



# BAT RESEARCH NEWS

Volume 16: Numbers 1–4

1975

---

Original Issues Compiled by Dr. Robert L. Martin, Editor of *Bat Research News* (1975).

**Copyright 1975 *Bat Research News*. All rights reserved.** This material is protected by copyright and may not be reproduced, transmitted, posted on a Web site or a listserve, or disseminated in any form or by any means without prior written permission from the Publisher. The article is for individual use only.

*Bat Research News* is ISSN # 0005-6227.

# BAT RESEARCH NEWS

## Table of Contents for Volume 16, 1975

---

### Volume 16: Number 1, January 1975

The Cover .....	1
News .....	1
Bat versus Flypaper by Ronald H. Pine and William B. Duncan .....	9
Recent Literature .....	10
More News .....	13

### Volume 16: Number 2, April 1975

The Cover .....	14
News .....	14
Bat Tower on Sugarloaf Key, Southern Florida by Donald F. Hoffmeister .....	18
More News .....	18

### Volume 16: Number 3, July 1975

The Cover .....	20
News .....	20
An Outdoor Flight Cage Suitable for Keeping and Maintaining Insectivorous Bats in Captivity by A. W. Gustafson .....	23
More News .....	27

### Volume 16: Number 4, October 1975

The Cover .....	28
News .....	28
Portable Apparatus for Observing High Frequency Sounds under Natural Conditions by Donald R. Griffin .....	31
Further Comments on Punch-marking Bats by Thomas J. O'Shea .....	37
More News .....	38

## BAT RESEARCH NEWS

Volume 16, No. 1

January 1975

### THE COVER

The cover, provided by Dr. Kunwar Bhatnagar and Gregory Cooper of the University of Louisville, illustrates the only postage stamp depicting a bat, as far as they know after diligent search. The stamp is listed as the following in the Scott Catalog: SEY-CHELLES 1957 Oct 25, #194 A 15 5¢ light violet. Philatelists take note: if there is any other postage stamp in the world depicting a bat, please so notify Dr. Bhatnagar or the editor of BRN. My thanks for the excellent photo of this stamp.

---

Bat Research News appears quarterly. Subscription rate is \$4.00 for two years. Address correspondence to the Editor, Robert L. Martin, Department of Biology, Preble Hall, University of Maine, Farmington, Maine 04938, U.S.A.

---

### NEWS

For any current LIBRARY subscriber, Dr. Wayne H. Davis, Department of Zoology, University of Kentucky, Lexington, Kentucky 40506, the former editor of Bat Research News, will supply the back issues (up to Volume 11, No. 4, where I started) on request. This is only for current library subscribers, however.

**WANTED:** Information, suggestions, actual plans, cost estimates, and case histories of cave and mine entrance grilles, bars, and closures which do not impede the flow of bats. It looks as if this country may begin to catch up with other bat-conscious countries in providing bat protection in winter months through gating schemes, and I would like to amass in one place as much information as possible regarding plans and costs. Requests for such information are coming in regularly now, and what information I have on hand is spotty and incomplete. Please send what information you have (no matter what country you are from) to the editor at the above address.

The Bat Conservation Group of Endangered Species Productions, 84 Berkeley Street, Boston, Massachusetts 02116, is attempting to use their computer to develop bibliographies on bats, and solicit information and input for this program.

Dennis Turner's book on vampire bats is now being published by the Johns Hopkins University Press. I am providing them with mailing labels for U.S. subscribers, so most of you will receive their advertising materials on the book. When it is published, more information will appear in BRN for those of you who do not get the advertising materials.

The Fifth Annual North American Symposium on Bat Research was held on November 29 and 30 at The Museum, Texas Tech University, Lubbock, Texas, with 35 or so papers given. The Sixth meeting will be held on October 10 and 11, 1975, at the University of Nevada, Las Vegas, and Roy Horst is (as usual) the chairman of the program committee.

According to the Pesticide Chemical News, a Section 18 specific exemption request for the use of DDT in Teton County, Wyoming, to control rabid bats was denied by the EPA. The reason given was that the bats were in a barn and other outbuildings and thus the threat to humans was remote. The case arose from the discovery of a rabid bat at a guest ranch near Moose, Wyoming, with the subsequent finding of a bat roost in a barn. Exemptions have been granted for Massachusetts and New Hampshire, where public fears concerning rabies have been fanned by numbers of state officials. The Health and Welfare Commissioner of New Hampshire, Frank Whaland, has made an AP news release to state that "half of New Hampshire's bat population is rabid". In reporting that federal officials have warned against the use of DDT because it causes the bats to become ill and wander around on the ground, where they are more likely to bite humans, he noted that the potential for attacks on humans have increased due to use of DDT.

The U.S. Fish and Wildlife Service has designated members of the Indiana Bat Recovery Team, which will meet in Indianapolis on February 22 and 23 to work on a recovery plan. The members are: James M. Engel (Leader), James R. Messerli, Fred R. Courtsal, Thomas H. Hooper, Leslie E. Terry, Dr. Russell E. Mumford, and Dr. Robert L. Martin.

The Huntsville Grotto of the National Speleological Society has established the policy that the Morgue section and entrances to Fern Cave in Jackson County, Alabama, will be closed from mid-September through the end of April to protect the colony of gray bats (Myotis grisescens). The lower Fern sections may be entered through the Johnston Entrance or the Fern Sink. Thanks go to this NSS Grotto and to Merlin Tuttle, whose hand is seen in this action.

The Virginia Region of the National Speleological Society has published and distributed lists of caves which are closed to protect the endangered bat species Myotis sodalis and Plecotus townsendii virginiana, as follows:

Hoffman School Cave, Pendleton Cty., W. Va. - 1 October - 1 May  
 Minor Rexrode Cave, Pendleton Cty., W. Va. - 1 October - 1 May  
 Schoolhouse Cave, Pendleton Cty., W. Va. - 1 October - 1 May  
 Cave Mtn. Cave (upper area), Pendleton Cty., W. Va. - 15 April - 15 July  
 Hell-Hole, Pendleton Cty., W. Va. - all year closure  
 Cave Hollow - Arbogast Cave, Tucker Cty., W. Va. - 1 October - 15 July  
 Greenville Saltpetre Cave, Monroe Cty., W. Va. - 1 October - 1 May  
 Starr Chapel Cave, Bath Cty., Va. - 1 October - 1 May  
 Cassell Farm Cave, Tazewell Cty., Va. - 1 October - 1 May

When provided with specific proposals as to how best to save endangered bats, NSS groups have certainly been eager to provide help. Peer group pressures can be a far greater deterrent than rules from some unknown authority above, and non-NSS cavers feel this pressure, too.




Arbeitskreis für  
Fledermausschutz und -forschung

am Institut für Landesforschung  
und Naturschutz Halle (Saale)

DDR - 402 Halle (Saale)

Postfach 200



**WATKINS**  
**NATURAL HISTORY BOOKS**  
 Rebecca and Larry C. Watkins  
 R.D.#1, Belden Corners Road  
 Dolgeville, New York 13329



Some bat designs:

In April 1974, Clay Mitchell wrote concerning the use of an ultrasonic bat repeller: "We are currently evaluating an electronic ultrasonic repeller in Nicaragua. In one test the machine was placed in the attic of a house that had a colony of approximately 100 Tadarida brasiliensis. The machine was turned on at 4:00 pm and at 9:00 am the following day no bats were found in the same attic. Nicaraguan veterinarians will continue to test the machine with different species and varying conditions....." The machine was made available by the manufacturer and tested in the Northeastern U.S. by members of the U.S. Fish & Wildlife Service. In spite of high hopes and lots of wishful thinking, the results seem discouraging, and John Peterson has allowed me as a member of the Northeast Bat Research Advisory Group to provide the following report. The commercial name of the device was deleted for obvious reasons, but I will be happy to discuss it with anyone wishing to write to me privately. The Northeast Bat Research Advisory Group is working, incidentally, on the possibility of utilizing polyurethane foam with a repellent incorporated as a means of bat exclusion from areas where the architecture provides inherent problems (e.g., corrugated roofing). Any suggestions?

TO : Members of Northeast Bat Research Advisory Group

FROM : John W. Peterson, Coordinator, U. S. Fish and  
Wildlife Service, Boston, Mass.

SUBJECT: Evaluation of the Effectiveness of Commercially  
Marketed Sonic Device

Attached are the results of tests conducted during the summer of 1974 with a sonic device, the (trade name deleted). This device emits an intermittent high pitched "beep" which it was hoped would repel bats from structures.

The results of the tests by States are as follows:

#### MAINE

The sonic device was placed in bat colonies in three situations; in all cases, the recognized species was Myotis lucifugus, little brown bat. The first was in a fully enclosed attic in a single-story residence. About 200 bats occupied a 28' x 16' x 4' area. On June 18, the device was placed on a closet shelf directly under the noisiest portion of the colony. The bats increased their squeaking immediately as the machine was turned on and were quite agitated as they emerged at dusk. They seemed confused and disoriented and flew more erratically around the building than is normal. However, they returned the same night, and after 10 days continuous use, had apparently adapted to the sound, and no unusual reactions were noted in their behavior. There was no apparent decrease in bat numbers.

On June 30, the device was placed in the belfry of the South Bridgton Congregational Church. About 527 bats had been

counted emerging from the belfry and adjoining attic area when the device was turned on. The remaining bats immediately increased their squeaking and emergence of bats ceased for about four minutes; then the remaining 30-35 bats emerged normally. The enclosed belfry was a structure about 10' x 10' x 20', and the device was positioned approximately in the center of the belfry. The device was operated continually from June 30 to August 1. There was no noticeable decrease in bat numbers. A few dead bats were picked up inside the belfry before the machine was operated, and about a dozen were retrieved outside the building while the device was in operation. There was an apparent movement of roosting bats away from the device at first, but the bats moved back into close proximity of the device and were roosting normally two yards from it when retrieved. The device was well covered with bat droppings upon retrieval.

On August 9, the device was placed under the roof of a log camp. It was a confined area, perhaps 2½ x 12' x 12' x 20', and contained approximately 100 little brown bats. A short-term displacement away, then subsequent return to within two feet of the device was noted. There was no visible reduction in the number of the colony. The device was removed on September 10.

In all three situations tested, there was disturbance to the bats, a certain repellency, at least initially, which moved the roosting bats a few yards away from the device. A certain amount of disorientation was noted initially, but all three colonies maintained their numbers, and there was no significant control observed.

It was felt that the device as tested has no practical value in controlling an established roost. The only recommendation for further testing would be an attempt to prevent the reinvasion of bats into an established colony in early spring. It might be possible that the device installed from mid-March and running continually through the migration period might be effective in preventing a buildup.

#### MASSACHUSETTS

Three separate tests were conducted in the western Massachusetts area with the sonic device.

1. Northampton, Massachusetts

A 2-1/2 story home had several bats in the attic. Entrance was gained through a small hole in the eaves. The device was installed on August 1, 1974 in such a way that bats entering or leaving had to pass in front of the machine.

Checks were made as follows:

August 8 - Bats had moved to two locations; one group behind the chimney; and the other group to far side of the attic.

August 14 - Bats moved to front wall, the furthest distance from machine.

August 21 - Some bats were still at front wall. At least two bats were back in original position--near the machine.

The device was removed on August 21. The device was able to move bats around attic, but not eliminate problem.

2. Palmer, Massachusetts

The attic was in the process of being renovated in a 2-1/2 story, old building. Bat droppings were 3-6 inches deep on the floor. Estimated total population was 300-400 little and Big brown bats. The device was installed on September 5, 1974.

Checks were made as follows:

September 9 - Some bats had left the building and moved to cellar and front porch. Further check revealed only Big brown bats were remaining. Little brown bats evidently had left the area, since this was the time of year for their normal migration. The device may or may not have influenced their move. Large bats were becoming a problem due to changes in location.

September 16 - Big brown bats still in new location (cellar) and causing problems with persons in the building. Machine was shut down and removed. Again, the device caused some movement of bats, but did not eliminate the problem.



(NOTE: In both test sites, the women in the buildings could hear the device's pulsing sound when near the machine. They claimed the sound was not irritating and eventually became used to it.)

The only further testing that might show effect would be the use of multiple units in a roost or the use of this machine during the spring, just prior to arrival of the bats.

