AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523

BIBLIOGRAPHIC INPUT SHEET

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Batch #20

1. SUBJECT CLASSIFICATION

A. PRIMARY: Agriculture — AL72-0000-0000

B. SECONDARY: Pests of animals

2. TITLE AND SUBTITLE
Investigations and progress obtained during 1969: USAID vampire bat project

3. AUTHOR(S)
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4. DOCUMENT DATE	5. NUMBER OF PAGES	6. ARC NUMBER
1970	8p.	ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS
Interior

8. SUPPLEMENTARY NOTES *(Sponsoring Organization, Publishers, Availability)*
(Presented at 7th annual reunion,Inst.Nacional de Investigaciones Pecuarias)

9. ABSTRACT

10. CONTROL NUMBER	11. PRICE OF DOCUMENT
PN-RAB-183	

12. DESCRIPTORS
Bats,vampire
Research

13. PROJECT NUMBER

14. CONTRACT NUMBER
PASA RA(ID)1-67 Res.

15. TYPE OF DOCUMENT

AID 590-1 (4-74)

INVESTIGATIONS AND PROGRESS OBTAINED DURING 1969. USAID

VAMPIRE BAT PROJECT.

Talk presented in the INSTITUTO NACIONAL DE INVESTIGACIONES PECUARIAS during the Seventh Annual Reunion, 14, 15, 16 and 17 of January, 1970.

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Station Leader

As most of you know, our vampire bat research studies are conducted both here at Palo Alto and at the Wildlife Research Center in Denver, Colorado. At Denver we have a physiologist who is presently devoting considerable time to basic studies. In addition, several other people, including a biologist soon to be reassigned to Palo Alto, are studying various problems related to the vampire and its control.

Briefly, studies undertaken at Denver during the past year involve:

1. Basic parameters of vampire physiology. This study is intended to obtain basic physiologic information such as heart rates, respiratory rates, EEG, excretory rates, blood composition, etc. These data, obtained from control animals, will then be compared

with data taken from animals treated with various chemical control agents. This study has recently been initiated.

2. Nutritive requirements of vampire bats. This study seeked to measure the digestability and metabolizable energy of bovine blood. The results indicate that the digestibility of blood protein by the vampire is approximately the same as that of the digestability of meat by man - that is about 93 percent. The energy requirements of the vampire, however, are about 10 times more than that required by man, all of which must be obtained from its blood meal. The data indicate that 30 of every 100 calories of protein energy are lost as heat and that a relatively large amount of water is needed for protein metabolism. Thus, it is believed that interference with protein metabolism, or with renal function, offer good possibilities as control techniques. Laboratory tests will be inititated to test selected, specific, chemical compounds which are known to block renal function, such as Diazoxide, an antidiuretic; and with 2,4-dinitrophenol, an agent which increases metabolism. The latter compound, it is hoped, would cause the vampire to utilize or metabolize more protein than could be obtained from its blood meal. To better evaluate this approach, studies will be undertaken to determine the thermoregulatory mechanisms of the vampire.

3. Sensory capabilities of the vampire. The sensory detection capabilities of the vampire will be investigated by the animal behaviorist in Denver. Results of this study may perhaps suggest methods by which chemical agents may be used to interfer with the sensory mechanisms used for flight or for locating prey.

4. Toxicants. Studies have begun in Denver to determine the lethal doses of the standard animal toxicants such as strychnine, zinc phosphide, and sodium fluoroacetate. These investigations have been made more difficult due to the peculiar structure of the gastrointestinal tract of the vampire. As some of you may know, the esophagus of the vampire terminates in a "T", at the junction of which is a valve. One end of the esophagus leads to the stomach, the other into the intestine. Standard administration of toxicants is by intubation or canulation; however, the peculiar structure of the esophagus prohibits the use of standard canulating apparatus. We have found that, depending on the method of administration, the test compound may enter either stomach or intestine, causing results to vary.

