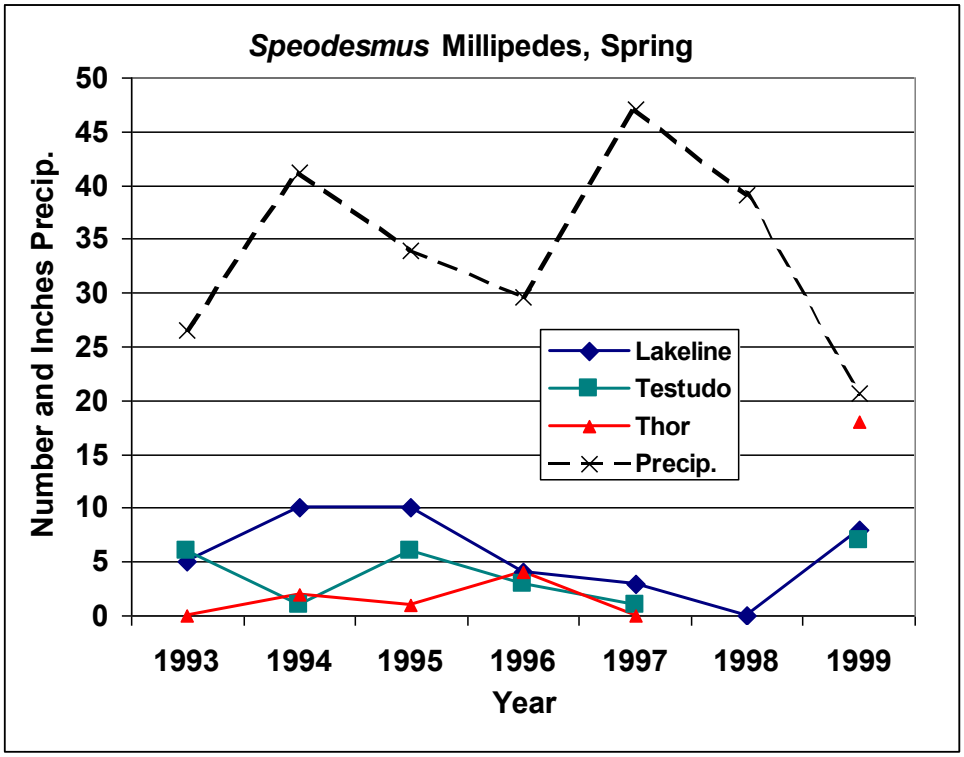



Fig. 6. *Speodesmus* millipedes in spring, compared to annual precipitation. There was a decrease since the mid-1990s, then an increase in 1999.

