

The University of Notre Dame

Natural History of the Vampire Bats of Eastern Mexico

Author(s): Walter W. Dalquest

Source: *American Midland Naturalist*, Vol. 53, No. 1 (Jan., 1955), pp. 79-87

Published by: [The University of Notre Dame](#)

Stable URL: <http://www.jstor.org/stable/2422300>

Accessed: 06/08/2014 18:25

Your use of the JSTOR archive indicates your acceptance of the Terms & Conditions of Use, available at <http://www.jstor.org/page/info/about/policies/terms.jsp>

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact support@jstor.org.



The University of Notre Dame is collaborating with JSTOR to digitize, preserve and extend access to *American Midland Naturalist*.

<http://www.jstor.org>

Natural History of the Vampire Bats of Eastern Mexico

Walter W. Dalquest

Midwestern University, Wichita Falls, Texas

Vampire bats of two species range throughout eastern Mexico from the southern limits of the republic northward to approximately 175 miles from the United States boundary. The common vampire, *Desmodus rotundus murinus* Wagner, is a common to abundant bat almost wherever it is found. The hairy-legged vampire, *Diphylla ecaudata centralis* Thomas, is one of the rarer North American bats but seems to reach its maximum abundance in eastern Mexico.

These disgusting but nevertheless interesting mammals do great damage to livestock and attack human beings on occasions. Domestic animals are weakened and sometimes die from loss of blood from the wounds inflicted by vampires, while the open wounds are a common site of infection by bacteria and parasitic insect larvae such as screw worms. Vampires are potential vectors of disease also. They are known to transmit rabies and some cattle diseases in Panama, Trinidad, and South America, and such communicable diseases as the hoof-and-mouth disease might easily be spread by vampires. In the British West Indies an intensive campaign has been carried out in an effort to rid the island of Trinidad of these dangerous animals. The writer is convinced that a similar campaign must soon be undertaken in Mexico. The following report, which may assist in such a campaign, is based on several years of field work in eastern Mexico, during which period approximately ten thousand vampires were examined.

In the uninhabited jungles of extreme southern Veracruz I found no vampires, although conditions, except for the absence of domestic animals, seemed to be ideal for these bats. Along the Rio Coatzacoalcos, at the northern edge of the uninhabited area, where people, horses, cattle and burros are again found, vampires again were encountered. Large game animals are abundant in the uninhabited area, but none of the many specimens taken showed evidence of vampire predation.

Probably vampires were rare to uncommon in eastern Mexico in prehistoric times, but the arrival of domestic animals accompanying the conquest of the country by Europeans presented the existing vampires with a constantly increasing food supply in the relatively helpless burros, horses, and cattle. The common vampire breeds throughout the year, is extremely shy, is probably safe from most predators in the caves it inhabits, is remarkably hardy, and has now increased in numbers until it is one of the commonest and most widespread mammals in eastern Mexico. It is adaptable enough to live in hollow trees and the structures of man and to live on the arid deserts as well as in the tropics. It is principally, perhaps almost entirely, dependent on domestic animals for food at the present time and may even attack man.

Recognition of vampire bats.—Vampires are large bats, measuring two to three inches from the tip of the nose to the rump. The forearm bone of the wing measures two to two and one-half inches. Vampires lack external tails

but there is a narrow, tail-like strip of membrane, the uropatagium, along the posterior edges of the legs and rump. The teeth of vampires differ from those of all other North American bats in that the anterior ends of the jaws possess large, flat, scoop-like canines and incisors that are in contact anteriorly, and the cutting edges of the anterior teeth in each jaw form a "V." The jaws of other bats contain large, pointed, canine teeth which are round in cross section and are never in contact; and usually there are several small, peglike, incisors separating the canines. Vampires have no noseleaves but do have naked pads at the ends of their truncated snouts which contain distinct, "U-shaped" grooves. The ears of both species are small and do not extend past the nose when laid forward. Vampires are of uniform body color.

