BAT RESEARCH NEWS

VOLUME 27 No. 1 Spring 1986

BAT RESEARCH NEWS

Volume 27: Numbers 1–4 **1986**

Original Issues Compiled by Dr. G. Roy Horst and Dr. Kunwar P. Bhatnagar, Editors of *Bat Research News* (1986).

Bat Research News is ISSN # 0005-6227.

BAT RESEARCH NEWS

Table of Contents for Volume 27, 1986

Volume 27: Number 1, Spring 1986

Volume 27: Number 2, Summer 1986

Volume 27: Number 3-4, Fall-Winter 1986

BAT RESEARCH NEWS

Publisher and Managing Editor

Dr. G. Roy Horst
Department of Biology
State University College at Potsdam
Potsdam, New York 13676 USA
Tel: 315-267-2259

Editor

Dr. Kunwar P. Bhatnagar
Department of Anatomy
Health Sciences Center
University of Louisville
Louisville, Kentucky 40292 USA
Tel: 502-588-5174

Instructions to Contributors and Subscribers

Bat Research News is published four times per year, each year consisting of one volume of four numbers. Publication dates, Spring, Summer, Autumn, and Winter. *Bat Research News* publishes short papers, general notes, etc., which are rigorously edited and reviewed. Manuscripts dealing with original work should be submitted in triplicate following the latest *CBE Style Manual* or following the style used in Journal of Mammology. In addition, latest news on bat research, correspondence, book reviews, meeting announcements, reports and recent literature citations are included. Communications concerning all these matters should be addressed to Kunwar Bhatnagar.

Subscriptions to individuals are U.S. $10.00 per year mailed 3rd class to U.S. addresses. All other countries, surface mail, printed matter, unless $10.00 per volume is prepaid for airmail 1st class to any address worldwide.

Institutional subscriptions are U.S. $15.00 worldwide.

Communication concerning dues, subscriptions, advertisement rates, or back issues should be addressed to G. Roy Horst.

Typeset by Tracy L. Robertson

Layout by G. Roy Horst

Mailed at Potsdam, New York 13676 USA

BAT RESEARCH NEWS

Vol. 27 Spring 1986 No. 1

CONTENTS

FRONT COVER

The ghost bat, *Macroderma gigas*, from the northern territory of Australia. Photograph by William E. Rainey, courtesy of Dr. Roger Coles and Anna Guppy, Australian National University, Canberra, Australia, and submitted by Elizabeth Pierson.

BAT RESEARCH NEWS

Volume 27 Spring Number 1

Some Comments on Bat Nutrition

Adam Krzanowski
Institute of Zoology, Slawkowska 17, 31-016 Krakow, Poland

Among bats there seems to exist a general inability to synthesize vitamins C and B_{12} (Birney and Jenness, 1978; Jacobsen and du Plessis, 1976). These vitamins are presumably indispensable for bats as they are for other mammals, yet one or other of these essential nutrients is absent from the major diet items of insectivorous and phytophagous bats. This raises the questions: 1) How do bats which are generally considered to be strictly insectivorous satisfy their vitamin C requirements when insects are deficient in this vitamin? and 2) How do phytophagus bats obtain sufficient vitamin B_{12} when plant material does not contain this nutrient? In considering this latter problem, I exclude the Phyllostomidae because most and probably all phytophagus species in this family include insects or other animal matter in their diets.

Because vitamin B_{12} deficiencies can be easily induced in captive *Rousettus aegyptiacus* maintained on a strict all-fruit diet (van der Westhuyzen and Metz, 1984), it seems unlikely that megachiropterans normally obtain vitamin B_{12} through coprophagy or intestinal fauna. This suggests that vitamin B_{12} is normally present in their diets in the wild. An increasing number of reports indicate that insects can occur in the feces or stomachs of megachiropterans and that this group may even occasionally be carnivorous (Lim, 1965; van Deusen, 1968). Although some insect remains in feces may be incidental and not indicative of insectivory (see Thomas, 1984), many of the remains found can only have occurred through ingestion of whole insects. Whether accidental or not, these insects may be an important and possibly the only source of vitamin B_{12}. Jacobsen and du Plessis (1976) have speculated that insects parasitizing fruits might constitute the major dietary source of this vitamin. Use of stagnant water and its associated microfauna may provide an alternate source of B_{12} to bats (Tuttle, 1974).

While animal tissue may satisfy requirements of vitamin B_{12}, its generally contains only trace amounts of vitamin C. On this basis it seems unlikely that any bats are strictly insectivorous. Indeed, the recent literature contains several references to the presence of plant material in the stomachs of "insectivorous" species (Tan, 1965; Whitaker, 1972). The inclusion of plant material in the diets of "insectivorous" species may in fact be more frequent than is commonly assumed. Preconceptions regarding diet regimes may cause plant material to be overlooked or to remain unreported because it is generally assumed that its presence is accidental and of little biological significance. While from a behavioral standpoint deliberate and accidental ingestions of plant material are distinct, from a nutritional perspective the effects are equivalent.

In this I have pointed out two interesting nutritional constraints faced by insectivorous and phytophagous bats which may affect diet choice and specialization. These constraints make it imperative for researchers to pay close attention to some of the rarer items in bat diets.

I express my deepest appreciation to the editor, Dr. Kunwar Bhatnagar for his patience and help. Drs. Don Thomas, M.B. Fenton, J.J. Rasweiler IV, and J.O. Whitaker, Jr. are to be thanked for critical reading and comments on the manuscript. I am also indebted to the three anonymous reviewers for their comments; one of them was especially kind and has rewritten the note. Of course, none of these specialists are responsible for any errors that remain.

Literature Cited

Birney, E.C., and R. Jenness. 1978. Biosynthesis of ascorbic acid by mammals. II. Congr. Theriol. Intern., 20-27 June 1978, Brno, p. 143.

Jacobsen, N.H.G., and E. du Plessis. 1976. Observations on the ecology and biology of the Cape fruit bat *Rousettus aegyptiacus leachi* in the eastern Transvaal. S. Afric. J. Sci., 72: 270-273.

Lim, B.L. 1965. Food and weights of small animals. Sarawak Mus. J., 12: 360-372.

Tan, K.B. 1965. Stomach content of some Borneo mammals. Sarawak Mus. J., 12: 373-385.

Thomas, D.W. 1984. Moth scales in feces of fruit bats: evidence of insectivory or fruit contamination? J. Mamm., 65: 484-485.

Tuttle, M.D. 1974. Unusual drinking behavior of some stenodermine bats. Mammalia, 38: 141-144.

van der Westhuyzen, J., and J. Metz. 1984. Betaine delays the onset of neurological impairment in nitrous-oxide-induced vitamin B-12 deficiency in fruit bats. J. Nutrition, 114: 1106-1111.

van Deusen, H.M. 1968. Carnivorous habits of *Hypsignathus monstrosus*. J. Mamm., 49: 335-336.

Whitaker, J.O., Jr. 1972. Food habits of bats from Indiana. Canad. J. Zool., 50: 877-883.

Received May 16, 1985
Revised and Accepted December 24, 1985

Karl F. Koopman — Mammalogist: A Tribute

J.E. Hill
Department of Zoology, British Museum (Natural History), Cromwell Road, London, SW7 5BD England

Karl F. Koopman was born in April, 1920 in Honolulu, Hawaii, his early years being spent in California, South Carolina and New York. An interest in animal life and a literary and academic home environment led him to Columbia University, whence he graduated in 1943, gaining a Master's degree in 1945 and finally the award of a Doctorate in 1950. His doctoral thesis was based on the genetics of two species of the fruit fly *Drosophila*: its considerable emphasis on the mechanism of speciation pointed to an interest that Karl has since pursued throughout his career.

He began his professional life as an instructor in Biology, first at Middleton Collegiate Center in New York State and later at Queens College, New York. In 1958 Karl became Assistant Curator in Mammalogy at the Academy of Natural Sciences of Philadelphia, moving in 1959 to the Field Museum of Natural History at Chicago. In 1961 he was appointed Assistant Curator of Mammals at the American Museum of Natural History, New York, where he has since remained, becoming Associate Curator in 1966 and Curator in 1978: in 1985 he retired from the formal service of the American Museum and now continues his studies as Curator Emeritus. From the beginning of his career Karl has participated in numerous field expeditions: to Jamaica, the Bahamas and Cuba during 1950–1956; the Virgin Islands in 1962–1965; Mexico, Uruguay and Bolivia during the same period; and to the Lesser Antilles in 1966–1970. He has travelled widely to attend international conferences or more especially to study specimens in other major museums in the United States, Canada, Mexico, South America, in the principal European countries, and in Africa and Australia.

By far the greater part of Karl's research has been concerned with bats, not only of the New World but characteristically in many instances from Old World faunas. Initially he studied the bats of the Caribbean island chains, both fossil and recent; his work in this region culminating in assessments of their past and present distribution. During his early period he also produced contributions to our knowledge of Mexican bats. The move to Chicago, however, and soon after to New York brought wider horizons, and he embarked on the study of the bats of the Sudan that now stands as the definitive work in English of this important part of the African bat fauna, with wide implications for the taxonomy of numerous groups of African bats as a whole. At the same time, he re-assessed the taxa described from central Africa many years before by J.A. Allen as a result of the American Museum Congo Expedition, providing a valuable critique of many named forms that had hitherto proved a source of some difficulty to students of the African bat fauna.

Since then, Karl's interest and enthusiasm for bat systematics has led to a variety of taxonomic papers of various kinds: among these may be mentioned important contributions to the systematics of *Chalinolobus* and *Glauconycteris*; of *Pipistrellus* from Indo-Australia; of *Nycticeius*; and of *Scotophilus*. An enduring interest in distributional and zoogeographical topics has led to studies that range from the recording of range extensions for unusual or apparently rare species to detailed analyses of the bat faunas of Peru, the islands off northeastern New Guinea, of tropical Australia, of the biogeography of South American bats, or to the distributional patterns of the nectar-feeding bats of the New World. Mention must also be made of his contributions to standard texts in mammalogy, especially of the section on the Chiroptera in Anderson & Jones, **Recent Mammals of the World** (1967, 1984) and of the chiropteran part of Honacki et al, **Mammal Species of the World** (1982), which owes its final form largely to his editorial efforts and cosmopolitan knowledge of the subject. His interest in the higher classification of the Chiroptera is evident in the series of articles on the families of bats that appeared recently under his name in the pages of this journal. This brief survey cannot fully indicate the variety and breadth of his work, but nevertheless demonstrates that in Karl the bat world has an enthusiastic and widely knowledgeable contributor to several of the many facets of chiropteran biology.

As a life member of the American Society of Mammalogists, Karl has served and still serves on its Board of Directors and on its Nomenclature, Checklist and Bibliography Committees. He is also a member of the Society of Vertebrate Paleontologists, the Linnaean Society of New York, and the American Nature Conservancy. Within the American Museum of Natural History he has been a member of its Grants, Appointments and Promotions, Library, and Scientific Publications Committees. As an informed and perceptive critic he has contributed reviews of a variety of mammalian publications to a wide range of journals. Thus over the years he has rendered many valuable services to American mammalogy, not least through the broad extent of his interests and knowledge. This, together with his position as a staff member of an important and leading museum, has enabled him to help and guide numerous students of mammalogy and especially of bat systematics, not to mention countless visitors and enquirers, ranging from fellow scientists through the genuinely interested to the merely curious.

In both the extent and quality of his scientific contribution Karl Koopman can with every justification take a leading place among mammalogists of the current generation. His work is often concerned with difficult, obscure topics, or those demanding a long period of patient effort with no immediate result. A mammalogist whose inclinations are toward synthesis and clarification rather than toward analysis, he brings keenly aware and penetrating intellect to bear on the problems that it presents. His published work often illuminates perplexing areas of chiropteran systematics and frequently points toward further fruitful lines of enquiry, and his conclusions are invariably based on the careful examination of specimens and on a detailed survey of literature. Karl is always willing to help others and to offer the benefit of his knowledge and experience, yet defends his point of view vigorously and courteously in discussion. There can be no doubt that as a contributor, counselor and critic he has greatly enhanced American systematic mammalogy during the past three decades.

The history of the Department of Mammalogy at the American Museum of Natural History is illuminated by many famous names: one thinks immediately of J.A. Allen, G.M. Allen, H.E. Anthony and G.H.H. Tate, all of whom worked in the Department or were closely associated with it and who without exception made significant and enduring contributions to the science. Of Karl it must be said that he has fittingly continued and maintained the traditions of original research and scholarship established by his distinguished predecessors.

Received September 11, 1985

An Open Letter to Karl Koopman

Dear Karl,

John Hill's tribute (above) to you is sure to receive heartfelt endorsement by your colleagues everywhere. John has succeeded admirably in giving us a tantalizing glimpse of your life among the chiroptera. It might be of interest to our readers to elaborate just a little on your relationship with this publication and to the Annual Bat Symposia in North America, now in its sixteenth year.

In 1970 at the American Society of Mammalogists' meeting at Texas A and M University, several "bat people" most prominently Jim Findley, Terry Vaughn, Phil Krutzch, this author, and others entertained the idea of a small local meeting "some weekend" where we could concentrate our attention and interest on "just bats." In November of 1970 we convened in Tucson, Arizona for two days of papers, discussions, questions, and yes, even arguments about chiropteran biology. We thoughtlessly did not invite you, since after all, you were 2600 miles away in New York, and could hardly be expected to travel such distances to share our interests. We could not have been more mistaken. You would have been there had you known about our little "Southwestern Symposium on Bat Research." Little did we know how cosmopolitan you were, but happily, you have been to every single one of the following 14 Annual North Symposia since then. Even now you are organizing a special workshop on systematics (see announcements, this issue) for the 16th symposium this October. We know in advance that this will be an interesting and lively session. So far as I can determine you have attended every bat conference of any description anywhere in the world for at least the last 15 years. Conservatively, this adds up to over 150,000 miles (you have come a long way, indeed). In any event, I have many times asked you to forgive that early oversight, and characteristically you have; also very much in character, you regularly and with great glee remind me of how parochial we were back at the beginning.

You have presented a paper at each of the symposia since 1971, and have chaired sessions at most of them. The meetings without you would have been less interesting, less informative, less worthwhile, and less fun. After all, we would not really be duly constituted if you were not there, center aisle, second row, waiting to jump in with, ". . . it seems to me . . ."

In 1977 at the Eighth Symposium in Ottawa, Canada the members of the symposium represented by Jim Findley and James Dale "Smitty" Smith presented you with the Gerrit S. Miller, Jr. Award, "In recognition of outstanding service and contribution to the field of chiropteran biology," an award given since then to only four others: Don Griffin, the late Bill Wimsatt, Brock Fenton, and Tom Kunz; fine company indeed.

You have also been a strong supporter of **BRN**, and have contributed more articles than any other author. You regularly review manuscripts for us, and have been most helpful with the section on recent literature. We appreciate the many occasions when you offered valuable advice and much needed encouragement. If **BRN** has made any progress at all during its 27 years of existance, much credit goes to you for your assistance and support.

Karl, we have all been illuminated by your bright intellect, warmed by your friendship, cheered by your good humor and inspired by your example. We salute your lifetime of achievements in chiroptology and we wish you a happy and enjoyable retirement. Thank you Karl, from all of us, your colleagues in the "bat business."

G.R. Horst

BOOK REVIEW

Kunz, Thomas H. ed., *Ecology of Bats*. Plenum Press, New York, NY. 425 pp., 1982. Price $49.50. (cloth)

Although there have been several edited volumes dealing with research on bats, this is the first volume dealing solely with bat ecology. The vast amount of information it contains demonstrates that the appearance of this book was timely, if not overdue (as is this review). The book does not, and is not intended to, provide a comprehensive treatise on bat ecology. Rather, it provides the most thorough reviews of existing information that are available for selected major topics. Also, for most topics considered, this information is interpreted within the conceptual framework of modern ecological theory, often with specific suggestions as to the information most urgently needed to more fully identify and understand emerging patterns. The topics that are covered in the ten chapters of this book are diverse and reflect the research interests and expertise of their authors, and the editor's intention of limiting redundancy with other recent review articles. Literature citations are at the end of each chapter, and the physical preparation of the book is excellent. In the paragraphs below I provide a brief synopsis of the contents of each chapter.

In his chapter on roosting ecology Thomas Kunz stresses that roosting sites fulfill diverse roles in bat ecology, that the types of roosts selected are at least in part a function of the morphology, physiology, and behavior of the bats using them, and that roost sites impose selective pressures on the bats, influencing morphology, physiology, social structures, reproductive schedules, and many other aspects of behavior. Kunz then considers patterns of roost site use and their interactions with these various aspects of bat biology. Kunz also reviews literature on how bats may alter their roost site environments, with a summary of available information dealing with bats which make their own roost sites ("tents") from large leaves. Rather than attempting a distillation of general patterns or trends, Kunz has chosen to emphasize diversity and the fact that the multiple selective pressures involved in roost site use have resulted in a variety of selective tradeoffs.

Paul Racey outlines the basic patterns of reproductive periodicity observed in temperate zone and tropical bats. He concludes that in temperate latitudes schedules of reproductive events are generally determined by thermal economy and food availability, while in tropical areas the abundance of food resulting from seasonal rainfall is the most important factor responsible for reproductive seasonality. Racey also concludes that reproduction is scheduled, as a rule, so that food peaks coincide with lactation and weaning rather than with pregnancy. Following these generalizations, he reviews literature concerned with the effects of environmental factors on hormones and the schedules of specific events in bat reproduction. There are also sections dealing with thermoregulation and energy budgets during pregnancy and lactation, and on the environmental factors that affect growth and survival of young. In addition to summarizing a large body of research, Racey provides thoughtful and critical interpretation of existing data. The unfortunate fact that most of this chapter deals with temperate zone bats points clearly to the need for much more research on reproduction in tropical species.

The chapter by Merlin D. Tuttle and Diane Stevenson considers growth and survival during the major ontogenetic stages in bat life history. Tuttle and Stevenson's review of information on gestation lengths, synchrony of parturition, and juvenile survival overlap with Racey's treatment of the same topics; however, the major portion of the chapter covers new material. Several themes permeate this chapter. One theme is that most, perhaps all, parameters of growth and survival in bats vary substantially not only between populations and taxa, but even within single populations. The authors emphasize that this variation provides as yet unexploited opportunities for testing hypotheses regarding the ecological factors which influence growth and survival. A second theme is that more data are needed in all areas they consider and that some topics are almost totally uninvestigated. The authors are explicit in pointing to topics that need work. Their compendious literature review (I counted 272 references) and several large summary tables of data make this chapter a valuable source of information.

Brian McNab points to a variety of reasons why the study of bats can contribute greatly to our knowledge of the physiological ecology of endothermy. He then lucidly presents an impressive assemblage of data showing that this is true. A major feature is McNab's emphasis on the influence of food habits on body temperatures, metabolic rates, and thermoregulatory abilities. The chapter also considers the ecological significance of energetics for bats; treating topics such as energy expenditures in temperate and tropical environments, migration, hibernation, daily torpor, the advantages of clustering, and the use of maternity roosts. There is also a section on the value, mechanisms, and pitfalls of constructing energy budgets. McNab speculates on the phylogeny of bat energetics, and discusses the distributional limits of bats in relation to energetics and diet. A short section on water balance serves primarily to point to the need for more work on the subject. McNab's ability to synthesize a large mass of information results in this being a most cohesive and informative chapter. A minor point is McNab's argument that the ability to employ torpor and hibernation correlates with longer life span. This is in contradiction to statements in the same book by Tuttle and Stevenson. Clearly, this is one more topic in need of resolution.

H.G. Erkert's chapter deals with diurnal activity patterns of bats. Erkert summarizes evidence that timing activity within roosts and emergence for foraging correlate with annual light cycles and with daily variation in light intensity. Laboratory studies on a variety of species also indicate that the diurnal activity schedules of bats result from endogenous circadian rhythms that "free-run" in the absence of external cues. Although day-night light cycles should provide a fairly rigid "zeitgerber" for daily activity patterns, there is, nonetheless, considerable variation within and among species in schedules of night-time activity. Erkert considers the importance of temperature (of little importance) and predation (can be important) in accounting for this residual variation. Erkert also identifies a general trend of bimodal night-time foraging activity in insectivorous bats and unimodal activity in frugivorous and nectarivorous species. For me the most striking result of reading this chapter was the realization of how little is apparently known regarding the ecology of night-time activity in bats.

Findley and Wilson propose that information on bat morphology should allow prediction of differences in diet, foraging behavior, and other aspects of community structure. They then review literature on wing morphology, brain size, jaw structure and dentition, and general body morphology which support the idea that form relates to function. They also recall the intuitively pleasing and much tested (with conflicting results) "niche width — variation" hypothesis and review literature, much of it by Findley, Wilson, and their colleagues, which relate morphological diversity of species within bat communities to food habit diversity, overlap in diets, and patterns of species packing. I come away from this chapter having gained much information on several major features of bat functional anatomy, and being sympathetic to (but not convinced of) their basic tenet that many aspects of bat morphology are indicative of community structure.

M.B. Fenton asks whether sympatric species of insectivorous bats partition the prey available to them, and if so how is partitioning effected? He begins with a brief review of the structural features of bat echolocation calls and the types of information bats may obtain from these calls. He also reviews literature on the abilities of insects to hear bat echolocation calls, and the coevolutionary responses of both insects and bats to these abilities. The use by bats of sensory cues other than echolocation calls is also considered. It seems that many bats should have the ability to make fine distinctions among prey types; however, Fenton cautions that possession of these abilities does not demonstrate that they are used to select among prey. Fenton considers various mechanisms by which insectivorous bats could partition food, but concludes that relevant data are so limited as to make conclusions premature. This chapter places clear emphasis on the need for more information, and problems inherent in field studies on foraging by insectivorous bats are made explicit. However, the prognosis for progress is optimistic with hope placed in the arsenal of equipment and techniques that are now available for field research on bats.

T.H. Fleming briefly reviews and compares features of the biology of the two groups of bats (Pteropidae and Phyllostomatidae) which visit plants for food, and points out that most of what we know about foraging by these bats consists of more or less incomplete descriptions of their diets. Detailed descriptions of foraging behavior are available for only a small number of species, and we know very little about the densities, distributions, and daily patterns of resource availability provided by the plants bats visit. However, Fleming provides an excellent review of the information we do have on diet and foraging behavior in plant visiting bats and on the spatial and temporal distributions of their foods. His approach is to summarize this information within the context of contemporary optimal foraging theory. For most of the species studied consideration of the available data in this context may seem premature; however, Fleming is circumspect and I believe his appeal to theory is generally useful for providing focus on the major questions to be answered.

E.R. Heithaus reviews literature on the characteristic of bats and plants, which are symptomatics of bat-plant interactions. He also reviews available information and speculates on the possible ecological consequences of these interactions for both the bats and the plants. In the context of these considerations, Heithaus produces an interpretive and speculative essay on the evolutionary processes which may have resulted in bat-plant mutualisms. In particular, he considers the precedence of flowering plants to bats in the fossil record, the observations that plant-visiting bats do not specialize on particular plant species and that few plants are specialized for visitations by a single bat species, and considers tradeoffs between specialization and flexibility, to question whether mutual dependence between bats and plants are in fact the result of coevolution, rather than results of preadaptations in plants and adaptive responses to these by bats. The reasons why this question is important are made explicit in a chapter that I found to be especially thoughtful and informative.

The final chapter, "the ecology of ectoparasitic insects on bats" by Adrian Marshall is well organized and informative. Marshall defines the groups of insects which are ectoparasitic on bats, gives their ranges and distributions on the bodies of hosts, and provides information on their life histories. He points out that dense infestations of parasites on hosts are usually symptomatic of ill health, rather than being its cause. I was particularly surprised at the apparent lack of any convincing evidence that infestations of ectoparasitic insects actually have pathological effects on their hosts. At the conclusion of his chapter, Marshall provides an appendix on techniques for collecting these parasites.

The **Ecology of Bats** is clearly aimed at professional biologists, though certainly not only those working on bats. The summaries of abundant information on what bats are doing and considerations in all ecological context of why they may be doing it will certainly be of interest to all bat biologists, no matter what their specialty areas may be. However, those whose research focuses on other taxa but who are concerned with general ecological, physiological, or evolutionary principles will also find much in this book that is useful. Given this assessment of the book's primary clientel, I believe its value will be determined, in part, by how well it reviews literature and integrates concepts in bat ecology, and, in greater part, by its effectiveness in stimulating and focusing future advances in research on bats. All chapters review extensive literature, and abound with thoughtful and often specific suggestions for the direction of future work. I believe that this will prove to be a very valuable book.

Gary F. McCracken
Department of Zoology
University of Tennessee
Knoxville, Tennessee 37996 USA

NEWS & VIEWS

HOW MANY UNKNOWN SPECIES ARE YET TO BE DISCOVERED?

Written by Jared M. Diamond, *Nature*, 315: 538-539, 1985, News and Views. Some excerpts:

"No new genus has been found in the United States since 1916 (the last being the doubtfully distinct bat *Idionycteris*) . . ."

"The 20 mammalian orders are represented unequally in the new finds (Table 2). Eleven orders, all of them poor in species, have contributed no new genera, whereas four (rodents, bats, shrews and marsupials) have produced 90 percent of the novelties . . ."

TABLE 2 (excerpted): Newly described genera of living mammals

Order	New genera/total number of species
Rodentia	72/1,752
Chiroptera	26/ 917
Insectivora	11/ 391
Marsupialia	11/ 260

The number of new genera are those described between 1900 and 1983; the total number of species are those found up to 1983.

"Small does not mean unimportant. Recent finds include two mammals so distinct that they had to be placed in new families. One of these, the bumblebee bat (*Craseonycteris*), found in Thailand in 1974, is the smallest known warm-blooded animal (see figure). With a weight of only 2 grams and a length of 3 cm, it challenges physiologists to understand how it reconciles small size with heat conservation."

"Bulmer's fruit bat *Aproteles* was described from 10,000-year-old fossils, then discovered alive in a New Guinea cave, and finally re-exterminated or driven out by hunters, all within the same year."

"The tiny Phillipine babbler *Micromacronus*, although in size no rival to the bumblebee bat, is still one of the smallest songbirds."

"Of the very few species throught extinct and subsequently rediscovered, almost all are now endangered. Man seems to find it much easier to bury species alive than to resurrect them permanently from the dead."

HIGHLIGHTS FROM BATS

Welcome to Mari Murphy, the new editor of **Bats**, the newsletter of Bat Conservation International. The Newsletter issues continue to be artfully produced and contain much useful information some of which is highlighted below:

Vol. 3
March 1986. Lemke, T.O. Marianas fruit bats near extinction. Flying foxes now protected in New South Wales.

Vol. 2
December 1985. Makin, D., and H. Mendelssohn. Insectivorous bats victims of Israeli campaign.
Tuttle, M.D. Joint effort saves vital bat cave.

September 1985. Daniel, M. New Zealand's unique burrowing bats are endangered.
Mayer, F. West Germany's bats in trouble.
Progress in Europe: our members report.

June 1985. Fenton, M.B. Introducing people to bats.
Building better bat houses.
Using live bats for public education.

February 1985. Perkins, M. The plight of *Plecotus*.
Krzanowski, A. Poland's bats in trouble.
Bat preserve in Queensland. Mines and bats.

BUILDING BAT HOUSES

Want to build your own bat house? An interesting article by Jay Heinrichs has appeared in **International Wildlife** (January-February 1986, page 42) complete with a full page of plans. It was developed by Mark Hodgkins, a member of Bat Conservation International (BCI). For more information on building bat houses, write BCI.

AUDUBON ADVENTURES HAS BAT INFO FOR KIDS

Audubon Adventures (Volume 2, no. 2, October-November 1985) has two full pages of Bat Facts and Fiction. Excellent reading for our school-going kids. Such materials are sure to develop their interest in these wooly creatures of darkness.

PROCEEDINGS OF JOINT BAT MEETINGS RECEIVED

Proceedings for the Seventh International Bat Research Conference and the Third European Bat Research Symposium (joint meeting), University of Aberdeen, U.K., August 19-24, 1985, have just been received as published in **Myotis**, 1985-86, vols. 23-24, 256 pp. (Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn, FRG). Compliments to the editors, Drs. H. Roer and Paul Racey for speed of publication as well as excellence in editing. Further details will appear in the next issue of **Bat Research News**.

* * * * *

16th ANNUAL BAT SYMPOSIUM

The Sixteenth Annual North American Symposium on Bat Research will meet on October 17 and 18, 1986 (Friday and Saturday) at the University of Massachusetts, Amherst, Massachusetts. David Klingener of Univ. Mass. will be in charge of local arrangements and Roy Horst will be in charge of program.

The University of Massachusetts is located approximately 90 miles west of Boston. Dr. Klingener will, in due time, provide detailed travel instructions, a description of housing and dining facilities and other pertinent information. He has arranged for our stay at the campus conference center at very reasonable rates.

You will receive a formal call for papers, preregistration materials and other information from Dr. Horst in early June.