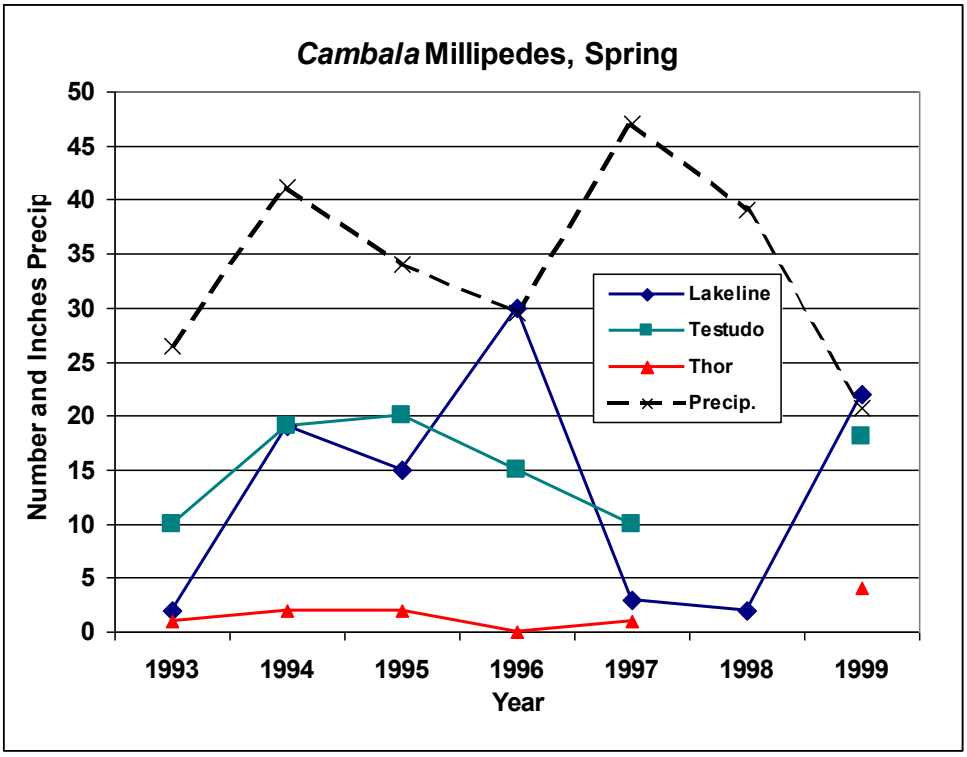
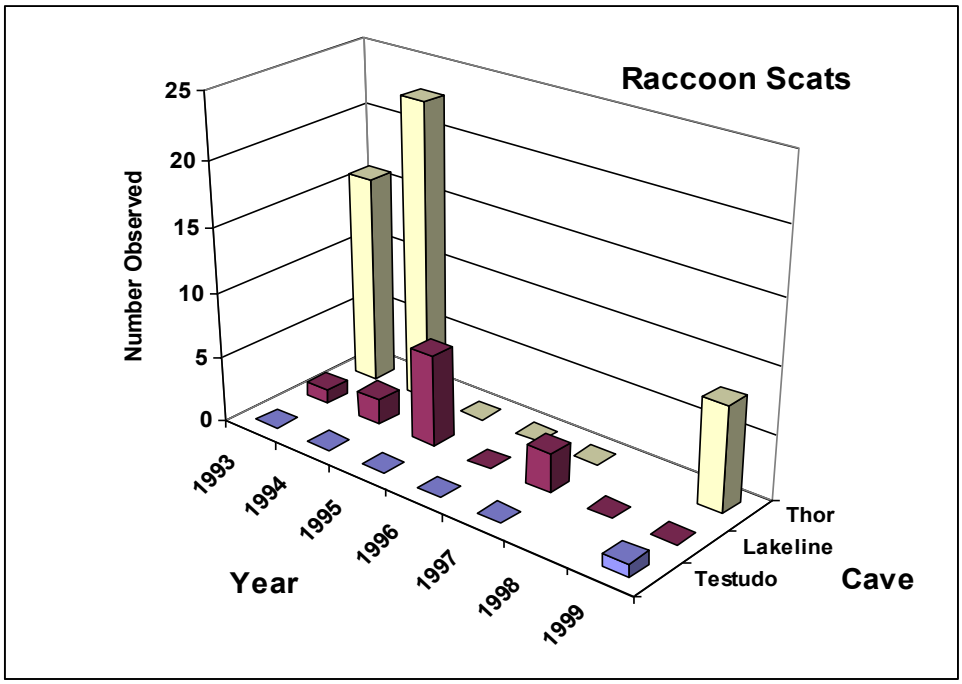



Fig. 7. *Cambala* millipedes in spring, compared to annual precipitation. There was a decrease since the mid-1990s, then an increase in 1999.

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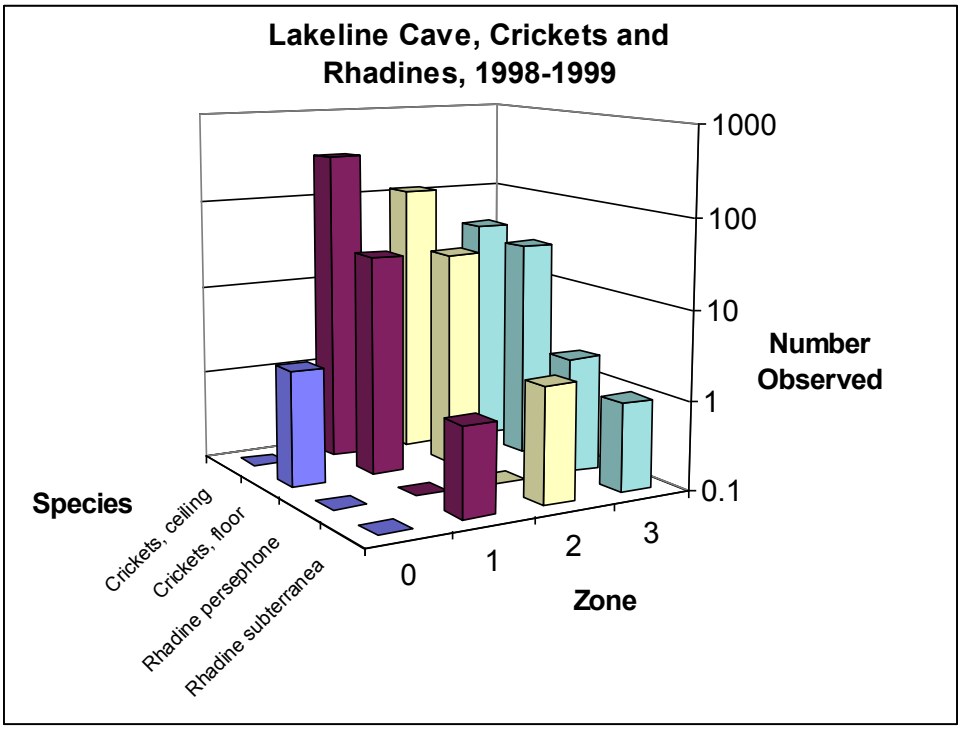