Lethal doses have now been determined for sodium fluoracetate and for strychnine. Both LD_{50}'s were calculated at about .4 to .5 mg per kilogram of body weight. These data will serve as references and will be compared with data resulting from

tests of new candidate toxicants. Another test was conduced to determine the effectiveness of the anticoagulant, Diphacinone. .2 mg per kilogram of body weight for 5 days was sufficient to cause the death of all test vampires.

Of interest to us at the present time are some of the systemic insecticides used in cattle for control of parasites. We recently received considerable help from a Department of Agriculture Laboratory located north of San Antonio, Texas. This center is devoted to the development of safe insecticides for livestock use. Five specific agents, all organic phosphorus compounds, were recommended for testing to determine the lethal doses necessary for vampires. All but one of them, after administration to the test animal, are converted into a much more toxic analogue. Considerable information has already been compiled as to their possible adverse effects on cattle. Obviously, systemic vampire control agents offer considerable advantages over those that must be applied topically or by means of mechanical devices.

5. Radio Telemetry. In addition to the chemical studies mentioned above, considerable work has been carried out during the past year on developing and improving radio telemetry equipment. This year we hope to learn something about the movement of vampires by attaching small radio transmitters weighing 4.6 grams to a limited

number of bats. Some of this equipment has already been field tested here in Mexico and, while certain limitations were found, the equipment generally proved satisfactory. One problem encountered was that of attaching the radio transmitters. Most of the methos tried resulted in the vampire sloughing off its skin at the point of attachment. The present and preferred method, a collar and back suture technique, appears satisfactory.

Here at Palo Alto we have been somewhat handicapped by a limited staff, but soon expect to increase our personnel with the addition of a physiologist, a veterinarian, and two field assistants.

The results of studies now underway should contribute toward the development of control techniques and methos of administering control agents. A very brief summary of these studies include:

1. Feeding and grooming behavior of captive vampire bats. These studies will be discussed by Dr. Flores Crespo.

2. Repopulation rates of vampire bat populations. This interesting study will be summarized in another paper by Dr. Burns.

3. Growth and age determination of vampire bats. We would like to know something about the growth of vampire bats and are

looking for a method to determine their age. If such a technique is found, we can then learn something as to the average life span of the vampire, how fast populations can recover from reduction by control, and more of the population dynamics of this species. Such data, we believe, will contribute to the development and application of control techniques. Mr. Burns has now obtained some interesting data on growth and anatomical development of young, and recent preliminary observations indicate that annuli in the teeth may possibly serve as a means of determining age to the nearest year.

4. Bat Repellents. We recently completed laboratory tests of two known repellents, one a rodent repellent and the second used to eliminate insectivorous bats from houses and other closed areas. One of these repellents showed some degree of repellency but additional study is needed. In addition, the technique employed in this investigation should prove useful for future tests of repellents or attractants.

5. Attractants. We hope to start a study soon which will seek to determine if bovine blood can be used to attract vampires to "bait" cattle, or to artificial bait stations either in roosts or within corralled cattle. We believe that attractants offer more possibilities than do repellents, for the latter would probably cause vampire to feed on adjacent, untreated livestock.

6. Behavior of wild vampires. Using night vision equipment similar to that previously used with considerable success by the FAO group, we hope to obtain additional data on attack, feeding, and behavior patterns of wild vampires. We plan to undertake these studies in four or five different regions of the country. It is hoped that such observations will enable us to determine which of the following two approaches is superior: application of control agents directly on livestock; or the use of mechanical devices located near corralled cattle. At the present time, we feel that control of vampire bats in their roosts is a less practical approach.

7. Application techniques. In addition to the radio telemetry work previously mentioned, this year we hope to begin tests to determine methods of applying control agents, such as sprays, dips, and carrier or "vehicle" compounds or solutions.

I intend to spend a month in South America this March where I hope to see some of the areas where derriengue is a problem, and to talk to those persons concerned with this disease. I hope to return with additional new ideas for controlling vampire bats.

In summary, we are very hopeful that our interdisciplinary approach, utilizing the knowledge of biologists, biochemists,

pharmacologists, physiologists, animal behaviorists and electronic specialists, will result in development of a satisfactory control technique for vampire bats.