BAT RESEARCH NEWS

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BAT RESEARCH NEWS

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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, February, May, August, and November. *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.

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CONTENTS

FRONT COVER

Craseonycteris thonglongyai
(Kitti's hog-nosed bat; bumble-bee bat)

How big is the bumble bee bat? When compared to the human hand, this tiny creature appears to establish its reputation as the world's smallest mammal. For other details see **Bat Research News** (25:3-4, 1984). Photograph courtesy of Dr. Merlin Tuttle, Bat Conservation International.

BAT NEWS RESEARCH

Volume 26 February 1985 No. 1

A Banded *Glossophaga soricina* Captured at Isla Barú Cartagena, Colombia

Carolina Murcia
Departamento de Biologiá, Universidad del Valle, Apartado 2188, Cali, Colombia

On 17 July, 1981, while mist-netting bats at the Isla Barú, I captured a banded *Glossophaga soricina*. Isla Barú is located adjacent to Cartagena and is a small strip of land 25 km long and five km wide, separated from the mainland by a very narrow channel.

The banded male (12 g, total length 64 mm, forearm 40 mm) had a pair of celluloid rings (inner white, outer red) on its right forearm. It was captured together with four other *G. soricina* (♂♂) and nine individuals of other glossophagine species. Mean weight and forearm length for *G. soricina* are 13 g and 40.2 mm, and for the other species are 10.4 g and 39.7 mm respectively. Four of the five *G. soricina* had a developed epididymis. A female, captured at Islas del Rosario at the same time, was lactating.

All the bats captured were roosting in the village church, where a huge colony is established and remains undisturbed during most of the year. The specimens are now in the Museo de Vertebrados, Departamento de Biologia, Universidad del Valle, with catalog numbers 2888-2901. There had been no banding programs here for at least four years before the finding.

Received and Accepted February 3, 1985

NEWS AND VIEWS

A NEW ULTRASONIC DETECTOR

A new ultrasonic detector (fig. 1) has been developed at the Department of Technology at Uppsala University, in cooperation with Prof. Ingemar Ahlen, Swedish University of Agricultural Sciences.

The detector, D 920, reduces the frequency of the ultrasound by a factor of 10 or 20 (selectable), but leaves the amplitude of the signal unaffected. The processed signal may be listened to on headphones and/or recorded on a cassette recorder. In the latter case an accurate laboratory analysis of the signal is possible. The processed signal is sine-shaped, and it may thus be meaningful to perform spectral analysis (FFT) on the recorded signal. Figure 2 shows a plot of an ultrasonic burst in its original (A) and processed (B) forms.

The main difference between the D 920 and the QMC S200* and the Westec respectively is the good amplitude linearity of the D 920, i.e. the instantaneous, relative amplitude of the output signal is the same as that of the original signal. Another difference is the sine-shaped output signal of the D 920. The QMC S200 and the Westec have square-wave outputs, making spectral analysis of the signal more unreliable, due to the presence of the harmonics of the square-wave.

In order to obtain a measure of the frequency of the signal of under field conditions, the D 920 is

also equipped with a digital display showing the frequency at the maximum amplitude of the ultrasound signal.

The instrument includes overload and battery condition indicators, as well as HF- and AF-outputs. A switchable filter at the input of the detector eliminates low-frequent signals during e.g. a line transect by car.

The D 920 is very compact (180 x 109 x 50mm), and has low weight (500 g. incl. batteries). Furthermore the power consumption is very low; alkaline batteries will last for appr. 45 hours.

The detector is sold by: L. Pettersson Elektronik, Sjudartorp Lagga, S-741 00 Knivsta, Sweden. The delivery time is at present appr. two months and the price of the detector, incl. a high-sensitivity capacitance microphone, is US $1050. Detailed information about the detector is being published elsewhere.

Submitted by L. Pettersson, March 12, 1984.

*countdown mode

NOTE: A new model of the detector will be introduced during the spring of 1985. This model (D 940) is basically a D 920 with a high-sensitive heterodyne system instead of the frequency display. The size, weight and price are the same as for D 920.

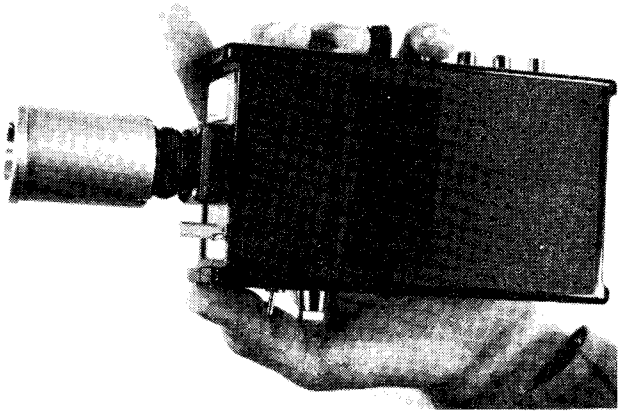

Fig. 1. The D 920 ultrasonic detector.

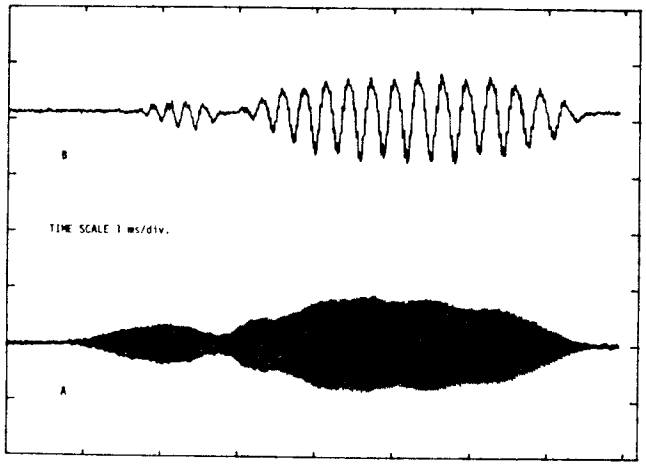

Fig. 2. Plot of an ultrasonic burst in its original (A) and processed (B) forms.

Special Research Expedition

The tropical regions of the earth, besides being amongst the most beautiful places of the world, contain the greatest diversity of life on the planet. These areas are the "storehouses" of a large percentage of the earth's genetic information and must be preserved. In order to effectively maintain these areas much more study is needed.

The country of Belize (formerly British Honduras), though quite small, encompasses a rich array of interesting tropical habitats, ranging from pine savannah and grassland to lush primary rainforests and coral reefs. Correlated with this variety of habitat types is an outstanding number and diversity of plants and animals, many of which are largely unstudied! In order to better understand this spectacular country's lands and wildlife, Zoological Research Institute (ZRI) is conducting several special expeditions, each with a different research focus.

Experts and interested non-experts alike are invited to participate in this exciting research in the biology of the tropics by joining our special expedition.

Participants will assist in a 10-day survey of the bats in the Toledo District of Southern Belize. To date the bat fauna of this area is poorly studied and species lists are quite incomplete. The survey will be conducted by mist netting and looking for bats in varied habitats and at different elevations. We can expect to collect many interesting species, including fruit bats (many kinds), fishing bats, and vampires. There are several species in the area that have not been recorded for Belize. Join in this

study of some of the most interesting, least understood mammals in the world!

Accommodations:

Our rainforest field station is a rustic wooden building located on the banks of beautiful Blue Creek River. Sleeping is either in hammocks or sleeping bags on the floor. The situation is primitive but comfortable. Meals are cooked by a local woman, and consist of local fare, such as rice and beans. On the travel nights between sites, we will use the Pelican beach Motel, an excellent hotel in Dangriga, Belize. The meals here are American-style with a Caribbean flare. In all, I am sure that you will find the accommodations satisfactory and relaxing!

Departure Dates and Duration

August 16-25 10 days

Cost of this Expedition:

*$550.00 per person

*This price includes ground transportation, three meals per day, airport transfers, experienced naturalist guide, hotels, but does **NOT** include airfare to Belize or exit taxes.

International Zoological Expeditions (IZE) will make **all** your necessary travel arrangements, including the **lowest** fare from your point of origin to Belize.

NOTE: To guarantee the low fare above, a minimum of 8 participants is needed, but to assure personal attention and efficiency, we must limit the number of co-workers to 15.

If you are interested in joining the expedition, please contact Mr. James Serach at International Zoological Expeditions, Zoological Research Institute, 210 Washington Street, Sherborn, MA 01770. Telephone: 317-655-1461.

SYMPOSIUM COMPETITION AND COEXISTENCE

The Zoological Society of Southern Africa is holding a symposium on "Competition and Coexistence" at the University of Natal in Pietermaritzburg, Republic of South Africa, July 23-26, 1985. Topics of interest and areas of specialization are likely to include: competition for space; experimental studies of competition theory; trophic niche separation; multigrazer systems; competition, evolution and speciation; coexistence; and parasitism and symbiosis. Authors who wish to present a paper or poster on the above mentioned topics or related areas of interest should submit titles no later than 1st February 1985. For further information on the program and registration forms, write Dr. Graham C. Hickman, Organizing Chair Committee Member, Department of Zoology, P.O. Box 375, Pietermaritzburg Natal 3200, Republic of South Africa.

DRS. PAUL RACEY AND ADRIAN MARSHALL WRITE FROM ABERDEEN, SCOTLAND, ON RESEARCH ON BATS

Drs. Paul Racey and John Speakman are entering the second year of a three-year project on the energetics of reproduction in insectivorous bats, using laboratory respirometry together with heavy water turnover in free-living bats. They are concerned mainly with comparing the energy costs of pregnancy and lactation.

Philip Neville is entering his third and last field season of his doctoral study, comparing the abundance and feeding ecology of bats in different forest types in North-east Scotland. Philip is using QMC bat detectors coupled to a multichannel battery-operated instrumentation tape recorder to monitor bat activity, and suction traps and light traps at different heights in the canopy to compare insect abundance. Bats are also caught in mist nets to provide faeces for analysis.

Paul Racey hopes to set a graduate student onto a laboratory-based analysis of foliage-gleaning in long-eared bats *Plecotus auritus* in October 1985. He also has final-year undergraduates working on experimental analyses of bats' reactions to potential predators at the nursary roost.

Adrian Marshall, continuing his interest in the Megachiroptera, is visiting Sulawesi in Indonesia for two months this year in part to make observations on bats as pollinators and seed dispersers. He also hopes to obtain finance for a postgraduate student to study fruit-bats in Malaysia, either *Cynopterus* or *Rousettus*. This should complement the work of one of his students currently in Malaysia studying birds as seed dispersers in the rain forest.

Received March 19, 1985

BAT ADDED TO THE ENDANGERED LIST:

Bulmer's flying fox

BAT ARTIFACT COLLECTORS NOTE:

Rock star Meat Loaf has a top-selling album *Bat out of Hell.* (Courier-Journal, Louisville, 21 January 1985).

The small booklet **The Most Famous Bat in the World** that you found enclosed with this issue was generously provided by Bacardi Imports, Incorporated. It is yet another example of the skillful and creative photography of Merlin Tuttle. This effort provides a welcome and timely assist in reeducating the public about our favorite animals.

OBITUARY

It is with great sadness that we record the untimely death of Dr. William A. Wimsatt on January 9, 1985. A memorial tribute will appear in the next issue of **Bat Research News**.

Book Review

Hill, J.E. and J.D. Smith. **Bats: A Natural History.** University of Texas Press, Austin, Texas, 243 pp., 1984. Price $24.95. (cloth)

The authors state in the Introduction that the purpose of **Bats: A Natural History** is "to present the general reader or serious student with a review of the fundamental aspects of bat biology." John Hill and James Smith are eminently qualified to take on such a challenge; both are respected bat biologists and have first-hand knowledge of bat faunas the world over.

The book begins with a short introduction to contemporary taxonomy. The occasional diversions into nomenclatural trivia (e.g. Oldfield Thomas' response to the challenge of producing the world's shortest scientific name, *Ia io*) make what otherwise might be a dry introduction to bat biology enjoyable reading. In the second chapter, the authors detail bat anatomy. Their discussions of external and internal form are rich with examples which serve them well in demonstrating the tremendous diversity in bat design. The third chapter is dedicated to discussion of the origin and evolution of bats. A polyphyletic origin of bats is strongly promoted, but the authors acknowledge this hypothesis is not accepted by all students of bat phylogeny. A very complete presentation of bat flight is provided in the fourth chapter. Frequent comparison of flight anatomy and physiology among bats, birds, and reptiles (pterosaurs) aids in illustrating how natural selection can arrive at a number of solutions to problems inherent in taking to the air. The next chapter, *Food Habits and Feeding*, reviews the varied diets of bats and the anatomical and ethological adaptations concomitant to obtaining and processing foods. Chapter six is a well-organized and clearly represented discussion of thermoregulation in bats. Under the veil of *Reproduction and Development*, the authors introduce in chapter seven the anatomy, physiology, ethology, and ecology of bat sex. Although their introduction to mating systems has a faint group selectionist ring to it ("It is presumed that the social organization of individuals within species, and mating systems in particular, guard against the eventuality of extinction."), the chapter is clear and complete. Chapter eight, *Echolocation and Vocalization*, is perhaps the weakest section of the book. The authors get off to a fine start with an enjoyable retelling of the Spallanzani story. The next section, however, on the physical aspects of sound is poorly presented. The text is often unclear, sometimes highly misleading (high frequency sounds don't "generally" [page 109] have short wavelengths, they **do** have short wavelengths), and in some places downright wrong (the horizontal axes in Figures 8.1 A, B and 8.3 A, B, C read "frequency" where in fact they should be "time"). Chapter nine is devoted to population ecology of bats and includes discussion of roost site selection, social behavior, predation, demographics, migration and homing. Chapter 10, entitled *Man and Bats* is excellent. Hill and Smith have done a fine job of gathering together a number of interesting myths and folk tales in which bats play a central role. This chapter is the high-point of the book and will be enjoyed by all readers, neo-chiroptologists and veterans alike. The sections on bat diseases, public health issues, bat-human interactions, and conservation are also clearly presented. The book ends with a long chapter on *Bats of the World*. Diagnostic characteristics, a generalized natural history, and range maps are presented for each family. The bibilography contains 361 entries. References are current (up to 1983) and are given at the end of the book on a chapter by chapter basis with special sections on *General Books* and *Regional Studies*. Citations are not given in the text and this may frustrate "serious students" looking for the original source of a peice of information. However, as the authors state in the introduction, this might complicate and lengthen the text, possibly to the distraction of the lay readership. A general index is provided along with indices of vernacular names and scientific names.

Hill and Smith have produced a very clean book. I noted few typographical errors. The figures are of mixed quality; the anatomical illustrations are excellent but many of the line-drawings of bats are less than spectacular. Figure 6.1 shows a lower limit of the thermoneutral zone of *Pipistrellus* to be 30° whereas the text states that it is 32°. The symbols in figure 7.6 are not explained and the Strelkov (1969) citation given in the legend for figure 9.6 is not included in the bibliography.

Although a number of excellent books on bat biology have been published since 1980, the Hill and Smith volume fills a unique niche. The concern the authors show for their lay audience in evident in the careful attention paid to defining technical terms. Sufficient detail is provided so that professional bat biologists wishing to learn what is being done outside their research, tax-

onomic, or geographic specialty will not be disappointed. The writing style is more relaxed than that found in recent technical volumes on bat biology , but Hill and Smith do not convey the personal excitement for the subject as does Fenton in his recent book, **Just Bats**. All things considered, the authors have achieved their goal. **Bats: A Natural History** will provide the serious student or general reader with a thorough introduction to bat biology.

— Peter V. August
Conservation and Research Center
Front Royal, Virginia 22630

NEW ADDRESS OF JOHN J. RASWEILER IV:
Department of Obstetrics & Gynecology
The New York Hospital-Cornell Medical Center
525 East 68th Street
New York, NY 10021 USA

EDITOR'S ACKNOWLEDGEMENTS

The editor is grateful to the following who reviewed manuscripts for volume 25 (1984) of the *Bat Research News*:
M. Brock Fenton, Arthur M. Greenhall, Karl F. Koopman, Thomas H. Kunz, Richard K. LaVal, John J. Rasweiler IV, Merlin D. Tuttle, William A. Wimsatt.

The editor also thanks Patricia Brown, K.B. Karim, S. Legendre, Robert E. and Joanne H. Lewis, B. Sige, and Harlan Walley for assistance with the Recent Literature section of *Bat Research News*, volume 25 (1984).

Errata

The article by Dr. Karl Koopman in Volume 25: 3-4 contained a larger than usual number of errors. Some of these might be attributed to the Latin names unfamiliar to our typesetter, some were missed during proofing. We apologize to Dr. Koopman for our oversight and offer the following corrections.

On page 25, please change:
Myoncyteris to *Myonycteris*
Harpyioycterini to *Harpyionycteris*
Scotoncyteris to *Scotonycteris*
Magaerops to *Megaerops*

On page 26:
Yinochroptera to Yinochiroptera
Saccoperyx to *Saccopteryx*
Cloetis to *Cloeotis*
Chroptopterus to *Chrotopterus*
Musinycteris to *Musonycteris*

On page 27:
Thyropteridea to Thyropteridae
Nyctoceius to *Nycticeius*
Nystophilini to Nyctophilini
Tomeatinae to Tomopeatinae

On line 19 maxillary should read premaxillary
On line 31 *Cloetis* to *Cloeotis*

Add after *Lasiuris*
Tribe Plecotini
Barbastella (2)
Plecotus (including *Idionycteris*) (6)
Euderma (1)

There are also some changes in the numbers of species in some taxa (provided by Koopman). They are:
Pteropodinae (165)
Dobsonia (11)
Harpionycteris (2)
Micropteropus (3)
Nyctimene (14)
Syconycteris (3)
Rhinolophidae (126)
Hipposideros (50)
Lonchorhina (4)
Phyllostomidae (139)
Lonchophylla (7)
Vespertilionidae (311)
Kerivoula (21)
Myotis (88)
Scotozous (49)
Scotophilus (5)
Murina (15)

There are now 912 species of bats rather than 888 (as of June 7!) and we all know that Karl is in the Department of Mammalogy and not Mammology. Again we apologize for these errors and additions. [The Editors]

RECENT LITERATURE

ANATOMY

Bassett, J.E., and C.A. Wiederhielm. 1984. Postnatal changes in hematology of the bat *Antrozous pallidus*. Como. Biochem. Physiol., Pt. A., 78: 737-740. (Univ. Washington, Dept. Physiology & Biophysics, Microcirculation Lab., Seattle, WA 98195 USA).

Buchanan, G.D., and R.E. Garfield. 1984. Myometrial ultrastructure and innervation in *Myotis lucifugus*, the little brown bat. Anat. Rec., 210: 463-476 (McMaster Univ., Fac. Hlth. Sci., Sch. Nursing, Hamilton, Ontario, Canada L8N 3Z5).

Dylevsky, I., and E. Trnkova. 1984. Origin and development of the muscles of the intermetacarpal space of the forelimb of the brown bat (*Myotis myotis*). Folia Morphol., 32: 40-46.

Findley, J.S., and D.E. Wilson. 1982. Ecological significance of chiropteran morphology, pp. 243-260. IN T. H. Kunz (ed.), Ecology of Bats. Plenum Press, New York, 425 pp.

Fenton, M.B., and L.M. Crerar. 1984. Cervical vertebrae in relation to roosting posture in bats. J. Mamm., 65: 395-403 (Biology, Carleton Univ., Ottawa, Canada K1S 5B6).

Foehring, R.C., and J.W. Hermanson. 1984. Morphology and histochemistry of flight muscles in free-tailed bats, *Tadarida braziliensis*. J. Mamm., 65: 388-394 (Zoology, Univ. of Florida, Gainsville, FL 32610 USA).

Hood, C.S., and J.D. Smith. 1984. Histology of a sexually dimorphic integumentary gland in *Macroglossus lagochilus* (Chiroptera: Pteropodidae). J. Mamm., 65: 1-9 (Biological Sciences and the Museum, Texas Tech. Univ., Lubbock, TX 79409 USA).

Kishida, R., R.C. Goris, S.-I. Terashima and J.L. Dubbeldam. 1984. A suspected infrared-recipient nucleus in the brainstem of the vampire bat, *Desmodus rotundus*. Brain Res., 322: 351-355. (Yokohama City Univ., Sch. Med., Dept. Anatomy, Minami Ku, Yokohama, Kanagawa 232, Japan).

Maina, J.N., and A.S. King. 1984. Correlations between structure and function in the design of the bat lung: a morphometric study. J. Exp. Biol., 111: 43-62 (Univ. Nairobi, Dept. Vet. Anat., Nairobi, Kenya).

Nagato, T., B. Tandler and C.J. Phillips. 1984. Unusual smooth endoplasmic reticulum in submandibular acinar cells of the male round-eared bat, *Tonatia sylvicola*. J. Ultrastructure Res., 87: 275-284 (Reprint: B. Tandler, Oral Biology, Case Western Reserve Univ. School of Dentistry, Cleveland, Ohio 44106 USA).

Nishimura, S., and M. Kato. 1983. Morphological observations on the tongue of the flying fox (*Pteropus dasymallus yayeyamae*, Kuroda, 1933). J. Mamm. Soc., Japan, 9: 267-273.

Phillips, C.J., K.M. Studholme and G.L. Forman. 1984. Results of the Alcoa Foundation Suriname Expeditions. VII. Comparative ultrastructure of gastric mucosae in four genera of bats (Mammalia: Chiroptera), with comments on gastric evolution. Ann. Carnegie Mus., 53: 71-117 (Biology, Hofstra Univ., Hempsted, NY 11500 USA).

Straney, D.O. 1984. The nasal bones of *Chiroderma* (Phyllostomidae). J. Mamm., 65:163-165 (Zoology, Michigan State Univ., East Lansing, MI 48824 USA).

Tandler, B., and R.P. Cohan. 1984. Ultrastructure of the parotid gland in the little brown bat. Anat. Rec., 210: 491-502 (Address in Nagato).

Trnkova, E., and I. Dylevsky. 1984. The musculi cantrahentes and their development in the brown bat (*Myotis myotis*). Folia Morphol., 32: 47-54.

Tuttle, M.D., and D. Stevenson. 1982. Growth and survival of bats, pp. 105-150. IN, T.H. Kunz (ed.), Ecology of Bats. Plenum Press, New York, 425 pp.

Uieda, W. 1982. Aspectos do comportamento alimentar das tres especies de morcegos hematofagos (Chiroptera, Phyllostomatidae). Unpublished M.S. Thesis, Instituto de Biologia da Universidade Estadual de Campinas, Brasil, 166 pp. (Departamento de Ciencias, Centro Universitario de Corumba, Universidade Federal de Mato Grosso do Sul, 79300-Corumba, MS, Brasil). English summary.

BEHAVIOR

Fleming, T.H. 1982. Foraging strategies of plant-visiting bats, pp. 287-325. IN, T.H. Kunz (ed.), Ecology of Bats. Plenum Press, New York, 425 pp.

Kolb, A. 1984. Schwimmen, starten vom wasser und orientierung einheimischer Fledermause. Z. Saugetierk., 49:1-6. English summary.

BIOCHEMISTRY

McLoughlin, J.L., and R.C. Cantrill. 1984. Vitamin B_{12} deficiency alters the distribution of membrane proteins on linear sucrose gradients in the fruit bat brain. Neurosci. Lett., 49: 175-180. (Univ. Witwatersrand, Sch. Med., Dept. Med. Biochem., Parktown 2193, S. Africa).

Quicke, G.V., S. Sowler, R.K. Berry and A.M. Geddes. 1984. Compostion of mammary secretion from the epauletted fruit bat, *Epomophorus wahlbergi*. S. African J. Sci., 80: 481 (Univ. Natal, Dept. Biochem., Pietermartizburg 3200, S. Africa).

van der Westhuyzen, J., and J.E. Gibson. 1984. Lipid composition of the brain in the Cobalamin inactivated fruit bat, *Rousettus aegyptiacus*. Int. J. Vitam. Nutr. Res., 54: 205-210 (S. African Inst. Med. Res., Sch. Pathol., Dept. Hematology, MRC, Brain Metab. Res. Unit, POB 1038, Johannesburg 2000, S. Africa).

CONSERVATION

Harvey, M.J., and V.R. McDaniel. 1983. Status of the bat *Myotis keenii* in the Arkansas Ozarks. Proc. Arkansas Acad. Sci., 37: 89.

DISEASE AND PARASITISM

Advani, R., and T.G. Vazirani. 1981. Studies on ectoparasites of bats of Rajasthan and Gujarat (India). Rec. Zool. Surv., India Occas. Papers, 22: 155 pp.

Jones, G.S., and H.S. Thomas. 1983. Distribution and ectoparasites of little brown bats, *Myotis lucifugus*, on Prince Edward Island. Canadian Field Natur. 97: 320-321.

Marshall, A.G. 1982. Ecology of insect ectoparasites on bats, pp. 369-401. IN, T.H. Kunz (ed.), Ecology of Bats. Plenum Press, New York, 425 pp.

Paterson, W.B., and P.T.K. Woo. 1984. The development of the culture and bloodstream forms of three *Trypanosoma* (*Schizotrypanum*) spp. (Protista: Zoomastigophorea) from bats in *Cimex lectularius* (Hemiptera: Climicidae). Can. J. Zool., 62: 1581-1587 (Reprint P.T.K. Woo, Univ. Guelph, Dept. Zoology, Guelph, Ontario, Canada N1G 2W1).

Peirce, M.A. 1984. Parasites of Chiroptera in Zambia. J. Wildl. Dis., 20: 153-154.

Roshdy, M.A., H. Hoogstraal, C.M. Clifford, J.E. Keirans and M.D. Corwin. 1984. Bat ticks of the genus *Argas* (Ixodoidea: Argasidae). 13. Haller's organ roof and anterior pit setae in *Carios* and *Chiropteragas*. J. Parasitology, 70: 407-411 (USN, Med. Res. Unit 3, Dept. Med. Zoology, New York, NY 09527 USA).

DISTRIBUTION

Aggundey, I.A., and D.A. Schlitter. 1984. Annotated checklist of the mammals of Kenya. I. Chiroptera. Ann. Carnegie Mus. Nat. Hist., 53: 119-161.

Baeten, B., et al. 1984. An annotated inventory of a collection of bats from Rwanda. Rev. Zool. Africaine, 98: 183-196.

Graham, G.L. 1983. Changes in bat species diversity along an elevational gradient up the Peruvian Andes. J. Mamm., 64: 559-571 (Biology, Univ. of New Mexico, Albuquerque, NM 87131 USA).

Graham, G.L., and L.J. Barkley. 1984. Noteworthy records of from Peru. J. Mamm., 65: 709-711.

Green, R.H., and J.L. Rainbird. 1984. The bat genus *Eptesicus* Gray in Tasmania. Tasmanian Natur., 76:1-5.

Heath, D.R., et al. 1983. Arkansas range extensions of the seminole bat (*Lasiurus seminolus*) and eastern big-eared bat (*Plecotus rafinesquii*) and additonal country records for the hoary bat (*Lasiurus cinereus*), silver-haired bat (*Lasiurus noctivagans*) and evening bat (*Nycticeius humeralis*). Proc. Arkansas Acad. Sci., 37: 90-91.

Lal, J.P. 1981. First record of the horseshoe bat, *Rhinolophus rouxi rouxi* Temminck (Chiroptera: Rhinolophidae) from Burma. Bull. Zool. Survey of India, 4: 389.

Lina, P.H.C. 1984. Vermoedelijke verplaatsing van Nathusius' dwergvleermuizen *Pipistrellus nathusii* door houttransporten van Polen naar Nederland (Supposed displacement of Nathusius' pipistrelles *Pipistrellus nathusii* by timber transports from Poland to the Netherlands). Lutra, 27: 154-156 (In Dutch, English summary; Ministerie van Visserij, Sector Gebiedsbescherming en Soortenbehoud, Postbus 20401, 2500 EK's - Gravenhage, Netherlands).

Saugey, D.A., et al. 1983. First report of Brazilian free-tailed bat maternity colonies in Arkansas. Proc. Arkansas Acad. Sci., 37: 98-99.

Schowalter, D.B. 1980. New records of British Columbia bats. Syesis, 13: 1-3.

Zingg, P.E. 1984. Erster Nachweis einer Wochenstubenkolonie von *Myotis brandti* in der Schweiz. Z. Saugetierkunde, 49: 190-191 (Zoologisches Institut der Universitat Bern und Naturhistorisches Museum Bern, Switzerland).

ECHOLOCATION

Habersetzer, J., G. Schuller and G. Neuweiler. 1984. Foraging behavior and Doppler shift compensation in echolocating hipposiderid bats, *Hipposideros bicolor* and *Hipposideros speoris*. J. Comp. Physiology A, 155: 559-568 (Univ. Frankfurt, Inst. Zoology, D-6000 Frankfurt, FRG).

Jen, P.H.-S. 1983. Neural basis of the Doppler-shifted compensation behavior of the mustache bat, *Pteronotus parnellii*. Proc. Natl. Sci. Counc. Taiwan, 7: 298-316.

Joermann, G. 1984. Recognition of spatial parameters by echolocation in the vampire bat, *Desmodus rotundus*. J. Comp. Physiol., A, 155: 67-74. (Univ. Bonn., Dept. Zoology, D-5300 Bonn 1, FRG).

Kick, S.A., and J.A. Simmons. 1984. Automatic gain control in the bat's sonar receiver and the neurethology of echolocation. J. Neurosci., 4: 2725-2737 (Reprint: JA Simmons, Univ. Oregon, Inst. Neuroscience, Eugene, OR 97403 USA).

Leonard, M.L., and M.B. Fenton. 1984. Echolocation calls of *Euderma maculatum* (Vespertilionidae): use in orientation and communication. J. Mamm., 65: 122-126 (Biology, Carleton Univ., Ottawa K1S 5B6, Canada).

Miller, L.A., and B.B. Anderson. 1984. Studying bat echolocation signals using ultrasonic detectors. Z. Saugetierk., 49: 6-13.

Neuweiler, G. 1984. Foraging, echolocation and audition in bats. Naturwissenschaften, 71: 446-455 (Madurai Kamaraj Univ., Sch. Biol. Sci., Indo German Project Anim. Behav., Madurai 625 021, Tamil Nadu, India).

Schuller, G. 1984. Natural ultrasonic echoes from wing beating insects are encoded by collicular neurons in the CF-FM belt. J. Comp. Physiol., A, 155: 121-128 (Univ. Munich, Inst. Zool., D-8000 Munich 2, FRG).

Shimozawa, T., X. Sun, and P.H.-S. Jen. 1984. Auditory space representation in the superior colliculus of the big brown bat, *Eptesicus fuscus*. Brain Res., 311: 289-296 (Reprint: PHS Jen, Univ. Missouri, Div. Biol. Sci., Columbia, MO 65211 USA).

Wenstrup, J.J. 1984. Auditory sensitivity in the fish-catching bat, *Noctilio leporinus*. J. Comp. Physiol., A, 155: 91-102 (Univ. Texas, Dept. Zoology, Austin, TX 78712 USA).

Wenstrup, J.J., and R.A. Struthers. 1984. Echolocation of moving targets by the fish-catching bat, *Noctilio leporinus*. J. Comp. Physiol., A, 155: 75-90.

ECOLOGY

Dinerstein, E. 1984. Reproductive ecology of fruit bats and seasonality of fruit production in a Costa Rican cloud forest. Diss. Abstr. Int., B, Sci. Eng., 44: 3252.

Erkert, H.G. 1982. Ecological aspects of bat activity rhythms, pp. 201-242. IN, T.H. Kunz (ed.), Ecology of Bats. Plenum Press, New York, 425 pp.

Fenton, M.B. 1982. Echolocation, insect hearing, and feeding ecology of insectivorous bats, pp. 261-285. IN, T.H. Kunz (ed.), Ecology of Bats. Plenum Press, 425 pp.

Hitchcock, H.B., R. Keen and A. Kurta. 1984. Survival rates of *Myotis leibii* and *Eptesicus fuscus* in Southeastern Ontario. J. Mamm., 65: 126-130 (Biology, Middlebury College, Middlebury, VT 05753 USA).

Lemke, T.O. 1984. Foraging ecology of the long-nosed bat, *Glossophaga soricina*, with respect to resource availability. Ecology, 65: 538-548.

Munson, P.J., and J.H. Keith. 1984. Prehistoric racoon predation on hibernating *Myotis*, Wyandotte cave, Indiana. J. Mamm., 65: 152-155 (Anthropology, Indiana Univ. Bloomington, IN 47405 USA).

Racey, P.A. 1982. Ecology of bat reproduction, pp. 57-104. IN, T.H. Kunz (ed.), Ecology of Bats. Plenum Press, New York, 425 pp.

