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FIELD OBSERVATIONS ON THE MODE OF ATTACK OF THE VAMPIRE BAT *(DESMODUS ROTUNDUS)* IN MEXICO*

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ABSTRACT

The mode of attack by vampire bats *(Desmodus rotundus murinus)* on cattle in Mexico, under natural conditions, is described. Night vision viewing scopes were used to make the observations. The types of behaviour reported include their approach and landing on cattle, the reaction by cows to bats upon them, the apparent searching by the bats for a suitable feeding site, interactions between vampires at feeding sites, observance of bat urinating on a cow while still feeding at the wound, and the location of the bites on the cows. These observations are discussed with reference to the literature.

RESUMEN

A través de aparatos para visión nocturna se observó a los murciélagos vampiros *(Desmondus rotundus murinus)* en el acto de atacar al ganado, en condiciones naturales, en México. Asimismo, se observaron las interacciones de los vampiros al momento de tomar su alimento. Se discuten la sobservaciones anteriores y las informaciones contenidas en la literatura respectiva.

INTRODUCTION

The foraging behaviour of the vampire bat *(Desmodus rotundus)* under natural conditions in Mexico has been reported by Wimsatt (1969). However, little is known about the behaviour of free-living vampire bats following foraging, when they actually approach and atack their prey. This paper describes the mode of attack of wild vampire bats *(Desmodus rotundus murinus* Wagner) on cattle in Mexico and discusses its relation to the transmission of disease. These studies have been undertaken during the course of the Research on Paralytic Rabies Projetc conducted by the Food and Agriculture Organization of the United Nations and the

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Study area

The observations were made at the Rancho San Ricardo, near the small village of Estación Vicente, Municipio de Acatlán, State of Oaxaca, Mexico, which has a high intensity of vampire bat predation on cattle and a serious problem of bovine paralytic rabies (Derriengue). Estación Vicente is located on the border of the State of Veracruz, in the western portion of the Papaloapan Depression, at the base of the Sierra Mazateca. The elevation is 60 meters. It has a "hot subhumid" climate, with rains occurring during the summer months of May to October (Aw, after Köeppen). The lower flatlands consist of cattle pastures and sugar-cane. The Mazateca Mountains, part of the Sierra Madre Oriental, rising to an elevation of 3,658 meters, are covered with tall tropical forest. These limestone mountains are riddled with caves and cracks of all sizes, providing excellent roosts for vampires as well as a great variety of other bats. In addition to cattle, other livestock at Rancho San Ricardo include sheep, pigs, horses and poultry, all of which are ocasionally attacked by vampire bats. The nearest cattle to those at this ranch are located betwen four to five kilometers away; thus San Ricardo dairy cattle form a concentration of "island" of an apparently desirable food supply which may account for the intensity of vampire predation.

METHODS AND MATERIALS

Four heavily bitten Holstein cows were confined to a small wire corral (10 x 4 meters) that was under trees but devoid of ground vegetation. These cows were observed with two United States Army Starlight Scopes, designed for night viewing, for three nights on 10-12 June and for one night on 18 August, 1969. The area was flooded with infrared light, the source of which was the headlights of a jeep covered with infrared filters (powered by the car battery). The scopes magnify the light intensity 45,000 times. The car and observers were 10 meters from the cattle, with the car being about five meters to one side of the observers. In June two observers sitting one meter apart watched the animals constantly from 20:30 to 00:30 hours exchanging comments on all events which took place. During the three nights, a total of about 50 vampire bats were observed.

In August four people, including Dr. Walter E. Howard from the University of California, Davis, who was a FAO Consultant to the Project, observed intermittently from 21:00 to 02:30 hours.

Bat's approach, search flight and landing

The vampires consistently arrived in groups of two to six, flying low, about ½ to 1½ meters above the ground. They circled around the cattle for one to five minutes, finally alighting either directly on a cow or on the ground near the animals. When the cow was standing, they landed either on the back or the crest of the neck, sometimes hopping or jumping once or twice. This was also observed on cattle lying down. Cattle lying down were also observed being attacked from the ground.

