

Guano Invertebrate Project
Carlsbad Caverns National Park
Project Update
Submitted by Diana E. Northup
University of New Mexico
W. Calvin Welbourn
The Ohio State University

Introduction

The objectives of this project, which was partially funded in 1990 by a grant from the Research Allocations Committee of the University of New Mexico, and by a grant from the National Speleological Society, are:

- To identify invertebrate species in Mexican freetail (*Tadarida brasiliensis mexicana*) guano in Carlsbad Cavern, Carlsbad Caverns National Park, New Mexico.
- To determine changes in number of individuals per unit volume of guano over a one year period.
- To determine seasonal succession of mites and other invertebrates in the Mexican freetail guano.
- To determine changes in species diversity over a one year period.

The bat guano community has interested a number of workers over the years (Decu 1986, Harris 1970, Mitchell 1970, Martin 1981, Poulson 1972). The significance of mites associated with bat guano has been noted by several workers (Decu 1986, Mitchell 1970, Martin 1981), but there have been few studies of guano mites. Martin (1981) found mites (16 families) to be dominant in numbers and biomass in the guano of *Myotis grisescens* in Missouri. Mites (12 families) were found to be the most important member of *Myotis velifer* guano community

from an Arizona cave. In addition the dominant mite species varied depending on the age of the guano (Welbourn unpublished data). Rat feces in Little Beauty Cave, Mammoth Cave National Park was found to have 20 families of mites, but a single species accounted for 49% of all individuals (Welbourn unpublished data).

The Mexican freetail bat *Tadarida brasiliensis mexicana* is the primary guano bat in the USA. In the western states colonies of thousands to millions of bats deposit large quantities of guano in caves. This guano supports large numbers of organisms (Mitchell 1970). But the mites of Mexican freetail guano have not been studied even though they represent the largest number of individuals in guano.

The Bat Cave section of Carlsbad Cavern serves as a maternity roost for about 250,000+ (more recent estimates have been closer to one million) Mexican freetail bats and as a gathering site for migrating Mexican freetail bats. Previous work on the mites in Bat Cave was limited to reporting a few parasitic mites from bats and rodents (Barr and Reddell 1967). Preliminary work by W. Calvin Welbourn (WCW) in Bat Cave revealed eight mite families (Glycyphagidae, Rosensteiniidae, Laelapidae, Cheyletidae, Ameroseiidae, Tydeidae, Pygmaphoridae, and Trombiculidae). Of these, the majority of individuals appear to be two or three species.

Methodology

Three random samples of Mexican freetail bat guano were taken from each of three sites every 28 days for 13 consecutive periods (one year) by Diana E. Northup (DEN). Sampling began on 3 February 1990 and ended on 5 January 1991. One site was below the current maternity roost, another site was under an alternative roosting site (formerly a maternity roost until about 8 years ago) where migrating bats often roost, and the third site was below the roosting site of the cave swallows. These sites were selected based on swallow and bat roosting patterns over the last 10 years.

Guano samples were placed in Berlese funnels within 24 hours of collection and remained there for at least 72 hours. Extracted invertebrates were collected and stored in 70% ethanol. Mites are currently being sorted to family and counted under a dissecting microscope. Representative specimens, immatures and small species (ie Tydeidae) are being sent to WCW for slide preparation and identifica-

tion. Representatives of each species were photographed using scanning electron microscopy (SEM) by the SEM facility in the Department of Biology. Sorted mites are being deposited in the Ohio State University Acarology Collection.

Air temperature, relative humidity, and guano temperature were recorded at each site most months. Guano input at each site was monitored with collection cans during the study.

Results

To date, with 90 of the 117 samples sorted and counted, we have found mites in the following families or suborder:

- Acaridae (Fungivores)
- Ameroseiidae (Fungivores)
- Bdellidae (Predators)
- Cheyletidae (Predators)
- Dithinotrichidae (Fungivores)
- Ereynetidae (Predators)
- Glycyphagidae (Fungivores)
- Laelapidae (Predators)
- Oribatids (Fungivores)
- Pygmaphoridae (Fungivores)
- Rosensteiniidae (Fungivores)
- Tarsonemidae (Fungivores)
- Tydeidae (Predators)

Other invertebrates found in the guano have included fleas, flea larvae, moth larvae, wasps, flies, psocids, and pseudoscorpions.

Number of invertebrates per sample has ranged from 18 to 3286 depending on the time of year.

Although the samples are not finished, some preliminary patterns have emerged:

- Within a site, the three sampling areas varied quite a bit, demonstrating that the guano is patchy. Visual observation of the sites revealed differences in moisture content of the individual sites, especially at site 2.
- As expected, the number of mites and other invertebrates is highest when the swallows and bats are present. However, the amount of variation seen in the numbers is surprising.
- The Laelapidae (predators) showed the highest numbers when fungivores were highest. Other predatory mites showed little response to fungivore numbers.
- In sites where fresh input of guano is received, the numbers of Rosensteiniidae shoot up dramatically, while other families of mites decline precipitously. This is consistent with the fact that Rosensteiniids are generally regarded as being guanophiles.
- Glycyphagids tend to be present in high numbers in the dryer, older guano under the old roost site.
- Tydeids have higher numbers in winter when the swallows and bats are not present. What this finding means is unclear.