If you are interested in other information about the Symposium, please contact G. Roy Horst, Department of Biology, State University College of Arts and Science, Potsdam, N.Y. 13676.

* * * * *

ANNOUNCEMENTS

BAIN DEVELOPS NEW PROSTHESIS

James R. Bain is now a research associate with W.L. Gore Medical Products Division, 1500 N 4th St., Flagstaff, AZ 86002 USA. He has invented and developed a ligament prosthesis which has been implanted in over one thousand humans. The short-term results are promising. James also sent an interesting logo B.A.T.S., of the British Association of Trauma in Sport, which appropriately depicts a bat silhoutte.

NEW ADDRESSES

M. Brock Fenton, Department of Biology, York University, Downsview, Ontario, Canada M3J 1P3, as of July 1, 1986.

Merlin Tuttle and the BCI, Bat Conservation International, Breckenridge Field Laboratory, University of Texas, Austin, TX 78712 USA.

WORKSHOP ON SYSTEMATICS

Individuals interested in participating in a workshop on "Higher Classification of Bats" are invited to submit titles to the undersigned as early as possible. This workshop is being planned as part of the 16th Annual North American Symposium on Bat Research at the University of Massachusetts October 17-18, 1986. Papers concerning the phylogeny and/or classification of bats above the generic level are welcome. It is intended that this special session be devoted to advancing understanding and discussion of the systematics and evolution of the chiroptera. We recognize that some of us hold very strong points of view and have our favorite positions vis-a-vis some aspects of this topic, but let us avoid the polemics and acrimony that occasionally has accompanied this topic earlier. We do welcome broad participation and energetic discussion. I eagerly await your response.

Karl F. Koopman, Department of Mammalogy,
American Museum of Natural History,
New York, New York 10024

ERRATUM

BRN, 26 (4): 1985, page 55:

The authorships of the abstract "Ultrastructure of the pineal . . ." should read as follows:

Kunwar Bhatnagar, Nada Chang, and Emily Merrell.

RECENT LITERATURE

Authors are requested to send reprints of their papers to the editor for inclusion in this section. Receipt of reprints will facilitate complete and correct citation. Our Recent Literature section is based upon several bibliographic sources and for obvious reasons cannot ever be up-to-date. Any error or omission is inadvertent. Voluntary contributions for this section, especially from foreign researchers, are most welcome.

ANATOMY

Beasley, N., M. Graydon and P. Giorgi. 1985. Topography of the retinal ganglion cell layer and choriod in 2 species of flying-foxes (Megachiroptera). Neurosci. Lett., Suppl., 19: S-39 (Abstract; Neuroembryology Lab., School of Anatomy, University of Queensland, St. Lucia, 4067 Australia).

Campbell, M., M. Graydon and P. Giorgi. 1985. Organization of visual centers in the brain of flying-foxes (Megachiroptera). Neurosci. Lett., Suppl. 19: S-48 (Abstract).

Cukierski, M.J. 1985. The effects of extended hibernation and flight on lipid droplets and mitochondrial content in papillary muscles of little brown bats. Anat. Rec., 211: 48 A (Abstract; Anatomy, State University of New York at Buffalo, Buffalo, NY 14214).

Doty, S.B., and E.A. Nunez. 1985. Activation of osteoclasts and the repopulation of bone surfaces following hibernation in the bat, *Myotis lucifugus*. Anat. Rec., 213: 481-495 (Columbia Univ., Department of Anatomy and Cell Biology, New York, NY 10032 USA).

Garfield, R.E., and G.D. Buchanan. 1985. Myometrial innervation during pregnancy in the bat, *Myotis lucifugus*. Anat. Rec., 211: 65 A (Abstract; Department of Neurosciences, Faculty of Health Sciences, McMaster Univ., Hamilton, Ont., Canada).

Griebel, C.P., and N.A. Connors. 1985. A histological study of the digestive tube of hibernating and active little brown bat, *Myotis lucifugus*. Anat. Rec., 211: 73A-74A (Abstract; Anatomy, St. Louis Univ. School of Medicine, St. Louis, MO 63104 USA).

Ishikawa, K., M. Matoba, H. Tanaka and K. Ono. 1985. Anatomical study of the intestine of the insect-feeder bat, *Myotis frater kaquae*. J. Anat., 142: 141-150 (Asahikawa Med. Coll., Dept. of Anatomy, Asahikawa 07811, Japan).

Kobayashi, S., and A. Shimamura. 1984. Scanning electron microscopic study on the bat tongue papillae. 5. Indonesian fruit-eating bats belonging to the family Pteropididae. Acta Anat. Nippon., 59: 418 (Abstract).

Mennone, A., C.J. Phillips and D.E. Pumo. 1985. Possible evolutionary significance of interspecific differences in density of mucosal nerve cells and cholecystokinin (CCK) and secretin-like immunoreactivity in the stomach of three species of bats. Am. Soc., Mammalogists 65th meeting abstracts, 54 (Biology, Hofstra University, Hempstead, NY 11550 USA).

Pettigrew, J.D. 1986. Flying primates? Megabats have the advanced pathway from eye to midbrain. Science, 231: 1304-1306 (Neuroscience Laboratory, Dept. of Physiology and Pharmacology, University of Queensland, St. Lucia, 4067 Australia).

Phillips, C.J., A. Mennone, D.E. Pumo and K.M. Studholme. 1985. Evidence of subepithelial nerve cell bodies in the stomachs of phyllostomid bats. Am. Soc. Mammalogists 65th meeting, 18 (Abstract; Biology, Hofstra University, Hempstead, NY 11550 USA).

Phillips, C.J., and B. Tandler. 1985. Unique salivary gland structure in two genera of tropical bats. Anat. Rec., 211: 152 A (Abstract).

Sood, P.P. 1985. A chemoarchitectural study of telencephalon and diencephalon of a microchiropteran bat (*Taphozous melanopogon* Temminck). Cellular and Molecular Biology, 31: 489- (Saurashtra Univ., Dept. Biosci., Rajkot 360 005, Gujarat, India).

Studholme, K.M., S. Yazulla and C.J. Phillips. 1985. Evolution of the visual system of bats: immunocytochemistry of the neural retina. Am. Soc. Mammalogists 65th meeting abstracts, 41 (Neurobiology and Behav., SUNY Stony Brook, Stony Brook, NY 11794 USA).

Tandler, B., and C.J. Phillips. 1985. Unique salivary gland structure in two genera of bats, *Trachops* and *Megaderma*. Am. Soc. Mammalogists 65th meeting, 18 (Abstract; Oral Biology, School of Dentistry, Case Western Reserve Univ., Cleveland, OH 44106 USA).

Tandler, B., and C.J. Phillips. 1985. Unusual secretory granules in the accessory submandibular gland of long-winged bats. Anat. Rec., 211: 192 A (Abstract).

Zook, J.M., and J.H. Casseday. 1985. Projections from the cochlear nuclei in the mustache bat, *Pteronotus parnellii*. J. Comp. Neur., 237: 307-324 (Reprint J.H. Casseday, Duke Univ., Med. Ctr., Dept. Surgery Otolaryngology, POB 3943, Durham, NC 27710 USA).

BIOCHEMISTRY

McLoughlin, J.L., and R.C. Cantrill. 1986. Nitrous oxide induced vitamin B_{12} deficiency: measurement of methylation reactions in the fruit bat (*Rousettus aegyptiacus*). Intl. J. Biochemistry, 18: 199- (Reprint, R.C. Cantrell, Univ. Witwatersrand, MRC, Brain Metab Res. Grp., Johannesburg 2001, S. Africa).

van der Westhuyzen, J., S. V. Vantonder, J.E. Gibson, T.A. Kilroesmith and J. Metz. 1985. Plasma amino acids and tissue Methionine levels in fruit bats (*Rousettus aegyptiacus*) with nitrous oxide induced vitamin B_{12} deficiency. Br. J. Nutrition, 53: 657-662 (S. African Inst. Med. Res., Sch. Pathology, Dept. of Hematology, POB 1038, Johannesburg 2000, S. Africa).

DISEASE AND PARASITISM

Duszynski, D.W., and L.J. Barkley. 1985. Eimeria from bats of the world: a new species in *Tomopeas ravus* from Peru. J. Parasit., 71: 204-208 (Univ. New Mexico, Dept. Biol., Albuquerque, NM 87131 USA).

Otubanjo, O.A. 1985. *Concinnum epomopis* Sandground, 1937 (Dicrocoeliidae) from the pancreas of the West African fruit bat *Eidolon helvum* in Nigeria. Z. Parasitenk-Parasitol. Res., 71: 485-494 (Univ. Ibadan, Dept. Zoology, Ibadan, Nigeria).

Smith, S.A., and M.E. Clay. 1985. Morphology of the antennae of the bat flea *Myodopsylla insignis* Siphonoptera: Ischnopsyllidae). J. Med. Entomol., 22: 64-71.

Walter, G., and D. Kock. 1985. Records of *Ixodes vespertilionis*, *I. simplex* and *Argas vespertilionis* (Ixodoidea: Ixodidae, Argasidae) from German bats (Chiroptera). Z. Parasitenk-Parasitol. Res., 71: 107-112 (Staatl Museum Nat. Kunde & Vorgeschichte, Damm 40-44, D-2900 Oldenburg, FRG).

DISTRIBUTION

Benzal, J. 1984. Presence of *Nyctalus leisleri* in Gredos, central Spain. Mammalia, 48: 461 (In French; Catedra de Zool. de Vertebrados, Fac. de Biol., Univ. Complutense, Madrid 3, Espagne).

Dinnerstein, E. 1985. First records of *Lasiurus casteneus* and *Antrozous dubiaquercus* from Costa Rica. J. Mamm., 66: 411-412 (c/o Smithsonian/Nepal Terai Ecology Project, National Zoological Park, Washington, DC 20008 USA).

Sanchez, H., C.B. Chavez Tapia, A.N. Garduno, E.C. Corona and M.A.G. Hidalgo. 1985. Notes on distribution and reproduction of bats from coastal regions of Michoacan, Mexico. J. Mamm., 66: 549-553 (Instituto de Biologia, Universidad Nacional Autonoma, Mexico).

Webster, W.D., and W.B. McGillivray. 1984. Additional records of bats from French Guyana. Mammalia, 48: 463-465 (Dept. Biol. Sci., Univ. N.C. Wilmington, Wilmington, NC 28403 USA).

Willig, M.R., and K.W. Selcer. 1985. Factors affecting bat species richness in the New World: a quantitative analysis of diversity patterns. Am. Soc. Mammalogists 65th meeting, 7 (Abstract; Biol. Sci., and the Museum, Texas Tech University, Lubbock, TX 79409 USA).

Wilson, D.E., A.L. Gardner and C.O Handley, Jr. 1985. Comparative abundance of the bats of Barro Colorado Island. Am. Soc. Mammalogists 65th meeting, 6 (Abstract; U.S Fish and Wildlife Service and Smithsonian Institution, Natl. Museum of Nat. Hist., Washington, DC 20560 USA).

Zava, B., and E. Catalano. 1984. On the presence of *Tadarida teniotis* in Sicily, Italy (Chiroptera). Mammalia, 48: 467-469 (Inst. Zoology, Dell'Univ. di Paermo, Via Archirafi 18, Italia).

ECHOLOCATION

Andreeva, N.G., and V.D. Zharskaya. 1984. Connections of superior olivary and inferior collicular neurons responding to amplitude-modulated stimuli by synchronized discharges in bats. Neurophysiology, 16: 615-619 (translated from Russian; A.A. Ukhtonskii Physiol. Res. Inst., Leningrad, USSR).

Andreeva, N.G., and V.D. Zharskaya. 1985. Morphofunctional characteristics of the neurons of the reticular formation responding to acoustic stimulation in the bat *Rhinolophus ferrumequinum*. J. Evol. Biochem. Phys.-Eng., 21: 35-39 (In English).

Fuzessery, Z.M., and G.D. Pollak. 1985. Determinants of sound location selectivity in bat inferior colliculus: a combined dichotic and free-field stimulation study. J. Neurophysiology, 54: 757-781 (Univ. Texas, Dept. Zoology, Austin, TX 78712 USA).

Fuzessery, Z.M., J.J. Wenstrup and G.D. Pollak. 1985. A representation of horizontal sound location in the inferior colliculus of the mustache bat (*Pteronotus p. parnellii*). Hearing Research, 20: 85-90.

Gooler, D.M., and W.E. O'Neill. 1984. Echolocation sounds elicited from the mustached bat by electrical stimulation of a supracallosal region of the brain. Soc. Neurosci. Abstr., 10: 399 (Abstract; Center Brain Res., Univ. Rochester Med. Ctr., Rochester, NY 14642 USA).

Guppy, A., and R. Coles. 1985. Frequency dependence for auditory sensitivity and directionality in the ghost bat *Macroderma gigas*. Neurosci. Lett., Suppl., 19: S 67 (5th meeting of the Australian Neuroscience Soc., Adelaide; Abstract; Acoustic lab., Research School Biological Sciences, Australian National Univ., Canberra, Australia).

Guppy, A., R. Coles and J.D. Pettigrew. 1984. Hearing and vocalization in the Australian ghost bat *Macroderma gigas*. Soc. Neurosci. Abstr. 10: 399.

Henson, O.W., Jr., G. Schuller and M. Vater. 1985. A comparative study of the physiological properties of the inner ear in Doppler shift compensating bats (*Rhinolophus rouxi* and *Pteronotis parnellii*). J. Comp. Physiol., A, 157: 587-598 (Univ. of North Carolina, Dept. of Anatomy, Chapel Hill, NC 27514 USA)

Kossl, M., and M. Vater. 1985. Evoked acoustic emisions and cochlear microphonics in the mustache bat, *Pteronotus parnellii*. Hearing Research, 19: 157-170 (Univ. Munich, Inst. Zoology, Luisentr. 14, D-8000 Munich 2, FRG).

Kossl, M., and M. Vater. 1985. The cochlear frequency map of the mustache bat, *Pteronotus parnellii*. J. Comp. Physiol., A, 157: 687-698.

Melzer, P. 1985. A deoxyglucose study on auditory responses in the bat *Rhinolophus rouxi*. Brain Res. Bull., 15: 677- (Univ. Arizona, College of Medicine, Dept. Pediatrics, Tucson, AZ 85721 USA).

Movchan, E.V. 1984. Role of auditory centers in echolocation tracking of a moving target by greater horseshoe bat. Neurophysiology, 16: 559-565 (translated from Russian; A.A. Ukhtomskii Physiol. Res. Inst., Leningrad, USSR).

O'Neill, W.E. 1985. Responses to pure tones and linear FM components of the CF-FM biosonar signal by single units in the inferior colliculus of the mustached bat. J. Comp. Physiol., A, 157: 797-816 (Univ. Rochester Med. Ctr., Crt. Brain Res., Rochester, NY 14642 USA).

Roverud, R.C., and A.D. Grinell. 1985. Discrimination performance and echolocation signal integration requirements for target detection and distance determination in the CF/FM bat, *Noctilio albiventris*. J. Comp. Physiol., A, 156: 447-456 (Univ. Munich, Inst. Zoology, Luisenstr. 14, D-8000 Munich 2, FRG).

Roverud, R.C., and A.D. Grinell. 1985. Echolocation sound features processed to provide distance information in the CF/FM bat, *Noctilio albiventris*: evidence for a gated time window utilizing both CF and FM components. J. Comp. Physiol., A, 156: 457-470.

Roverud, R.C., and A.D. Grinell. 1985. Frequency tracking and doppler shift compensation in response to an artificial CF/FM echolocation sound in the CF/FM bat, *Noctilio albiventris*. J. Comp. Physiol., A, 156: 471-476.

Schnitzler, H.-U., H. Hackbarth, U. Heilmann and H. Herbert. 1985. Echolocation behavior of rufous horseshoe bats hunting for insects in the flycatcher-style. J. Comp. Physiol., A, 157: 39-46 (Univ. Tubingen, Inst. Biology 3, Lehrstuhl Zoophysiol., D-7400 Tubingen 1, FRG).

Simmons, J.A. 1985. Perceptual functions of cortical neural maps of target range in echolocating bats. Soc. Neurosci. Abstr., 10: 399 (Inst. Neuroscience, Univ. Oregon, Eugene, OR 97403 USA).

Surlykke, A., and L.A. Miller. 1985. The influence of arctiid moth clicks on bat echolocation; jamming or warning? J. Comp. Physiol., A, 156: 831-843 (Odense Univ., Inst. Biology, DK-5230 Odense M, Denmark).

ECOLOGY

Bain, J.R., and S.R. Humphrey. 1986. Social organization and biased primary sex ratio of the evening bat, *Nycticeius humeralis*. Florida Scientist, 49: 22-31 (W.L. Gore & Assoc., Inc., 1500 N. Fourth Street, Flagstaff, AZ 86001 USA).

Barclay, R.M.R. 1985. Long-versus short-range foraging foraging strategies of hoary (*Lasiurus cinereus*) and silver-haired (*Lasionycteris noctivigans*) bats and the consequences for prey selection. Can. J. Zool., 63: 2507-2515 (Univ. Calgary, Dept. Biology, Calgary, Alberta, Canada T2N 1N4).

Brack, V., Jr., and R.K. LaVal. 1985. Food habits of the Indiana bat in Missouri. J. Mamm., 66: 308-315 (WAPORA Inc., 511 Old Lancaster Road, Berwyn, PA 19312 USA).

Fenton, M.B., R.M. Brigham, A.M. Mills and I.L. Rautenbach. 1985. The roosting and foraging areas of *Epomophorus wahlbergi* (Pteropididae) and *Scotophilus viridis* (Vespertilionidae) in Kruger National Park, South Africa. J. Mamm., 66: 461-468 (Biology, Carleton Univ., Ottawa K1S 5B6, Canada).

Fors, K. 1984. Foxtail *Setaria viridis* entangles bat. Trans. Kans. Acad. Sci., 87: 68 (Museum High Plains, Fort Hays State Univ., Hays, Kansas 67601 USA).

Gerell, R. 1985. Tests of boxes for bats. Nyctalus (N.F.), 2: 181-185 (Dept. of Animal Ecology, Ecology Building, S-223 62 Lund, Sweden).

Griffith, L.A., and J.E. Gates. 1985. Food habits of cave-dwelling bats in the central Appalachians. J. Mamm., 66: 451-460 (Appalachian Environmental Lab., Center for Environmental and Estuarine Studies, Univ. of Maryland, Frostburg, MD 21532 USA).

Rodrigues-Doran, A., and A.R. Lewis. 1985. Feeding ecology of three species of bats from western Puerto Rico. Am. Soc. Mammalogists 65th meeting abstracts, 46 (Biological Sciences, Boston Univ., Boston, MA 02215 USA).

Timm, R.M. 1985. Predation by squirrel monkeys and double-toothed kits on tent-making bats. Am. Soc. Mammalogists 65th meeting abstracts 49 (Mammals, Field Museum of Natural History, Chicago, IL 60605-2496 USA).

Tuttle, M.D., M.J. Ryan and J.J. Belwood. 1985. Acoustical resource partitioning by 2 species of phyllostomid bats (*Trachops cirrhosus* and *Tonatia sylvicola*). Anim. Behav., 33: 1369-1370 (Reprint: M.J. Ryan, Univ. Texas, Dept. Zoology, Austin, TX 78712 USA).

Ward, D.W. 1983. Relationship between location of *Antridesmus* sp., a millipede and bat guano density. Trans. Mo. Acad. Sci., 17: 208 (Abstract; Central Missouri State Univ., 131 B Nickerson, Warrensburg, MO 64093 USA).

EVOLUTION AND GENETICS

Svoboda, P., J.R. Choate and R.K. Chesser. 1985. Genetic relationships among southwestern populations of the Brazilian free-tailed bat. J. Mamm., 66: 444-450 (Museum of the High Plains, Fort Hays State Univ., Hays, KS 67601 USA).

FOSSIL RECORD

Legendre, S., and B. Sige. 1983. La place du "Vespertilion de Montmarte" dans l'histoire des chiropteres molossides. in E. Buffetaut, J.M. Mazin and E. Salmon (eds.): actes du symposium paleontologique, G. Cuvier, Montbeliard, pp. 347-361 (In French, English summary; Institut des Sciences de l'Evolution, U.S. T.L., Place Eugene Bataillon, F-34060 Montpellier Cedex, France).

Sabatier, M. and S. Legendre. 1985. Une faune a rongeurs et chiropteres plio-pleistocenes de Madagascar. Actes du 110^{e} Congres National des Societes Savantes, Montpellier, 1985. Sciences, fasc. VI, p. 21-28 (In French, English summary).

Sige, B. 1985. Les chiropteres oligocenes du Fayum, Egypte. Geologica et Palaeontologica, 19: 161-189 (In French, English summary).

KARYOLOGY

Baker, R.J., M.W. Haiduk, K. Nelson, M. Qumsiyeh and R. Bass. 1985. Implications of homologous biarmed chromosomes in the karyotypes of different subfamilies of Phyllostomidae. Am. Socy. Mammalogists 65th meeting abstracts, page 41 (The Museum, Texas Tech Univ., Lubbock, TX 79409 USA).

Harada, M., S. Yenbutra, K. Tsuchiya and S. Takada. 1985. Karyotypes of seven species of bats from Thailand (Chiroptera, Mammalia). Experientia, 41: 1610-1612 (Osaka City, Univ. Sch. Med., Exptl. Anim. Lab., Osaka 545, Japan).

Harada, M., S. Yenbutra, I.H. Yosida and S. Takada. 1985. Cytogenetical study of *Rhinolophus* bats (Chiroptera, Mammalia) from Thailand. Proc. Jpn. Acad., B, 61: 455-.

Qumsiyeh, M.B. and R.J. Baker. 1985. G- and C-banded karyotypes of the Rhinopomatidae (Microchiroptera). J. Mamm., 66: 541-544 (Biological Scs. and the Museum, Texas Tech Univ., Lubbock, TX 79409 USA).

Tucker, P.K. 1985. Sex chromosome-autosome translocations in phyllostomid bats and mammalian sex chromosome evolution. Am. Socy. Mammalogists 65th meeting, page 24 (Abstract; Wildlife and Fisheries Sciences, Texas A & M Univ., College Station, TX 77843 USA).

Volleth, M. 1985. Chromosomal homologies of the genera *Vespertilio*, *Plecotus* and *Barbastella* (Chiroptera, Vespertilionidae). Genetica, 66: 231- (Inst. Human Genet., Schwabachanlage 10, D-8520 Erlangen, West Germany).

PHYSIOLOGY

Andreeva, N.G., A.G. Vasilev and E.P. Vinogradova. 1984. Species characteristics of electrical activity of the inferior colliculi. J. Evolutionary Biochemistry & Physiology, 20: 345-349 (translated in English from Russian; A.A. Ukhtomskii, Physiol. Inst., Leningrad, USSR).

Bassett, J.E., C.A. Wiederhielm and R.D. Hogan. 1985. Interspecific comparison of subcutaneous tissue fluid pressure in the bat wing. Microvascular Res., 30: 75-79 (Univ. Washington, Dept. Physiol. & Biophy., Microcirculation Lab, SJ-40, Seattle, WA 98195 USA).

Beasley, L.J., and M. Leon. 1986. Metabolic strategies of pallid bats (*Antrozous pallidus*) during reproduction. Physiol. Behav., 36: 159-166 (University of California Irvine, Dept. Psychobiology, Irvine, CA 92717 USA).

Fleming, B.P., and M.E. McKinney. 1985. Andrenergetic innervation in the microcirculation of the bat wing. Microvascular Res., 29: 387-400 (Louisiana State Univ., Med. Ctr., Dept. Physiol. & Biophy., Shreveport, LA 71130 USA).

Genoud, M., and F.J. Bonaccorso. 1986. Temperature regulation, rate of metabolism and roost temperature in the greater white-lined bat . . . . Physiological Zoology (in press).

Joshi, D., and M.K. Chandrashekaran. 1985. Spectral sensitivity of the photoreceptors responsible for phase shifting the circadian rhythm of activity in the bat, *Hipposideros speoris*. J. Comp. Physiol., A, 156: 189-198 (Madurai Kamaraj Univ., DST, Neurobiology & Mechanisms Behav. Unit, Madurai 625 021, Tamil Nadu, India).

Kurta, A. 1985. Bats as mammalian hummingbirds: effects of limited foraging success on thermoregulation and metabolic rate in the little brown bat (*Myotis lucifugus*). Am. Socy. Mammalogists 65th meeting abstracts, page 10 (Biology, Boston Univ., MA 02215 USA).

O'Shea, J.E., and B.K. Evans. 1985. Innervation of bat heart: cholinergic and adrenergic nerves innervate all chambers. Am. J. Physiol., 249: H876-882 (Univ. Melbourne, Dept. Zoology, Parkville VI c.3052 Australia).

Rayner, J.M.V., and H.D.J.N. Aldridge. 1985. Three-dimensional reconstruction of animal flight paths and the turning flight of microchiropteran bats. J. Exptl. Biol., 118: 247-266 (Univ. Bristol, Dept. Zoology, Woodland Road, Bristol BS8 1UG, Avon, England).

REPRODUCTION

Chricton, E.G., and P.H. Krutzsch. 1985. Reproductive biology of the female leaf-nosed bat, *Macrotus californicus*, in southwestern United States: I.A. morphometric analysis of the annual ovarian cycle. Am. J. Anat., 173: 69-88 (Univ. Adelaide, Dept. Anatomy & Histol., POB 498, Adelaide, SA 5001 Australia).

Karim, K.B., and S. Banerjee. 1985. Storage of spermatozoa in the epididymis of the tropical bat, *Rhinopoma hardwickei hardwickei* (Gray). Anat. Rec., 211: 95A (Abstract; Zoology, Institute of Science, Nagpur 440 001, Maharashtra, India).

SYSTEMATICS

Diamond, J.M. 1985. How many unknown species are yet to be discovered? News & Views. Nature, 315: 538-539 (Univ. of California Med. Sch., Los Angeles, CA 90024 USA).

Griffiths, T.A. 1985. Molar cusp patterns in the bat genus *Brachyphylla*: some functional and systematic observations. J. Mamm., 66: 544-549 (Biology, Illinois Wesleyan Univ., Bloomington, IL 61701 USA).

Hood, C.S. 1985. Phylogenetic relationships of the Old World nectar-feeding bats (Pteropodidae: Macroglossinae) based on features of the female reproductive tract. Am. Socy. Mammalogists, 65th meeting abstracts, page 3 (Biological Scs., and the Museum, Texas Tech Univ., Lubbock, TX 79409 USA).

VIROLOGY

Lentz, T.L. 1985. Rabies virus receptors. Trends in Neurosciences, 8: 360-363 (Yale Univ. Sch. Med., Dept. Cell Biology, 333 Cedar St., POB 3333, New Haven, CT 06510 USA).

THESES, DISSERTATIONS

Brack, V.W. 1984. The nonhibernating ecology of bats in Indiana with emphasis on the endangered bat, *Myotis sodalis*. Diss. Abstr. Int., B, Schi. Eng., 44: 3586-3587.