The continued circling of vampires about their prey may have given rise to the fanciful stories in the early literature and accounts of explorers and historians that vampire bats hover in front of their victims fanning their faces with their wings to induce a cool, soothing hypnotic sleep.

Cow's reaction to the landing of bats

In some instances no apparent cow reactions were noted. However, in most cases the cows reacted to the vampire bats' landing on their backs with shaking of the head, flapping of the ears, or an attempt to brush the bat or bats off with their muzzle or horns. Often these movements were successful, causing the bats to take flight, but they usually returned immediately. In the majority of instances observed, the vampires avoided being hit by rapidly withdrawing backwards or moving to the other side of the cow's neck. As soon as the cows resumed their normal position, with head forward, the bats darted back to their original location.

Search for biting site and feeding.

Once bats had landed on the cows, they crawled slowly or rapidly to either crest of the neck or the back of the cows, moving about a good deal from one side to the other apparently searching for a suitable feeding site. This action took from a few seconds to several minutes. When feeding on the cows the bats invariably hung their head downward, or slightly sideways from the crest of the cow's neck, either clinging with both hind feet or one foot and corresponding forearm. The other extremities support the rest of the body (Fig. 1). One bat chose an ear for its feeding.

After landing on the ground, most vampires inmediately walked, ran or briskly jumped around a cow for a time, finally stopping at an armpit, flank, udder, vulva, tail or upper part of a leg. Three bats were observed attempting to climb the flank and leg of cows, but were unable to secure a hold and came sliding back to the ground. While feeding from the ground, the bats stood on the ground, elevated their body anteriorly, supported their weight on their thumbs and stretched their neck upward to feed. Several appeared to be feeding from an armpit while in a prostrate position. Vampires feeding on the neck or ear of cattle usually, but not always, remained there for longer periods without moving than those feeding from the ground. Those on the ground often moved back and forth, even flying off, then returning to the same wound.

The time a vampire remained at one wound varied considerably, even when not disturbed. The following overall feeding times, or periods when the bats remained uninterruptedly at the wounds, were recorded for 13 vampires feeding on the neck of cows: 9, 12, 14, 15, 16, 18, 25, 26, 29, 31, 35, 38, 40 minutes, giving an average of 23.69 and a maximum and minimum of 40 and 9 minutes respectively.

It was more difficult to establish the feeding times for vampires on the ground. One bat which was feeding at the armpit of a cow, sometimes withdrawing and returning to the wound, remained at this site for a total of 41 minutes, including the interruptions.

Cow's reactions to vampires that were feeding

There were few reactions by cows to bats feeding on their necks. Some cows occasionally moved their heads, whereupon the bats withdrew, only to immediately return to the wound. When an additional vampire landed on the cow's neck, the cow would react again as previously described. Vampire bats feeding from the ground likewise caused few disturbances to cows. No reactions were observed to bats feeding on the flank. Feeding on the tail, vulva and udder caused movements of the tail, to which the vampires reacted by jumping back and immediately returning. The same reactions occurred with vampires feeding at the flank or legs if the cow rolled slightly to one side of moved a leg.