### 3. Amherst, Massachusetts

Sonic instrument was placed in attic space of private residence (typical 1850 vintage N.E. home with slate roof providing adequate bat access) with long history of bat roosting. Instrument was placed within 5 feet of most active roost area and enabled each day (turned off at night) for about 7 consecutive days. Bats were obviously disturbed as evidenced by excited movements and vocal response to pulsations of instrument. They "squeaked" in echo to the pulsators, reshuffled in the roost area, but did not vacate the attic.

### 4. New Hampshire

The machine was used in the attic of a year-round old colonial house located in northern New Hampshire. Last winter at least 100 pounds of bat manure were removed from the attic before installing new insulation in the attic floor and upper wall openings. The attic room is about 32 feet long by 25 feet wide and 8 feet high at the ridgepole, with roof sloping nearly to the floor at the sides. There is a large central chimney, with trapdoor to the second floor of the house to one side. In spite of sealing up a window and some holes, the bats returned to the attic this past spring.

Before installing the machine, 40 bats were counted between 3 rafters (32 inches) at noontime, and about 50 bats emerged from just one end of the house at dusk. It was estimated there must have been at least 100 bats roosting near the ridgepole in the attic.

The sonic machine was installed after 10:00 PM at night when the bats had all left. At noon the next day the attic was completely empty of bats. However, that evening 48 bats emerged from the same place as the 50 on the previous night. Over the summer it became clear that after installation of the machine in early July the bats left entirely the open space

of the attic, but moved down into the enclosed wall spaces and system of eaves. However, the same number of bats came out each night from small holes under the eaves.

The machine was located as follows. The machine was placed about 4 feet off the floor, with its back against the central chimney, pointed toward one end of the attic. Thus, the machine directly radiated only one half of the attic, but, nevertheless, kept the entire space, even on the opposite side of the chimney, clear of bats at all times. Furthermore, it should be mentioned that the attic floor had only occasional floor boards over the new 6-inch deep fiberglass insulation, which deadened the sound in the attic considerably. In spite of these physical obstacles and sound absorbency of the insulation, the machine evidently produced enough ultrasonic sound energy to repel the bats.

The sonic machine eliminated at least 100 bats from the open space of the attic, which saved the new fiberglass insulation in the attic floor from being covered with bat manure, and allowed the owner to work freely in the attic and make extensive repairs. The bats remained within the walls of the house as long as entrance holes were present under the eaves and exterior trim. However, after two months of work, the last hole was sealed at night after the bats came out, and the problem now appears to be solved, for the first time in the sixty years since the house was built.

#### SUMMARY

In all cases, it was evident that the device did agitate, confuse and disorient the bats causing them to fly more erratically and to relocate away from the machine. Bat counts before and after using the machine did not indicate any appreciable reduction in numbers.

---

The NOVA educational television show, in a special on Oxford Scientific Films entitled, "The Making of a Natural History Film", which won an International EMMY, started with a big-eared bat for a dramatic beginning. Right on, NOVA! The show was aired on public television in Maine on 29 December.

The star of the movie, "The Bat People", supposedly a doctor of preventive medicine and a research immunologist, gets my "Chump of the Year" Award. The movie, by Eastborn Productions, Inc. and an American International Release, started with closeups of bats while the soundtrack screeched; the male lead referred to dermestid beetles as mites and then what followed went downhill. I fell asleep and missed most of the film, but when I found that three of my students had also missed the end for the same reason, I felt vindicated. The only offsetting movie I've seen advertised recently was "Waltz of the Bat", rated X, in sizzling color, but I missed it, too; I hope nobody fell asleep during it. So much for the cinema!

Russell Reidinger, Jr. writes from the Philippines: "Last November several colleagues and I were on the island of Mindoro near Lake Naujan. We observed a flight of the flying fox, Acerodon jubatus, shortly after sunset (from 1753-1920), with most activity (21 bats) within the first five minutes. We saw 17 more in the next ten minutes. No additional bats were sighted from 1809-1920 despite a bright moon and clear sky. The flight came from a nearby swampy jungle area, and the next morning we located a fig tree within the jungle which served as a day-roost for many Acerodon.

"Of interest, Filipinos harvest these bats. In Mindoro, flying foxes sell for ₱3.00 (ca US\$0.43) each as a food source. Villagers catch the bats with a small kite (the one I saw was rectangular, about 0.3m x 0.7m, and made from plastic that was blackened to resemble the bats). The guide string had from six to ten hooks placed at 10 cm intervals on strings which also serve as tails. The kite is manipulated in a flyway and retrieved after a bat is snagged.

"In Laguna Province on Luzon, we began observations at dusk of several kapok trees (Ceiba pentrada), which bore fruit in early January of 1975. Pteropus (species not yet identified) arrived for feeding shortly after sunset (about 1800), with three or four alighting in a single tree at the same time, and crawling from fruit to fruit along its branches. Although feeding may last only a few minutes per bat, Pteropus may be observed on the trees (sometimes hanging near the ends of branches) until 2000 or so. Mike Fall and I have encountered two methods of harvesting these fruit bats on Luzon. In one case, young boys used a long, thin bamboo pole with a head of grasses to swat the bats from the trees. In another situation, bats were simply shot with air guns. In both cases, bats that crawled along branches or hung from them could be located with flashlights and were easy prey for man.

"Although these comments are based on just a few nights' observations on two of the many islands of the Philippines, I am sure that flying foxes are harvested here by a great variety of methods whenever they are within the reach of man. Although bats may have evolved with fewer predators than many other mammalian orders (J. W. Wilson, *Evolution*, 28(1):124-140, 1974), it appears that man may be a significant predator of these species in the Philippines."

Harlan Walley reports that Commonwealth Edison Company has donated the Blackball Mine in Utica, LaSalle County, Illinois, to the Illinois Department of Conservation. This system is familiar to many of us who spent time in the Midwest, and Harlan deserves a great deal of credit for his efforts to see Blackball placed under the protection of conservationists. There is a sizeable colony of Myotis lucifugus and the only known colony of Myotis sodalis in the state, and it is hoped that these can best be protected by the State. Another example of the need for controlled access by gating.

The National Wildlife Federation's book, "Gardening with Wildlife", 1974, notes that bats, although traditionally given a bad press, are actually highly beneficial.

"The Phantom" comic strip for January introduces some mystery with some seven-fingered bats, the artists having added additional free fingers to the nasty-looking creatures depicted. Oh, well, his lions and tigers feed only on fish, too; so much for reality.

## SHORT NOTE

## BAT VERSUS FLYPAPER

On 3 September 1973 at approximately 10-11 AM, one of us (Duncan) found a live bat stuck to a piece of flypaper hung from the ceiling of an open porch of the "Arts and Crafts Building" at the Lake Geneva Campus of George Williams College, Williams Bay, Walworth Co., Wisconsin. Not being a mammalogist, he was unable to identify it although he examined it closely. Judging from the size and color of the animal, it appears to have been a big brown bat, Eptesicus fuscus. Duncan left the porch for a period, but when he returned both bat and flypaper had been removed.

The porch is 7 feet by 15 feet. Windows to the porch were open at the time the bat became stuck. The flypaper was attached to the ceiling by a thumbtack at a height of 7 feet, 7 inches, and on the day the bat was caught, the paper had been in place for more than two days, being hung over a raccoon cage on the porch.

The flypaper was made in Western Germany, with active ingredients in the adhesive consisting of "rosin-rubber-mineral oil", 62%, with 38% inert ingredients. The product is listed as being non-toxic to pets, and during the time the bat was observed it appeared to be in good condition and was quite active. The dimensions of the adhesive surface in a sample of the product measured were 750 mm x 41 mm. One wing of the bat was completely extended and was stuck throughout the entire length of its ventral surface to the bottom portion of the flypaper, the other wing and body dangling freely below.

Bats have been recorded as impaled on barb wire fences (accounts summarized by Long, 1964 and DeBlase and Cope, 1967) and as getting caught by burdocks (Little, 1925; Lyon, 1925; Johnson, 1933; Davis, 1966), but to our knowledge this is the first report of one caught by flypaper.

At the time this work was done, Pine's salary was paid out of a grant to George Williams College from the Kellogg Foundation.

## Literature Cited:

- Davis, W. H. 1966. The cover. *Bat Research News*, 7(2):17 + cover.  
 DeBlase, A. F. and J. B. Cope. 1967. An Indiana bat impaled on barbed wire. *Amer. Midland Nat.*, 77(1):238.  
 Johnson, P. B. 1933. Accidents to bats. *J. Mamm.*, 14(2):156-157.  
 Little, T. 1925. Birds caught by burdocks. *Auk*, 42(2):284.  
 Long, C. A. 1964. Red bat impaled on barbed wire. *Trans. Kans. Acad. Sci.*, 67(1):201.  
 Lyon, M. W., Jr. 1925. Bats caught by burdocks. *J. Mamm.*, 6(4):280.

RONALD H. PINE and WILLIAM B. DUNCAN: Institute for Environmental Awareness, Department of Leisure and Environmental Resources Administration, George Williams College, Downers Grove, Illinois 60515 and Lake Geneva Campus, George Williams College, Williams Bay, Wisconsin 53191.

## RECENT LITERATURE

Compiled by Larry C. Watkins, Director, Beaversprite Nature Center, R. D. 1, Dolgeville, New York, 13329. Publications examined for bat literature routinely include the American Midland Naturalist, Kansas Academy of Science, New York State Fish and Game Journal, Journal of Mammalogy, Southwestern Naturalist, American Naturalist, Ecology, Canadian Field Naturalist, and Wildlife Review. BRN subscribers are urged to send their reprints or reprint titles to the above address especially if you publish somewhere other than the above. It would make my non-profit job a lot easier. Thanks.

- Anonymous. 1975. Red bat: *Lasiurus borealis*. S. Carolina Wildl., 22:inside front cover.
- Arnold, J.R., and J. Schonewald. 1972. Notes on the distribution of some bats in southern Mexico. *Wasmann. J. Biol.*, 30:171-174.
- Baagge, H. J. 1973. Taxonomy of two sibling species of bats in Scandinavia *Myotis mystacinus* and *Myotis brandtii* (Chiroptera). *Dansk Natur. Forening*, 136:191-216.
- Baker, R. J., H. H. Genoways, W. J. Bleier, and J. W. Warner. 1973. Cytotypes and morphometrics of two Phyllostomatid bats, *Micronycteris hirsuta* and *Vampyressa pusilla*. *Occas. Papers Mus. Texas Tech Univ.*, 17:1-10.
- Bhatnagar, K. P., and F. C. Kallen. 1974. Cribriform plate of ethmoid, olfactory bulb and olfactory acuity in forty species of bats. *J. Morph.*, 142(1):71-90.
- Bhatnagar, K. P., and F. C. Kallen. 1974. Morphology of the nasal cavities and associated structures in *Artibeus jamaicensis* and *Myotis lucifugus*. *Am. J. Anat.*, 139:167-190.
- Boqan, M. A. 1973. Geographic variation in *Myotis californicus* in the southwestern United States and Mexico. Unpubl. PH. D. Dissertation, Univ. New Mexico, Albuquerque.
- Boqan, M. A. 1974. Identification of *Myotis californicus* and *M. leibii* in southwestern North America. *Proc. Biol. Soc. Wash.*, 87(7):49-56.
- Burns, R. J., and R. F. Crespo. 1975. Notes on local movement and reproduction of vampire bats in Colima, Mexico. *Southwest. Nat.*, 19(4):446-449.
- Cerny, V. 1969. Nuevos conocimientos sobre la ixodofauna Cubana. *Torreia*, Nueva Serie No. 21, 12 pp., 1 table, 2 figs.
- Dunsmore, J. D., L. S. Hall, and K. H. Kottek. 1974. DDT in the bent-winged bat in Australia. *Search*, 5(3):110-111.
- Eastela, D. A. 1973. Ecology of the 18 species of Chiroptera at Big Bend National Park, Texas. *Northwest Missouri State Univ. Studies*, 34(2): 1-53 (Part I), 34(3):54-165 (Part II).