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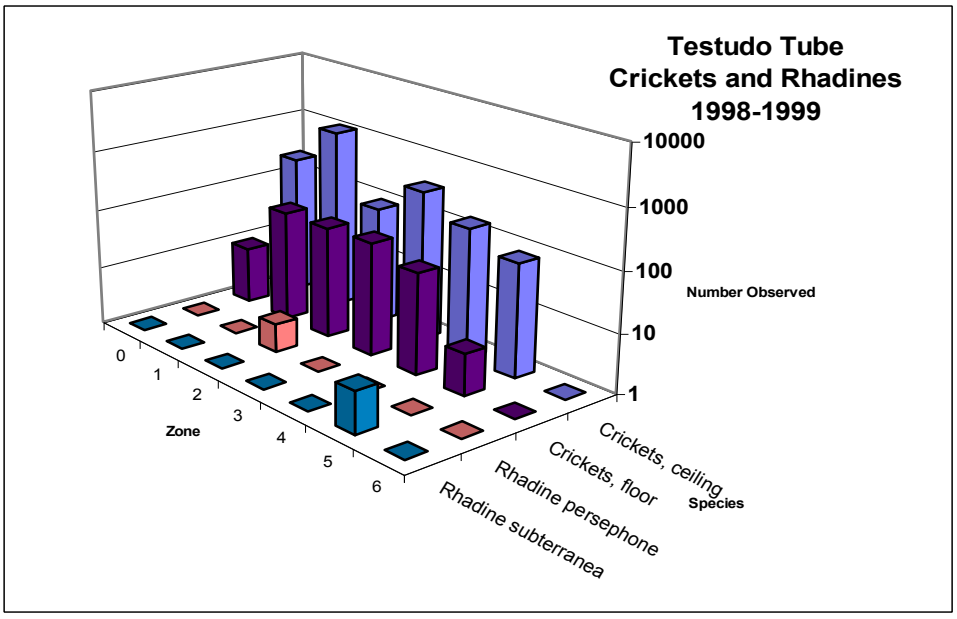
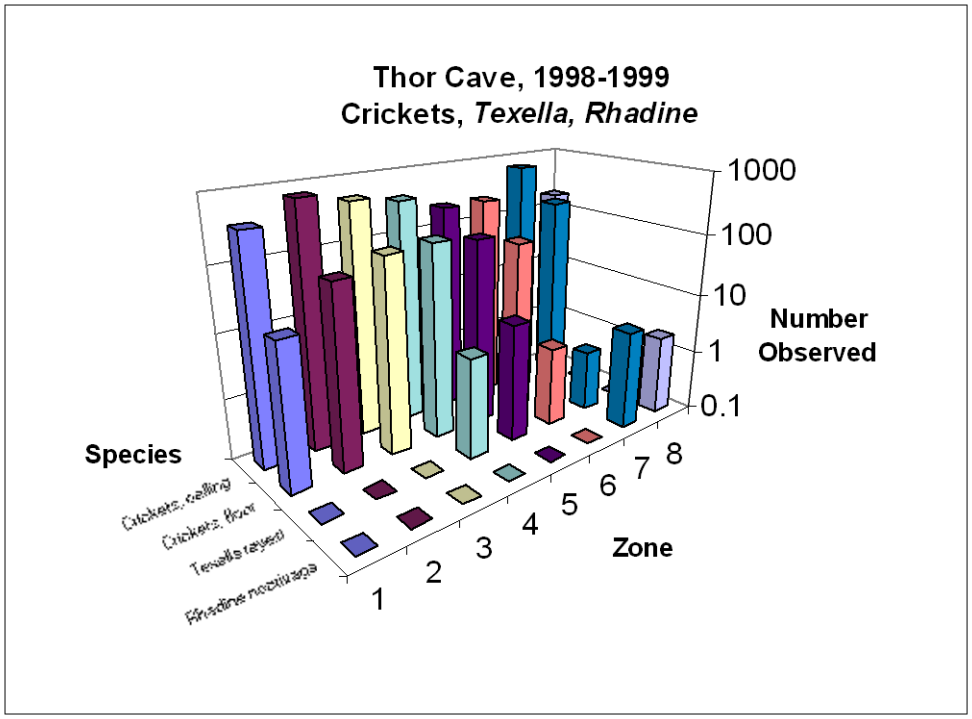