BOOKS ABOUT BATS

FOR ADULTS

Bats of America
A great bat book; life history and identification ofbats all over the U.S. Many illustrations in B&W and color. By Roger W. Barbour and Wayne H. Davis, 286pp. 1969, hb. **$35.00**

Cave Fauna of North America
Reprinted from the memoirs of the National Academy of Sciences, Vol. 4, Part 1, 1888. For those interested in the history of cave biology. By A.S. Packard, 155pp. hb. **$16.00**

Bats: A Natural History
This book will appeal to amateur naturalist and conservationalist, as well as scientists and professional zoologists. By John E. Hill and James D. Smith, 248pp. 1984, hb. **$25.00**

Ecology of Bats
10 chapters, each by a different well-known author. Includes Reproduction, Roosting Ecology, Growth and Survival, Plant-visiting Bats, Bat Parasites, and more. Edited by Thomas Kunz, 425pp. 1982, hb. **$49.50**

The Lives of Bats
A wide-range book including breeding, feeding, physiology, aerodynamics, and more. By Wilfred Schober, 212pp. 175 illus., 1984, hb. **$25.00**

What About Bats?
A great introduction to bats for both children and adults. By James K. Baker, 60pp. 1979, pb. **$1.50**

Bats and Public Health
This book is valuable for its bibliography as well as its general health information. By Merlin Tuttle and Stephen J. Kern, 11pp. 1981, pb. **$1.00**

Just Bats
An illustrated view of bats for a general audience. By M. Brock Fenton, 165pp. 1983, pb. **$10.00**

The Vampire Bat
The first comprehensive study of the interaction between vampire bats and their principal prey, the cow, at one location. By Dennis C. Turner, 145pp. 1975, hb, no/dj. **$10.00**

Cave Life of Oklahoma
Special issue of the Oklahoma Underground. A complete study which could serve as a guide for speleologists working on similar projects. By Jeffrey Black, 59pp. 1971, pb. **$5.00**

The Bat
A great B&W picture book of bats. The text is mostly identification of the species shown. By Nina Leen, 78pp. 1976, hb. **$7.50**

The Greater Horseshoe Bat
43 pages of great photos and simple but interesting text. A good conservation message at the end. By Roger Ransome, 1980, hb. **$5.00**

House Bat Management
Hints on how to "de-bat" and "bat-proof" a house. By Arthur Greenhall, 33pp., 30 illus. 1982, pb. **$6.00**

Cave Life: Evolution and Ecology
A technical study of cave populations including mathematical models of genetic and ecological communities. Deals very little with bats. By David Culver, 189pp. 1982, hb. **$25.00**

Photographing Bats: At Carlsbad Caverns National Park
A full-color flyer by Ronald C. Kerbo. 2pp. 1985. **$.50**

Communication in the Chiroptera
Reviews the available information on communication in bats including apparatus for sending and receiving signals. By M. Brock Fenton, 161pp. 1985, hb. **$35.00**

Bats
A British general information book that "sets the record straight about bats." This includes information on what the British have done to protect bats. By Phil Richardson, illustrated with drawings by Gary Troughton, 128pp. 1985, hb. **$10.00**

Vertebrate Flight — A Bibiolography
Over 2500 references on all aspects of flight in vertebrates. The most detailed coverage is given to flight in birds and bats. By J.M.V. Rayner, 200pp. 1985, pb. **$14.00**

FOR CHILDREN

I Can Read About Bats
A simple view of bats with quite a bit of information. By Elizabeth Warren, 42pp. 1975, pb. **$1.50**

Bats in the Dark
A "Let's-read-and-find-out" science book. A very basic book on bats for K to 3. By John Kaufman, 33 pp. 1972, library bound, hb. **$10.50**

Bats, The Night Fliers
A scientific book for kids 8 to 10. Mostly text with a few sketches. By Anabel Dean, 56pp. 1974, hb. **$6.00**

Vampire Bat
Written for 3rd to 6th grade but I learned a lot. By Lawrence Pringle, 62pp. 1982, hb. **$9.50**

Bats
From the "not so awful creatures" series. A humorous look at "Biff the Bat" who is "Wanted Dead or Alive for biting people and sucking blood." Exposes misconceptions for 3rd graders. By George Shea, 40pp. 1977, pb. **$4.00**

Bats in the Night
A beginning bat book which explains bats in simple but detailed terms. Includes identification information on 12 species. Grades 3-6. By George Laycock, 69pp. 1981, hb. **$10.00**

Billions of Bats
Includes information on the Vampire, the Little Flying Cow, Fisherman Bat, giants of the bat world and more. By Miriam Schlein, 56pp. 1982, hb. **$9.50**

Bats
A very good first bat book for kids. Stresses conservation and importance to man. Illus. with B&W photos by Merlin Tuttle. By Alice L. Hopf, 64pp. 1985, hb. **$8.50**

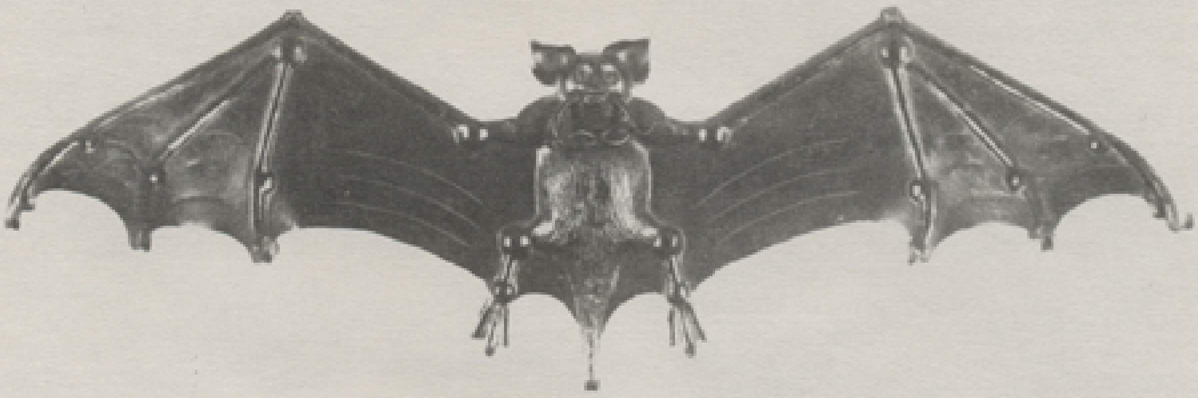
Know-It-All-Library Bats
Facinating facts about bats for 1st grade to 3rd grade kids. By Joanna Foley, 24pp. 1982, pb **$1.00**

What's in the Cave
A lift-the-flap pop-up book for those with a good sense of humor. Kids and adults will love this book because in the cave are a fat bat, a lazy lizard, and a big surprise. 8 pop-up animals. By Peter Seymour, 1985, hb. **$7.75**

* * * * *

The titles listed on this page can be purchased from:
Speleobooks
Emily Davis Mobley
P.O. Box 10
Schoharie, NY 12157
N.Y. State residents add 7% sales tax. All orders add $1.50 mailing costs for first book, $.50 for each additional item.
Send a card or letter for free catalogue covering many rare bat books, prints, bat toys and other "bat paraphernalia."

BAT RESEARCH NEWS



VOLUME 27 No. 2 Summer 1986

BAT RESEARCH NEWS

Instructions to Contributors and Subscribers

Bat Research News is published four times per year, each year consisting of one volume of four numbers. Publication dates, Spring, Summer, Autumn, and Winter. *Bat Research News* publishes short papers, general notes, etc., which are rigorously edited and reviewed. Manuscripts dealing with original work should be submitted in triplicate following the latest *CBE Style Manual* or following the style used in Journal of Mammology. In addition, latest news on bat research, correspondence, book reviews, meeting announcements, reports and recent literature citations are included. Communications concerning all these matters should be addressed to Kunwar Bhatnagar.

Subscriptions to individuals are U.S. $10.00 per year mailed 3rd class to U.S. addresses. All other countries, surface mail, printed matter, unless $10.00 per volume is prepaid for airmail 1st class to any address worldwide.

Institutional subscriptions are U.S. $15.00 worldwide.

Communication concerning dues, subscriptions, advertisement rates, or back issues should be addressed to G. Roy Horst.

Typeset by Tracy L. Robertson

Layout by G. Roy Horst

Mailed at Potsdam, New York 13676 USA

BAT RESEARCH NEWS

Vol. 27 Summer 1986 No. 2

CONTENTS

FRONT COVER

Original artefact stamped out of iron. It was said to be a keyholder for a small hotel and is equipped with 13 hooks for holding keys. It may, therefore, be more than just a coincidence that this iron bat measures 13 inches, wingtip to wingtip. Photograph requested from the owner of the artefact, Dr. Frank C. Kallen, State University of New York at Buffalo. More details see page 15.

BAT RESEARCH NEWS

Volume 27 | Summer | Number 2

A Case of Superfetation in the Indian Fruit Bat, *Rousettus Leschenaulti* (Desmarest)

K.B. Karim and Neelima Gupta
Department of Zoology, Institute of Science, Nagpur 440 001, India

Earlier studies on *Rousettus leschenaulti* from Aurangabad, India (Gopalakrishna and Choudhary, 1977) and our observations on this species collected from an abandoned manganese mine tunnel at Kandri, Ramtek, near Nagpur, India have shown that this bat experiences two pregnancies in quick succession in the year. The first pregnancy commences in the second week of November and terminates in the middle of March. The second pregnancy starts soon after parturition and goes until the last week of July. Gestation lasts for about 125 days. During each pregnancy only one uterine cornu bears a single embryo. While collecting *Rousettus leschenaulti* from Kandri, out of 41 females collected during 1984-85, on 1st March 1985 we came across a female which had an embryo in each of the uterine cornu (Fig. 1), a situation hitherto unreported for *Rousettus*. The female weighed 100 gms. Further, the embryo in the right uterine cornu was considerably larger in size than the one on the left and so was the placental disc. From the size of the embryos and from the earlier records on the breeding habits of this species and our own observations (a newborn bat was first noticed in this colony on 13th March 1984) one could conclude that the embryo in the right cornu would have been delivered in about two weeks time. Both the embryos were male. Histological examination of the two ovaries revealed the presence of a corpus luteum in each ovary indicating that both the ovaries had released an ovum. Gopalakrishna (1964) has shown that the corpus luteum in the ovary of the first breeding cycle remains throughout the period of gestation and persists after parturition until about the middle of the following pregnancy. From the different sizes of the two embryos it appears that the smaller fetus was actually conceived well after the larger and hence this represents a case of superfetation in *Rousettus*.

Observations of female bats carrying two conceptuses at different developmental stages have been reported for *Megaderma lyra* (Ramaswami and Anand Kumar, 1963), *Rhinolophus rouxi* (Gopalakrishna and Ramakrishna, 1977), *Carollia* (de Bonilla and Rasweiler, 1974) and *Peropteryx kappleri* (Rasweiler, 1982). Superfetation has also been recorded for other mammals (Deanesly, 1966).

The occasional occurrence of superfetation in bats probably creates problems for the females in which it occurs, since it seems unlikely that both fetuses could be carried to term and successfully delivered. It has been suggested, however, that continued folliculogenesis during pregnancy on the non-gravid side of the reproductive tract may be advantageous to some bats since, in the event of a reproductive failure, this might enable them to quickly establish a new pregnancy on that side (Rasweiler, 1982).

The authors are most grateful to Dr. John J. Rasweiler IV, Cornell Medical Center, New York, USA for critically reading the manuscript and for providing very helpful suggestions.

Literature Cited

Bonilla, H. de and J.J. Rasweiler IV. 1974. Breeding activity, preimplantation development, and oviduct histilogy of the short-tailed fruit bat, *Carollia*, in captivity. Anat. Rec., 179: 383-404.

Deanesly, R. 1966. The endocrinology of pregnancy and foetal life. IN: Marshall's Physiology of Reproduc-

tion. Vol. III. A.S. Parkes, ed. Longman's Green and Co., Ltd., London, pp. 918-919.
Gopalakrishna, A. 1964. Unusual persistence of the corpus luteum in the Indian fruit bat, *Rousettus leschenaulti* (Desmarest). Curr. Sci., 38: 388-389.
Gopalakrishna, A. and P.N. Choudhary. 1977. Breeding habits and associated phenomena in some Indian bats. Part I — *Rousettus leschenaulti* (Desmarest) — Megachiroptera. J. Bombay Nat. Hist. Soc., India, 74: 1-16.
Gopalakrishna, A. and P.A. Ramakrishna. 1977. Some reproductive anomalies in the Indian rufus horse-shoe bat, *Rhinolophus rouxi* (Temminck). Curr. Sci., 46: 767-770.
Ramaswami, L.S. and T.C. Anand Kumar. 1963. Differential implantation of twin blastocysts in Megaderma (Microchiroptera). Experientia, 19: 641-642.
Rasweiler, J.J. IV. 1982. The contribution of observations on early pregnancy on the little sac-winged nat, *Peropteryx kappleri* to an understanding of the evolution of reproductive mechanisms in monovular bats. Biol. Reprod., 27: 681-702.

Received June 20, 1985
Revised and Accepted February 17, 1986

* * * * *

BOOK REVIEW

Jurgen Gebhard, *Unsere Fledermause*. Basel: Naturhistorisches Museum 1985. 56 pp. An identical edition by the title "Nos chauves-souris" is also available in French. SFr.5. Second edition.

An important objective of any natural science book at the popular level should be to call attention to the intrinsic value of animal life, to stimulate the interest of a large audience and to give scientifically valid information. In this sense, Jurgen Gebhard's *Unsere Fledermause* (our bats) is certainly an excellent publication.

The author wants to demystify bats and at the same time to show that they are animals with amazing abilities worth understanding and species to be protected. Although the booklet is addressed primarily to a Swiss audience, the species described are common over most of Europe.

After a short introduction to the taxonomic position, the author describes particularities of their morphology, locomotion and sensory capacities with the usual emphasis on echolocation. The description of the variety of habitats, roosting places and foraging strategies introduces the reader to the interesting problems of the behavioral ecology of insectivorous bats. Chapters on behavior, migration, hibernation and reproduction complete the first section on the biology of insectivorous bats. In the small but very significant chapter on predation, the author shows the impact of humans on bat survival. In the following chapter, each of the 28 recorded species in Switzerland is briefly described by its external morphological features which are easy to recognize, its distribution, habitat and roost, its behavioral and ecological adaptations, reproductive data and foraging strategies.

The last chapters contain practical hints for the amateur naturalist on how to observe and, most important, how to protect bats. The author does not try to convince by doubtful anthropocentric arguments concerning the utility of bats. His arguments are by no means apologetic. He simply says what has to be done to save bats.

This well-written booklet of only 56 pages is presented in a clear and popular style adequately illustrated by informative photographs, many in color, and is therefore likely to appeal to a wide range of people interested in knowing what bats are all about. English-speaking people would certainly wait to see this booklet appear in an edition they can readily follow.

Georg Baron
Departement des Sciences Biologiques
Universite de Montreal
C.P. 6128 "A"
Montreal H3C 3J7, Canada
Received November 26, 1985

* * * * *

NEWS & VIEWS

FOURTH EUROPEAN BAT RESEARCH SYMPOSIUM
Prague, Czechoslovakia
August 21-26, 1987

PRELIMINARY ANNOUNCEMENT

According to suggestions made at the previous meeting of the European Bat Research Organisation, the 4th European Bat Research Symposium will be organized in Prague, Czechoslovakia in August 21-26, 1987. The symposium will be arranged in a simple form — i.e. with oral presentations on a plenary session, poster exhibition and parallel evening discussions. A one- or two-day excursion is planned in Southern Bohemia; a special sight-seeing program may be arranged for accompanying members during the Symposium by Cedok travel agency. Topics of the papers are not strictly delimited but a few leading themes will be proposed to stress the interdisciplinary approaches in bat study.

The Symposium will be held in the Historical Hall of Charles University situated in the centre of the town. Accommodation in hotels is possible; however, we suggest a less expensive alternative in a nicely equipped student hostel. Prices are 127 kcs or 28 DM for a single and 218 Kcs or 48 DM for a double room per night. A Symposium fee of 200 Kcs or 45 DM has been imposed to cover printing, mailing and other expenses. The organizers are looking for ways to reduce the participants' expenses, particularly for students, unemployed colleagues, etc.

All who are interested in the study of bats are welcome to attend the Prague meeting. The final application form and more detailed information will be mailed during 1986 to all those from whom a positive reply is received. We ask all who might consider attending to send their preliminary inquiries to the organizers as soon as possible.

Vladimir Hanak
Ivan Horacek
Jiri Gaisler

Write to:
Dr. Vladimir Hanak
Institute of Systematic Zoology
Charles University
Vinicna 7
128 44 PRAHA 2
Czechoslovakia

* * * * *

16th ANNUAL BAT SYMPOSIUM

The **Sixteenth Annual North American Symposium on Bat Research** will meet on October 17 and 18, 1986 (Friday and Saturday) at the University of Massachusetts, Amherst, Massachusetts. David Klingener of Univ. Mass. will be in charge of local arrangements and Roy Horst will be in charge of program.

The University of Massachusetts is located approximately 90 miles west of Boston. Dr. Klingener will, in due time, provide detailed travel instructions, a description of housing and dining facilities and other pertinent information. He has arranged for our stay at the campus conference center at very reasonable rates.

If you are interested in attending the Symposium, please contact G. Roy Horst, Department of Biology, State University College of Arts and Science, Potsdam, N.Y. 13676.

* * * * *

HONORS

The American Society of Mammalogists at its 66th annual meeting at the University of Wisconsin in Madison. Wisconsin elected two distinguished biologists to Honorary Life Membership in the Society. They are **Dr. Bernardo Villa-Ramirez** of the Instituto de Biologia of the Universidad Nacional Autonoma de Mexico, and **Dr. Randolph L. Peterson** of the Royal Ontario Museum and the University of Toronto. Both these eminent biologists have concentrated their scholarly attention upon questions in chiropteran biology.

One cannot work on neotropical bats without immediately recognizing that Bernardo Villa laid the foundations for our continuing efforts in this enormous area. No person in biology has done more to bring together scientists in Mexico and Latin America with their colleagues in the United States and Canada. He is truly an international figure "in the bat business." We congratulate Professor Villa on this great honor.

Dr. Peterson has long since established his worldwide reputation as the ultimate authority on the evolution and systematics of the molossid bats of the world. One cannot read the literature on African species but to realize that "Pete was already there." We congratulate Professor Peterson on this richly deserved recognition by his colleagues. **Bat Research News** and its readers are both fortunate and proud that Dr. Peterson and Dr. Villa count us among their friends and colleagues.

G. Roy Horst

* * * * *

FRONT COVER

The November 1982 issue of **Bat Research News** carried the artefact "*Pectoral Quiropteriforme-precolombiano*" on its cover. We present another, even more interesting artefact:

The editor noticed this antique in his mentor's laboratory in the late sixties and did not forget what a great object of admiration it was for chiroptophiles. Professor Kallen honoring the request not only sent a sharp photograph but also an accurate description of the iron bat which I name as *Keyholder Ferropteropus kallenii*. It may not be easy to assign this new "species" to a family, but that is the domain of Karl Koopman and John Edwards Hill. It must be pointed out that this artefact is an accurate representation of the external morphology of a bat if one ignores the swollen joints, the sharply pointed ears and the symmetrically arranged Mm. plagiopatagiales.

Dr. Kallen writes: "Very little of the keyholder is actually known. Many years ago I received it as a gift from a dental research fellow in my laboratory; his mother was interested in antiques, and could not resist the piece when she saw it in an antique shop. And so it was bestowed upon me. It is stamped out of iron, and was said to be a keyholder for a small hotel, or large boardinghouse. I can find no makers mark or date upon it. Each thumb, fingertip, foot, and tail are equipped with hooks. I have no idea of the significance of the knotted cord, represented by a piece of wire, which the animal holds in its mouth. It may be of some significance that, if the hooked ends of the wire were also used to hang keys, a total of 13 keys would be accommodated; it may, therefore, be more than coincidence that our iron bat measures 13 inches, from wingtip to wingtip."

Any correspondence on this subject will be cheerfully received.

* * * * *

ERRATUM

We seem to insist on calling Dr. Karl Koopman everything but a **Mammalogist**. (Contents, Vol. 27: 1) Sorry for the error (Mammaligist: a tribute). We have a stray Yingochiropteran loose in our typesetting machine!

G.R.H.

RECENT LITERATURE

Authors are requested to send reprints of their papers to the editor for inclusion in this section. Receipt of reprints will facilitate complete and correct citation. Our Recent Literature section is based upon several bibliographic sources and for obvious reasons cannot ever be up-to-date. Any error or omission is inadvertent. Voluntary contributions for this section, especially from foreign researchers, are most welcome.

ANATOMY

Bhatnagar, K.P., N. Chang and E. Merrell. 1985-86. Ultrastructure of the pineal organ of the Indian mouse-tailed bat, *Rhinopoma microphyllum*. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 45-49 (Anatomy, Univ. of Louisville School of Medicine, Louisville, KY 40292 USA).

Caxton-Martins, A.E., E.E. Okon and O.O. Oriyomi. 1984. Histochemical studies on the tongue of the straw-colored, fruit-eating bat, *Eidolon helvum* (Kerr). IN Proc. Sixth Intl. Bat Res. Conf., (E.E. Okon and A.E. Caxton-Martins, Eds.), pp. 57-69 (Anatomy and Cell Biology, Univ. of Ife, Ile-Ife, Nigeria).

Caxton-Martins, A.E., G. Tabansi and E.E. Okon. 1984. The ultrastructural and histochemical basis of pituitary metabolism in the fruit-eating bat, *Eidolon helvum* (Kerr). IN Proc. Sixth Intl. Bat Res. Conf. (E.E. Okon and A.E. Caxton-Martins, Eds.), pp. 71-84.

Ferrer, I., I. Fabreques and E. Condom. 1986. A Golgi study of the sixth layer of the cerebral cortex. I. The lissencephalic brain of Rodentia, Lagomorpha, Insectivora and Chiroptera. J. Anat., 145: 217- (Hosp. Llobregat, Ciudid Sanitaria Principes Espana, Hosp. Principes Espana, Dept. Anat. Patol., Barcelona, Spain).

Lowry, M.L., and S.B. Lall. 1985-86. Morphometric and enzymological changes in the adrenal cortex and medulla of *Taphozous melanopogon melanopogon* Temminck from the nulliparous to the parous state. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Mytotis, 23-24: 105-113 (R 20, University, Udaipur 313 001, India).

Maina, J.N. 1985-86. The structural design of the bat lung. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 71-77 (Veterinary Anatomy, Univ. of Nairobi, P.O. Box 30197, Nairobi, Kenya).

Mendel, F., W. Hicks, Jr., F.C. Kallen and D. Fish. 1985. Jaw/Hyoid movements in two species of bats: Is there a basic eutherian pattern? J. Mamm., 66: 774-777 (Anatomical Sciences, State University of New York, Buffalo, NY, 14214, USA).

Morton, D. 1986. The structure of the fundic caecum of the recently fed common vampire bat, *Desmodus rotundus*. Anat. Rec., 214: 89A (Abstract; Biology, Frostburg State College, Frostburg, Maryland 21532 USA).

BIOCHEMISTRY

Adegoke, J.A. 1984. Thermal stability of the reassociated DNA of the African fruit bat *Eidolon helvum*. IN Proc. Sixth Intl. Bat Res. Conf., (E.E. Okon and A.E. Caxton-Martins, Eds.), pp. 39-45 (Zoology, University of Ife, Ile-Ife, Nigeria).

Folayan, J.O., and F.B. Akojie. 1984. Primary tissue cultures from fruit bat (*Eidolon helvum*) embroyos. IN Proc. Sixth Intl. Bat Res. Conf., (E.E. Okon and A.E. Caxton-Martins, Eds.), pp. 85-90 (Biochemistry, University of Ife, Ile-Ife, Nigeria).

Okon, E.E., and M.C. Ngaha. 1985-86. Brown adipose tissue as a nutrient source in the fruit bat, *Eidolon helvum*. IN. Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 57-62 (Zoology, University of Ife, Ile-Ife, Nigeria).

van der Westhuyzen, J. 1986. Tissue of vitamin B_{12} levels in bat sucklings (*Rousettus aegyptiacus*) born of vitamin B_{12} deficient mothers. Comp. Biochem. Physiol., Pt. B, 83: 301-304 (S. African Inst. Med. Res., Sch. Pathol., Dept. Hematology, Brain Metab. Res. Grp., POB 103B, Johannesburg 2000, S. Africa).

Vantonder, S.V., A. Ruck, J. van der Westhuyzen, F. Fernandescosta and J. Metz. 1986. Dissociation of Methionine synthetase (EC 2.1.1.13) activity and impairment of DNA synthesis in fruit bats (*Rousettus aegyptiacus*) with nitrous oxide-induced vitamin B_{12} deficiency. Br. J. Nutr., 55: 187-192 (Reprint F. Fernandescota, S. African Inst. Med. Res., Hematology, Johannesburg).

CONSERVATION

Braun, M. 1985-86. Bat-mapping: a comparison between two regions of Nordbaden. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 235-238 (Landessammlungen fur Naturkunde, Erb prinzenstrasse 13, D-7500 Karlsruhe, FRG).

Calandra, V. 1985-86. A study model — the bat colony of Cefalu cathedral in Sicily. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 239-244 (Zoologica, Univ. di Palermo Via Archirafi 18, 90123 Palermo, Italy).

Judes, U. 1985-86. Basic data for bat conservation in North Germany. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 229-233 (IPN/University of Kiel, Olshausenstrasse 40-60, D-2300 Kiel, FRG).

DISEASE AND PARASITISM

Balogun, R.A. 1984. In vitro rearing of Tsetse flies on bat's wing membrane. IN Proc. Sixth Intl. Bat Res. Conf., (E.E. Okon and A.E. Caxton-Martins, Eds.), pp. 19-24. Univ. of Ile-Ife, Nigeria. (Zoology, Univ. Ife, Ile-Ife, Nigeria).

Kalunda, M., L.G. Mukwaya, A. Mukuye, M. Lule, E. Sekyalo, J. Wright, and J. Casals. 1986. Kasokero virus: a new human pathogen from bats (*Rousettus aegyptiacus*) in Uganda. Amer. J. Trop. Med. Hyg., 35: 387-392 (Uganda Virus Res. Inst., POB 49, Entebbe, Uganda).

Lotz, J.M., and W.F. Font. 1985. Structure of enteric helminth communities in two populations of *Eptesicus fuscus* (Chiroptera). Can. J. Zool., 63: 2969-2978 (Wartburg College, Dept. Biology, Waverly, IA 50677 USA).

Lumio, J., M. Hillbom, R. Roine, L. Ketonen, M. Haltia, M. Valle, E. Neavonen, J. Lahdevirta. 1986. Human rabies of bat origin in Europe. Lancet, vol. 1, No. 8477: 378 (University Tampere, Cent. Hosp., Dept. Infect. Dis., SF-33520, Tampere, Finland).

ECHOLOCATION

Habersetzer, J. 1982. Adaptive echolocation sounds in the bat *Rhinopoma hardwickei*. A field study. J. Comp. Physiol., 144: 559-566.

Habersetzer, J., and G. Marimuthu. 1986. Ontongeny of sounds in echolocating bat *Hipposideros speoris*. J. Comp. Physiol., A, 158: 247-258 (Forschunsinst. Senckenberg, Senckenberganlage 25, D-6000 Frankfurt a.M., FRG).

Hartley, D.J. 1985-86. An investigation of the sonar basis of pulse flexibility in two vespertilionid bats. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 189-193 (Med. Scs. Prog., Indiana University, Bloomington, Indiana 47405 USA).

Kobler, J.B., B.S. Wilson, O.W. Henson, Jr., and A.L. Bishop. 1985. Echo intensity compensation by echolocating bats. Hearing Res., 20: 99-108 (Massachusetts Eye & Ear Infirm., Eaton Peabody Lab., 243 Charles St., Boston, MA 02114 USA).

Konstantinov, A.I., and E.V. Movchan. 1985-85. Changes in the process of echolocation as a result of inferior colliculus destruction in a CF-FM bat, *Rhinolophus ferrumequinum*. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 181-187 (A.A. Ukhtomsky Inst. of Physiology Leningrad State Univ., 7/9 University Embankment, Leningrad 198 164 USSR).

Maries, K. 1985-86. Recent developments in bat detector field instrumentation. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 249-254 (QMC Instruments Ltd., 229 Mile End Road, London E1 4AA, UK).

Park, S.R. 1985-86. Die ontogenetische entwickling der vokalsation bei der vampirfledermaus *Desmodus rotundus*. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 51-55 (Audiology, Inst. of Laryngology and Otology, 330 Gray's Inn Road, London WCIX 8EE UK).

Pye, A. 1985-86. Analysis of cochlear components from surface preparations in bats. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 245-248 (Queen Mary College, Mile End Road, London E1 4 NS, UK).

Pye, J.D., and F.A. Mutere. 1985-86. Recording bat sounds by new techniques. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp. (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 245-248 (Queen Mary College, Mile End Road, London E1 4 NS, UK).

Schnitzler, H.U., D. Menne and H. Hackbarth. 1985. Range determination by measuring time delays in echolocating bats, pp. 180-204. IN Time Resolution in Auditory Systems, (A. Michelsen, Ed.), Springer-Verlag, Berlin, 242 pp. (Inst. Biol. 3, Lehrstuhl Zoophysiol., D-7400 Tubingen, FRG).

Schuller, G. 1986. Influence of echolocation pulse rate on Doppler shift compensation control system in the greater horseshoe bat. J. Comp. Physiol., A, 158: 239-246 (Univ. Munich, Inst. Zoology, Luisenstr, 14, D-8000 Munich 2, FRG).

Suga, N., and J. Horikawa. 1986. Multiple time axes for representation of echo delays in the auditory cortex of the mustached bat. J. Neurophysiology, 55: 776-805 (Washington Univ., Dept. of Biology, St. Louis, MO 63130 USA).

Zbinden, K. 1985-86. Echolocation pulse design in bats and dolphins. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 195-200 (Inst. Zoology, Univ. of Berne, Hallerstrasse 6, CH-3012 Berne, Switzerland).

ECOLOGY AND BEHAVIOR

Aldridge, H.D.J.N. 1985-86. Manoeuvrability and ecology in British bats. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 161-166 (Biology, Univ. of Calgary, Calgary, AB, Canada T2N 1N4).

Barclay, R.M.R. 1985-86. Foraging strategies of silver haired (*Lasionycteris noctivigans*) and hoary (*Lasiurus cinereus*) bats. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 161-166 (Biology, Univ. of Calgary, Calgary, AB, Canada T2N 1N4).

Barclay, R.M.R., and K.J. Cash. 1985. A non-commensal maternity roost of the little brown bat (*Myotis lucifugus*). J. Mamm., 66: 782-783 (Zoology, Univ. of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2).

Funmilayo, O. 1984. Departute times from the roost in the straw-colored fruit bat, *Eidolon helvum*. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 15-18. Univ. Ile-Ife, Nigeria (Agricultural Biology, Univ. of Ibadan, Ibadan, Nigeria).