Graphs of samples counted to date are attached to this report. Site 1 (swallows) was quite variable throughout the year, but did show low numbers in the winter months of January through early March (when the swallows are absent). June was the highest count of mites in site 1. Site 2 was highest in April-May and October-November, possibly reflecting the presence of migrating bats. Site 3 had the highest count during May, but this is probably an artifact of many July-August site 3 samples not yet being counted (they're huge, so we're avoiding them!).

The completion of the project promises a rich dataset with many interesting patterns and observations emerging.

Literature Cited

Barr, Jr. T.C. and J. Reddell. 1967. The arthropod cave fauna of the Carlsbad Caverns region New Mexico. *Southwestern Naturalist* 12:253-274.

Decu, V. 1986. Some considerations on the bat guano synusia. *Trav. Inst. Speol. Emile Racovitza* 25:41-51.

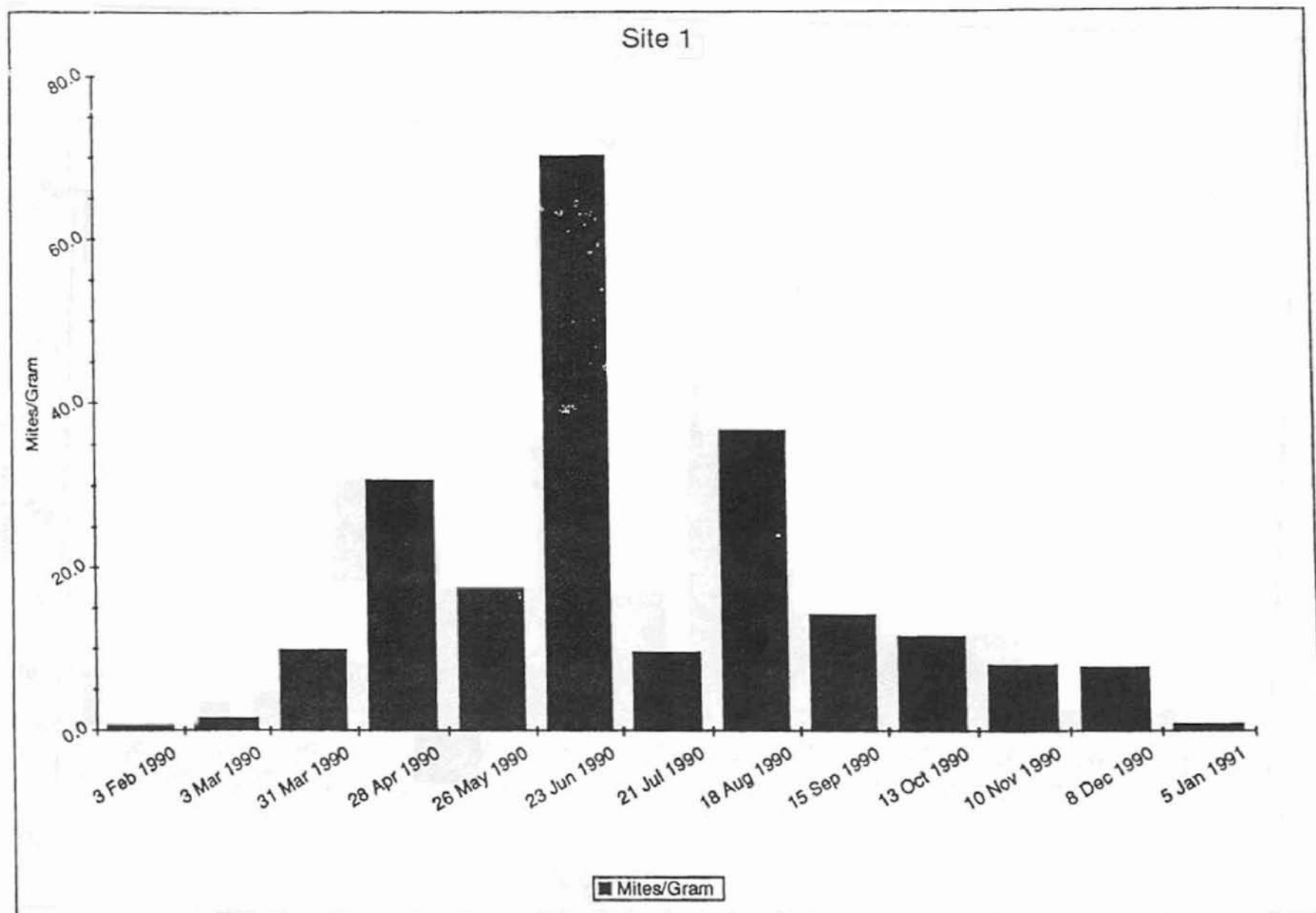
Harris, J.A. 1970. Bat-Guano cave environment. *Science* 169:1342-1343.