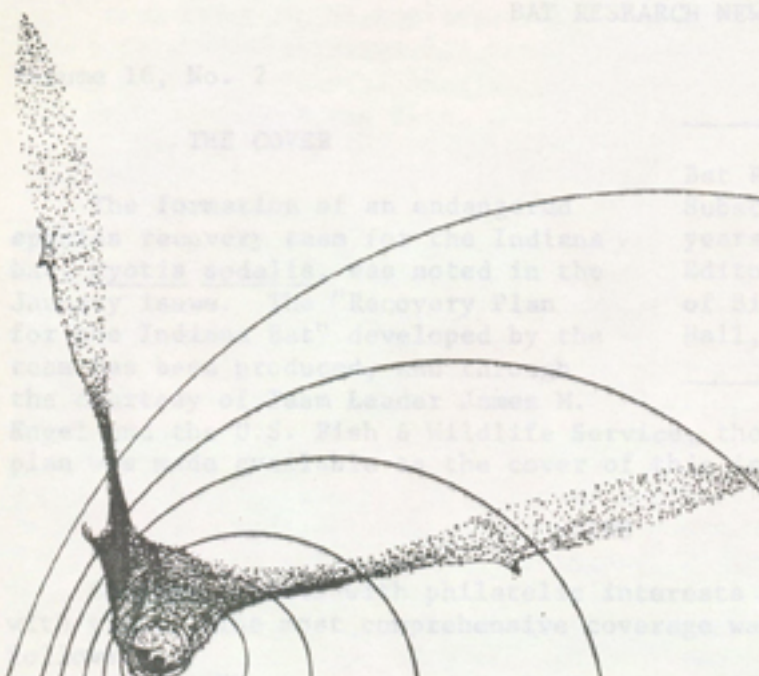
- Fayenuwo, J. O., and L. B. Halstead. 1974. Breeding cycle of straw-colored fruit bat, Eidolon helvum, at Ile-Ife, Nigeria. *J. Mamm.*, 55:453-454.
- Fenton, M. B. 1974. The role of echolocation in the evolution of bats. *Amer. Nat.*, 108:386-388.
- Fenton, M. B. 1974. Feeding ecology of insectivorous bats. *Bios*, 45:3-15.
- Fenton, M. B., and K. D. Roeder. 1974. The microtymbats of some Arctiidae. *J. Lepidopterist's Soc.*, 28(3):205-211.
- Findley, J. S., and D. E. Wilson. 1974. Observations on the Neotropical disk-winged bat, Thyroptera tricolor Spix. *J. Mamm.*, 55:562-571.
- Forman, G. L. 1974. Structure of Peyer's patches and their associated nodules in relation to food habits of New World bats. *J. Mamm.*, 55:738-746.
- Genoways, H. H., R. J. Baker, and W. B. Wyatt. 1973. Nongeographic variation in the long-nosed bat, Choeroniscus intermedius. *Bull. So. California Acad. Sci.*, 72:106-107.
- Greenbaum, I. F., and C. J. Phillips. 1974. Comparative anatomy and general histology of tongues of long-nosed bats (Leptonycteris sanborni and L. nivalis) with reference to infestation of oral mites. *J. Mamm.*, 55:489-504.
- Greenhall, A. H. 1973. Indiana bat: a cave dweller in trouble. *National Parks and Conservation Magazine*, 47(8):14-17.
- Harris, A. H. 1974. Myotis yumanensis in interior southwestern North America, with comments on Myotis lucifugus. *J. Mamm.*, 55:589-607.
- Heithaus, E. R., P. A. Opler, and H. G. Baker. 1974. Bat activity and pollination of Bauhinia pauletia: plant-pollinator coevolution. *Ecology*, 55(2):412-419.
- Hill, J. E. 1974. A new family, genus and species of bat (Mammalia:Chiroptera) from Thailand. *Bull. British Mus. (Nat. Hist.)*, 27(7):303-336.
- Hill, J. E. 1974. A review of Scotoecus Thomas, 1901 (Chiroptera: Vespertilionidae). *Bull. British Mus. (Nat. Hist.) Zool.*, 27(4):169-188.
- Howell, D. J. 1974. Acoustic behavior and feeding in Glossophagine bats. *J. Mamm.*, 55:293-308.
- Husar, S. L. 1973. Behavioral character displacement: evidence of food limitation in bats. Unpubl. M. S. Thesis, Univ. New Mexico, Albuquerque.
- Koopman, K. F. 1974. Eastern limits of Plecotus in Mexico. *J. Mamm.*, 55:872-873.
- Lowery, G. H., Jr. 1974. The mammals of Louisiana and its adjacent waters. Louisiana State Univ. Press, xxiv + 568 pp., 14 color plates, \$15.00

- Martin, B. 1973. A study of some aspects of bat ecology using an automatic ultrasonic sensing system. B. Sc. Thesis, Dept. Biol., Queen's Univ., 60 pp.
- Maser, C., and J. F. Franklin. 1974. Checklist of vertebrate animals of the Cascade Head Experimental Forest. USDA For. Serv. Resour. Bull. PNW-51, 32 pp., illus.
- Matson, J. O., and F. P. Brown, Jr. 1974. Notes on some bats from a cave on Peninsula Paraguana, Venezuela. Bull. S. California Acad. Sci., 73:52-53.
- McManus, J. J. 1974. Activity and thermal preference of the little brown bat, Myotis lucifugus, during hibernation. J. Mamm., 55:844-846.
- Neuhauser, H. N., and A. F. DeBlase. 1974. Notes on bats (Chiroptera: Vespertilionidae) new to the faunal lists of Afghanistan and Iran. Fieldiana Zool., 62(5):85-96.
- Pagels, J. F., and C. Jones. 1974. Growth and development of the free-tailed bat, Tadarida brasiliensis cynocephala (Le Conte). Southwest. Nat., 19(3):267-276.
- Racey, P. A. 1973. Environmental factors affecting the length of gestation in heterothermic bats. J. Reprod. Fert., Suppl., 19:175-189.
- Racey, P. A. 1973. The time of onset of hibernation in Pipistrelle bats, Pipistrellus pipistrellus. J. Zool., 171:465-467.
- Racey, P. A., and W. H. Tam. 1974. Reproduction in male Pipistrellus pipistrellus (Mammalia: Chiroptera). J. Zool., London, 172:101-122.
- Schlitter, D. A., and L. W. Robbins. 1973. Presence of Tadarida in the Central Sahara. Mammalia, 37(1):199.
- Schmidly, D. J., and C. O. Martin. 1973. Notes on bats from the Mexican State of Queretaro. Bull. So. California Acad. Sci., 72(2):90-92.
- Schmidt, V. U. 1974. Die tragzeit der Vampirfledermause (Desmodus rotundus). Z. Säugetierk., 39(3):129-132.
- Senger, C. M. 1974. Winter records of Myotid bats in Western Washington. Murrelet, 55:13-14.
- Spennath, C. A., and R. K. LaVal. 1974. An ecological study of a resident population of Tadarida brasiliensis in Eastern Texas. Occas. Papers Texas Tech. Univ., 21:1-14.
- Suga, N., and T. Shimosawa. 1974. Site of neural attenuation of response to self-vocalized sounds in echolocating bats. Science, 183:1211-1213.





THE COVER



Bat Research News appears quarterly. Subscription rate is \$4.00 for two years. Address correspondence to the Editor, Robert L. Martin, Department of Biology, University of Maine, Presb. Hall, Farmington, Maine 04830 U.S.A.

The formation of an endemism... recovery team... Indiana... noted in the... Recovery Plan... developed by the... the... Leader James N. ... J. Nash & Wildlife Service...

The cover art work for the Recovery Plan... of Bat Research News.

Interests responded to the January cover... comprehensive coverage was by Anthony DeNiro, and is as... W. J. Souley - 1973. Mammals of the World on... Wisconsin 53116. This source...

Interests responded to the January cover... comprehensive coverage was by Anthony DeNiro, and is as... W. J. Souley - 1973. Mammals of the World on... Wisconsin 53116. This source...

<i>Myotis</i>	Chile	\$194	1957	3 c
<i>Myotis</i>	Chile	\$195	1963	50 c
<i>Myotis</i>	Chile	\$196	1962	10 c
<i>Myotis</i>	Chile	\$21	1942	80 c
<i>Myotis</i>	Chile	\$22	1948	2.00 p
<i>Myotis</i>	Chile	\$23	1948	3 p
<i>Myotis</i>	Germany D. R.	\$24	1962	40 pf

The above stamp is not listed by Scott's... product of Chile, Chile... stamps are all the same picture with a different... The German stamp is multicolor and by far the most attractive of the series.



In addition to the above, the following stamps incorporate bats as design element in borders or on sheets of stamps:

<i>Myotis</i>	\$168	1941	2 c
<i>Myotis</i>	\$169	1941	4 c
<i>Myotis</i>	\$170	1941	3 c
<i>Myotis</i>	\$171	1941	15 c
<i>Myotis</i>	\$25	1952-56	5 p
Spanish Guinea	\$ 43		
	\$ 44	1958	15 c + 10 c
	\$ 45	1958	15 c + 10 c
	\$ 47	1958	50 c + 10 c

*Robert L. Martin*

THE COVER

The formation of an endangered species recovery team for the Indiana bat, *Myotis sodalis*, was noted in the January issue. The "Recovery Plan for the Indiana Bat" developed by the team has been produced, and through the courtesy of Team Leader James M.

Engel and the U.S. Fish & Wildlife Service, the cover art work for the recovery plan was made available as the cover of this issue of Bat Research News.

Bat Research News appears quarterly. Subscription rate is \$4.00 for two years. Address correspondence to the Editor, Robert L. Martin, Department of Biology, University of Maine, Preble Hall, Farmington, Maine 04938 U.S.A.

NEWS

Chiroptologists with philatelic interests responded to the January cover with vigor. The most comprehensive coverage was by Anthony DeBlase, and is as follows:

"Wagner, R. and W. F. Stanley. 1973. Mammals of the World on Stamps. American Topical Association Handbook No. 79, 75 pp. \$5.00. A.T.A., 3306 North 50th Street, Milwaukee, Wisconsin 53216. This source lists the following bats pictured on stamps:

<u>Pteropus</u> sp.	Seychelles	#194	1957	5 c
<u>Pteropus</u> sp.	Seychelles	#205A	1968	60 c
<u>Monophyllus cubanus</u>	Cuba	non-Scott	1962	10 c
<u>Stenoderma rufum</u>	Chile	#254	1948	60 c
<u>Stenoderma rufum</u>	Chile	#255	1948	2.60 p
<u>Stenoderma rufum</u>	Chile	#C124	1948	3 p
<u>Plecotus auritus</u>	German D. R.	#594	1962	40 pf

"The Cuban stamp is not listed by Scott since, as a product of Cuba, there is a trade embargo on it. The three Chilean stamps are all the same picture with a different color for each value. The German stamp is multicolor and by far the most attractive of the series.

"In addition to the above, the following stamps incorporate bats as a design element in borders or on coats of arms:

Hong Kong	#168	1941	2 c	4 bats in margin
" "	#169	1941	4 c	2 bats around dates
" "	#170	1941	5 c	3 bats in margin
" "	#171	1941	15 c	1 bat in margin
Spain	#1046	1962-66	5 p	bat on coat of arms
Spanish Guinea	B 45	1958	10 c + 5 c	" " " " "
" "	B 46	1958	15 c + 10 c	" " " " "
" "	B 47	1958	50 c + 10 c	" " " " "
Spanish Sahara	B 45	1958	10 c + 5 c	" " " " "
" "	B 46	1958	15 c + 10 c	" " " " "
" "	B 47	1958	50 c + 10 c	" " " " "

"Finally, Papua and New Guinea #178, 1964, 1lp, shows a carved head that bears a head of a flying fox as a design in the center of the forehead of the main carving."

Paul Pirlot, Josefina Rauch, Albert Beck, Julie Moore, Dieter Kock, and Jack Speece wrote concerning a Japanese stamp, with photos included for possible future use as BRN cover material. Jack Speece gave the following information on the stamp: "Issued on November 15, 1974, Japan depicts this large bat peculiar to Bonin and Volcano Islands as the fourth segment of its Nature Protection series. The 20 yen value shows Pteropus pselaphon and was printed in a total of 40 million copies using a combination of three-color photogravure and one color intaglio. The mammal was designated as a national monument by Japan in 1969, according to data from the Japanese Philatelic Bureau in Tokyo."