Rodriguez, G.A., and D.P. Reagan. 1984. Bat predation by the Puerto Rican boa, *Epicrates inornatus*. Copeia, 1: 219-220.

Schaller, G.B. 1983. Mammals and their biomass on a Brazilian ranch. Arquivos de Zoologia, 31: 1-36 (includes bats; New York Zoological Society and Instituto Brasileiro de Desenvolvimento Florestal, Brasilia).

Thomas, D.W. 1984. Moth scales in feces of fruit bats: evidence of insectivory or fruit contamination? J. Mamm., 65: 484-485 (College of Forest Resources AR-10, Univ. of Washington, Seattle WA 98195 USA).

Thomas, D.W., B. Crawford, S. Eastman, R. Glafscheskie, and M. Heir. 1984. A reappraisal of the feeding adaptations in the hairs of nectar-feeding bats. J. Mamm., 65: 481-484.

Timm, R.M. 1984. Tent construction by *Vampyressa* in Costa Rica. J. Mamm., 65: 166-167 (Mammals, Field Museum of Natural History, Chicago, IL 60605-2496 USA).

EVOLUTION AND GENETICS

Haiduk, M.W. 1984. Evolution in the family Pteropidae (Chiroptera: Megachiroptera) as indicated by chromosomal and immunoelectrophoretic analyses. Diss. Abstr. Int., B, Sci. Eng., 44: 2677.

Haiduk, M.W., and R. J. Baker. 1984. Scientific method, opinion, phylogenetic reconstruction, and nectar-feeding bats: a response to Griffiths and Warner. Syst. Zool., 33: 343- (Lamar Univ. Biology Dept., Beaumont, TX 77710 USA).

Heithaus, E.R. 1982. Coevolution between bats and plants, pp. 327-367. IN, T.H. Kunz (ed.), Ecology of Bats. Plenum Press, New York, 425 pp.

McCracken, G.F. 1984. Social dispersion and genetic variation in two species of emballonurid bats. Z. fur Tierpsychologie, 66: 55-69 (Univ. Tenn., Dept. Zoology, Knoxville, TN 37996 USA).

Obara, Y. 1983. An example of partial albinism in the Japanese long-fingered bat, *Miniopterus schreibersi fulginosus*. J. Mamm. Soc. Japan, 9: 302-307.

Wesselman, H.B. 1984. Omo micromammals. Systematics and paleoecology of early man sites from Ethiopia — Contributions to vertebrate evolution, vol. 7 (Family Pteropodidae, pp. 44-45; Family Emballonuridae, 46; Family Hippodideridae, 55). S. Karger, Basel, 219 pp.

KARYOLOGY

Yong, H.S. 1984. Robertsonian translocation, pericentric inversion and heterochromatin block in the evolution of the tailless fruit bat. Experientia, 40: 875-876 (Univ. Malaya, Dept. Genetics & Cellular Biology, Kuala Lumpur 2211, Malaysia).

PALEONTOLOGY

Legendre, S. 1984. Identification de deux sous-generous fossiles et comprehension phylogenique du genre *Mormopterus* (Molossidae, Chiroptera). (Identification of two fossil subgenera and phylogenetic proposal of genus *Mormopterus* (Molossidae, Chiroptera). C.R. Acad. Sci. Paris, 298: 715-720. (Inst. des Sciences de l'Evolution, L.A. no. 327, Univ. de Sciences et Techniques du Languedoc, Montpellier-II, Place Eugene Bataillon, 34060 Montpellier, Cedex, France).

PESTICIDES AND PUBLIC HEALTH

Clark, D.R., and R.M. Prouty. 1984. Disposition of dietary Dieldrin in the little brown bat, and correlation of skin levels with body burden. Bull. Environmental Contamination and Toxicology, 33: 177-183 (U.S. Fish and Wildlife Res. Ctr., Laurel, MD 20708 USA).

Clark, D.R., C.M. Bunck, E. Cromartie and R.K. LaVal. 1983. Year and age effects on residues of Dieldren and Heptachlor in dead gray bats, Franklin County, Missouri — 1976, 1977, and 1978. Environmental Toxicology and Chemistry, 2: 387-393.

Fleming, W.J., D.R. Clark, and C.J. Henny. 1983. Organochlorine pesticides and PCB's a continuing problem for the 1980's. IN, Transections of the 48th North American Wildlife and Natural Resources Conference, Wildlife Management Inst., Washington, D.C., pp. 186-199.

PHYSIOLOGY

Ahmad, A. 1984. A comparative study of the flight surface and aerodynamic parameters of insects, birds and bats. Ind. J. Exp. Biol., 22: 270-278 (Nizam College, Dept. Physics & Biophysics Lab., Hyderabad 500 001 AP, India)

Arganbright, K. 1984. Electromyographic analysis of an intrinsic wing muscle in *Antrozous pallidus*. J. Mamm., 65: 480-481 (Biology, Univ. of New Mexico, Albuquerque, NM 87131 USA).

Chen, I.I. H., B.P. Fleming and R.L. Prewitt. 1984. A mathematical representation of the microvascular network in the bats wing — Hypothesis. Microcirculation, Endothelium and Lymphatics, 1: 57-70. (Louisiana St. Univ., Med. Ctr., Dept. Physiology & Biophysics, Shreveport, LA 71130 USA).

Marimuthu, G. 1984. Seasonal changes in the precision of the circadian clock of a tropical bat under natural photoperiod. Oecologia, 61: 352-357.

McNab, B.K. 1982. Evolutionary alternatives in the physiological ecology of bats, pp. 151-200. IN, T.H. Kunz (ed.), Biology of Bats. Plenum Press, New York, 425 pp.

REPRODUCTION

Banerjee, S., and K.B. Karim. 1984. Histogenesis of the corpus luteum in the Indian mouse-tailed bat, *Rhinopoma hardwickei hardwickei* (Gray). Proc of the Symposium on Recent Advances in Developmental Biology of Animals, Allahabad, India, pp. 24-26 (Zoology, Inst. of Science, Nagpur 440 001 India).

Beasley, L.J., and I. Zucker. 1984. Photoperiod influences the annual reproductive cycle of the male pallid bat. J. Reprod. Fert., 70: 567-573.

Cervantes, V.I. 1981. Estado funcional de los ovarios en *Artibeus lituratus* (chiroptera, Phyllostomatidae). Rev. Cienc. Univ. Nac. May. San Marco, 73: 85-94 (English summary).

Damassa, D.A., and A.W. Gustafson. 1984. Control of plasma sex steroid-binding protein (SBP) in the little brown bat: effects of photoperiod and orchiectomy on the induction of SBP in immature males. Endocrinology, 115: 2355-2361 (Reprint: See Gustafson).

Gadegone, M.M., and V.M. Sapkal. 1983. Mucins in the male accessory sex glands of pipistrellid bat, *Pipistrellus dormeri* (Dobson). Comp. Physiol. Ecol. Jodhpur, India, 8: 219-222.

Gustafson, A.W., and D.A. Damassa. 1984. Perinatal and postnatal patterns of plasma sex steroid-binding protein and testosterone in relation to puberty in the male little brown bat. Endocrinology, 115: 2347-2354 (Tufts Univ., Sch. Med., Dept. Anatomy & Cell Biology, Boston, MA 02111 USA).

Pal, A.N. 1984. Histophysiology of the male accessory sex glands of the Indian sheath-tailed bat, *Taphozous longimanus* (hardwickei). J. Current Biosciences, Jodhpur, India, 1: 122-126.

Sandhu, S., and A. Gopalakrishna. 1984. Some observations on the breeding biology of the Indian fruit bat, *Cynopterus sphinx* (Vahl). Curr. Sci., 53: 1189-1192 (Zoology, Inst. of Science, Nagpur 440 001 India).

SYSTEMATICS

Davis, W.B. 1984. Review of the large fruit-eating bats of the *Artibeus "lituratus"* complex (Chiroptera: Phyllostomatidae) in Middle America. Occas. Pap. Mus. Texas Tech., 93, 16 pp.

Freeman, P.W. 1984. Functional cranial analysis of large animalivorous bats (Microchiroptera). Biol. Jour. Linnean Soc., 21: 387-408 (Univ. Nebraska, State Museum, Div. Zoology, Lincoln, NE 68588 USA).

Herd, R.M. 1983. A simple antibody test for field identification of morphologically similiar mammals. J. Mamm., 64: 700-701 (*Myotis lucifugus* and *M. yumanensis*; Biology, Carleton Univ., Ottawa, Canada K1S 5B6).

Koepcke, J., and R. Kraft. 1984. Cranial and external characters of the larger fruit bats of the genus *Artibeus* from Amazonian Peru. Spixiana, 7: 75-84.

Legendre, S. 1984. Etude odontologique des representants actuels du groupe *Tadarida* (Chiroptera, Molossidae). Implications phylogeniques, systematiques at Zoogeographiques. (Odontological study of the living representatives of the *Tadarida* group. Phylogenetical, systematic, and zoogeographical implications). Revue Suisse Zool., 91: 399-442 (English summary. See address in Paleontology).

Maeda, K. 1983. Geographic and sexual variations of taxonomical characters in *Miniopterus macrodens* Maeda, 1982, and *M. magnater* Sanborn, 1931. J. Mamm. Soc. Japan, 9: 291-301.

Maeda, K. 1984. Geographic and sexual variations of the external and skull characters in bats of the *Miniopterus australis* group. J. Mamm. Soc. Japan, 10: 9-33.

Moore, D.W., and J.K. Braun. 1983. Key to the hairs of the families Soricidae, Vespertilionidae nad Muridae within Tennessee. J. Tennessee Acad. Sci., 58: 40-43.

Owen, J.G., D.J. Schmidley and W.B. Davis. 1984. A morphometric analysis of *Carollia* (Chiroptera, Glassophaginae) from Middle America. Mammalia, 48: 85-93.

Webster, W.D. 1984. Systematics and evolution of bats of the genus *Glossophaga*. Diss. Abstr. Int., B., Sci. Eng., 44: 2359.

Yoshiyuki, M. 1983. A new species of *Murina* from Japan (Chiroptera, Vespertilionidae). Bull. Natl. Sci. Mus. Tokyo, 9A: 141-150.

BOOKS

Anderson, S., and J.K. Jones, Jr. (eds.) 1984. Orders and Families of Recent Mammals of the World. John Wiley & Sons, New York, 686 pp.

MAMMALIAN SPECIES

Hood, C.S., and J.K. Jones, Jr. 1984. *Noctilio leporinus*. Mammalian Species, 216: 1-7.

Webster, W.D., and R.W. Owen. 1984. *Pygoderma bilabiatum*. Mammalian Species, 220: 1-3.

MISCELLANEOUS

Brower, J.C., and J. Veinus. 1981. Allometry in Pterosaurs. Univ. Kansas Paleontol. Contr. No. 105: 1-32 (wing structure of bats and flight; Heroy Geology Lab., Syracuse Univ., Syracuse, NY 13210 USA).

Cox, P.A. 1983. Observations on the natural history of Samoan bats. Mammalia, 47: 519-524 (Brigham Young Univ., Dept. of Botany, Provo, U T 84604 USA).

Hanmer, D.B. 1983. Not so batty bats. Nvala, 9: 19-21.

Helmer, W. 1983. Tree dwelling Daubenton's bats, *Myotis daubentonii* near Nijmegen (The Netherlands). Lutra, 26: 1-11 (Joanneslaan 7 6564 AE Heilig, Landstichting, The Netherlands).

Studier, E.H., and K.H. Lavoie. 1984. Microbial involvement in scent production in noctilionid bats. J. Mamm., 65: 711-714 (Biology, Univ. of Michigan-Flint, Flint, MI 48502-2186 USA).

Zullinger, E.M., R.E. Ricklefs, K.H. Redford, and G.M. Mace. 1984. Fitting sigmoidal equations to mammalian growth curves. J. Mamm., 65: 607-636 (Biology, Leidy Laboratory, Univ. Pennsylvania, Philadelphia, PA 19104 USA).

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Editor

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

Managing Editor

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

Past Editors

Wayne H. Davis (1960-1970)
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BAT RESEARCH NEWS

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WILLIAM ABELL WIMSATT (1917-1985) A MEMORIAL TRIBUTE

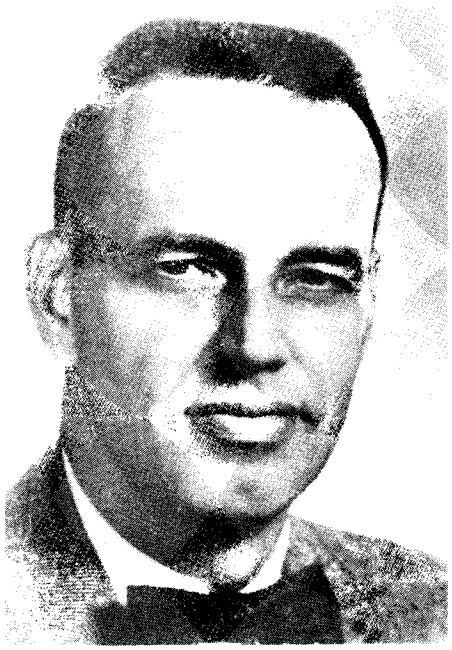
William A. Wimsatt passed away at his home in Ithaca, NY on January 9, 1985 after a lengthy illness. He was born in Washington, D.C., on July 28, 1917, the eldest of three children born to Alma Chaney and William Church Wimsatt.

Bill's childhood was spent in Washington D.C. and in the Tarpon Springs area of Florida. His home in Washington was in the shadow of the old Smithsonian Institution and the museum and its grounds were his favorite childhood haunts. Early years spent along the Chesapeake Bay helped instill in Bill an abiding love of nature and a strong sense of wonder about living creatures.

As a youth Bill developed a keen interest in birds, especially birds of prey of which his favorite was the peregrine falcon. He trained several birds for falconry and retained a lifelong interest in this noble sport. His fondness for birds and their biology was enhanced by summers spent in New England as a camper and nature counselor. Here he befriended Carl Buckheister, the camp director who later became President of the Audobon Society.

Bill was an avid reader and among other works, enjoyed the writings of the late Dr. Arthur A. Allen, the Cornell University Ornithologist. While Bill was a student at St. Johns Preparatory School in Washington, he met Dr. Allen for the first time at a lecture Dr. Allen gave at Constitution Hall. Later Bill became one of Allen's graduate students at Cornell University and subsequently published five communications in ornithology. He prepared a fine collection of bird skins which he later gave to Cornell where they are still used in ornithology courses.

While he was a student in Dr. Allen's course he met Ruth Claire Peterson, also a student in Dr. Allen's course. In 1940 he and Ruth were married and she remained ever the light and love of his life.



At Cornell, Bill came to study under the distinguished embryologist, Dr. Howard B. Adelmann, and through him was introduced to the study of embryology and microscopic anatomy. Dr. Adelmann helped Bill develop broad interests while continuing his doctoral program as a teaching assistant. Bill focused his doctoral studies on reproduction in a variety of mammals, but he never lost his love of birds and this served as catalyst for his study of bats. He went on to conduct pioneering research on the interrelationships between hibernation and reproduction.

When Bill completed his graduate studies at Cornell in 1943, he was appointed Instructor of Anatomy at Harvard Medical School. There he

enjoyed a close relationship with George Wislocki and made many friends and alliances, many of whom became research collaborators. He often remarked how these early relationships helped him remain productive throughout his professional career.

Two years later he returned to the Department of Zoology at Cornell as Assistant Professor, responsible for teaching Histology and Embryology in both the College of Veterinary Medicine and the College of Arts and Sciences. Bill was appointed Associate Professor in 1947 and Professor in 1951. He was Chairman of the Department of Zoology from 1955-1964. For five years he was a research collaborator at Brookhaven National Laboratory where he spent his first sabbatical leave. For another five years he was a guest at the annual Macy Conferences at Princeton University where he reaffirmed some of the relationships he initiated at Harvard and made many new professional friends.

Throughout the years Bill took numerous collecting trips to Columbia, South America, Trinidad, the Virgin Islands, and the British West Indies. But his first love of the tropical countries was Mexico. In 1962 Bill spent a year working with Dr. Bernardo Villa at the University of Mexico as a recipient of a Guggenheim Fellowship. Not only was this a fine professional opportunity but the development of a deep and treasured friendship which extended to the entire Villa family, including Dr. Villa's son-in-law, William Lopez-Forment, who earned his Masters degree at Cornell while living with the Wimsatt family. His affection for Bernardo was enduring to the last. Bill returned to Mexico on many occasions and made every scientific trip into a working holiday for his family and students. He always wanted to make "one more trip to Mexico."

Bill loved the desert and spent three sabbatical leaves at the University of Arizona College of Medicine in Tucson with Dr. Philip Krutzsch who had similar research interests. Bill enjoyed this intellectual stimulation and he and Phil had a long and productive relationship.

Bill was widely acclaimed as the editor of the multivolume series **Biology of Bats** and for his expertise on the functional morphology of the placenta. He has published 65 major articles, many abstracts and several book reviews. His publications reveal a capacity to use novel approaches in such diverse areas of reproduction as embryology, placentation, and fetal membranes; in ecological physiology; in hibernation; as well as observations on the integumentary, urinary and digestive systems. These wide interests served him well in his position as Associate Editor of the American Journal of Anatomy from 1974 until shortly before his death.

After the Division of Biological Sciences was formed at Cornell in 1964, Bill held a joint appointment in the Section of Genetics and Development and the Section of Physiology. He was responsible for teaching Histology, but at Cornell for decades he **was** "Histology." He also taught Organology and Embryology.

Bill was a superb teacher both in the classroom and in the field. His observational skills were legendary and he incorporated his life experiences into his lectures in such a creative way that his presentations were indeed very rich experiences. In another tribute it was said that ". . . he possessed an eloquent vocabulary and an elegant style yet he never let his erudition obfuscate the basic concepts that he was attempting to elucidate."

He had a natural rapport with students who affectionately called him "Doc." At the graduate level he was the mentor for 17 Ph.D. candidates, 7 Master candidates, two postdoctoral Associates and served as a minor committee member for nearly one hundred other graduate students. His students were devoted to him because he asked for excellence and set such a fine example. He never pushed students to publish, but instead insisted that a "piece of work" be accomplished. It was characteristic of him that he refused to be included as a co-author of work completed under his supervision unless his contribution was truly that of co-author and not merely because the idea, the materials or inspiration originated from Bill or his laboratory.

Bill was assisted in his work by the dedicated service of Mr. Anthony Guerriere who was his technician for nearly 35 years. Tony became Bill's "right hand" in the laboratory and he and Bill developed a working partnership that was not dissolved even by Bill's forced retirement.

In a tribute sent to his family by the Board of Trustees of Cornell University, of which he was a member from 1960 through 1965, he was complemented for his long and distinguished career at Cornell and his devotion to the University as a teacher, trustee and leader in Campus Governance. During his term as trustee, he also served on the Board of Cornell United Religious Work, The Board of Governors of Willard Straight Hall, and the Board of Editors for Cornell University Press.

As a faculty member, Bill was Chairman of the Faculty Committee on Student Conduct, served on the Advisory Committee for Premedical Students, the Administrative Committee of the Division of Unclassified Students, and the University Policy Committee, which he chaired. He served for many years as a Director of the Cornell University Research Foundation, Inc. and he served on many other committees, councils and boards of the University. Bill was a member of

Sigma Xi, Phi Kappa Phi, Phi Zeta (The Veterinary Honorary Society), a Fellow and Member of the American Association for the Advancement of Science, a member of the American Association of Anatomists, the American Society of Mammalogists, the Histochemical Society, the Society for the Study of Reproduction, and the American Society of Zoologists. He played a seminal role in the founding of the Annual North American Symposia on Bat Research which in 1981 presented Bill with the Gerrit R. Miller Award "for his outstanding record of contribution to chiropteran biology."

Bill was an athlete, artist, craftsman, falconer, and bow hunter but he abandoned most of these activities so that he could channel his leisure time into those interests he could enjoy with his family. With their help he reforested a large tract of land, constructed ponds and built a lovely rustic cabin in the woods. Here he could enjoy nature and the out of doors with his family and friends. He often went there to write or to meditate among the trees, watching the humming birds, being serenaded by wood thrushes and the soft winds. It is in this place of simple beauty and quiet peace that his mortal remains forever rest.

He is survived by his wife, six children, and four grandchildren. Bill, the eldest son, married Barbara Horberg and is professor of Philosophy of Science at the University of Chicago. Michael, a surgeon, married Anne Mosher and practices surgery in Lewistown, Pennsylvania. Mary, who has a Masters of Science in Teaching from Cornell, is working toward an advanced degree. John has a Business and Computer Science degree and is in business in Athens, Pennsylvania. Jeffrey, who graduated from the New York State College of Veterinary Medicine in 1985, is Resident Veterinarian at the Primate Research Center, Davis, California. Ruth, the youngest child, married Gary Kwiecinski and is a Registered Dietician practicing in Malden, Massachusetts. Ruth Wimsatt continues to reside with her daughter Mary at the family home at 121 Cayuga Park Road, Ithaca, NY 14580.

No one was more devoted to the people he loved than Bill Wimsatt. Another such as he will not soon pass this way again. Bill is lovingly remembered by many more than he knew.

ARTICLES

1. Wimsatt, W.A. 1942. Survival of spermatozoa in the female reproductive tract of the bat. Anat. Rec. 83: 299-307.

2. Wimsatt, W.A. 1944. Further studies on the survival of spermatozoa in the female reproductive tract of the bat. Anat. Rec. 88: 193-204.

3. Wimsatt, W.A. 1944. Growth of the ovarian follicle and ovulation in *Myotis lucifugus lucifugus*. Am. J. Anat. 74: 129-173.

4. Wimsatt, W.A. 1944. An analysis of implantation in the bat, *Myotis lucifugus lucifugus*. Am. J. Anat. 74: 355-411.

5. Wimsatt, W.A. 1945. Notes on breeding behavior, pregnancy, and parturition in some vespertilionid bats of the eastern United States. J. Mamm. 26: 23-33.

6. Wimsatt, W.A. 1945. The placentation of a vespertilionid bat, *Myotis lucifugus lucifugus*. Am. J. Anat. 77: 1-51.

7. Wimsatt, W.A. and C.M. Waldo. 1945. The normal occurrence of a peritoneal opening in the bursa ovarii of the mouse. Anat. Rec. 93: 47-57.

8. Waldo, C.M. and W.A. Wimsatt. 1945. The effect of colchicine on cleavage of mouse ova. Anat. Rec. 93: 363-375.

9. Wimsatt, W.A. and G.B. Wislocki. 1947. The placentation of the American shrews, *Blarina brevicauda* and *Sorex fumeus*. Am. J. Anat. 80: 361-436.

10. Wislocki, G.B. and W.A. Wimsatt. 1947. Chemical cytology of the placenta of two North American shrews (*Blarina brevicauda* and *Sorex fumeus*). Am. J. Anat. 81: 269-308.

11. Wimsatt, W.A. and F.T. Lewis. 1948. Duplication of the mitral valve and a rare apical interventricular foramen in the heart of the yak calf. Am. J. Anat. 83: 67-108.

12. Wimsatt, W.A. 1948. The nature and distribution of lipoids in the placenta of the bat (*Myotis lucifugus lucifugus*), with observations on the mitochondria and Golgi apparatus. Am. J. Anat. 82: 393-468.

13. Wimsatt, W.A. 1949. Cytochemical observations on the fetal membranes and placenta of the bat, *Myotis lucifugus lucifugus*. Am. J. Anat. 82:63-142.

14. Wimsatt, W.A. 1950. New histological observations on the placenta of the sheep. Am. J. Anat. 87: 391-458.

15. Wimsatt, W.A. 1951. Observations on the morphogenesis, cytochemistry and significance of the binucleate giant cells of the placenta of ruminants. Am. J. Anat. 89: 233-282.

16. Wimsatt, W.A. and F.C. Kallen. 1952. Anatomy and histophysiology of the penis of a vespertilionid bat, *Myotis lucifugus*, with particular reference to its vascular organization. J. Morph. 90: 415-466.

17. Wimsatt, W.A. and H. Trapido. 1952. Reproduction and the female reproductive cycle in the tropical American vampire bat, *Desmodus rotundus murinus*. Am. J. Anat. 91: 415-446.

18. Wimsatt, W.A. 1954. The fetal membranes and placentation of the tropical American vampire bat, *Desmodus rotundus murinus*, with notes on the histochemistry of the placenta. Acta. Anat. 21: 285-341.

19. Wimsatt, W.A. 1955. On the nature of the interscapular gland of the tropical fruit bat, *Artibeus jamaicensis*, Leach. Anat. Rec. 121: 549-564k.

20. Wimsatt, W.A. 1956. Observations on the histology and histochemistry of the salivary glands of the tropical fruit bat, *Artibeus jamaicensis*, Leach. J. Morphol. 99: 169-210.

21. Wimsatt, W.A. 1956. Bats. Sci. Am., 197: 105-114.

22. Wimsatt, W.A. and F.C. Kallen. 1957. The unique maturation response of the graafian follicles of hibernating vespertilionid bats and the question of its significance. Anat. Rec. 129: 115-132.

23. Wimsatt, W.A. 1958. The allantoic placental barrier in Chiroptera: A new concept of its organization and histochemistry. Acta. Anat. 32: 141-186.

24. Wimsatt, W.A. and A. Gapalakrishna. 1958. Occurrence of a placental hematoma in the primitive sheath-tailed bats (Emballonuridae), with observations on its structure, development and histochemistry. Am. J. Anat. 103: 35-68.

25. Wimsatt, W.A. 1959. Portrait of a vampire. Wards Nat. Sci. Sci. Bul. 32: 35-40.

26. Wimsatt, W.A. 1959. Attempted "cannibilism" among captive vampire bats. J. Mammal. 40: 439-440.

27. Leonard, S.L. and W.A. Wimsatt. 1959. Phosphorylase and glycogen levels in skeletal muscle and liver of hibernating and non-hibernating bats. Am. J. Physiol. 197: 1059-1062.

28. Wimsatt, W.A. 1960. An analysis of parturition in Chiroptera, including new observations on *Myotis l. lucifugus*. J. Mammal. 41: 183-200.

29. Wimsatt, W.A. 1960. Problems of reproduction in relation to hibernation in bats. Bul. Mus. Comp. Zool. (Harvard) 124: 249-267.

30. Wimsatt, W.A. and A.L. Guerriere. 1961. Care and maintenance of the common vampire in captivity. J. Mammal. 42: 449-455.

31. Wimsatt, W.A. and A.L. Guerriere. 1962. Observations on the feeding capacities and excretory functions of captive vampire bats, *Desmodus rotundus murinus*. J. Mammal. 43: 17-27.

32. Wimsatt, W.A. 1962. Responses of captive common vampires *Desmodus rotundus murinus* to cold and warm environments. J. Mammal. 43: 185-191.

33. Kallen, F.C. and W.A. Wimsatt. 1962. Circulating red cell volume in little brown bats in summer. Am. J. Physiol. 203 (6): 1182-1184.

34. Wimsatt, W.A. 1962. Some aspects of the comparative anatomy of the mammalian placenta. Am. J. Obs. Gynecol. 84 (11) (2): 1568-1594.

35. Wimsatt, W.A. 1963. Delayed implantation in Ursidae, with particular reference to the black bear (*Ursus americanus*). Symposium on Delayed Implantation, A.C. Enders (ed.) Rice University. Univ. of Chicago Press, pp. 49-67.

36. Krutzsch, P. and W.A. Wimsatt. 1963. Hematological values in the vampire bat. J. Mammal. 44: 556-559.

37. Anderson, J.W. and W.A. Wimsatt. 1963. Placentation and fetal membranes of the central American noctilionid bat, *Noctilio labialis minor*. Am. J. Anat. 113: 181-202.

38. Alvarez-Lomeli, B. Villa-R. and W.A. Wimsatt. 1964. Contribucion al conocimiento de la epidemiologia de la rabia en algunos murcielagos de la Republica Mexicana. Bol. del Inst. de Estud. Med. y Biol. 22: 387-392.

39. Lyman, C.P. and W.A. Wimsatt. 1966. Temperature regulation in the vampire bat, *Desmodus rotundus*. Physiol. Zool. 39: 101-109.

40. Wimsatt, W.A. and H.F. Parks. 1966. Ultrastructure of the surviving follicle of hibernation and of the ovum-follicle cell relationship in the vespertilionid bat, *Myotis lucifugus*. Symp. Zool. Soc. Lond. 15: 419-454.

41. Wimsatt, W.A., P.H. Krutzsch, and L. Napolitano. 1966. Studies on sperm survival mechanisms in the female reproductive tract of hibernating bats. I. Cytology and ultrastructure of intrauterine spermatozoa in *Myotis lucifugus*. Am. J. Anat. 119: 25-60.

42. Davies, J. and W.A. Wimsatt. 1967. Observations on the fine structure of the sheep placenta. Acta. Anat. 65: 182-223.

43. Enders, A.C. and W.A. Wimsatt. 1968. Formation and structure of the hemodichorial placenta of the bat (*Myotis lucifugus*). Am. J. Anat. 122: 453-490.

44. Bjorkmann, N. and W.A. Wimsatt. 1968. The allantoic placenta of the vampire bat (*Desmodus rotundus murinus*): a reinterpretation of its structure based on electron microscopic observations. Anat. Rec. 162: 83-98.

45. McFarland, W.N. and W.A. Wimsatt. 1969. Renal function and its relation to the ecology of the vampire bat, *Demodus rotundus*. Comp. Biochem. Physiol. 28: 985-1006.

46. Wimsatt, W.A. 1969. Transient behavior, nocturnal activity patterns and efficiency of vampire bats (*Desmodus rotundus*) under natural conditions. J. Mammal. 50: 233-244.

47. Wimsatt, W.A. 1969. Some interrelations of reproduction and hibernation in mammals. Symp. Soc. Exp. Bio. 23: 511-549.

48. Wimsatt, W.A. and B. Villa-R. 1970. Locomotor adaptations in the disc-winged bat *Thyroptera tricolor*. I. Functional organization of the adhesive discs. Am. J. Anat. 129: 89-120.

49. Enders, A.C. and W.A. Wimsatt. 1971. Transport and barrier function in the chorioallantoic placenta of the bat, *Myotis lucifugus*. Anat. Rec. 170: 381-400.

50. Hoffman, L.H. and W.A. Wimsatt. 1972. Histochemical and electron microscopic observations on the sperm receptacles in the Garter snake oviduct. Am. J. Anat. 132: 71-96.

51. Wimsatt, W.A., A.L. Guerriere and G.R. Horst. 1973. An improved cage design for maintaining vampires (*Desmodus*) and other bats for experimental purposes. J. Mammal. 54 (1): 251-254.

52. Wimsatt, W.A., A.C. Enders and H.W. Mossman. 1973. A reexamination of the chorioallantoic placental membrane of a shrew, *Blarina brevicauda*: Resolution of a controversy. Am. J. Anat. 138: 207-234.

53. Wimsatt, W.A. 1974. Morphogenesis of the fetal membranes and placenta of the black bear, *Ursus americanus* (Pallus). Am. J. Anat. 140: 471-496.

54. Wimsatt, W.A. 1975. Some comparative aspects of implantation. Biol. Reprod. 12 (2): 1-40.

55. Enders, A.C., W.A. Wimsatt and B.F. King. 1976. Cytological development of yolk sac endoderm and protein-absorptive mesothelium in the little brown bat, *Myotis lucifugus*. Am. J. Anat. 146: 1-30.

56. Krook, L., W.A. Wimsatt, J.P. Whalen, I. MacIntyre and E.A. Nunez. 1977. Calcitonin and hibernation bone loss in the bat (*Myotis lucifugus*). Cornell Vet. 67: 265-271.

57. Wimsatt, W.A. 1978. Vampire Bats. In: Zoo and Wild Animal Medicine, Morris Animal Foundation, M. Fowler, ed., W.B. Saunders, Philadelphia, pp. 507-513.

58. King, B.F., A.C. Enders and W.A. Wimsatt. 1978. The annular hematoma of the shrew yolk-sac placenta. Am. J. Anat. 152: 45-57.

59. Wimsatt, W.A. 1979. Reproductive asymmetry and unilateral pregnancy in Chiroptera. J. Reprod. Fertil. 56: 345-357.

60. Karim, K.B., W.A. Wimsatt, A.C. Enders and A. Gopalakrishna. 1979. Electron microscopic observations on the yolk-sac of the Indian fruit bat, *Rousettus leschenaulti* (Desmarest) (Pteropidae). Anat. Rec. 195: 493-510.

61. Morton, D. and W.A. Wimsatt. 1980. Distribution of iron in the gastrointestinal tract of the common vampire bat: evidence for macrophage-linked iron clearance. Anat. Rec. 198: 183-192.