Gaisler, J., and Z. Bauerova. 1985-86. The life of bats in a city. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 209-215 (Biology, Fac. Sc., Kotlarska 2, 611 37 Brno, Czechoslovakia).

Haffner, M., and H.P. Stutz. 1985-86. Abundance of *Pipistrelus pipistrellus* and *Pipistrellus kuhlii* foraging at street lamps. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 167-172 (Zoologisches Museum, Universitat Zurich-Irchel, Winterthurerstrasse 190, CH-8057 Zurich, Switzerland).

Lundberg, K., and R. Gerell. 1986. Territorial advertisement and mate attraction in the bat *Pipistrellus pipistrellus*. Ethology, 71: 115-124 (Univ. Lund, Dept. Animal Ecology, Ecology Building, S-22362 Lund, Sweden).

Mayrand, E., and G. Baron. 1985-86. Some aspects of social behaviour in *Artibeus jamaicensis* in the roost. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 143-147 (Biology, Univ. de Montreal, C.P. 6128 Succ. "A," Montreal, Que. Canada H3C 3J7).

McWilliam, A.N. 1985-86. The feeding ecology of *Pteropus* in Northeastern New South Wales, Australia. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 201-208 (Zoology, Univ. of Aberdeen, Aberdeen AB9 2TN, UK).

Mutere, F.A., I.R. Aggundey and A.N. McWilliam. 1984. Bat ringing in Kenya. IN Proc. Sixth Intl. Bat Res. Conf., (E.E. Okon and A.E. Caxton-Martins, Eds.), pp. 1-14 Univ. Ile-Ife, Nigeria (Zoology, Kenyatta Univ. College, Nairobi).

Roer, H. 1985-86. The population density of the mouse-eared bat (*Myotis myotis* Borkh.) in Northwest Europe. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 217-222 (Zoologisches Forsch. und Museum A. Koenig, Adenauerallee 150-164, D-5300 Bonn 1, FRG).

Stutz, H.P., and M. Haffner. 1985-86. Activity patterns of non-breeding populations of *Nyctalus noctula* (Mammalia, Chiroptera) in Switzerland. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 149-155 (Zoologisches Museum, Universitat Zurich-Irchel, Wintertherenstrasse 190, CH-8057 Zurich, Switzerland).

Usman, K., J. Habersetzer, R. Subbaraj, G. Gopalakrishnaswamy and K. Paramanandam. 1980. Behavior of bats during a lunar eclipse. Behav. Ecol. Sociobiol., 7: 79-81 (Biology, Madurai Kamaraj Univ., Madurai 625 021 India).

Vaughn, T.A., and R.P. Vaughn. 1986. Seasonality and the behavior of the African yellow-winged bat. J. Mamm., 91-102. (Biological Sciences, Northern Arizona Univ., Flagstaff, AZ 86011 USA).

IMMUNOLOGY

Paul, B.N., and A.K. Chakravarty. 1986. *In vitro* analysis of delayed immune response in a bat, *Pteropus giganteus*: process of con-A mediated activation. Develop. Comp. Immunol., 10: 55-68 (Univ. N. Bengal, Ctr. Life Sci., Immunol. & Cell Biology Lab, Raja Rammohanpur 734 430 West Bengal, India).

KARYOLOGY

Dulic, B. 1984. Chromosomes of four species of microchiroptera. IN Proc. Sixth Intl. Bat Res. Conf., (E.E. Okon and A.E. Caxton-Martins, Eds.), pp. 25-37. Univ. Ile-Ife, Nigeria (Zoology, Faculty of Sciences, Zagreb).

Naidu, K.N., and M.E. Gururaj. 1985. Karyotypic architecture of the false vampire bat, *Megaderma lyra*. Cyyologia, 50: 913-919 (Univ. Mysore, Dept. Post-graduate Studies & Res. Zoology, Mysore 570 006, Karnataka, India).

PHARMACOLOGY

Cole, O.F., O.A. Fasanmi and V.O. Marquis. 1984. The inhibitory action of piperine on the gut of fruit bat (*Eidolon helvum*). IN Proc. Sixth Intl. Bat Res. Conf., (E.E. Okon and A.E Caxton-Martins, Eds.), pp. 91-93 (Pharmacology, Univ. of Ife, Ile-Ife, Nigeria).

Fasanmi, O.A., and V.O. Marquis. 1984. Effect of piperine on the bat and mouse vasa deferentia preparations. IN Proc. Sixth Intl. Bat Res. Conf., (E.E. Okon and A.E. Caxton-Martins, Eds.), pp. 94-101 (Pharmacology, Univ. of Ife, Ile-Ife, Nigeria).

PHYSIOLOGY

Bassett, J.E. 1986. Habitat aridity and urine concentrating ability of nearctic, insectivorous bats. Comp. Biochem. Physiol., Pt. A, 83: 125-132 (Univ. Washington, Dept. Physiol. & Biophysics, Seattle, WA 98195 USA).

Bell, G.P., and M.B. Fenton. 1986. Visual acuity, sensitivity and binocularity in a gleaning insectivorous bat, *Macrotus californicus* (Chiroptera, Phyllostomidae). Anim. Behav., 34: 409-414 (Boston Univ., Dept. Biol., 2 Cummington St., Boston, MA 02215 USA).

Bell, G.P., G.A. Bartholomew and K.A. Nagy. 1986. The roles of energetics, water economy, foraging behavior, and geothermal refugia in the distribution of the bat, *Macrotus californicus*. J. Comp. Physiol., B, 156: 441- (Boston Univ., Dept. Biology, 2 Cummington St., Boston, MA 02215 USA).

Brack, V., Jr. and J.W. Twente. 1985. The duration of the period of hibernation of three species of vespertilionid bats. I. Field studies. Can. J. Zool., 63: 2952-2954 (WAPORA Inc., 511 Old Lancaster Rd., Berwyn, PA 19312 USA).

Carpenter, R.E. 1986. Flight physiology of intermediate-sized fruit bats (Pteropodidae). J. Exp. Biol., 120: 79-104 (San Diego State Univ., Dept. Biology, San Diego, CA 92182 USA).

Chandrashekaran, M.K. 1982. Social cues and circadian rhythms. Curr. Sci., 51: 158-167 (Biology, Madurai Kamaraj Univ., Madurai 625 021 India).

Cukierski, M.J., and P.M. Hogan. 1986. Hibernation and membrane electrical phenomena from cardiac papillary muscle cells of the bat, *Myotis lucifugus*. Anat. Rec., 214: 26A-27A (Abstract; Anatomical Sciences, State University of New York at Buffalo, Buffalo, NY 14214 USA).

Genoud, M., and F.J. Bonaccorso. 1986. Temperature regulation, rate of metabolism, and roost temperature in the greater white-lined bat *Saccopteryx bilineata* (Emballonuridae). Physiological Zool., 59: 49-54 (Univ. Lausanne, Inst. Zool. & Ecology, CH-1000 Lausanne 17, Switzerland).

Marimuthu, G., R. Subbaraj and M.K. Chandrashekaran. 1978. Social synchronization of the activity rhythm in a cave dwelling insectivorous bat. Naturwissenschaften, 65: 600 (Biology, Madurai Kamaraj University, Madurai 625 021, India).

Marimuthu, G., and M.K. Chandrashekaran. 1983. Continuous light inside a cave abolishes the social synchronization of the circadian rhythm of an emballonurid bat. Naturwissenschaften, 70: 620.

Marimuthu, G., and M.K. Chandrashekaran. 1985. Communication and synchronization of circadian rhythms in insectivorous bats. Proc. Indian Acad. Sci., (Anim. Sci.), 94: 655-665.

Rayner, J.M.V., G. Jones and A. Thomas. 1986. Vortex flow visualizations reveal change in upstroke function with flight speed in bats. Nature, 321: 162-164 (Univ. Bristol, Dept. Zoology, Bristol BS8 1UG, Avon, England).

Subbaraj, R., and M.K. Chandrashekaran. 1977. 'Rigid' internal timing in the circadian rhythm of flight activity in a tropical bat. Oecologia, 29: 341-343 (Biology, Madurai Kamaraj Univ., Madurai 625 021, India).

Subbaraj, R., and M.K. Chandrashekaran. 1978. Pulses of darkness shift the phase of a circadian rhythm in an insectivorous bat. J. Comp. Physiol., 127: 239-243.

Twente, J.W., J. Twente and V. Brack, Jr. 1985. The duration of the period of hibernation of three species of vespertilionid bats. II. Laboratory studies. Can. J. Zool., 63: 2955-2961 (Univ. Missouri, Div. Biol. Sci., Columbia, MO 65211 USA).

REPRODUCTION

Beasley, L.J. 1985-86. Seasonal cycles of pallid bats (*Antrozous pallidus*): proximate factors. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 115-123 (Psychobiology, Univ. of California, Irvine, CA 92717 USA).

Bhiwagade, D.A. 1985-86. Contraceptive agents: endocrinological approach to male fertility control in the Indian fruit bat, *Rousettus leschenaulti*. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 87-104 (Zoology, Inst. of Science, Bombay 32, India).

Damassa, D.A., A.W. Gustafson, G.C. Kwiecinski and R.D. Pratt. 1985. Control of plasma sex steroid-binding protein (SBP) in the little brown bat: effects of thyroidectomy and treatment with L- and D-thyroxine on the induction of SBP in adult males. Biol. Reprod., 33: 1138-1146 (Tufts Univ., Sch. Med., Anatomy & Cellular Biology, 136 Harrison Ave., Boston, MA 02111 USA).

Gustafson, A.W., and D.A. Damassa. 1985. Annual variation in plasma sex steroid-binding protein and testosterone concentrations in the adult male little brown bat: relation to the asynchronous recrudescence of the testis and accessory reproductive organs. Biol. Reprod., 33: 1126-1137 (address as above).

Horacek, I., and J. Gaisler. 1985-86. The mating system of *Myotis blythi*. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 125-130 (Vokacova 1182, 140 00 Praha 4, Czechoslovakia).

Karim, K.B., and M. Fazil. 1985-86. Post-implantation development of the Indian rhinopomatid, *Rhinopoma hardwickei hardwickei* (Gray). IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 63-69 (Zoology, Inst. of Science, Nagpur 440 001, India).

Lall, S.B. 1985-86. Folliculogenesis in *Rhinopoma kinneari* Wroughton (Microchiroptera: Mammalia). IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 37-44 (Zoology, Sukhadia University Udaipur 313 001, India).

Okon, E.E., M.C. Opara and A.E. Caxton-Martins. 1984. A histological study of the ovarian cycle in the fruit bat, *Eidolon helvum*. IN Proc. Sixth Intl. Bat Res. Conf., (E.E. Okon and A.E. Caxton-Martins, Eds.), pp. 47-55 (Zoology, Univ. of Ife, Ile-Ife, Nigeria).

Sapkal, V.M. 1985-86. Biochemical studies in the male accessory structures of *Rousettus leschenaulti*. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 79-86 (Institute of Science, Nagpur 440 001, India).

Stutz, H.P., and M. Haffner. 1985-86. The reproductive status of *Nyctalus noctula* (Schreber, 1774) in Switzerland. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 131-136 (address in Ecology and Behavior).

West, C.C. 1985-86. Reproductive biology of *Pteropus rodricensis*. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 137-141 (Jersey Wildlife Preservation Trust, Trinity, Jersey, Channel Islands).

Willig, M.R. 1985. Reproductive patterns of bats from Caatingas and Cerrado biomes in Northeast Brazil. J. Mamm., 66: 668-681 (Biol. Scs., and The Museum, Texas Tech Univ., Lubbock, TX 79409 USA).

Willig, M.R. 1985. Ecology, reproductive biology, and systematics of *Neoplatymops mattogrossensis* (Chiroptera: Molossidae). J. Mamm., 66: 618-628.

Wingate, L.R. 1986. Age of sexual maturity in female *Rhinolophus clivosus* Cretzschmar 1828 and *Myotis tricolor* Temminck 1832). Cimbebasia, Ser. A, vol. 8 (18): 155-159 (Kaffrarian Museum, King William's Town, 5600, Republic of South Africa).

SYSTEMATICS

Bogdanowicz, W., and A.M. Wojcik. 1985-86. Morphological and electrophoretic differentiation between *Myotis daubentoni* (Kuhl, 1819) and *Myotis nathalinae* Tupinier, 1977. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 17-30 (Mammals Res. Inst., Polish Acad. Scs., 17-230 Bialiwieza, Poland).

Horacek, I., and V. Hanak. 1985-86. Generic status of *Pipistrellus savii* and comments on classification of the genus *Pipistrellus* (Chiroptera, Vespertilionidae). IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 9-16 (Vokacova 1182, 140 00 Praha 4, Chechoslovakia).

Koopman, K.F. 1984. A progress report on the systematics of African *Scotophilus* (Vespertilionidae). IN Proc. Sixth Intl. Bat Res. Conf., (E.E. Okon and A.E. Caxton-Martins, Eds.), pp. 102-113 (American Museum of Natural History, New York, NY 10024 USA).

Martin, R.D. 1986. Are fruit bats primates? Nature, 320: 482-483 (News and Views; Physical Anthropology, Univ. College London, London WC1E 6BT, UK).

DISSERTATIONS

(Research carried out under the mentorship of Dr. M.K. Chandrashekaran, Madurai Kamaraj Univ., Madurai, 625 021, India).

Joshi, D.S. 1985. Light and circadian rhythm in the bat *Hipposideros speoris*.

Marimuthu, G. 1982. Social behaviour and social timing of the biological clock of a tropical bat *Hipposideros speoris* Schneider 1800.

Sripathi, K. 1982. Light relations of the circadian rhythm in the tropical bat *Taphozous nudiventris kachhensis* Dobson 1872 under seminatural and laboratory conditions.

Subbaraj, R. 1979. Circadian organization in behaviour of bats *Taphozous melanopogon* Temminck).

Usman, K. 1981. Ecological and ethological studies on the insectivorous bat, *Rhinopoma hardwickei hardwickei* Gray 1831.

MISCELLANEOUS

Lewin, R. 1986. Why dynamiting vampire bats is wrong? Case studies in ecology. Science, 232 (4746): 24.

Tupinier, D. 1985-86. La chauve-souris dans l'heraldique et la symbolique. IN Proc. Seventh Intl. Bat Res. Conf., and Third European Bat Res. Symp., (P.A. Racey and H. Roer, Eds.), Myotis, 23-24: 255-256 (5-B, rue Claude Baudrand, F-69300 Caluire, France).

* * * * *

BOOKS ABOUT BATS

FOR ADULTS

Bats of America
A great bat book; life history and identification ofbats all over the U.S. Many illustrations in B&W and color. By Roger W. Barbour and Wayne H. Davis, 286pp. 1969, hb. **$35.00**

Cave Fauna of North America
Reprinted from the memoirs of the National Academy of Sciences, Vol. 4, Part 1, 1888. For those interested in the history of cave biology. By A.S. Packard, 155pp. hb. **$16.00**

Bats: A Natural History
This book will appeal to amateur naturalist and conservationalist, as well as scientists and professional zoologists. By John E. Hill and James D. Smith, 248pp. 1984, hb. **$25.00**

Ecology of Bats
10 chapters, each by a different well-known author. Includes Reproduction, Roosting Ecology, Growth and Survival, Plant-visiting Bats, Bat Parasites, and more. Edited by Thomas Kunz, 425pp. 1982, hb. **$49.50**

The Lives of Bats
A wide-range book including breeding, feeding, physiology, aerodynamics, and more. By Wilfred Schober, 212pp. 175 illus., 1984, hb. **$25.00**

What About Bats?
A great introduction to bats for both children and adults. By James K. Baker, 60pp. 1979, pb. **$1.50**

Bats and Public Health
This book is valuable for its bibliography as well as its general health information. By Merlin Tuttle and Stephen J. Kern, 11pp. 1981, pb. **$1.00**

Just Bats
An illustrated view of bats for a general audience. By M. Brock Fenton, 165pp. 1983, pb. **$10.00**

The Vampire Bat
The first comprehensive study of the interaction between vampire bats and their principal prey, the cow, at one location. By Dennis C. Turner, 145pp. 1975, hb, no/dj. **$10.00**

Cave Life of Oklahoma
Special issue of the Oklahoma Underground. A complete study which could serve as a guide for speleologists working on similar projects. By Jeffrey Black, 59pp. 1971, pb. **$5.00**

The Bat
A great B&W picture book of bats. The text is mostly identification of the species shown. By Nina Leen, 78pp. 1976, hb. **$7.50**

The Greater Horseshoe Bat
43 pages of great photos and simple but interesting text. A good conservation message at the end. By Roger Ransome, 1980, hb. **$5.00**

House Bat Management
Hints on how to "de-bat" and "bat-proof" a house. By Arthur Greenhall, 33pp., 30 illus. 1982, pb. **$6.00**

Cave Life: Evolution and Ecology
A technical study of cave populations including mathematical models of genetic and ecological communities. Deals very little with bats. By David Culver, 189pp. 1982, hb. **$25.00**

Photographing Bats: At Carlsbad Caverns National Park
A full-color flyer by Ronald C. Kerbo. 2pp. 1985. **$.50**

Communication in the Chiroptera
Reviews the available information on communication in bats including apparatus for sending and receiving signals. By M. Brock Fenton, 161pp. 1985, hb. **$35.00**

Bats
A British general information book that "sets the record straight about bats." This includes information on what the British have done to protect bats. By Phil Richardson, illustrated with drawings by Gary Troughton, 128pp. 1985, hb. **$10.00**

Vertebrate Flight — A Bibiolography
Over 2500 references on all aspects of flight in vertebrates. The most detailed coverage is given to flight in birds and bats. By J.M.V. Rayner, 200pp. 1985, pb. **$14.00**

FOR CHILDREN

I Can Read About Bats
A simple view of bats with quite a bit of information. By Elizabeth Warren, 42pp. 1975, pb. **$1.50**

Bats in the Dark
A "Let's-read-and-find-out" science book. A very basic book on bats for K to 3. By John Kaufman, 33 pp. 1972, library bound, hb. **$10.50**

Bats, The Night Fliers
A scientific book for kids 8 to 10. Mostly text with a few sketches. By Anabel Dean, 56pp. 1974, hb. **$6.00**

Vampire Bat
Written for 3rd to 6th grade but I learned a lot. By Lawrence Pringle, 62pp. 1982, hb. **$9.50**

Bats
From the "not so awful creatures" series. A humorous look at "Biff the Bat" who is "Wanted Dead or Alive for biting people and sucking blood." Exposes misconceptions for 3rd graders. By George Shea, 40pp. 1977, pb. **$4.00**

Bats in the Night
A beginning bat book which explains bats in simple but detailed terms. Includes identification information on 12 species. Grades 3-6. By George Laycock, 69pp. 1981, hb. **$10.00**

Billions of Bats
Includes information on the Vampire, the Little Flying Cow, Fisherman Bat, giants of the bat world and more. By Miriam Schlein, 56pp. 1982, hb. **$9.50**

Bats
A very good first bat book for kids. Stresses conservation and importance to man. Illus. with B&W photos by Merlin Tuttle. By Alice L. Hopf, 64pp. 1985, hb. **$8.50**

Know-It-All-Library Bats
Facinating facts about bats for 1st grade to 3rd grade kids. By Joanna Foley, 24pp. 1982, pb **$1.00**

What's in the Cave
A lift-the-flap pop-up book for those with a good sense of humor. Kids and adults will love this book because in the cave are a fat bat, a lazy lizard, and a big surprise. 8 pop-up animals. By Peter Seymour, 1985, hb. **$7.75**

* * * * *

The titles listed on this page can be purchased from:
Speleobooks
Emily Davis Mobley
P.O. Box 10
Schoharie, NY 12157

N.Y. State residents add 7% sales tax. All orders add $1.50 mailing costs for first book, $.50 for each additional item.

Send a card or letter for free catalogue covering many rare bat books, prints, bat toys and other "bat paraphernalia."

BAT RESEARCH NEWS

VOLUME 27 No. 3-4 Fall-Winter 1986

BAT RESEARCH NEWS

Instructions to Contributors and Subscribers

Bat Research News is published four times per year, each year consisting of one volume of four numbers. Publication dates, Spring, Summer, Autumn, and Winter. *Bat Research News* publishes short papers, general notes, etc., which are rigorously edited and reviewed. Manuscripts dealing with original work should be submitted in triplicate following the latest *CBE Style Manual* or following the style used in Journal of Mammology. In addition, latest news on bat research, correspondence, book reviews, meeting announcements, reports and recent literature citations are included. Communications concerning all these matters should be addressed to Kunwar Bhatnagar.

Subscriptions to individuals are U.S. $10.00 per year mailed 3rd class to U.S. addresses. All other countries, surface mail, printed matter, unless $10.00 per volume is prepaid for airmail 1st class to any address worldwide.

Institutional subscriptions are U.S. $15.00 worldwide.

Communication concerning dues, subscriptions, advertisement rates, or back issues should be addressed to G. Roy Horst.

Typeset by Tracy L. Robertson

Layout by G. Roy Horst

Mailed at Potsdam, New York 13676 USA

BAT RESEARCH NEWS

Vol. 27 — Fall-Winter — No. 3-4

CONTENTS

FRONT COVER

Pteropus pselaphon, a 20 Yen postal stamp from Japan. Submitted by Kunwar Bhatnagar.

BAT RESEARCH NEWS

Volume 27 | Fall-Winter | Number 3-4

Raccoons Catch Mexican Free-tailed Bats "On the Wing"

Gary F. McCracken, Mary K. Gustin, and Michael I. McKamey
Department of Zoology, University of Tennessee, Knoxville, Tennessee 37996 USA

Maternity colonies of Mexican free-tailed bats provide seasonally available resource concentrations for a diversity of predators. These predators are reported to include at least five snake species (Twente, 1956; Eads et al., Davis et al., 1954, 1956; Herreid, 1960; Davis et al., 1962; Taylor, 1964; Caire and Ports, 1981), and three species of mammals (Twente, 1956; Eads et al., 1957; Davis et al., 1962). Predation by raccoons (*Procyon lotor*) is evidently common in *T. b. mexicana* maternity roosts (Twente, 1956; Eads et al., 1957; Davis et al., 1962); however, existing observations suggest that this occurs mostly by scavenging of dead or dying bats which have fallen to the roost floor. Here we report on active and, evidently, highly successful capturing of bats in flight of raccoons.

In summer, Davis Cave (Blanco, Co., Texas) is inhabited by a large population (estimated at one to four million individuals, Eads et al., 1957; Davis et al., 1962) of *T. b. mexicana*. In the entrance of this cave, extending to approximately 1.5 m above the cave floor, are two intersecting, sloping poles which are remnants of a structure that was used for harvesting bat guano. Just before dawn on June 22, 1981, as large numbers of bats were returning to the cave from their nightly foraging, we observed a raccoon standing upright on these posts, facing away from the cave and into the incoming stream of bats, and capturing bats using both forepaws (Fig. 1). On inspection, we found that the substrate directly below the raccoon's perch was littered with the remains of several hundred bat wings, may with fresh skin and coagulated blood still adhering to them. Apparently, the raccoon was consuming the heads and bodies of batrs and discarding their wings. On that same day we returned to Davis Cave during the evening bat exodus, and again observed a raccoon hunting in the same fashion from the same location. However, it was now facing the toward the cave and into the exiting stream of bats.

In early afternoon, June 26, 1981, we removed all skeletal remains and other debris from an approximately 4m^2 area centered below the raccoon's hunting perch. We then visited this site between 1 and 3 p.m. each afternoon for the next four days. We found no fresh wing remnants or other evidence of hunting by the raccoon at this site on June 27 or 28. However, on June 29 we collected a total of 74 bat wings which had been dropped on the previous night directly below the raccoon's perch. These were saved for further examination. On June 30, we collected and counted an additional 46 newly dropped bat wings, which we then discarded. The wings collected on both days are largely intact. For 51 of the 74 wings collected on June 29, the phalanges, carpels, metacarpels, and radius were intact, with most also having an attached fragment of the humerus. Most of the remaining wings consisted of phalanges, carpels, and metacarpels attached to a large fragment of the radius. Additional examination showed that 36 of these wings were fromt he right side of a bat's body and 38 from the left side, suggesting that a minimum of 38 bats were eaten from on or near this perch during the night of June 28-29, 1981. Assuming that the weight of wings do not exceed 15% of a *T. b. mexicana*'s total body weight, given an average adult body weight of 13 g, and because fragments of other body parts are very rare beneath the raccoon perch, we estimate that these wing remains reflect the consumption of approximately 418 g of bat tissue.

Other observations from the five summers during which two of us (GFM and MKG) have worked in this cave are relevant to this note. First, while raccoons frequently hunt in the manner described from the posts in the cave's entrance, they also hunt in the same manner from other, similar vantage points in the twilight area of this cave. Second, we have observed at least three raccoons hunting simultaneously in this manner within Davis Cave. Third, Mr. Gould Davis, owner of the cave, has told us that over 20 years ago he observed raccoons hunting bats in his cave in the same manner we relate here.

Finally, in addition to our observations on raccoons, we are able to add two additional species to those reported as predators of Mexican free-tailed bats. These are turkey vultures (*Cathartes aura*) and feral pigs (*Sus scrofa*), both of which were observed scavenging fallen bats from guano in the twilight zone of Davis Cave.

FIGURE 1.

A raccoon attempting to catch Mexican free-tailed bats as the bats fly out of their cave roost. The projection of rock seen behind the raccoon is beyond its reach. Although not in focus, images of flying bats are visible above the raccoon's head and back, and below its fore limbs.

LITERATURE CITED

Caire, W., and M.A. Ports. 1981. An adaptive method of predation by the great horned owl on Mexican free-tailed bats. S. W. Nat. 26: 69-70.

Davis , R.B., C.F. Herreid II, and H.L. Short. 1962. Mexican free- tailed bats in Texas. Ecol. Mongr. 32: 311-346.

Eads, R.B., J. S. Wiseman, and G.C. Menzies. 1957. Observations concerning the Mexican free-tailed bat in Texas. Texas J. Sci. 9: 227-242.

Herried, C.F. 1960. Roadrunner, a predator of bats. Condor 62: 67.

Herreid, C.F. 1962. Snakes as predators of bats. Herpetologica 17: 271-272.

Macy, R.M., and R.W. Macy. 1939. Hawks as enemies of bats. J. Mamm. 20: 252.

Stager, K.E. 1941. A group of bat-eating duck hawks. Condor 43: 137-139.

Taylor, J. 1964. Noteworthy predation on the guano bat. J. Mamm. 45: 300-301.

Twente, J.W., Jr. 1954. Predation on bats by hawks and owls. Wilson Bull. 66: 135-136.

Twente, J.W., Jr. 1956. Ecological observations on a colony of *Tadarida mexicana*. J. Mamm. 37: 42-47.

Received April 4, 1986
Revised and Accepted April 30, 1986

Echolocation Over Flowing Water by Two Species of Mytosis

Robert M. Herd N.S.W. Department of Agriculture, Agricultural Research Center Trangie, N.S.W. 2823 Australia

The small insectivorous bats *Myotis lucifugus* and. *Myotis yumanensis* forage over the waters of the Okanagan River in British Columbia, Canada (Herd and Fenton, 1983). These bats must identify the echoes of potential prey against the background noise of the river. Recordings were made of slow-flowing (upstream) and fast-flowing (downstream) water at South Weir (sites 1 and 2; Herd and Fenton, 1983), with a microphone (frequency response flat from 10 to 80 kHz) held 2m above the water and inclined at 60 ° to the water surface. To determine the range of frequencies used in echolocation calls, the search-phase echolocation calls of known bats flying over open fields were also recorded. The methods used to record and analyse sounds are described in Herd and Fenton (1983).

Bats foraging over fast-flowing water would encounter more intense noise then when foraging over slow-flowing water (Fig. 1). The perceived loudness of this noise will depend upon the sensitivity of hearing at particular frequencies. The hearing of *M. lucifugus* is most sensitive to sounds between 20 and 50kHz and is much less sensitive to frequencies outside this range (Grinnell, 1963; Suga and Jen, 1975). This range includes the frequency with maximum energy and the lowest frequencies in its echolocation calls, and frequencies just below those used in echolocation calls (Fig. 1). The hearing sensitivity of *M yumanensis* is not known, but another vespertilionid bat.

Eptesicus fuscus, has hearing most sensitive to frequencies between 10 and 30 kHz (Dalland, 1965) which again include frequencies within and just below those in its echolocation calls (frequency with maximum energy is 28 kHz and lowest frequency is 27 kHz; Fenton and Bell, 1981).