Fig. 10. In-cave counts of crickets and *Rhadine* beetles at Testudo Tube, 1998-1999, using a logarithmic scale. *Texella reyesi* does not inhabit this cave.

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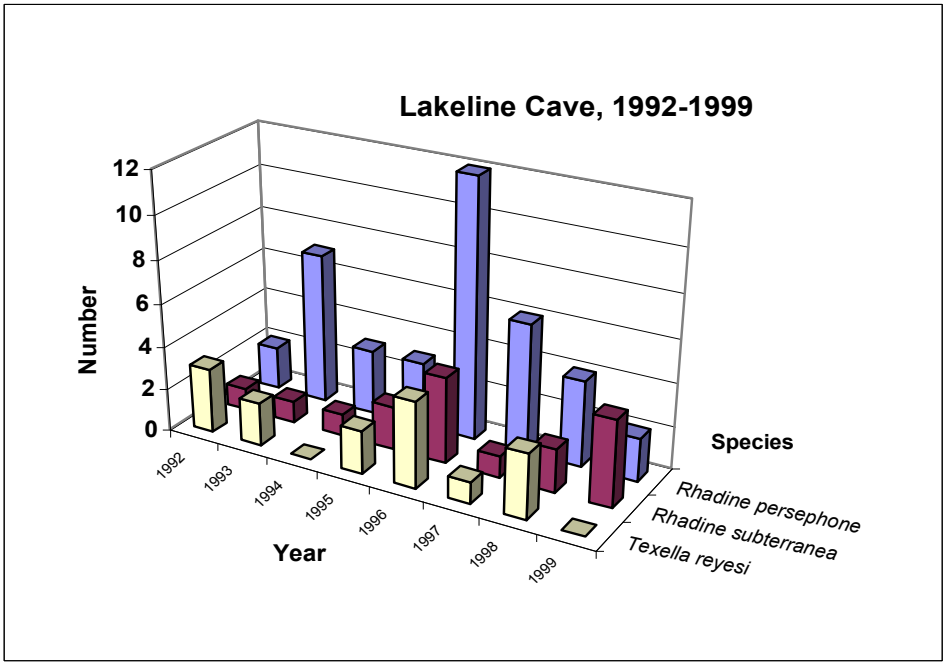


Fig. 12. Long-term trend of *Texella reyesi* and *Rhadine* beetles at Lakeline Cave, 1992-1999. Cyclical patterns may be caused by drought, fire ants, and other factors. *Texella reyesi* was not observed in 1994 and 1999.

