

REPORT ON LEPTONYCTERIS NIVALIS

FOR BIG BEND NATIONAL PARK

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REPORT ON LEPTONYCTERIS NIVALIS FOR BIG BEND NATIONAL PARK

Population estimate for 1988, census methods, management recommendations
general biology and bibliography

by

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Several techniques have been used to determine bat populations ranging from simple counting of animals exiting the roost opening to more sophisticated mathematical or technical methods. These methods have varying appropriateness to the study of Leptonycteris nivalis in Big Bend National Park.

Counting Leptonycteris as they exit has the advantages of being simple and inexpensive and of not disturbing the bats inside the roost. The disadvantages are several: Leptonycteris do not exit in a discrete flow; rather they circle back, seemingly to solicit company for the small flocks in which they forage. Thus the exodus is a mass of bats, some coming, some going and is difficult to census by eye. Additionally, the fault cave nature of Emory Peak cave and its broad exit, as well as the exposure of the mountain does not provide a good view against the night sky. Scattered trees in the entrance compound an already dark and confusing situation in which to attempt a visual count of flying bats.

To a lesser degree, direct counts of exiting bats may also be confounded by other bat species roosting in the cave (Myotis spp.; Eptesicus, Plecotus and Antrozous). In the dark indistinct conditions of the entrance, these bats may not be readily distinguishable from the nectar-feeders.

Photometric techniques have been used in the east and midwest to census Myotis colonies exiting attics. These methods involve a photocell hooked up to a strobe, camera and counter or involve motion picture records. The disadvantages of these techniques for L. nivalis in BBNP are many. The equipment is expensive and delicate and would be difficult to pack up the steep, densely vegetated trail to the cave. The intense lighting required for both techniques would require more or less heavy batteries; lights would inevitably delay the onset of the evening flight many hours and would disturb the bats. The back and forth nature of the Leptonycteris exodus would make the first technique unreliable and would require much slowing down and rerunning if cinematic techniques were used.

In similar situations to those mentioned above, ultrasound detectors have been used to census bats leaving a roost. Unfortunately, this technique works only when the roost opening is small and when bats leave individually (ie, Myotis in attics). Since the nectar-feeding bats often circle or backtrack recruiting other bats, this technique is not useful in BBNP. This audiometric method is further reduced in its usefulness when one considers that Leptonycteris rely much on vision and all the exiting bats may not echolocate all the time as do the vespertilionid bats.

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Various mark-recapture techniques have been widely used to census wildlife, the most popular being the Lincoln Index. The population (N) is related to the number marked and released (M) in the same way that the total number caught later (n) is related to the number of marked individuals recaptured (m) or:

$$\frac{N}{M} = \frac{n}{m} \quad \text{or} \quad N = \frac{Mn}{m}$$

The animals need not be literally recaptured, but may sometimes be visually recaptured if marking is obvious. The advantage of this technique is its relative reliability with large populations and its simplicity. On the other hand it represents quite a disturbance to the bats, possible mortality at the hands of inexperienced workers and the chance of driving the bats away from the roost entirely. Results for these animals may be less reliable as the animals are quite intelligent and may become "trap shy" after the initial capture. The nature of the entrance at Emory Peak Cave would create some difficulties for coverage with mist nets or "Tuttle" harp traps (bulky to pack). The inside of the cave is more restricted and would thus be easier to trap but footing for workers is steep and slippery and this location would also represent a disturbance inside the roost.

How to mark the bats would also be problematic. Because of "thin feet" bats have been banded just proximal to the wrist area. Metal bands and even plastic bands proved so harmful that the USFW banding program was abandoned years ago. Although metal or plastic bird bands could be used on the bats placement is necessarily near the brachial artery; bats chew on and thus sharpen the band edges and endanger wing tissue. Should this technique ever be adopted, and I recommend against it, marking should be done with harmless food coloring. The main disadvantage, in summary, is extensive handling of delicate animals. The mathematical and theoretical disadvantages of these techniques in general are discussed in Wildlife Management Techniques edited by S.D. Schemnitz published by the Wildlife Society, Washington DC 1980.