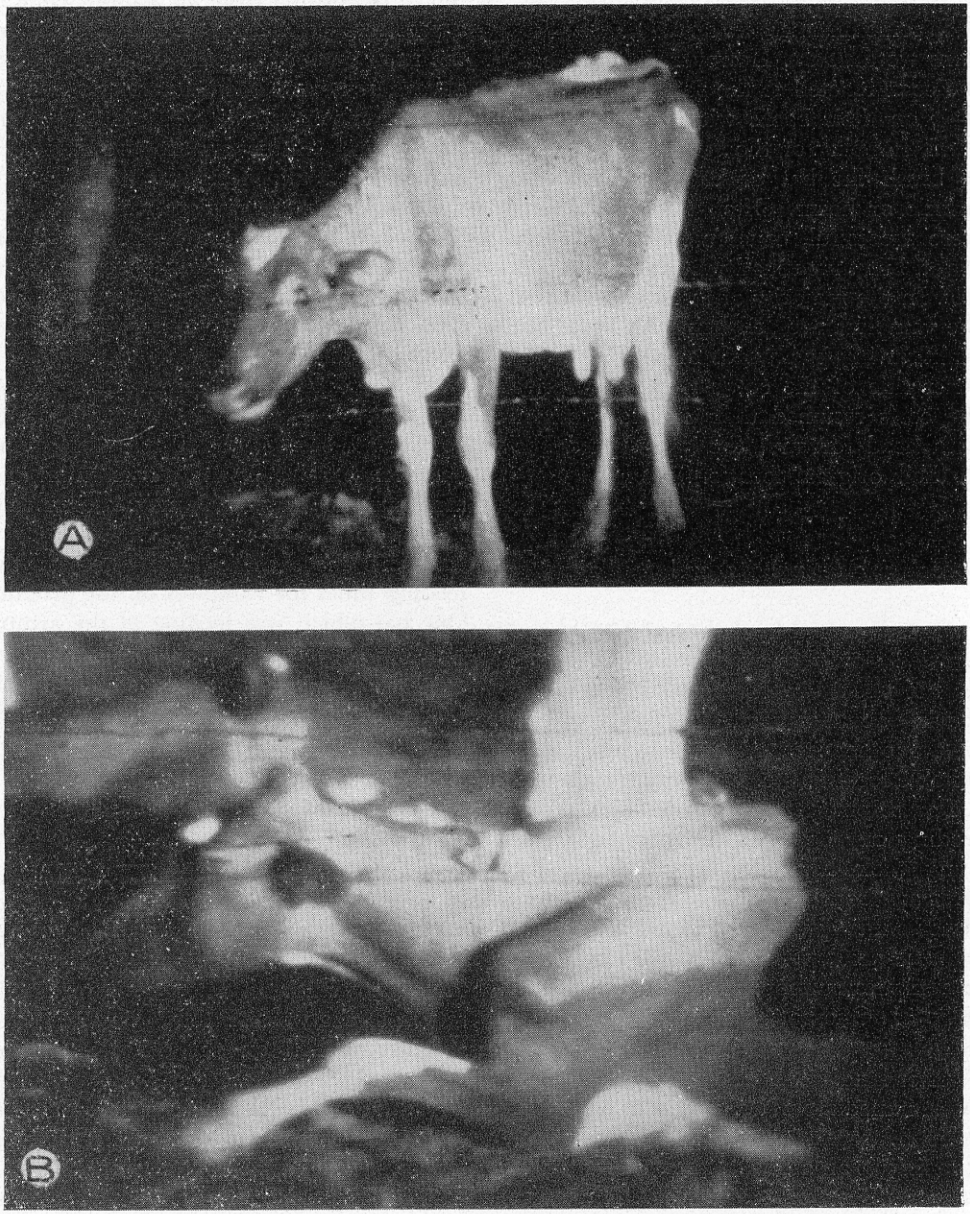

Fig. 1. *A,* Vampire bat hanging from the crest of the neck of standing cow. *B,* Two vampire bats hanging from the crest of the neck of lying cow. Photos taken through night-vision scopes by U. Schmidt.

Interactions between vampires at feeding sites

As many as four vampires were observed feeding simultaneously on one cow, but at different sites. Most bats fed one at a time from a single wound, although two vampires were observed feeding at the same neck bite for 10 minutes. This heavily bleeding wound served as a feeding site for seven different bats, one after another, during one three-hour period. Each newcomer landed on the neck and approached the feeding vampire until they were side by side. After some pushing and jostling of each other, the first bat frequently stopped feding and flew off and the newcomer started feeding at once.

Similar interactions were observed in vampire bats feeding from the ground. These included pushing, jumping to and fro, fighting and some screaming. Once, one bat feeding at a cow's armpit showed repeated territorial agression, driving invaders away from the wound site. This bat remained at the site for some time, driving others off, even though it appeared to have finished feeding.

Urination by vampires

In two instances, during and immediately after feeding, urination was observed. One vampire, standing on the crest of a cow's neck, with its posterior elevated and facing the observers, was seen urinating individual drops, which fell in rapid sucession rather than in a continuos stream. As the drops of urine fell, they reflected light and were clearly visible. This urine was seen to flow freely down the side of the cow's neck about six inches from a flow of blood. The two fluids were easily distinguished by te two observers watching at that time. A second bat was seen urinating while still feeding.