The common vampire differs from the hairy-legged vampire in being larger, having shorter, coarser fur and in being reddish brown or rusty in color rather than dusky gray. The most prominent difference between the two species is found in the thumb. The thumb of the common vampire is more than one-half of an inch long and has a distinct, fleshy pad on the ventral side, midway between the base of the thumb and the base of the claw. The thumb of the hairy-legged vampire is only about a quarter inch in length and lacks the median pad. The hairy-legged vampire gets its name from the fur that fringes the uropatagium, along the inner sides of the legs. The uropatagium of the common vampire is almost naked.

Several species of fruit-eating bats, especially of the genus *Artibeus*, resemble vampires in size and also lack tails. In addition to possessing facial stripes and teeth of a different type, all fruit bats that might be mistaken for vampires have prominent, erect, noseleaves. Because fruit-eating bats so often occur with vampires, and are so often mistaken for them, it should be stressed that *any bat with a noseleaf is not a vampire!*

Handling live vampires.—Live vampires should be handled with extreme care, for they move swiftly and bite viciously, leaving wounds that are large and painful and which heal slowly, even when disinfected immediately. Heavy gloves would probably protect the hands but are clumsy to work with. After some painful experimentation the following method of handling the bats was developed. The bat is pinned flat with a quick slap of the palm, care being taken not to cover its head. The bats have such short necks that they can not turn their heads upwards or to the sides at right angles. Keeping the bat pressed down, a large flap of skin at the base of the neck, between the anterior edges of the wings, is pinched tightly between thumb and forefinger. A bat so held is completely helpless and can be examined or moved as desired. Vampires seized around the neck are unable to bite but can scratch unpleasantly and flap their wings.

Most mammal collectors kill live bats by placing their index finger against a bat's back, thumb on its chest, and asphyxiating the animal by squeezing. This method is not recommended for vampires. They are so tenacious of life that they can survive several minutes of hard squeezing, time enough to exhaust the muscles of the fingers; and apparently dead animals that had been so treated often recovered. Fruit-eating bats of equal size or larger were quickly killed by pressures that seemed to have little effect on vampires.

Vampires display similar toughness when shot. A charge of shot sufficient to kill large fruit bats almost instantly did not kill vampires unless they were

actually struck in the hearts or heads. A shot into a cluster of fruit-eating bats usually brought down numerous dead and dying bats, and few wounded bats were strong enough even to try to escape. A similar shot into a cluster of vampires usually brought down more wounded than dead bats and, unless they were seriously wounded or dead, the vampires flew or scampered off along the ground. On some occasions a shot into a dense cluster of vampires would bring down a dozen or more individuals but every animal would hop, scurry, or fly away and escape.

Distribution.—Vampire bats range from South America northward through Central America and Mexico. The northernmost record of occurrence in eastern Mexico is in the coastal lowlands near Victoria, Tamaulipas (Baker, 1951). This locality is only 175 miles from the United States boundary. The northernmost record on the Mexican Plateau is near Presa de Guadalupe, in the state of San Luis Potosi. Doubtless the bats range even farther north.

Within their range in eastern Mexico vampires are among the most adaptable of mammals. They are found in the steaming jungles of the eastern side of the Isthmus of Tehuantepec, Veracruz; near sea level on the arid and coastal plain of eastern Veracruz; up to 6500 feet elevation in the mountains near Atotonilco el Grande, Hidalgo; in the brush and mesquit plains near Victoria, Tamaulipas; and far out on the cactus-and-yucca covered desert near Presa de Guadalupe, San Luis Potosi. Vampires seem to have occupied the range where they are now found for a long time, for Cushing (1945) reported the remains of a vampire from a fossil deposit in southern Nuevo Leon, associated with the bones of the sabertooth tiger and other Pleistocene mammals. This locality is near the northern limit of the range of the species at present and is also somewhat higher (7400 feet). Considering the length of time vampires have lived in eastern Mexico and their tolerance to elevation, climate, and varied habitat, it is most surprising that they do not range northward into the United States.