From my 24 years working with the genus Leptonycteris, I suggest the following methods for annual census. These are presented in hopes of achieving a compromise between disturbing the animals and obtaining a reliable count:

A. Establish one (or at the most 2) people inside the cave at night while the bats are out feeding. Between 10 PM and 3 AM would be the safest time. Put several strips of duct tape, gaffer's tape or white medical adhesive tape of known length on the ceiling (see map below). This could be done using some rope assists or the tape could be affixed simply by using one or two telescoping fishing poles or Lechuguilla stalks gathered along the trail. This could even be done in the spring before the bats arrive. When the bats return from feeding toward dawn, wait at least an hour until they have all settled down then estimate the ceiling area covered by bat bodies using the tape as guides. Figure 13 bats hang in a 5½ inch square. Try to make several estimates of area covered then calculate the number of bats present by dividing the observed area by 5½ square inches and multiplying by 13. The "equipment" for this census, although simple, is important. Several powerful flashlights covered by red gel or red taillight covers provide the light. The person doing the census should bring a soft cushion to

sit on and should get himself situated and comfortable before the bats return to minimize shuffling around which causes high frequency sounds that disturb the bats. The worker must scrupulously avoid the following items or activities which create high frequency noise that seriously disturbs the bats resulting in reshuffling of the bat clusters and hundreds of animals in flight overhead urinating and defecating on the worker. An hour will be wasted waiting for bats to settle down again.

Items and activities to be avoided:

- Working zippers
- Undoing velcro
- Ripping tape off rolls
- Nylon clothing rustling
- keys or chains jingling
- Motor driven equipment (Cameras, tape recorders)

B. It is strongly suggested that a few 35 mm still photos be made to validate the counts. In August 1988, I took 4 photos of the clusters using a wide angle lens and an Osram BCS 44 studio flash. Apparent disturbance of the bats was minimal (none took flight) probably due to the extremely short duration of the flash (or its similarity to the lightening the bats must surely see through the small upper entrance during summer storms). Camera placement, focus and trial shots should be done while bats are out feeding. 8x10 enlargements of resulting photos should be made. Unfortunately, my 1988 film was ruined by heat , but the experiment was successful in that it showed bats to be relatively insensitive to the sound of the shutter and to the flash. The worker should exit the cave as quietly as possible, leaving final pack-up and rustling of equipment for outside the entrance.

C. If desired, a plastic sheet of known weight could be installed during the bats' feeding hours one week before the worker went up to do the survey. Before the tape was installed on the ceiling, the plastic would be folded in on itself and placed in a cloth bag of known weight and the entire bundle weighed later on a balance or spring scale. This measured weight of guano could be correlated with visual bat counts for a few years and perhaps would support the visual counts. Guano contributed by other species would be negligible as the numbers of insectivorous bats using the cave is small and in general they do not roost in the same area as the nectar bats. Some way would have to be found to secure the plastic so that it would not slide or blow down the slope. This technique would be rendered less useful if it was discovered that rain comes in the top entrance during summer storms and washes the guano off the plastic. It should be emphasized that the placement and removal of this sheet be done during the night in the bats absence and that it be left for at least a week to increase the sample size and weight in what is at best a gross technique.

D. It is suggested that in 1989 only, 2 counts be made to determine whether bats mass prior to migration. This phenomenon has been noted for some other chiroptera and suspected but not documented for Leptonycteris. The relatively large numbers I saw during the summer of 1988 compared to what I had noted between 1980 and 84 might be due to my count

being late in the season. Although BBNP contains the only known roosting locality for the species, there has been a net record from the Chinati Mountains and a $\frac{1}{2}$ possibility exists that there are other roosts in the park besides Emory Peak. The widely bracketted residence time for Leptonycteris nivalis in the park is late May through September. I suggest a count be made in mid to late JULY 1989 and another in mid to late August. If the numbers are roughly the same, only one count should be made in subsequent years and that in mid July to late July. If the numbers are substantially increased in the August 1989 count over the July count, it could indicate bats coming in from other roosts preparatory to migration. In this case an effort should be made to locate the other roosts with a view toward protection. Again, only one count should be made in subsequent years, but the count should probably be made in Mid to late August.

Whatever date is chosen it should be flexible relative to Agave havardiana bloom. Although choosing a fixed date, say July 30 each year, seems at first to be standardizing the procedures, it is my feeling that such fixed date would provide a less reliable time comparison since agaves straggle from year to year. A more reliable measure would be achieved if bats were counted each year when 80% of the Agave havardiana along Green Gulch were in bloom half way up the stalk (assuming the July count) or $\frac{3}{4}$ the way up the stalk (assuming an August count). This is the best you can do toward controlling the very important variable of a somewhat unpredictable food plant phenology. Apparently Leptonycteris stay well beyond the peak bloom of Agave havardiana and even beyond its last bloom, feeding on the later blooming Agave chisoensis on the rim, but it is strongly suggested that the count be made before the Agave havardiana have finished their topmost flowers and have set fruit half way up the stalk. If the count is delayed, one risks missing the bats entirely.