62. Wimsatt, W.A. and A.C. Enders. 1980. Structure and morphogenesis of the uterus, placenta and paraplacental organs of the neo-tropical disc-winged bat *Thyroptera tricolor* Spix (Microchiroptera: fam. Thryopteridae). Am. J. Anat. 159: 209-243.

63. Crichton, E.G., P.H. Krutzsch and W.A. Wimsatt. 1981. Studies of prolonged spermatozoa survival in Chiroptera — I. Role of uterine free fructose in the spermatozoa storage phenomenon. Comp. Biochem. Physiol., 70A: 387-395.

64. Wimsatt, W.A. 1983. Bat In: "Funk and Wagnalls New Encyclopedia," pp. 338-340.

65. Wimsatt, W.A. 1985. Vampire Bats In: "Zoo and Wild Animal Medicine," Morris Animal Foundation, M. Fowler, ed., Second Edition, W.B. Saunders, Philadephia (in press).

ABSTRACTS

1. Wimsatt, W.A. 1948. Cytochemical observations on the fetal membranes and placenta of the bat, *Myotis lucifugus lucifugus*. Anat. Rec. 100: 724-725.

2. Wimsatt, W.A. 1949. Some important cytological and cytochemical features of the binucleate giant cells characteristic of the placenta of ruminants and their interpretation. Anat. Rec. 103: 522.

3. Wimsatt, W.A. 1949. Glycogen, polysaccaride complexes and alkaline phophatase in the ovary of the bat during hiberation and pregnancy. Anat. Rec. 103: 564-565.

4. Wimsatt, W.A. 1950. The placentation of the vampire bat, *Desmodus rotundus murinus*. Anat. Rec. 104: 295.

5. Wimsatt, W.A. and H. Trapido. 1952. The reproductive cycle of the vampire bat, *Desmodus rotundus murinus*. Anat. Rec. 112: 437-438.

6. Wimsatt, W.A. and F.C. Kallen. 1952. Demonstration of an unusual accessory cavernous body in the penis of the bat, *Myotis lucifugus lucifugus*. Anat. Rec. 112: 468.

7. Anderson, J.W. and W.A. Wimsatt. 1953. The fetal membranes and placentation of the tropical American noctilionid bat, *Dirias albiventer minor*. Anat. Rec. 117: 573-574.

8. Wimsatt, W.A. 1953. A reinterpretation of the structure of the placental barrier in Chiroptera. Anat. Rec. 117: 574.

9. Napolitano, L., P. Krutzsch and W.A. Wimsatt. 1963. Electron microscopy of the sperm-uterine relationship in a hibernating bat. Anat. Rec. 145: 365.

10. Wimsatt, W.A. and H.F. Parks. 1965. Ultrastructure of the surviving follicle of hibernation and of the ovum-follicle cell relationship in the vespertilionid bat, *Myotis lucifugus*. J. Reprod. Fertil. 9: 387-388.

11. McFarland, W.N. and W.A. Wimsatt. 1965. Urine flow and composition in the vampire bat. Am. Zool. 5: 662.

12. Wimsatt, W.A. and B. Villa-R. 1966. Structure and function of the suctorial discs of the bat, *Thyroptera tricolor albigula*. Anat. Rec. 154: 495.

13. Wimsatt, W.A. and A.C. Enders. 1977. Morphology of the uterus, placenta and paraplacental organs in the disc-winged bat *Thyroptera tricolor* spix. Proc. 8th Annual Symposium on Bat Research. Carleton Univ., Ottawa, Canada.

14. Karim, K.B., W.A. Wimsatt and A. Gopalakrishna. 1977. Structure of the definitive placenta in the Indian bat *Rousettus leschenaulti* (Pteropidae). Anat. Rec. 190: 438.

BOOKS

1. Wimsatt, W.A. (editor) Biology of Bats., vol. I, 406 pp. Academic Press, NY 1970. (October)

2. Wimsatt, W.A. (editor) Biology of Bats., vol. II, 477 pp. Academic Press, NY 1970. (December)

3. Wimsatt, W.A. (editor) Biology of Bats., vol. III, 651 pp. Academic Press, NY 1977. (January)

Doctoral Candidates

Arlene Seaman, Ph.D. '49
Johns Hopkins University (retired)
Nicholas Gerald, Ph.D. '51
Hamilton College (retired)
Duncan Chiquoine, Ph.D. '52
Hamilton College
Guy-Laurent Remillard, Ph.D. '54
University of Montreal (deceased)
Robert Troyer, Ph.D. '55
Temple University
John Anderson, Ph.D. '56
University of Wisconsin
John Bergeron, Ph.D. '56
General Eclectric Research Labs
Frank Kallen, Ph.D. '62
State University of New York, Buffalo
Roy Horst, Ph.D. '67
State University College — Potsdam
Loren Hoffman, Ph.D. '68
Vanderbuilt University
John Resweiler, IV, Ph.D. '70
Cornell University
Kathryn Martin, Ph.D.'73
State University College — Oswego
Frederic Martini, Ph.D. '74
South Pacific Marine Sciences Service
Alvar Gustafson, Ph.D. '75
Tufts University
David Morton, Ph.D. '77
Wright State University
Gary Kwiecinski, Ph.D. '84
Tufts University
Mark Cukierski, Ph.D. '85
University of California — Davis

Master's Candidates

Jane Bishop ('58), Paula DiSanto ('59), Albert Mastraccio ('71), Mary Sisk ('57), Martha Snead ('61), Robert Stephens ('59), Yang Yang Wu ('69).

Submitted by Roy Horst, Department of Biology, State University College at Potsdam, New York and Gary Kwiecinski, Department of Anatomy, Tufts University College of Medicine, Boston, Mass.

The family and friends of Dr. Wimsatt and the American Society of Mammalogists are establishing the William A. Wimsatt Memorial Fellowship. The income from this fund will be awarded to the best applicant who is a full-time graduate student in the United States, Canada, or Mexico and whose research concerns the biology of bats. The details and procedures are currently being arranged. Formal invitations and instructions to friends and colleagues who wish to contribute to this memorial fund will appear in the next issue of **Bat Research News**, and in future issues of the **Journal of Mammalogy** and the **American Journal of Anatomy.**

Reproductive Activity of Female Bats from Northeast Brazil

Michael R. Willig
Department of Biological Sciences and The Museum, Texas Tech University, Box 4149, Lubbock TX

Wilson (1979) summarized data concerning phyllostomid reproductive patterns, and concluded that adequate information to infer annual breeding cycles was available for only 20 species in 11 genera. Because of the paucity of the data, reproductive records from distant geographic localities that were obtained over extended periods of time often formed the bases for the suggested patterns. Taddei's (1973, 1976) extensive study of bats in the northwest of the Brazilian state of Sao Paulo provided the first well-documented study of reproduction in South American bats; however, he also pooled reproductive records over a six year period in order to obtain adequate monthly samples. More recently, Willig (1985a,b) documented the reproductive phenology of eight species of bats from well-delimited populations in two biomes of Northeast Brazil during a 20 consecutive month period. *Noctilio leporinus* and *Neoplatymops mattogrossensis* exhibited seasonal monestry. *Glossophaga soricina, Carollia perspicillata, Vampyrops lineatus, Artibeus jamaicensis,* and *A. lituratus* exhibited seasonal bimodal polyestry. *Desmodus rotundus* exhibited asynchronous polyestry. Differences were not detected between Caatingas and Cerrado populations of any species even though the total amount and predictability of precipitation was different in the two biomes. Most species weaned their young primarily in the wet season; in contrast, *G. soricina* weaned its first litter during the dry season and its second litter during the wet season. This paper reports reproductive activity from September 1976, to May, 1978, for 26 additional species of bats from Caatingas and edaphic Cerrado habitats of the Brazilian Northeast. Detailed information on the flora and mammalian fauna of the Northeast are reported elsewhere (Mares *et al.*, 1981; Willig, 1983, 1985a; and Mares *et al.*, 1985). Materials and Methods for this work are as reported in detail by Willig (1985a). For each species, the number of pregnant (based upon macroscopic examination of dissected specimens), lactating, simultaneously pregnant and lactating, and inactive females, respectively, are reported within parentheses, for available monthly samples in each biome.

Peropteryx macrotis macrotis. — This aerial insectivore was uncommon in the Caatingas, and absent from edaphic Cerrado habitats. Reproductive activity follows: January (0,1,1,0); September (2,0,0,0); October (2,0,0,1).

Pteronotus davyi davyi. — This uncommon aerial insectivore was captured only in Cerrado habitats. Reproductive activity follows: September (1,0,0,0); October (1,0,0,0); November (2,0,0,0).

Micronycteris magalotis megalotis. — This foliage-gleaning insectivore was uncommon in the Caatingas. Reproductive activity follows: July (0,0,0,1); August (3,0,0,0); September (0,0,0,1). only males were captured in Cerrado habitats.

Micronycteris minuta. — This uncommon foliage-gleaning insectivore was captured both in Caatingas and Cerrado habitats; females were obtained only from the Caatingas. Reproductive activity follows: June (0,0,0,1); December (1,0,0,1).

Tonatia bidens bidens. — This rare foliage-gleaning insectivore was captured only in Caatingas habitats. The single female, obtained in September, was pregnant.

Tonatia brasiliense. — This uncommon foliage-gleaning insectivore was netted only from Caatingas habitats. Reproductive activity follows: January (0,0,0,1); March (0,1,0,0); August (1,0,0,0); September (1,0,0,0,); October (1,0,0,0); December (1,0,0,0).

Mimon crenulatum. — This uncommon foliage-gleaning insectivore was restricted to Caatingas habitats. Reproductive activity follows: January (0,0,0,1); May (0,0,0,1); August (2,0,0,0).

Tonatia silvicola. — This common foliage-gleaning insectivore was obtained only in Caatingas habitats. Reproductive activity follows: February (1,1,0,0); April (0,0,0,1); July (0,9,0,5); August (0,0,0,5); September (1,0,2,3); October (2,0,0,0); November (2,0,0,1); December (1,0,0,1).

Phyllostomus discolor. — This omnivore was rare to common in the Caatingas and abundant in Cerrado habitats. Reproductive activity in the Caatingas follows: October (0,0,1,0); November (0,0,1,0); March (0,1,3,0). Reproductive activity in the Cerrado follows: January (0,2,0,1); February (2,0,0,2); March (1,7,1,2); April (0,7,2,0); September (3,1,2,1); October (0,1,5,1); December (7,9,1,1).

Phyllostomus hastatus hastatus. — This omnivore was rare in the Caatingas but abundant in Cerrado habitats. Reproductive activity in the Caatingas follows: January (0,1,0,0); February (0,2,0,2); June (0,0,0,1); November (0,1,0,0). Reproductive activity in edaphic Cerrado habitats follows: January (0,15,1,5); February (0,8,0,5); March

(0,11,0,9); April (0,15,1,5); May (0,0,0,2); June (4,0,1,0); July (4,0,0,0); August (1,0,0,0); September (0,6,0,0); October (1,2,0,1); November (0,8,0,0); December (0,13,0,1).

Trachops cirrhosus cirrhosus. — This common omnivore was captured only in Caatingas habitats. Reproductive activity follows: January (3,0,0,1); February (3,0,0,0); March (0,1,0,0); April (0,1,0,0); May (0,1,0,1); June (0,0,0,3); August (0,0,0,1).

Lonchophylla mordax mordax. — This nectivore was common in the Caatingas and absent from edaphic Cerrado habitats. Reproductive activity follows: January (0,1,0,1); February (0,1,0,1); April (0,3,0,1); May (0,1,0,3); June (0,1,0,0); July (2,0,0,5); August (1,1,0,2); September (1,1,0,0); November (2,0,0,0); December (0,0,0,1).

Anoura geoffroyi geoffroyi. — This nectivore was rare in the Caatingas but common in edaphic Cerrado habitats. Reproductive activity in the Caatingas follows: January (1,0,0,1); February (0, 0,0,1); March (0,0,0,1); April (0,0,0,2); June (0,0,0,1); July (0,0,0,1); August (0,0,0,2); October (0,0,0,1); November (2,0,0,1). Reproductive activity in the Cerrado follows: May (0,0,0,1); July (0,0,0,6); August (0,0,021); September (2,0,0,17); October (7,0,0,12); November (26,0,0,8); December (20,0,0,0).

Sturnira lilium lilium. — This frugivore was rare in the Caatingas and uncommon in the Cerrado habitats. Reproductive activity in the Caatingas follows: February (1,0,0,1); September (0,0,1,0); October (1,0,0,0). Reproductive activity in edaphic Cerrado habitats follows: March (0,0,0, 1); April (0,1,0,1); June (1,0,0,0); July (2,1,0,0); August (1,0,0,0); September (1,0,2,2); October (0, 0,1,0); November (1,1,0,1); December (2,0,0,0).

Uroderma magnirostrum. — This frugivore was rare in both Caatingas and edaphic Cerrado habitats. Reproductive activity in the Caatingas follows: August (0,0,0,1); December (0,0,1,0). A single female, captured from the Cerrado in July, was pregnant.

Artibeus concolor. — This frugivore was rare in edaphic Cerrado habitats and absent from the Caatingas. Reproductive activity in the Cerrado follows: March (0,1,0,0); April (0,0,0,1); July (0, 1,0,0); August (2,0,0,0); September (1,0,0,0).

Desmodus rotundus rotundus. — This sanguinivore was abundant in the Caatingas, where it exhibited acyclic polyestry (Willig, 1985). It was rare in edaphic Cerrado habitats, its reproductive activity there, follows: January (1,1, 0,0); February (0,1,0,1); March (2,4,2,1); June (1, 5,0,1); July (0,1,0,0).

Diphylla ecaudata ecaudata. — This sanguinivore was rare in the Caatingas and absent from edaphic Cerrado habitats. Reproductive activity in the Caatingas follows: June (1,0,0,0); November (0,1, 0,0).

Myotis nigricans nigricans. — This aerial insectivore was common to abundant in the Caatingas and common in edaphic Cerrado habitats. Reproductive activity in the Caatingas follows: January (2,1,0,8); February (0,3,1,6); March (1,2,0,5); April (3,12,0,12); May (2,1,0,7); June (0,1,0,5); July (0,0,0,1); August (1,1,0,2); September (1,1,0,1); October (1,1,0,3); November (1,1,0,0); December (0,1,0,0,). Reproductive activity in the Cerrado follows: January (4,0,0,1); February (2,1,0,2); March (1,0,0,7); April (0,1,0,1); June (0,0,0,2); September (1,0,0,1); October (1,0,0,0); December (1,0,0,1).

Furipterus horrens. — This uncommon aerial insectivore was captured only in the Caatingas; the single female captured in April was lactating.

Eptesicus furinalis. — This aerial insectivore was captured only in edaphic Cerrado habitats, where it was uncommon. Reproductive activity follows: January (1,0,0,0); February (0,4,0,3); March (0,1, 0,2); November (0,3,0,0).

Lasiurus borealis. — This aerial insectivore was captured only in edaphic Cerrado habitats where it was rare. A single inactive female was captured in each of the following months: February, March and April.

Lasiurus ega caudatus. — This aerial insectivore was rare both in Caatingas and Cerrado habitats. Reproductive activity for Caatingas females follows: February (0,0,0,1); March (0,0,0,2); November (1,0,0,0). A single inactive female was captured in March from the Cerrado.

Molossops planirostris. — This molossid aerial insectivore was captured only in the Caatingas, where it was rare. One pregnant and one inactive female were collected in October.

Molossops temminckii temminckii. — This molossid aerial insectivore was rare in both Caatingas and Cerrado biomes. Three pregnant females were captured from the Caatingas in September. Reproductive activity in the Cerrado follows: February (0,0,0,1); June (0,0,0,1); December (0,1,0,0,).

Molossus molossus. — This molossid aerial insectivore was common in both Caatingas and Cerrado habitats. Reproductive activity in the Caatingas follows: January (0,0,1,0); Feburary (0, 0,1,0); March (1,3,2,0); April (0,3,0,0); May (0,0, 0,1); June (0,0,0,2); July (0,0,0,2); August (0,0,0, 6); September (6,0,0,0); October (1,0,0,0); November (3,0,0,0). Reproductive activity in edaphic Cerrado habitats follows: January (1,5,15 0,); Febuary (7,7,3,5); March (0,2,0,5); April (0,8, 0,8); May (0,3,0,7); June (0,0,0,12); July (0,0,0,

12); August (0,0,0,10); September (15,0,0,0); October (29,0,0,0), November (6,4,0,0).

Small or incomplete monthly samples characterize the data for 22 of the 26 species studied; hence, reproductive patterns are not suggested in those cases. The utility of these data awaits the collection of additional field information, which in combination, may provide sufficient information to define reproductive patterns. Four species from the Northeast were obtained in adequate numbers to suggest particular reproductive patterns.

Wilson (1979) summarized knowledge of the reproductive biology of *Phyllostomus hastatus* and suggested that it may be a species in which the reproductive pattern varies geographically: in Central America and Trinidad, reproduction appears to be monestrous, whereas the pattern appears to be polyestrous in South America. The data for *P. hastatus* in edaphic Cerrado habitats suggest seasonal monestry. Pregnancy commenced in April and persisted until October. Lactating females appeared from September until April. May was the only month in which females failed to exhibit reproductive activity. As such, parturition commenced at the end of the dry season, with the bulk of the weaning period concentrated in the wet season. Taddei's (1973) data from northwestern Sao Paulo, in general, conform to this pattern.

Knowledge about the reproductive biology of *Anoura geoffroyi* is, for the most part, cursory and restricted to Central American populations (see Wilson, 1979). Goodwin and Greenhall (1961) suggested that *A. geoffroyi* exhibited a discrete breeding season that occurred toward the end of the rainy season. The opposite pattern is suggested for Northeast Brazilian populations from edaphic Cerrado habitats; females became pregnant during the final months of the dry season (September and October) with pregnancy continuing through the beginning of the rainy season. Nonetheless, little can be said about annual reproduction patterns because of temporally restricted samples from the Brazilian Northeast.

Myotis nigricans was the first neotropical vespertilionid to have its reproductive cycle elucidated; Wilson and Findley (1970) and Wilson (1971) conclusively showed that a population of these bats on Barro Colorado Island reproduced continuously, except for a 3 month period at the end of the rainy season. Samples of *M. nigricans* from the Brazilian Northeast also evidenced continuous breeding. The frequency of pregnancy and lactation followed parallel or coincident courses; in addition, neither pregnancy nor lactation achieved high frequency in any particular month. Unfortunately, small samples in critical months (July, November, and December) prevented delineating the annual reproductive pattern with confidence.

Although somewhat inconclusive, the data for *Molossus m. molossus* from edaphic Cerrado habitats revealed that females were pregnant from September to February, that lactation occurred from January until May, and that an inactive period extended from June until August. The incidence of simultaneously pregnant and lactating specimens in January and February suggested that *M. molossus* exhibited seasonal polyestry in the Brazilian Northeast.

Clearly, more comprehensive data on neotropical bat reproduction, as well as more detailed information concerning local resource availability over time is required to go beyond the descriptive nature of this and most other studies of chiropteran reproductive phenology. Analysis of the variety and lability of bat reproductive strategies elicited by different environmental regimes remains an area deserving a concerted effort in the future.

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LITERATURE CITED

Goodwin, G.G. and A.M. Greenhall. 1961. A review of the bats of Trinidad and Tobago. Bull. Amer. Mus. Nat. Hist., 122: 187-302.

Mares, M.A., M.R. Willig, K.E. Streilein, and T.E. Lacher, Jr. 1981. The mammals of northeastern Brazil: a preliminary assessment. Ann. Carnegie Mus. 50: 80-137.

Mares, M.A., M.R. Willig, and T.E. Lacher, Jr. 1985. The Brazilian Caatinga in South American zoography: tropical mammals in a dry region. J. Biogeog., 12: 57-69.

Taddei, V.A. 1973. Phyllostomidae da regiao norte-ocidental do Estado de Sao Paulo. Unpubl. Ph.D. dissert, Univ. Estadual Paulista de Sao Jose do Rio Preto, Sao Paulo, 249 pp.

Taddei, V.A. 1976. The reproduction of some Phyllostomidae (Chiroptera) from the northwestern region of the state of Sao Paulo. Bolm. Zool., Univ. S. Paulo, 1: 313-330.

Willig, M.R. 1983. Composition, microgeographic variation, and sexual dimorphism in Caatingas and Cerrado bat communities from Northeast Brazil. Bull. Carnegie Mus. Nat. Hist., 23: 1-131.

Willig, M.R. 1985a. Reproductive patterns in bats from Caatingas and Cerrado biomes of Northeast Brazil. J. Mamm., (in press).

Willig, M.R. 1985b. Ecology, reproductive biology, and systematics of *Neoplatymops mattogrossensis* (Chiroptera: Molossidae). J. Mamm., (in press).

Wilson, D.E. 1971. Ecology of *Myotis nigricans* (Mammalia: Chiroptera) on Barro Colorado Island, Panama Canal Zone. J. Zool. 163: 1-13.

Wilson, D.E. 1979. Reproductive patterns. Pp. 317-378, in Biology of Bats of the New World Family Phyllostomatidae. Part II. (R.J. Baker, J.K. Jones, Jr., and D.C. Carter, eds.). Spec. Publ. Mus. Texas Tech. Univ., 16: 1-441.

Wilson, D.E. and J.S. Findley. 1970. Reproductive cycle of a neotropical insectivorous bat, *Myotis nigricans*. Nature, 225: 1155.

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Revised and Accepted May 22, 1985

THE OTTAWA BAT SCENE

There are two foci of bat study activity in Ottawa, one at the Department of Mammalogy of the National Museum of Natural Sciences (Dr. C.G. van Zyll de Jong, Curator of Mammalogy, National Museum of Natural Sciences, Ottawa, Canada K1A 0M8), the other in the Department of Biology at Carleton University (Dr. M.B. Fenton, Department of Biology, Carleton University, Ottawa, Canada K1S 5B6). In the last several months both foci have been productive in terms of contributions to the literature and in both locations research is ongoing.

The National Museums of Canada has just published (1985) **A Handbook of Canadian Mammals: 2, Bats** by C.G. van Zyll de Jong, and this compilation of information about the species of bats which occur in Canada, including keys for their identification, is available for $19.95 Canadian (in Canada). The U.S. Agent for the NMNS publications is the University of Chicago Press. Late in 1984 Stan van Zyll published a paper in the Canadian Journal of Zoology (van Zyll de Jong, C.G. 1984. Taxonomic relationships of Nearctic small-footed bats of the *Myotis leibii* group (Chiroptera: Vespertilionidae). Can. J. Zool., 62: 2519-2526) which concludes that the western *M. ciliolabrum* be treated as a species separate from the eastern *M. leibii*. This nomenclature is followed in the handbook of Canadian bats.

At Carleton, Brock Fenton and several students are active in various projects related to the ecology and behavior of bats. **Mark Brigham** is about to start a Ph.D. investigation of foraging areas and strategies in some insectivorous bats and common nighthawks in the Okanagan Valley of British Columbia. The bats he selects will be those large enough to carry the radio transmitter package he used in his M.Sc. work on roosting of *Eptesicus fuscus*. **Virginia Wai-Ping** is preparing to continue her M.Sc. studies of mate selection by female *Myotis lucifugus*. She is planning to see if different size classes of males in the mating population is related by choice to females. **Mike Stoneman** has shifted the emphasis of his M.Sc. project from sensory ecology to an investigation of the effects that the clicks of arctiid moths have on the behaviour of insectivorous bats. He plans to compare the reactions in species which rely on echolocation to locate prey, versus those which use other cues. **Jonathan Balcombe** plans to further explore the communicative rile of echolocation calls for his M.Sc. and will conduct field work this summer in the Okanagan Valley of British Columbia. **Doris Audet** will use temperature-sensitive transmitters to examine the influence of temperature on roost selection by *E. fuscus* as her project this summer. She will use experimental exclusion to see of evicted bats are forced to move to roosts with temperature regimes that are different from the preferred roosts. **Brian Hickey** is completing a study of hairs specialized for scent dispersal in bats (osmetrichia), work he has been doing for an honours research project. **Janis Klein** is finishing a similar project on the ability of *Artibeus jamaicensis* and *Epomophorus wahlbergi* to carry fruit from one site to another.

A postdoctoral fellow, **Hugh Aldridge**, has just joined the laboratory and plans to continue his work on the influence of wing morphology on flight maneouvreability and foraging behaviour. He is now planning to take his photographic system to the Okaganan to exploit the rich (by Canadian standards) bat fauna there this summer. Hugh just finished his Ph.D. at the University of Bristol. **Brock Fenton** continues to be interested in bat ecology and behaviour and is currently planning field work in Africa later this year with a view to collecting data about foraging areas of three species of insectivorous bats. With those data he expects to examine foraging strategies and prey selection. The study will rely on radio-taking to determine use of space, foraging strategy and prey selection. **Gary Bell**, currently a postdoctoral fellow in George Bartholomew's laboratory at UCLA hopes to come along on this trip and use doubly labeled water to consider the energetic im-

plications of the behaviour and ecology data. Hugh Aldridge will also join in and collect data on wing morphology and flight behaviour. Brock is also working on the distribution of *Hipposideros caffer* in Zimbabwe and adjacent areas.

At this time, several publications from the laboratory are in press and should appear in the next few months:

Fenton, M.B. 1985. Communication in the Chiroptera. Indiana University Press, Bloomington, Indiana.

Geggie, J.F. and M.B. Fenton. 1985. A comparison of foraging by *Eptesicus fuscus* (Chiroptera: Vespertilionidae) in urban and rural environments. Can. J. Zool. in press.

Fenton, M.B., R.M. Brigham, A.M. Mills, and I.L. Rautenbach. 1985. The roosting and foraging areas of *Epomophorus wahlbergi* (Pteropodidae) and *Scotophilus viridis* (Vespertilionidae) in Kruger National Park, South Africa. J. Mamm., in press.

Bell, G.P. and M.B. Fenton. 1985. Visual acuity, sensitivity and binocularity in a gleaning insectivorous bat, *Macrotus californicus* (Chiroptera: Phyllostomidae). Anim. Behav., in press.

Thomson, C.E., M.B. Fenton and R.M.R. Barclay. 1985. The role of infant isolation calls in mother-infant reunions in the little brown bat *Myotis lucifugus*, (Chiroptera: Vespertilionidae). Can. J. Zool., in press.

Bell, G.P. 1985. Behavioral and ecological aspects of gleaning by the desert insectivorous bat, *Macrotus californicus* (Chiroptera: Phyllostomidae). Behav. Ecol. Sociobiol., in press.

M. Brock Fenton
Received April 17, 1985

NEWS AND VIEWS

Australian Bat Research News (ABRN) takes a new name — Macroderma

ABRN was initiated by Elery Hamilton-Smith and Dave Purchase in 1964. They produced thirteen issues, the last in 1974. Greg Richards restarted it in 1979 and carried it through Number 20. The Editorial group of Chris Tidemann (Zoology Department, Australian National University, GPO Box 4, Canberra ACT 2601), Barry Baker (Australian National Parks & Wildlife Service, GPO Box 636, Canberra ACT 2601), and Bill Phillips (Australian Bird and Bat Banding Schemes, ANPWS, GPO Box 8, Canberra ACT 2601) have completely "revamped" the newsletter and have given it a new name **Macroderma**. **Bat Research News** welcomes **Macroderma**, an old friend in its new garb. Along with **Bat Research News**, **Bats**, and **Myotis**, **Macroderma** is expected to disseminate useful information to bat researchers far and wide.

Volume 1, number 1 of **Macroderma** was issued in March 1985. The format is 24.5 x 17 cms with a hard cover and an elegant style. It will be published twice yearly in March and September by the Bat Research Group, Zoology Department. Australian National University, Head of Department — Professor C. Bryant. The yearly subscription is A$5.00. Stan Flavel, Terry Reardon, Bruce Thomson, Laurie Canole, Grant Baverstock, Robert Taylor, Dedee Woodside, Simon Robson, and Norm McKenzie are listed as correspondents. The March 1985 issue has 27 pages and the table of contents appears here.

Kunwar Bhatnagar

NOTICE

The Mammal Slide Library is a non-profit educational service of the American Society of Mammalogists and has a large number of 35mm slides of bats and of other mammals available for purchase. The collection at present includes over 800 slides of mammals from nearly 100 families. There are 130 slides of bats, representing 14 families, 63 genera, and 106 species. Individual slides may be selected from a Slide List (free), or from a catalog ($2 to addresses in North America, $4 outside North America); the catalog provides a brief description of each slide. Slides cost $.80 US each; no discounts; We pay shipping costs. For a free slide list, or a catalog, write to: Dr. J.A. Lackey, Dept. Zoology, SUNY, Oswego NY 13126.

BOOK REVIEW

Schober, Wilfried. **Mit Echolot und Ultraschall. Die phantastische Welt der Fledertiere.** Edition Leipzig (East Germany). 211 pp., 1983. Cloth with a jacket in color.

Schober, Wilfried. (English edition). **The Lives of Bats.** ARC Publishing, Inc., New York. 200 pp. 1984. $24.95. Translated from the German by Sylvia Furness, revised by A.M. Hutson.

The stated purpose of the author is to enlighten people and foster a better understanding of bats among those who will help in their protection and conservation. Schober has studied bats professionally for many years and writes about these animals in a sensitive manner.

Schober emphasizes that bats have evolved in highly special ways, carry out their particular roles in nature, and in most instances, are economically important animals deserving of man's protection. The author is not attempting to write an encyclopedic work but rather to select those subjects that people would like to know about the lives of bats.

In some ways **The Lives of Bats** reminded me of an updated version of G.M. Allen's **Bats** published in 1939. To illustrate this I shall list Schober's chapter headings in italics, followed by Allen's chapter's within parentheses:
Bird or mammal, deity or demon (Bats in Folklore; Bats, Gods and Man); *Flight* (Flight of Bats); *Distribution of bats throughout the world* (The Geographic Distribution of Bats); *Where bats live* (Where Bats Hide); *What bats eat* (What Bats Live by); *Bat flowers and flower bats* (Bat Flowers); *Breeding habits* (Breeding Habits and Young of Bats); *Why some bats hibernate* (Hibernation of Bats); *1000 kilometers without a compass* (Migration of Bats). Schober's chapter *Vampires — fable and fact*, discusses rabies as does Allen's chapter (Bats in Relation to Disease). In addition to updating bat rabies, Schober emphasizes how vitally important it is to study in detail the way of life and habits of any species requiring control.

It is clear in the chapter *Bats need friends* that bats certainly do need and deserve all the friends they can obtain. While Schober discusses the bat conservation efforts undertaken by the United Kingdom, it is unfortunate that he does not mention such efforts undertaken in the United States, especially the work of Bat Conservation International, c/o Milwaukee Public Museum, Milwaukee, Wisconsin 53233 USA.

There is a limited biography, a survey of bat families, and a listing of the distribution and principal foods of bats. The book is well illustrated with a variety of color and black and white photographs.

While the material covered will be well known to most professional chiroptologists, the book is more suitable for students, teachers and amateur bat enthusiasts seeking a readable, authoritative accout about the lives of bats.

Arthur M. Greenhall, Office of Scientific Authority, U.S. Fish & Wildlife Service, Washington, D.C. 20240.
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THE STAMP ON THE FRONT COVER

Date of issue: 13 July 1978
Offset printing in six colors
Size: 25.5 x 43 mm
Motif: Fossil bat (*Palaeochiropteryx tupaiodon*) from the mine Messel near Darmstadt (near Frankfurt/M. West Germany)

The slate from the open pit mine at Messel contains fossils of uniquely preserved forms. The bat fossil portrayed on the stamp is from diggings conducted by the Frankfurt Forschungsinstitut and Naturmuseum Senckenberg in Messel and is about 50 million years old. Together with North American discoveries, the bats from Messel belong to the earliest documentations of this mammalian order in the world. Normally fossil mammals are seen only in the form of a few teeth or fragments of bones. In Messel, complete skeletons appear, sometimes even with skin and hair. The illustrated example shows preserved soft tissues in the abdominal region. The significance of such superbly preserved fossils becomes clear when one imagines that the flying ability of bats is one of the most extreme specializations which developed during the course of mammalian evolution. One would assume that such extreme specializations occurred rather recently, but the wonderful documentation from Messel shows that bats, if certain primitive proportions are ignored, were in principle fully developed 50 million years ago.

Submitted by Dr. Kunwar Bhatnagar, University of Louisville and Dr. Heiko Frahm, Max-Planck-Institut fur Hirnforschung, Frankfurt/Main.

English translation of the German text by Senckenbergische Naturforschende Gesellschaft, Frankfurt am Main by Dr. Heiko Frahm.

Simultaneously issued along with a 2 DM stamp depicting a fossil horse, *Propalaeotherium messelense*.

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 on several bibliographic sources and for obvious reasons cannot ever be up-to-date. Any error or ommission is inadvertent. Voluntary contributions for this section, especially from foreign bat researchers, are most welcome.