Myotis yumanensis often forage over fast-flowing water whereas *M. lucifugus* rarely does (Herd and Fenton, 1983). Were *M. lucifugus* to forage over fast-flowing water it would encounter higher noise levels at frequencies used for echolocation (up to -20 dB at 30 kHz) and at lower frequencies to which its hearing is still sensitive (up to -10 dB at 20 kHz). However, *M. yumanensis* does not use frequencies below 35 kHz for echolocation and its hearing is probably much less sensitive to frequencies below about 30 kHz. Fenton et al., (1983) observed that bats concentrated their activity over

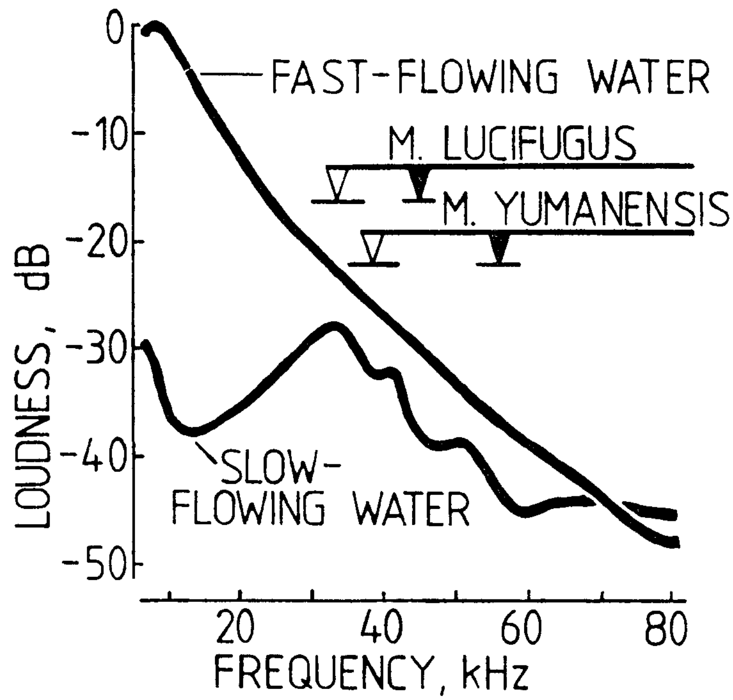


Fig. 1

Frequency spectra of search-phase echolocation calls and background noise over the Okanagan River. Horizontal lines represent frequencies in the echolocation calls; open triangles indicate the mean minimum frequency; solid triangles indicate the mean frequency with maximum energy; bars are range about each mean.

a small pool within 10m of a turbulent mountain creek in Mount Revelstoke National Park, Canada. They measured the noise level over the stream to be about 100 times that over the pool and suggested that the high level of background noise over the stream could interfere with echolocation.

These observations highlight two aspects of echolocation. Firstly, these bats are able to forage in a noisy environment, implying either that they are able to pick out the echoes of their calls from the background clutter (the "cocktail party" effect), or that the decrease in detection range for echoes is not a problem. Secondly, environments with different acoustic properties demand different sonar capacities of the echolocating bats using them.

I thank Denise Herd for assistance with field work, and Peter O'Brien, Dedee Woodside and two anonymous referees for comments on earlier drafts of this note. This study was supported by a NSERC operating grant to M.B. Fenton.

REFERENCES

Dalland, J.I. 1965. Hearing sensitivity in bats. Science. 150:1185-1186.

Fenton, M.B. and G.P. Bell. 1981. Recognition of species of insectivorous bats by their echolocation calls. J. Mamm., 62:233-243.

Fenton, M.B., H.G. Merriam, and G.L. Holroyd. 1983. Bats of Kootenay, Glacier, and Mount Revelstoke National Park in Canada: identification by echolocation calls, distribution, and biology. Can. J. Zool., 61:2503-2508.

Grinnell, A.D. 1963. The neurophysiology of audition in bats: Intensity and frequency of parameters. J. Physiol. (Lond.), 167:38-66.

Herd, R.M. and M.B. Fenton. 1983. An electrophoretic, morphological, and ecological investigation of a putative hybrid zone between *Myotis lucifugus* and *Myotis yumanensis* (Chiroptera: Vespertilionidae). Can. J. Zool., 61:2029-2050.

Suga, N. and P.H.S. Jen. 1975. Peripheral control of acoustic signals in the auditory system of echolocating bats. J. Exp. Biol., 62:277-311.

Received April 18, 1986
Revised and Accepted September 21, 1986

An *Eptesicus fuscus* Lives 20 Years

Wayne H. Davis
School of Biological Sciences, University of Kentucky, Lexington, KY 40506 USA

On 18 June, 1966, Roger W. Barbour and I banded 19 male *Eptesicus fuscus* we netted over the Martyr Campground Campgrounds, two miles SW of the Southwest Research Station, six miles SW Portal, Cochise Co., Arizona, elev. 5800 feet. One of these bats was reported by Dr. Yar Petryszyn of the University of Arizona as having been found dead at Paradise, Arizona, near Portal, in April 1985. Inquiry of Dr. Petryszyn revealed that the bat was found by Brook White after it drowned in a metal stock tank. When originally banded, I expect the bat was at least one-year-old making it 20-years-old at the time of its death. Apparently, the oldest recorded *Eptesicus fuscus* was banded by Harold B. Hitchcock in Ontario and is known to have lived 19 years (Paradiso and Greenhall, 1967, as cited in Tuttle and Stevenson, 1982).

LITERATURE CITED

Paradiso, J.L., and A.M. Greenhall. 1967. Longevity records for American bats. Am. Midl. Nat., 78: 251-252.

Tuttle, M.D., and D. Stevenson. 1982. Growth and survival. IN: *Ecology of Bats*. T.H. Kunz, ed., pp. 105-150, Plenum Press, New York.

Received April 21, 1986
Revised and Accepted May 13, 1986

BOOK REVIEW

Bluten und Fledermause (Flowers and bats) by Klaus Dobat and Therese Peikert-Holle. Verlkag Waldemar Kramer, Frankfurt am Main, 1985. 370 pp. price (hardbound), DM 78. (In German)

It is not often that botanists write a book on bats. But the authors wanted to treat a particular aspect of chiropteran biology which is of interest to zoologists as well as botanists, i.e., the relationship between bats and flowers.

Botanical and zoological research has provided a multitude of interesting facts on the symbiosis of flowers and bats. However, these are dispersed in various publications. This book represents an admirable attempt to describe and integrate botanical, zoological and ecological knowledge, and fills a void by bringing together literature relating to chiropterophily from even older documents not readily available through modern information-retrieval systems.

While frugivorous chiroptera play an important role in the dispersion of seeds, nectivorous bats and flying foxes perform an equally important biological function for plants: they pollinate flowers. However, not just any flower can be pollinated by bats nor can any bat exploit the alimentary resources offered by flowers. Flowers and pollinating bats are tuned with each other. This is the topic of the book, the first of its kind.

After a short and easy-to-read summary on flower morphology and a historical overview of chiropterophily, the authors present a detailed description of the syndromes of "bat-flowers," such as the typical morphological patterns, nocturnal efflorescence, nectar production and nectar composition, odours, etc., followed by a chapter on morphological adaptations and sensory equipment in nectivorous bats. Although very stimulating, the chapter on behavioral adaptations and ecology shows how little is really known, particularly about the behavioral strategies of these nectarivorous species. The discussion of factors limiting chiropterophily raises the question of trophic plasticity and seasonal migration. The authors conclude by tracing the evolution of chiropterophily. Finally, there are two very useful tables. One contains a systematic compilation of chiropterophylic plants with family name, species name and the country of origin, the typical morphologic pattern (e.g. bell-shaped, penicillate, brush type, etc.), some distinguishing marks (e.g. tree, herb, epiphyte) the proof of chiropterophily by direct observation or circumstantial evidence, the visiting bat, the country in which the observation was made andthe pertinent references. The second table lists flower-visiting chiroptera and the plants visited. These comprehensive tables enormously enhance the value of the book and can be used with efficacy even by readers not familiar with the German language. Finally a glossary explains the scientific terms used in the text.

This well-organized book constitutes a laudable effort to bring together data and ideas from various research disciplines addressing different, but not mutually exclusive, problems. Conflicting information is exposed clearly and coherently. In my opinion, the material presented covers most of the relevant research. The illustrations, comprising photos and drawings, are extensive and well reproduced; they support and clarify the text; tables are frequently and effectively used to summarize and compare pertinent data. However, the work has one major weakness: it is not written in English. Nevertheless, I am convinced that this book will encourage further research in the fascinating field of chiropterophily and will set the standard for future publications on this subject.

Georg Baron

SLIDES OF BATS AVAILABLE AND SOUGHT

Colored slides of a world-wide selection of mammals are available from the Mammal Slide Library, a non-profit educational service of The American Society of Mammalogists. The 1986-1987 catalog lists over 900 slides of mammals depicting 605 species in 400 genera, 102 families and 19 orders. A variety of tropical and temperate bat species are represented by over 130 slides. The diversity of subjects unique and valuable resource for a wide variety of educational and research activities. Slide lists are available free of charge, and the complete catalog (with slide descriptions) costs $2.00 ($4.00 outside the USA, Canada, and Mexico). Slides of bats and other mammals, which are unrepresented, may be contributed. A want list is available from the library upon request. For more information or to order a catalog, write to: Dr. Dwight W. Moore, Division of Biological Sciences, Box 50, Emporia State University, Emporia, KS 66801 USA.

A Letter from the Publisher or a Sad Tale of Woe

Many of you have written inquiring "where is the fall issue of *Bat Research News*." Well you finally have it before you, living proof that *BRN* is still in existence. It was however a "near thing" and you deserve an apology, an explanation, and thanks for being so patient.

A few years ago we adopted our present typeset style in an attempt to make *BRN* a little more professional looking. This involved obtaining the services of a skilled typesetter and also a professional printer. Our earlier style was put together using a considerable amount of inexpensive student help and even volunteers; this new style is obviously more expensive to produce. We were able to keep the costs down by switching to computer disk for typesetting and things were going along quite smoothly. Now comes the "sad tale of woe."

Usually the third issue (late summer) is generally short, so the third issue (27:3) was combined with the fourth. That issue is usually our largest, since it contains the abstracts of the annual symposium. Many authors wished to revise their abstracts, so we did not have them all until late December, at which point Tracy typeset them to a soft disk. At about this time Tracy's position on campus was retrenched, and the college decided it could no longer do "unofficial" work in the clerical center. Disaster struck when the campus changed printing systems; we now had loaded disks that the typesetting machine could not read!! Tracy eventually obtained a position at St. Lawrence University nearby, and they agreed to let her freelance for us. However, their system was not compatible with our loaded disks but after much magic, which I at least don't understand, she managed to create a program to salvage our manuscript. All this took a long time indeed and was quite frustrating! Having *BRN* custom-produced would be much easier and quicker but would cost twice as much as it does now!

But there is good news. We have a new student helper, Lynne Lamitie, who is a computer whizz and will assist Tracy and myself. All the gadgets now are speaking the same language and get along quite well. We already have Vol. 28:1 on disks but feel that Vol. 27:3-4 should reach you first. Don't you like tales with happy endings? Thank you for your patience.

G. Roy Horst

ANNOUNCEMENT

THE SEVENTEENTH ANNUAL NORTH AMERICAN SYMPOSIUM ON BAT RESEARCH

The Seventeenth Annual North American Symposium on Bat Research will be held between 15 and 17 October 1987 in Toronto, Canada.

The local organizing committee includes Dr. J.L. Eger (Department of Mammalogy, Royal Ontario Museum, Toronto, Canada, M5S 2C6; 416-586-5767), Dr. M.B. Fenton (Department of Biology, York University, North York, Ontario M3J 1P3; 416-736-5243) and Dr. J.H. Fullard (Department of Zoology, Erindale College, University of Toronto, Mississauga, Ontario, L5L 1C6; 416-828-5364) who will be assisted cheerfully by an assortment of friends and colleagues.

Registration and technical sessions will be held in the Royal Ontario Museum (ROM—the corner of University Avenue and Bloor Street W.), and we have arranged for a block of rooms to be reserved in Venture Inn, which is two blocks north of the Museum. The Thursday evening registration at the ROM will be organized around a cash bar and the opportunity for registrants to view the Bat Cave exhibit.

The schedule for the meetings is as follows:

Thursday 15 October
  Registration from 18:00–21:30 at ROM
Friday 16 October
  Sessions from 09:00–17:00 at ROM
  Banquet Sai Woo's Restaurant
Saturday 17 October
  Sessions from 09:00–17:00 at ROM

On Friday morning we will devote one session to paapers entered in the student competition. Students who want to enter this competition should complete the attached form. As in the past, we hope to have a modest array of cash prizes for the best contribution from students.

Toronto is the capital of the province of Ontario and is relatively easily reached by air or by road. Visitors travelling by air usually arrive at the Pearson International Airport (Terminal 1 or Terminal 2). There is an excellent bus and subway service from the airport to within three blocks of the hotel (total cost $5.00 Canadian), as well as limosine and taxi service ($30.00–$40.00). People arriving at the airport can take a bus to the end of the subway line (Islington or The Royal York Hotel) and leave the subway at the Museum stop which is closest to the hotel.

In the middle of October, the weather in Toronto can be very pleasant (sunny and 10° C), or wet and cold. We suggest you plan for the latter and enjoy the former. Toronto is a city of approximately 2.5 million people which offers many attractions (other than the bat meetings in 1987). There is a very good Zoo (with colonies of Rousettus and Pteropus), a Science Center, art galleries and some local professional n'er do well baseball, football and hockey teams all of which could be in action in October.

The Royal Ontario Museum is also an important attraction. It is located at the northern edge of the St. George campus of the University of Toronto and close to many shops and restaurants. The "main drag" is Yonge Street about four blocks east of the museum.

The local currency is Canadian $$$. We suggest you consider buying them at a bank where you will undoubtedly do better than at the hotel, local shops or restaurants. In April 1987, one U.S.$$ = c. $1.40 Canadian).

Registration Fee is $20.00 Canadian, paid before 1 September 1987, and $30.00 Canadian if paid after 1 September 1987. Please make cheques or money orders payable to **The Seventeenth Annual Bat Conference.**

The Banquet will be held in Sai Woo's Restaurant on Friday evening. Tickets will be $20.00 Canadian each (cost includes two subway tokens for going to and coming from the banquet). Please make cheques or money orders payable to **The Seventeenth Annual Bat Conference** and note that by Tuesday 13 October we must tell the restaurant how many people will attend the banquet. This means that you should not count on being able to get a ticket at the last minute.

Hotel Room (Canadian $$$) 62.00 single; 67.00 double plus 5% tax.

An important feature of the ROM is its mammal collection in general and specifically, the bat collection. Those interested in working in the collection or touring the facilities of the Department of Mammalogy should contact Dr. Eger directly.

In the Toronto area there are three main foci of bat research. At the Royal Ontario Museum, R.L. Peterson and J.L. Eger are studying the systematics of bats, focussing particularly on molossids. At the Erindale campus of the University of Toronto, J.H. Fullard is continuing his research on the interactions between bats and their insect prey and paying special attention to the neurobiological implication of bat-sensitive moth ears. At York University, M.B. Fenton and several colleagues (Mark Brigham, Joe Cebek and Brian Hickey) are studying the behavioral ecolocy of bats, including foraging strategies and echolocation, and social behavior.

M.B. Fenton

CONFERENCE PROCEEDINGS

Air Borne Animal Sonar Systems:
Signal Processing and Wave Analysis
Symposium, Lyon-France,
25 Feb.-1 March 1985

B. Escudie (ICPI, Lyon, France), Y. Biraud (Obs. Meudon, Meudon, France): "Synthese des travaux des equipes francaises. A review of the French Group Research"

D. Mein (Univ. Lyon I, Lyon, France), Y. Tupinier (Museum, Paris, France): "Histoire des chiropteres en relation avec les systemes de localisation acoustiques"

J.A. Simmons (Univ. of Oregon, Eugene OR, USA: "Detection of sonar targets by echolocating bats"

H.U. Schnitzler, D. Menne (Univ. Tubingen, Tubingen, FRG): "Accuracy of distance measurement in the bat *Eptesicus fuscus*"

D. Menne, H. Hackbarth, I. Wagner (Univ. Tubingen, Tubingen, FRG): "There is no proof for optimal filtering in bats."

U. Schmidt, G. Joermann (Univ. Bonn, Bonn, FRG): "The influence of acoustical interferences on echolocation in bats"

B. Mohl (Aarhus Univ., Aarhus, DK): "Detection by a Pipistrelle bat of normal and reversed replica of its sonar pulses"

L.A. Miller, A. Surlykke (Odense Univ., Odense, DK): "The effects of arctiid moth clicks on target range discrimination by bats"

J.A. Simmons (Univ. of Oregon, Eugene OR, USA): "Sensitivity of the bat's sonar receiver"

M.B. Fenton (Carleton Univ., Ottawa, Canada): "Design of bat echolocation calls : implications for foraging ecology and communication"

J.D. Pye (Queen Mary College, London, GB): "Signals as clues to system performance"

P. Flandrin, P. Cros, G. Mange (ICPI, Lyon, France): "Sensitivity of Doppler tolerance to the structure of bat-like sonar signals"

M. Mamode (Univ. de la Reunion, Ste Clotilde, La Reunion): "Vers une definition adaptee de la date d'arrivee d'un echo sonar en vue de son estimation"

M. Zakharia (UCL-ICPI, Lyon, France): "Sonar evaluation in natural environment"

I. Ahlen (Swedish Univ. of Agric. Sci., Uppsala, Sweden): "Sonar signals used in census work and flight activity studies on bats"

K. Zbinden, P. Zingg (Naturhist. Museum, Bern, CH): "Cruising and hunting signals of echolocating free-tailed bats, *Tadarida tarniotis* in Southern Switzerland."

R.A. Altes (Oricon Corp., La Jolla CA, USA): "Overlapping windows and signals representations on the time-frequency plane"

W. Martin, K. Kruger-Alef (Univ. Bonn, Bonn, FRG): "Application of the Wigner-Ville spectrum to the spectral analysis of a class of bio-acoustical signals blurred by noise"

Y. Grenier (ENST, Paris, France): "Modeling of non-stationary signals with application to bat echolocation calls"

V. Gibiat, P. Jardin, F. Wu (Univ. Paris-Sud, Orsay, France): "Analyse Spectrale Differentielle: application aux signaux sonar de *Myotis mystacinus*"

M. Jessel (LMA-CNRS, Marseille, France): "De quelques resultats theoriques pouvant servir en bioacoustique"

J.P. Sessarego, C. Gazanhes (LMA-CNRS, Marseille, France), M. Zakharia (UCL-ICPI, Lyon, France): "Reponse acoustique de cibles et formation d'echos"

M. Mamode (Univ. de la Reunion, Ste Clotilde, La Reunion), B. Escudie (ICPI, Lyon, France): "Tolerance a l'effet Doppler et signaux optimaux. Signaux sonar emis par les chauve-souris"

J. Munier, C. Bard (CEPHAG-INPG, Grenoble, France): "Interfermetres a correlation"

M. Zakharia (UCL-ICPI, Lyon, France), J.P. Sessarego (LMA-CNRS, Marseille, France): "Sonar seeing"

Y. Tupinier (Museum, Paris, France): "Signaux d'echolocation de *Myotis mystacinus*"

G. Neuweiler (Univ. Munchen, Munchen, FRG): "Foraging, echolocation and audition in bats"

Submitted by Karl Zbinden Zoologisches
Institut Universitat Bern Switzerland.

RECENT LITERATURE

Authors are requested to send reprints of their papers to the editor for inclusion in this section. Receipt of reprints will facilitate complete and correct citation. Our Recent Literature section is based upon several bibliographic sources and for obvious reasons cannot ever be up-to-date. Any error or omission is anadvertent. Voluntary contributions for this section, especially from foreign researchers, are most welcome.

ANATOMY

Bhatnagar, K. P. 1985. Comparative morphology of the vomeronasal receptor-free epithelium of some phyllostomid bats: light microscopic observations. Aust. Mammal., 8: 265-270 (Anatomy, Univ. of Louisville School of Medicine, Louisville, KY 40292 USA).

Bhatnagar, K. P., H. D. Frahm and H. Stephan. 1986. The pineal organ of bats: a comparative morphological and volumetric investigation. J. Anat., (in press).

Chang, N., K. P. Bhatnagar, M. T. Tseng and K. B. Karim. 1986. Ultrastrucure of the pineal gland of the tropical bat *Rousettus leschenaulti*. Acta Anat., (in press; Anatomy, Univ. of Louisville School of Medicine, Louisville, KY 40292 USA).

Chase, J. 1985. Complementary roles of vision and echolocation in New World Microchiroptera. Macroderma, 1: 65-66 (Abstract; Biol. Scs., Bernard College, Columbia Univ., New York, USA).

Graydon, M., N. Beasley and P. Giorgi. 1985. Functional organization of the retina of Megachiroptera. Macroderma, 1: 67-68 (Abstract; Anatomy, Univ. of Queensland, St. Lucia, QLD 4067, Australia).

Kratzing, J. E. 1986. Preliminary studies on the nasal anatomy of three megachiropteran species: *Pteropus poliocephalus*, *Pteropus scapulatus* and *Nyctimene robinsoni*. Macroderma, 2: 23 (Abstract; Veterinary Anatomy, Univ. of Queensland, St. Lucia QLD 4067, Australia).

Mennone, A., C. J. Phillips and D. E. Pumo. 1986. Evolutionary significance of interspecific differences in gastrin-like immunoreactivity in the pylorus of phyllostomic bats. J. Mamm., 67: 373-384 (Biology, Hofstra Univ., Hempstead, NY 11550 USA).

Pettigrew, J. D., M. B. Calford, L. Z. Wise and M. L. Graydon. 1985. Topographic organization of cortical sensory fields in the grey-headed flying fox (*Pteropus poliocephalus*). Macroderna, 1: 67 (Abstract; Physiology, Univ. of Queensland, St. Lucia, QLD 4067, Australia).

Rouse, G. W., and S. K. Robson. 1985. An ultrastructural study of megachiropteran (Mammalia: Chiroptera) spermatozoa: implecations for chiropteran phylogeny. Macroderma, 1: 70-71 (Abstract; Zoology, Univ. of Queensland, St. Lucia, Brisbane, QLD 4067, Australia).

Tedman, R. A., and L. S. Hall. 1985. The absorptive surface area of the small intestine of *Pteropus poliocephalus* (Megachiroptera: Pteropidieae): an important factor in rapid food transity? Aust. Mammal., 8: 271-278 (Anatomy & Histology, Univ. of Aldelaide, GPO Box 498, Adelaide, Australia 5001).

Tedman, R. A., and L. S. Hall. 1985. The morphology of the gastrointestinal tract and food transit time in the fruit bat *Pteropus alecto* and *P. p. poliocephalus* (Megachiroptera). Aust. J. Zool., 33: 625-640.

CONSERVATION

Purchase, D. 1985. Bat-banding in Australia, 1957-1984. Macroderma, 1: 45-47 (CSIRO Div. of Wildl. Rangeland Res., PO Box 84, Lyneham, ACT 2602, Australia).

Richards, G. C. 1984. The conservation status of the rainforest bat fauna of North Queensland. pp. 292-299, IN Australian National Rainforest Study Report to the World Wildlife Fund, vol. I (G. L. Warren and A. P. Kershaw, eds.).

DISEASE AND PARASITISM

Constantine, D. G. 1985. Disease exchange between bats and researchers: problems and precautions. Aust. Mammal., 8: 325-329 (California Dept. Hlth Svcs., 2151 Berkeley Way, Berkeley, CA 94704 USA).

Domrow, R., and L. N. Lester. 1985. Chiggers of Australia (Acari: Trombiculidae): an annotated checklist, keys and bibliography. Aust. J. Zool., Suppl., Series No., 114: 1-111.

Durden, L. A., and N. Wilson. 1985. Ectoparasites from the grey-headed flying fox, *Pteropus poliocephalus* **and red flying fox,** *P. scapulatus* (Chiroptera: Pteropodidae) from Southeastern Queensland, Australia. Macroderma, 1: 51-53 (Anatomy, Vanderbilt Univ. Sch. Med., Tennessee 37232 USA).

Gadzhiev, A. T., T. A. Dubovchenko, Z. A. Mustafaeva and M. G. Kuliev. 1981-83 (?). Ectoparasites of synanthropic animals (rodents, bats, birds) and cases of their infestation of man in Azerbaijan. IN, Tagi-zade, T. A., ed., Aktual nye voprosy meditsinskoi parazitologii i tropicheskoi meditsiny Chast I: 66-68.

Labunets, N. F., and L. V. Degtiareva. 1985. Fleas of bats from the North Caucasus. Parazitologiya, 19: 177-180.

Lewis, R. E. 1985. Notes on the status of species assigned to the subgenus *Tanglha* (Siphonoptera: Ischnopsyllidae). J. Med. Entomol., 22: 338 (Entomology, Iowa State University, Ames, Iowa 50011 USA).

Mardon, D. K. 1986. A new species of *Coorilla* Dunnet and Mardon (Siphonaptera: Ischnopsyllidae) from Australia. J. Aust. Ent. Soc., 25: 47-50 (Mormopterus, Molossidae; 22 Craignavie Estate, Killin, Perthshire FK21 8SH, Scotland).

Prociv, P. 1985. Do bat worms make people sick? Macroderma, 1: 62-63 (Abstract; Parasitology, Univ. of Queensland, St. Lucia, QLD 4067, Australia).

Provic, P. 1985. Observations on the prevalence and possible infection source of *Toxocara pteropodis* (Nematoda: Ascaridoidea) in Queensland flying-foxes. Aust. Mammal., 8: 319-321. (Parasitology, Univ. of Queensland, St. Lucia, QLD 4067, Australia).

Reid, L., and D. Hoyte. 1985. The ins and outs of flying fox parasites. Macroderma, 1: 63-64 (Abstracts; Parasitology, Univ. of Queensland, St. Lucia, QLD 4067, Australia).

DISTRIBUTION

Anonymous 1985. Golden-tipped bat — a rare and precious find. Aust. Zool., 22: 13.

Conole, L., and G. Baverstock. 1982. Mammals of the Inverleigh Common. An annotated list. Gelong Nat., 19: 39-41.

Kitchener, D. J., and S. Foley. 1985. Notes on a collection of bats (Mammalia: Chiroptera) from Bali. I. Indonesia. Rec. W. Aust. Mus., 12: 223-232.

Lehmann, R. 1983. Bat research in Southern Finland, faunistic notes from summer 1982 (Chiroptera: Vespertilionidae). Memo. Soc. Fauna Flora Fenn. 59: 155-160 (Diseased; Dept. Zoology Univ. Helsinki, P. Rautatiekatu, B. Helsinki 10, Finland).

Pettigrew, J., G. B. Baker, D. Baker-Gabb, G. Baverstock, R. Coles, L. Conole, S. Churchhill, K. Fitzherbert, A. Guppy, L. Hall, P. Helman, J. Nelson, D. Priddel, I. Pulsford, G. Richards, M. Schultz and C. R. Tidemann. 1986. The Australian ghost bat, *Macroderma gigas*, at Pine Creek, northern territory. Macroderma, 2: 8-19 (Physiology & Pharmacology, University of Queensland, St. Lucia, QLD 4067, Australia).

Racey, P. A., and S. M. Swift. 1985. Bats about Britain. BBC Wildlife, 3: 379 (Zoology, Univ. of Aberdeen, Aberdeen, Scotland).

Robinson, N. H. 1985. Bats of the Illawarra region. Aust. Zool., 22: 1-4.

ECHOLOCATION

Calford, M.B., L.Z. Wise and J.D. Pettigrew. 1985. Audiogram of the grey-headed flying-fox, *Pteropus poliocephalus* (Megachiroptera: Pteropodidae). Aust. Mammal., 8: 309-312. (Physiology & Pharmacology, Univ. of Queensland, St. Lucia, Queensland, Australia 4067).

Fenton, M.B. 1985. Echolocation: a window on the activities of some bats. Tower Karst, 5: 23-26.

Guppy, A., R.B. Coles and J.D. Pettigrew. 1985. Echolocation and acoustic communication in the Australian ghost bat, *Macroderma gigas* (Microchiroptera: Megadermatidae). Aust. Mammal., 8: 299-308 (Acoustic Lab., Sch. Biol. Scs., Australian National Univ., Canberra, ACT, Australia 2601).

McAnally, K. 1985. The use of Doppler information by frequency modulating bats. Macroderma, 1: 56 (Abstract; Zoology, Univ. of Queensland, St. Lucia, QLD 4067, Australia).

Taniguchi, I. 1985. Echolocation sounds and hearing of the greater Japanese horseshoe bat (*Rhinolophus ferrumequinum nippon*). J. Comp. Physiol., A, 156: 185-188 (Tokyo Med. & Dent. Univ., Inst. Med. Res., Dept. Auditory Disorders, 1-5-45 Yshima, Bunkyo Ku, Tokyo 113, Japan).

Vater, M., A.S. Feng and M. Betz. 1985. An HRP-study of the frequency-place map of the horseshoe bat cochlea: morphological correlates of the sharp tuning to a narrow frequency band. J. Comp. Physiol., 157: 671-686 (Univ. Munich, Inst. Zool., Lusenstr. 14, D-8000 Munich 2, FRG).

Wise, L.Z., M.B. Calford and J.D. Pettigrew. 1985. Frequency organization of auditory cortical fields in the flying fox. Macroderma, 1: 66 (Abstract: Physiology & Pharmacology, Univ. of Queensland, St. Lucia, QLD 4067).