The number of vampires is regulated locally by the presence of suitable daytime retreats. The bats reach their greatest abundance in limestone areas, where there are numerous caves. They are adaptable animals, however, and in the absence of caves they are able to find substitutes in buildings, rock walls, or hollows of trees.

Feeding habits.—Food of vampire bats consists entirely of the blood of mammals and birds. The digestive tract, modified for a diet of blood, was first described by Huxley (1865) and more recently by other writers (see Parks and Hall, 1951). The vampire's method of feeding and the species of animals preyed upon vary in different parts of the country.

In the state of Veracruz the bats prefer to feed upon the blood of the burro, the little Mexican donkey, although horses are also extensively attacked. In areas where the bats are numerous it is a rare night that an unprotected burro or horse escapes being bitten. Two horses roaming near a cave containing a large colony of vampires near Potrero Viejo, Veracruz, were often attacked, became emaciated in about two weeks, and would doubtless have died, had they not been removed. Calves are commonly bitten, but adult cattle are bothered less by the bats, although some Brahma oxen weighing fully a ton

were observed with fresh vampire wounds on their cheeks. Vampires seem not to bite domestic fowls in Veracruz. The chickens and turkeys that belong to the country people usually roost, unprotected, in low trees and bushes near houses, and no report of vampires attacking these birds was ever received.

In the tropical, eastern part of San Luis Potosi also the vampires attack burros and horses, but they seem to feed upon the blood of cattle to a far greater extent than they do in Veracruz. Domestic fowls are a favored prey, and any chickens or turkeys that are not tightly penned at night are likely to be soon killed by the bats. On the Mexican Plateau of San Luis Potosi, the vampires seem to feed principally on horses and cattle. Burros are less common on the plateau but are heavily preyed upon where they do occur. Chickens are rarely molested on the plateau.

Relatively few sheep, goats, or pigs were examined for evidence of vampire predation. No direct evidence of molestation of these animals by vampires was ever secured, but the data are too slight to prove that they are not bitten. A number of large wild game animals, including deer, brocket, collared peccary, white-lipped peccary and tapir, were examined, but no scars that could certainly be attributed to bites of vampires were noted.

Many residents of Veracruz were asked whether vampires ever bit people, and all definitely denied that the bats ever bit human beings. Neither the writer nor any of his native assistants were ever attacked in several months of field work when the entire party slept in the open or in tents with open doors near known vampire colonies. The evidence of the natives becomes less conclusive, however, when one notes that the people of San Luis Potosi also vehemently denied that the bats bite human beings and were revulsed at the very thought. Children with unmistakable vampire bites were seen, but these bites, the people said, were bites of *brujas* or witches. Perhaps questioning the natives of Veracruz about witches would reveal that the vampires in that state bite people just as they do farther north.

Vampires do not leave their retreats until after darkness. Near San Andres Tuxtla, Veracruz, observations showed that the vampires did not leave their cave until several species of insectivorous and fruit-eating bats were on the wing. The vampires are rarely seen in flight, partly because they are extremely skillful at dodging out of the beam of a flashlight and partly because they fly close to the ground when they are hunting. Near Rio Verde, San Luis Potosi, Japanese silk "mist nets" were stretched between cypress trees near a vampire colony. No bats were taken in the nets until complete darkness. Once it had become dark, however, numerous vampires were trapped, and nearly all of them were taken in the lowest panel of the nets, less than one meter from the ground. The bats flew silently and were not heard until they had become entangled in the nets. This is in marked contrast to their noisy flight in the caves where they spend the day. More than 100 vampires were taken by chance in nets set at night in the open and in the jungle of San Luis Potosi. Most of the bats were entangled less than a meter from the ground. The bats were taken from the onset of darkness throughout the night, although most were taken about one hour after dark and relatively few were taken after midnight.