ANATOMY

Agrawal, K.A., and B.B. Gupta. 1982. The gastric morphology and histology of an insectivorous bat — *Rhinopoma kinneari*. Lynx, 21: 5-14 (Zoology, Dharam Samaj College, Aligarh (U.P.), India 202 001.

Alexander, K.M., and J.C. George. 1982. Fibre type composition of the breast muscle of the North American little brown bat and of the Indian giant fruit bat. J. Anim. Morphol. Physiol., 29: 98-102 (Zoology, Univ. Kerala, Kariavattom 695 581, Kerala, India).

Calford, M.B., M.L. Graydon, M.F. Huerta, J.H. Kaas and J. D. Pettigrew. 1985. A variant of the mammalian somatotropic map in the bat. Nature (Lond.), 313: 477-479 (*Pteropus poliocephalus*. Neuroscience Laboratory, Physiology & Pharmacology, University of Queensland, St. Lucia, 4067 Australia).

Cotter, J.R. 1985. Retinofugal projections of the big brown bat, *Eptesicus fuscus* and the neotropical bat, *Artibeus jamaicensis*. Am. J. Anat., 172: 105-124 (SUNY Buffalo, Dept. of Anatomical Sciences, Buffalo, NY 14214 USA).

Hood, C.S. and J.D. Smith. 1983. Histomorphology of the female reproductive tract in Phyllostomid bats. Occa. Pap. Mus. Texas Tech., 86: 1-38 (Biology, Texas Tech. Univ., Lubbock, TX 79409 USA).

Jones, E. 1985. Cortical maps: upside-down world in bat's brain. Nature (Lond.), 313: 434 (News and Views; *Pteropus poliocephalus*; Anatomy, Univ. of California, Irvine, CA 92717 USA).

Kratky, J. 1981. Postnatale Entwicklung der Wasserfledermaus *Myotis daubentoni* Kulh, 1819 und bisherige Kenntnis dieser Problematik,) im Rahmen der Unterordnung Microchiroptera (Mammalia: Chiroptera). Folia Mus. Rer. Natur. Bohemiae Occid., 16, 34 pp.

Madkour, G. 1982. Skull osteology in some species of bats from Egypt. Lynx, (Prague), 21: 97-110 (Zoology, Fac. Sci., Qatar Univ. Doha).

Pal, A.N. 1983. Male accessory glands of bat, *Miniopterus schreibersii fulginosus* (Hodgson). Comp. Physiol. Ecol., Jodhpur, 8: 307-308.

Rua, C., *et al.* 1983. Ultrastructural features of the centralis superior and raphe magnus nuclei in the bat. Folia Morphol., 31: 280-283 (Departemento de Morfologia microscopica, Facultad de Biologia, Univ. Complutense, Ciudad Universitaria, Madrid-3, Spain).

Sinha, Y.P. 1982. The osteology of a cave-dwelling bat, *Rhinopoma microphyllum kinneari* Wroughton (Chiroptera: Rhinopomatidae) from Rajasthan. Rec. Zool. Surv. India, 79: 437-455.

Zook, J.M., J.A. Wilner, G.D. Pollak and R.D. Bodenhamer. 1985. Topology of the central nucleus of the mustache bat's inferior colliculus: correlation of single unit properties and neuronal architecture. J. Comp. Neur., 231: 530-546 (Ohio Univ., Zoology & Biomed. Sci., Athens, OH 45701 USA).

BIOCHEMISTRY

Gibson, J., and J. van der Westhuyzen. 1984. Effect of L-Dihydroxyphenylamine (L-dopa) and Methionine on tissue S-Adenosylmethionine concentrations in Cobalamin-inactivated fruit bats. Int. J. Vitam. Nutr. Res., 54: 329-332 (Reprint J. van der Westhuyzen, S. African Inst. Med. Res., Sch. Med. MRC, Brain Metab. Res. Grp., POB 1038, Johannesburg 2000, S. Africa.)

Gillett, M.P.T., and R.B. Wilson. 1985. Unusual lipid composition of erthrocytes from the insectivorous bat *Molossus molossus*. Comp. Biochem. Physiol., 80: 149-150 (Univ. Fed. Pernambuco, Ctr. Ciencas Biol., Bioquim, Metab. Pipidico Lab., BR-50000 Recife, PE, Brazil).

CONSERVATION

Glasser, J. 1983. Connaissance et protection des chauves-souris l'exemple de la Lorraine. Spelunca (Paris), 10: 38-42.

Kurten, L. 1983. Haltung und Zucht der neotropischen Fledermaus *Carollia perspicillata*. Z. Kolner Zoo, 26: 53-57 (English summary).

Laycock, P. 1983. The bats of De Hoop Nature Reserve. African Wildl., 37: 13-15.

Lekagul, B. 1983. Wrinkle-lipped bats. Conserv. News (Bangkok), 5: 25-26.

Stebbings, R.E. 1983. Legislation to protect bats: a code of conduct for cavers. Caves Caving, 21: 30-31.

DISEASE AND PARASITISM

Kagei, N., and I. Sawada. 1983. Helminth fauna of bats in Japan, XXVIII. Annot. Zool. Japan, 56: 19-26 (Parasitology, National Inst. Health, Tokyo 141, Japan).

Prociv, P. 1983. Observations on the transmission and development of *Toxocara pteropodis* (Ascaridoidea: Nematoda) on the Australian grey-headed flying-fox, *Pteropus poliocephalus* (Pteropididae: Megachiroptera). Z. Parasitenk., 69: 773-781.

Sawada, I. 1983. Helminth fauna of cave bats in Wakayama prefecture. Bull. Nara Univ. Educ., 32: 37-47 (In Japanese, English summary)

Sutton, M. 1984. Rabies, just the facts. Virginia Wildl., 45: 8.

Sutton, R.H., and P.D. Wilson. 1983. Lead poisoning in grey-headed fruit bats (*Pteropus poliocephalus*). J. Wild. Dis., 19: 294-296 (Vet. Pathology, Pub. Hlth., Univ. Queensland, St. Lucia, 4067 Queensland, Australia).

Thomas, J.G., Jr., and H.J. Harlan. 1981. Vampire bat bites seen in humans in Panama: their characterization, recognition, and management. Military Med., 146: 410-412.

Woo, P.T.K., J.R. Baker and L.F. Selden. 1984. DNA buoyant densities of *Trypanosoma* spp. from bats in Ontario, Canada. Syst. Parasitol., 6: 75-79 (Zoology, Univ. Guelph, Ontario, N1G 2W1 Canada).

Zdzitowiecki, K., and A.L. Ruprecht. 1982. Helminth parasites of bats from the genus *Plecotus* Geoffroy, 1818 from Kujawy. Wiad. Parazytol., 28: 445-448.

DISTRIBUTION

Ahlen, I. 1983. The bat fauna of some isolated islands in Scandinavia. Oikos, 41: 352-358 (Dept. Wildl., Ecol., Sweden Univ. Agric. Sci., S-750 07 Uppsala, Sweden).

Beaucournu, J.-C., *et al.* 1983. Nouvelles donees sur les chiropteres de Corse. Mammalia, 47: 125-127.

Beaucournu, J.-C., D.B. Hamba, H. Launay, H. Hellal and C. Chastel. 1983. Two little known Chiroptera of Tunisia. Mammalia, 47: 127-128 (Laboratoire de Parasitologie, U.E.R. Medicales, Avenue du Prof. Leon Bernard, F-35043 Rennes, Cedex).

Brack, V., Jr., R.E. Mumford and V.R. Holmes. 1984. The gray bat (*Myotis grisescens*) in Indiana. Am. Midl. Natur., 111: 205 (Dept. Forestry and Natural Res., Purdue Univ., West Lafayette, IN 47907 USA).

Cerveny, J. 1982. Results of investigation of bats (Chiroptera) at Loreta near Klatovy, Czechoslovakia. Lynx (Prague), 21: 41-66 (Ricna S, 110 00 Praha 1).

Clark, D.B. 1983. Hibernating bat populations in eastern New York state. Occas. Pap. Biol. Field Sta., Cooperstown, NY, 14: 1-60.

Daniel, M.J., and M. Yoshiyuki. 1982. Accidental importation of a Japanese bat into New Zealand. New Zealand J. Zool., 9: 461-462.

Harrison, D.L. 1982. Two bats (Chiroptera) new to the fauna of Malawi. Nyala, 8: 99-100.

Lehmann, R. 1983. Bat research in southern Finland. Faunistic notes from summer 1982 (Chiroptera: Vespertilionidae). Mem. Soc. Flora Fauna Fennica, 59: 155-160 (Zoology, Univ. Helsinki, P. Rautatiekatu 13, Helsinki 10, Finland).

Lesinski, G. 1983. The lesser noctule, *Nyctalus leisleri* (Kuhl) (Mammalia, Chiroptera) in Mllocinski Park. Przeglad Zool., 27: 203-206 (In Polish, English summary).

Lina, P.H.C. 1984. Vondsten van de tweekleurige vleermuis *Vespertilio murinus* L., 1758 in Noordwijk en Breda (Records of the parti-coloured bat *Vespertilio murinus* L., 1758 in the Netherlands; English summary; Ministerie van Landbouw en Visserij Directie Natuur, Milieu en Faunabeheer, Postbus 20401, 2500 EK's — Gravenhage).

McCarthy, T.J., G.A. Cadena and T.O. Lemke. 1983. Comments on the first *Tonatia carrikeri* (Chiroptera: Phyllostomatidae) from Colombia. Lozania (Bogota), 40, 5 pp. (Sect. Mammals, Carnegie Mus. Nat. Hist., 5800 Baum Blvd., Pittsburgh, PA 15206 USA).

Menu, H. 1983. Presence de *Plecotus austriacus* (Fischer, 1829) dans la region Champagne-Ardenne. Mammalia, 47: 271.

Nikodem, Z. 1983. Materials to the bat fauna (Chiroptera) of Lublin region (southeastern Poland). Przeglad Zool., 26: 197-205 (In Polish, English summary; UL. Pulaskiego 71, 42-200 Czestochowa).

Richardson, P.W. 1983. Whiskered bat — new records for Northamptonshire. Northamptonshire Nat. Hist. Soc., 38: 71-72.

Ridder, R.M., and V. Van Laar. 1983. First record of Nathusius' pipistrelle *Pipistrellus nathusii* (Keyserling & Blasius, 1839) in the Ijsselmeer. Lutra, 26: 92 (In Dutch, English summary).

Sinha, Y.P. 1983. Occurrence of *Pipistrellus paterculus Thomas,* 1915 (Chiroptera: Vespertilionidae) in Bihar: an addition to the Indian mammal fauna. J. Bombay Nat. Hist. Soc., 80: 206-207.

Strelkov, P.P. 1983. Analysis of distribution of bat fauna in Kazakhstan. Trudy Zool. Inst. Leningrad, 119: 139-150. (In Russian).

Strelkov, P.P. 1983. Localities of *Myotis brandti* Eversmann, 1845 and *Myotis mystacinus* Kuhl, 1819 (Chiroptera: Vespertilionidae) based on collections from meuseums of USSR. Trudy Zool. Inst. Leningrad, 119: 38-42. (In Russian).

Strelkov, P.P., and R.T. Shajmardanov. 1983. The new data on the distribution of bats (Chiroptera) in Kazakhstan. Trudy Zool. Inst. Leningrad, 119: 3-37. (In Russian).

Stutz, H.-P., and M. Haffner. 1983-84. Summer colonies of *Vespertilio murinus* Linnaeus, 1758 (Mammalia: Chiroptera) in Switzerland. Myotis, 21-22: 109-112.

Stutz, H.-P. and M. Haffner. 1983-84. Maternity roosts of the mouse-eared bat *Myotis myotis* (Borkhausen, 1797) in the central and eastern part of Switzerland. Myotis, 21-22: 180-184.

Vernier, E. 1983. Presenza di *Nyctalus noctula* e altri Vespertilionidi (Mammalia: Chiroptera) nei parchi della citta di Padova. Problemi sulla protezione dei rifugi, pp. 45-48. IN, Patrizio Guilini (ed.). L'Albero, l'uomo, la citta. Signum edizioni, Padua. (English summary).

ECHOLOCATION

Bell, G.P., and M.B. Fenton. 1984. The use of Doppler-shifted echoes as a flutter detection and clutter rejection system: the echolocation and feeding behavior of *Hipposideros ruber* (Chiroptera: Hipposideridae). Behav. Ecol. Sociobiol., 15: 109-114.

Brown, P.E., *et al.* 1983. Echolocation, development, and vocal communication in the lesser bulldog bat, *Noctilio albiventris*. Behav. ecol. Sociobiol., 13: 287-298.

Gorlinsky, I.A. 1985. Influence of unilateral disturbance of auditory perception on ability of bats to detect direction of adequate ultrasound signals. Zhurnal Vysshei Nervnoi Deyatelnosti Imeni I.P. Pavlova, 35: 173-175 (In Russian, English abstract. A.A. Ukhtomskii Physiol. Inst., Leningrad, USSR).

Harnischfeger, G., G. Neuweiler and P. Schlegel. 1985. Interaural time and intensity coding in superior olivary complex and inferior colliculus of the echolocating bat *Mollosus ater*. J. Neurophysiology, 53: 89-109 (Reprint: G. Neuweiler, Univ. Munich, Inst. Zoology, Luisenstr. 14, D-8000 Munich-2, FRG).

Herbert, H. 1983. Vocal communication in the megachiropteran bat *Rousettus aegyptiacus*: development of isolation calls during postnatal ontogenesis. Z. Saugetierkd., 48: 187-189 (Inst. Biol. III, Lehrbereich Zoophysiol., Auf Morgenstelle 28, D-7400 Tubingen, FRG).

Konstantinov, A.I., and E.V. Movchan. 1984. Role of the auditory cortex and inferior colliculus in the control of echolocation process in the greater horseshoe bat, *Rhinolophus ferrumequinum*. Zh. Evol. Biokhim. Fiziol., 20: 70-78 (In Russian, English summary).

Novacek, M.J. 1985. Evidence for echolocation in the oldest known bats. Nature, 315: 140-141 (Veterbrate Paleotology, American Museum of Natural History, New York, NY 10024 USA).

Pettersson, L., and A. Svardstrom. 1983. An instrument for shifting ultrasonics to audible sounds developed for bat detection. Institute of Technology, Uppsala University. Report 8346 R, 21 pp. (Dept. of Tech., Uppsala Univ. Box 534, S-751 21 Uppsala, Sweden).

Sokolov, B.V. 1984. Changes in the frequency of echolocation emission and auditory tuning in the bat *Rhinolophus ferrumequinum*. Zh. Evol. Biokhim. Fiziol., 20: 61-69 (In Russian, English summary).

Stosman, I.M., and A.K. Mekarov. 1983. Characteristics of binaural ineraction of brain-stem auditory formations of bats during dichotic stimulation. Zh. Evol. Biokhim. Fiziol., 19: 180-185 (Transl. Consultants Bur., New York, pp. 141-145, Nov. 1983). 9 Pl.

Thomas, D.W., and S.D. West. 1984. On the use of ultrasonic detectors for bat species identification and the calibration of QMC Mini Bat Detectors. Can. J. Zool., 62: 2677-2678 (Univ. Washington, College of Forest Resources, AR 10, Seattle, WA 98195 USA).

ECOLOGY AND BEHAVIOR

Advani, R. 1982. Emergence and foraging behaviour of *Rhinopoma microphyllum kinneari* in Rajasthan. Saugetierkd. Mitt., 30: 41-45 (799 Sukh Nivas, 5th Chopasni Rd., Sardarpura, Jodhpur — 342 001, India).

Advani, R. 1982. Feeding, foraging and roosting behaviour of the fruit-eating bats and damage to fruit crops in Rajasthan and Gujaret, India. Saugetierkd. Mitt., 30: 46-48.

Advan, R. 1982. Species composition, habitat preference and relative occurrence of Chiroptera populations in South Gujaret, India with comparison of two major biomes. Saugetierkd. Mitt., 30: 31-40.

Aellen, V. 1983. Migrations des chauve-souris en Suisse. Bonner Zool. Beitr., 34: 3-27 (English summary).

Avery, M.I., P.A. Racey and M.B. Fenton. 1984. Short distance location of hibernaculum by little brown bats (*Myotis lucifugus*). J. Zool. London, 204: 588-590 (Zoology, Univ. of Aberdeen, Tillydrone Ave., Aberdeen, AB9 2TN, UK).

Black, H.L. 1983. Differential utilization of bat boxes by house wrens, Troglodytes aedon. Great Basin Nat., 43: 456.) (Dept. Multicultural Education, Brigham Young Univ., Provo, Utah 84602 USA).

Caire, W., J.F. Smith, S. McGuire and M.A. Royce. 1984. Early foraging behavior of insectivorous bats in western Oklahoma, USA. J. Mamm., 65: 319-324 (Biology, Cent. State Univ., Edmond, OK 73034 USA).

Daniel, M.J., and G.R. Williams. 1983. Observations of a cave colony of the long-tailed bat (*Chalinolobus tuberculatus*) in North Island, New Zealand. Mammalia, 47: 71-80 (Biol. Div., Dept. Sci. & Indus. Res., Private Bag, Lower Hutt, New Zealand).

Huang, W., and X. Huang. 1982. The seasonal activity of *Pipistrellus abramus* in relation to environmental factors. Acta Teriol. Sinica., 2: 143-155.

Hurka, L. 1983. Drei Tyoen von Winterquartieren der Fledermaase in Westbohmen. Folia Mus. Rer. Natur. Bohemiae Occid., 17, 18 pp.

Lindeman, G.V., and A.E. Subbotin. 1983. On bat flight in Transvolga seni-deserts with clay soil. Biul. Moscow Obsheh. Ispyt. Prirod. Biol., 88: 88-90 (In Russian).

Medellin, R.A., *et al.* 1983. Notes on the biology of *Micronycteris brachyotis* (Dobson) (Chiroptera), in southern Vera Cruz, Mexico. Bronesia, 21: 7-11.

Northants Bat Group. 1983. Emergence times of pipistrelles. Northamptonshire Nat. Hist. Soc., 38: 69-71.

Racey, P.A., and S.M. Swift. 1985. Feeding ecology of *Pipistrelles pipistrellus* (Chiroptera: Vespertilionidae) during pregnancy and lactation. 1. Foraging behaviour. J. Anim. Ecol., 54: 205-215 (Zoology, Univ. of Aberdeen, Tillydrone Ave., Aberdeen, AB9 2TN, UK).

Rakhmatulina, I.K. 1983. Ecology of *Vespertilio kuhlii* Kuhl, 1819 in Azerbaijan. Biul. Moscow Obshch. Ispyt. Prirod. Biol., 88: 33-42 (In Russian, English summary).

Sazima, M., *et al.* 1982. Poliniacao de *Luehea speciosa* (Tiliaceae) por *Glossophaga soricina* (Chiroptera: Phyllostomatidae). Rev. Brasil. Biol., 42: 505-513 (English summary).

Schum, M. 1984. Phenetic structure and species richness in north and central American bat faunas. Ecology, 65: 1315-1324.

Stebbings, R.E. 1983. Cave life. Part 7: Bats. Caving, 20: 3-5.

Stephens, W., and V. Blackwood. 1983. Wahlberg's eagle catching bats in Malawi. Ostrich., 54: 25.

Swift, S.M., P.A. Racey and M.I. Avery. 1985. Feeding ecology of *Pipistrellus pipistrellus* (Chiroptera: Vespertilionidae) during pregnancy and lactation. 2. Diet. J. Anim. Ecol., 54: 217-225 (Zoology, Univ. of Aberdeen, Tillydrone Ave., Aberdeen, AB9 2TN, UK).

Walton, R., and B.J. Towbridge. 1983. The use of radiotracking in studying the foraging behaviour of the Indian flying-fox (*Pteropus giganteus*). J. Zool. London, 201: 575-579.

Weisburd, S. 1984. Altruism absent in mom bats. Sci. News, 125: 148.

EVOLUTION AND GENETICS

Robbins, L.W. 1984, Evolutionary and biogeographical relationships in the family Emballonuridae (Mammalia: Chiroptera). Diss. Abstr. Int., B. Sci., Eng., 44: 3684-3685.

Sige, B., and S. Legendre. 1983. L'histoire des peuplements de chiropteres du bassin Mediterraneen: l'apport compare des remplissages karstiques et des depots fluviolacustres. Mem. Biospeol., X: 209-225 (In French, English summary. Institut des Sciences de l'Evolution, L.A. 327 du C. N. R. S., U. S. T. L., Place Eugene-Bataillon, 34060 Montpellier Cedex, France).

PESTICIDES, PUBLIC HEALTH AND VIROLOGY

Constantine, D.G. 1982. Weather-induced mortality in migratory bats confused with rabies mortality. California Morbidity, Report no. 36, September 17; weekly report from the Infectious Disease Section, State Dept. of Health Services (Dept. of Health Services, 2151 Berkeley Way, Berkeley, CA 94704 USA).

Randhawa, H.S., V.P. Chaturvedi, S. Kini, and Z.U. Khan. 1985. *Blastomyces dermatitidis* in bats: first report of its isolation from the liver of *Rhinopoma hardwickei hardwickei* Gray. Sabouraudia, 23: 69-76.

Thiry, L., L.J. Cogniaux, R. Olislager, G.S. Sprecher and P. Buekens. 1983. Cell receptors for baboon endogenous virus recognized by monoclonal antibodies. J. Viriol., 48: 697-708 (Bat cells. Inst. Pasteur Brabant, 1180 Brussels, Belgium).

PHARMACOLOGY

Cole, O.F., and the late V.O. Marquis. 1985. A pharmacological analysis of the responses of the gastrointestinal smooth muscle of the bat to transmural and periarterial nerve stimulation. Brit. J. of Pharmacology, 84: 587-594 (Royal Coll. Surg., England, Inst. Basic Med. Sci., Dept. Pharmacology, Lincolns Inn Fields, London WC2A 3PN, England).

PHYSIOLOGY

Andreeva, N.G., V.D. Zharskaya and A.G. Vasilev. 1983. Pathways for synchronized discharges from the superior olivary complex and inferior colliculus in the bat *Rhinolophus ferrumequinum*. Zh. Evol. Biokhim. Fiziol., 19: 201-203 (In Russian, English summary. A.A. Ukhtomskii Physiological Inst., Leningrad University, Leningrad, USSR).

Bouskelatorres, E., I.P.T. Filho, D.W. Slaaf and C.A. Wiederhielm. 1984, The bat wing as a model of the intact tissue. IN, K. Messmer, F. Hammersen, and B.W. Zweifach (eds.), Perspectives in Methodology for Studies of the Microcirculation, pp. 69-76. Karger Basel, 159 pp. (Univ. Estado Rio de Janeiro, Inst. Biol., Dept. Ciencias Fisiol., Rio de Janeiro, RJ, Brazil).

Joshi, D., and M.K. Chandrashekaren. 1985. Light flashes of different durations (0.063-3.33 msec) phase shift the circadian flight activity of a bat. J. Exp. Zoology, 233: 187-192 (Reprint: M.K. Chandreshekaran, Madurai Kamaraj Univ., School of Biol. Sci., Neurobiology & Mechanisms Behav. Unit, Madurai 625 021 Tamil Nadu, India).

Neuweiler, G., S. Singh and K. Sripathi. 1984. Audiograms of a south Indian bat community. J. Comp. Physiol., 154 A: 133-142 (Zool. Inst. der Universitat Munchen, Luisenstrasse 14, D-8000 Munchen 2, FRG).

REPRODUCTION

Advani, R. Reproductive biology of *Pipistrellus mimus mimus* (Wroughton) in the Indian desert. Z. Saugetierkd., 48: 211-217.

Bernard, R.T.F. 1983. Reproduction of *Rhinolophus clivosus* (Micrchiroptera) in Natal, S. Africa. Z. Saugetierkd., 48: 321-329.

Bernard, R.T.F. 1985. The occurrence of abnormal sperm in the cauda epididymis of *Rhinolophus capensis* (Mammalia: Chiroptera). J. Morph., 183: 177-184 (Rhoades Univ., Dept. Zool. & Entomol., Grahamstown 6140, S. Africa).

Gopalakrishna, A., and D. Bhatia. 1982. Breeding habits and associated phenomenon in some Indian bats. Pt. VII — *Hipposideros speoris* (Schneider) (Hipposideridae) from Chandrapur, Maharashtra. J. Bombay Nat. Hist. Soc., 79: 549-556 (Zoology, Inst. Sci., Nagpur, 440 001, India).

Lal, J.P., and D.K. Biswas. 1983. Courtship and mating in the Indian sheath-tailed bat, *Taphozous longimanus longimanus* (Hardwickei). J. Bombay Nat. Hist. Soc., 80: 409-410.

Maeda, K., and H. Dewa. 1982. Breeding habits of Japanese long-legged whiskered bats, *Myotis frater kaguyae* in Asahikawa, Japan. J. Mamm. Soc., Japan, 9: 82-87 (In Japanese, English summary. Anatomy, Gifu College of Dentistry, Hozumi, Gifu, Japan.

Pal, A.N. 1983. Seasonal changes in the male accessory glands of the Indian leaf-nosed bat, *Hipposideros speoris* (Schneider). Comp. Physiol. Ecol., (Jodhpur), 8: 12-16.

Pal, A.N. 1984. Seasonal effects on the male accessory glands of the Indian vampire bat, *Megaderma lyra lyra* (Geoffroy). J. Current Biosciences, Jodhpur, India, 1:109-114 (Zoology, M.M. College of Science, Nagpur 440 009, India).

Sapkal, V.M., and K.G. Khamre. 1983. Breeding habits and associated phenomenon in some Indian bats. Part VIII — *Taphozous melanopogon* (Temminck) Emballonuridae. J. Bombay Nat. Hist. Soc., 80: 303-311.

SYSTEMATICS

de Jong, C.G. van Zyll. 1984. Taxonomic relationships of Nearctic small-footed bats of the *Myotis leibii* group (Chiroptera: Vespertilionidae). Can. Zool., 62: 2519-2526 (National Museums Canada, National Museum Nat. Sci., Ottawa, Ontario, Canada K1A 0M8).

Genoways, H.H., and S.L. Williams. 1984. Results of the Alcoa Foundation-Suriname expeditions. IX. Bats of the genus *Tonatia* (Mammalia: Chiroptera) in Suriname. Ann. Carnegie Mus., 53: 327-346.

Hill, J.E. 1983. Bats (Mammalia: Chiroptera) from Indo-Australia. Bull. British Mus. Nat. Hist. (Zool.), 45: 103-208 (n. sp. *Hesperoptenus gaskelli*).

Khajuria, H. 1979. Studies of bats (Chiroptera: Mammalia) of M.P., India. Pt. I. (Families Pteropidae, Rhinopomatidae and Emballonuridae). Rec. Zool. Survey of India, Occas. Pap., 13: 59 pp., 7 pl.

Khajuria, H. 1980. Taxonomical and ecological studies on the bats of Jabalpur, Dist. Madhya Pradesh, India. Pt. II. (Families Megadermatidae, Rhinolophidae and Vespertilionidae). Rec. Zool. Surv. India, Occas. Pap., 19: 69 pp.

Koopman, K.F. 1983. Taxonomic and distributional notes on tropical Australian bats. American Mus. Novitat., 2778, 48 pp. (ssp. nov. *Pipistrellus tenuis westralis*). Mammalogy, Am. Mus. Nat. Hist., Central Park West at 79th St., New York, NY 10024 USA).

Kraft, R. 1983. List of the original Spix type specimens of neotropical primates and bats (Mammalia: Primates, Chiroptera) at State Zoological collection, Munich, West Germany. IN, E.J. Fittkau (ed.), Festschrift zu ehren von Dr. Johann Baptist Ritter von Spix. Spixiana Suppl. (Munich), 429-441 (Brazil; In German; Staatssammlung, Maria-Ward-Str., 1B, D-8000 Munich 19, FRG).

Myers, P., and R.M. Wetzel. 1983. Systematics and zoogeography of the bats of the Chaco Boreal. Univ. Michigan Mus. Zool., Misc. Publ., 165, 59 pp.

Nader, I.A., and D. Kock. 1982. *Rhinopoma microphyllum asirensis*, n. subsp. from southwestern Saudi Arabia. Senckenberg. Biol., 63: 147-152.

Taddei, V.A., L.D. Vizzoto and I. Sazima. 1983. Uma nova especie de *Lonchophylla* do Brasil chave para identificacao das especies do genero (Chiroptera, Phyllostomatidae). Cinnc. Cultur., 35: 625-629 (English summary; Dep. de Zool., Univ. Estudual Paulista, Sao Jose Do Rio Preto, Sao Paulo, Brasil).

Webster, W.D., and J. Knox Jones, Jr. 1984. A new subspecies of *Glossophaga mexicana* (Chiroptera: Phyllostomatidae) from southern Mexico. Occas. Pap. Mus. Texas Tech., 91, 5 pp.

Yenbutra, S., and H. Felten. 1983. A new species of the fruit bat genus *Megaerops* from SE Asia. Senckenberg. Biol., 64: 1-11 (sp. nov. *Megaerops niphanae*).

THESES, DISSERTATIONS

Bain, J.R. 1981. Roosting ecology of three Florida bats: *Nycticeius humeralis, Myotis brasiliensis*. Unpublished Master's thesis, University of Florida, Gainesville. vi + 131 pp. (P.O. Box 1560, Flagstaff, Arizona 86002 USA).

Bell, G.P. 1984. Prey location and sensory ecology of two species of gleaning, insectivorous bats, *Antrozous pallidus* (Vespertilionidae) and *Macrotus californicus* (Phyllostomatidae). Diss. Abstr. Int., B, Sci. Eng., 44: 2042.

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BAT RESEARCH NEWS

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Myotis lucifugus

Photograph by Thaddeus Szczesny and John Cotter, Anatomical Sciences, State University of New York at Buffalo, Buffalo, New York.

BAT NEWS RESEARCH

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John Edwards Hill — Mammalogist: A Tribute

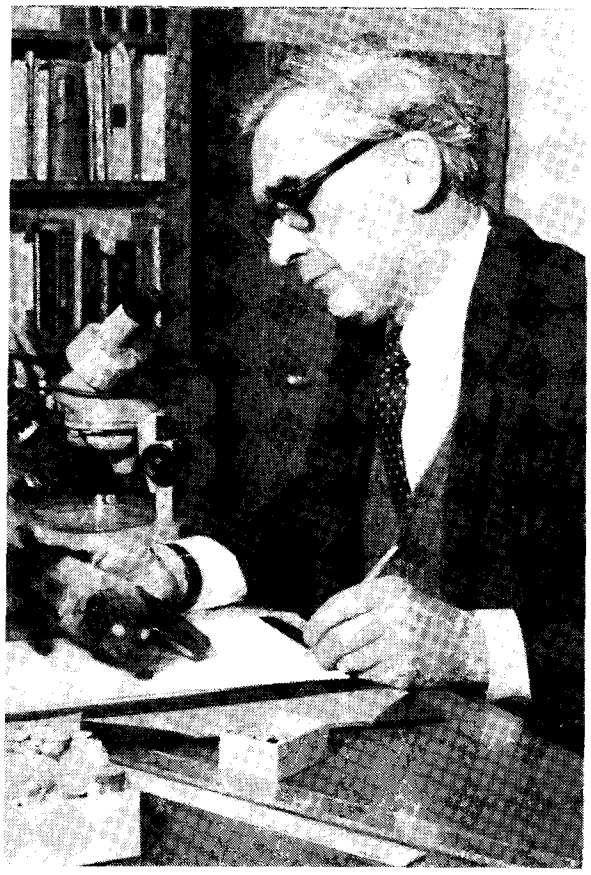
David L. Harrison
Harrison Zoological Museum, Bowerwood House, St. Botolph's Rd., Sevenoaks, Kent, England

John Edwards Hill was born on 11 June 1928 at Ashdown House, Forest Row, near East Grinstead in Sussex. With parents and family of farming stock, he grew up in a farming community, which during his adolescence was engaged in the vital task of food production during the Second World War, with the Battle of Britain raging in the skies above Kent and Sussex.

Early education at the Church of England an Elementary School Sussex (1934-1939) led to a scholarship to the East Grinstead County Grammar School (1939-1946) where the School Certificate, Matriculation and Oxford Higher School Certificates were secured. There, his early interest in natural science was channelled into biology by the science staff, and this interest was to become the main devotion of his subsequent brilliant career as a scientist.

In 1946 he joined the Royal Air Force, serving as a Meteorological Observer in the U.K., Japan (where he observed the effects of nuclear weapons at first hand), Malaysia and the Nicobar Islands. He helped to establish meteorological outposts in the Far East for the embryonic Civil Aviation industry, so soon to become an established worldwide feature of twentieth century life.