Woodside, D. P., and K. J. Taylor. 1985. Echolocation calls of fourteen bats from eastern New South Wales. Aust. Mammal., 8: 279-297 (Zoological Parks Board of New South Wales, POB 20, Mosman, New South Wales, Australia 2088).

ECOLOGY AND BEHAVIOR

Avery, M. I. 1985. Winter activity of pipistrelle bats. J. Anim. Ecol., 54: 721-738 (Zoology, Univ. of Aberdeen, Aberdeen, Scotland).

Hall, L. S., and R. A. Tedman. 1985. Flying foxes: fast food specialists. Macroderma, 1: 62 (Abstract: Anatomy, Univ. of Queensland, St. Lucia, QLD 4067, Australia).

Hoye, G. 1985. Observations on bats of Cape Hillsborough National Park, Queensland. Macroderma, 1: 48-51 (5 Blaxland Ave., Singleton Heights, NSW 2330, Australia).

Humphrey-Smith, I. 1985. Thermoregulatory and clustering behavior of *Miniopterus* bats during winter in eastern Australia. Macroderma, 1: 58 (Abstract: Parasitology, Univ. of Queensland, St. Lucia, QLD 4067, Australia).

Irvin, B., and P.V. Driscoll. 1986. Seasonal change in the diet of the Queensland blossom bat (Syconycteris australia) in coastal vegetation of Brivie Island. Macroderma, 2: 22 (Abstract: Biology, Queensland Inst. of Technology, Brisbane, QLD 4001, Australia).

Kloske, B.L. 1986. Behavioral changes between mated grey-headed flying-foxes *Pteropus poliocephalus*. Macroderma, 2: 22-23 (Abstract: Psychology, Univ. of Queensland, St. Lucia, Queensland 4067, Australia).

Lane, R. 1985. Mother-young relationships in the grey-headed flying-fox *Pteropus poliocephalus*. Macroderma, 1: 68-69 (Abstract: Zoology, Univ. of Queensland, St. Lucia, QLD 4067, Australia).

Lunney, D., L. Barker and D. Priddel. 1985. Movements and day roosts of the chocolate wattled bat *Chalinolobus morio* (Gray) (Microchiroptera: Vespertilionidae) in a logged forest. Aust. Mammal., 8: 313-317 (Natl. Parks and Wildlife Svce, POB N 189, Grosvenor St., Sydney, NSW, Australia 2000).

Gebhard, J., and M. Ott. 1985. Etho-ocologische Beobachtungen and einer Wochenstube von *Myotis myotis* (Borkh., 1797) bei Zwingen (Kanton Bern, Schweiz). Mitteilungen der Naturforschenden Gesellschaft in Bern N. F. 42: 129-144 (In German; Naturhistorisches Museum, Augustinergasse 2, CH-4001 Basel, Switzerland).

Gebhard, J., and K. Hirschi. 1985. Analyse des Kotes aus einer Wochenstube von *Myotis myotis* (Borkh., 1797) bei Zwingen (Kanton Bern, Schweiz). Mitteilungen der Naturforschenden Gessellschaft in Bern N.F. 42: 145-155 (In German).

Parry-Jones, K. 1985. Winter flying-fox colonies in Southern NSW. Aust. Zool. 22: 5-6.

Richards, G. 1986. *Dobsonia* flight and ecology: more on lift at low speed. Macroderma, 2: 20 (Wildlife & Rangelands Res., Trop. Forest Res. Ctr., CSIRO Atherton, QLD 4883, Australia).

Richards, G.C., and F. H. Crome. 1985. The effect of rainforest fragmentation on a tropical insectivorous bat community. Macroderma, 1: 57 (Abstract).

Robson, S. 1985. Population dynamics and dispersal patterns of *Rhinolophus megaphyllus* in the Brisbane forest park, Southeast Queensland. Macrodernan, 1: 56 (Abstract; Zoology, Univ. of Queensland, St. Lucia, QLD 4067, Australia).

Ryan, M.J. 1986. The Panamanian love call. Natural Hist. Mag., 95: 37-43 (Figures; remarks on *Trachops cirrhosus* and *Cardioderma cor*).

Savva, N., and R. Taylor. 1986. Bat remains in a Tasmanian cave. Macroderma, 2: 21 (Zoology, Univ. of Tasmania, GPO Box 252 C, Hobart, Tasmania, GPO Box 252 C, Hobart, Tasmania 7001).

Schulz, M., and K. Menhorst. 1986. Roost preferences of cave-dwelling bats at pine creek, northern territory. Macroderma, 2: 2-7 (167 South Beach Rd., bittern, Vic., 3918, Australia).

Strong, M., and E. Cuffe. 1985. Drongos pursue Microchiroptera. Sunbird, 15: 42-43.

Tideman, C.R., D.M. Priddel, J. E. Nelson and J. D. Pettigrew. 1985. Foraging behavior of the Australian ghost bat. *Macroderma* gigas (Microchiroptera: Megadermatidae). Aust. J. Zool., 33: 705-713.

Toop, J. 1985. Habitat requirements survival strategies and ecology of the ghost bat *Macroderma gigas* Dobson. (Microchiropotera, Megadermatidae) in central coastal Queensland. Macroderma, 1: 37-41 (Queensland Natl. Parks & Wildlife Svce., P.O. Box 1362, Rockhampton, QLD 4701, Australia).

Williams, C. F. 1986. Social organization of the bat, *Carollia perspicillata* (Chiroptera: Phyllostomidae). Ethology, 71: 265-282 (Univ. Miami, Dept. Biology, Coral Gables, Fl. 33124 USA).

Young, A. 1985. Results of a questionnaire survey of Australian bats using building as roosts. Macroderma, 1: 69-70 (Abstracts; Darling Downs Inst. of Advanced Education, Toowoomba, QLD 4350, Australia).

PESTICIDES AND PUBLIC HEALTH

Clark, D. R. 1986. Toxicity of methyl paration to bats: mortality and coordination loss. Environmental Tox. & Chim., 5: 191-195 (Fish & Wildlife Svce., U.S. Dept. Interior, Patuxent Wildlife RFs. Center, Laurel, Maryland 20708 USA).

Clark, D. R., A. S. Wenner and J. F. Moore. 1986. Metal residues in bat colonies, Jackson County, Florida, 1981-1986. Florida Field Nat., 14: 38-45. 1 Fig.

Racey, P. A., and S. M. Swift. 1986. Residual effects of remedial timber on bats. Biol. Conservation, 35: 205-214 (Zoology, Univ. of Aberdeen, Aberdeen, Scotland).

Sutton, R. H., and W. R. Kelly. 1985. Lead poisoning in fruit bats. Macroderma, 1: 64-65 (Abstract; Vet. Pathol. & Publ. Hlth., Univ. of Queensland, St. Lucia, QLD 4067, Australia).

PHYSIOLOGY

Harmata, W. 1985. The length of awakening time from hibernation of three species of bats. Acta Theriol., 30: 321-323 (Psychol. & Ethology Anim., Jagiellonian Univ., M. Karasia 6, 30-060 Krakow, Poland).

McCoy, M. 1985. Temperature regulation in the little red flying fox, *Pteropus scapulatus*. Macroderma, 1: 60 (Abstract; Zoology, Univ. of New England, Armidale, NSW 2351, Australia).

Speakman, J.R., and P.A. Racey. The effects of non-steady state CO production on the accuracy of the multiple sample curve fitting doubly-labelled water technique of estimating CO production. J. Appl. Physiol., (in press: Zoology, Univ. of Aberdeen, Aberdeen, Scotland).

Wightman, J., J. Roberts and N.S. Agar. 1985. Blood physiology of the grey-headed fruit bat (*Pteropus poliocephalus*). Macroderma, 1:61 (Abstract; Physiology, Univ. of New England, Armidale, NSW 2351, Australia).

Wilson, P. 1985. Does *Dobsonia* (Chiroptera: Pteropodidae) have a fling? Macroderma, 1: 53-55 (Zoology, Univ. of New South Wales, PO Box 1, Kensington, NSW 2033, Australia).

REPRODUCTION

Breed, W. G., and R. W. Inns. 1985. Variation in sperm morphology of Australian Vespertilionidae and its possible phylogenetic significance. Mammalia, 49: 105-108.

Heidman, P. D. 1986. Delayed development in a paletropical fruit bat: possible initiation and termination cues. Biol. Reprod., 34: 239 (Abstract; Mammal. Div., Museum of Zoology, Univ. of Michigan, Ann Arbor, MI 48109 USA).

Kenagy, G.J., and S.C. Trombulak. 1986. Size and function of mammalian testes in relation to body size. J. Mamm., 67: 1-22 (*Pteropus tonganus*) mentioned; Zoology, Univ. of Washington, Seattle, WA 98195 USA).

McGuckin, M.A., and A.W. Blackshaw. 1985. Reproductive seasonality in male fruit bats, genus *Pteropus*. Macroderma, 1: 59-60 (Abstracts; Physiology & Pharmacology, Univ. of Queensland, St. Lucia, QLD 4067, Australia).

McWilliam, A. N. The reproductive and social biology of *Coleura afra* (Emballonuridae) in a seasonal, tropical environment. IN, Recent Advances in the Study of Bats. M. B. Fenton, P.A. Racey and J.M.V. Rayner, eds. Cambridge University Press (in press; Zoology, Univ. of Aberdeen, Aberdeen, Scotland).

Phillips, W.R., and S.J. Inwards. 1985. The annual activity and breeding cycles of Gould's long-eared bat, *Nyctophilus gouldi* (Microchiroptera: Vespertilionidae). Aust. J. Zool., 33: 111-126

Racey, P. A. Reproductive assessment. IN, Ecological and Behavioral Methods for the Study of Bats. T. H. Kunz, ed. Smithsonian Institution Press (in press; Zoology, Univ. of Aberdeen, Aberdeen, Scotland).

Speakman, J. R., and P. A. Racey. The energetics of pregnancy and lactation in the brown long-eared bat *Placotus auritus*. IN, Recent Advances in the Study of Bats. M.B. Fenton, P.A. Racey and J.V.M. Raynor, eds. Cambridge University Press (in press; Zoology, Univ. of Aberdeen, Aberdeen, Scotland).

Towers, P., and L. Martin. 1985. Ovarian function in the grey-headed flying fox *Pteropus poliocephalus*. Macroderma, 1: 58-59 (Abstracts; Physiology & Pharmacology, Univ. of Queensland, St. Lucia, QLD 4067, Australia).

Towers, P. A., and L. Martin. 1985. Some aspects of female reproduction in the grey-headed flying-fox, *Pteropus poliocephalus* (Megachiroptera; Pteropodidae). Aust. Mammal., 8: 257-263.

Taylor, R. 1985. Identity of *Nyctophilus* in Tasmania. Macroderma, 2: 21-22 (Zoology, Univ. of Tasmania, GPO Box 252 C, Hobart, Tasmania 7001).

SYSTEMATICS

Wilson, 1985. Maeda's *Miniopterus* taxonomy. Macroderma, 1: 29-36 (Zoology, Univ. of New South Wales, Kensington, NSW 2033, Australia).

VIROLOGY

Cybinski, D.H. 1986. Antibodies to arboviruses in flying fox serum. Macroderma, 2: 24 (Abstract; CSIRO Long Pocket Labs, Private Mail Bag 3, Indooroopilly, Queensland 4068, Australia).

THESES

Ellis, W.A.H. 1985. The effect of a temperature-determined food supply on the annual activity cycle of the lesser long-eared bat: *Nyctophilus geoffroyi* Leach 1821 (Microchiroptera: Vespertilionidae) B. Sc. Hons. Thesis, Aust. Natl. Univ., Zoology Dept., Canberra.

McCoy, M. 1984. Body temperature and oxygen consumption of *Pteropus scapulatus* Peters, 1862 (Megachiroptera) and the reaction to radiant heat — a bioelemetric study. B. Sc. Hons. Thesis, Univ. of New England, Armidale, Australia.

O'Neill, M.G. 1984. Structure and composition of Tasmanian bat communities. B. Sc. Hons. Thesis, Zool. Dept., Univ. of Tasmania.

Winderlich, S. 1982. The reproductive biology of five vespertilionid bats. B. Sc. Hons. Thesis, Zool. Dept., Australia Natl. Univ.

MISCELLANEOUS

Johnswood, L. 1985. Beautiful bats — that bite. People, 02 85: 24-26.

Marsh, S. 1985. Drive 'em batty. People, 23 Sept.: 32.

Abstracts of Papers and Posters Presented at the Sixteenth Annual North American Symposium on Bat Research at the University of Massachusetts, Amherst, Massachusetts October 17-18, 1986

Abstracts appear alphabetically by first author. Addresses of authors may be found under the list of attendees following the abstracts in this issue.

Morphology, Echolocation and Resource Partitioning in Insectivorous Bats

By Hugh D.J.N. Aldridge

Using a community of 26 insectivorous bats I tested three hypotheses: (1) Wing morphology and echolocation call design determine foraging site selection and behaviour. (2) Echolocation call design should be compatible with wing morphology, some combinations of morphology and echolocation design not occuring because they would be maladaptive. (3) Morphology and echolocation call design are the primary mechanisms leading to resource partitioning bats.

The first hypothesis was supported by the data; there were significant correlations between wing morphology, echolocation call design and foraging behaviour. Significant correlations between those morphological parameters which increase manoeuvrability in clutter and clutter-resistant echolocation calls supports the second hypothesis. There was an association between foraging habit and diet; bats that fed in the same habitats tended to take the same prey, while species foraging in different habitats took different prey, supporting the third hypothesis.

Heterothermy, Activity, and Roost Choice in *Eptesicus fuscus*

Doris Audet

Temperate insectivorous bats are considered to be heterothermic. So far, laboratory experiments have shown that this characteristic may have major implications in the life and ecology of these bats. For example, gestation period of some vespertilionid bats increases at low ambiant temperatures (Racey 1973). The purpose of the present study was to investigate to what extent big brown bats use this ability to enter upper torpor in their natural roosts according to their sex and reproductive state. I used radio-telemetry to monitor body temperature and roost temperature. Seventy-five bats (65 adult females, 8 adult males and 2 juveniles) were radio-tagged and observations were made for the equivalent of 153 transmitter-days. In the spring, (early pregnancy), females often enter daily torpor, unlike later in the season, when females near parturition or lactating maintain, most of the time a high body temperature, and increase foraging activity. Males were rarely found in the colonies, however, they seem to allow their body temperature to drop more often than pregnant or lactating females. This thermoregulatory strategy, together with energy requirements seems to motivate temperature preferences of the bats.

The Frequency of Occurrence of *Histoplasma capsulatum* in Southern New England Bat Colonies

P. August, L. Ajello, and R. Weeks

The purpose of this study was to evaluate the frequency with which the fungus *Histoplasma capsulatum* occurs in guano deposits from bat colonies in Southern New England. We collected 31 guano samples form 10 colonies of *Myotis lucifugus* in New Hampshire and Rhode Island. There were assayed at CDC for the presence of *H. capsulatum*. All samples tested negative for the fungus. Given our small sample size, we are hesitant to conclude that the fungus does not occur in New England bat colonies. However, it is clear that *H. capsulatum* is not common in these conditions. Definitive conclusion on the presence of this pathogenic fungus in bat colony environments awaits further sampling by bat biologists and testing by CDC. Bat biologists wishing information on having guano samples tested should write L. Ajello at the address given in the symposium participants section in the back.

The Communication Role of Echolocation Calls in Vespertilionid Bats

Jonathan Balcombe

Playback presentations of echolocation calls to *Myotis lucifugus* and *M. yumanensis*, and to *Lasiurus borealis* to assess the potential of these vocalizations in communication. If design of echolocation call reflects foraging strategy, I predict that foraging bats will respond more to calls similar in design to their own. This work follows on the work of Barclay (Behav. Ecol. Sociobiol., 10: 271-275, 1982) who showed that *M. lucifugus* en route to feeding sites responded positively to the calls of conspecifics, artificial representations of the same, and the calls of sympatric *Eptesicus fuscus*.

Presentations to the *Myotis* species were made in the vicinity of roost and foraging sites, while those to *L. borealis* were performed at foraging sites only. Stimuli presented included the calls of conspecifics, calls of similar design (duration, bandwidth, pattern of frequency change over time), and calls of different design, including the CF-FM calls of *Rhinolophus megaphyllus*. *L. borealis* were also presented with normal conspecific calls, conspecific feeding "buzzes," and each of these two stimuli played back in reverse. Control stimuli included "white noise," reverse conspecific calls, and for the *Myotis* species, artificially produced *Myotis* calls.

At both the British Columbia (*M. yumanensis*) and Ontario (*M. lucifugus*) roosts, responsiveness to playback stimuli increased dramatically (~50%) when the young bats became volant in early July. *Myotis yumanensis* bats in British Columbia responded most strongly to conspecific calls. *M. lucifugus* in Ontario also reacted strongly to conspecific calls, but even more so to the novel *Rhinolophus* stimulus. At feeding sites, the responsiveness of *Myotis* bats was less pronounced; none of the bats in a feeding swarm was observed to investigate the stimuli.

L. borealis responded most strongly to the feeding buzz stimulus, but also showed response in both the normal conspecific and reverse feeding buzz stumuli. *L. borealis* returned nightly to forage at the same illuminated area (B. Hickey pers. comm.), and aerial chases were common, especially when one bat pursued an insect.

The findings largely support the hypothesis that bats are attracted to feeding calls most similar in design to their own. However, the strong attraction of *M. lucifugus* to *R. megaphyllus* calls suggests that these bats may show curiosity towards certain novel sounds. While *Myotis* appear to eavesdrop on a foraging neighbour in attempts to 'steal' a pursued insect.

A Comparison of the Foraging Ecology of *Myotis evotis* and *M. lucifugus* in the Alberta Foothills

Robert M.R. Barclay

The foraging ecology of sympatric *Myotis lucifugus* and *M. evotis* (the long earred bat) was studied in the Rocky Mountain foothills of southwestern Alberta in an attempt to investigate resource partitioning between these two species. Spatial and temporal activity was assessed by monitoring echolocation calls and capturing bats in mist nets and harp traps. Captive bats were tested for their maneouverability and ability to capture insects in the air and from surfaces. The echolocation calls recorded from free-flying individuals were also compared. In structure, the echolocation calls of the two species are very similar but those of *evotis* are considerably less intense. *M. evotis* proved much more maneouverable and could fly more slowly than *M. lucifugus* due to *evotis'* lower wing loading. These attributes correlate well with the habitat-use patterns of the two species. Whereas *lucifugus* was most common in open areas, particularly over calm bodies of water where aerial insect abundance was highest, *evotis* was almost exclusively restricted to more cluttered, forested habitats. The low intensity calls and slow maneouverable flight adapt *evotis* for this type of situation. In the lab *evotis* was adept at taking insects from surfaces (by landing on them) and was attentive to prey-emitted sounds. However, they were also able to capture prey in the air and field observations could not confirm previous suggestions that these bats are "gleaners." Of particular interest is the fact that the study area supports both male and reproductive active female *evotis* but almost exclusively male *lucifugus*. It appears the high energy demands of female *lucifugus* can not be supported by the low aerial insect abundance and short, cool growing season of the area. The lower energy demands and option of entering daily torpor, however, allow males to occupy the area. The different foraging strategy and prey base of *evotis* may allow females of this species to successfully rear their young where *lucifugus* can not.

Seasonal Strategies of Energy and Time Allocation in *Phyllostomus hastatus* (Phyllostomidae)

G.P. Bell, T.H. Kunz, K.A. Nagy, and G.F. McCracken

We examined the energetic strategies of pregnant, lactating, and non-reproducing female, and harem male *Phyllostomus hastatus* in Trinidad between April 1984 and September 1985. Time budgets were obtained using radio-tracking. Total daily energy expenditure (DEE), and water flux were measured directly in free-living animals using the doubly labeled water technique. We then used these values, combined with published information on the cost of flight, and the composition of various foods of *Phyllostomus* to estimate food intake and diet composition, actual flight time, and foraging efficiency.

Pregnant females and harem males were significantly heavier than lactating and non-reproductive females, but there were no significant differences in rates of water flux, total body water, DEE, foraging flight times, or foraging efficiency. Actual differences in these parameters between lactating and non-lactating females, and between harem males and females may be obscured because of small sample sizes.

A harem male during the period of mating (January) had the highest daily field metabolic rate measured (173.6 kJ/day), which was 43% higher than the rate of a similar-sized harem male during the period of pregnancy and lactation (April). This higher daily energy cost is directly attributable to increased roost activity associated with mating and harem-maintenance, and accounts for 20% of DEE during this period.

Lactating females had surprisingly low DEE's, which did not differ markedly from those of pregnant or non-reproductive females, although mass-specific FMR of lactating females was 25% higher than for pregnant females. However, incorporating the cost of production of milk, lactating females had total daily energy intakes which were some 23% greater than pregnant and 21% greater that non-reproductive females. Thus, during lactation, females are increasing their energy intake to meet the demands of milk production without having to expend extra energy to obtain it. This seeming paradox is explained by a change in foraging behavior. While males and non-lactating females tended to use a mixed diets of insects and fruit, energy and water flux values suggest that lactating females feed exclusively on insects. Lactating females spent an average of 3.92 h/night foraging, 39% more time than pregnant females but only 3% more time than non-reproductive females. Foraging efficiency of reproductive females (44.2 kJ/h) was significantly higher than that of non-reproductive females, which may reflect greater food availability in April.

Winter Activity by *Eptesicus fuscus*: The Influence of Energy Reserves

R. Mark Brigham

I tested the hypothesis that hibernating big brown bats (*Eptesicus fuscus*) become active when they reach a critically low energy reserve level. I predicted that bats who become active as a last resort should 1) show no relations between body mass or fat levels and date of capture and, 2) have lower energy reserves (body mass, fat levels) than individuals still hibernating. There was no significant relations between either the mass or fat content and the date of capture of active bats. The masses of inactive bats sampled throughout the winter at a hibernacula (R=17.4 ± (SE)0.2g, n=116) were significantly greater than the masses of active bats captured in buildings (x=12.7±0.3g, n=43). The masses of inactive bats from 2 March samples, near the end of the hibernation period (x=16.3 ± 0.2, n=63) were also significantly heavier than those of active bats. The fat content of inactive individuals (x=2.46 ± 0.15g, n=18) was significantly greater than that of active bats (x=0.63 ± 0.20g, n=6.) For two different size classes, 16 of a total of 18 active individuals weighed less than the mass predicted for inactive bats leaving hibernation on 1 April. These results are consistent with the hypothesis that bats become active at critically low energy reserve levels, possibly to find food.

Habitat Use and Social Behaviour of the Tent-Bat, *Ectophylla Alba*

Anne P. Brooke

The habitat use and social behavior of *Ectophylla alba* was studied in the wet tropical forest at Finca La Selva, Costa Rica during June-July 1984, April-May 1985, Jan.-April 1986. *E. alba* has a clumped distribution in secondary growth but can be found scattered throughout the primary forest. Roost tents are distinctive in the manner in which they are cut by the animals. Tents were found in eight of the nine common species of *Helioconia* at La Selva, as well as in epiphytes, saplings, and other understory herbaceous plants. New tents were predictable, based on location, age, accessability and angle of the leaf. *Heliconia* tents are serviceable for at least nine months and non-heliconia tents may be used for at least 12 months. Individual plants were used reptitively for three years, with new tents being cut in freshly emerged leaves. Day roost and night roost tents of a single group of bats were located in close proximity. Bats used day roosts continuously for periods of at least 45 days.

I checked all tents daily for bats in 1985 and 1986. Forty-six animals were marked with numbered aluminum collars in 1985. Twelve (26%) of these were recaptured in the same area in 1986, including one of six young; however, only four individuals were found consistently. There were 34 animals new to the area marked in 1986. Groups ranged in size from two to 17 individuals and were of mixed gender composition until parturition in mid-April. At this time groups divided forming bachelor (n=3) and harem tents (n=5). Harem tents contained two to four females, a single adule male, and frequently a non-reproductive male. Bachelor groups consisted of two to 12 adults and juvenile males. Births were highly synchronous both within and between tents with a single pup being born to each female. In 1985, during the three week period of dependency by the pups, the six females nursed pups other than their own 20% of the time. Recapture data does not suggest that individual members of tent groups are related although sample size is small.

The Ovarian Cycle of *Myotis lucifugus*: A Critical Review of Previous Studies and a New Hypothesis Based on Recent Observations

G. Dale Buchanan

Our concept of ovarian activity in *Myotis lucifugus* stems principally from classic studies by Mary J. Guthrie and William A. Wimsatt, and their students. As described, the ovarian cycle fits the classic mammalian pattern except for the cessation of activity during hibernation. Briefly, a post-lactational follicular growth wave gives rise to several antral follicles, but only one survives. Mating precedes hibernation, but ovulation does not ensue, and the single mature follicle, which is distinctive due to accretion of glycogen in the cumulus oophorus cells, persists with no evidence of changes until spring. Ovulation occurs 1-3 days after permanent arousal, during which interval both follicle and ovum undergo pre-ovulatory changes. Luteinization is rapid and a solid corpus luteum is usually present when the conceptus reaches the 2-cell stage. There is renewed folliculare growth during pregnancy and follicles often acquire antra before regressing. The corpus luteum regresses at the end of pregnancy and there is no corpus luteum of lactation.

The existence of a post-lactational follicular growth wave is inferential. Such a wave has been described in *Myotis grisescens* and one would have to occur in young females that mature before hibernation. However, there is no published description on ovarian activity during the critical August-September period when the mature follicle is selected. The static appearance of this follicle and the absence of other antral follicles is convincing evidence that it survives and ovulates. However, this does not prove that all follicular activity is halted; in fact, recurrent growth of secondary follicles has been described in hibernating *M. lucifugus*. On the other hand, efforts to induce ovulation by premature arousal and/or pituituary hormones led to the conclusion that the hypothalamus or pituitary was refractory to stimuli in the first part of hibernation and that function returned gradually during the second part.

The crucial evidence for the refractory/recovery hypothesis is the report that neither arousal nor administration of pituitary extract evoked ovulation in December, whereas both procedures did so with increasing efficacy during subsequent months. However, recent studies showing recurrent fluctuations in plasma progesterone during hibernation indicate that hypothalamo-pituitary function is episodic not biphasic, suggest that earlier results may have been confounded due to choice of examination times. Moreover, observations of ovarian hypertrophy following unilateral ovariectomy of hibernating bats, and, if the mature follicle was in the excised ovary, formation of a new glycogen-laden follicle, show that substantial ovarian activity can be elicted.

In an effort to reconcile the various studies mentioned above, I propose the following hypothetical ovarian cycle, recognizing that although it is consistent with the data available, significant portions require experimental verification. Female *M. lucifugus* experience recurrent, 60 day, periods of hypothalamo-hypophyseal-ovarian activity which are presumably governed by an endogenous circannual cycle. During each period there is increased follicular growth and increased steroidogenesis in the interstitial tissue, and, in theory, ovulation would occur. During hibernation, however, ovulation is prevented by the low metabolic rate of torpor and formation of new antral follicles is, in turn, blocked by the presence of a mature follicle. Premature arousal, if it coincides with a period of activity, does permit ovulation and pregnancy, just as normal spring arousal (which must necessarily coincide with an activity period) does. Antral follicles do form during pregnancy, but formation of a mature, ovulable follicle is prevented by atresia due to the high levels of progesterone secreted by the corpus luteum. An activity period at the end of pregnancy is presumably responsible for the elevated progesterone levels observed during lactation, but whether a new "mature" follicle is selected at this time or during the post-lactational activity period is unknown.

Use of a Predictive Tracking Strategy by *Noctilio leporinus*

Karen A. Campbell and Roderick A. Suthers

Noctilio leporinus, a fish-catching bat, was trained to dip its feet at a food reward supported 0.5 cm above the surface of a pool by a vertical wire, moving horizontally at a constant speed in a direction perpendicular to the flight path of the bat. When this moving target disappeared beneath the water surface before the bat reached it, *N. leporinus* did not dip at the point where the target disappeared, but rather, the dip was displaced from the point of target disappearance in a direction that indicated that the bat had allowed for continued movement of the submerged target. Trials were performed at two different speeds, 0.66 and 1.25 m/s, such that the submerged target moved an average distance of 9.3 ± 0.2 and 18.1 ± 0.6 cm, respectively, between the time of disappearance and the time of the bat's dip. In all moving trials, at both target speeds, the bat dipped ahead of the point of target disappearance. At the slower target speed, the bat dipped its feet within 1.2 ± 1.2 cm of the submerged target, displaced from the point of disappearance by an average distance of 13.7 ± 0.9 cm. There was no significant disappearance between accuracy of dips at disappearing stationary targets and those at moving disappearing targets.