Take of flight

After feeding, all the vampires lifted their heads and moved them from side to side before taking off. They then invariably flew straight off without any preliminary walking or circling. The same behaviour occurred with those bat which had fed from 35 to 40 minutes. Even the bat feeding from the ground for 41 minutes had no difficulty in launching itself into flight. In other words, there was no indication that any of the bats consumed so much blood that they had difficulty in flying.

Biting sites

After each observation period in June the cattle were carefully inspected for biting sites and wounds. The distribution of bites on the four cows observed was as follows:

The most heavily bitten cow had five fresh bites in one night (Fig. 2).

Special events

During the first night, our helper, who was sleeping in the car with all doors and windows open, was awakened by the flapping wings of a vampire bat, which apparently was ateempting to feed on him.

During the August observations, one observer went inside of the restraining corral to photograph feeding bats. One vampire, feeding on the far side of a cow's

Night	*Neck*	*Flank*	*Ear*	*Elbow*	*Tail*	*Vulva*	*Udder*	*Hind leg*	*Inside front leg*
1st.	4	1	1	1	2	—	—	—	—
2nd	3	4	—	—	1	1	—	—	—
3rd	4	2	—	1	—	1	1	2	1

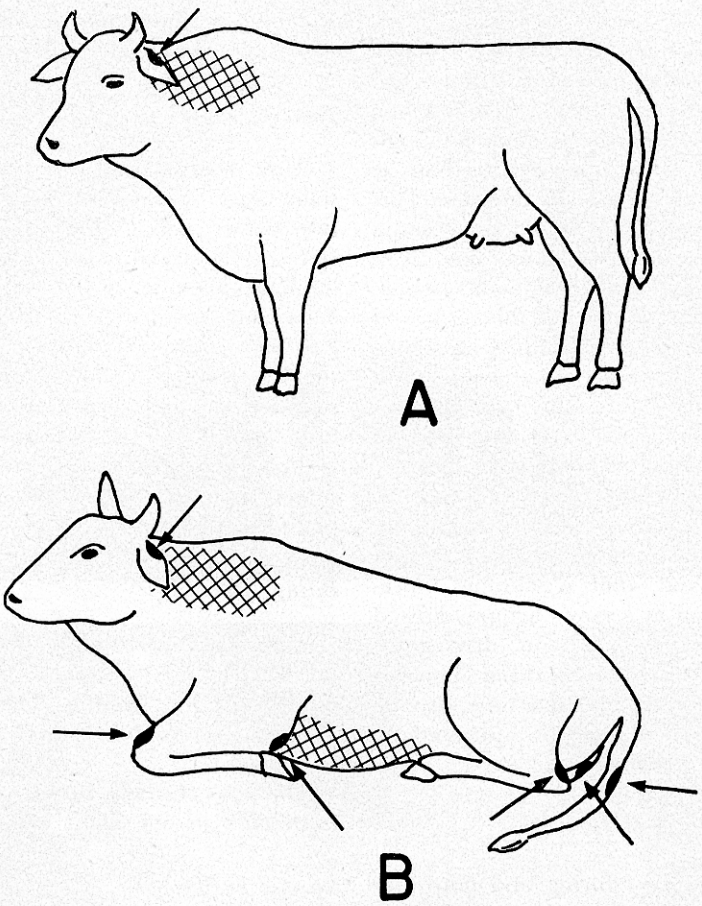

Fig. 2. *A*. Sketch showing preferable vampire biting sites on standing cow. *B*. Sketch showing preferable vampire biting sites on lying cow.

neck with only its posterior visible, was not frightened away by a camera strobe flash between two and three meters away. Bats that were frightened by the brilliant light of the flashes soon returned, even though the observer was still in the small corral.

From about 02:30 to 06:00 hours, 48 meters of mist nets were placed along and beyond two sides of the small corral. Trapped bats were removed about every half hour. About 03:30 hours, approximately 50 dairy cows were driven by the nets and confined in a larger corral behind the nets. When the cattle went past the nets and for perhaps the next 30 minutes, two observers remained at the nets removing bats. Apparently quite a few vampires rode or followed the cows as they were driven from the field to the corral.