Dr. Kock mentioned the stamps from Chile as being of Stenoderma chilensis and noted that there was a Paraguayan stamp picturing Desmodus rotundus (in Paraguay three years ago, I bought what I thought to be the entire wildlife stamp series, including a first day cover with the entire series supposedly included, but the vampire bat stamp was not included - perhaps they had second thoughts about bringing attention to them! - RLM). He also notes that there is an unknown fruit bat on a stamp issued by the fictive "Republik Maluku Selatan", which exists for inexperienced stamp collectors.

Dr. Beck mentions a Czechoslovakian stamp (1.80 kcs) which has a bat in an upper corner of sky. O.K., numismaticists and collectors of paper money, it's your turn now to find some bat portrayals!

From Tom Aley comes the information that Mickey Fletcher of the Department of Life Sciences, Southwest Missouri State University, Springfield, Missouri, has begun research on the microbiologic succession in bat guano piles at the Ozark Underground Laboratory for his master's thesis.

Daniel F. Williams, Department of Biological Sciences, California State College, Stanislaus, 800 Monte Vista Avenue, Turlock, California 95380, found a banded Myotis yumanensis on 27 April 1975. Found in a maternity colony near La Grange, Stanislaus Co., California, it had a private band (BAT - 2,06134). He would like information on where and when it was banded.

The National Speleological Society issued in May of this year a new paper entitled "Caving", which will hopefully provide monthly information to cavers in general as a four-page newsletter. The pilot issue has an excellent piece entitled, "Bats aren't all bad", almost 400 words dedicated to educating cavers about the value of bats and how to avoid endangering them. My commendations to Ian G. Ellis, the editor of "Caving".

In Sidney Sheldon's 1973 novel "The Other Side of Midnight", now in 1975 Dell Book paperback edition, one of the main female characters is deliberately left in a Greek cave to die, where she is practically smothered by bat wings and is clawed in the face by bats. So that's what ouzo and retsina do to an author's mind!

From the Netherlands comes the 4 April 1975 issue of "NIEUWE REVU" with an article on Sjoerd Braaksma's work in bat protection, with one double-page color photo and several smaller photos (by Eberhard Menz and Carel de Vogel) the text by George van Aken. Such good bat coverage in a popular magazine is gratifying, as is the public recognition of Braaksma's work.

M. Brock Fenton's article, "Echoes: why bats can live in caves." in the October 1974 Canadian Geographical Journal (Vol. 89, No. 4, p. 16-23), has 16 excellent bat photographs of worldwide origin and a nice ending on the limited aspect of bat rabies. Marvelous propaganda for bats! It would make a nice booklet for distribution at science fairs and the like.

The 1969 book, "Night Rovers", by Irmengarde Eberle (Doubleday & Company, Inc.) deals with flying squirrels and their neighbors, devoting two pages to bats and including one photograph of a flying bat. Using large typeprint, it is an excellent juvenile book.

Vincent Brach contributed a good head photograph of an evening bat, Nycticeius humeralis, for the cover of the April issue of the Bulletin of the Southern California Academy of Sciences (Vol. 74, No. 1).

Under the Nature Notebook section of the Ithaca Journal (New York) of May 10, 1975, Woodward S. Bousquet has written an article entitled, "In Defense of Bats". The series is written by students in Cornell's Environmental Education Program, and this one is an excellent example of good public education.

For a general listing of some bat poetry, here are some odds and ends: "Cats and Bats and Things with Wings - Poems by Conrad Aiken", Atheneum Press, N.Y., 1969, has a full-page drawing by Milton Glaser and a full-page poem entitled, "The Bat".

"In a Spring Garden" (a collection of haiku poetry), edited by Richard Lewis, Dial Press, N.Y., 1965, has a stylized picture of a bat by Ezra Jack Keats with a three-liner poem on a bat by Buson.

"The Golden Journey", edited by Louise Bogan, Reilly & Lee Co., Chicago, 1965, includes the poem, "The Bat" by Theodore Roethke.

"Out of the Ark", edited by Gwendolyn Reed, Atheneum Press, N.Y., 1970, has a poem by John Clare entitled, "Bat".

"Under the Tent of the Sky", edited by John Edmund Brewton, Macmillan Co., 1937, includes two bat poems, "Viewpoints" by Arthur Guiterman and "An Inconvenience" by John Banister Tabb.

"Wonders and Surprises", edited by Phyllis McGinley, J. B. Lippincott Company, Philadelphia and N.Y., 1968, includes "The Baby Bat" by Randall Jarrell.

"Oxford Nursery Rhyme Book", by Iona and Peter Opie, Oxford Univ. Press, 1955, repeats the charm, "To the Bat".

"The Complete Poems of Emily Dickinson", Little, Brown and Company, 1924, has poem CIV devoted to a bat.

Many thanks to Shirley G. Martin, Reference Librarian at the University of Maine at Farmington, for the above listing.

The NSS News for March 1975 (Vol. 33, No. 3) announces the awarding of the 1974 NSS Conservation Award to the Virginia Region, noting among the conservation actions the compilation and maintenance of a list of critical bat caves in the region.

Ivan Horáček of Charles University, Prague, Czechoslovakia, has completed seven years' work on the biology of Plecotus auritus and P. austriacus, with results to be published soon.

Reference is made in James M. Michener's Centennial (Random House, 1974) to shipping boxcar loads of bat guano from Cralsbad Caverns in New Mexico to the fictitious town of Centennial, Colorado, in 1905. The interweaving of fact and fiction in logical historical development is what makes Michener so readable and interesting to me, and, apparently, to a few million other readers. For those of you who read the novel and skimmed a bit, it was on page 682.

The National Wildlife Federation, 1412 16th St., N.W., Washington, D.C. 20036, has the Hawaiian hoary bat and the Indiana bat heading the list of mammals on their free sheet on "List of species and subspecies found in U.S. and Puerto Rico designated as endangered by U.S. Fish and Wildlife Service". They provide a one page, both side, leaflet entitled, "The Indiana Bat, and Others" free, and an excellent booklet entitled, "Endangered Species of the United States" which does not mention bats, but does give good general background information. They provide the free twice-monthly Conservation News and the weekly newsletter, Conservation Report, utilizing income from their Conservation Stamp Program and donations and sales of their other publications. Their Conservation Report is most useful when writing congressmen (and congresswomen) about pending legislation.

George R. Campbell, International Coordinator of the Fund for Animals, provided a full page and a half of bat coverage in the January 10, 1975, issue of the Island Reporter (Florida). Entitled, "Search goes on for island bats", and illustrated with two pen and ink drawings by Molly Eckler Brown, it is not always fully accurate and there are some spellings and unscientific interpretations that give one pause, but in general it is a good piece of news propaganda for bats. I do wish that adequate biological training were a prerequisite for working for an international group educating the public in the role of wildlife in the world, though.

The Minneapolis Tribune of 24 February 1975 reports on the 24th annual college bat hunt, where students and two professors gather bats from the attic of old campus buildings and take them to a lab for weighing and banding. The professor in charge reported that the data is sent to Washington, D.C., where it is combined with reports of the nation's other 50 bat-banding organizations. Storm sewers are also searched. One of the biology students was quoted as saying, "When you pull them out they start to spit this musk at you...really starts to smell." My immediate reaction, after discounting the journalistic license of newspaper reporters, is that the data gathered are surely not valuable enough to justify the rather extended period of energy loss of the bats, and the biology students could possibly be better educated as to what the hunt was all about, if indeed there is some scientific reason. I just loved the accompanying photo of "a spitting bat", too!

Page 179 of "The Trailblazers" (Time-Life Books, 1973) has an attractive plate of two bats from William Hensley Emory's Report of the United States and Mexican Boundary Survey 1856-1859. While surveying, they certainly got in a lot of natural history work in those days.



Richard S. Frith, 1117 West Elna Rae Street, Tempe, Arizona 85281, has provided information on new Arizona cave legislation which would make it unlawful to kill, harm or disturb plant or animal life found therein, except for safety reasons. He would greatly appreciate information on bats in the state of Arizona, and would appreciate communication with anyone who might be interested in helping to close the hunting season on bats (now open season at all times, as in most states). He is working on his master's degree in Health Services Administration.

With regard to the short note in this issue on the Florida bat tower, a news item from the 27 December 1964 New York Times is of possible interest:

"On Sugar Loaf Key, 15 miles north of here, a tall, shingled, windowless tower is a reminder of an anti-mosquito campaign in 1929 that failed.

"The tower was built by Richter Perky, who had discovered that mosquitoes were the biggest handicap to development of a fishing resort for wealthy sportsmen.

"A Texas scientist had explained to him that bats, emerging from the tower, would destroy the mosquitoes. The tower was constructed and baited with the scientist's special bat bait to lure bats into the tower.

"However a hurricane blew the bat bait into the Gulf of Mexico. A call to Texas for more bait showed that the scientist had died, leaving behind neither bait nor formula. Bats were placed in the tower, but they all disappeared.

"The tower still stands, but legend has it that the mosquitoes ate the bats.

The December 30, 1973 edition of The Key West Citizen had an article by Pat Parks (mentioned in Dr. Hoffmeister's note) entitled, "About bats" and based on Perky's bat tower and the one being built by Ralph Raschig in Wisconsin. She mentions that the Perky tower cost about \$10,000 in 1929, and that in spite of the reports, no bats were ever imported.

Although I see little hope for bats "migrating" to Raschig's bat tower, his efforts to popularize bats are appreciated, and his "BATS NEED FRIENDS" bumper stickers are worth far more than the \$1.00 he asks for them. His address is either Rt. 2, Box 413, Eagle River, Wisconsin 54521, or c/o General Delivery, Lutz, Florida 33549, depending upon the time of year. They can be acquired in a hurry from Endangered Species Productions in Massachusetts, too.

For a hilarious account of con artists trying to sell a bat tower to the public, read Thomas McGuane's The Bushwhacked Piano, Simon and Schuster, N.Y., 1971, but only if you like free-wheeling irreverent wit with a touch of the completely absurd.

A. R. Wallace's The Malay Archipelago, 1869, has been reprinted by Dover Books (1962), and on page 256 of the reprint recounts how the Orang Sirani eat flying foxes - "generally cooked with an abundance of spices and condiments, ... are really very good eating, something like hare."

The March-April issue of American Scientist (Vol. 63, No. 2) has an excellent paper by James Simmons, Donna Howell, and Nobuo Suga entitled, "Information content of bat sonar echoes" (p. 204-215.) with good illustrations to help the non-echolocator biologist to understand the jargon of the specialist. (I can hear again, doctor.....)

RECENT LITERATURE is temporarily suspended while Larry Watkins works on his house.





## BAT RESEARCH NEWS

Volume 16, No. 3

July 1976

### THE COVER

The cover photographs constitute Figures 1 and 2 of the paper by A. W. Gustafson, with the explanation given on page 26 of this issue. He also sent an excellent photo of the 20 yen Japanese bat stamp, adding his name to the list of those who had already done so (see April issue).

---

Bat Research News appears quarterly. Subscription rate is \$4.00 for two years. Address correspondence to the Editor, Robert L. Martin, Department of Biology, University of Maine, Preble Hall, Farmington, Maine 04938 U.S.A.

---

### NEWS

At the May 10th meeting of the Southern California Academy of Sciences, held in Los Angeles, Charles Bufalino of California State University at Northridge presented a paper on the structural morphology of the sterna of five genera of bats in the family Emballonuridae.

Erik Kiviat of the Division of Natural Sciences and Mathematics at Bard College, Annandale-on-Hudson, New York 12504, is working on a zoological survey of Dutchess County, New York and is interested in records of bats from that county and surrounding areas. The main purpose of this survey in the Hudson River Valley is to provide recommendations on habitat preservation and management for uncommon and rare vertebrates. He would appreciate any suggestions and information available.

Eugene D. Kitzke, Biology Research Manager of the S. C. Johnson & Son, Inc. (makers of Johnson Wax, Off, etc.), wrote an excellent article entitled, "Bats and Man" for the Johnson Magazine (Vol. 47, No. 1). With ten photographs, using the Milwaukee Public Museum and Milwaukee County Zoo as sources for many of them, he provides an educational summary on bats and notes the research on bat repellents. For such structural problems as those posed by corrugated roofing, closing the entryways for bats is difficult, and a good, long-lasting repellent would work wonders, so I'm hoping that he and his company are going to continue in this line of research.