The temporal pattern of sonar pulses emitted during trials in which the moving target disappeared differed from that preceding dips at a moving non-disappearing target. In the latter case, the interpulse intervals (IPI), measured from the end of one pulse to the beginning of the next, were progressively reduced to a minimum of 4.5 ms, such that the pulse repetition rate (PRR) typically reached 185 pulses/s int he terminal phase of target approach. During trials with a disappearing target, the IPI was never reduced below 10 ms (a maximim PRR of 100 pulses/s), with the PRR decreasing after the time of target disappearance to reach an average rate of 30 pulses/s at the time of the bat's dip. Despite the absence of a terminal buzz in the disappearing trials, flight behavior remained unchanged as *N. leporinus* executed an apparently normal, coordinated dip at the position of the subemerged target. This predictive tracking strategy is in contrast to the non-predictive tracking behavior reported for *Eptesicus fuscus* (Masters, Moffat and Simmons, 1985, Science 228:1331). This project is supported by NSF grant BNS 48-830-11.

An Update on the Conservation Effort for the Indiana Bat at Trout Cave

Virginia M. (Tipton) Dalton

The National Speleological Society (NSS) purchased Trout Cave in West Virginia in 1982. I was asked to do a survey of the bats in the cave. In February, 1983, we counted about 750 bats, 21 of which were *M. sodalis*. Trout historically had several thousand hibernating *M. sodalis*. Realizing the potential for recolonization of Trout by *sodalis*, John Hall and I recommended that the cave be closed during the period of hibernation for five to ten years. Even though observations of a recovering colony of Indiana bats at a nearby cave suggest longer may be necessary, we were reluctant to recommend a longer time period because the cave had become a heavily trafficked cave. Because of its popularity as a spelunking cave, several cavers started a campaign to oppose the closure of the cave for even part of the year. Sad to say, it was rather effective. Many cavers, not understanding the plight of the Indiana bat or the importance of recovering historical hibernacula, jumped on the "Trout is for cavers (and implied not for bats" bandwagon. Fortunately, there were enough advocates of "Troute is for cavers *and* for bats" to convince (barely) the NSS Board of Governors to establish a moratorium on caving in Trout Cave for a period of six winters to give the bats a chance to recover the hibernating population.

Part of the problem with the Trout Cave situation was that people favoring closure for the bats were much less organized and vocal than those favoring leaving the cave open for cavers. Regardless, the fact that so many cavers were much less inclined to accept arguments for closing seems indicative of a potential lack of understanding of (hopefully, not lack of caring about) bat biology and conservation. Perhaps we could write more articles about bats for the NSS through its publications, *The NSS News*.

The Diet of Female Big-Eared Bats and Their Young

Virginia M. (Tipton) Dalton and Virgil Brack, Jr.

Several aspects of the life history and ecology of the big-eared bat, *Plecotus townsendii virginianus*, were studied during the maternity seasons of 1983-1985. The insect diet of the maternity colony was determined by fecal analysis. Overall, more than 95% of the fecal material contained moth *Lepidoptera* fragments. Moth consumption was greatest in late summer. Beetles *Coleoptera*, the second most common dietary item, were much less important than moths. The bats also consumed small quantities of Homoptera, Neuroptera, Tricoptera, and Plecoptera. This study further substantiates that the species is a moth specialist throughout its large range despite the spotty distribution and the geographical isolation of the subspecies.

Foraging Behaviour of Three African Insectivorous Bats

M.B. Fenton

During November 1985 I studied the foraging behaviour of three species of African insectivorous bats in Kruger National Park in South Africa. Using radio-transmitters, I collected data on 10 *Rhinolophus hildebrandti*, 9 *Scotophilus borbonicus* and 10 *Tadarida midas*. While the *Scotophilus* and the *Tadarida* foraged only from continuous flight, the *Rhinolophus* alternated between foraging from continuous flight and hunting from a perch. All three species foraged for the same time each night, but they covered different areas, with the *Tadarida* ranging at least 10 km from their roost, the *Scotophilus* 1 km, and the *Rhinolophus* less than 2 km. The *Tadarida* foraged high above the ground in uncluttered surroundings, while the *Scotophilus* operated closer to the vegetation, and the *Rhinolophus* foraged below the canopy.

Ecological Relationships Among Sympatric *Carollia* Species in Costa Rican Tropical Dry and Wet Forests

Theodore H. Fleming

Phyllostomid bats of the genus *Carollia* are among the most common bats in many lowland neotropical forests. In Central America, two species (*C. perspicillata* and *C. subrufa*) are sympatric in tropical dry forests, and three species (*C. brevicauda, C. castanea*, and *C. perspecillata*) co-occur in tropical wet forests. In this paper, I examine two questions: (1) How extensively do the niches of sympatric species overlap and (2) Do similar patterns of resource partitioning occur in both habitat types? To answer these questions, I present data from a long-term study in Costa Rican tropical dry forest and preliminary data from tropical wet forest.

Sympatric *Carollia* species are sometimes difficult to distinguish externally but differ significantly in size. These size differences, in turn, lead to predictable differences in patterns of resource use. In both habitats, *C. perspicullata* in patterns of resource use. In both habitats, *C. perspicullata* is larger than its congeners: it is 26% heavier than *subrufa* and 18% and 58% heavier than *brevicauda* and *castanea*, respectively. *Perspicullata* is 22% heavier in wet forest than in dry forest. The mean Euclidean distance between *Carollia* species in 2-dimensional morphological space is identical to both habitats, which suggests that an ecologically-determined rule of limiting similarity is in operation.

Sympatric species differ in relative abundance and in patterns of roost use, diet, and distributions among habitats. In dry forest, *C. perspicullata* far outnumbers *subrufa* and roosts in cave and hollow trees (rather than in man-made holes where *subrufa* is more common): its diet is less-dominated by *Piper* fruits and it eats larger fruits, on average, than does *subrufa*: and it forages more in undisturbed and less in disturbed habitats than does *subrufa*. In wet forest, all three sympatric species are equally abundant and roost in hollow trees in primary forest. *C. castanea* is the most dependent and *C. perspicullata* is the least dependent on *Piper* fruits: *casteana* is the most common *Carollia* in second growth habitats and *perspicullata* is the most common *Carollia* in primary forest. *C. brevicauda* is intermediate in its dependence on *Piper* fruits and its pattern of habitat use.

These results suggest that similar size-dependent rules operate to determine ecological relationships between sympatric *Carollia* species in wet and dry tropical forests. These rules appear to reflect allometric relationships between size, energetics, and interspecific behavioral interactions.

Low Light/Infrared Videography System for Study of Commensal Bats

Stephen C. Frantz

A high-resolution infrared closed-circuit television system has been developed and adapted for remote indoor/outdoor studies of commensal bats under natural conditions. With visible light, the camera has a usable picture at 0.1 lux, suitable for dusk/dawn and some daytime attic applications. For darker areas and nighttime observations, non-visable infrared (IR) illuminators (800-1200 nm) can be utilized to take advan-tage of the camera's IR sensitivity of 700 to 940+ nm. Alternative red filters (approx. 660-720 nm) can be used where dark backgrounds would otherwise preclude observations with IR alone. The high resolution video camera (800 TV lines) with 10X zoom lens is housed in an automatic ventilating, weathertight batproof enclosure which is mounted on a motorized pan/tilt unit. Lens focus and zoom, camera pan/tilt positioning, and positions of one illuminator are accomplished via remote control. The high resolution monitor (850 Tv lines) is coupled with a motion detector, allowing fully automatic recording of activity within adjustable, sensitized areas on the TV display, and connects to a time-lapse videotape recorder (VTR). Detailed analysis of behavior and editing functions are enhanced by the VTR's full-function remote controller (on 3 m cable). The camera/lens controls, monitor, and VTR are all secured on a mobile video cart. The cart is typically kept in a research van which can be located up to 60 m (or more) from the on-site camera and illuminators; two cables connect on-site equipment with van equipment and with an AC power source. This CCTV system was field-tested in the late summer of 1985; refinements have been made and the system is now playing a major role in the development and evaluation of management strategies for commensal bats.

Food Preference in the Old World Bat, *Cynopterus brachyotis*

M. S. Fujita and Mark Leighton

Fruit choice, handling behavior and characteristics of preferred food items were investigated using a captive group of *Cynopterus brachyotis* (Chiroptera: Pteropodidae) in Gunung Palung Nature Reserve, West Kalimantan, Indonesia. Preliminary results of tests in which fruits of different species were presented singly suggest that these bats will accept a variety of fruits (33 among 70 species offered), including husked primate fruits. However, bats were not able to eat primate fruits unless husks were removed prior to presentation. Ranking and handling times of preferred fruits were examined using dyadic presentations. A series of trials was also conducted to determine the weight range of fruits a bat could successfully carry and manipulate. *C. brachyotis* appears to choose fruits which share certain morphological traits including a thin rind, a single seed, green coloration and small size (20 gm). The preferences exhibited for fruits that are easily carried and rapidly processed is commensurate with the propensity of these bats to take single fruits away from a source to separate feeding roosts and to consume a large number of fruits per night to meet high energetic demands.

Sexual Dimorphism in the Ears of the Gypsy Moth as a Result of Differential Predation Pressure by Bats

J.H. Fullard and B. Cardone

Most moths possess simple ears to detect the echolocation calls of sympatric, insectivorous bats and reveal auditory sensitivities matched to the frequencies generated by those signals. The gypsy moth, *Lymantria dispar* belongs to a family profound sexual behavioural dimorphism with flighted males and flightless females. Males respond to high-frequency acoustic stimuli (key jingling) with altered flight patterns and it has been suggested that bat-like sounds could be used to control the pest. The purpose of our study was to: 1) characterize male and female *L. dispar* ears and, 2) examine any auditory differences related to the moth's sex-based behavioural dimorphism. Whole-nerve recordings of tympanic nerves indicate that males have ears with peak sensitivities syntonic with local bat echolocation calls (30-50 kHz) while females have ears with comparable sensitivities but tuned to significantly lower frequencies (15-20 kHz). Comparisons of the auditory threshold curves of both sexes reveal that females have reduced sensitivity to those frequencies used by echolocating bats. We suggest that volant males gypsy moths remain within the predation influence of insectivorous bats while flightless females are in a process of auditory degeneration. Support for this hypothesis comes from the observation that females exhibit higher auditory threshold variability than males. That colony-raised males reveal similar levels of variability cautions against the use of colony insects in auditory studies requiring levels of naturally-occurring selection pressure. Based on our results, synthetic bat echolocation signals as a control for this moth will only function against males and, for this purpose, acoustic stimuli should be structured with syntonic frequencies of 30-40 kHz.

On the Use of the Hyoid, Laryngeal, and Pharyngeal Regions in Defining Infraorders and Superfamilies of Bats

Thomas A. Griffiths, Angela M. Bray, and Robert F. DuBose

The families of the suborder Microchiroptera have been formally grouped in four superfamilies for almost 60 years (Weber, 1928), though the basis for this grouping was recognized as early as 1892 by Winge. Recently Koopman (1984) placed the superfamilies Emballonuroidea and Rhinolophoidea in the Infraorder Yinochiroptera (defined as bats possessing moveable premaxillae), and the superfamilies Phyllostomoidea and Vespertilionoidea he placed in the Infraorder Yangochiroptera (defined as bats with premaxillae fused and non-moveable). Though the validity of the four superfamily taxa has not been seriously questioned since they were proposed, the composition of superfamilies has changed with the addition of newly discovered families or, less often, with the shift of a family from one superfamily to another. Data from our extensive dissections of hyoid and adjacent musculature of phyllostomoid and emballonuroid bats, and our preliminary dissections of vespertionoid and rhinolphoid bats, strongly support the validity and monophyly of the Infraporder Yangochiroptera and can be interpreted to support the validity of the superfamily Emballonuroidea (as listed in Koopman, 1984). Some data support the validity and monophyly of the superfamily Phyllostomoidea, and some support the validity of the superfamily Rhinolophoidea, although the data from Sprague (1943) on the hyoid muscles of the Megadermatidae (which we have not yet dissected) could be interpreted two ways: 1) as evidence that megadermatids are more closely related to emballonuroids; and or 2) as evidence strongly supporting that validity and monophyly of the Infraorder Yingochiroptera. The superfamily Vespertilionoidea is so diverse and our dissections so preliminary, we cannot address the question of question of monophyly at this time. Ultimately, it may prove possible to define the most or all higher taxa of bats (suoerfamilies, infraorders, and suborders) using derived characters of musculature of the hyoid/laryngeal/pharyngeal regions.

The Affect of Food Patchiness on the Foraging Behaviour of *Lasiurus borealis*

M. Brian Hickey

I studied the affect of prey patchiness on the foraging behaviour of *Lasiurus borealis* in south western Ontario. Lights at the main entrance and campsite office at Pinery Provincial Park provide sites with high insect density that are predictable. Transacts with bat detectors through areas with lights and along unlit roads and riverbanks indicate that *L. borealis* feed primarily at lit sites and only occasionally along dark roads and riverbanks.

I banded bats with unique combinations of reflective colourbands at four lit sites. The sex ratio of captured bats was 4:1 in favour of females. This may reflect on actual difference in sex ratio or a difference in feeding behaviour between the sexes (i.e. females may feed more at lights or spend more time feeding).

Pregnant females were caught until 7 June and lactating females from 8 June–30 June. Activity (number of bats at lit sites) increased during the first week of August. This increase probably corresponds to the young becoming volant. The first young was caught on 5 August.

Colour banded bats were regularly observed foraging at the site where they were banded but rarely at any of the other sites. Some banded bats used only one or two lights at a site while others used the entire lit site but individuals followed the same pattern each night.

Bats were active within one hour of sunset and fed until less than one hour before sunrise. Individuals usually had several foraging bouts separated by periods of absence (presumably roosting or feeding young).

Several bats regularly foraged at the same light(s). Chases were often seen between bats and after a feeding buzz two or more bats would often chase the same moth. Presumably the feeding buzzes of bats are used by neighbors to locate large moths.

At one of the sites one out of six banded males returned to the site where they were banded while five out of ten banded females returned to the same site.

New insect patches set up were and often used by bats but banded individuals did not change their established feeding pattern.

Several nights of driving around to look for banded individuals feeding at other sites also suggested that banded bats do not use other sites for feeding.

Maternal Investment and the Energetics of Post-natal Growth in Two Species of Insectivorous Bats

Thomas H. Kunz and Kenneth A. Nagy

Accretionary growth, water flux, and field matabolic rate (FMR) were measured in two species of free-ranging insectivorous bats (*Myotis lucifugus* and *Eptesicus fuscus*) from birth throughout weaning. Water flux and FMR were determined from the turnover of doubly-labeled water. Daily milk energy intake by sucklings was estimated from daily water flux and energy content of milk. Maternal investment at peak lactation was estimated from the energy intake of sucklings.

Suckling bats are poikilothermic early in the preflight period and appear to allocate little of their metabolize energy to thermoregulation. Deferred development of thermoregulation in insectivorous bats (as in altricial birds) may allow the maximum amount of metabolizable energy and material to be allocated to growth before the onset of flight and weaning. Maternity roosts are often located at sites that are warmed by solar radiation during the day-roosting period, or become altered by the entrapment of metabolic heat. These conditions appear to promote rapid post-natal growth, minimize heat loss from the sucklings, and reduce the maintenance cost to females during the energetically costly period of lactation. Maternal investment (milk energy intake of sucklings) was 18.98 kJ/day for *M. lucifugus* (litter size of one) and 45.74 kJ/day for *E. fuscus* (litter size of two). Gross growth efficiency during the suckling period was approximately 0.20 for both species.

Genetic Structure in Summer and Winter Colonies of the Migratory Bat *Tadarida brasiliensis mexicana*

Gary F. McCracken, Mary K. Gustin, and A. Thomas Vawter

Populations of *Tadarida brasiliensis mexicana* overwinter in northern and central Mexico and migrate each spring to the southwestern United States. Protein polymorphisms at 6 loci were used to examine genetic structure in summer and winter colonies of these bats. Samples were taken in June and July from lactating females in 7 maternity colonies located in Texas (4 colonies), Oklahoma (1 colony), and New Mexico (2 colonies), and from a single colony in Arizona consisting mostly of adult males. Samples were taken in January and February from 4 colonies located in Nuevo Leon, Tamaulipas, Durango, and Michoacan. These colonies consisted of both adult males and females. Allele frequencies were very similar in all 8 colonies from the United States. Genetic variance among the 4 colonies in Texas, as measured with the F^{st} statistic, was very slight and insignificant at every locus examined (mean F^{st} = .0037). Among colony genetic variance increased with inclusion of the Oklahoma and New Mexico colonies (mean F^{st} = .0065), and slightly more with the inclusion of the colony from Arizona (mean F^{st} = .0082); however, F^{st} vlaues still were not significantly greater than zero at any locus examined. This pattern of increasing among colony variance with inclusion of increasingly more distant populations suggests that gene flow among proximate colonies is more frequent than among more distant colonies; however, the very high genetic similarity among all colonies from the U.S. suggests the occurrence of substantial gene flow among all of them. Genetic structuring was greater among the 4 Mexican colonies than among those in the U.S. (mean F^{st} = .0208 for females; mean F^{st} = .0163 for males). Statistically significant genetic variance among populations occurred at one locus (ME-1) among males. Previous banding studies of *T.b. mexicana* suggest that maternity colonies are assemblages of bats from several winter roost sites. The high genetic similarity among maternity colonies further suggests that bats from the same winter roost site may occupy different maternity sites. Additional support for these ideas is provided by a pattern of slight heterozygote deficiency that is observed within maternity colonies but not within winter colonies. This pattern is expected if maternity colonies are assemblages of bats from several genetically heterogeneous winter colonies.

Why Carnivory Affects Wing Design in Bats

U.M. Norberg and M.B. Fenton

Only large bats can take large food, such as frogs, rodents, other bats, large fruits etc., and some of the carnivorous bats are able to carry prey weighing 50% of their own body weight. Some animal-eating bat species use continuous flight during foraging, some a sit-and-wait strategy (perch-hunting), whereas others may use a mixed strategy. Prey density may be an important factor determining which strategy should be used, or when to switch from one foraging strategy to another. Continuous flight is very expensive, and bats using this foraging type should have wings of high aspect ratio ($wingspan^2$/wing area) to minimize flight costs. If they handle their prey in flight the handling time should be short (small prey). Bats with low aspect ratio wings cannot afford to fly continuously, but instead use a sit-and-wait strategy during foraging. But take-off and landing are also costly, so perch-hunters with low aspect ratio should make as few foraging flights as possible. To maximize their net energy gain they should therefore take large prey. Bats using perch-hunting invariably forage within or near vegetation and need to have slow and manoeuvrable flight. This is obtained with low wing loading (weight/wing area), which also enables the bat to carry heavy prey, and contributes to reducing aerodynamic noise. Further, flight within vegetation restricts wingspan. Thus, perch-hunters taking heavy prey should have large wings (low wing loading) of low aspect ratio, which in fact are found in carnivorous species such as *Nycteris grandis*, *Megaderma lyra*, *Macroderma gigas*, *Vampyrum spectrum*, *Chrotopterus auritus* (relative wing loading 33.5-35.3, aspect ratio 5.2-6.2), and, to some extent, *Trachops cirrhosus* (relative wing loading 43.0, aspect ratio 6.3). Several of these bats often switch off echolocation and rely on vision during foraging to be able to make a silent approach to the prey. All large bats are not carnivorous, but large insectivorous bats usually have high aspect ratio wings (about 8-15) and high wing loading (relative wing loading about 40-80) and use fast continuous flight.

Two Origins for Mammalian Flight

J.D. Pettigrew and S.K. Robson

Recent neurophysiological evidence has questioned the monophyletic status of the Chiroptera. Here we examine the wings of both sub-orders, the major factor cited as linking the two groups, and conclude that their apparent similarities represent convergent rather than homologous evolution. Previous studies of flight cycles and flight musculature, and this study of wing elements, based on absolute forearm lengths and the relative lengths of the metacarpus and first phalynx (MP ratios), reveal differences consistent with separate evolutionary origins. Megachiropterans are considered to have evolved from large forearmed ancestors with low MP ratios, while microchiropterans are considered to have evolved from small forearmed ancestors with high MP ratios. Transitions from high MP ratios in ancestoral microchiropterans to lower MP ratios inthe more derived megachiropterans are consistent both between and within families. Megachiropteran MP ratios have remained relatively constant and there has been some shift towards smaller forearm lengths in the more derived forms. These trends shown in wing forearm lengths and MP ratios in each sub-order cannot be reconciled with a common origin. Thus we consider 1) the Chiroptera to represent a diphyletic grouping, and 2) that flight has evolved twice within the mammals.

Variation in the Mitochondrial Genome of the Jamaican Fruit Bat, *Artibeus jamaicensis*, From the Islands of Jamaica and St. Vincent

Carleton J. Phillips, Everett Goldin, Beth Elliot, Dorothy E. Pumo, and Hugh H. Genoways

The Jamaican fruit bat, *Artibeus jamaicensis*, is widely distributed on the Latin American mainland and on islands in the Caribbean. The Antillean populations currently are divided into three subspecies based on geographic variation in morphology but nothing is known about their genetics or the extent to which island populations might be reproductively isolated. In the present investigation we used restriction endonucleases, ^{32}p end-labeling, and gel electrophoresis to analyze the mitochondrial DNA (mtDNA) in 34 individuals of *A. jamaicensis* on the Greater Antillean island of Jamaica (the type locality for the species) and the Lesser Antillean island of St. Vincent, 1800 km to the southeast. Seven restriction enzymes (Hind III, Pvu II, Bgl II, BamH I, Pst I, Sal I, and EcoR I) that recognize specific 6-base pair (bp) sequences were used singly and in double and triple digests to map the mtDNA in these animals. Three restriction enzymes (Mbo I, Hinf I, and Taq I) that recognize specific 4-bp sequences were used to obtain additional data on genetic variation in these bats. Three mtDNA genotypes were identified and designated as J-1 (15 individuals), J-2 (2 individuals), and SV-1 (17 individuals). The J-1 mtDNA genotype was found in bats collected on both Jamaica and St. Vincent. The J-2 genotype was found only on Jamaica and the SV-1 genotype was found only on St. Vincent. Restriction maps were used to determine areas of homology among the genotypes. Estimates of genotypic divergence were made by means of fragment analysis and Upholt's formula (1977, Nucleic Acids Res., 4:1257-1265). The J-2 genotype lacked one particular Hind III site found in J-1 and thus appeared to be a lineage derived from it. Genotypic divergence between J-1 and J-2 was estimated as p 0.005 (0.5%). Because the J genotypes are found in the Jamaican population and because Jamaica is the type locality for the species, we assigned these mtDNA genotypes to the species *A. jamaicensis*. The discovery of the J-1 genotype on both Jamaica and St. Vincent shows that contrary to popular opinion, *A. jamaicensus* either is a recent (late Pleistocene?) arrival to one or both islands or that these animals commonly move from island to island and effectively form a single interbreeding population rather than isolated (insular) subpopulations. Both J mt DNA genotypes differed considerably from the SV-1 genotype; divergence between J-1 and SV-1 was estimated as p=0.065 (7%). The extent of divergence of SV-1 from both of the J genotypes suggests that individuals with the SV-1 genotype might represent a species different from *A. jamaicensis*. When specimens are evaluated morphologically in terms of their mtDNA genotypes, the SV-1 animals appear to be slightly larger (forearm length) and darker in color in comparison to J-1 bats. The SV-1 animals are not examples of *A. lituratus* because the SV-1 genotype also differs by more than 7% from the mtDNA from Grenadian specimens of *A. lituratus*. It seems likely that restriction endonuclease analysis of mtDNA from additional individuals and other geographic locations will further elucidate our understanding of the evolutionary history and relationships among these phyllostomid bats. These data might also refine our concepts of island biogeography.

Higher Taxon Relationships of the Microchiroptera: a Molecular Perspective

Elizabeth D. Pierson

An immunological investigation of family level relationships within the Microchiroptera, using the transferrin molecule, suggest that the four currently recognized superfamilies Emballonuroidea, Rhinolophoidea, Phyllostomoidea, and Vespertilionoidea may not adequately reflect phylogenetic relationships within the suborder. The data indicates that many modern families originate near the base of the microchiropteran radiation, giving the proposed tree a distinctly bush-like appearance. Two well-separated major clades emerge: one confined to the Old World, composed of the Rhinolophidae, Megadermatidae and Rhinopomatidae; the other centered in the New World, comprised of the Noctilionidae, Mormoopidae, Phyllostomidae, and Mystacinidae. The association of rhinopomatids with rhinolophoids, and of mystacinids with the phyllostomoids are departures from current classifications. Three additional major lineages, the Emballonuridae, Molossidae, and Vespertilionidae show no close association with each other nor with either of the above mentioned clades. Three small New World families (Natalidae, Furipteridae, and Thyropteridae) form two lineages, with an association between the Natalidae and Furipteridae. These lineages, although apparently basal, show a weak association with the phyllostomoids. Analysis of relationships within clades indicates that the Rhinolophidae, Mormoopidae and Vespertilionidae may not be monophyletic. The position of the Nycteridae is unclear.

Mitochondrial DNA Divergence Between *Artibeus Jamaicensus* and *A. Lituratus*

Phillip F. Ray

Bats of the genus *Artibeus* are widely distributed in the Neotropics. The relationships among species and the evolutionary history of the genus have been investigated with a variety of techniques but many questions remain unanswered. *Artibeus jamaicensis* and *Artibeus lituratus* are two species whose relationships are not fully understood. The species differ from each other morphologically in that *A. lituratus* is significantly larger (forearm lengths of 70 vs 60 mm). Their genetic distinctness has been estimated from isozyme comparisons. They also often occur in the same geographic localities and habitats without any indication of hybridization. One means of learning more about these bats is to determine the genetic history of maternal lineages by the use of restriciton endonuclease analysis of their mitochondrial genomes. The circular, mitochondrial DNA (mtDNA) is a relatively small (16,000 ± 800 base pairs) macromolecule thought to evolve at the rate of approximately 1% per million years. Because of its size, rate of evolution, and pattern of maternal inheritance, mtDNA is ideally suited for the study of genetic relationships among individuals. MtDNA isolated from specimens of *A. lituratus* and *A. jamaicensis*, from the Antillean islands of Grenada and Jamaica respectively, was compared by single and double digests with restriction endonucleases that recognize specific 6 base pair (bp) sequences. A tentative restriction map was prepared for both species. The derived data suggest that the mitochondrial genomes diverge by about 5% (as estimated by Upholt's formula). The differences found between the two species involved the presence or absence of restriction sites recognized by Hind III, Blg II, and Pvu II. These genetic differences did not appear to be localized and instead were spread throughout the genome. Five Hind III sites, two Pvu II sites, and two BamH I sites were conserved. The amount of divergence between these two species is relatively small in comparison to similar data from other mammals, in which conspecifics sometimes differ by as much as 5%. Using conventional ideas of mutation rates in mammalian mtDNA, I estimate that the lineages of *A. lituratus* and *A. jamaicensis* that I examined shared a common maternal ancestor approximately 5 million years ago. This relationship probably predates their speciation.

New Perspectives on the Epizoothology of Chiropteran Rabies

Charles E. Rupprecht

Compared to the entrenchment of rabies worldwide among numerous mammalian wildlife, chiropteran rabies exists principally as a New World phenomenon. The disease is essentially endemic, albeit at an extremely low prevalence, within those temperate and Neotropical bat populations adequately sampled, yet interspecific host-virus relationships remain obscure. Considering the ease of mobility afforded via long distance flight and a diversity of roost interactions between frugivorous, insectivorous, and hematophagous bat species, the potential for frequent viral genome exchange readily provides the basic ecological opportunity for creation of an antigenic continuum of rabies viruses throughout the Americas, akin to the previously held belief of a homogeneous rabies serotype. Alternatively, characterization by sensitive monoclonal antibody probes of 140 bat rabies isolates, representing 15 species diagnosed during 1981-85 from eastern Canada, northeastern and southwestern USA, and northern South America, defined at least five major antigenic patterns (ie. affilited with *Lasiurus*, *Tadarida*, *Desmodus*, and two *Eptesicus* variants) and suggests individual New World bat species-associated rabies virus cycles.

In constrast, a closely related but antigenically distinct group of rhabdoviruses (e.g. Duvenhage, Lagos bat, Mokola), described from sub-Saharan Africa has been primarily associated with Megachiropteran hosts (ie. *Eidolon*, *Epomophorus*, *Micropteropus*) since the 1950s. However, recent isolations of one of these strains, Duvenhage virus, from *Eptesicus Serotinus* concommitantly within the Federal Republic of Germany, Poland, and Denmark, and the post-mortem isolation of a rather unique rhabdovirus strain from a Finnish bat biologist, where bat rabies was previously unknown, has prompted concern over the possible consequences of human introduction of viruses formerly confined to central and southern Africa into indigenous European bat fauna. The public health significance of these rabies-related viruses from the standpoint of veterinary and human rabies vaccines is currently under assessment.