DISCUSION

The meagre knowledge of the attacking behaviour of the vampire bat *(Desmodus rotundus)* under natural conditions is based on a few observations made by some early naturalists and zoologists. The first planned observations on the mode of attack by *Desmodus* were made in Trinidad by Ditmars and Greenhall (1935) on captive vampires attacking a goat. In citing the literature we have referred only to those authors whose observations are specific for *Desmodus*. We have not disregarded the excellent but generalized accounts of vampire bats made by the very early observers such as D'Azara and Darwin, but these are summarized in the specific studies of Ditmars and Greenhall (1935), Husson (1962) and Villa (1966).

Desmodus attacking cattle, horses, pigs, goats and poultry from the ground has been described in Trinidad and Brazil by Ditmars and Greenhall (1935), DeVerteuil and Urich (1936), Chile by Mann (1951), Argentina by Crespo et al (1961) and Mexico by Villa (1966). The bat "walks up" to its victim and bites the lower extremities such as the fetlock of horses, around the dew claws of goats and pigs, between and behind the hooves of cattle, and the toes of poultry. The bat avoids being stepped on or pecked, by skillfully darting out of reach of hooves and beaks. Mules in Trinidad often throw themselves on their backs to remove vampires attacking them, a defensive behaviour not reported for other livestock. It has been suggested that painful bites are caused by inexperienced bats with imperfect technique that causes pain as has been observed in Panama *(op. cit.)* Pawan (1936) has queried "But, may not this difference in the fierceness of attack between a healthy and a rabid bat due to infection with the virus?"

To our knowledge this is the first report on the interactions between feeding bats. Single bats feeding undisturbed from one wound, several feeding consecutively from a single wound and still others crowding, jostling, fighting and screaming all indicate the presence of a social hierarchy with dominant and submissive relationhips. Perhaps this antagonistic behaviour may be due to special requirements or territoriality while feedings.

Some of the feeding times we observed are longer than those reported in the literature. Captive vampires have been found to consume an average of 15 to 16 milliliters of blood daily, and in about 10 to 20 minutes (Crespo *et al,* 1961; Villa, 1966). In eastern Mexico Dalquest (1955) stated that "vampires were taken as they were returning to their caves with freshly filled stomachs only about a half hour after they had left." Our recorded times from 9 to 40 minutes for 13 bats feeding uninterruptedly might be explained by the results of blood meal studies. In Trinidad a single bat may feed upon several different hosts in one night. If this is true for Mexico, then a bat feeding for 9 to 12 minutes on a cow might have fed previously upon one or more other cows, or possibly other hosts, earlier the same evening.

We still do not know how many vampires may feed entirely on a wound made by another individual, hence the significance of multiple bites on individual animals is not clear. In Trinidad one cow had 12 different fresh bites inflicted in a single night in addition to 49 recent wounds, while on the border of British Guiana and Brazil, one steer dying of rabies had been bitten more than 30 times in one night (Goodwin and Greenhall, *op. cit.)* We postulate that multiple fresh bites on one host indicate that: *a)* nearby there may be a colony of pregnant females or mothers carrying young, which therefore do not or cannot fly far with their

extra loads, and *b)* that the particular host is for some reason more attractive than another, hence served many vampires of both sexes and all ages.

Our observations that wild vampires urinate during and immediately after feeding confirm reports that captive bats start to urinate within minutes after starting to feed and that copious diuresis continues for up to two hours (Ditmars and Greenhall, 1935; Wimsatt and Guerriere, 1962; Villa, 1966; Wimsatt, 1969). Whether urination, either by feeding or flying vampires, is a possible avenue of rabies transmision as well as leptospirosis as has been suggested by Greenhall (1964), has not been confirmed.

In our observations vampires had no difficulty in launching into flight after feeding for 40-41 minutes. In Trinidad, however, vampires have been reported engorging such large quantities of blood that their bodies were almost spherical, and they were incapable of flight (Ditmars and Greenhall, 1935). Also in Trinidad several vampires in this flightless condition were caught after a chase on the ground (Goodwin and Greenhall, 1961).

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