From the Milwaukee Journal of July 12, 1975, comes a clipping, sent by Kitzke, reporting a theory of Dr. George Dean, Director of the Medico-Social Research Board of Dublin, that the "Curse of the Pharaohs" was in reality infection by histoplasmosis caused by inhalation of bat guano dust. Based on men having contracted the disease after wading in bat droppings which reached six feet in depth in Rhodesia, Dean theorizes that Egyptologists inhaled the fungal spores from droppings of bats which inhabited the tombs after they had been opened. Specialists in tropical medicine consider his hypothesis to be one of many, and the Salford University Tropical Medicine Department member of the team currently unwrapping a mummy at Manchester University, Prof. William Kershaw, has suggested a number of other likely causes.

From 19-26 May 1975, a collecting party sponsored by Texas Christian University went to the Isle Roatan off the coast of Honduras. J. Stephen McCusker, graduate student of Dr. Arthur Cleveland, collected a series of 23 Artibeus jamaicensis jamaicensis Leach from four different localities on the island. A note with measurements, sex ratio, and reproductive observations is in preparation.

W. Wilson Baker, at the Tall Timbers Research Station, is following a nursery colony of Myotis austroriparius in a building and winter populations of Pipistrellus in a cave.

John F. Parrish III is still assembling information on the life history of Mormoops megalophylla in Texas.

The Maine State Supervisor of Wildlife Services of the USF&WS, Francis Gramlich, writes as follows: "A long-standing bat roost located around an outside chimney of a residence in Readfield, Maine, has been declining in recent years. Once containing 50 or more little brown bats, Myotis lucifugus, it now has less than a dozen. In 1974 a very sick and dis-oriented bat was picked up under the roost. It squeaked continuously and bit wildly at anything within its reach, including its own body. Before it could be tested, it was taken from its cage by an unknown predator.

"In mid-May 1975, it was noticed that a single bat appeared daily about noon, flew slowly to a small pond about 100 yards from the roost and apparently drank several times by dipping to the water in flight, then returning to the roost. On one of its daylight trips in late May, it appeared to be very weak and landed on a tree trunk half way back to the roost. Upon being approached, it squeaked continually and exhibited aggressive behavior. After resting an hour or more, it flew weakly to the base of the chimney roost, but could not climb to a secure position. The bat was placed in a box overnight where it squeaked often and bit at any object moved close to it. It appeared somewhat recovered the following morning and was placed at the base of the chimney. It still could not climb to a protected area and died during the day. The bat was tested at the Augusta Public Health Lab and diagnosed positive for rabies by the fluorescent antibody test."

An Associated Press release from Concord, New Hampshire on 11 June 1975 quotes New Hampshire Health and Welfare Commissioner Frank Whaland as saying that half of New Hampshire's bats are rabid and the potential for attacks on humans have increased because of the use of DDT because they become ill and wander around on the ground for an undetermined period of time before dying, and thus are in a condition to make it easier to bite humans. On the basis of the percentage of humans diagnosed as having VD in New Hampshire compared to the percentage of bats having rabies, one could conclude that humans in New Hampshire have more than two-thirds of the population with VD. So there, Mr. Whaland! The problem of public and high official ignorance is a serious problem in New Hampshire, obviously, in spite of my snide humor.

The Harvard College Library Department of Printing and Graphic Arts in 1971 published An Animated Alphabet in facsimile monochrome of the art of Marie Angel. Nyctalus noctula serves for the letter N. A beautiful booklet!

The Meramec River Basin lies in the northeastern portion of Missouri's Ozark Highlands. The major drainage for the almost four thousand square mile area is the Meramec River and its two main tributaries, the Big and Bourbeuse rivers. The United States Army Corps of Engineers' are currently in the process of preliminary construction of an earth and rock filled dam to be located on the Meramec River, not far from the city of Sullivan, MO. The present proposed site of the Meramec Park Dam will create a lake with a surface area of 12,600 acres at normal pool, and will expand to 23,000 acres at maximum flood pool. The creation of this dam and resultant lake will have the effect of either totally or partially inundating something in the vicinity of one hundred caves. Several of these caves provide habitation sites for bats. Of particular concern is the fact that Myotis sodalis occurs in several cases in the project area. Additionally, Myotis grisescens is known to utilize some of the caves which will be totally inundated. In addition to the adverse effects which the construction of this proposed dam would have on bat population, several commercial caves will be destroyed as well as inundating some of the most beautiful unspoiled natural recreational streams left in the state of Missouri.

There has been a long history behind the United States Army Corps of Engineers' Meramec River Basin Project. The first inception of the idea to dam up the Meramec River can be traced back to the late 1830's. The current authorization can be traced to the Federal Flood Control Act of 1938. By 1949, the Corps of Engineers' had developed a plan for construction of three dams in the Meramec River Basin. However, then, Governor Forrest Smith managed to have the project shelved. In 1958, a group called the Meramec Basin Corporation was set up, with the purpose of "providing the public with information about what was going on." In 1964, the Meramec Basin Corporation became the Meramec Basin Association and came out openly in support of the project. The Meramec Basin Association is a public relations organization composed mainly of individuals and organizations who stand to make money off of lake developments, etc.

In 1972, the Ozark Chapter of the Sierra Club and four individuals who owned land in the project area brought suit against the United States Army Corps of Engineers'. The Sierra Club suit challenged the legality of the dam in seven major areas including the cost-benefit ratios, failure of federal officials to consider alternatives to the project, and possible violation of the Endangered Species Act of 1973. On March 19, 1975, a decision upholding the legality of the dam was handed down. This decision has now been appealed by the Sierra Club. The most interesting aspect of this litigation which is currently underway is that it may be possible to block the construction of the dam as a result of the occurrence of the species of bats, (Myotis sodalis) in caves in the project area. In the opinion of the Sierra Club, the construction of this dam would result in a violation of the Federal Endangered Species Act of 1973. In addition to the Sierra Club appeal, another suit challenging the legality of the Meramec Park Dam as violating an article of admission of the State of Missouri into the union has recently been filed in the federal district court by attorneys representing Mr. Lester B. Dill, owner of Meramec Caverns and Onondaga Cave. Individuals interested in obtaining additional information relating to this project may do so by writing to:

Tom Cravens  
 Department of Sociology  
 Meramec Community College  
 11333 Big Bend Blvd.  
 Kirkwood, MO 63122

The above was written for BRN by Tom Cravens, whose work in the NSS is well-known to members of the Society. He has a six-page leaflet available with more information on the Meramec problem. Please help!

SHORT, UNREFEREED NOTEAN OUTDOOR FLIGHT CAGE SUITABLE FOR KEEPING AND MAINTAINING  
INSECTIVOROUS BATS IN CAPTIVITY

Recently, Rasweiler (in press) has summarized the literature regarding the methods and facilities for the care and maintenance of bats in captivity. It is obvious from this work that bats are becoming popular animals for laboratory studies. However, conspicuously lacking from the literature is a description of a flight cage for keeping insectivorous bats in a captive situation under semi-natural conditions. This note apparently presents the first description of the construction of such a cage and the subsequent maintenance of the insectivorous bat Myotis lucifugus lucifugus in it during the summer months.

The cage (see cover, Figs. 1 and 2) was built primarily with 2X4's and 2X2 mesh hardware cloth in a modular design with the overall dimensions of 8X8X16 ft. Each side of the cage and the roof sections are separate units held together at various points with machine bolts, thus allowing easy assembly, disassembly, and portability if needed. Hardware cloth of 2X2 mesh was used because it has holes large enough for small insects including moths to enter but small enough so that the bats cannot escape. The foundation of the cage is composed of cinder blocks embedded in a trench of gravel. The hardware cloth was extended by six inches into this gravel trench to prevent access by rodents, etc. and also to prevent egress points for the bats should the ground heave.

Water was provided in a large galvanized reservoir (see Fig. 1). A bush (Fig. 1) was transplanted into the cage hopefully to serve as an insect roost.

Under the main roof of the cage, a roosting box (Fig. 2) was constructed (dimensions: 1X1X4 ft.). This structure was designed so that it could be removed to the laboratory if needed. It is entirely enclosed but has a sliding floor. Furthermore, it is fully lined with hardware cloth and is provided with variably spaced partitions so that the bats could hang more easily and securely. When in place the floor was opened about an inch so that an access slot (1"X4') was provided for the bats. A second "door" in the side of this box was provided for the ease of the experimentalist when introducing new bats into it.

To attract flying insects into the flight cage through the hardware cloth, a "black light" apparatus (see Fig. 1) was constructed. This device consists of two standard fluorescent fixtures fitted with Sylvania UV "black light" tubes. To increase the visibility of the light, a reflecting cloth was hung between the two fixtures. Power to the lights (Fig. 2) passes through a time clock which regulated their operation in accordance with the bat activity cycle.

Bats were kept in this cage during the summers of 1970 and 1971 with good success. Small numbers were maintained without supplementary diet but up to 40 or 50 animals could only be maintained when additional food (mealworms) was provided daily. The additional food was placed in flat dishes on the shelf described in Figure 2. The black light was very effective in attracting insects. Many small moths passed through the wire mesh and succumbed to the bats' foraging ability. This was evidenced by the fact that the water reservoir had to be cleaned almost daily of the uneaten moth parts (wings, etc.) and the floor of the cage at certain roosting sites was littered with these same remnants. A most interesting feeding observation was noted with respect to the reflecting cloth. This

surface attracted many insects to it and soon the bats "learned" this for on many occasions individual bats were seen crawling across the fabric acting as veritable vacuum cleaners as they devoured the insects that had alighted there.

Once the bats became accustomed to the roosting box, they preferentially spent their daylight hours there. This was probably due to the fact that this was the darkest site, but also the partitions inside the box provided many tight crevices for the bats to retreat into.

The water reservoir was frequently used. In fact on several occasions bats were seen swimming in this trough. They would land in the water with their wings outstretched, drink, and then swim to the side and crawl up the hardware cloth (some pieces of hardware cloth were placed around the border of the reservoir so that the bats wouldn't become trapped in it). When they had climbed to the top of the reservoir, only then would they begin flight. Apparently these bats are not capable of initiating flight from the surface of water.

The transplanted bush also proved to be a success in that many moths roosted here during the day.

With the increasing use of insectivorous bats for laboratory studies, a cage such as described here may be very important for maintaining a semblance of normal physiology. In our experience, it was noted (at least in Myotis l. lucifugus) that bats kept in small cages in the laboratory often lose their ability to fly. That at least normal male reproductive physiology was preserved in this flight cage was suggested by the paralleling of the captive male reproductive cycle to its wild counterpart.

#### Literature Cited:

- Rasweiler, J. J., IV. (in press). The care and management of bats as laboratory animals. In "Biology of Bats" (W. A. Wimsatt, ed.), Vol. III, Chapt. 5. Academic Press, N.Y.

## EXPLANATION OF FIGURES

A flight cage for insectivorous bats.

Figure 1. Front view of flight cage.

- A. Heavy duty black polyethylene plastic to darken roosting area in daylight and protect area from wind and rain.
- B. "Black light" apparatus for attraction of insect food: two 4 ft. fluorescent fixtures with UV "black light" tubes mounted at center top of cage under protective roof. A reflective cloth is hung between these fixtures to increase UV dispersion.
- C. Water reservoir.
- D. Bush transplanted into cage to serve as insect roost.

Figure 2. Oblique view to show roosting area.

- A. Roosting box (removable) mounted under main roof of flight cage and against a central "wall" of hardware cloth. This "wall" is provided to allow bats an access into the roosting box through an opening in its floor.
- B. Shelf mounted just below roosting box to provide area for supplementary food (mealworms) if large numbers of bats are kept in the flight cage.
- C. Power line from time clock to "black light" fixtures. The clock is adjusted so that the lights come on when the bats become active in the evening and go off when they return to the roosting box in the early morning.

A. W. GUSTAFSON; Department of Anatomy, Tufts University School of Medicine, 136 Harrison Street, Boston, Massachusetts 02111

The July issue of Upcountry, New England's Magazine of Upland Living, has an article by Anthony G. Rud, a columnist for the Berkshire Evening Eagle (Pittsfield, Massachusetts). Entitled "Bats are Beautiful", the article notes the great value of insectivorous bats and even suggests putting up bat houses as well as bird houses. He makes this suggestion, I believe, without the knowledge that this is an idea gaining in popularity in many areas as a practical matter. As a former resident of the Berkshires and as an owner of some property there still, I hereby provide Mr. Rud with a free year's subscription to Bat Research News to show him that his neighbors appreciate him!