Demobilized in 1948, he was appointed to the staff of the British Museum (Natural History), joining the Mammal Section as an Assistant Experimental Officer. Thus began a long and distinguished career in the Section, serving no less than five Directors, Keepers and Heads of Section, and extending to the present time when he is himself a Principal Scientific Officer.



He was fortunate indeed to receive his early training in mammalogy from R.W. Hayman, and to be influenced greatly by the work of Sir Terence Morrison Scott and Sir John Ellerman. These distinguished mammalogists continued the strong tradition of descriptive, analytical and synoptic taxonomy, established at the Section by Michael Rogers Oldfield Thomas, appointed in 1878 (d. 1929). Thomas was the father of the Mammal Section and indeed one of the founding fathers of scientific mammalogy. It could be said that John Hill is probably one of the last proponents of this tradional taxonomy, handed down through a succession of practitioners, each trained and influenced by his predecessor. Whatever one's view of modern taxonomic methods may be, the fundamental descriptive work of this formidable lineage will always endure as a large part of the unchallenged foundation of the science of mammalogy.

His own very substantial contributions are reflected in a personal bibliography of around 100 publications, ranging world-wide geographically and across a very broad spectrum of mammalian life. His voluminous researches are characterized by a meticulous attention to detail and factual evidence for conclusions. They include the addition of no less than 52 new taxa. In 1974 he described an altogether unknown family of bats (Craseonycteridae), in fact only the second to be described from new material of Recent mammals in this century. Three new genera (*Mayermys, Barticonycteris, Craseonycteris*), one subgenus (*Milithronycteris*) and twenty-four new species give a good impression of the scope and impact of his taxonomic work.

Although a general mammalogist of great talent, with a truly phenomenal knowledge of the literature, it is without doubt as a specialist in Chiroptera that he will be most remembered. It is largely due to his interest and devotion that the National Collection now contains one of the finest systematic collections of bats in the world, with large numbers of relevant holotypes. His recently published book **Bats — A Natural History** with J.D. Smith, is in a very real sense a crowning culmination to his long interest in and affection for these unique and ancient creatures. Predictably the work is enjoying great popularity and will have an indispensible place in the libraries of all serious students of Chiroptera. Other very important works of a more general nature include his **A World List of Mammalian Species** (1980 with G.B. Corbett) which has proved an invaluable reference work for all engaged in systematic mammalogy. His regional checklists include **List of Land Mammals of New Guinea, Celebes and Adjacent Islands** (1954 with E.M.O. Laurie) and **Chiroptera** (1971 with R.W. Hayman). His generosity in imparting his enormous knowledge of mammalogy to his colleagues and friends has become a legendary part of the Mammal Section. His kindly help is given without stint, often imparted with an uplifting sense of humour, which impels his friends to visit him regularly in the Section.

He has carried the standard of his illustrious predecessors with great distinction and success thus perpetuating the long-established tradition for public service and research at the British Museum (Natural History). He deserves a place of honour in the history of mammalogy.

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USE OF AN UNDERGROUND BURROW BY *LASIONYCTERIS*

Virgil Brack, Jr. and Jerry C. Carter

Wapora, Inc., 511 Old Lancaster Road, Berwyn, PA 19312 and Department of Biological Sciences, Purdue University, West Lafayette, IN 47907

There are few reports of bats utilizing subterranean burrows other than in cliffs and other vertical embankments. *Myotis leibii* has been found in cracks of cave floors and beneath rocks both in and out of caves (Davis, 1955; Tuttle, 1964; Martin et al, 1966; Fenton, 1972; Tuttle and Heaney, 1974), and *Eptesicus fuscus* has been found hibernating under rocks in caves (Martin et al., 1966). Dalquest and Walton (1970), summarizing the roosts of bats, reported several species that found refuge under rocks; *Micronycteris* was found in an agouti burrow and *Tonatia* in rabbit burrows. *Mystacina tuberculata* is the only bat known to have adaptations for living in burrows (Daniel, 1979).

On May 11 1984 a non-pregnant female *Lasionycteris noctivagans* was found by Charles Watkins and Ralph Schocke while digging a hole in Plainview Cemetery, Clinton County, Indiana. While at an average depth of 30 to 45 cm the hissing of a bat caught their attention. The bat was clinging to a wall of the hole just several centimeters from a small tunnel opening belonging, they believed, to a thirteen-lined ground squirrel (*Spermophilus tridecemileatus*). However, another burrowing rodent, the eastern chipmunk (*Tamias striatus*), is also present in the graveyard. The bat's pelage was muddy when first found. The workmen spent several minutes procuring a container, during which time the bat assumed an

open-mouthed defensive posture and hissed but made no attempt to fly or crawl away. Consequently the men believed that the bat "acted like it was hibernating," and that it had come out of the rodent burrow. The nearest foliage was 16 m away and nearby monuments provided no usable cracks or spaces. When the bat was acquired from the workmen several hours later it was active and appeared in normal health.

Lasioncyteris noctivagans is migratory through Indiana but is not a summer resident (Mumford and Whitaker, 1982). This species has been found behind loose tree bark, in cracks in trees, woodpecker holes, bird's nests, in and on a variety of buildings, ship hulls, sandstone and limestone caves, silica mines, rock crevices, and frequently takes refuge in piles of lumber, fence posts, or the like when migrating through prairie areas (Barbour and Davis, 1969; Kunz, 1982). Hayward (1970) found during migration that many species of bats use an increased variety of roosts. Thus, migration through a prairie-like habitat likely contributed to this bat's choice of a rodent burrow as a roost site.

LITERATURE CITED

Barbour, R.W., and W.H. Davis. 1969. Bats of America. Univ. Press, Kentucky, Lexington, 286 pp.

Dalquest, W.W., and D.W. Walton. 1970. Diurnal retreats of bats. Pp. 162-187, in About bats: a chiropteran symposium (B.H. Slaughter and D.W. Walton, eds.). Southern Methodist Univ. Press, Dallas, Texas, 339 pp.

Daniel, M.J. 1979. The New Zealand short-tailed bat, *Mystacina tuberculata*; a review of present knowledge. New Zealand J. Zool., 6: 357-370.

Davis, W.H. 1955. *Myotis subulatus leibii* in unusual situations. J. Mamm., 36: 130.

Fenton, M.B. 1972. Distribution and overwintering of *Myotis leibii* and *Eptesicus fuscus* (Chiroptera: Vespertilionidae) in Ontario. Life Sci. Occas. Pap. Roy. Ont. Mus., 21: 1-8.

Hayward, B.J. 1970. The natural history of the cave bat, *Myotis velifer*. Res. Sci. Western New Mexico Univ., 1: 1-74.

Kunz, T.H. 1982. *Lasioncyteris noctivagans*. Mamm. Species, 172: 1-5.

Martin, R.L., J.T. Pawluk, and T.B. Clancy. 1966. Observations on hibernation of *Myotis subulatus*. J. Mamm., 47: 348-349.

Mumford, R.E., and J.O. Whitaker, Jr. 1982. Mammals of Indiana. Indiana Univ. Press, Indiana, 537 pp.

Tuttle, M.D. 1964. *Myotis subulatus* in Tennessee. J. Mamm., 45: 148-149.

Tuttle, M.D., and L.R. Heaney. 1974. Maternity habits of *Myotis leibii* in South Sakota. Bull. S. California Acad. Sci., 73: 80-83.

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BOOK REVIEW

van Zyll de Jong, C.G., **Handbook of Canadian Mammals 2. Bats.** National Museum of Natural Sciences, Ottawa, Canada K1A 0M8, 212 pp., 1985. Available in the U.S. from The University of Chicago Press. Price: $19.95 (also available in French under the title: **Traite des mammiferes du Canada — 2. Les chauves-souris**).

As I initially opened van Zyll de Jong's new book, I wondered what this book could provide that was not already adequately covered in Kunz's **Ecology of Bats**, in Hall's **Mammals of North America**, or in Barbour and Davis' **Bats of America**. It quickly became apparent that the answer was "plenty." Dr. van Zyll de Jong has combined, in a single book, a comprehensive introduction to the biology of temperate bats and an excellent field guide to the bats of Canada and adjacent regions. The book will be of use to a broad spectrum of people, from students of natural history to wildlife specialists, professional mammalogists and naturalists.

The book opens with an "Introduction to Volume 2" that gives a brief explanation of the scope and purpose of the book, a short history of Canadian research on bats, and an extremely useful pictorial summary of the external characteristics and the dental and skeletal measurements used to recognize different Canadian species. The Introduction is followed by one of the real highlights of the book: four superbly executed color plates (by Paul Geraghty) illustrating the eighteen bat species commonly found in Canada. The main text of the book begins on page 25, with an essay on bat biology. The essay is not restricted to what is known about bats of Canada (as the author puts it, there is a "dearth of information on many . . . native species"). Rather, it broadly covers the topics of general characteristics of the order, distribution of bats (with a special section on Canadian bats), classification, evolution, flight, echolocation, vision and olfaction, roosting habits, migration, thermoregulation, reproduction, parasites, feeding habits, conservation, and public health. Because it is rather general, the essay will be the least useful to the bat specialist, but of great interest to the student of natural history or a lay reader. Much of the remainder of the book is a species-by-species account of the twenty known Canadian bat species, including the one accidental record of *Tadarida macrotis* (or *Nyctinomops macrotis* if one follows Freeman, Fieldiana-Zool., n.s. 7:vii + 173 pp., 1981) and records of several species whose ranges extend marginally into southern Canada.

The species accounts open with two keys to the identification of species: one key uses external character, the other uses cranial characters. Both keys are among the best-illustrated keys I have seen, which makes them very easy for the novice to use. The author has wisely included *Myotis sodalis* in his list of keyed species. By so doing, the book becomes not only a field guide to Canadian bats, but also a field guide to virtually all the bat species found in the northern half of the United States. This greatly increases the usefulness of the book to U.S. naturalists.

The species accounts form the heart of the book. Each account starts with the Latin binomium, and the common name of the species in both English and French. Following the Latin names is a brief synonomy of some of the prior Latin names, and then tables giving ranges of external measurements, skull measurements, and weights. Each account opens with a short "Description," which serves as a "diagnosis" of the species. I am pleased to note that the "Description" section was particularly well-written for all twenty species. In every case, potentially-confusing species are mentioned, and morphological characteristics are given that should help positively to identify a specimen in hand. Next is a section entitled "Distribution" which is principally a list of Canadian marginal localities. A section on "Systematics" gives the currently recognized Canadian subspecies, and some very interesting comments in species interrelationships. Finally, there is a section entitled "Biology." In my opinion, the "Biology" sections are another highlight of the book. Each summarizes in succinct fashion the current knowledge of habitat, predators, echolocation, prey, parasites, etc. for each species. The author has included results from virtually every significant paper, but has not belabored any one topic. References are given in the text if the reader wishes to consult a primary source. Each account concludes with the pertinent endnotes, and each account is illustrated with a superb drawing of the skull (dorsal, ventral, and lateral views) and a map showing Canadian and North American ranges.

I am most impressed with the care that went into designing this book. It is not pocket-sized, but it is small enough (about 17x24 cm) so that it will easily fit in a backpack pocket. The signatures are sewn, and the cover is a tough paper that should withstand field conditions easily (there is a well-designed, but rather superfluous, dust jacket on the book). The faults with the book are few and minor. It would be most helpful if, in future editions, the List of Distribution Maps (p. 11) and the List of Tables (p. 12) had page numbers included; it would make locating the maps and tables much easier. I would personally find the book easier to use if there were a running head on each page of the species accounts giving the species described. For example, if one opens the book to page 74, it takes a few seconds to find that the text is describing *Myotis lucifugus*, whereas a small "*M. lucifugus*" at the top of the page would eliminate the problem. I found only one omission: although Hitchcock, Keen, and Kurta (1984) are cited in the text, the reference is not included in the Bibliography.

All things considered, the book is a gem. The price is most reasonable, and I recommend the book most highly to any person interested in chiroptology.

Thomas A. Griffiths
Department of Biology
Illinois Wesleyan University
Bloomington, Illinois 61702

Received July 30, 1985

NEWS AND VIEWS

GIFT TO LIBRARY

I have given all my bat banding records, 1939-72 to the University of Vermont with the hope that they may in this way be available to any who want to use them. Included are all recapture data and field notes. The areas most fully covered are hibernating populations in Renfrew County, Ontario, and with Wayne Davis in Southern New England, focussed on bats using the cave in East Dorset, Vermont. The University of Vermont has also been given a copy of the bat bands used by Donald R. Griffin in his earlier New England studies.

Persons wishing to use these materials should make arrangements to do so with Chairman, Wildlife and Fisheries Biology Program, Aiken Center for Natural Resources, University of Vermont, Burlington, VT 05405

—Harold B. Hitchcock
1 Locust Lane, Middlebury, VT 05753 USA
Received July 26, 1985

CURRENT RESEARCH ON BATS

I am currently involved in two bat projects. The first involves sampling New England *Myotis* and *Eptesicus* colonies for the pathogenic fungus *Histoplasma capsulatum*. The impetus to begin this study arose from a 1981 article in the *American Journal of Public Health* which reported an outbreak of histoplasmosis among individuals who directly or indirectly came in contact with guano from an *Eptesicus* colony in Illinois. The article has tangible implications of real and presumed health risks of bat colonies in or near human occupied buildings. The focus of this study is to evaluate the frequency with which *Histoplasma* truly occurs in bat colonies. Drs. Libero Ajello and L. Weeks, both of CDC in Atlanta, are collaborating on this study.

The second project involves further investigation of *Artibeus* distress calls. In 1986 I will conduct a series of field playback experiments designed to clarify what acoustic components of *Artibeus* distress calls bats cue on in their "mobbing" response. Playback tapes will consist of synthesized sounds where frequencies, bandwidths, and repetition rates are varied. Dr. Edwin Gould is collaborating in this project.

-Peter V. August
The University of Rhode Island
Kingston, RI 02881-0816 USA
Received February 19, 1985

NOTICE

The **SIXTEENTH ANNUAL NORTH AMERICAN SYMPOSIUM ON BAT RESEARCH** will meet Friday and Saturday, October 17 and 18, 1986, at the conference center of the University of Massachusetts in Amherst, Massachusetts. Dr. David Klingener will be our host and Dr. Roy Horst will arrange the program. There will be a social gathering on Thursday evening, October 16, check out on Sunday morning, October 19. Amherst is within easy driving distance (2-3) hours from Boston and Albany. Hartford, Connecticut is served by major airlines. Dr. Klingener will arrange van service from that airport. Housing is in single ($40.00 per person per night) or double ($25.00 per person per night) rooms in a very modern facility. Registration fees will be as in the past, $25.00.

Each issue of **Bat Research News** will carry successively more detailed announcements and registration materials as the meeting date approaches. We look forward to seeing you again.

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

Anthony, E.L.P., J.C. King and E.G. Stopa. 1984. Immunocytochemical localization of LHRH in the median eminence, infundibular stalk and neurohypophysis: evidence for multiple sites of releasing hormone secretion in humans and other mammals. Cell Tissue Res., 236: 5-14 (Anatomy & Cellular Biology, Tufts Univ. Med. Sch., 136 Harrison Ave., Boston, MA 02111 USA).

Azzali, G., G. Romita and R. Gatti. 1983. Ultrastructure of the urinary bladder lymphatic vessels. Acta Bio-med Ateneo Parmense, 54: 105-116 (In Italian; Dell' Istituto di Anatomia Umana Normale, Dell' Universite di Parma, 43100 Parma, Italy).

Baranga, J. 1984. The incidence of accessory adrenocortical bodies in *Rousettus aegyptiacus* E. Geoffrey (Megachiroptera: Mammalia). Mammalia, 48: 267-273.

Baranga, J., H. Schliemann, F.I.B. Kayanja and R.T. Muwazi. 1984. The epididymis of the fruit bat, *Epomophorus anurus*. African J. Ecol., 22: 55-61 (Zoology, Makerere Univ., P.O. Box 7062, Kampala, Uganda).

Bruns, V., et al. 1983-84. Structural diversity of the inner ear of bats. Myotis, 21-22: 52-61.

Burikova, N.V., and E.I. Krasnoshchekova. 1983. Cytoarchitectonics of the cerebral auditory cortex in animals with the agranular type of neocortex (Vestn. Leningrad, Univ., Biol., 0 (2): 64-70 (Leningr. Univ., Leningrad, USSR).

Dulic, B., and M. Mrakovcic. 1983-84. Morphological characteristics of a population of *Pipistrellus savii* from some Adriatic Islands. Myotis, 21-22: 37-40.

Feng, A.S., and M. Vater. 1985. Functional organization of the cochlear nucleus of rufous horseshoe bats (*Rhinolophus rouxi*): frequencies and internal connections are arranged in slabs. J. Comp. Neur., 235: 529-554 (Univ. Illinois, Dept. Physiol. Biophysics, 524 Burill Hall, 407 S. Goodwin St., Urbana, IL 61801 USA).

Greet, D.G., and F. De Vree. 1984. Movements of the mandibles and tongue during mastication and swallowing in *Pteropus giganteus* (Megachiroptera). A cine radiographical study. J. Morph., 179: 95-114 (Biology, Univ. Instelling Antwerpen, Universiteitsplein 1, 2610 Wilrijk, Belgium).

Imrychova, A., and J. Malinsky. 1983. Changes in glial elements in the spinal cord of the hibernating bat. Folia Morphol. (Prague), 31: 399-403 (Normal Anatomy, Fac. Med., Palacky Univ., Olomouc).

King, J.C., and E.L.P. Anthony. 1983. Biosynthesis of LHRH inferences from immunocytochemical studies. Peptides, 4: 963-970 (Anatomy & Cellular Biology, Tufts Univ. Sch. Med., 136 Harrison Ave., Boston, MA 02111 USA).

King, J.C., and E.L.P. Anthony. 1984. LHRH neurons and their projections in humans and other mammals — species comparisons. The Schmitt Brain Symp. on neuropeptides, 5 (Suppl. 1), 195-208.

Konstantinov, A.I., and N.V. Burikova. 1983-84. Organization of the auditory pathways in the bat *Myotis blythi*. Myotis, 21-22: 47-51.

Lechner, A.J. 1985. Pulmonary design in a microchiropteran bat (*Pipistrellus subflavus*) during hibernation. Respiration Physiol., 59: 301-312 (St. Louis Univ., Sch. Med., Dept. Physiol., St. Louis, MO 63104 USA).

Malinovsky, L., V. Berkova and L. Pac. 1982. The ultrastructure of axon processes in sensory corpuscles. Z. Mikrosk-Anat. Forsch (Leipz), 96: 844-856 (Anatomy, Fac. Medicine, Purkyne Univ., Komenskeho Nam. 2, CS-662, 43 Brno, Czechoslavakia).

Malinska, J., and J. Malinsky. 1983. Changes in the organelles of spinal cord cells of hibernating bats. Folia Morphol (Prague), 31: 410-412 (Dept. Normal Anatomy, Fac. Med., Palacky Univ., Olomouc).

Murthy, K.V.R. 1981. Studies on the male genitalia of Indian bats. 5. Male genitalia of the Indian vespertilionid bat *Pipistrellus ceylonicus chrysothrix*. J. Zool. Soc. India, 33: 53-62 (A-15, Amazari Layout, North Ambazari Rd., Nagpur 440 010 India).

Oommen, M.M., and K.M. Alexander. 1983. Distribution pattern of succinic dehydrogenase in the myocardia of some vertebrates. Proc. Indian Acad. Sci., Animal Sci., 92: 37-42 (Zoology, Univ. Kerala, Kariavattom PO, Trivendrum 695 581, Kerala, India).

Patankar, V.B., and V.Y. Patil. 1983. Mucopolysaccharide histochemistry of chiropteran glomerulus. Z. Mikrosk-Anat. Forsch (Leipzig), 97: 713-718 (Zoology, Rajaram College, Kolhapur 416 004, Maharashtra, India).

Regidor, J., S. Torija and C. Lopez Garcia. 1983. The globoid neurons of the auditory cortex of the bat *Rhinolophus ferrumequinum*. Neurosci. Lett., 0 (Suppl. 14): S 301 (Abstract; Biology, Colegio Univ., Las Palmas, Spain).

van der Merwe, M. 1985. Deciduous teeth and their replacement in *Miniopterus schreibersii natalensis*. S. African J. Zool., 20: 72-76 (Univ. Pretoria, Mammal Res. Inst., Pretoria, 0002, South Africa).

BEHAVIOR

Advani, R. 1983. The seasonal variations in food composition and some behavioral patterns of *Scotophilus heathi* (Chiroptera, Vespertilionidae) in Rajasthan, India. Mammalia, 47: 215-220 (Central Plantation Crops Res. Inst., Kasragod 670 124, India).

Gebhard, J., 1983-84. *Nyctalus noctula* — Beobachtungen an einem traditionellen Winterquartier im fels. Myotis, 21-22: 163-170 (English summary).

Ryan, J.M., D.B. Clark and J.A. Lackey. 1985. *Artibeus lituratus* (Chiroptera, Phyllostomidae) to distress calls of conspecifics-response. J. Mamm., 66: 179-180 (Univ. Mass., Dept. Zoology, Amherst, MA 01003 USA).

Schmidt, S. et al. 1983-84. Behavioral audiogram from the bat, *Megaderma lyra* (Geoffroy, 1810; Megachiroptera). Myotis, 21-22: 62-66.

Tupinier, Y., and Y. Biraud. 1983-84. Variabilite des signaux de croisiere de *Myotis daubentoni* (Kuhl, 1819) (Chiroptera: Vespertilionidae). Myotis, 21-22: 78-81.

Wilkinson, G. S. 1984. Reciprocal food sharing in the vampire bat, *Desmodus rotundus*. Nature (Lond.), 308: 181-184 (Biology, C-016, Univ. California San Diego, La Jolla, CA 92093 USA).

BIOCHEMISTRY

David, S.K., and S.B. Lall. 1983. Histochemical site and pattern of distribution of monoamine oxidase succinic dehydrogenase and alpha glycero phosphate dehydrogenase in the adrenal cortex and medulla of the flying fox *Pteropus giganteus giganteus* (Megachiroptera, Mammalia) Pak. J. Sci. Ind. Res., 26: 318-320 (Zoology, Univ. Udaipur, Udaipur, India).

de Jong, W.W., and M. Goodman. 1982. Mammalian phylogeny studied by sequence analysis of the eye lens protein alpha crystallin. Z. Saugetierkd., 45: 257-276 (Lab voor Biochemie, Geert Grooteplein Noord 21, Universiteit van Nijmegen, 6525 EZ Nijmegen, Netherlands).

Kelker, H.C., Y.K. Yip, P. Anderson and J. Vilcek. 1983. Effects of glycosidase treatment on the physicochemical properties and biological activity of human interferon Gamma. J. Biol. Chem., 258: 8010-8013 (Bat lung cells; Microbiology, New York Univ. Sch. Med., New York, NY 10016 USA).

Moore, D.W., and T.L. Yates. 1983. Rate of protein inactivation in selected mammals following death. J. Wildlife Management, 47: 1166-1169 (Biology & Mus. Southwestern Biol., Univ. New Mexico, Albuquerque, NM 87131 USA).

CONSERVATION

Carroll, J. B. 1983-84. The conservation and wild status of the Rodrigues fruit bat *Pteropus rodricensus*. Myotis, 21-22: 148-154.

Richarz, K. 1983-84. Ergebnisse und Erfahrungen mit einem Fledermausschutzprogramm in Oberbayern. Myotis, 21-22: 155-162 (English summary).

Roer, H. 1983-84. Zur Bestandssituation von *Rhinolophus ferrumequinum* (Schreber, 1774) und *Rhinolophus hipposideros* (Bechstein, 1800) (Chiroptera) im westlichen Mitteleuropa. Myotis, 21-22: 122-131 (English summary).

DISTRIBUTION

Aellen, V. 1983-84. Migrations de chauvessouris en Suisse. Note complementaire. Myotis, 21-22: 185-189 (English summary).

Dalquest, W. W. 1983. Mammals of the Coffee ranch local Hemphillian fauna of Texas, USA. Pearce-Sellards Ser. Tex. Mem. Mus., 0 (38): 1-41 (Biology, Midwestern State Univ., Wichita Falls, TX 76308 USA).

de Paz, O. 1984. On the distribution of the genus *Plecotus* (Chiroptera: Vespertilionidae) in the Iberian peninsula and Balearic isles. Mammalia, 48: 585-592 (Comundad Autonoma Madrid, Consejera, Dept. Ecology, Unidad Zool., Aplicada El Ensin, Madrid, Spain).

Gaisler, J. 1983-84. Bats of northern Algeria and their winter activity. Myotis, 21-22: 89-95.

Hall, L. 1984. And then there were bats. Pp. 837-852. IN, Vertebrate Zoogeography and Evolution in Australasia (M. Archer and G. Clayton, eds.). Hesperian Press, Carlisle, Western Australia, 1203 pp.

Harrison, D.L., and P.J.J. Bates. 1984. Occurence of *Nyctalus noctula* Schreber, 1774 (Chiroptera: Vespertilionidae) in the Cromerian interglacial of England. Mammalia, 48: 603-605 (Harrison Zool. Mus., Bowerwood House, St. Botolphs Rd., Sevenoaks, Kent, England).

Lehmann, R. 1983-84. *Myotis mystacinus* (Kuhl, 1819) and *Myotis brandti* (Eversmann, 1845) in Finland. Myotis, 21-22: 69-101.

MacFarlane, M.A., B.L. Walthers and G.C. Suckling. 1982. Mammals of the reef hills state forest in north-eastern Victoria, Australia. For. Comm. Victoria Bull., 0 (29): 15-24.

Medellim, R.A. 1983. *Tonatia bidens* and *Mimon crenulatum* in Chiapas Mexico. J. Mamm., 64: 150 (Zoology, Inst. Biol., U.N.A.M., AP. Postal 70-153, 04510 Mexico, D.F. Mexico).

Mok, W.Y., D.E. Wilson, L.A. Lacey and R.C.C. Luizao. 1982. Updated list of chiropterans of the Brazilian Amazon region. Acta Amazonica, 12: 817-824 (In Portuguese; Instituto Nacional de Pesquisas da Amazonia, Manaus, AM).

Nagel, A., et al., 1983-84. Distribution of hibernating bats in Wuerttemberg (South Germany). Myotis, 21-22: 116-121.

Nagorsen, D.W., and S.V. Nash. 1984. Distributional records of bats from the James Bay region. Canadian Field Nat., 98: 500-502 (British Columbia Prov. Mus., Div. Vert. Zool., Victoria, BC Canada V8V 1X4).

Schober, W., and M. Wilhelm. 1983-84. Zur Verbreitung und Bestandentwicklung der kleinen Hufeisennase (*Rhinolophus hipposideros*) in der DDR. Myotis, 21-22: 132-137 (English summary).

Shaimardanov, R.T. 1982. *Otonycteris hemprichi* and *Barbastella leucomelas* (Chiroptera) in Kazakhstan USSR. Zool. Zh., 61: 1765 (Inst. Zool., Acad. Sci. Kaz. SSR, Alma-Ata, USSR).

Tyler, J.D., and C.M. Scott. 1982. Status and distribution of *Lasiurus cinereus* (Chiroptera: Vespertilionidae) in Oklahoma, USA. Proc. Okla. Acad. Sci., 62: 91-92 (Biol. Sci., Cameron Univ., Lawton, Oklahoma 73505 USA).

Urbanczyk, Z. 1983-84. Massenquartiere Ubenwinternder Fledermause in alten Befestigungsanlagen des 2. Weltkrieges in Westpolen. Myotis, 21-22: 113-115.

ECHOLOCATION

Ahlen, I., L. Pettersson and A. Svardstrom. 1983-84. An instrument for detecting bat and insect sounds. Myotis, 21-22: 82-88.

Belwood, J. J., and J. H. Fullard. 1984. Echolocation and foraging behaviour in the Hawaiian hoary bat, *Lasiurus cinereus semotus*. Can. J. Zool., 62: 2113-2120 (Reprint, J. H. Fullard, Univ. Toronto, Erindale Coll., Dept. Biol., Mississauga, Ontario, Canada L5L 1C6).

Fullard, J.H., 1984. Acoustic relationships between tympanate moths and the Hawaiian hoary bat (*Lasiurus cinereus semotus*). J. Comp. Physiol., A, 155: 795-802.

Konstantinov, A.I. 1983-84. Origin of echolocation in bats. Myotis, 21-22: 67-70.

Masters, W.M., A.J.M. Moffat and J.A. Simmons. 1985. Sonar tracking of horizontally moving targets by the big brown bat, *Eptesicus fuscus*. Science, 228: 1331-1333 (Inst. of Neuroscience, Univ. of Oregon, Eugene, OR 97403 USA).

Ostwald, J. 1984. Tonotopical organization and pure tone response characteristics of single units in the auditory cortex of the greater horseshoe bat. J. Comp. Physiol., A 155: 821- (Univ. Tubingen, Inst. Biol., 3, Lehrstuhl Zoophysiol., D-7400 Tubingen 1, FRG).

Paige, K.N., L.A. Mink and V.R. McDaniel. 1985. A broad-band ultrasonic field detector for monitoring bat cries. J. Wildlife Management, 49: 11-13 (Northern Arizona Univ., Dept. Biol., Flagstaff, AZ 86011 USA).

Rubsamen, R. 1983-84. Control of echolocation calls in the CF-FM bat, *Rhinolophus rouxi*: neurophysiological investigations of the brain stem motor nucleus innervating the larynx, the nucleus ambiguus. Myotis, 21-22: 71-77.

Suga, N., and K. Tsuzuki. 1985. Inhibition and level-tolerant frequency tuning in the auditory cortex of the mustached bat. J. Neurophysiol., 53: 1109- (Washington Univ., Dept. Biol., St. Louis, MO 63130 USA).

Taniguchi, I. 1983. A possible role of pinna movement in the Japanese horseshoe bat *Rhinolophus ferrumequinum nippon*. Neurosci. Lett., 0 (Suppl. 13): S 7 (Abstract; Med. Res. Inst., Tokyo Med. Dent., Univ., Bunkyo-Ku, Tokyo 113, Japan).

Wong, D. 1984. Spatial tuning of auditory neurons in the superior colliculus of the echolocating bat, *Myotis lucifugus*. Hearing Res., 16: 261-270 (Indiana Univ. Sch. of Med., Dept. Anatomy, Indianapolis, IN 46223 USA).

ECOLOGY

Advani, R. 1984. Ecological analysis of small mammal populations and their status in the crop ecosystem of the Indian desert. Z. Angew. Zool., 71: 1-20.

Barclay, R.M.R. 1985. Foraging behaviour of the African insectivorous bat, *Scotophilus leucogaster*. Biotropica, 17: 65-70 (Univ. Calgary, Dept. Biology, Calgary, Alberta, Canada T2N 1N4).

Geggie, J.F., and M.B. Fenton. 1985. A comparison of foraging by *Eptesicus fuscus* (Chiroptera: Vespertilionidae) in urban and rural environments. Can. J. Zool., 63: 263-266 (Carleton Univ., Dept. Biology Ottawa, Ontario, Canada K1S 5B6).

Haussler, U., and A. Nagel. 1983-84. Remarks on several group composition turnover in captive *Nyctalus noctula* (Schreber, 1774). Myotis, 21-22: 172-179.

Heyneman, A.J. 1983. Optimal sugar concentrations of floral nectars dependence on sugar intake efficiency and foraging costs. Oecologia (Berl), 60: 198-213 (Zoology, Univ. California, Berkeley, CA 90027 USA).

Holroyd, G.L., and E.G. Beaubien. 1983. Ring-billed gull *Larus delawarensis* predation on bat *Myotis* injured by an American Kestral *Falco sparverius*. Can. Field Nat., 97: 452 (Canadian Wildlife Serv., 1000, 9942-108 St., Edmonton, Alberta T5K 2J5, Canada).

Hopkins, H.C. 1983. The taxonomy, reproduction, biology and economic potential of Parkia (Leguminosae, Mimosoideae) in Africa and Madagascar. Bot. J. Linn. Soc., 87: 135-168 (NY Botanical Garden, Bronx, NY 10458 USA).

Hopkins, H.C. 1984. Floral biology and pollination ecology of the neotropical species of Parkia. J. Ecol., 72: 1-24 (*Phyllostomus discolor*; Pteropodidae: Botany Sch., Oxford University, South Parks Rd., Oxford).

Kubik, J., H. Leniec and W. Sitkowski. 1984. Analysis of the mammal fauna of the Lublin coal basin based on owl pellets. Acta Theriol., 29: 167-173 (Inst. Biol., M. Curie-Sklodowska, Univ. Akademicka 19, 20-33 Lublin, Poland).

Luang, W., and X. Huang. 1982. The seasonal activity of *Pipistrellus abramus* in relation to environmental factors. Acta Theriol. Sin., 2: 143-154 (Biology, Fudan Univ., China).