Maternal Age Class Differences Within Two Species of Vespertilionid Bats (*Antrozous pallidus* and *Eptesicus fuscus*) and the Trivers-Willard Sex Ratio Model

Ronnie Sidner

According to the sex ratio adjustment theory of Trivers and Willard, in species for which differential body condition affects variance in reproductive success of males more than females, females in good condition should produce higher proportions of male offspring. In polygynous mammals competition to inseminate females results in potentially greater reproductive success for good condition males than for females in comparable condition. Two species of vespertilionid bats in southern Arizona have been found to meet assumptions of the theory. Upon their return from hibernation and before parturition occurs, yearling pallid bats, *Antrozous pallidus*, weigh significantly less than older females despite similar forearm lengths. Assuming greater body weight represents better physiological condition, according to the logic of the Trivers-Willard model, older females are expected to produce higher offspring sex ratios than yearlings. However, no significant differences were found in offspring sex ratios between yearling and older female pallid bats. Most older females produce two young while yearlings produce one young, thus pallid bats appear to maximize reproductive fitness by adjusting litter size rather than offspring sex. In southern Arizona the big brown bat, *Eptesicus fuscus*, shows comparable differences in body weight by age class. This species has been reported to produce only one young per litter in western populations, and this would prevent an adjustment of offspring number. Again, no significant differences in offspring sex ratios occurred between maternal age classes; however, litter sizes for these populations are not as previously reported in the literature. This apparent lack of sex ratio adjustment in both pallid and big brown bats suggests that the Trivers-Willard model may not apply to vespertilionids.

Wing Amputation: Making the Best of a Sad Situation

Ronnie Sidner and Russell Davis

In 1984, a banded two-year old female pallid bat was captured from a maternity colony within a bridge roost in southern Arizona, and her attached newborn twins were banded. The following week during routine monitoring of the colony, this family was captured together again. One week later this female was found behind a rock on the ground below the bridge roost. Only one of her banded young was attached. The missing young was then found trapped in the tenacious web of a black widow spider within one of the bridge crevices. The adult was later examined carefully and found to have a compound fracture of the right humerus. Laboratory studies have demonstrated the ability of these bats to retrieve their own young on the basis of individual vocalizations. We surmise that this "Lady" had attempted to retrieve her crying young and during this attempt had crashed due to the burden of her other attached offspring. The injured female and the attached juvenile were removed from the colony and taken to the lab in hopes that the wound might heal over and that at least one young might be raised successfully. The adult female had milk tissue for several weeks and grew fat on a mealworm diet. Although she tolerated the crawling young and allowed it to nurse even under the broken wing, the juvenile ceased growth and development before permanent teeth erupted and died after two months. The juvenile left with the colony was found dead within two weeks of the mother's removal. Because the sharp edges of the fractured bone were constantly moved when the limp wing flopped about, even after two months in captivity the adult's wound had not healed and eventually became infected. Splinting was impractical because the humerus was fractured close to the shoulder, so we decided to amputate. Anaesthesia and surgical procedures are described. Lady survived, recovered, and soon learned to move about within her cage without the limb. For two years she has been an excellent display animal at pro-bat talks to children and adults, and has changed the negative opinions of many observers, partly because of her maternal behavior story, but also because of her handicap. Lady will be present during the poster session.

Adaptation of Sonar Operating Range and Depth of View During Pursuit

James A. Simmons

The airborne interception maneuver by insectivorous bats is characterized by a stereotyped series of parallel acoustical and behavioral responses that progress through distinct and recognizable search, approach, track, and terminal stages. The signals emitted during the search stage and the rate of their emission are adjusted by many species of bats to conform to the size of the space available for searching, whether in the open or bounded by obstacles such as vegetation. Comparisons of different species can give the impression that there are greater differences among species in their acoustic strategies unless the bat's whole adaptive range of echolocation is taken into account. When adaptiveness is considered, "FM bats" may use one basic strategy overall. For example, *Eptesicus fuscus* exhibits a broad range of signals for intercepting prey in open areas. The search signals are long, shallow FM sweeps, while the approach signals each have steep initial sweeps and shallow final sweeps, and the tracking signals just have steep sweeps. In more constricted spaces, *Eptesicus* uses a truncated version of its entire pursuit repertoire. The segment of the repertoire that is used varies according to the size of the space. Both the maximum operating range for target detection (based upon individual signals) and the depth of view (based upon repetition rate) are adjusted in tandem, although the bat can change them independently in laboratory situations. Many other bats of the families Molossidae and Vespertilionidae appear to use the same basic pursuit strategy or a portion of the strategy corresponding to a truncated segment of the repertoire, as used by *Eptesicus* in restricted spaces. Also, some species appear to be less adaptable than others. The use of several harmonics in conjunction with shallow FM sweeps instead of broad sweeps (as *Rhinopoma*) appears to be a variant on this same strategy.

Thermoregulatory Strategies and the Distribution of Bats Along Climatic Gradients

Donald W. Thomas and Gary P. Bell

In this paper we consider how the different summer thermoregulatory strategies pursued by male and non-reproductive females of the *Myotis* species on one hand and pregnant or lactating females on the other can influence their distribution along environmental or climatic gradients. On the western slope of the Cascade Mountains in Washington, summer netting at elevations above 400 m yields a catch dominated by adult males and non-reproductive females. In a sample of 191 individuals netted over 3 summers, only 10.5% were females and none of these were reproductive (pregnant or lactating). This pattern stands in marked contrast with that found either on the eastern slope of the Cascades at the same elevation or to the south in the Oregon Coast Range. In samples collected on the eastern slope of the Cascades, females comprised 44.1% of the catch and 82.3% were either pregnant or lactating. Similarly, in the Oregon Coast Range 32.7% of the netted individuals were female and 90.9% of these were pregnant or lactating. What causes the major differences in the abundance of reproductive female *Myotis* between these sites? Compared with the eastern slope or sites further south, the western slope of the Cascades received substantially more rain more frequently and is more often immersed in heavy cloud. All these factors contribute to impede foraging in aerial insectivorous bats. We argue that because pregnant and lactating female *Myotis* species are homeothermic (maintain constant high body temperatures), their high energy demands require them to forage daily. The adverse climate on the west slope of the Washington Cascades acts to impede foraging at these sites and limits reproductive females to more benign sites. In contrast, males and non-reproductive females are heterothermic (fall into torpor daily) and have reduced energy demands. As a consequence, they are able to forage less frequently if required and so can make use of more adverse sites.

Rabies and the Bat Researcher: Update 1986

Charles V. Trimarchi

The recent tragic death in Finland of bat biologist Rudolf Lehmen from rabies apparently contracted by bat bite is a startling reminder of the potential hazard to persons handling bats. Assumptions which may lead to a casual attitude toward this disease, such as accepting the apparent absence of rabies in European bats, are obviously very dangerous. Increased surveillance for the disease since the human case has disclosed 81 cases in Denmark as well as several confirmed cases in Poland and Germany. All of the cases reported to date have been in *Eptesicus serotinus*. The vast majority of bats in North America do not have rabies, and the likelihood of encountering a rabid bat among normally-behaving individuals is very small. However, the small number of rabid bats (probably less than 1% at any time) is widespread on this continent, both geographically and by species. It is therefore obviously prudent to avoid potential exposure to the disease by wearing protective gloves when handling species capable of inflicting a bite wound. It is also necessary, when a bite wound is inflicted to have the bat examined for evidence of rabies infection. If the bat should be found rabid, rabies post-exposure vaccination should be started immediately. This currently requires individuals without previous rabies vaccination to receive five intramuscular injections of human diploid cell vaccine. These are administered in the arm on days, 0,3,7,14 and 28, with the initial dose given as soon as possible after exposure. A single intramuscular injection of rabies immune globulin is administered at the same time as the first dose of vaccine. Pre-exposure immunization is recommended for those individuals at recurring risk of exposure to rabies, for two reasons: 1) an individual with previous rabies vaccination need only receive two booster injections given three days apart if a recognized exposure to rabies should occur, and 2) pre-exposure vaccination protects an individual should an inapparent exposure to rabies occur. Pre-exposure vaccination currently requires three intramuscular or subcutaneous injections in the arm, and a single booster dose every two years thereafter. Because of the superior immunizing capability of the human diploid cell vaccine, routine serologic confirmation of antibody levels is no longer necessary. This vaccine has proven to be safe and effective when properly administered.

Bat Conservation International Progress Report

Merlin D. Tuttle

In the past year BCI membership has, again, more than doubled, now including close to 1,200 members in 32 countries. BCI became a guest of the University of Texas in Austin on 1 March 1986 and has increased its staff from one full-time person in 1986 to four currently. Addition of a Ph.D. (or as least Masters) level Assistant Director position is anticipated in 1987. Establishment of a substantial endowment is a current goal, and nearly a million dollars already willed to BCI should become available in the next 5-10 years. Education at all levels continues to be BCI's primary goal, but anticipated success of current endowment initiatives should ensure substantial support of research and other conservation related activities in the future. More than 800 of BCI's slide cassette tapes are now in use in 15 countries, and at least 20 states in the U.S. are using BCI materials in substantial bat conservation efforts. More than 500 private and government organizations were assisted in the past year. In the same time period BCI played an important role in gaining legislative protection of flying foxes in American Samoa and in New South Wales, Australia, generated a major public outcry against Israeli poisoning of bat caves that has led to policy reversal and major progress in public education there, and gained private and governmental cooperation in many other areas. Permanent protection of Bracken Cave, home of the world's largest known bat colony, is anticipated in the near future. BCI has arranged a private donation of the cave to the Texas Nature Conservancy with a lease agreement to BCI for management.

Bat Activity Over Calm and Turbulent Water

B. von Frenckell

A comparison of the activity of the little brown bat *Myotis lucifugus* over calm pools and a fast-flowing riffles was performed in the vicinity of the Kananaskis Valley in southwestern Alberta, Canada. Bat activity was assessed by monitoring echolocation calls using ultrasonic detectors. Activity was higher over pools than riffles. This could be due to differences in prey abundance or accessibility in the two habitats. Alternatively, water noise at turbulent sites may interfere with the bats' echolocation abilities. Sticky traps were used to assess prey abundance, and water noise was recorded for intensity-frequency analysis. Insect abundance at the height where the bats flew (1 m above the water) did not differ between sites, but insects close to or at water level at calm pools may be more accessible than at fast-flowing riffles since feeding close to the water's surface may be easier if the surface is calm and predictable. Further, the acoustic situation over riffles is much more cluttered, which may make insect detection more difficult at such locations. Water noise at riffles was approximately 15 dB greater than at pools and may interfere with bats' echolocation abilities and thus decrease the efficiency with which bats detect targets.

Nectar Concentration Preference and Daily Food Uptake in *Glossophaga soricina*, a Flower-Visiting Bat in Costa Rica

Y. Winter

Four bats (3 females, 1 subadult male; weights 7.9, 6.9, 7.1, and 8.0 g) were kept in a 3.5x2.5x7 m flight cage in the secondary rainforest at La Selva Biological Station, northeastern Costa Rica from April 13 to May 8, 1986. Bats were sustained on a diet of sugar water, dry pollen, insects, and vitamins. Five concentrations of sucrose solution (10%, 20%, 25%, 30%, and 40%) were offered from 4 mm diameter glass tubes attached to free hanging feeders. A cup under each feeder collected drips. Feeder position was randomized each night among five locations in the cage. To assist the bats in locating a specific concentration the feeders were covered with materials of differing acoustical reflectivity. The amount of pollen and the volumes of sugar water taken were measured every morning. The 20% to 40% sucrose solutions were preferred over the 10% solution. Feeder position had a highly significant influence on feeder choice (twoway ANOVA,p 0.001;interaction n.s.) but its effect on sugar concentration choice was eliminated by following the balanced, randomized design. Although there was a large difference between nights in the preference of concentrations from 20% to 40%, there was no overall difference in the preference for any of these concentrations. The average concentration taken during a night was 28.1% (sd 4.2%). The volume taken per night per bat ranged from 6.6 ml to 13.0 ml (9.19, sd 1.76). There was a highly significant negative correlation between volume taken and average concentration (V=19.5-0.38av.conc; r0.94). The caloric value of the sucrose ingested from sugar water and pollen ranged from 9.2 - 11.5 cal. bat night (=10.2 cal, sd 0.7). A nightly intake of 0.2-0.4 g of insects (small scarabs and moths) per bat was an additional, variable component of the diet. In a second experiment free-ranging bats were attracted to sugar water feeders in the primary rainforest. During the habituation period bats were baited to the feeding site with two-day-old bananna mash mixed with honey. The feeders were readily accepted and subsequently visited heavily. With this technique it seems possible to use flower-bats in manipulative experimental field studies.

RECOGNITION

The Garret R. Miller Jr. Award was presented to Dr. Harold Hitchcock, retired from Middelbury College, for his pioneering work in the study of bat ecology and behavior. He was among the very first scientists to band bats and published many reports on his work. Nearly all of us have built some part of our research upon the foundations he set down so well, in most cases before we were born.

The Miller Award was also presented to Dr. Merlin Tuttle of Bat Conservation International for his work making the public more aware of the significance of bats in the worlds' ecology. His efforts are truly cosmopolitan and he can take a very large share of the credit for bat conservation programs on every continent.

Dave Klingener did a masterful job of hosting us and attending to all the small details that made the meeting so successful. Congratulations to Hal and Merlin and our gratitude to Dave. It was a good meeting.

G. Roy Horst

The 16th Annual North American Symposium on Bat Research at the University of Massachusetts

PARTICIPANTS

ALDRIGE, HUGH, Department of Biology, York University, 4700 Keele Street, North York, Ontario M3J Canada

AUDET, DORIS, Department of Biology, Carleton University, K155B6 Canada

AUGUST, PETER, Department of Nat'l Res. Center, University of R.I., Kingston, RI 02881 USA

BALCOMBE, JONATHON, Department of Biology, York University, 4700 Keele Street, North York, Ontario M3J Canada

BARCLAY, ROBERT, Biology Department, University of Calgary, Calgary, Alberta T2N 1N4 Canada

BELL, GARY, P., 2 Cummington Street, Boston, MA 02215 USA

BONACCORSO, FRANK, PK Yonge Lab. School, University of Fla., Gainsville, FL 32611 USA

BRANDON, CARL, DR., Vermont Tech. Colloge, Randolph Center, VT 05061 USA

BERRY, ROBERT, 658 Sonja Ct., Ridgecrest, CA 93555 USA

BRIGHAM, R., MARK, Department of Biology, York University, North York, Ontario M3J 1P3 Canada

BROOKE, ANNE, Department of Biology, 2 Cummington Street, Boston University, Boston, MA 02215 USA

BROWN, PATRICIA, 658 Sonja Ct., Redgecrest, CA 93555 USA

BUCHANAN, G., DALE, Faculty of Health Sciences, McMaster University, 1200 Main Street West Room 2J32, Hamiltion, Ontario L8N 3Z5 Canada

BUTCHKOSKI, CALVIN, RD #1 Box 118-A, Petersburg, PA 16669 USA

CAMPBELL, KAREN, Indiana University, Medical Sciences Program, Bloomington, IN 47405 USA

CLARK, BRENDA, 404 Life Sciences West, Oklahoma State University, Stillwater, OK 740788 USA

CLAWSON, RICHARD, 1110 College Ave., Columbia, MO 65201 USA

CLOUTIER, DANIELLE, Department of Biology, University of Sherbrooke, Sherbrooke, P.Q. J1K 2R1 Canada

COWLAND, THOMAS, 22 Clement Road, Somersworth, NH 03878 USA

DALTON, VIRGINIA, Bradford University, Department of Biology, Bradford, VA 24142 USA

DIDOMENICO, LILIA, Department of Zoology, University of Vermont, Burlington, VT 05405 0086 USA

DUNN, JOHN, RD #1 Box 259 A, Shippensburg, PA 17257 USA

EIFLER, DOUGLAS, P.O. Box 12113, Gainsville, FL

FENTON, BROCK, Department of Biology, York University, North York, Ontario M3J 1P3 Canada

FLEMMING, THEODORE, Department of Biology, University of Miami, Coral Gables, FL 33124 USA

FRANCIS, CHARLES, M., Queens University, Biology Department

FRANTZ, STEPHEN, C., DR., Wadsworth Ctr. of Labs & Res., New York State Department of Health, Empire State Plaza, Albany, NY 12201 USA

FUJITA, MARTY, Museum of Comparative Zoology, Harvard University, Cambridge, MA 02138 USA

FULLARD, JAMES, Department of Biology, Erindale College, 3359 Mississauga Road, Mississauga, Ontario L5L 1C6 Canada

GARDNER, JAMES, Illinois Natural History Survey, 607 East Peabody, Room 99, Champaign, IL 61820 USA

GREENHALL, ARTHUR & ELIZABETH, M.S. Fish & Wildlife Service, Office Scientific Authority, Washington, DC 20240 USA

GRIFFITHS, THOMAS, A., Department of Biology, Illinois Wesleyan University, Bloomington, IN 61702 USA

GUSTIN, MARK, University of Tennessee, Zoology Department, Knoxville, TN 37996 USA

HALL, JOHN, S., Lavina Hall, Department of Biology, Albright College, Reading, PA 19603 USA

HARVEY, MICHAEL, J., 1014 E. 6th Street, Cookeville, TN 38501 USA

HICKEY, BRIAN, Department of Biology, York University, 4700 Keele Street, North York, Ontario M3J Canada

HICKS, ALAN, Wildlife Resource Center, Delmar, NY 12004 USA

HITCHCOCK, HAROLD, MR. & MRS., 1 Locust Lane, Middlebury, CT 05753 USA

HOAGLAND, BUZZ, University of Vermont, Department of Zoology, Burlington, VT 05405 0086 USA

HOFMANN, JOYCE, Illinois Natural History Sur., 607 East Peabody, Room 99, Champaign, IL 61820 USA

HORST, G., ROY, Department of Biology, State University of New York, Potsdam, NY 13767 USA

JOHNSON, MURRAY & SHERRY, Burke Memorial Washington State Museum, University of Washington, DR-10, Seattle, WA 98195

KILPATRICK, C., WILLIAM, University of Vermont, Department of Zoology, Burlington, VT 05405 USA

KIRKLAND, GORDON, L., JR., Vertebrate Museum, Shippensburg University, Shippensburg, PA 17257 USA

KLINGENER, DAVID, HOST, Dept. of Zoology, University of Massachusetts, Amherst, MA 01003

KLINGHAMMER, KIRSTEN, 166 Spruce Street, Apt. 1, Keene, NH 03431 USA

KOEHLER, CATHY, Biology Department, University of Calgary, Calgary, Alberta T2N 1N4 Canada

KOOPMAN, KARL, Department of Mamlogy, American Museum of Nat. History, New York, NY 10024 USA

KUNZ, THOMAS, Department of Biology, Boston University, Boston, MA 02155 USA

KURTA, ALLEN, Department of Biology, Boston University, Boston, MA 02155 USA

KWEICINSKI, GARY, Departmento of Biochemistry, 420 Henry Mall, University of Wisconsin, Madison, WI 53706 USA

LAUBACH, CHRISTYNA & RENEE, 472 W. Mountain Road, Lenox, MA 01240 USA

LORD, REXFORD, D., Indiana University of Pennsylvania, Biology Department, Indiana, PA 15705 USA

McCRACKER, GARY, Department of Zoology, University of Tennessee, Knoxville, TN 37916 USA

MISTRY, SHAHROUKH, University of Tennessee, Zoology Department, Knoxville, TN 37996 USA

MOBLEY, EMILY, DAVIS, Box 10, Schoharie, NY 12157 USA

NORBERG, ULLA, Department of Zoology, University of Goteborg, Box 25059, S-400 31, Goteborg, Sweden

OKINIEWSKI, MARIA, P.O. Box 12113, Gainsville, FL

PETERSON, RANDOLPH, Department of Mammology, 100 Queens Park, Toronto, Ontario M5S 2C6 Canada

PHILLIPS, CARLETON, J., Hofstra University, Department of Biology, Hempstead, NY 11550 USA

PIERSON, ELIZABETH, 2558 Hilgard Avenue, Berkeley, CA 94709 USA

RAY, PHILLIP.E., Hofstra University, Department of Biology, Hempstead, NY 11550 USA

RAINEY, WILLIAM, 2558 Hilgard Avenue, Berkeley, CA 94709 USA

REIFENSNYDER, GRETCHEN, 137 E. Lynde Street, Watertown, NY 13601 USA

ROBERTSON, KERRY, 6 BRENTWOOD Road, Exeter, NH 03833 USA

ROBSON, SIMON, Boston University, Biology Department, Boston, MA 02215 USA

RUPPRECHT, CHARLES, Rabies Unit, The Wistar Inst., 3601 Spruce Street, Philadelphia, PA 19104 USA

SAUNDERS, MARK, Biology Department, University of Calgary, Calgary, Alberta T2N 1N4 Canada

SERACH, JAMES, Lawrence Academy, Box 992, Groton, MA 01450 USA

SIDNER, RONNIE, Box 122 Biology Science West, University of Arizona, Tucson, AZ 85721 USA

SIMMONS, JAMES, DR., Department of Psychology, Brown University, Providence, RI 02912 USA

SOROKA, DOUGLAS, Box 13 Driftwood Cove, 9th Street & RT 25, Greenport, NY 11944 USA

STILLWAGON, NANCY, P.O. Box 140, Alton Bay, NH 03810 USA

SZEWCZAK, JOSEPH, Brown University, Biology Department, Box G, Providence, RI 02912 USA

THOMAS, DONALD, Department of Biology, University of Sherbrooke, Sherbrooke, P.Q. J1K 2R1 Canada

TRIMARCHI, CHARLES, NY State Department of Health, Rabies Laboratory, Empire State Plaza, Albany, NY 12201 USA

TUTTLE, MERLIN, D., Bat Conservation International, C/O Brackenridge, Field Laboratory, University of Texas, Austin, TX 78712 USA

VON FRENCKELL, BEATRIX, Biology Department, University of Calgary, Calgary, Alberta T2N 1N4 Canada

WINKLEMANN, JOHN, R., Department of Biology, Gettysburg College, Gettysburg, PA 17325 USA

WINTER, YORK, 109 Zoology Bldg., 318 Church Street S.E., Mpls., MN 55455 USA

WILLIAM A. WIMSATT MEMORIAL FELLOWSHIP

Dear Colleague:

The family and friends of the late William A. Wimsatt have proposed to the American Society of Mammalogists that a fellowship be established in his memory in perpetuity. The Trustees and Directors of the Society have agreed to establish such a memorial and the details of its establishment are now complete. The fellowship will be known as the William A. Wimsatt Memorial Fellowship of the American Society of Mammalogists. Funds donated to this fellowship will be invested by the trustees of the Society, the income being awarded annually to a full-time graduate student in an accredited university in Mexico, Canada or the United States, who is writing a thesis or dissertation on any aspect of the biology of bats. In the event no acceptable application is received in a given year, the income from the fund shall be added to the principal of that year.

The Society's Committee on Grants in Aid will issue a continuing announcement in the Journal of Mammalogy describing the application procedure, deadline dates and other pertinent information. This Committee will also receive all applications and select the student who will be designated the "William A. Wimsatt Fellow" for that year.

No segment of the scientific community was more dear to Bill Wimsatt than his students and the students of his colleagues. He gave to them gifts beyond price, and to each he gave a large measure of his intellect and his heart. To the last lingering days he continued to advise and guide and encourage his students, and does so still in their memories. What more appropriate monument can we erect than to offer our support of a deserving graduate student as a living memorial to Bill's spirit?

The trustees of the Society have recommended that the principal amount in such an endowment should be a minimum of $10,000. If one hundred of Bill's friends each contribute $100 we can easily surpass that figure. Contributions may be spread over more than one payment and additional gifts can be added at any time.

We invite you to join with us in establishing this fellowship. Donations should be to the William A. Wimsatt Fund and sent to Roy Horst (address below) who will receive your contributions in behalf of the Wimsatt family and the Society. Dr. Horst will send you an appropriate recognition from the Wimsatt family and record for your tax purposes, and he will forward the funds to the Treasurer and Trustees of the Society.

We are grateful to you for joining us in this act of love and gratitude.

Dr. Horst's address is: G.R. Horst
Department of Biology
State University of New York
Potsdam, New York 13676 U.S.A

BOOKS ABOUT BATS

FOR ADULTS

Bats of America
A great bat book; life history and identification ofbats all over the U.S. Many illustrations in B&W and color. By Roger W. Barbour and Wayne H. Davis, 286pp. 1969, hb. **$35.00**

Cave Fauna of North America
Reprinted from the memoirs of the National Academy of Sciences, Vol. 4, Part 1, 1888. For those interested in the history of cave biology. By A.S. Packard, 155pp. hb. **$16.00**

Bats: A Natural History
This book will appeal to amateur naturalist and conservationalist, as well as scientists and professional zoologists. By John E. Hill and James D. Smith, 248pp. 1984, hb. **$25.00**

Ecology of Bats
10 chapters, each by a different well-known author. Includes Reproduction, Roosting Ecology, Growth and Survival, Plant-visiting Bats, Bat Parasites, and more. Edited by Thomas Kunz, 425pp. 1982, hb. **$49.50**

The Lives of Bats
A wide-range book including breeding, feeding, physiology, aerodynamics, and more. By Wilfred Schober, 212pp. 175 illus., 1984, hb. **$25.00**

What About Bats?
A great introduction to bats for both children and adults. By James K. Baker, 60pp. 1979, pb. **$1.50**

Bats and Public Health
This book is valuable for its bibliography as well as its general health information. By Merlin Tuttle and Stephen J. Kern, 11pp. 1981, pb. **$1.00**

Just Bats
An illustrated view of bats for a general audience. By M. Brock Fenton, 165pp. 1983, pb. **$10.00**

The Vampire Bat
The first comprehensive study of the interaction between vampire bats and their principal prey, the cow, at one location. By Dennis C. Turner, 145pp. 1975, hb, no/dj. **$10.00**

Cave Life of Oklahoma
Special issue of the Oklahoma Underground. A complete study which could serve as a guide for speleologists working on similar projects. By Jeffrey Black, 59pp. 1971, pb. **$5.00**

The Bat
A great B&W picture book of bats. The text is mostly identification of the species shown. By Nina Leen, 78pp. 1976, hb. **$7.50**

The Greater Horseshoe Bat
43 pages of great photos and simple but interesting text. A good conservation message at the end. By Roger Ransome, 1980, hb. **$5.00**

House Bat Management
Hints on how to "de-bat" and "bat-proof" a house. By Arthur Greenhall, 33pp., 30 illus. 1982, pb. **$6.00**

Cave Life: Evolution and Ecology
A technical study of cave populations including mathematical models of genetic and ecological communities. Deals very little with bats. By David Culver, 189pp. 1982, hb. **$25.00**

Photographing Bats: At Carlsbad Caverns National Park
A full-color flyer by Ronald C. Kerbo. 2pp. 1985. **$.50**

Communication in the Chiroptera
Reviews the available information on communication in bats including apparatus for sending and receiving signals. By M. Brock Fenton, 161pp. 1985, hb. **$35.00**

Bats
A British general information book that "sets the record straight about bats." This includes information on what the British have done to protect bats. By Phil Richardson, illustrated with drawings by Gary Troughton, 128pp. 1985, hb. **$10.00**

Vertebrate Flight — A Bibiolography
Over 2500 references on all aspects of flight in vertebrates. The most detailed coverage is given to flight in birds and bats. By J.M.V. Rayner, 200pp. 1985, pb. **$14.00**

FOR CHILDREN

I Can Read About Bats
A simple view of bats with quite a bit of information. By Elizabeth Warren, 42pp. 1975, pb. **$1.50**

Bats in the Dark
A "Let's-read-and-find-out" science book. A very basic book on bats for K to 3. By John Kaufman, 33 pp. 1972, library bound, hb. **$10.50**

Bats, The Night Fliers
A scientific book for kids 8 to 10. Mostly text with a few sketches. By Anabel Dean, 56pp. 1974, hb. **$6.00**

Vampire Bat
Written for 3rd to 6th grade but I learned a lot. By Lawrence Pringle, 62pp. 1982, hb. **$9.50**

Bats
From the "not so awful creatures" series. A humorous look at "Biff the Bat" who is "Wanted Dead or Alive for biting people and sucking blood." Exposes misconceptions for 3rd graders. By George Shea, 40pp. 1977, pb. **$4.00**

Bats in the Night
A beginning bat book which explains bats in simple but detailed terms. Includes identification information on 12 species. Grades 3-6. By George Laycock, 69pp. 1981, hb. **$10.00**

Billions of Bats
Includes information on the Vampire, the Little Flying Cow, Fisherman Bat, giants of the bat world and more. By Miriam Schlein, 56pp. 1982, hb. **$9.50**

Bats
A very good first bat book for kids. Stresses conservation and importance to man. Illus. with B&W photos by Merlin Tuttle. By Alice L. Hopf, 64pp. 1985, hb. **$8.50**

Know-It-All-Library Bats
Facinating facts about bats for 1st grade to 3rd grade kids. By Joanna Foley, 24pp. 1982, pb **$1.00**

What's in the Cave
A lift-the-flap pop-up book for those with a good sense of humor. Kids and adults will love this book because in the cave are a fat bat, a lazy lizard, and a big surprise. 8 pop-up animals. By Peter Seymour, 1985, hb. **$7.75**

* * * * *