Dr. Josefina Rauch of the University of Manitoba sent me a copy of a postcard she received from Fiji, printed in France, illustrating on one side a place setting with wine, condiments, and a fruit bat; on the other side, in both French and English, a recipe for flying fox in wine sauce, which I provide here for the gourmet:

"Recipe (for 4 persons). - Take two large flying foxes, skin and clean them, cut each into four pieces and marinate for 24 hours in Bordeaux wine with onions, garlic, bouquet garni, (parsley, thyme, and bay leaf), salt, pepper, and cloves. Fry until golden brown with the onions, add the marinade mixture and simmer gently for 40 minutes. Thicken the gravy, at the end of the cooking time, with 2 flat tablespoons of flour. The most reluctant gourmet will allow himself to be seduced by this succulent dish."

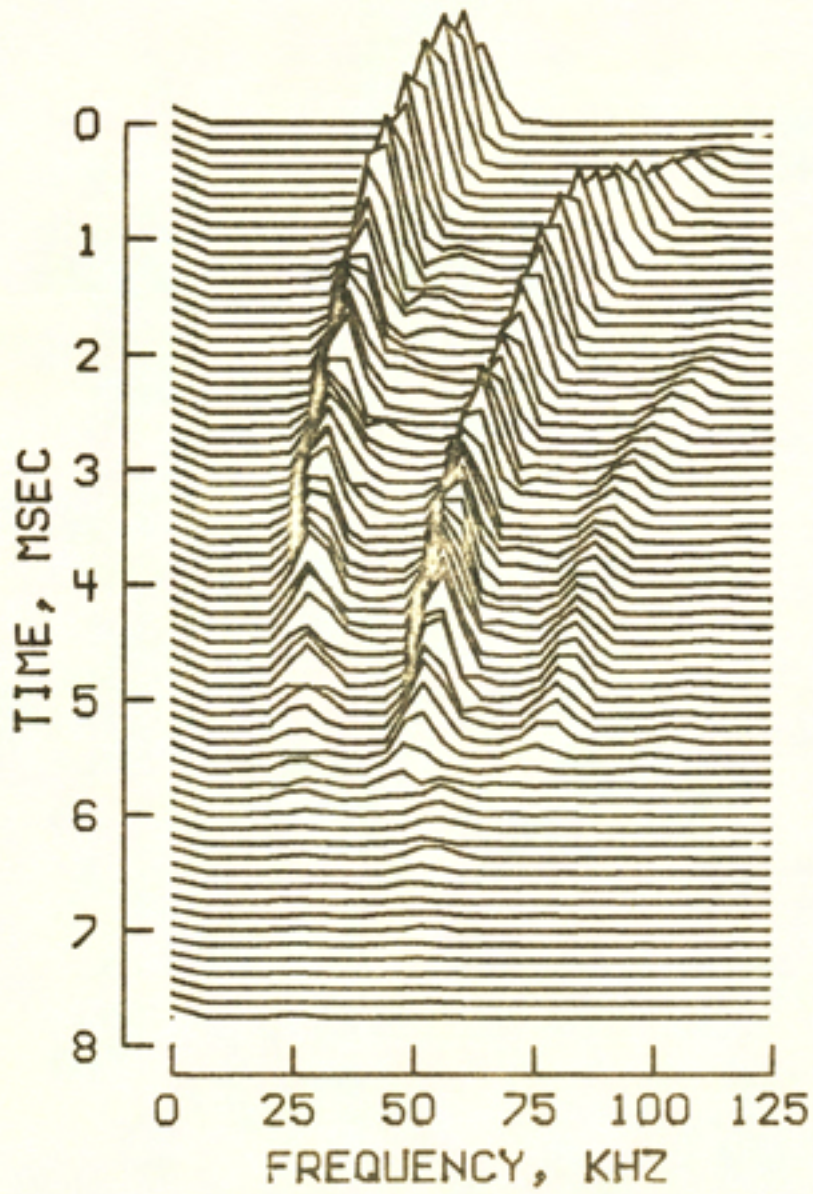
Dr. Rauch is doing her part in keeping bats in the public eye in Manitoba with an article in the Winter issue of Manitoba Nature (Vol. 13, No. 4), 1972, entitled "How bats survive in the cold" and an article in the Summer issue of the same magazine (Vol. 14, No. 2), 1973, entitled "Birth of a bat". With all the time it takes to write such articles, it is good to see professional biologists taking the time off from research to make such presentations to the public.

Dr. Donald R. Patten, Southern California Academy of Sciences, 900 Exposition Boulevard, Los Angeles, CA 90007, is appealing to BRN readers for any unpublished accounts of predation on bats, and any references to publications dealing with instances of predation on bats. He would appreciate whatever new data and/or references readers might know.

RECENT LITERATURE is still suspended until Larry Watkins gets his house completed.



EPTESICUS FUSCUS



BAT RESEARCH NEWS

Volume 16, No. 4

October 1975

THE COVER

The cover illustrates a computer graph of the frequency structure of a sonar signal used by Eptesicus while discriminating target range in the presence of noise. It is similar to the "detectional" signal the bat uses in early stages of insect hunting. My thanks for its use to the Washington University Bat Lab; J. A. Simmons, W. A. Lavender, and B. A. Lavender. It seems an appropriate cover for this issue with a paper on portable apparatus for observing high frequency sounds by Donald Griffin.

---

Bat Research News appears quarterly. Subscription rate is \$4.00 for two years. Address correspondence to the Editor, Robert L. Martin, Department of Biology, University of Maine, Preble Hall, Farmington, Maine 04938 U.S.A.

---

NEWS

Gustav Kirk provides the following information, which I hope readers will correct and bring up to date as much as possible: "In 1813, Dr. Johann Philipp Achilles Leisler of Hanau in West Germany, after whom Leisler's bat is named, proposed the protection of insectivorous bats, but not until after 1900 was there any legislation. Bats are now legally protected in the following countries: Hungary since 1901, Salzburg 1909, Finland 1923, Denmark 1931, Prussia 1933, Liechtenstein 1933, Portugal 1934, Germany 1936, Austria 1939, Italy 1939, Yugoslavia 1947, Poland 1952, USSR 1960, Bulgaria 1962, Czechoslovakia 1965, Switzerland 1967, Sweden 1968, Luxembourg 1973, Netherlands 1974. - They are not protected in Iceland, Norway, Great Britain, Ireland, Belgium, France, Spain, Albania, Greece, and Roumania." Mr. Kirk's efforts in mammal protection are appreciated. A number of European correspondents are using the GESCHUTZTES TIER - HUFEISENNASE stamps depicting horseshoe bats.

The September-October issue of American Scientist has a book review by J. A. Simmons and J. E. Childs on the book, Ultrasonic Communication by Animals, by Gillian Sales and David Pye (Halsted Press, 1974, 281 pp.). They recommend the book highly.

Wilbur Gunier writes that he is taking a group of his students on a trip to Gasparilla Island, off Placida, Florida, and hopes to mist net some Florida bats for his Missouri students to look at in a 19 December to 14 January trip.

In the Summer issue of Maine Fish and Wildlife (1975), Francis Gramlich has an article entitled, "What to do about unwelcome wildlife." In it, he notes the protection in some countries of insectivorous bats and the use of bat boxes, and points out that they are beneficial. Plugging entrances is the method he suggests to exclude them where they are unwanted.

To offset feelings of guilt engendered by the abundance of good propaganda articles being produced about bats, I provided a page for "Maine's Changing Wildlife" section of Maine Audubon News for June 1975. Entitled imaginatively "Bats", it briefly describes the types of Maine bats, their value, and some comments on the rabies problem, the pesticide problem, and how to deal with unwanted bats in the attic.

Word comes from the Biology Department of Montana State University that David Fassler has donated a collection of 400 mammal specimens to the department. In the Summer Quarter Notes (August 4, 1975) of MSU, a photo is included showing Dave with a tray of bats, and a write-up noting his special interest in bats, with the comment that he is working on his Ph.D. in biology at MSU.

The Director of Procurement, John H. Hink, of Cutter Laboratories, Inc., writes as follows concerning the immune serum derived from humans: "Following the announcement that Cutter Laboratories was licensed to manufacture and make available a purified immune serum derived from rabies-immunized human volunteers, we have had a tremendous response throughout the United States from volunteers such as yourself. However, even though supplies of the serum are in short supply, I regret to say that at the present time we are unable to accept the unselfish offer of your blood. Difficulties involving geographical location, regulatory restrictions and access to authorized bleeding facilities prevent us from making appropriate arrangements in your area. Currently we are making a concentrated effort to build up a serum supply from areas presenting a minimum of problems. If, at some future date, we find that arrangements can be made for your area, we hope to be able to contact you again." For readers who are immunized and wish to donate blood for this supply, you might write him at Cutter Laboratories, Fourth and Parker Streets, Berkeley, CA 94710; assuming that you are not located in the boondocks as I am, that is....

From Poland, Adam Krzanowski writes that he has ready for printing an article, "How bats get to Iceland" (2 pages), another entitled, "How far eastwards do the bats reach in Polynesia?" (1 page), and an article on "An overlooked paper on New Zealand bats" to the New Zealand journal, Forest & Bird. He is experiencing difficulties in publishing his "Bibliography of Bats, 1958-1967" (510 pages) - it averages about 500 titles per year, while the Zoological Record averages 212 titles for the same period.

An October 5th cartoon strip, "The Wizard of Id", by Parker and Hart, features the problems encountered in obtaining bat wings for his sorcery; a bat appearing from the body of a Dracula-type informs him that bats have been declared an endangered species, whereupon the wizard suddenly recalls an alternate ingredient - bald eagle plumes!

Aida Parkinson (Dept. of Zoology, Storer Hall, Univ. of California at Davis, Davis, CA 95616), working under Dr. R. L. Rudd, is studying morphological variation in Myotis lucifugus and M. yumanensis along the east slope of the Sierra Nevada in California from Lake Tahoe up to Tulelake National Wildlife Refuge. If any BRN readers have collected bats in this area, the information would be appreciated.

The Morning Sentinel (Waterville, Maine) for October 3, 1975, had a half-page article with half of that being a "cartoon" of a woman armed with many kinds of items, including a broom, aiming at a bat hovering in the light of a lamp. Entitled, "Bats are company for insomniacs but ...", it treats the problem of unwanted bats with much of the information provided by the general manager of an exterminating and fumigation agency. Surprisingly, the in-

formation is quite reasonable in its direction. Chasing the bats out and exclusion are the methods suggested, and it is an excellent presentation in spite of the implied value of having the company do the work. My congratulations to both the staff writer, Sarah Betts, and to Robert Dulle of New England Sanitation Systems, Inc.

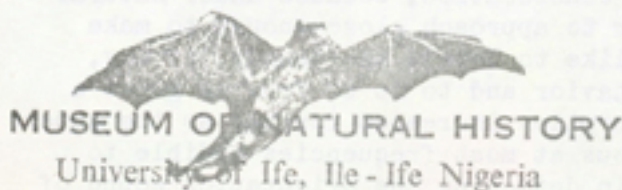
Tom Aley writes from the Ozark Underground Laboratory that the summer colony of 150,000 Myotis grisescens in the Laboratory cave send their greetings. Love that kinda talk!

In the October 1974 issue of BRN, I mentioned a letter to the newspapers from a representative of the Humane Society of the U. S., with a suggestion that polite corrective letters to her might be useful. Wayne Davis and James Hedges wrote, and the response was most favorable. A revised edition of a 1974 booklet entitled "Animals - Laws, Habits, Problems, Handling" designed for use by police departments and eventual distribution throughout the state of New Jersey, has a section on rabies and distemper in which Mrs. Maxwell gets in a good word on bats. She writes, "Rabies is a dreadful disease. Nevertheless, its incidence in New Jersey has been exaggerated in the public mind. Bats are extremely beneficial as they consume vast numbers of mosquitoes and other insects. But they never should be handled and any bat observed abroad during the day should be suspect and reported immediately to the board of health." Although the results to the BRN notice are not staggering, it is gratifying that the results were beneficial.