Vampires were observed on numerous occasions near the stables at Potrero Viejo, Veracruz, but were never seen in the actual act of feeding. The feeding

habits of captive vampires have been described by Ditmars and Greenhall (1935). Some vampires find their prey and fill their stomachs with blood in a short time. Near San Andres Tuxtla, Veracruz, vampires were taken as they were returning to their caves with freshly-filled stomachs about a half-hour after they had left for their evening hunt. Unlike insectivorous and fruit-eating bats, which commonly retire to rest after feeding in some sheltered place other than the place where they ordinarily spend the day, vampires seem to return to their daytime retreats after they have fed. No vampires were ever seen, nor were their unmistakable droppings ever noted, in places where they did not live by day. Perhaps the high-protein diet of the vampires makes it unnecessary for the bats to fill their stomachs more often than once a night, while the resting period of other bats is only a respite before hunting is resumed.

In eastern Mexico vampires usually bite burros, horses, and cattle on the cheeks and necks, at the bases of the ears, or slightly below. Oxen are usually bitten on the cheeks, and chickens and turkeys on the legs just above the place where the feathers begin. In South America it has been reported (Hensel, 1896; Caraccolo, 1895; Allen, 1916) that cattle are bitten above the hooves, chickens on the necks, and human beings on the fingers, toes or noses. In Mexico, human beings are usually bitten on the cheeks, over the zygoma, and rarely if ever on fingers, toes or noses. Strangely enough, children are bitten far more often than adults, and women more often than men. One might think that vampires are repelled by whiskers, although one alleged victim had a full beard.

Wounds made by vampires are unmistakable. A round or oval area of skin, three or four millimeters wide, five millimeters or more in length, and a millimeter or so in depth, is completely bitten away. The wounds bleed freely; even when disinfected and bandaged they sometimes bleed for a half-hour. Horses and burros bitten in the night are marked by long streaks and blobs of coagulated blood on the following morning, and blood-sucking insects usually make a swarm about the wound itself, while yellow-jacket wasps chew on and enlarge it.

Vampires bite with a swift outward thrust of the head, nip as the outward motion is completed, and quickly withdraw again. No attempt is ever made to hold or chew. The teeth of the vampire are razor-sharp. On one occasion when the writer was demonstrating the biting motion of the vampire with a cleaned skull, the teeth came into contact with the edge of his thumb. The teeth bit in effortlessly, and made a deep cut, which bled profusely and required bandaging.

Vampires probably spread diseases among the animals they attack in Mexico, as they do elsewhere (Clark and Dunn, 1932, 1933; Hurst and Pawan, 1932; Pawan, 1936), but this subject has been little investigated in Mexico. Considering the broad range of the vampires, their abundance, and the extent to which they feed on domestic animals, it is safe to say that no lethal disease is being transmitted by them at present or the Mexican livestock population would be decimated.

It should be noted, as suggested by Allen (1939) that vampires may not be efficient vectors of diseases in many cases. There is a possibility of infection when the bat bites its victim, but, if the blood runs freely, as it usually

does, the bat laps the blood running from the wound and does not further come into actual contact with the exposed flesh. If, however, the flow of blood is less copious, the bat actually licks the raw wound and infection is probable.

Daytime retreats.—Almost ninety percent of the more than 100 vampire retreats known to the writer are caves. Other retreats include deserted buildings, mine shafts, old wells, hollow trees, and crevices in stone walls. The number of vampires composing a colony varies from a half-dozen to well over 2000. Most colonies include about 100 bats.

Inhabited caves, where caves are numerous enough to allow the bats any choice, are large enough to have entrances sufficiently small that there are areas of almost complete darkness. Vampire caves are usually so dark that the bats cannot be seen without the aid of a flashlight. Even in such dark places, the bats hide at the apices of pits or crevices or behind ledges, where there is even less light. In areas where there are no dark caves, the bats creep into the deepest and darkest crevices that are available.