Palmeirim, J. 1985. The influence of man-made trails on foraging by tropical frugivorous bats. Biotropica, 17: 82-84 (Univ. Kansas, Mus. Nat. Hist., Lawrence, Kansas 66045 USA).

Rodriguezduran, A. 1985. Seasonal predation by merlins on sooty mustached bats in western Puerto Rico. Biotropica, 17: 71-74 (Boston Univ., CTR Biol. Sci., Boston, MA 02215 USA).

Romero, A. 1985. Cave colonization by fish-role of bat predation. Amer. Midl. Nat., 7-12 (Univ. Miami, Dept. Biol., POB 249118, Coral Gables, Florida 33124 USA).

Slater, J.A. 1983. On the biology of cave inhabiting Antillocorini with the description of a new species from New Guinea (Hemiptera, Heteroptera, Lygaeidae). J. N. Y. Entomol. Soc., 91: 424-430 (Bat Biology; Sec. Syst. & Evol. Biol., Univ. of Connecticut, Storrs, CT 06268 USA).

Warner, R.M. 1985. Interspecific and temporal dietary variation in an Arizona bat community. J. Mamm., 66: 45-51 (Univ. California, Mus. Vert. Zool., Berkeley, CA 94720 USA).

Whitaker, J.O., and P. Quentin. 1983. Food habitats of the hoary bat *Lasiurus cinereus* from Hawaii USA. J. Mamm., 64: 151-152 (Dept. Life Sci., Indiana State Univ., Terre Haute, IN 47809 USA).

Williams, J.A. 1983. A chiropteran analog for primate dietary adaptation. Am. J. Phys. Anthropol., 60: 271 (Abstract; Univ. North Dakota, Grand Forks, North Dakota, USA).

FOSSIL RECORD

Krishtalka, L., and R.K. Stucky. 1984. Middle Eocene marsupials (mammalia) from northeastern Utah, USA and the mammalian fauna from Powder, Washington. Ann. Carnegie Mus. 53: 31-45 (Chiropteran description; Carnegie Mus. of Nat. Hist., 4400 Forbes Ave., Pittsburgh, PA 15213 USA).

Topal, G. 1983. New and rare fossil mouse-eared bats from the middle Pliocene of Hungary (Mammalia, Chiroptera). Fragm. Mineral Paleontol., O: 53-54 (Zoology, Hungarian Nat. Hist. Mus., H-1088 Budapest, Baross U. 13, Hungary).

GENETICS AND EVOLUTION

Arnold, M.L., R.J. Baker and R.L. Honeycutt. 1983. Genic differentiation and phylogenetic relationships within 2 New World bat genera. Biochem. Syst. Ecol., 11: 295-304 (Dept. Population Biol., Res. Sch. Biol. Sci., Australian National Univ., PO Box 475, Canberra City, A. C. T. 2601, Australia).

Baker, R.J., J.W. Bickham and M.L. Arnold. 1985. Chromosomal evolution in Rhogeesa (Chiroptera, Vespertilionidae) — possible speciation by centric fusions. Evolution, 39: 233-243 (Texas Tech Univ Museum, Lubbock, TX 79409 USA).

Grafodatskii, A.S., A.A. Isaenko and S.I. Radzhabli. 1983. Genome size in 28 mammalian species. Izv. Sib. Otd. Akad. Nauk. SSSR Ser Biol. Nauk., O: 115-119 (In Russian; Inst. Cytol. Genet., Sib. Dept., Acad. Sci. USSR, Novosibirsk, USSR).

KARYOLOGY

Ando, K., F. Yasuzumi, A. Tagawa and T.A. Uchida. 1984(?). Further study on the karyotypic evolution in the genus *Rhinolophus* (Mammalia Chiroptera). Caryologia, 36: 101-111 (Anatomy, Sch. Med., Univ. of the Ryukyus, Okinawa, Japan).

PARASITOLOGY

Cerny, V., and T. Scholz. 1983. The finding of Mallophaga on *Pipistrellus kuhli* (Chiroptera). Folia Parasitol. (Prague), 30: 268 (Inst. Parasitol., Czech. Acad. Sci., Prague).

Emerson, K.C., and R.D. Price. 1981. A host parasite list of the Mallophaga on mammals. Misc. Publ. Entomol. Soc. Am., 12: 1-72 (560 Boulder Dr., Sanibel Island, FL 33957 USA).

Fain, A., F.S. Lukoschus and M. Nadchatram. 1982. The genus *Teinocoptes* (Acari, Astigmata, Teinocoptidae) in Malaysia and Indonesia. Description of 3 new species. Bull. Ann. Soc. R. Belge Entomol., 118: 73-79 (Inst. Med. Tropicale, 155 Nationalestr., B-2000 Antwerpen, Belgium).

Gardner, R.A. 1983-84. Blood parasites of British bats. Myotis, 21-22: 185-189.

Goff, M.L. 1984. A new species of *Sasatrombicula* (Acari, Trombiculidae) from a horseshoe bat *Rhinolophus ferrumequinum* collected in Korea. Int. J. Acarol., 10: 23-26 (Entomology, Univ. of Hawaii at Monoa, Gilmore Hall, 3050 Maile Way, Honolulu, Hawaii 96822 USA).

Goff, M.L., J.O. Whitaker, Jr., and L.J. Barkley. 1984. *Loomisia peruviensis* new species (Acari, Trombiculidae) from a Peruvian bat. J. Med. Entomol., 21: 80-81.

Haas, G.E., A.J. Beck and P.Q. Tomich. 1983. Bat fleas Siphonaptera (Ischnopsyllidae) of California, USA. Bull. South Calif. Acad. Sci., 82: 103-114 (557 California St., No. 7, Boulder City, Nevada 89005 USA).

Hadi, T.R., S. Sarbini and R.J. Brown. 1983. Small mammalian ectoparasites from the mount Bromo area, East Java, Indonesia. Southeast Asian J. Trop. Med. Pub. Hlth., 14: 422-425 (Ecol. Div., Natl. Inst. Hlth. Res. Div., Percetaken Negara 1, Jakarta, Indonesia).

Haitlinger, R., and A.L. Ruprecht. 1982. *Spinturnix acuminatus* (new sp., Acarina, Spinturnicidae) a new mite species for the fauna of Poland. Przegl. Zool., 26: 171-172 (Katedra Zool., AR, UL. Cybulskiego 20, 50-205 Wroclaw).

Paterson, W.B., and P.T.K. Woo. 1983. An ultrastructural study of the culture forms of *Trypanosoma myoti*. Can. J. Zool., 61: 2807-2815 (Zoology, Univ. Guelph, Guelph, Ont. Canada N1G 2W1).

Rausch, R.L., and V. R. Rausch. 1983. *Maseria vespertilionis*, new genus, new species, (Dorylaimina, Muspiceidae), a nematode from Nearctic bats (Vespertilionidae). Ann. Parasitol. Hum. Comp., 58: 361-376 (Div. Anim. Med. SB-42, Sch. Med., Univ. Washington, Seattle, WA 98195 USA).

Rybin, S.N. 1983. Gamasid mites of Chiroptera and their habitats in the southern Kirgiz-SSR USSR Gamasina. Parazitologiya (Leningrad), 17: 355-360 (Omsk Obl. Sanit-Epidemiol. Stn., Omsk, USSR).

Sawada, I. 1985. A survey on bat cestodes from Thailand with descriptions of six new species. Zoological Sci., 2: 271- (Nara Univ., Dept. Biol., Nara 630, Japan).

Sawada, I., N. Kagei and W.C. Lee. 1983. Helminth fauna of bats on Cheju island, Korea. Zool. Mag. (Tokyo), 92: 164-167 (Biol. Lab., Nara Univ. Education, Nara 630, Japan).

Vaucher, C. 1982. Parasitic helminths of Paraguay 3. *Atriotaenia hastati* new species (Cestoda, Linstowiidae) parasite of *Phyllostomus hastatus hastatus*. Bull. Soc. Neuchatel Sci. Nat., 105: 155-162 (In French; Museum D'Histoire Naturelle, Case Postale 284, CH-1211 Geneve 6).

Whitaker, J.O., Jr., and F.S. Lukoschus. 1982. Notes on ectoparasites and other associates of small mammals of Huntington county, Pennsylvania, USA. Proc. Pa. Acad. Sci., 56: 187-192 (Life Scs., Indiana State Univ., Terre Haute, IN 47809 USA).

PHYSIOLOGY

Bassett, J., and C. Wiederhielm. 1983. Alteration of microvascular function in the bat wing by anesthesia. Microvasc. Res., 25: 225 (Abstract; Physiology & Biophysics, Univ. Washington, Seattle, WA 98195 USA).

Bruce, D.S., M.L. Tuggy and P.J. Pearson. 1984. Summer hibernation induced in ground squirrels (*Citellus tridecemlineatus)* by urine or plasma from hibernating bats (*Myotis lucifugus* or *Eptesicus fuscus*). Cryobiology, 21: 371-374 (Wheaton College, Dept. Biol., Wheaton, IL 60187 USA).

Chen, I.L.H. 1983. A mathematical representation for vessel networks. 2. J. Theor. Biol., 104: 647-654 (Dept. Physiology & Biophysics, LA State Univ. Med. Ctr., Shreveport, LA 71130 USA).

Chen, I.L.H., and J.N. Diana. 1984. A method to obtain volumetric blood flow and red cell velocity in the microvascular network. Microvasc. Res., 27: 379-384.

Fleming, B.P. 1983. Myogenic reactivity of arterioles in the denervated bat wing. Microvasc. Res., 25: 234 (Abstract; Physiology & Biophysics, LA State Univ. Med. Ctr., Shreveport, LA 71130 USA).

Gustafson, A.W., and D.A. Damassa. 1985. Repetitive blood sampling from small peripheral veins in bats. J. Mamm., 66: 173-177 (Tufts Univ., Sch. Med., Dept. Anatomy & Cellular Biol., Boston, MA 02111 USA).

Pettigrew, J.D., R. Coles, A. Guppy, M. Brown and J. Nelson. 1983. Sensory abilities of the Australian ghost bat, *Macroderma gigas*. Neurosci. Lett., Suppl. 11, S 68 (Abstract; National Vision Res. Inst., Carlton).

REPRODUCTION

Bassett, J.E. 1984. Litter size and postnatal growth rate in the pallid bat, *Antrozous pallidus*. J. Mamm., 65: 317-319 (Physiology & Biophysics, SJ-40, Univ. Washington, Seattle, WA 98195 USA).

Gustafson, A.W., D.A. Damassa and G.G. Kwiecinski. 1984. Plasma sex steroid binding protein in the little brown bat *Myotis lucifugus lucifugus* and Djungarian hamster *Phodopus sungorus:* identification and temporal variations in males from birth through puberty. Biol. Reprod., 30 (Suppl. 1), 161 (Abstract; Anatomy & Cellular Biol., Tufts Univ. Sch. Med., Boston, MA 02111 USA).

Nunez, E.A., and M.D. Gershon. 1983. Thyrotropin induced thyroidal release of 5 hydroxytryptamine an accompanying ultrastructural changes in parafollicular cells. Endocrinology, 113: 309-317 (*Myotis lucifugus;* Anatomy & Cell Biology, Columbia Univ. College of Physicians & Surgeons, 630 West 168th St., New York, NY 10032 USA).

Oh, Y.K., T. Mori and T.A. Uchida. 1985. Prolonged survival of the Graafian follicle and fertilization in the Japanese greater horseshoe bat, *Rhinolophus ferrumequinum nippon*. J. Reprod. Fertil., 73: 121-126 (Reprint: T.A. Uchida, Kyushu Univ., 46-06, Fac. Agr. Zool. Lab., Fukuoka 812, Japan).

SYSTEMATICS

Brosset, A. 1984. Bats of the Mount Nimba high altitude (Guinea). Description of a new species, *Hipposideros lamottei*. Mammalia, 48: 545-556 (Mus. Nat. Hist., 4 Ave Petit Chateau, F-91800, Brunoy, France).

Hackethal, H. 1983. Uber die Variabilitat der Wasserfledermaus, *Myotis daubentoni* (Leisler, 1819) in der DDR und ihre Abgrenzung gegenuber *M. nathalinae* Tupinier, 1977 (Chiroptera, Vespertilionidae). Mitt. Zool. Mus. Berlin, 59: 11-21 (English summary).

Hanak, V., and I. Horacek. 1983-84. Some comments on the taxonomy of *Myotis daubentonii* (Kuhl, 1819) (Chiroptera, Mammalia). Myotis, 21-22: 7-19.

Kock, D., and I.A. Nader. 1984. *Tadarida teniotis* (Rafinesque, 1814) in W Palaearctic and a lectotype for *Dysopes rupelii* Temminck, 1826 (Chiroptera: Molossidae). Z. Saugetierk., 49: 129-133.

Koopman, K.F. 1984. Taxonomic and distributional notes on tropical Australian bats. Amer. Mus. Novitates, 2778: 1-48 (Dept. Mammalogy, American Museum of Natural History, New York, NY, USA).

Mclellan, L.J. 1984. A morphometric analysis of *Carollia* (Chiroptera, Phyllostomidae). Amer. Mus. Novitates, 2791: 1-35.

Smith, J.D., and C.S. Hood. 1984. Genealogy of the New World nectar feeding bats [illegible] Griffiths. Sys. Zool., 33: 435-439 (California State University Fullerton, Dept. Biology, Fullerton, CA 92634 USA).

THESES, DISSERTATIONS

Dolan, P.G. 1983. Systematics of Middle American mastiff bats (*Molossus*). Diss. Abstr. Int., B., Sci. Eng., 44:73.

Kwiecinski, G. 1984. Some factors regulating skeletal homeostasis in the little brown bat, *Myotis lucifugus*, with particular reference to pregnancy and lactation. Diss. Abstr. Int., B., Sci. Eng., 44: 3682.

Robbins, L.W. 1984. Evolutionary and biogeographical relationships in the family Emballonuridae (Mammalia: Chiroptera). Diss. Abstr. Int., B., Sci. Eng., 44: 3684-3685.

Summers, C.A. 1983. Acoustic orientation in the megachiropteran bat, *Rousettus*. Diss. Abstr. Int., B., Sci. Eng., 44: 721.

Wenstrup, J.J. 1983. Echolocation of moving targets by fish-catching bats. Diss. Abstr. Int., B., Eng., 44: 722.

BOOKS

Gotch, A.F. 1979. Mammals — Their Latin names explained. A guide to animal classification. Blandford Press, Poole, England.

Willig, M.R. 1983. Composition, microgeographic variation, and sexual dimorphism in Caatingas and Cerrado bat communities from Northeast Brazil. Bulletin of Carnegie Museum of Natural History. No. 23, 131 pp., 8 figs., 29 tables. Price $14. Order from Carnegie Mus. Nat. Hist., 4400 Forbes Ave., Pittsburgh, PA 15213 USA. (Texas Tech Univ., Lubbock, TX 79409 USA).

MAMMALIAN SPECIES

Herd, R.M. 1983. *Pteronotus parnelli*. Mamm. Spec., 209: 5 pp.

Swanepoel, P., and H.H. Genoways. 1983. *Brachyphyla nana*. Mamm. Spec., 206: 3 pp.

Swanepoel, P., and H.H. Genoways. 1983. *Brachyphyla cavernarum*. Mamm. Spec., 105: 6 pp.

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COVALT-DUNNING, DOROTHY, Department of Biology, West Virginia University, Morgantown, West Virginia, 26506

CRANFORD, JACK, Department of Biology, Virginia Polytechnic Institute, Blacksburg, Virginia, 24061

CRAWFORD, CPT. ROBERT, PO Box 613, Hixon, Tennessee, 37343

CREIGHTON, G. KEN, Museum of Zoology, University of Michigan, Ann Arbor, Michigan, 48104

CROSS, STEPHEN P., Department of Biology, South Oregon State College, Ashland, Oregon, 97520

CROSSNER, KENNETH A., 101 Hollywood Ave., Somerset, New Jersey, 08873

CUKIERSKI, MATTHEW J., Department of Anatomy, School of Medicine, State University of New York-Buffalo, Buffalo, New York, 14214

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DAVIS-MOBLEY, EMILY, Box 333, Wilbraham, Massachusetts, 01095

DISALVO, ARTHUR F., Bureau of Lab Services, State Board of Health, Columbia, South Carolina, 29201

DONOVAN, MARK, 107 Harrison Ave., Vincennes, Indiana, 47591

DOOD, STEVEN B., Dept. of Biological Science, Bowling Green State University, Bowling Green, Ohio, 43403

DRUECKER, JAY DEE, Department of Biology, Chadron State College, Chadron, Nebraska, 69337

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ELDER, WILLIAM H., 2105 Rock Quarry Rd., Columbia, Missouri, 65201

ELLINS, STUART R., Dept. of Psychology, California State College, San Bernadino, California, 92407

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FARNEY, JOHN, Rural Route 2, Kiowa, Kansas, 67070

FAXON, D & N, 6290-CL, P.O. Box 70, Norwood, Massachusetts, 02062

FINDLEY, JAMES S., Dept. of Biology, University of New Mexico, Albuquerque, New Mexico, 87131

FISHER, L.E., Lincoln Park Zoo, 2200 N. Cannon Dr., Chicago, Illinois, 60614

FLATH, DENNIS L., Montana State University, Box 5, Bozeman, Montana, 59717

FLEMING, BERNARD, Dept. of Physiology, Louisiana Medical Center, Shreveport, Louisiana, 71130

FLEMING, THEODORE H., Dept. of Zoology, University of Miami, Miami, Florida

FORMAN, G. LAWRENCE, Dept. of Biology, Rockford College, Rockford, Illinois, 61101

FORS, KEVIN, RR1, Fort Dodge, Iowa, 50501

FOWLER, BRAD, Coleman Lab, House 863, University of California, San Francisco, California, 94143

FREEMAN, JERRY, 1300 30th St., No. 82 15, Boulder, Colorado, 80303

FREEMAN, KRISTIN K., Box 175, Underhill Center, Vermont, 05490

FREEMAN, PATRICIA, University of Nebraska State Museum, W4 36 Nebraska, Lincoln, Nebraska, 66588

FROM, W. GENE, 1612 6th Ave., Huntington, West Virginia, 25703

GARDNER, ALFRED L., Fish and Wildlife Service, US National Museum, Washington, DC, 20560

GARDNER, JAMES E., Box 47, Edgar Star Rt., Rolla, Missouri, 65401

GARNER, JAMES D., Dept. of Conservation, 600 N. Grand Ave. W., Springfield, Illinois, 62706

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HAYS, H.A., Biology Department, Pittsburgh State University, Pittsburgh, Kansas, 66762

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KOOPMAN, KARL F., Department of Mammalogy, American Museum of Natural History, New York, New York, 10024

KOSCIUSKO, KRIS, c/o Eric Freeman, Box 125, Castleton, Vermont

KRUTZSCH, PHILIP H., Department of Anatomy, University of Arizona, Tucson, Arizona, 85724

KUNZ, THOMAS, Department of Biology, Boston University, Boston, Massachusetts, 02215

KURTA, ALAN, Department of Biology, Nazareth College, Nazareth, Michigan, 49074

KWIECINSKI, GARY, Department of Anatomy, Tufts University Medical School, Boston, Massachusetts, 02111

LACKI, MICHAEL J., Earth and Environmental Sciences, SUNY Plattsburgh, Plattsburgh, New York, 12901

LAMPE, RICHARD, Department of Biology, Buena Vista College, Storm Lake, Iowa, 50588

LANGWORTHY, MARGARET, Florida State Museum, University of Florida, Gainsville, Florida, 32611

LARSEN, S.A., 8101 Speer Lane, Crestwood, Kentucky, 40014

LAURION, THOMAS R., USFWS, Box 81, Model, Colorado, 81059

LAYNE, JAMES N., Archibold Biology Station, Box 2057, Lake Placid, Florida, 33852

LEITNER, PHILIP, Biology Department, St. Mary's College, Moraga, California, 94573

LEWIS, R.E., Department of Entomology, Iowa State University, Ames, Iowa, 50011

LEWIS, WARREN, 2225 Oxford St., Rockford, Illinois, 61103

LIDICKER, JR., W.Z., Museum of Vertebrate Zoology, University of California, Berkeley, California, 94720

LONG, GLENIS R., Department of Audiology, Purdue University, W. Lafayette, Indiana, 47907

LOOMIS, RICHARD B., Biology, California State University, Longbeach, California, 90840

MAHAN, CAROL, Department of Conservation, 600 N. Grand W., Springfield, Illinois, 62706

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MARTIN, ROBERT A., Biology, Fairleigh Dick University, Madison, New Jersey, 07940

MARTIN, ROBERT, Department of Biology, University of Maine, Farmington, Maine, 04938

MASTERS, W. MITCH, Department of Biology, University of Oregon, Eugene, Oregon, 97403

MAZO, BERNARDO, PO Box 14400, MS 543, Las Vegas, Nevada, 89114

McCARTHY, TIM, 25-30 30th Rd. 6K, Astoria, New York, 11102

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McCOY, C.J., Carnegie Museum, 4400 Forbes Ave., Pittsburgh, Pennsylvania, 15213

McCRACKEN, GARY, Department of Zoology, University of Tennessee, Knoxville, Tennessee, 37996

McDANIEL, V. RICK, Department of Biology, Arkansas State University, State University, Arkansas, 72467

McDONNELL, TIMOTHY, 743 Poplar St., Ramona, California, 92065

McFARLANE, DONALD A., Department of Mammalogy, Natural History Museum, Los Angeles, California, 90007

McHUGH, ROBERT A., Environmental Quality Laboratory, 1712 SW 11th Ave., Portland, Oregon, 97201

McMURRAY, DAVID N., Department of Med. Micro. Immunology, Texas, A&M College of Medicine, College Station, Texas, 77843

McPHERSON, A.B., Department of Biology, Centenary College, Shreveport, Louisiana, 71104

MERITT, JR., DENNIS, Assistant Director, 2200 N. Cannon Dr., Chicago, Illinois, 60614

MEYERS, PHILIP, Museum Zoology, University of Michigan, Ann Arbor, Michigan, 48109

MITCHELL, CLAY, Denver Wildlife Reserve, Federal Bldg. 16, Denver, Colorado, 80225

MITCHELL, HENRY A., College of Arts and Science, University of Missouri, Kansas City, Missouri, 64110

MLYNCZAK, B.J., 2414 Rustic Ridge Dr. Apt. 1, St. Louis, Missouri, 63114

MOHR, CHARLES E., Lake Club Apartments, B-Z6, Dover, Delaware, 19901

MOORE & ASSOCIATES, JULIE, 6130 Camino Rehl 223, PO Box 5156, Riverside, California, 92517

MORRILL, IRENE, RT 32, N. Franklin, Connecticut, 06254

MORRISON, DOUGLAS, Department of Zoology, Rutgers University, Newark, New Jersey, 07102

MORSE, SUSAN G., Department of Zoology, Boston University, Boston, Massachusetts, 02215

MORTON, PATRICIA A., 5204 Old Indian Trail, Madison, Wisconsin, 53711

MUELLER, HELMUT C., Biology, University of North Carolina, Chapel Hill, North Carolina, 27514

NEIDICH, CAROLE, Tackapausha Museum, Washington Ave., Seaford, New York, 11783

NELLER, EARL, Box 641, Honolulu, Hawaii, 96809

NELLIS, DAVID, Division of Fish and Wildlife, 101 Nazareth, St. Thomas, Virginia, 00802

OAKS, EMILY, 2 Chantel Apartments, RD 7, Oswego, New York, 13126

O'FARRELL, MICHAEL, 4241 Ridgeview Dr., Las Vegas, Nevada, 89103

OKONIEWSKI, MARIA, Box 16484, Knoxville, Tennessee, 37996

O'SHEA, THOMAS J., US Fish and Wildlife Service, Gainsville, Florida, 32611

OTTENWALDER, JOSE, Florida State Museum, University of Florida, Gainesville, Florida, 32611

OWEN, ROBERT, Department of Zoology Sutton, University of Oklahoma, Norman, Oklahoma, 73019

PAGELS, JOHN, Biology Department, Virginia Community University, Richmond, Virginia, 23284

PALMEIRIM, JORGE M., Museum of Natural History, University of Kansas, Lawrence, Kansas, 66045

PARKINSON, AIDA, Department of Biology, University of New Mexico, Albuquerque, New Mexico, 87131

PARMALEE, PAUL W., Department of Anthropology, University of Tennessee, Knoxville, Tennessee, 37916

PATTEN, DONALD, Natural History Museum, 900 Esposition, Los Angeles, California, 90007

PAWLEY, RAY, 15'506 W. 63 Rd. St., Hinsdale, Illinois, 60521

PEREZ, GERALD S.A., Duty Free Shoppers, PO Box 7746, Tamuning, Guam, 96911

PERKINS, J. MARK, 5130 S.W. Idaho, Portland, Oregon, 97221

PIERSON, ELIZABETH D., Museum of Vertebrate Zoology, University of California, Berkeley, California, 94720

PINE, RONALD H., George Williams College, 555 31st Street, Downers Grove, Illinois, 60515

QUAY, W.B., 2003 Ida St., Napa, California, 94558

QUMSIYEH, MAZIN, Biology Department, Texas Tech University, Lubbock, Texas, 79409

RABB, MARY, Library, Chicago Zoological Society, Brookfield, Illinois, 60513

RASCHIG, RALPH A., 543 Bloom Rd., Eagle River, Wisconsin, 54521

RASWEILER, IV., JOHN J., Cornell University, 1300 York Ave., New York, New York, 10021

RICHARDSON, BRUCE, Biology Department, University of Michigan, Flint, Michigan, 48503

RICHTER, ANDREAS R., 39 NW 39 Ave. 108, Gainesville, Florida, 32609

RIDEDSEL, M.L., Department of Biology, University of New Mexico, Albuquerque, New Mexico, 87131

ROBADOU, CHARLES A., 1879 North Main St., Fall River, Massachusetts, 02720

ROBBINS, BRIAN, NHB 390, Smithsonian Institution, Washington, DC, 20560

ROGERS, GEORGE, Department of Biology, Mohawk Valley Community College, Utica, New York, 13501

ROOS, CHUCK, 2930 N. Bryant St, Oklahoma City, Oklahoma, 73121

ROSENTHAL, MARK A., Lincoln Park Zoo, 100 W. Webster, Chicago, Illinois, 60614

ROST, ALAN F., Dickerson Park Zoo, 3043 N. Fort, Springfield, Missouri, 65803

ROTH, JR., STANLEY D., Science Department, Lawrence High School, Lawrence, Kansas, 66044

ROTHENBERG, JEFFREY, c/o JM Johnson Inc., 15 East St., Boston, Massachusetts, 02111

RUDD, ROBERT L., Zoology, University of California, Davis, California, 95616

RYDER, RICHARD D., Nassau County Museum, Washington Ave., Seaford, New York, 11783

SCHAEFFER, III, GEORGE, 4143 Seabreeze Dr., Jacksonville, Florida, 32250

SEALANDER, JOHN A., Zoology, University of Arkansas, Fayetteville, Arkansas, 72701

SENGER, CLYDE M., Department of Biology, Western Washington University, Bellingham, Washington, 98225

SERACH, JAMES, 7 Concord St., Ashland, Massachusetts, 01721

SHUMP, KARL, 10 Fogg Drive, Durham, New Hampshire, 03824

SIMMONS, JAMES A., Department of Biology, University of Oregon, Eugene, Oregon, 97403

SMALLWOOD, JEFFREY A., 5474 Cochise Ave., Simi Valley, California, 93063

SMILEY, DANIEL, Mohawk Lake, New Paltz, New York, 12561

SMITH, ELIZABETH, Box 408, Smithville, Ohio, 44677

SMITH, JAMES DALE, Department of Biological Science, California State University, Fullerton, California, 92634

SNYDER, DANA P., Department of Zoology, University of Massachusetts, Amherst, Massachusetts, 01003

STACK, M.H., Department of Biology, Boston University, Boston, Massachusetts, 02215

STAGER, KENNETH E., 2715 Veteran Ave., Los Angeles, California, 90064

STANGEL, PETER W., Box 41, Department of Zoology, University of Georgia, Athens, Georgia, 30602

STARRETT, ANDREW, Biology, California State University, Northridge, California, 91330

STERLING, KEIR, 324 Webster St., Bel Air, Maryland, 21014

STRICKLER, TIMOTHY, School of Health Science, Grand Valley State College, Allendale, Missouri, 49401

STROMBERG, MARK R., National Audubon Society, Box 44, Elgin, Arizona, 85611

SUTHERS, RODERICK A., Medical Sciences Program, Indiana University, Bloomington, Indiana, 47405

SVOBODA, P.L., 411 Mix Street, Oregon, Illinois, 61061

SWENSON, JON, Box 36, Rosebud, Montana, 59347

TAFT, LUCINDA, 2142 Golf Course Rd., Reston, Virginia, 22091

THOMAS, STEVEN P., Biological Sciences, Duquesne University, Pittsburgh, Pennsylvania, 15282

TIMM, ROBERT M., Division of Mammals, Field Museum, Chicago, Illinois, 60605

TIPTON, VIRGINIA, Biology Department, Radford University, Radford, Virginia, 24142

TODD, RICHARD, Arizona Game-Fish Reserve, 2222 W. Greenway, Phoenix, Arizona, 85023

TORODE, WILLIAM W., National Speleology Society, 1 Cave Avenue, Huntsville, Alabama, 35810

TRIMARCHI, CHARLES V., Veterinary Science Labs, New Scotland Avenue, Albany, New York, 12201

TRUNE, DENNIS R., Otological Research Labs, 456 Clinic Dr., Columbus, Ohio, 43210

TUTTLE, MERLIN D., Vertebrate Division, Milwaukee Public Museum, Milwaukee, Wisconsin, 53233

TWENTE, JOHN W., Biological Science, Tucker Hall, University of Missouri, Columbia, Missouri, 65211

WARD, G.L., Biology Department, Earlham College, Richmond, Indiana, 47374

WARNER, RICHARD M., Museum of Vertebrate Zoology, University of California, Berkeley, California, 94720

WEBB, JR., JAMES P., Deparment of Biology, California State University, Long Beach, California, 90840

WEISS, JACK M., 1527 Packard Avenue, Ann Arbor, Michigan, 48104

WELBOURN, W. CALVIN, OSU Acarology Lab, 484 W. 12th St., Columbus, Ohio, 43210

WHITAKER, JR., JOHN D., Department of Life Sciences, Indiana State University, Terre Haute, Indiana, 47809

WILES, GARY, P.O. Box 23367 GMF, Guam, 96921

WILLIAMS, DANIEL F., Department of Biological Sciences, Stanislaus State College, Turlock, California, 95380

WILSON, DON E., National Museum of Natural History, FWS Rm. 378, Washington, DC, 20560

WILSON, NIXON, Department of Biology, University of Northern Iowa, Cedar Falls, Indiana, 50613

WINKLEMANN, JOHN, Department of Biology, Gettysburg College, Gettysburg, Pennsylvania, 17325

WRAY, PHOEBE, Endangered Species, 175 W. Main St., Ayer, Massachusetts, 01432

YACOE, MARSHALL, 1707 A. Solomon Rd., Charlottesville, Virginia, 22901

YOUNG, DAVID B., Rt. 1 Box 99AAA, 109 Westwood, Windsor, Missouri, 65360

ZOOK, JOHN M., Zoological & Biomedical Sciences, Ohio University, Athens, Ohio, 45701

CANADIAN SUBSCRIBERS

BARCLAY, ROBERT, Box 38 RR2, Port la Prairie, Manitoba, Canada

BARON, GEORG, Dept. Biology, University Montreal, Montreal, Quebec, H3C 3J7, Canada

BLACK, JOHN, 52 Academy Rd. A 106, Westmount, Quebec, H3Z 1N6, Canada

BLEAKNEY, J.S., Biology Department, Acadia University, Wolfville, Nova Scotia, Canada

BRIGHAM, R. MARK, Department of Biology, Carleton University, Ottawa, Ontario, K1S 5B6, Canada

BROOKS, D.R., Dept. Zoology, University of British Columbia, Vancouver, British Columbia, V6T 2A9, Canada

BUCHANAN, G.D., Faculty Health Science, McMaster University, Hamilton, Ontario, L8N 3Z5, Canada

CASEY, G.A., ADRI, P.O. Box 11300 Station H, Nepean, Ontario, Canada

DOWNES, C.M., Dept. Biology, Carleton University, Ottawa, Ontario, K1S 5B6, Canada

FENTON, M. BROCK., Dept. Biology, Carleton University, Ottawa, Ontario, K1S 5B6, Canada