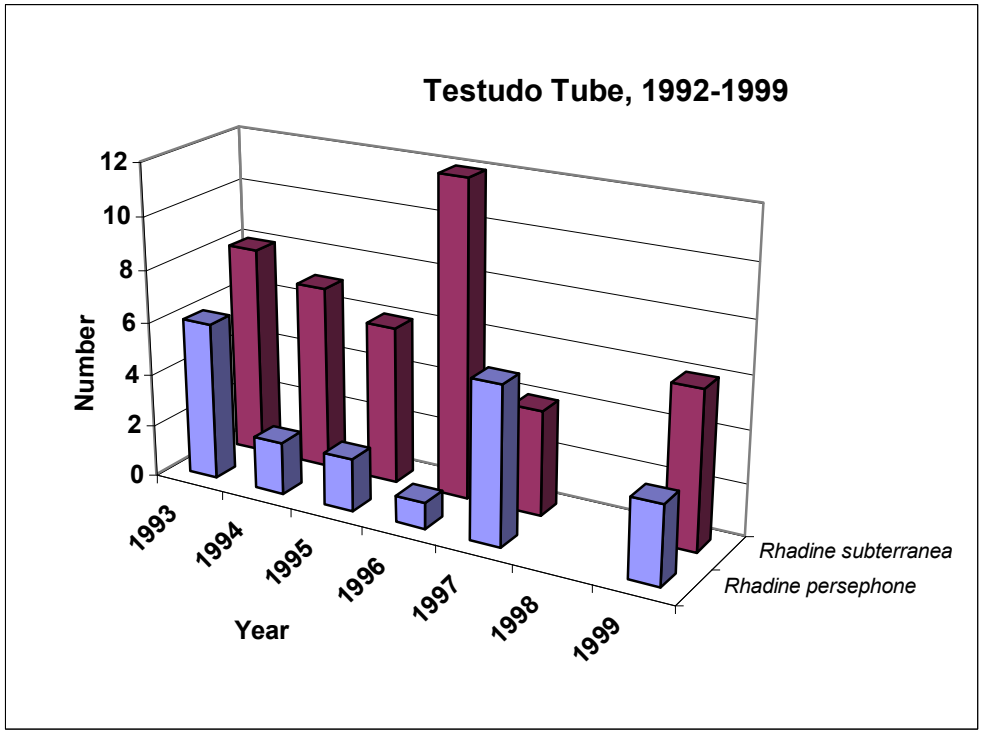


Fig. 13. Long-term trend of *Rhadine* beetles at Testudo Tube, 1992-1999. No data collected 1997-1998.

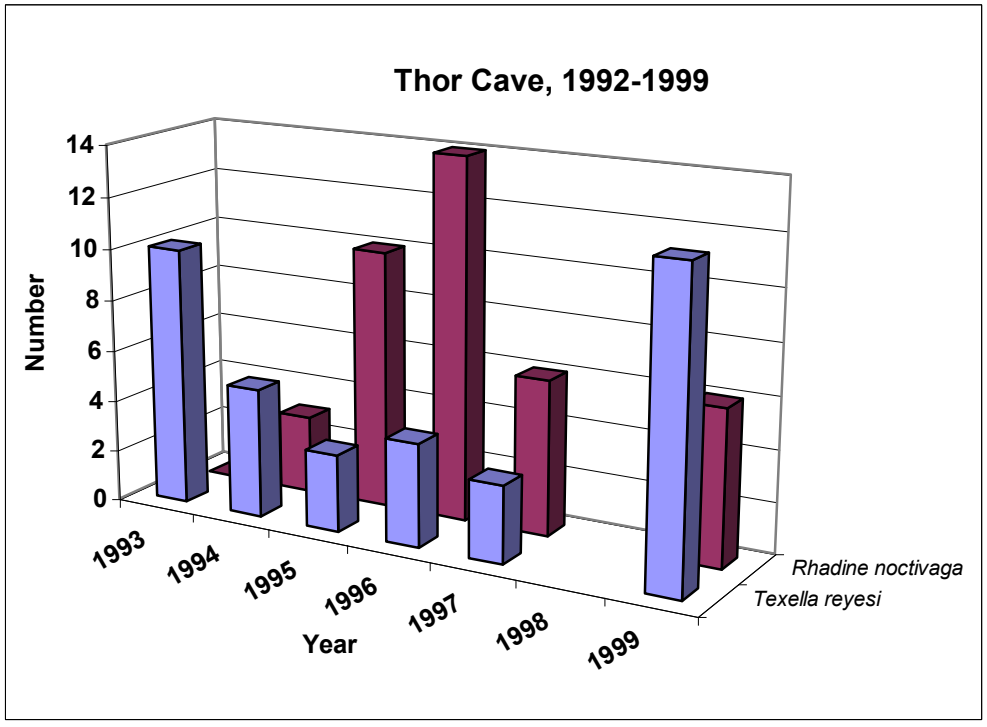


Fig. 14. Long-term trend of *Texella reyesi* and *Rhadine noctivaga* at Thor Cave, 1992-1999. No data collected 1997-1998.