Hill, M.O. 1973. Diversity and evenness: a unifying notation and its consequences. *Ecology* 54:365-389.

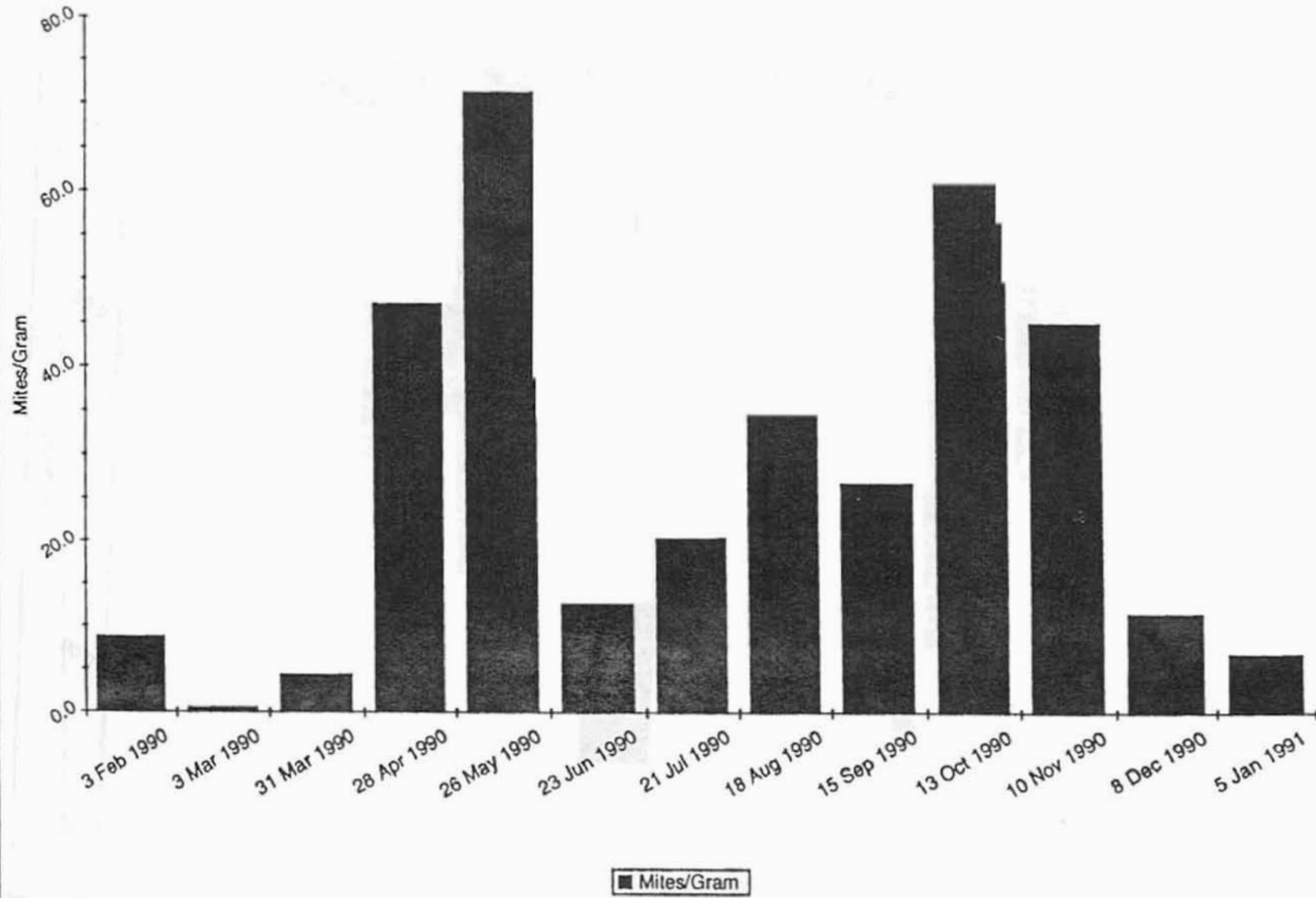
Martin, B.J. 1981. The community structure of arthropods associated with bat guano and bat carcasses in Tumbling Creek Cave, Missouri. In: Beck, B.F. *Proceedings of the Eighth International Congress of Speleology*, v.1:3.

Mitchell, R.W. 1970. Total number and density estimates of some species of cavernicoles inhabiting Fern Cave, Texas (1). *Ann de Speleologie* 25:73-90.

Poulson, T.L. 1972. Bat guano ecosystems. *Bull. Nat. Speleol. Soc.* 34:55-59.



Site 2



Site 3