FULLARD, JAMES, Dept. Biology, Erindale College, Mississauga, Ontario, Canada

GRANT, PATRICIA, 52 Academy Rd., No. 106, Westmont, Quebec, H3Z 1N6, Canada

GUNSON, JOHN R., Fish and Wildlife Division, 6909 116 St., Edmonton, Alberta, Canada

HOLROYD, GEOFF, RM 1000 9942 108 St., Edmonton, Alberta T5K 2J5, Canada

KERRIDGE, DAVID C., Dept. of Biology, Malaspina College, Naniamo, British Columbia, Canada

MAYRAND, ELISE, 991 Riel, Laval, Quebec, H7C 2L4, Canada

McMANUS, REID., Memramcook, New Brunswick, E0A 2C0, Canada

NESBIT, J. ROBERT, GR P.O. Box 140 R.R.1, Whitby, Ontario, L1N 5R4, Canada

PETERSON, B.V., Entomology Research Institute, CT Experimental FA, Ottawa, Ontario, K1S 5B6, Canada

PETERSON, RANDOLPH L., Dept. of Mammalogy, Royal Ontario Museum, Toronto, Ontario, Canada

PIRLOT, P., Dept. des Sciences Biologique, Universite de Montreal, Case Postale 6128, Montreal, Quebec, H3C 3J7, Canada

ROSATTE, RICHARD C., P.O. Box 50, Rabies Research Lab, Maple, Ontario, Canada

SMITH, DONALD, Dept. of Zoology, Carleton University, Ottawa, Ontario, K1S 5B6, Canada

SMITH, H. GH[illegible] 54 Beaverbrook Crescent, St. Albert, Alberta, Canada
STONEMAN, MIKE, Dept. Biology, Carleton University, Ottawa, Ontario, K1S 5B6, Canada
STRONG, KAREN, 916 Echo Dr., Ottawa, Ontario, Canada
THOMAS, DON, Dept. de Biologie, Universite de Sherbrooke, Sherbrooke, Quebec, Canada
THOMPSON, C.E., Dept. of Zoology, University of Alberta, Edmonton, Alberta, T6G 2E9, Canada
WOO, P.T.K., Dept. of Zoology, University of Guelph, Guelph, Ontario, N1G 2W1, Canada
WOODSWORTH, G.C., Dept. of Biology, Carleton University, Ottawa, Ontario, K1S 5B6, Canada

INTERNATIONAL SUBSCRIBERS

ADAMS, M., Inst. Med. and Vet. Science, Lab. Med. Serv., Frome Road, Adelaide, S. Australia 5000, Australia
ADVANI, R., Central Arid Zone Res. Inst., Jodhpur, 342 003, India
AGRAWAL, A., Dept. of Zoology, Aligarh Muslim University, Aligrh, U.P., India
ALLEN, V., Museum Naturale Historie, Case Postale 284, CH-1211 Geneve, Switzerland
ALLISON, F.R., 307 Vulture St., South Brisbane, Queensland 4101, Australia
ANDERSON, H., Swedish Mus. Nat. Hist., Zoology, Helgonavaegen 3, S 22362, Lund, Sweden
AZZALI, GIACOMO, Instituto di Anatomia Umana Normal, Univ. Degli Studi di Parma, 43100 Parma, Italy
BAAGOE, HANS, Zoologisk Museum, Univ. Parken 15, 2100 Copenhagen, Denmark
BABMINDRA, V.P., Lab Neurohistol A.A., Ukhtomskii Inst. Physiol., Leningrad State University, Leningrad, USSR, Russia
BALDINI P., GIANCARLO, Ceneci Vincente Mar, Apartado Pt. 14191, Caracas, Venezuela
BARNABY, HARRY, School of Zoology, Univ. New South Wales, Kensington, N.S.W., Australia
BARQUEZ, R.M., Instituto Miguel Lillo, Tucuman, Argentina
BARTON, N.H., Dept. of Genetics, University Cambridge, Cambridge CB2 3EH, England
BEHRENDT, HERMANN, 5300 Bonn 69070, West Germany
BERMANNS, W., Instituut Voor Taxonomische Zoologie, Universiteit van Amsterdam, Amsterdam, Holland
BERNARD, R.T.E., Dept. Zoology-Entomology, Rhodes University, Grahamstown G140, S. Africa
BERNARD, SIGE, Lab. Paleontologie, USTL, Place Bataillon, 34060 Montpellier, France
BHAT, H.R., Nat. Inst. Virology, 20, Dr. Ambedkar Road, Pune 411 001, India
BHATIA, D., Dept. of Zoology, Inst. of Science, Nagpur, India
BROSSET, A., Mus. Nat. Hist., 4 Ave. Petit Chateau, F-91800 Brunoy, France
BURDA, H., Czechoslavak. Acad. Sci. Inst. Exptl. Med., U. Nemocnice 2, CS-12808 Praha 2, Czechoslavakia
CABEZUDO, LUCIA M., Servico de O.R.L., Centro Especial Ramon y Cajal de la S.S., Carretera de Colmenar, Km 9100, Madrid 28034, Spain
CHAKRABORTY, A.K., University of N. Bengal, Ctr. of Life Science, Immunol. & Cell Biol. Lab., Darjeeling 734 430, India
CHANDRASHEKARAN, M.K., Dept. of Biology, Madurai Kamraj. University, Madurai, 625 021, India
CRUCITTI, P., Instituto di Zoologia, Dell' Universita 32, 00100 Roma, Italy
CZECZUGA, B., Med. Acad. Bialystok, Dept. Biolo., Kilinskego 1, PL-15230, Bialystok, Poland
DANIEL, M.J., Ecol. Division, DSIR, Priv. Bag, Lower Hutt, New Zealand
DEGN, H.J., Skolevej 44, 6950 Ringkobing, Denmark
DEJONG, N., Inst. Taxonomische Zoologie, Afdeling Mammalia, Plantage Kerklaan 36, 1018 CZ, Amsterdam, Netherlands
DESHMUKH, B.G., Dept. Zoology, Shivaji University, Vidyanagar, Kolhapur, India
DUNLOP, I.M., Hull Health Authority, Hull HUZ 8TD, England
ELGADI, AHMED, P.O. Box 13411, Al Fateh University, Tripoli, Libya
FAVEAUX M. ANCIAUX de, BP 228, Recette Principale, Constantine, Algeria
FUNAKOSHI, K., Dept. Anat. Faculty Med., Kyushu University, Fukuoka, Japan
GAISLER, JIRI, Dept. Biology, Purkyne University, Bruno, Czechoslovakia
GAUR, B.S., Dept. Zoology, University Jodhpur, Jodhpur 34200, India
GEBHARD, Jurgen, Museum of Natural History, Augustinergasse 1, CH 4001 Basel, Switzerland
GOPALKRISHNA, A., 39 Vijayanagar, Chadni Nagpur MS, 440013, India
HARMATA, W., Institute of Environmental Biology, Jagellonian University, 30-060 Krakow, ul. M. Karasia 6, Poland
HELVERSEN, OTTO U., Zoologisch Institut, Universit Erlangen, Bismarckstrasse 10, Erlengen, West Germany

HERD, R., Dept. of Zoology, University New South Wales, Kensington 2033, Australia

HERD, ROBERT M., Research Station, Private Mail Bag 19, Trangie 2823, Australia

HERNANDEZ, CORNELIO SANCHEZ, Instituto Biologia, Dept. of Zoologica, Laboratorio de Mastozoologia, Apdo. Postal 70-153 CP, 04510 Mexico D.F., Mexico

HOWELL, K.M., Box 35064, Dar Es Salaam, Tanzania, Africa

HOPKINS, HELEN C., Masons Arms, Hutton Roof, Via Carnforth, Lancashire LA6 2PE, England

JANAIAH, C., Dept. Zoology, University College — Kakatiya Univ., Viduaranyapuri, Warangal 506 009, India

JIMENEZ, G. ARTURO, Dept. Biologia, Univ. Aut. Nuevo Leon, Monterrey, Mexico

KARIM, KAMAR BANU, Noorain, second floor, Samiullah Khan Marg., Sadar Bazar, Nagpur 440001, India

KASHYAP, S.K., Dept. Zoology, University Saugor, Saugor, India

KRAPP, FRANZ, Zool. Forschungsinst, Adenauerallee 150, D-5300 Bonn, West Germany

KRZANOWSKI, ADAM, Polish Academy of Science, Stawkowska 17, Krakow, Poland

LAVAL, RICHARD, Apartado 10165, San Jose, Costa Rica

LINA, P.H.C., Titus Brandsmastraat 75, 2286 RC Rijswijk, The Netherlands

LOPEZ-FORMENT, WILLIAM, Inst. Biologica, U.N.A.M., AP Postal 70-153, Distrito Federal 20, Mexico

LUMSDEN, LINDA, P.O. Box 137, Heidelburg, Victoria, 3084, Australia

MAEDA, KISHIO, Department of Anatomy, Gifu College of Dentistry, 1851 Takano, Japan

MARIMUTHU, G., Department of Animal Behavior, School of Biological Sciences, Madurai Kamaraj University, Madurai, 625-021, India

MARSHALL, Dr. A.G., Department of Zoology, University of Aberdeen, Aberdeen AB9 2TN, Scotland

McCOY, MARIA, P.O. Box 3 U. NE. Union, Armidale New South Wales 2351, Australia

MEDELLIN, RODRIGO, Instituto Biologia, Univ. Nac. Auton. Mex., AP Postal 70-153 04510 Distrito Federal 20, Mexico

MENU, M. HENRI, Rue Grands Clos, Cauroy Les Hermonviue, 51220 Hermonviue, France

MOLINARI, J., Apartado 384, Merida 5101, Venezuela

MORGAN, MRS. S., Cambridge Jackson Lt., P.O. Box Birmingham B5 48T, England

MUTERE, FESTO, Faculty of Science, Kenyatta University, Nairobi Kenya

MYERS, NORMAN, Upper Meadow Old Road, Headington Oxford, Great Britain

NADAR, IYAD, P.O. Box 557, Abha, Saudi Arabia

NAVARRO, DANIEL, Estacion Nat. Aut. Me., Apartado Ptl. 51, Catemaco, Veracruz, Mexico

NELSON, JOHN, Zoology Department, Monash University, Clayton, Victoria, Australia

NERONOV, V., USSR MAB Committee, Leninsky Prospect 33, Russia

NEUWEILER, G., Zoological Institute University, Luisenstrasse 14, D-8000 Munich 2, West Germany

NORBERG, U.M., Dept. of Zoology, 400 31 Goteberg, Sweden

OKEN, EYO E., Department of Biology, University of Ife, Ife Ife, Nigeria, Africa

O'SHEA, JAMES, Department of Zoology, University of Melbourne, Parkville, Victoria, Australia

PAGLIUSI, I.F., Museu Zoologia,, Univ. Sao Paulo, CP 7172 Sao Paulo, Brasil

PARNABY, HARRY, School of Zoology, University of New South Wales, Kensington, N.S.W. Australia 2033

PETERSON, NORMAN E., OPAS/OMS Caixa Post, 04 0229, 70000 Brasilia, Brasil

PYE, J. DAVID, School of Biological Sciences, Queen Mary College, Mile End Rd., London, E1 4NS, United Kingdom

RANSON, ROGER D., 14B Dursley Road, Dursley, Gloucester, England

RACEY, PAUL, Zoology Department, University Aberdeen, Aberdeen, Scotland

REDDY, M.R.G., Department of Zoology, Kakatiya University, Warangal, India

ROER, HUBERT, Museum Koenig Bonn, Adenauerallee 160, 5300 Bonn 1, West Germany

RUIZ, B. FERNANDEZ, Dept. Morfologia Micr., Facultad de Ciencias Biologicas, Universidad Complutense, 28040 Madrid, Spain

SCHMIDT, UWE, Zoological Institute, Poppelsdorfer Schloss D-5300, Bonn 1, West Germany

SCHNITZLER, HANS-ULRICH, Institut fur Biology III, auf der Morgenstelle 28, D-7400, Tubigen, West Germany

SLATER, F.M., UWIST, Newbridge on Wye, Llandrindod Wells, Powys, Wales, United Kingdom

SWANEPOEL, P., Kaffranan Museum, King Williamstown 5600, South Africa

THOMAS, MAURICE, International Ct. Med. Res., Universidad 5390, Cali, Columbia

TRINGALI, LUCA, Via Agostino Richelny 8.00165 Roma, Italy

VILLA-R, BERNANDO, Priv. San Lucas 9, Coyoacan 21 DF, Mexico City, Mexico

VOUTE, ALDO M., University of Ulrecht, Plompet Gracht 9, Utrecht, Holland
WILLIAMS, JOHN G., 14 Tyne Rd., Oakham, Rutland, Leics., LE15 6SJ, England, United Kingdom
WINGATE, LLOYD, Kaffrarian Museum, P.O. Box 1434, King Williamstown 5600, South Africa
WOODSIDE, DEDEE, Tarong Zoo, P.O Box 20, Mosman, N.S.W., 2088 Australia
WU, Q., Acad. Scinica, Inst. Biophyst., Peking, Peoples Rupublic of China
YOSHIDA, M., Fujita Gakven Univ., Sch. Med., Dept. Anat., Toyoake, Aichi 47011, Japan
YOUNG, R.A., Darling Downs Institute, Toowoomba, Queensland 435, Australia

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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

Past Editors

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BAT RESEARCH NEWS

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BAT RESEARCH NEWS

Volume 26 November 1985 No. 4

The Seventh International Bat Research Conference at Aberdeen, Scotland

G. Roy Horst
Department of Biology, State University College of Arts and Science
Potsdam, N.Y. 13676

The Seventh International Bat Research Conference and conjoined Third European Bat Research Symposium met on August 19 through 24, 1985 at the University of Aberdeen in Aberdeen, Scotland. The abstracts of the presented papers and posters are included in this issue and convey the extraordinary breadth of interest in the Chiroptera around the world. Even casual examination of these abstracts reveals the generally high level of excellence reached by investigators of bat biology in many countries. What these abstracts cannot possibly portray is the scientific fellowship and personal comradship enjoyed by the attendees.

It was wonderful and reassuring that in these times of tension and competition between nations biologists from many countries did for one happy week become neighbors. Needless to say all of us now have many new friends in far away places.

We were welcomed on Monday the 19th by Paul and Adrian and their many able and friendly assistants, shown to the bar and toasted by true Scots, in proper Scottish fashion, with proper scotch whiskey.

The formal programme opened with a welcoming address by Dr. G. M. Dunnet, the Dean of the Faculty of Science at University of Aberdeen. Not only did he wish us a successful and rewarding conference, he also delivered to us excellent facilities and a splendid and enthusiastic team whose efforts guaranteed success.

The presentations by the graduate students were especially good and assure us that the future of research in bat biology is in strong and capable hands. Each of these papers was very carefully prepared and delivered with such style (often in the speaker's second or third language!) as to make many of us elder figures both envious in their ability and proud of their achievements. Mark Brigham of Carleton University in Canada truly deserved the Bat Research News Award for the best paper delivered by a graduate student, but to be truly fair, we would have needed several more awards.

The poster displays were literally overwhelming in their diversity. All were informative, most were also entertaining, many were artistically pleasing as well. Our congratulations to John Zook of Ohio University, U.S. for his exhibit which won the University of Aberdeen Department of Zoology award for excellence in a visual presentation.

The Business Meeting in Friday began with a eulogy to the late William Wimsatt, a great figure in Chiroptology who is sorely missed by all of us. The meeting closed with a lively discussion of the location of the Eighth International Bat Conference, Australia ultimately chosen as our host country.

The conference had no disappointing moments, in fact a few incidents were so memorable that they bear repeating, not only to inform those who were not there of what great things they missed, but also because it pleasures those of us who participated to relive those wonderful experiences.

How can we ever forget the tender loving care that goes into the making of *real* whiskey after

that evening tour of the distillery. Just to see George Pollak practically fall into a vat of several thousand gallons of fermenting brew was worth the fare to Aberdeen. And none of us on the now infamous tour will ever forget the salty, irrascable, but ultimately warm and lovable driver of our coach.

Who can forget the sweet smile of the barmaid in the dormitory lounge as she slammed down the shutters of the bar at "closing time" with finger-smashing finality. Much to her credit, each evening's closing time was later than the one before and the portions she served were as generous as a true Scottish heart could allow.

It was indeed a thrill for those of us from the colonies (England included) and abroad to be piped to dinner in true highland fashion, even though we all dreaded being served haggis. And how thoughtful it was of Paul to tell us all how to act, where to sit, when to rise, etc., beforehand so we would not feel awkward or strange during the delightful pre-dinner ceremonies.

And how wonderful to see Paul, ever in control, drinking that magnificent and enormous bowl of scotch and then sharing the refill with us all; truly he is a jolly good fellow. None of us yet know how he managed to have the Canadian delegation line up on the stage of venerable Crombie-Johnston Hall and demonstrate that "even though the sun may have set on the old Empire, the moon still rises on Britannia."

We do have a few suggestions for our future hosts in Australia. Have at least one dozen ice cubes available in the country that week; force the kitchen staff to share our food; have a few double bedrooms for those who bring spouses(?) or those who like to entertain; provide a finer grit of sand paper in the W.C. than was available in Aberdeen; require all papers to be in English or some other recognized language and not in American; and finally, have the Canadians form a straighter line next time and sing "Oh, Canada" during their performance.

It will be difficult to exceed the quality and spirit of the Aberdeen Conference, but surely the eighth conference in Australia will be just as enjoyable and rewarding as the seventh in Aberdeen. Until then, we invite all of you to join us in October 1986 at our sixteenth annual bat symposium in North America.

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.

NEWS & VIEWS

LETTERS TO THE EDITOR

TIMBER USED AS FOOD BY BATS

Gnawing into wood has been rarely recorded for bats (Allen, 1940: 109; Rosevear, 1965: 75; Daniel, 1979: N.Z.J. Zool., 6, 357). Yet, nowhere bats are regarded as being explicite wood eaters thereby being a source for serious economical losses.

Malagnoux and Gautun's article "An enemy of *Araucaria* plantations in the Ivory Coast" contains five good quality photos. The summary, in part, reads: "Attacks by bats (fox-bats) on *Araucaria cunninghamii* and *A. heterophylla* were observed during long dry seasons . . . in the Ivory Coast. These were systematic attacks for the purpose of seeking food, and were sufficiently serious to compromise the future of plantations of these species. Furthermore, the adaptations of these animals to these introduced species leads to the fear of a similar adaptation to pines (notably *Pinus caribaea*) which are destined for large-scale development in view of the setting up of plantations for papermaking purposes in the southwest of the Ivory Coast." Other excerpts from this article in my translation read: "The trees . . . are literally devoured by bats. The bark, leaves and even the wood are being gnawed. The attack begins at the top and progresses downwards; consequently, some trees, eight to twelve meters tall are being gnawed down to one meter above the ground. More often, girdling and scratching of the stem takes place which results in the desiccation and death of the tree. The bats wait until the tree reaches a height of about four meters because it then exceeds the neighboring vegetation and the houses in height. Similar attacks on trees have been recorded in Ghana." The culprit is *Eidolon helvum* (Pteropodidae).

Adam Krzanowski, Institute of Zoology,
Slawkowska 17, 31-016 Krakow, Poland
Received August 8, 1985

LARGE-SCALE DIE-OFF OF BATS IN NORTHERN ALBERTA, CANADA

On Friday, August 2, 1985, over 1000 dead bats were found floating face-down on the surface of Steele Lake, approximately 150 km north of Edmonton, Alberta. At least 24 dead ducks were also found. All carcasses were localized in an area approximately 300m x 150m on the windward shore of the lake. The water in this area was covered with thick, white scum and had a noticeable blue-green sheen. Unfortunately, only six *Myotis* spp., one *Lasiurus cinerus*, and two *Anas platyrhynchos* were collected. Post-mortum examination indicated very acute death with no visible lesions or indications of trauma or disease. The "rapid death factor" of *Anabaena* sp. was indentified in high concentrations in green slime taken from the bat carcasses. Results suggest poisoning due to toxins of blue-green algae as the probable cause of death. Presumably, the bats ingested lethal amounts of toxin while drinking from the lake.

Submitted by M.J. Pybus, Rabies Biologist, Alberta Fish and Wildlife Division, O.S. Longman Building, Edmonton, Alberta T6H 4P2.
Received October 1, 1985

WORKSHOP ON SYSTEMATICS

Individuals interested in participating in a workshop on "Higher Classification of Bats" are invited to submit titles to the undersigned before June 1, 1986. 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 but below the ordinal level are welcome. It is intended that this special session be devoted to advancing understanding and discussion of the sytematics 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

ENDANGERED SPECIES WORKSHOP

The Oklahoma Cooperative Fish and Wildlife Research Unit at Oklahoma State University is interested in sponsoring a workshop on methods of studying sensitive species of bats. It is anticipated that emphasis will be placed on technologies in bat detection, telemetry (particularly for small species), and survey methods for establishing population status and trends. The goal of the workshop will be to provide state and federal resource managers with the knowledge of techniques and options for planning recoveries of

threatened and endangered bats, such as the Ozark and Virginia big-eared bats (*Plecotus townsendii ingens* and *P. t. virginianus*). We plan to assemble a panel with expertise in the areas mentioned above, and the workshop is tenatively planned for spring 1986, **if** sufficient interest exists. People interested in attending or participating as a workshop speaker should contact Dr. David M. Leslie, Jr., Oklahoma Cooperative Fish and Wildlife Research Unit, Department of Zoology, Oklahoma State University, Stillwater, OK 74078 (Phone 405-624-6342 or FTS 728-4440).

Received October 15, 1985

GRADUATE RESEARCH ASSISTANTSHIP

ENDANGERED SPECIES RECOVERY

It is anticipated that a research assistantship for a Ph.D. candidate will be available through the Oklahoma Cooperative Fish and Wildlife Research Unit in the Department of Zoology, Oklahoma State University. Research will focus on the recovery objectives for the Ozark big-eared bat, an endangered subspecies that occurs in isolated locations in eastern Oklahoma and western Arkansas. Objectives will include examination of habitat use with electronic bat detection devices, possible application of radio-telemetry, and surveys.

Experience with bat research is desirable; strong interest in endangered species and familiarity with recovery objectives is necessary.

SALARY: The successful candidate will receive an annual stipend of $7,800, and out-of-state tuition will be waived.

STARTING DATE: August 1, 1986

Interested persons should send a letter of intent and resume to:

Dr. Tracy Carter, Department of Zoology, Oklahoma State University, Stillwater, OK 74078 (405) 624-5555

or

Dr. David M. Leslie, Jr., Oklahoma Cooperative Fish and Wildlife Research Unit, 404 Life Sciences West, Oklahoma State University, Stillwater, OK 74078 (405) 624-6342; FTS 728-4440

Received October 31, 1985

1981 BAT CONFERENCE PROCEEDINGS AVAILABLE

Limited copies of the proceedings of the Sixth International Bat Research Conference held at the University of Ife, Nigeria in August 1981 are available in U.S. $40.00 per copy including postage. Please write to Professor Eyo E. Okon, Zoology Department, University of Ife, Ife-Ife, Nigeria.

BOOK REVIEWS

NEW BOOK

Mendez, Eustorgio. Indentification de los grupos (familias y subfamilias) de murcielagos Panamenos. Escuela de Biologia, Universidad de Panama; Laboratorio Commemorativo Gorgas, Vicerrectoria de Investigacion y Postgrado, Universidad de Panama. 24 pp., no date. Soft cover. In Spanish.

The booklet presents keys and illustrations of the major bat groups in Panama which harbors bats belonging to 10 families, 42 genera, and about 105 species. This booklet was prepared for biology students and veterinarians. In addition to the keys, to family and subfamily levels, and a list of references, there are line drawings of 15 species.

Fenton, M.B. **Just Bats.** University of Toronto Press, Toronto, Canada. 165 pp., 1983 (corrected printing, 1984). $10.00. (paper)

Intended for general readers, Brock Fenton's book, **Just Bats**, is a lively, up-to-date summary of the present state of knowledge about the biology of bats. While the exclusive use of common names in the text and the lack of literature citations undoubtedly make for easier reading by non-biologists, unobtrusively including references to key papers would have greatly increased the value of the book for many. Common and scientific names are cross-referenced by family in an appendix. The book is well illustrated with many black and white photographs, line drawings, and a few graphs. The illustrations have informative captions but are not numbered or referred to in the text, a situation that makes the presentation unnecessarily disconnected in places.

The book has 17 (unnumbered) chapters, beginning with an Introduction that covers anatomical adaptations and taxonomic diversity. Here, as throughout, Fenton provides examples of his points with bats from many parts of the world. The introductory chapter closes with a brief review of many of the methods now being employed to study bats, valuable background for general readers. In the second chapter, *Flight*, Fenton presents an interesting comparison between the flight adaptations of bats and birds. Although generally a very lucid explanation, this chapter dives too deeply into aerodynamics for most general readers without first explaining the basics of the wingbeat cycle. Beginning with the mandatory historical review, the next chapter, *Echolocation*, clearly explains how the variations observed in the echolocation systems of various

species of bats are designed to solve problems encountered by bats with desparate lifestyles. The chapter includes some interesting notes about species with audible echolocation calls and the anti-bat tactics used by some moths. Following this, a short chapter on *Seeing and Smelling* dispells the notion that bats are blind and emphasizes the importance of olfaction in several aspects of bats' lives.

Fenton's recurrent themes of diversity among, and flexibility within, species is prominent in the relatively long chapter on *Diet*. Here, the range of food items bats consume is reviewed by examining each food type, and adaptations to these types are illustrated with a cross-section of the world's bat fauna. In the section on blood as food, Fenton suggests that applying paste-like poison to vampires will kill only "guilty" bats, but this seems questionable in that common vampires may share their roosts with other ("innocent") species. It is also unfortunate that in his discussion of frugivorous bats, Fenton contributes (unintentionally, no doubt) to the "bad press" bats generally receive by describing the destruction of cash crops without mentioning the beneficial role fruit bats play in seed dispersal and cleaning up of over-ripe cash crops. The next chapter, entitled *Energy and Survival*, synthesizes much research on thermoregulation in summer and winter and includes information on aestivation in tropical climates. Although distinguishing features of torpor and hibernation are scattered throughout this chapter, general readers are likely to become confused about these terms, especially because the first comparison of them states that, "Torpor over a long period is called hibernation" (page 70).

Fenton livens things up in his introduction to the chapter on *Roosts* with a description of crawling through a warhog tunnel in search of roosting bats. Morphological and behavioral adaptations to day roosts, night roosts, and hibernation sites are then described for several temperate and tropical species. A very short chapter on *Activity* follows with discussion of the effects of rainfall and moonlight on activity away from the roost. *Migration and Navigation* includes examples of seasonal movements to hibernacula and summarizes the results of homing studies. The chapter on *Reproduction* briefly covers reproductive cycle variations, postnatal development, and mating behavior. Difficulties encountered obtaining reliable age structure data and factors influencing population levels are the main topics of the next chapter, entitled *Populations*. More detail about population level factors is then presented in short chapters on *Predation and Mortality* and *Parasites*.

Fenton devotes a relatively long chapter to *Behaviour*, in which studies of mating systems, mother-young interactions, miscellaneous communications, and swarming behavior are summarized. Chapters on *Public Health*, *Keeping Bats Out*, and *Conservation* round out the body of the book. Fenton's advice on bat-proofing buildings is particularly good. A circuit diagram of a simple bat detector is included to encourage students to conduct their own bat studies. The bibliography lists 36 publications on bat biology, seven on methods for studying bats, and eight children's books on bats. A general index is included.

Overall, *Just Bats* is an information-packed introduction to the world of bats well-suited for general readers and biologists looking for up-to-date summaries of the various realms of bat research. Graduate students should find it particularly stimulating as Fenton frequently points out fertile areas for future research. These qualities, combined with an ample sprinkling of anecdotes from Fenton's wide-ranging field experiences, make the book as enjoyable as it is informative.

Christopher D. Burnett
Illinois Natural History Survey
Received September 4, 1985

REQUEST FOR INFORMATION

I have received a grant from World Wildlife fund to spend a year in Costa Rica establishing a program of bat conservation lectures and workshops throughout the country. I would appreciate any suggestions and advice from anyone familiar with bat conservation in Latin America, concerning what I might include in my presentations. Please contact me at the address given.

Thank you,

phone: 1-608-271-0067 Patricia Morton
5204 Old Indian Trail
Madison, WI 53711

EDITOR'S ACKNOWLEDGEMENTS

The editor expresses his grateful thanks to the following colleagues who reviewed manuscripts for Volume 26 (1985) of the **Bat Research News:**

Edythe L.P. Anthony, Theodore H. Fleming, Robert L. Martin, Russell Mumford, John J. Rasweiler IV, Donald Thomas, Merlin Tuttle, and Don E. Wilson.

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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

Chakravarty, A.K., and A.K. Chakravorty. 1984. Histophysiology of the white pulp follicles and the germinal centers in spleen and lymph nodes of a bat, flying fox (Pteropus giganteus). Comp. Physiol. Ecol., 9: 197-200.

Friauf, E., and H. Herbert. 1985. Topographic organization of facial motoneurons to individual pinna muscles in rat (*Rattus raitus*) and bat (*Rousettus aegyptiacus*). J. Comp. Neur., 240: 161-170 (Univ. Tubingen, Dept. Zoolphysiol., Morgenstelle 28, D-7400 Tubingen 1, FRG).

Hermanson, J.W., and J.S. Altenbach. 1985. Functional anatomy of the shoulder and arm of the fruit-eating bat *Artibeus jamaicensis*. J. Zool., 205: 157-177.

Jimenez, L., et al. 1984. Mammary involution and fasting effect on the fine structure of the mammary gland of the pregnant *Myotis myotis*. Z. Mikrosk. Anat. Forsch., 98: 893-908 (Universidad Complutense, Biologicas, Departamento de Morphologia Microscopica, C. Universitaria, 28040 Madrid-3, Spain).

Kumar, S., and S. Ral. 1984. Neurohistology of the aortic arch of some mammals. Proc. Natl. Acad. Sci., India, Sect. B (Biolo. Sci.), 54: 41-44 (School of Biological Science, Bhopal University, Bhopal, India).

Kurten, L. 1985. Mechanorezeptoran im Nasenaifsatz der Vampirfledermaus *Desmodus rotundus* Z. Saugetierk., 50: 26-35 (In German, English summary. Zoological Inst., Poppelsdorfer Schloss, D-5300 Bonn, FRG).

Laing, R., F. Xiao and M. Wang. 1984. On the morpho-physiological indices of long-winged bat *Miniopterus schreibersii chinensis* in the period of hibernation. Acta Theriol. Sin., 4: 167-175 (Biology, Anhui Normal University, China).

Maina, J.N. 1985. A scanning and transmission electron microscope study of the bat lung. J. Zool., 205: 19-27.

Nunez, E.A., R. Payette and M.D. Gershon. 1985. The bat pituitary cleft: phasic production and release of secretory granules by microvillus cells. Anat. Rec., 213: 176-181 (Columbia University College of Phys. and Surg., Dept. Anatomy and Cell Biology, New York 10032 USA).

Ochoa, G.J., and A.F. Badillo. 1982. Caso de hiperdoncia en *Choroniscus minor* (Chiroptera — Phyllostomatidae). Acta Cient. Venezolan, 33: 428-430 (English summary).

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 (Entomology, Ohio State University, Columbus, OH 43210 USA).

BEHAVIOR

Barclay, R.M.R. 1984. Observations on the migration ecology and behavior of bats at Delta Marsh, Manitoba, Canada. Can. Field Nat., 98: 331-336 (Biology, Univ. Calgary, Calgary, Alberta T2N 1N4 Canada).

Gerell, R., and K. Lundberg. 1985. Social organization in the bat *Pipistrellus pipistrellus*. Behav. Ecol. Sociobiol., 16: 177-184.

Lord, R.D., and L. Lazaro. 1982. Patrones de actividad de murcielagos vampiros en cautiverio. An. Inst. Biol. Univ. Nac. Auton. Mexico, 52: 439-446 (English summary).

Puddicombe, R. 1985. A behavioral study of the grey-headed flying-fox, *Pteropus poliocephalus* (Megachiroptera). Macroderma 1: 14-15.

CONSERVATION

Brack, V. Jr., et al. 1984. Hibernacula of the endangered bat in Indiana. Proc. Indiana Acad. Sci., 93: 463-468.

Caubere, B., P. Goucher and J.F. Julien. 1984. A world of longevity record for a wild insectivorous bat. Rev. Ecol. Terre Vie, 39: 351-354 (*Rhinolophus ferrumequinum*; In French; c/o A. Brosset, Lab. Ecol., Museum Natl. Histoire Naturelle, 4 Ave. Petit-Chateau, F-91800 Brunoy, France).

Creevey, C. 1984. Like bats into hell. Australian Wildl., 21: 5-6 (*Pteropus* removed from protection).