E. It would be useful to attempt a correlation of bat populations through the years with some standardized measure of food plant abundance because such has never been attempted. The outcome of this would indicate whether manipulating the food resource might be a viable management strategy. I suggest a mere visual count of the Agaves along the basin road with a notation of the dates of first and last bloom.

Management recommendations

Emory Peak cave in Big Bend National Park is probably the best protected site in the species' range. Mexican localities are increasingly disturbed by increasing population, agriculture, development and programs to eradicate vampires. I seem to remember that a dim trail to the cave off the Laguna Meadows trail existed when I first started working with the BBNP bats in 1980. If it still exists I failed to find it in 1988. So much the better! The density of the shrub cover (Garrya, oak, manzanita, juniper, agave) and the fact that one really can't see the cave from the Laguna Meadows trail discourage the casual visitor. It is strongly suggested that park naturalists and rangers not mention the existence of the cave and if specifically pressed about its existence to mention that it is only a fault cave with no scenic value (Stalactites etc) and very little depth to explore; that it is dangerously slippery with guano as well.

If possible, the cave should be put off limits to visitors but not in such a way as to tantalize those who would disobey rules, ie a sign should NOT be put on the Laguna Meadow Trail or in visitor centers saying "Due to endangered bats, Emory Peak Cave is closed". A small sign at the entrance to the cave saying something about the bats or that the cave was off limits for public safety reasons might suffice. Park personnel might be advised to respond to specific inquiries by stating the cave was closed.

Should human disturbance become a problem. it might be necessary to gate the cave. In such case, work should be completed well before bats return in the spring. Care must be taken not to change the air flow and thus change the microclimate which the bats now find suitable. Horizontally placed bars about one foot apart might be a good gate design, the horizontal bars are more easy for a bat to pass through than a human.

Anything that can be done in the park to minimize disturbance of the sentury plants will be helpful, ie transplanting any in areas due for development. A "reforestation" project might be initiated on a small scale using 2-3 year old greenhouse grown plants set out in the sloping talus areas where they thrive. Such a pioneering approach would have few drawbacks; agaves lend scenic value to the park and are not likely to "escape" and overwhelm other native vegetation.

In Arizona, Leptonycteris sanborni numbers are up compared to the last 10 years. A conceivable reason for this might be the bats discovery, within the last 10 years, of hummingbird feeders in Cave creek and Ramsey canyons, Cochise county. Ramsey canyon is a Nature Conservancy Preserve reknown for its large numbers and diversity of hummingbirds. Dozens of feeders are placed in the visitor center area and around guest cabins. Overnight the feeders are drained of nectar. Using my data on Leptonycteris energetics, researchers estimated that 300-400 bats are feeding nightly. An Arizona Game and Fish and US Forest Service "bat night" was held supporting this estimate. Overnight guests at the cabins are being made aware of the nocturnal happenings at the feeders and are adding "bat watching" to their experience at the preserve. The feeders are nicely backlit from the cabin lights, presenting excellent views of the animals. New T-shirts are being designed for the preserve to supplement the usual hummingbird shirts. They show nectar bats drinking from the feeders and say "Ramsey Canyon, the night shift". I cite these events for two reasons, to point out something that might be done to increase the food supply for the bats and to indicate an opportunity for public education about bats. It is fortunate that Leptonycteris is a "cute" animal who engages in a benign activity (drinking from flowers). It is therefore an excellent animal for interpretation. Additionally its role as a major pollinator may endear it to people more disposed to like flowers than bats. I encourage several seasonal programs emphasizing these nectar bats and possible a permanent display in the PJ visitor center. The number of feeders around the lodge or in the amphitheater area might be increased, helping the bats (especially in years of scarce agaves) and providing an opportunity for tourists to sit around on the patio in the evening and bat-watch. Certainly a dramatic evening talk would result if bats included amphitheater feeders on their nightly

rounds.

Finally, any opportunity to educate and/or forge an agreement with Mexicans about protecting habitat (roosts, agaves) should be fully taken advantage of.

POPULATION ESTIMATE FROM AUGUST 1988 CENSUS

The census was made using the previously described methods between August 13 and 14, 1988. All of the Agave havardiana along the Basin road and most of the plants on the Laguna Meadow Trail were out of bloom and in young fruit. Agave chisoensis on the rim were in the last stages of flowering with young fruits already developing on the lower panicles. Three clumps of Leptonycteris were present on the ceiling of the cave when the census began. These clumps were 4' by 2½', 6'x4' and 8'x4'. Mid survey, the red lens fell off the flashlight and slid down the 2nd level floor for a short distance. The sound disturbed the bats although the flashlight was immediately turned off. About half the bats took flight momentarily. 10 minutes later, the colony had resettled into 2 clusters approximately 10'x3' and 10'x5'. Using these areas in the manner described above, I estimated 5240-6630 bats in residence. Edges of the clumps are, of course, ragged and account for some of the variability in these figures. It is also possible that the density of clustering changed somewhat after the disturbance. My quietly leaving the cave aroused no further flights.