The September 1, 1975, issue of Conservation News (Vol. 40, No. 17) has a section, "An endangered bat and an endangered law", dealing with the Meramec project. U. S. District Court Judge H. Kenneth Wangelin rejected Sierra Club arguments, stating that the "Indiana bats would probably become extinct within fifteen to twenty years" whether or not the dam is built. The write-up, two and a half pages long, is a good one, in spite of the distress generated in intelligent people by the judge's attitude.

Dr. Beverly Halstead is no longer in Nigeria, having settled at the University of Reading. He sent me a fruit bat dissection guide, which is quite nicely illustrated. No. 3 of the Dissection Guides of Common Tropical Animals, it is entitled "Fruit bat (Eidolon helvum)" and was written by Dr. Halstead and A. O. Segun, with illustrations by Jennifer Middleton. Published by the Ethiope Publishing House, Midwest Mass Communication Corporation, Benin City, Nigeria, 1975, it has 59 pages. I rather wish we had such excellent dissection guides available for American bats, although I hate to encourage such use of our native bats except in the small numbers required for advanced students.

Some bat letterheads:



INSTITUTO DE BIOLOGIA  
LAB. DE MASTOZOLOGIA  
APARTADO POSTAL 70-153  
MEXICO 20, D. F.



PORTABLE APPARATUS FOR OBSERVING HIGH FREQUENCY SOUNDS UNDER NATURAL CONDITIONS  
(Summary of a paper at the Symposium on Bat Research at New Orleans, November, 1973)  
Donald R. Griffin, The Rockefeller University, New York, N.Y. 10021.

Echolocation has not yet been studied under as wide a range of natural conditions as would be highly desirable (Griffin, 1958; Simmons, Howell, and Suga, 1975). Portable apparatus exists which allows direct observation and recording of the principal acoustic properties of ultrasonic orientation sounds, but it is not widely available to those who know bats best and have the most abundant and favorable opportunities to study their behavior and ecology. Experimental analyses of echolocation have tended to be confined to the laboratory, and some physical scientists tend to consider bats solely as furry sonar circuits. This memorandum is intended to provide practical information to zoologists who study bats in the real world where they evolved.

Other small mammals use ultrasonic sounds for communication and sometimes also for echolocation (Sales and Pye, 1974). One is cut off from this aspect of their behavioral ecology unless equipped with suitable instruments to reveal whether or not sounds above the range of human hearing are being emitted, and if so in what situations. Bats and birds often do not survive well enough in captivity to avoid "behavioral distortion" of specialized behavior such as social communication or echolocation. Thus the ideal instrument is one which extends the range of the normal human ear to as high frequencies as possible and with the greatest practicable sensitivity. The primary element is the microphone which converts sound waves into electrical voltages. Unfortunately all microphones have limitations either in the frequency range to which they respond, the range of sound intensities that will produce detectable electric voltages, or both. An important factor is the minimum sound intensity necessary to generate an electrical voltage greater than the internal electrical noise level of the microphone. This is ordinarily proportional to the width of the frequency band to which the device is sensitive. No microphone has at the same time a frequency band wide enough to include the sounds used by all known animals and also an internal noise level low enough to detect all these frequencies at the minimum levels audible to mammalian ears. Greater sensitivity can be obtained by restricting the instrument to a narrow band of frequencies, either at the microphone or, at a later stage in the circuit, by use of band pass filters.

Physical scientists like first to ascertain the frequency of interest and then arrange apparatus sharply tuned to that frequency. But bats usually refuse to play this game; instead they use sounds with a very wide band of frequencies. For instance the typical orientation sounds of the Vespertilionidae sweep during a few milliseconds (thousandths of a second) over at least one octave. An octave centered at 90 kHz encompasses a frequency band four times wider than the entire range of human hearing. No known microphones for ultrasonic sounds have as low internal noise levels as the best audio frequency equipment. One must compromise between bandwidth and sensitivity. Sensitivity is very important to biological studies of echolocation, because under natural conditions it is difficult for the observer to approach close enough to make the best possible measurement. One would like to detect the sounds, if any, emitted by animals during their natural behavior and to do so from as great a distance as possible. The atmospheric absorption increases roughly as the square of the frequency, and while it is not serious at most frequencies audible to human ears, it becomes a major limitation in detecting the orientation sound of bats (Griffin, 1971; Evans et al. 1972).

The best available microphones by far are electrostatic or condenser microphones in which a thin layer of plastic separates two metal surfaces that act as the plates of a condenser. This type of microphone was thoroughly described in a classic paper by Kuhl, Schroeder and Schroeder (1954). These microphones required a DC polarizing voltage of roughly 200 volts. Unfortunately the plastic diaphragms are somewhat delicate and subject to noise generated by high humidities. The most widely used type employs a mylar film only about 6 micra (0.25 mil) in thickness with an evaporated metal film of almost molecular thickness forming the outer metalized surface. It is also unfortunate that this type of microphone is likely to change its sensitivity and frequency response with time. Recently this requirement has been avoided in electret microphones having the plastic permanently polarized (Wintle, 1973; Sessler and West, 1973; Fraim, Murphy and Ferran, 1973; and Madsen, 1973), but unfortunately the electret principle has not yet been applied effectively to microphones sensitive to the ultrasonic frequencies used by bats.

Another important type of ultrasonic microphone uses a thin stretched metal diaphragm separated from the backplate by a very thin layer of air. In practice it is necessary to decrease the diameter of the sensitive surface progressively in order to obtain sensitivity to higher and higher frequencies. The most widely used microphones of this type are manufactured by Bruel and Kjaer of Naerum, Copenhagen, Denmark (U.S. sales agency 5111 West 164th St., Cleveland, Ohio 44142). The one inch diameter size is adequate for most audio frequencies and the internal noise level is quite low (although even this microphone cannot register sounds quite as faint as those to which the human ear is sensitive); its bandwidth is 3 to 18,000 Hz. These microphones are also available in progressively smaller sizes all of which have in turn progressively wider bandwidths: the one-half inch microphone is sensitive from 4 Hz to 40 kHz. Unfortunately the internal noise level of these microphones increases inversely with their size. Using the conventional scale of sound pressure levels in which 0 dB is approximately the minimum sound level audible to the human listener under ideal conditions ( $0.0002 \text{ dyne/cm}^2$  or  $2 \times 10^{-7} \text{ Newton/m}^2$ ), the one inch B & K microphone has an internal noise level low enough to detect sounds of about 10 dB, but the comparable threshold level of detectability increases to 29 dB for the one-half inch, 59 dB for the one-quarter inch, 76 dB for the one-eighth inch microphones of the same type. Those insectivorous bats emitting the most intense orientation sounds achieve levels of 110 dB at the few centimeters from the mouth, but many other species generate only about 60 dB. Thus the smaller B & K microphones are almost useless except under laboratory conditions where the microphone can be brought very close indeed to the animal's mouth. Some compensation can be achieved by using band pass filters to narrow the frequency band after the electrical signal from the microphone has been amplified to a suitable level. But investigators have sometimes erroneously concluded that no ultrasonic sounds were being emitted because their apparatus was either tuned to the wrong frequencies or because it had too high an internal noise level to detect relatively faint components. Bats complicate the investigator's task under some conditions by lowering the intensity of their orientation sounds, so that settings of the apparatus which are adequate under some conditions may be quite inappropriate in other circumstances.

To increase the effective sensitivity the microphone can be placed at the focus of a parabolic reflector. A parabola deflects sound waves arriving parallel to its axis and concentrates them at the focus where they produce a higher local sound intensity. But this procedure suffers from a serious limitation at ultrasonic frequencies because all available microphones are themselves directional, that is, their sensitivity is high only for sounds

arriving along the axis of the microphone itself. At the focus of the customary type of broad, shallow parabolic reflector such a microphone receives most of the deflected sound waves from unfavorable angles. A long, deep parabolic reflector is more effective, and G. W. Pierce used in his pioneering work in the 1930s deep parabolic "horns" approximately eight inches in mouth diameter and about twelve inches deep (Pierce, 1948). The waves deflected by the walls of such a parabola reach the focus, for the most part, nearly along the axis of the microphone. In practice I have found that horns of approximately this size and shape increase the received sound pressure at a microphone by about four or five times (12-14 dB). Sufficient ingenuity and application of well established theory of mirrors might produce something more effective.

The best ultrasonic microphones produce only a few microvolts in response to typical orientation sounds of bats or communication sounds of rodents. But solid state technology now allows amplifiers to be very small and to require very small batteries. But even an amplified ultrasonic signal is useless until displayed in some manner accessible to human senses. The cathode ray oscilloscope is a very useful instrument which, in effect, draws a graph of sound pressure as a function of time (Griffin, 1958). Small, battery operated oscilloscopes such as the Tektronix Model 211 can easily be used in the field. An alternate method is to convert the ultrasonic signal into an audible sound. One can then watch the bat rather than an oscilloscope and more easily correlate what it is doing with patterns of sound emission. Specialists in electronics when asked to produce such a "translator" like to use the heterodyne principle and generate a difference frequency by mixing the ultrasonic frequency with sine waves from a "local oscillator". This is satisfactory when the animal emits a single frequency or a series of frequencies that remain approximately constant for one second or more. G. W. Pierce used heterodyne detectors, and an excellent circuit was described by Pye and Flinn (1964). The Holgate ultrasonic detector is basically similar (available from Holgates of Totton, Southampton, England). Its current cost is approximately \$500, including a plastic dielectric microphone of the type described by Kuhl et al. Unfortunately it suffers from several defects. The unprocessed ultrasonic signal is available but at an inconveniently low level (a few microvolts). Worse still it is often contaminated by a steady high frequency signal. Several individual Holgate instruments have been delivered with wiring not complete. Deeply concealed inside the instrument are eight small high voltage batteries needed to provide the polarizing voltage for the microphone. Not only are they unavailable in the United States, even testing their state is difficult and replacing them even more so. Individual Holgate instruments differ considerably in sensitivity and frequency response. A final flaw, difficult to explain in an instrument this specialized, is the great reluctance of the manufacturer to part with a circuit diagram. Without this maintenance is rendered much more difficult than necessary. I can provide a Xerox copy of this circuit to unfortunate purchasers unable to obtain one from the manufacturer.

Most bats do not cooperate with heterodyne detectors by emitting a single frequency for long enough to produce a clear difference tone. The output then becomes an irregular click. An alternate approach is to use a detecting circuit which converts the envelope of amplitude modulation into an audio frequency. One of the best such instruments are those developed in 1960 by the Lincoln Laboratory of Massachusetts Institute of Technology (McCue and Bertolini, 1964).

More modern components should permit at least a slight improvement in sensitivity, but in comparisons with several other instruments under field conditions as well as in laboratory tests the McCue-Bertolini instruments have so far always had the best sensitivity and been able to detect bats at the greatest distance. Minor improvements in the published circuit of this instrument include more convenient packaging to hold the batteries more securely, different choices of band pass filters. Provision of a separate switch to turn on and off the loudspeaker is especially important when one is using an oscilloscope or other silent device to display ultrasonic signals and wishes to listen with his unaided ears to learn whether or not audible sounds accompany the ultrasonic frequencies.

A few bats such as the Old World families Rhinolophidae and the neotropical Pteronotis parnellii emit long constant frequency orientation sounds and heterodyne detectors are more sensitive than envelope detectors to such sounds. Many other species emit orientation sounds intermediate in frequency pattern. Even some of the Vespertilionidae such as Eptesicus fuscus emit signals part of which has a sufficiently slow frequency sweep that a heterodyne detector does give a brief tone. These variations in pulse patterns seem to be correlated with ecological and behavioral circumstances, but far too little direct observation under natural conditions has yet been carried out.

David Pye, Department of Zoology and Comparative Physiology, Queen Mary College, University of London, London E1 4NS and J. A. Simmons, Department of Psychology, Washington University, St. Louis, Missouri 63130 have developed for their own use instruments which combine the sensitivity of the McCue-Bertolini instrument with heterodyne capability. Those interested are urged to communicate with them directly.

Obviously it is desirable to obtain a permanent record that can be studied later, but only very expensive (roughly ten times the cost of reasonably good audio frequency tape recorders) "instrumentation" tape recorders have yet become available for the frequencies used by many bats (up to 150 kHz). It would be a great service to students of bats if someone would discover how to adapt a \$300 tape recorder to cover the necessary frequency range. As a practical alternative, one can record the audio frequency output of a heterodyne detector or an envelope detector such as the McCue-Bertolini unit.