Caves inhabited by vampires were found in sandstone, gravel, basalt, conglomerate, earth, and especially limestone. The caves vary from shallow niches in cliffs to tunnels more than a mile in length, but in the latter case the bats were not found at the extreme end of the cave. Some caves had enormous entrances, more than 100 feet across; others would scarcely admit the body of a man. When choice of a number of caves is offered, however, vampires seem to prefer caves with small entrances and with dark rooms, twenty feet or more in diameter, near their mouths.

The presence of vampires in a cave can be detected as soon as the cave is entered, often before. The bats customarily group themselves in tight masses within their retreats and a deep pool of stinking liquid or semi-liquid feces, composed entirely of digested blood, collects under the roost. The decay of this "vampire pool" releases a large quantity of free ammonia which pervades the atmosphere of the cave and the area near its mouth. An invertebrate fauna is usually found in the mud at the edges of vampire pools, with larvae of insects and some isopods living in the muck itself. The pH of one vampire pool, tested with indicator paper, was 13.

When a man enters a vampire cave, and the bats are not alarmed, he rarely hears a sound, even from tightly packed clusters of 100 or more bats. Once frightened, however, the bats are noisy and flee by creeping swiftly away, using their feet and long thumbs, or by dashing off in headlong flight. Their flight makes a characteristic sound, a loud swishing, with the first wing beats loud and with the later beats diminishing in volume. An observer quickly learns to detect the flight noise of a vampire and identify it, even when bats of several other species are flying about in the cave. Vampires are rarely seen when they fly. They take off from concealed perches and fly in straight lines away from the observer, keeping in the shadow and avoiding flashlight beams. Other species of bats keep more in the open and wheel about when they fly. On some occasions an entire colony of vampires will have a deep crevice into which they retreat when disturbed. Near Potrero Viejo, Veracruz, a colony of about 100 bats flew immediately to a rock wall by a deep, narrow crevice into which they moved in single file through a small opening. Each bat patient-

ly waited its turn to enter, and shooting into the waiting bats caused only a few of them to fly.

The agility of vampires is surprising. They can creep along on a rock wall almost as fast as a man can walk on the level. Wounded bats that are unable to fly sometimes run along the ground, using their legs and wings, so fast that a man must run to catch them. On one occasion a vampire was seen to jump, using feet and thumbs and with wings closed, a distance of about twelve inches. Vampires resemble large spiders when they are moving about on the wall of a cave.

Unlike some other species of bats, vampires do not carry their young with them in flight. Retreats visited after the vampires had left on their hunting flight still contained bats too young to fly. When colonies are menaced, the adult vampires promptly desert the young, leaving them clinging to the retreat while the parents take shelter in crevices or distant parts of the cave.

When some vampire colonies were disturbed several times in a period of a week or so, the bats deserted the caves. In other instances colonies were investigated and specimens collected almost daily for two weeks or more, but the bats did not leave. In the latter cases it may be that no other suitable caves were available in the vicinity.

Some species of cave-inhabiting bats emerge from their caves in the hot, tropical midday and cling to shaded recesses near the mouths of their caves, ready to dart into the depths at the least alarm. This habit was noted only once among vampires. On the open desert near Presa de Guadalupe, San Luis Potosi, a cave was visited at midday and three common vampires flew into the cave from a perch near its mouth when the party drew near. In all other instances the bats remained deep in the caves throughout the day.

The ability of vampires to substitute the structures of man for their more natural retreats is shared by many other species of bats. A hundred or more abandoned native huts, constructed of bamboo or sticks and with thatched roofs, were examined for bats but vampires were never found in such well-lighted, warm and dry places. Abandoned stone or concrete buildings, on the other hand, were usually occupied by vampires if they were dark and cool.