A BRIEF ECOLOGY OF LEPTONYCTERIS NIVALIS

Description: Leptonycteris nivalis is easily distinguished from other Texas bats by having a long rostrum and by the presence of a "leaf" or cutaneous flap on the end of the nose. The fur is relatively long and fluffy, warm brown in adults and greyish in juveniles. Total head and body length is 75-95 mm; the forearm 55-60mm, making them one of the larger bats in the state.

Range: Leptonycteris nivalis occurs primarily in the central uplands of Mexico, but their range extends northward to the Chisos Mountains in Big Bend National Park. Two unpublished specimens from Hidalgo county New Mexico comprise the western boundary. The southernmost records are two from Guatemala. In Texas there is only one known roost, a fault cave in a pinyon-juniper-oak association. A single juvenile male was captured in Pinto Canyon, Chinati Mountains, Presidio County Texas in 1969. Since few if any researchers have returned to the site since that time and since appropriate food plants are in the area, it should be presumed that long-nosed bats still frequent that region.

These bats occupy a variety of habitats through their Mexican and Texas range. In the United States they are in the upper Sonoran and transition zones. Vegetative associations which include Agave havardiana and Agave chisoensis comprise their feeding grounds. Easterla found them in 5 distinct associations in BBNP: Arroyo-mesquite-acacia 1800'-4000', Lechuguilla-cactus-creosote 1800-3500', deciduous woodland 3700-7800', Pinyon-juniper-oak 3700-7800' and Cypress-pine-oak 5800-7200'.

Roosts: These nectar-feeding bats roost by day in a variety of caves, mines, old buildings and possibly culverts. Occasionally they use manmade structures for their prolonged digestion roost in the middle of the night, but may also simply cluster on a rock face. It is my impression that they never use cool caves below 65 F nor geothermally heated caves. Generally their day roosts are 68-80 F. Most caves are below individual bat thermoneutral zones, but the dense clustering typical of this species helps them to achieve microenvironmental thermoneutrality. One of the inevitable consequences of declining populations is higher energy cost for individual thermoregulation.