Several commercial instruments have recently become available to detect the high frequency hissing caused by gas leaking from high pressure tubes. These all use a microphone inherently limited to a very narrow frequency band, commonly about 5 kHz centered around 40 kHz. They are quite sensitive to these frequencies, which fortunately are used by many bats. Hence these leak detectors have been used with at least moderate success to detect, monitor, and count the number of orientation sounds emitted by bats in a given situation (Fenton et al., 1973). While such instruments are certainly better than nothing, there is a serious danger that they may fail to register some orientation sounds, since these are known to change in frequency patterns under different conditions.

#### Behavioral and ecological problems awaiting investigation.

All Microchiroptera seem to use echolocation, but they differ significantly in the degree to which they employ this mode of perception under various conditions. In general the Phyllostomatidae and Emballonuridae seem to use vision and olfaction more, and echolocation less, than the Vespertilionidae and



Molossidae. But this is a crude generalization based on wholly inadequate data. Such ideas urgently require testing and modification through field studies which in turn require the sort of instrumentation discussed above. Shrews seem to have a limited type of echolocation (Gould et al. 1964, Buchler 1972). Do other nocturnal birds or mammals also use echolocation? Field studies with appropriate portable apparatus can help answer this question. Not only the presence but, almost equally important, the absence (or extremely low intensity) of high frequency sounds must be ascertained under appropriate conditions.

What are the relative roles of echolocation and passive listening to sounds generated by insects or other prey? A few scattered observations suffice to show that both processes occur, although echolocation seems to predominate. But this impression may result from inadequate observation, again necessarily under natural conditions. Much can be inferred from temporal patterns in which orientation sounds are emitted. Sharp increases in repetition rate ("buzzes") seem to characterize difficult maneuvers guided by echolocation whether these be landings, drinking on the wing, dodging small obstacles, or pursuing flying insects. It seems logical that passive listening for sounds from prey will involve reduction in the emission of orientation sounds, but in the absence of appropriate field observations we can only speculate about this fundamental question. Communication sounds of small mammals often include, and sometimes are virtually limited to ultrasonic frequencies (Sales and Pye, 1974). Adult laboratory rats, at least those of certain strains, emit ultrasonic calls during courtship and mating behavior. No small mammal had been observed more intensively, and of its full behavioral repertoire courtship and copulation had received enormous attention from psychologists, but until suitable instruments such as those discussed above were employed no one realized that ultrasonic sounds played an important role in their reproductive behavior. What else are we missing in the behavioral ecology of bats and other small mammals?

Identifying species of bats through properties of their orientation sounds is made difficult by the considerable variation in the orientation sounds according to what the bat is doing (cruising, landing, catching insects etc.). More careful studies under natural conditions might improve the situation, and there may be less obvious patterns of orientation sound production which, perhaps together with other observable features such as altitude, flight pattern, time of activity or others not yet discerned could, in combination, prove helpful in identification. We will never know the answers to such questions until field observers try to compare bats' orientation sounds as they have compared other behavioral and ecological characteristics. We should not assume prematurely that all major patterns of sound production and acoustic behavior of bats have yet been discovered. Many significant surprises resulted when much crude apparatus was first taken out-of-doors to study bats under natural conditions. Relatively few such observations have yet been made, considering the variety of bats and their known or suspected behavioral adaptations.

## References

- Buchler, E. (in press) The use of echolocation by the wandering shrew, Sorex vagrans Baird. *Animal Behaviour*.
- Evans, L. B., and Bass, H. E. 1972. Tables of absorption and velocity of sound in still air at 60°F (20°C). Report WR 72-2, Wyle Laboratories, Huntsville, Alabama.
- Evans, L. B., Bass, H.E., and Sutherland, L. C. 1972. Atmospheric absorption of sound: theoretical predictions. *J. Acoust. Soc. Amer.*, 51, 1565-1575.
- Fenton, M. B., Jacobson, S. L., and Stone, R. N. 1973. An automatic ultrasonic sensing system for monitoring the activity of some bats. *Can. J. Zool.*, 51, 291-299.
- Fraim, F. W., Murphy, P. V., and Ferran, R. J. Electrets in miniature microphones. *J. Acoust. Soc. Amer.*, 53, 1601-1608.
- Gould, E., Negus, N. C., and Novick, A. Evidence for echolocation in shrews. *J. Exptl. Zool.*, 156, 19-38.
- Griffin, D. R. 1958. *Listening in the dark*. New Haven, Conn., Yale Univ. Press. (Reprinted by Dover Publications 1974).
- Griffin, D. R. 1958. The importance of atmospheric attenuation for the echolocation of bats (Chiroptera). *Animal Behaviour*, 19, 55-61.
- Kuhl, W. Schodder, G. R., and Schroeder, F. K. 1964. Condenser transmitters and microphones with solid dielectric for airborne ultrasonics. *Acustica*, 4, 519-532.
- Madsen, H. S. 1973. Optimization of a ridge backplate for electret microphones. *J. Acoust. Soc. Amer.*, 53, 1616-1619.
- McCue, J. J. G., and Bertolini, A. 1964. A portable receiver for ultrasonic waves in air. *Trans. Sonics and Ultrasonics Group, Inst. Elec. and Electronic Engineering*, SU-11, 41-49.
- Pierce, G. A. 1948. *The songs of insects*. Cambridge, Mass., Harvard Univ. Press.
- Pye, J. D., and Flinn, M. 1964. Equipment for detecting animal ultrasound. *Ultrasonics*, 2, 23-28.
- Sales, G. and Pye, D. 1974. *Ultrasonic communication by animals*. London, Chapman and Hall.
- Simmons, J. A., Howell, D. J., and Suga, N. 1975. Information content of bat sonar echoes. *Amer. Scientist*, 63, 204-215.
- Wintle, H. J. 1973. Introduction to electrets. *J. Acoust. Soc. Amer.*, 53, 1578-1588.

---

The foregoing discussion of ultrasonic instruments is an update of Dr. Griffin's 1973 comments, and was condensed sufficiently to be included here in BRN. With interest in this field expanding, it seemed appropriate to provide readers with this coverage.

The Cave Research Foundation has awarded a fellowship and a grant of interest to bat workers. A fellowship of \$750 went to Mickey W. Fletcher to support his project, "Microbial Ecology of Bat Guano", and a grant of \$400 was awarded to Barbara J. Martin, University of Illinois at Chicago, for her project, "Cave Communities Around Bat Guano".

SHORT, UNREFEREED NOTE

## FURTHER COMMENTS ON PUNCH-MARKING BATS

Bonnacorso and Smythe (J. Mamm., 53:389-390, 1972) recommended the use of punch-marking for individual identification of bats. They proposed this technique as an alternative to banding with metal bands as banding often results in injury and bats frequently chew bands to the point where they are no longer legible. These authors punched identification numbers into the plagiopatagia of several species of bats using a "Tattoo Outfit" (Western Manufacturing and Supply Co., Denver, Colorado, 80204) equipped with one-quarter inch numbered punches fitted into tongs. Upon healing the holes created by the punch were covered with white scar tissue legible as numbers against the remaining pigmented portions of the membranes. Bonnacorso and Smythe (1972) found no injuries or illegibility in 13 recaptures of 162 marked bats on Barro Colorado Island, Panama. The longest period elapsed between marking and recapture was reported to be 32 days. On the basis of these results these authors suggested using punch-marking on a nationwide scale for identification of bats.

More recently Kleiman and Davis (Bat Res. News, 15:29-30, 1974) reported that punch-marks in a small colony of captive Carollia perspicillata did not last much longer than an average of 53.2 days and that the bats had to be re-marked at least every six weeks. Results on the efficiency of the punch-marking method on free ranging bats, however, have not been reported to date.

I employed the punch-marking technique in a recent study of the social organization and behavior of Pipistrellus nanus helios, a small (3.5 gram) insectivorous vespertilionid, conducted in the field near Kibwezi, Kenya (unpublished data). Bats were punched in the plagiopatagium with two digit numbers beginning in July 1973. The recapture ratio of both sexes for the period from the following September through October was 69.7 per cent (100 marked of 144 taken). The ratio for the next 60 day period (November through December) fell to 40.0 per cent (12 marked of 30 taken). This decrease in the ratio of marked to unmarked bats coincided with the November rainy season and initially led me to believe that movements or other changes within the population had occurred in response to the dramatic climatic shift. Further scrutiny of the membranes of some punched bats, however, showed that the scarred numbers were growing obscure. Many of the "unmarked" bats taken in November and December may have been previously handled individuals with illegible numbers mistaken for scars from natural injuries. The punch-marking technique could have led to improper ecological inferences.

As a result of these findings I instead used colored celluloid split rings (available from A.C. Hughes, Ltd., 1 High Street, Hampton Hill, Middlesex, TW 12 1NA, England). When bats were so marked I also employed the punch-marking technique to document the period of legibility for identification scars. This dual marking procedure was used from January through August 1974. Table 1 shows the percentages of legible punch-marked numbers on recaptured banded P. nanus helios of both sexes over five-week increments. The minimum period elapsed between marking and illegibility was 44 days. The maximum interval between marking and legibility was 91 days. After a minimum of 113 days some individuals had formless scars which were totally impossible to distinguish from old natural wounds because of the irregular entering of pigment around the edges.



The Sigma Xi Grants-in-Aid of Research Awards for 1974-75 and 1975-76 include one to David A. Saugey of Arkansas State University for a study entitled "The reproductive biology of the gray bat, Myotis grisescens, in north-central Arkansas", one to Carl Brandon of the University of Massachusetts for a study entitled "The functional anatomy and flight of the fishing bats and the free-tailed bat", and one to Earl R. Heithaus of Northwestern University for a study entitled "Bat foraging and the evolution of mutualism between neotropical bats and plants".

A normally-colored and an albino Myotis sodalis grace the cover of the September BioScience (Vol. 25, No. 9), thanks to Steve Humphrey, who notes in the cover photo description that summer habitat (riparian vegetation) is destroyed in most impoundment and channelization projects in the Midwest. He also notes that biologists and spelunkers cause winter losses.

On a similar subject, Berton Roueché, whose science writing has won many awards, has written a beautiful though saddening report on the Meramec in the October 27 issue of The New Yorker magazine.

A four page article with excellent color plates is in the October issue of National Geographic World; entitled simply "BATS!", it is dramatically colorful. The one and a half page color photo of a bat with open mouth was distressing to me, as the bat's mouth was full of debris which was obviously the result of the bat's having been dropped with open mouth, and the least the photographer could have done before taking the photo was to help it clean up a bit. The caption notes that it is snarling, and although that seems an unusual form of bat communication, I think I'd snarl if my mouth were full of dirt!

In the article, "Vampire Bats", by Joseph L. Ranft in the September 1974 issue of Americas (Vol. 26, No. 9, pp. 32-35), published by the O.A.S., the major photo of a vampire bat has the legend: "Baring two long incisors,....". The article notes the utilization of the diphenadione anti-coagulant on vampire bats in Nicaragua, Panama, Colombia, Brazil, Honduras, Venezuela, Ecuador, and Mexico. One of the successful ventures sponsored by A.I.D., it has been given widespread publicity and has been made available throughout Latin America.

Art Greenhall provided an article on rabies in bats for La Revue de Médecine (No. 10-11, March 1975, p. 751-753) which provides an excellent review on the subject. The editors, however, felt impelled to provide photographs and some comments on the photographs which do not detract from the paper, but provide a view into the pitfalls of letting non-biologists provide such materials; one depicts Rhinolophus ferrumequinum and then not only refers to it as a fruit-eating bat, but instead of providing the scientific name translates it into "rinolophe fer à cheval" as the name of the bat. Delightful, but improper! Now that I think about it, lots of things that are delightful are improper....

Barbour and Davis' Bats of America, though popular and widely used, has been dropped from the University Press of Kentucky line, which not only makes me unhappy at the loss to the public, but since I gave my two personal copies to foreign correspondents, I now lack my own copy. Anyone out there have a copy they might sell me?

RECENT LITERATURE coverage is promised for the January 1976 issue by Larry Watkins, who is still completing home work.