Bats of other species are usually found in the caves and other retreats where vampires live, although no other species of bat was ever found in a cluster of vampires. Species associated with vampires in Veracruz and San Luis Potosi include: *Balantiopteryx plicata*, *Balantiopteryx io*, *Saccopteryx bilineata* (in a hollow tree), *Pteronotus davyi*, *Chilonycteris rubiginosa*, *Chilonycteris personata*, *Mormoops megalophylla*, *Micronycteris sylvestris*, *Mimon bennettii*, *Glossophaga soricina*, *Leptonycteris nivalis*, *Choeronycteris mexicana*, *Carollia perspicillata*, *Artibeus jamaicensis*, *Artibeus lituratus*, *Natalus mexicanus*, *Myotis nigricans*, and *Molossus nigricans* (in a hollow tree).

The habits of the hairy-legged vampire are less well known than those of the common vampire. Observations in Veracruz, Hidalgo, and San Luis Potosi indicate that this species is less colonial than the common vampire, does not live in tight clusters in the caves it inhabits, and consequently does not form a "vampire pool," and does not flee immediately to some pre-selected retreat when molested. All of the dozen or so retreats of this species discovered by the writer were caves except for an old mine tunnel in Hidalgo (Dalquest and Hall, 1947).

Young.—Both species of vampires bear but a single young. Young of the common vampire are born at all months of the year, and every colony of moderate size or larger that was examined contained young bats of various ages as well as pregnant females and adult, non-lactating females. The hairy-legged vampire seems to have a regular breeding season and may have but a single young a year. Females of this species group together when the young are born, though not in tight colonies like common vampires. Near Xilitla, San Luis Potosi, three females with very large embryos were taken on March 10, 1950, and about 35 bats of this species seen in the same cave on July 12, 1950, were mostly females with half-grown young.

Protection from, and control of, vampires.—Sanborn (1931) reported that in South America he was able to keep vampires from killing his horses by hanging lighted gasoline lanterns near the animals during the night. In San Luis Potosi domestic fowls are protected from vampires by placing them at night in pens of chicken wire or closely-woven bamboo.

Protection of range cattle and horses, however, seems hopeless at the present time. Unless cattle and horses could be completely enclosed at night the bats would get at them. Stables with openings as small as a few inches across failed to protect the horses in some places in Veracruz, and similar results were reported by Hurst and Pawan (1932). In most of eastern Mexico there are no stables or barns of any kind, nor can the country people afford to build them. Penning of the half-wild range cattle is utterly impossible.

Destruction of the vampires in their daytime retreats seems to be the most practical method of control, but a few experiments made by the writer indicate that this will be far from easy. Any control method must be cheap and simple. The shyness and toughness of the vampires has been mentioned; killing the bats by hand, whether with nets, guns, or clubs, will be largely ineffectual. In the few native attempts at control witnessed by the writer, harmless fruit-eating bats were killed in numbers while few vampires or none at all were destroyed.

Sealing up the caves in which the vampires are living offers some promise, when caves are small enough to seal and have one or a few entrances. This would be a laborious undertaking because the vampires can creep through even rather small crevices and effective sealing would require the use of very small stones. The writer attempted to close off the entrance to one cave with a heavy seine net. The cave mouth was well adapted for this, having relatively smooth, even walls about the mouth and some narrow crevices into which the net could be wedged. The cave was examined that night but, although fruit-eating bats were still confined to the cave, the vampires had forced their way between the cliff face and the net and so escaped. Some of the vampires returned and re-entered the cave during the night, again forcing their way between the net and the face of the cliff. Only by sealing the net to the stone with some adhesive could the vampires have been trapped. Caves could doubtless be sealed off with cement but this would be a method of control far too expensive for most Mexican ranchers.