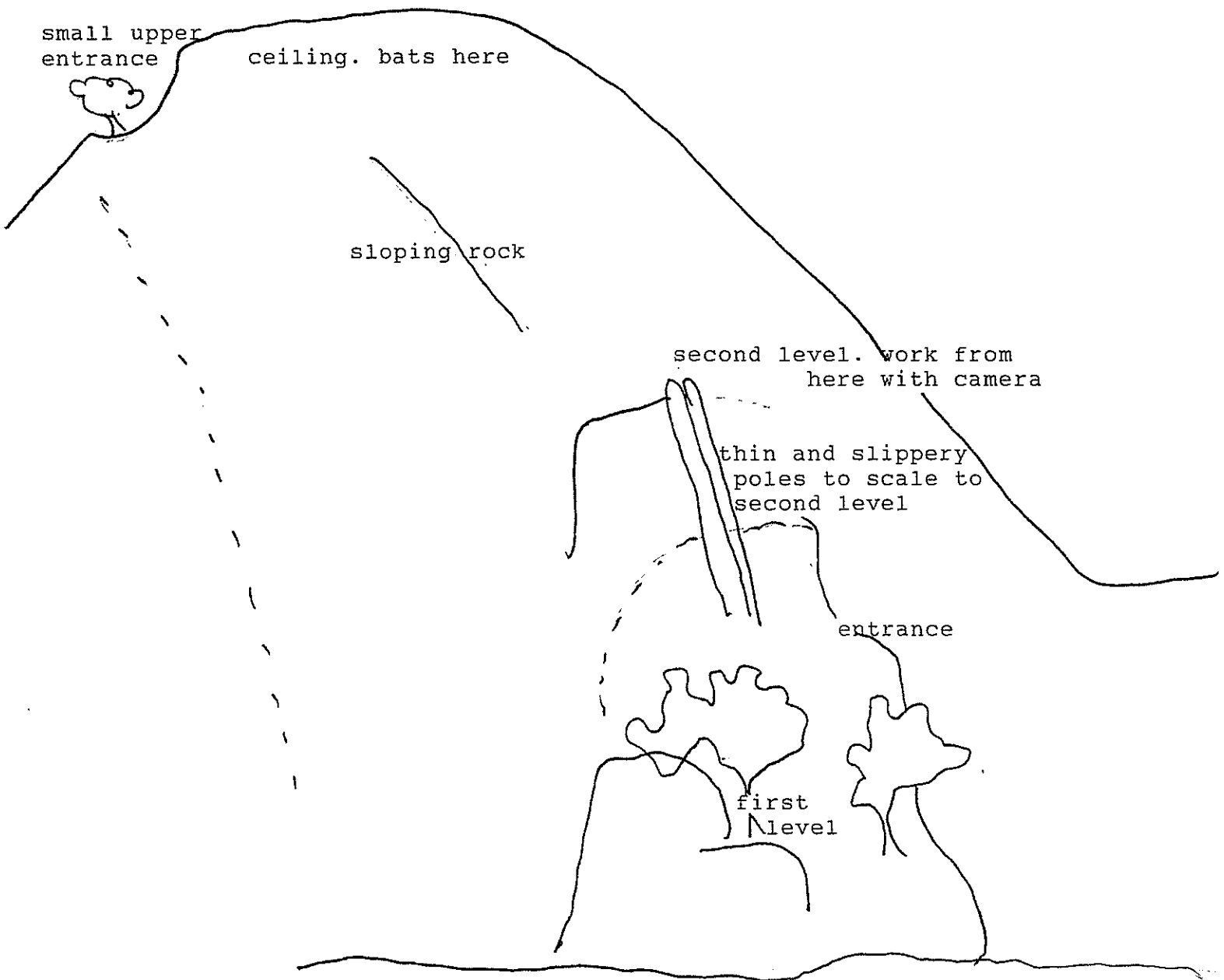
Diet: Leptonycteris are committed nectar feeders. Besides consuming flower nectar, they ingest large amounts of pollen, picked up inadvertently as they thrust their heads into flowers. Later the pollen is groomed off and ingested. They do not eat anthers. The pollen provides vitamins and minerals and the important nitrogenous fraction of their diet. The pollen of bat-adapted flowers is richer in protein than other pollens and also provides a full complement of essential amino acids. Adult bats must ingest about 170 mg. of protein daily to meet minimal nitrogen demands; Agave pollen is about 20% protein. To balance their 24 hour energy budget bats must take in about 10 Kcal/day. Agave nectar is 17-22% sugar. How many blossoms a bat must visit depends on production and whether other nectar feeding animals have visited the plant before.

Migration: Long-nosed bats are migratory following a complex co-evolved phenology of several dozen plant species. They leave the United States in late summer or early fall as the local Agave species go out of bloom and follow later blooming Agave species southward through Chihuahua and Coahuila. By November they are over 500 miles into Mexico and start picking up some of the semi-tropical bat trees such as Ipomoea and Ceiba. In the winter they are in the lush central valley feeding from a large variety of host plants. In the spring they work their way north again following the bloom times of columnar cactus and early Agave species.

Reproduction: Of critical importance to the conservation of these animals is the fact that they have only one young per year. They probably give birth in Mexico in late June before migrating with volant young to Texas. The Emory Peak cave population is almost entirely adult females with mixed sex young of the year. At birth the young are sparsely furred and somewhere midway on the continuum between altricial and precocial. Mothers recognize their own young by a combination of olfaction and individual distress cries made by their particular offspring. Young are nursed for about 1 month. The young male bats, after several months in the same roost with their mother (including a few months of feeding on their own) leave on the migratory journey in advance of the females, thus achieving separation of the sexes into female and bachelor colonies. This is the state of the populations for much of the year.

Status: The bat and its congener L. sanborni from Arizona was listed as endangered on Oct. 31, 1988. By accounts of Mexican and U.S. scientists, L. nivalis used to be common in Mexico but a recent survey by Don Wilson of the US National Museum showed they were extirpated from many of their previous roosts or their numbers showed severe decline. In 1976, Easterla reported 10,650 in BBNP. I counted about 1000 annually between 1980 and 84. Several reasons for this decline may be postulated. I have published evidence that the moonshine (bootleg) tequila industry is taking at least 80,000 agaves annually in Northern Mexico without replanting. These are cut just before they bloom. It is my belief that this is creating a swath of foodlessness in the bats migratory path. Habitat destruction in Mexico is another important factor, as is the ongoing vampire control program. To many Mexicans, including those effecting vampire control, all bats are "vampiros". Certainly their summer home in BBNP is a safe haven, but since they spend most of their year in Mexico, and "Mexican Ecology" seems to be an oxymoronic term, their future looks bleak.

ROUGH MAP OF EMORY PEAK CAVE



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