Smoking the bats out with wood smoke is also ineffective. When the writer wished to obtain specimens of vampires from a deep well on the coastal plain of Veracruz, a bucket filled with smouldering corn cobs was lowered into the well on a long rope and the rope shaken. The well filled with dense smoke in which the vampires could be heard flying from perch to perch but no bats

were driven out. An hour later, at the suggestion of a watching Mexican, the bucket was again lowered, filled this time with glowing corn cobs, green grass, and dry chili peppers. The well again filled with smoke and the vapor from this concoction was so acrid that even a trace made the watcher's eyes water and irritated the nose and throat. Two hours later the bats could still be heard flying when stones were dropped into the well. A native boy, lowered to the bottom of the shaft the next day, reported that there were no dead bats in the well. The bats deserted the well for a few days but were again living there a week later.

Fumigation of the vampire caves with poisonous gas is practical only in the case of small caves with a few entrances, and in any case would be too expensive and dangerous to appeal to most ranchers. Any control measure must be adapted for use by poor and uneducated people. The possibility that crude oil or creosote, painted on the necks and cheeks of horses and cattle, might protect them from vampires should be investigated. Vampires are so adapted to feeding on domestic animals at the present time that actual protection of livestock might result in wholesale starvation of the bats. In some large areas of eastern Mexico there is little else upon which they might feed.

In any event vampires are a menace to livestock and the health of man in eastern Mexico at the present time and may be expected to be increasingly so in the future. Control of the bats promises to be a problem of major importance, and effective control may be impossible.

REFERENCES

- ALLEN, GLOVER M. 1939—Bats. Cambridge University Press, pp. x, 1-368.
- ALLEN, JOEL A. 1916—Mammals collected on the Roosevelt Brazilian Expedition, with field notes by Leo E. Miller. Bull. Amer. Mus. Nat. Hist. 35:559-610.
- BAKER, ROLLIN H. 1951—Mammals from Tamaulipas, Mexico. Univ. Kansas Publs., Mus. Nat. Hist. 5:207-218.
- CARACCOLO, HENRY 1895—Bats. Journ. Trinidad Naturalist Club 2:164-170.
- CLARK, HERBERT C. AND LAWRENCE H. DUNN 1932—Experimental studies on Chagas' disease in Panama. Amer. Jour. Tropical Medicine 12:49-77.
- 1933—Animal susceptibility to *Trypanosoma hippicum*, the equine trypanosome of Panama. *Ibid.* 13:273-281.
- CUSHING, J. E., JR. 1945—Quaternary rodents and lagomorphs of San Josecito Cave, Nuevo Leon, Mexico. Jour. Mammalogy 26:182-185.
- DALQUEST, WALTER W. AND E. RAYMOND HALL 1947—Geographic range of the hairy-legged vampire in eastern Mexico. Trans. Kansas Acad. Sci. 50:315-317.
- DITMARS, RAYMOND L. AND ARTHUR M. GREENHALL 1935—The vampire bat a presentation of undescribed habits and review of its history. Zoologica 19:53-76.
- HENSEL, REINHARDT 1896—Beiträge zur Kenntnis der Thierwelt Brasiliens. er Zool. Garten, Frankfurt 10:135-140.
- HURST, E. WESTON AND J. L. PAWAN 1932—A further account of the Trinidad outbreak of acute rabies myelitis; histology of the experimental disease. Jour. Pathology and Bacteriology 35:301-321.
- HUXLEY, THOMAS H. 1865—On the structure of the stomach in *Desmodus rufus*. Proc. Zool. Soc. London, pp. 386-390.
- PARKS, HELEN AND E. RAYMOND HALL 1951—The gross anatomy of the tongue and stomachs of eight New World bats. Trans. Kansas Acad. Sci. 54:64-72.
- PAWAN, J. L. 1936—The transmission of paralytic rabies in Trinidad by the vampire bat (*Desmodus rotundus murinus* Wagner, 1841). Ann. Tropical Medicine and Parasitology 30:101-129.
- SANBORN, COLLIN C. 1931—Protection against vampire bats. Jour. Mammalogy 12:312-313.