Savidge, J.A. 1984. Guam: western pacific paradise lost for wildlife. Biol. Conserv., 30: 305-318 (Ecology, Ethology and Evolution, Univ. Illinois, Urbana, IL 61801 USA).

Wenner, A.S. 1984. Current status and management of gray bat caves in Jackson county, Florida. Florida Field Nat., 12: 1-6.

DISEASE AND PARASITISM

Daniel, M. and P.H. Vercammen-Grandjean. 1985. *Holubicula torocnsis* g.n., sp. n. (Acari: Trombiculidae), parasitic on the bat *Tadarida condylura* in SW Uganda. Folia Parasitol., 32: 93-94.

de la Cruz, J. and R. Abreau. 1984. Ectoparasites of Cuban bats of the Charles T. Ramsden collection. 1. Poeyana Inst. Zool., Acad. Cienc., Cuba, pp. 1-19 (Inst. Zoology, Acad. Ciencias, Cuba).

Kumari, S. and N.K. Gupta. 1984. Some trematode parasites of michrochiropteran bats in India. 1. Rev. Iber. Parasitol., 44: 1-10 (Zoology, Panjab University, Chandigarh, India).

Kumari, S. and N.K. Gupta. 1984. Two new species of trematodes from bats in India. 2. Rev. Iber. Parasitol., 44: 11-20.

Kumari, S. and N.K. Gupta. 1984. *Vesperugidendrium chandigarhensis* (new species) and *Vesperugidendrium bogdani* (new species), 2 new species of trematodes from microchiropteran bats in India. Rev. Iber. Parasitol., 44: 21-28.

Landau, I., D. Baccam, N. Ratanaworabhan, S. Yenbutra, Y. Boulard and A.G. Chabaud. 1984. New haemoproteidae, parasites of Chiroptera in Thailand. Ann. Parasitol. Hum. Comp., 59: 437-448 (Zoology-Vers. Associe au CNRS, Museum National D'Histoire Naturelle, 61 Rue Buffon, F-75231 Paris Cedex 05).

Sawada, I. 1984. Cestode fauna of cave bats in Nansel Shoto, Japan. 55th annual meeting of the Zoological Society of Japan, p. 1003 (Abstract; Biol. Lab., Nara Univ. of Educ., Nara, Japan).

DISTRIBUTION

Arrizabalaga, A., and E. Montagud. 1984. Notes sobre la fauna de quiropteres del Valles Oriental (Barcelona, Catalunya). Una nova espesie per a la fauna espanyola. Misc. Zool., Barcelona, 8: 307-310 (English summary).

Beskaravainy, M.M. 1985. A new find *Pipistrellus kuhli* in the Crimea. Vestn. Zool., 1985 (1): 82-83 (In Russian).

Fernandez, B.A., 1981. Murcielagos de Venezuela I: Phyllostomidae-Desmodontidae (murcielagos vampiros). Rev. Fac. Agron., Maracay, 12: 109-122.

Fernandez, B.A., 1982. Murcielagos de Venezuela II: Phyllostomidae-Stenodermatinae. Rev. Fac. Agron., Maracay, 12: 327-352.

Francis, C.M. et al. 1984. Notes on some bats in Bako National Park and Samunsam wildlife sanctuary, Sarawak. Sarawak Mus. J., 33 (54): 171-176.

Hanak, V., and A. Elgadi. 1984. On the bat fauna (Chiroptera) of Libya. Vestn. Cesk. Spol. Zool., 48: 165-187 (Vinicna 7, 128 44 Praha 2).

Herselman, J.C., and P.M. Morton. 1985. The distribution and status of bats (Mammalia: Chiroptera) in the Cape Province. Ann. Cape Prov. Mus., Nat. Hist., 16: 73-126.

Kennedy, M.L., T.L. Best and M.J. Harvey. 1984. Bats of Colima, Mexico. Mammalia, 48: 397-408 (Biology, Memphis State University, Memphis TN 38152 USA).

Lazell, J.D., Jr., and K.F. Koopman. 1985. Notes on bats of Florida's lower keys. Florida Sci., 48: 37-41.

Ota, H., et al. 1984. On the specimen of *Rhinolophus cornutus* collected in Yakushima island of the Ohsumi group. J. Mamm. Soc. Japan, 10: 67-68 (In Japanese; English summary).

Phillips, W.R. 1985. The use of bird bands for marking tree-dwelling bats, a preliminary appraisal. Macroderma, 1: 17-21.

Sawada, I. 1984. On the distribution of cave bats and the endoparasite fauna in Sanin district. Bull. Nara Univ. Educ., 33: 33-44 (In Japanese; English summary).

ECHOLOCATION

Fullard, J.H. 1984. External auditory structures in two species of neotropical notodontid moths. J. Comp. Physiol., A, Sens-Neural Behav. Physiol., 155: 625-632 (Bat predation; Biology, Erindale College, Univ. Toronto, Mississauga, Ont., Canada L5L 1C6).

Rother, G., and U. Schmidt. 1985. Die ontogenetische Entwicklung der Vokalisation bei *Phyllostomus discolor* (Chiroptera).

Thomson, C.E., M.B. Fenton and R.M.R. Barclay. 1985. The role of infant isolation calls in mother-infant reunions in the little brown bat, *Myotis lucifugus* (Chiroptera: Vespertilionidae). Can. J. Zool., 63: 1982-1988 (Carleton Univ., Dept. Biology, Ottawa, Ontario, Canada K1S 5B6).

ECOLOGY

Boinski, S., and R.M. Timm. 1985. Predation by squirrel monkeys and double-toothed kites on tent-making bats. Am. J. Primatology, 9: 129-136 (Reprint: R.M. Timm, Field Museum Nat. Hist., Div. Mammals, Chicago, IL 60605 USA).

Marcot, B.G. 1984. Winter use of some north-western California caves by western big-eared bats and long-eared *Myotis*. Murrelet, 65: 46.

GENETICS

Buchanan, G.D. 1985. Comments on frequency of melanism in *Myotis lucifugus*. J. Mamm., 66: 178.

Gupta, B.B. 1984. Phyogeny of bats. Uttar Pradesh J. Zool., 4: 37-42 (Zoology, D.S. College, Aligarh 202 001 U.P., India).

Lemen, C.A., and P.W. Freeman. 1984. The genus: a macroevolutionary problem. Evolution, 38: 1219-1237 (School of Life Sciences, Univ. Nebraska, Lincoln, NB 68588 USA).

KARYOLOGY

Naidu, K.N., and M.E. Gururaj. 1984. Karyotype of *Rhinolophus luctus* (Chiroptera). Curr. Sci., 53: 825-826 (Dept. Post Graduate Studies Res. Zoology, Univ. Mysore, Manasa Gangotri, Mysore

Zima, J., and B. Kral. 1984. Karyotypes of European mammals 1. Prirodoved Pr. Ustavu Cesk. Akad. Ved. Brne, 18: 1-51 (in English; Inst. of Vertebrate Zoology, Czechoslavak Academy of Sciences, Kvetna 8, 603 65 Brno, CSSR).

PHYSIOLOGY

Joshi, D., and M.K. Chandrashekaran. 1985. White light of different spectral composition causes differential phase shifts of circadian rhythm of activity in a bat. Naturwissenschaften, 72: 548 (Madurai Kamraj Univ., Neurobiology and Mechanisms Behav. Unit, Madurai 625 021 India).

Kurta, A. 1985. External insulation available to a non-nesting mammal, the little brown bat (*Myotis lucifugus*). Comp. Biochem. Physiol., A, 82: 413-420 (Boston Univ., Dept. of Biology, Boston, MA 02215 USA; present address — Biology, Nazareth College in Kalamazoo, Nazareth, MI 49074 USA).

Stellar, D.C. 1985. The dietary energy and nitrogen requirements of the grey-headed flying-fox, *Pteropus poliocephalus* (Temminck). Macroderma, 1: 12 (Abstract).

Wise, L.Z., M.B. Calford and J.D. Pettigrew. 1985. Frequency organization of auditory cortical fields in the flying-fox, *Pteropus poliocephalus*. 5th mtg. of the Australian Neuroscience Society, Adelaide, Neuroscience Lett., S 111 (Abstract; Physiology and Pharmacology, Univ., Queensland, St. Lucia, Queensland 4067 Australia).

REPRODUCTION

Chari, G.C., and A. Gopalkrishna. 1984. Morphogenesis of the foetal membranes and placentation in the bat, *Miniopterus schreibersii fulginosus* (Hodgson). Proc. Indian Acad. Sci., 93: 463-483.

Crichton, E.G., and P.H. Krutzsch. 1985. Reproductive biology of the female leaf-nosed bat, *Macrotus californicus*, in southwestern United States: 1. A morphometric analysis of the annual ovarian cycle. Am. J. Anat., 173L 69-87.

Damassa, D.A., and A.W. Gustafson. 1985. Relationship of food intake to the induction of plasna sex steroid-binding protein and testicular activity in immature male little brown bats (*Myotis lucifugus lucifugus*). J. Reprod. Fertil., 74: 701-708 (Tufts Univ., Sch. Med., Dept. Anatomy and Cellular Biology, 136 Harrison Ave., Boston, MA 02111 USA).

Kimura, K., A. Takeda and T.A. Uchida. 1984. Delayed implantation in the Japanese long-fingered bat 3. Changes in plasma progesterone concentration. 55th Annual meeting of the Zoological Society of Japan, Morioka, p. 976 (Abstract; Lab. Animal Reprod., Fac. Text. Sci. and Tech., Shinshu Univ., Ueda).

Mori, T., and T.A. Uchida. 1984. Sperm storage and its mode in hibernating bats. 55th annual meeting of the Zoological Socy. of Japan, Morioka, Japan, p. 940 (Abstract; Zool. Lab., Fac. Agriculture, Kyushu Univ., Fukuokam, Japan).

Phillips, W.R., et al. 1985. The Tasmanian pipistrelle: *Pipistrellus tasmaniansis* Gould 1858; annual activity and breeding cycles. Macroderma, 1: 2-11.

Sapkal, V.M., and W.R. Bhansarkar. 1984. Breeding habits and associated phenomena in some Indian bats. J. Bombay Nat. Hist. Soc., 81: 380-386 (Institute of Science, Dept. of Zoology, Nagpur, India).

Sastry, M.S., and A. Madhavan. 1984. Early development, implantation and amniogenesis in the microchiropteran bat *Scotophilus heathi*. Proc. Nat. Acad. Sci., India, Sect. B (Biol. Sci.), 54: 9-20 (Zoology, Nagpur University, Nagpur Campus, Nagpur 440 010 India).

MAMMALIAN SPECIES

Fujita, M.S., and T.H. Kunz. 1984. *Pipistrellus subflavus*. Mammalian Species, 228: 1-6.

Greenhall, A.M. 1984. *Diphylla ecaudata*. Mammalian Species, 227: 1-3.

Timm, R.M. 1985. *Artibeus phaeotis*. Mammalian Species, 235: 1-6.

Warner, R.M., and N.J. Czaplewski. 1984. *Myotis volans*. Mammalian Species, 224: 1-4.

Webster, W.D., and J.K. Jones, Jr. 1984. *Glossophaga leachii*. Mammalian Species, 226: 1-3.

SYSTEMATICS

Ibanez, C. 1984. Quiropteros neotropicales en el Museu Nacional de Ciencias Naturales de Madrid. Pp. 399-410, IN Actas II Reunion Iberoamericana de Conservacion y Zoologia de Vertebrados (J. Castroviejo, ed.). Caceres, Spain, 631 pp.

Koopman, K.F. 1984. A synopsis of the families of bats — Part VII. Bat Res. News, 25: 25-27.

Menu, H. 1984. Revision of the status of *Pipistrellus subflavus* — a new generic name is proposed (*Perimyotis*, new genus). Mammalia, 48: 409-416 (In French; Caurey-les-Hermonville, 51220 Hermonville).

Ochoa, G., J., and C. Ibanez. 1982. Nuevo murcielago del genero *Lonchorhina* (Chiroptera: Phyllostomidae). Mem. Soc. Cienc. Nat. La Salle, 42: 145-159 (sp. nov. *Lonchorhina fernandezi*).

Robbins, C.B. 1984. A new high forest species in the African bat genus *Scotophilus* (Vespertilionidae). Ann. Mus. Roy. African Centr., Soc. Zool., 237: 19-21 (sp. nov. *Scotophilus nucella*).

Robbins, C.B. et al. 1984. A review of the systematics of the African bat genus *Scotophilus* (Vespertilionidae). Ann. Mus. Roy. African Centr., Soc. Zool., 237: 25.

Rozendaal, F.G. 1984. Notes on macroglassinae bats from Sulawesi and the Moluccas, Indonesia, with the description of a new species of *Synconycteris* Matschie, 1899 from Halmahera (Mammalia: Megachiroptera). Zool. Med., 58: 187-212 (sp. nov. *Synconycteris carolinae*).

van Zyll de Jong, C.G. 1984. Taxonomic relationships of Nearctic small-footed bats of the *Myotis leibii* group (Chiroptera: Vespertilionidae). Canadian J. Zool., 62: 2519-2526.

Yoshiyuki, M. 1984. A new species of *Myotis* (Chiroptera: Vespertilionidae) from Hokkaido, Japan. Bull. Natl. Sci. Mus. Tokyo, 10: 153-159 (sp. nov. *Myotis yesoensis*).

DEATH ANNOUNCEMENT

We are all saddened by the untimely death of Rudolph Lehmann of Helsinki, Finland on October 29, 1985. He succumbed to rabies contracted via bat bites. The February 15, 1986 issue of *The Lancet* (p. 378) presents a medical history of his case and a short history of bat rabies in Europe. We anticipate publishing a more formal obituary in a later issue.

GRH

Abstracts of Papers* and Posters† Presented at the Seventh International Bat Research Conference at Aberdeen, Scotland August 19–24, 1985

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

Manoeuverability and Ecology in British Bats*

H.D.J.N. Aldridge

The relationships between flight performance, morphology and ecology will be discussed. It will be shown that the feeding strategy used by a bat can be predicted on the basis of both flight performance and those morphological parameters found to be important in determining manoeuverability (the ability to turn tightly) and agility (the ability to turn fast).

Bat Flight Kinematics, the Scapulo-Humeral Lock*

J. Scott Altenbach and John W. Hermanson

Electromyographic (EMG) data have led investigators to modify the hypothesis of Vaughan (1959) involving a division of labor between the primary downstroke muscles of microchiropteran bats and the engagement of the dorsal genoid fossa border and the humeral greater tuberosity, the scapulohumeral lock. Formulation of the original hypothesis by an intuitive approach from gross dissection data and testing with EMG data have all involved indirect evidence. High-speed cinematography of percutaneous steel pins surgically implanted in the scapula and humerous allows direct observation of the movements of both components involved in the locking mechanism. The technique was applied during accelerating flight in genera representing three families: *Artibeus* (Phyllostomidae, *Eptesicus* (Vespertilionidae), and *Tadarida* (Molossidae). The data support the hypothesis that the dorsal scapulo-humeral lock is established by contraction of the pectoralis. The lock increases the in moment arm of the pectoralis and allows subsequent contraction of the caudal division of serratus ventralis thoracis to provide additional adductive effort. Simultaneous abduction of both scapula and humerus support the hypothesis that a ventral scapulo-humeral lock facilitates powering of the upstroke by inward rotators of the lateral scapular border.

The Roles of the Hypothalamus and Pituitary in Control of Reproduction in Bats*

Edythe L. P. Anthony

The hypothalamic-pituitary-gonadal axis controls reproductive functions in bats, as in all vertebrates. In many bat species, changes in ovarian and testicular morphology have been described throughout the annual reproductive cycle. However, related changes in the hypothalamus and pituitary have only been investigated in a few species. It will be the purpose of this paper to review the existing knowledge of hypothalamic and pituitary involvement in reproductive cycles of bats. Included in this review will be a summary of data I have gathered on the annual cycle of *Myotis lucifugus*. I have used immunocytochemistry to identify the pituitary cells responsible for LH secretion and the hypothalamic neurons that secrete LHRH. LH-secreting cells in this species are distributed throughout the pituitary pars distalis, but are especially numerous adjacent to the infundibular stalk. Seasonal studies suggest increased secretory activity of LH-cells in females at the time of ovulation, and in males just prior to the annual peak in plasma testosterone levels. LHRH-containing neuronal cell bodies are numerous in the medial basal hypothalamus, but they also extend more rostrally in the ventral forebrain. Fiber tracts project to the median eminence, pituitary stalk and neural lobe, as well as to extra-hypothalamic sites such as the habenula and amygdala. Preliminary seasonal studies in females suggest decreased LHRH-immunoreactivity in cell bodies and in extra-hypothalamic fiber systems at the time of ovulation.

The Scandinavian Bat Fauna – Adaptive Wing Morphology and Free Flight in the Field*

Hans J. Baagoe

Four functionally well understood wing morphological characters and rough weight classes were selected. Based on these, the 14 bat species of the southern Scandinavian bat fauna can be separated and predictions can be made about the flight characteristics of the species. "Search phase" flight of 13 of the species was studied in the field in order to provide quantitative data for a species comparison. The bats were found and identified in the field by the use of bat detectors. Estimated flight heights, nearness to larger objects and manoeuvres in "search phase" flight were observed directly and classified in rough categories. Multiflash photography aided by the use of a night vision device were used primarily for flight speed analyses. There is a good over-all correlation between the field results and the predictions based on wing morphology.

Foraging Strategies of Silver-Haired (*Lasionycteris noctivagans*) and Hoary (*Lasiurus cinereus*) Bats*

Robert M.R. Barclay

The foraging strategies of *Lasiurus cinereus* and *Lasionycteris noctivagans* were studied from 1981 to 1985 at Delta Marsh, Manitoba using night vision scopes, ultrasonic detectors, radiotelemetry, and fecal analysis. Both species are open air foragers. *L. noctivagans* is adapted for short range insect detection and pursuit. They fly slowly, are highly maneouverable and were frequently observed feeding in small clearings in a forested ridge. They feed opportunistically on a wide range of insects and prey heavily on chironomids when dense swarms are available. The search/approach stage echolocation calls of this species are FM signals adapted for short range insect detection in relatively uncluttered situations. *L. cinereus* is adapted for long range insect detection and pursuit. It is fast and less maneouverable and was always observed foraging in large open areas or above the canopy. At

times individuals were highly aggressive on small feeding territories while at others, individuals made long distance (up to 40 km) feeding trips. *L. cinereus* fed primarily on large insects (moths, beetles and dragonflies) and did not consume the highly abundant smaller insects. Although small insects may be ignored for energetic reasons, they may also be poorly detected. The search/approach calls of *L. cinereus* are low (17-20 kHz), almost constant frequency signals that are adapted for detecting insects at long range thus giving the bat time to manoeuver for the capture. Small insects, detected only at close range, may thus be less available as prey.

Seasonal Cycles of Pallid Bats (*Antrozous pallidus*): Proximate Factors*

Laura J. Beasley

As in other temperate zone vespertilionid bats, pallid bats, (*Antrozous pallidus*) manifest marked seasonal cycles in body weight, thermoregulatory condition and reproductive physiology. Several physiological parameters were examined in captive pallid bats maintained in constant laboratory conditions longterm (4 mo.–3 yrs.). Body weight, food intake and scrotal size were characterized by endogenous "circannual" cycles. In addition, there was an endogenous change from homeothermy to heterothermy in the autumn. The transition from "summer condition" (spermatogenic activity, low body weight, homeothermy) to "autumnal condition" (regressed testes and epididymal spermatozoa, increased body weight, heterothermy) was accelerated by exposure to short photoperiods and/or treatment with melatonin (which is released by the pineal gland under short photoperiods). However, decreasing daylength was not a necessary proximate cue because animals kept in long photoperiods and warm ambient temperatures came into "autumnal condition" one month later. Pallid bats exhibit circannual cycles which may be synchronized with the geophysical cycle by photoperiod, temperature or other factors.

Water Balance, Roost Selection, and the Overwintering Survival of *Macrotus californicus* (Phyllostomidae) in Southeastern California*

Gary P. Bell

Macrotus californicus is the only member of the neotropical family Phyllostomidae to reside as a year-round resident in the United States. Its northern distribution is made possible by the availability of hot roost sites in the form of mine tunnels in geothermally-heated mountain ranges. I examined the water balance of these bats using a combination of field-laboratory experiments and the use of triated water to measure body-water turnover rates. *Macrotus* exhibits rates of flight and roosting evaporative (pulmo-cutaneous) water loss approximately 10% lower than for similarly-sized neotropical members of the family. Fecal water loss is approximately 70%, and their insect food comprises approximately 65%–75% free water. Combining these data with laboratory generated data of pulmo-cutaneous water loss indicate that *Macrotus* are able to remain in water balance while roosting in mine tunnels up to 29__ C. The actual temperature of the geothermally-heated day roosts of this species are between 28.5__ and 29.5__ C, indicating that *Macrotus* uses the warmest roost sites available to conserve energy reserves during the winter, while remaining in water balance in its dry desert environment.

The Effects of Predation by Bats on the Evolution of Calling Behaviour in Neotropical Katydids (Orthoptera: Tettigoniidae)*

Jacqueline J. Belwood

Foliage gleaning bats in Panama (Phyllostomidae: Phyllostominae), particularly *Tonatia silvicola, Micronycteris hirsuta,* and *M. megalotis*, can use the mating calls of nocturnal katydids (bush crickets; Orthoptera: Tettigoniidae) to locate these insects as prey. Mist nets 'baited' with calling katydids attracted bats, while control nets did not. Also, katydids make up a large portion of the diets of these bats. Strong predation pressure by bats has resulted in reduced sound production in most species of forest-dwelling katydids, and in a switch from acoustic to tactile signalling as the principal form of mate attraction in these insects. Insects that sing infrequently are harder for bats to locate than are those that sing more consistently. Contrary to expectation, female katydids, which do not sing, made up a large proportion of the diets of the foliage gleaning bats. They are probably taken as prey as they approach 'calling' males.

Male Reproduction in the Cape Horseshoe Bat (*Rhinolophus capensis*)*

R.T.F. Bernard

The reproductive cycles of male bats that hibernate are characterized by an unusual lack of synchrony between primary and secondary reproductive processes (Gustafson, 1979). The aim of this project has been to examine the timing of primary and secondary reproductive processes in *Rhinolophus capensis*, a hibernating species that occurs in South Africa below 32° S. Spermatogenesis occurs between October and June and the seminiferous tubules are inactive from July to September, a period coinciding with late winter hibernation. Sperm are released to the epididymes in April and May, and stored there for three to five months until copulation which occurs in August and September. Leydig cells have been examined at an ultrastructural level, and mean monthly lipid droplet diameter and the occurrence of mitochondria with tubular cristae used to indicate steroidiogenic activity. Lipid droplet diameter shows two peaks, one in March and the other in July, and tubular cristae are present in March and April, and July and August. Blood has been collected for testosterone assay, and the results will be presented. Activity of the accessory gland complex was determined using histochemistry and electron microscopy. The ampullary and prostate glands show peaks of activity between March and November. The urethral gland comprises two cell types, one of which is active throughout the year and the other active between January and April only. These results indicate that there is an asynchrony in the timing of primary and secondary reproductive processes in *R. capensis* and that this falls into pattern 1a of Gustafson (1979).

References

Gustafson, A.W. (1979) Male reproductive patterns in hibernating bats. *J. Reprod. Fert.* 56, 317-331.

The Adaptive Significance of Reproductive Delay Phenomena in South African Microchiroptera†

R.T.F. Bernard

Examples of the three basic reproductive delay phenomena (sperm storage, by males in *Rhinolophus capensis*, and by females in *Myotis tricolor*; delayed implantation or preimplantation diapause in *Miniopterus schreibersi*; and retarded embryonic development in *Hipposideros caffer*) have been reported from South Africa. In all cases the period of reproductive delay coincides with all or part of winter (May to August), during which the species enter prolonged or interrupted periods of hibernation. Parturition occurs between November and January when insect biomass is maximal. The question of the adaptive significance of such reproductive delays is highlighted by the sympatric occurrence of 'typically reproducing' species, such as *Nycteris thebaica*, with the above mentioned species. It has been suggested that the adaptive significance of such reproductive delays may be that they allow the young to be born at favorable times; that they result in synchronous parturition (particularly relating to sperm storage), or that they allow reproduction in an area where the summer is too short. Although the reproductive season in South Africa may be as long as eight months, and the gestation periods (excluding periods of delay) of the species no more than three months, it is proposed that in the present case, the third suggestion above is valid. It will be argued that, for the species that do not remain active throughout the year, the winter represents a period of reproductive inactivity so that the entire reproductive process (from the onset of gametogenesis to a time when the young are independent) must fit into the eight month reproductive season. It will be shown that the total length of the reproductive processes may be longer than eight months, and therefore, that the reproductive delays allow reproduction in an environment where normal reproduction would be unsuccessful.

Ultrastructure of the Pineal of the Indian Mouse-Tailed Bat, *Rhinopoma microphyllum**

Kunwar P. Bhatnagar

Rhinopoma inhabits the arid and semi-arid regions of the Old World living in absolute darkness. *Rhinopoma microphyllum* (males and terminally pregnant females) were captured from Gwalior fort, India on June 29, 1984, quickly brought to the laboratory, and were immediately perfused under chloroform anesthesia with 3.5% glutaraldehyde-2% paraformaldehyde in 0.18M cacodylate buffer, pH 7.35, after a cacodylate buffer wash. Pineal tissue was stored in fixative at 5 °C until processed later in the U.S. The ultrastructural observations are based on the pineals of three females and one male. No attempt was made to delineate sexual differences. The type-A pineal organ is oval in coronal plane and is situated deeply, covered by the cerebral hemispheres. Septa divide the parenchyma into follicles. A huge habenular commissure courses through the gland anteriorly. The pineal vasculature is not prominent. Two populations of pinealocytes predominate the gland — one light and the other dark, the dark cells being smaller. The pinealocytes appear synthetically active as judged by their large nuclei predominantly containing euchromatin and prominent nucleoli. Additional features are the Golgi bodies, mitochondria, polyribosomes, and microtubules all of which are numerous, and fewer lysosomes and elements of rough and smooth endoplasmic reticulum. Concentric lamellar whorls, pigment bodies, cilia, centrioles, multivesicular bodies, and some unusual cytoplasmic structures such as crystalline bodies are occasionally observed. Pinealocyte processes typically contain numerous clear and fewer granular vesicles. Glial cells are rare and contain densely packed filaments and abundant glycogen particles. Intermediate junctions and desmosome-like structures are frequently seen between the parenchymal elements. Unmyelinated nerve bundles are common constituents of the pericapillary space. The most unusual feature of the *Rhinopoma* pineal is the scattered foci of an elaborate network of dilated intercellular spaces filled with an electron-dense material. The pinealocyte plasma membrane in such regions appears highly tortuous. Vesicles, presumably exocytotic, are seen both in the pinealocyte perikarya as well as their processes in proximity to the dense extracellular material. We believe that this may be a pineal secretory product, perhaps proteinaceous in nature, released into the intercellular compartment.

Contraceptive Agents: Endocrinological Approach to Male Fertility Control in Indian Fruit Bat, *Rousettus leschenaulti**

D.A. Bhiwgade

The effects of several contraceptive agents of established anti-fertility action in male rodents and humans have been tested in male bats and an attempt has been made to investigate their effect on the pituitary gonadotrophin secreting cells participating in the control of spermatogenesis in the Indian fruit bat, *Rousettus leschenaulti*. 1) **Cyproterone acetate**: affected the gonadotrophic basophils of anterior pituitary, which decreased in abundance and in granulation. This compound also arrested spermatogenesis. 2) **Depoprovera** (Medroxyprogesterone acetate): resulted in regression and degranulation of both FSH and LH gonadotrophs in the anterior pituitary after 30 days of treatment. The testes showed complete inhibition of spermatogenesis and marked shrinkage of the seminiferous tubules. 3) **Testosterone ester**: both FSH and LH cells were equally abundant after 4 weeks treatment with large doses and in neither type of cells were any degenerative changes or reductions in cell numbers observed. Spermatogenesis was unaffected. 4) **Cyproterone**: resulted in hypertrophy and slight degranulation of LH cells accompanied by hypertrophy of the Golgi apparatus after four weeks of treatment. High doses of cyproterone had no effect on spermatogenesis. 5) **Oestradiol benzoate**: did not affect spermatogenesis. In the pituitary, both FSH and LH gonadotrophs hypertrophied. 6) **Clomiphene citrate**: caused complete degranulation of both FSH and LH gonadotrophs after 30 days of treatment, inhibited all stages of spermatogenesis and caused a marked shrinkage of the seminiferous tubules. 7) **Gossypol**: after four weeks treatment the FSH and LH gonadotrophs showed progressive hyperplasia, massive hypertrophy and high secretory activity. Vacuolation in spermatogonial cells, together with absence of spermatids and primary spermatocytes was also apparent.

Electrophoretic and Morphological Differntiation Between *Myotis daubentoni* (Kuhl, 1819) and *Myotis nathalinae tupinier*, 1977†

Wieslaw Bogdanowicz and Anna Wojcik

Electrophoretic and the most of morphological studies were made of 50 bats obtained from one winter colony, 41 of which were identified as *M. daubentoni* and nine as *M. nathalinae*, on the strength of formation of the protocone on P^4. Of the 18 loci examined 12 were monomorphic for the same allele in both of the groups studied. Five loci were distinguished by weak polymorphism. A considerable degree of variation was shown only by esterase of the kidneys (Es-2) coded by one locus with three alleles. Proportions of genotypes were in

conformity with the Hardy-Weinberg equilibrium ($p > 0.05$) both in the whole sample and for *M. daubentoni* and *M. nathalinae* taken separately. On the basis of electrophorograms of the proteins examined differentiation of the two species was not possible. The multivariate analysis of 51 body and skeleton measurements was used to estimate the phenetic relations. In DF-analysis the maximum of jacknifed classification (90%) was not obtained for a priori chosen groups until the 18th of the 48 characters simultaneously taken into consideration. Only 78% was obtained with the three best characters (foot length, width of caput humeri and proximal epiphysis femur width). In the A-space analyzed, despite rotation, we were not able to determine the axes capable of reflecting any possible differences between the species. The above shows the great homogeneity of the two groups and suggests that the *nathalinae* form comes within the range of genetic and phenetic variation of *M. d. daubenoti*, and consequently it cannot be treated as a valid species, or even as a separate subspecies.

Bat-Mapping: A Comparison Between Two Regions of Nordbaden†

Monika Braun

Within the scope of studies for the Bat-Protector-Project of Nordbaden, bat occurrence has been mapped 1980-1982 and protection measurements have been realized. One result among other things of this project was: in the region named "Kraichgau" comparatively more bats could be observed, whereas in another region "Bauland" nearly no bats were observed. To compare the bat fauna of the two regions, I started a special project in 1983. Churches, school buildings, framework houses, towers have been controlled at first. Walking from house to house, the inhabitants of the villages have been asked whether they have seen bats flying or hanging. School classes assisted by asking people. Everyone received a registration card for bat observation. Public relations methods were used. The results were: "Bauland," before the project in 1982: two *Plecotus spec.*, some observations of bats, two reports from the population. In the project in 1983: two *Plecotus spec.*, 17 *Myotis myotis*, two *Pipistrellus pip.* (dead), 52 reports from the population. "Kraichgau," before the project in 1982: four *Myotis myotis* (mummified) 0, 12 *Plecotus spec.*, 60 *Pipistrellus pip.*, 5 reports from the population. In the project in 1983: one *Vespertilio murinus*, 10 *Plecotus spec.*, one *Plecotus auritus*, one *Plecotus austriacus*, two *Pipistrellus nath.*, 211 *Pipistrellus pipistrellus*, one Nyctalus noctula, some other observations of bats, 114 reports from the population. I received more results (more bat roosts, more species, more individuals) in these well defined bat projects using a house to house survey technique. Especially the roosts of *Pipistrellus pipistrellus* could only be found by asking in every house. The different bat fauna of the two regions could perhaps be explained by a different agricultural using of the land. Slight differences in the average yearly temperatures and rainfall of the two regions or a different offer of insects may be a reason. Exact climatical investigations should provide further clarifications.

The Function of Communal Roosting by *Eptesicus fuscus**

R. Mark Brigham

I used radio-tracking to test five hypotheses which explain the functional significance of *E. fuscus* aggregating in maternity colonies. These include, a limit to the number of sites, avoidance of ambush predators, information-transfer for food finding, minimizing travel costs to feeding areas, and enhancing thermoregulation for efficient young production. From May to September of 1983 and 1984, 57 adult females, seven adult males, nine subadult females and five subadult males carried 1.0g transmitters for a total of 539 bat nights ($\bar{x} = 6.3$ nights/bat). Individuals returned to the same day roost 94.3% of the time ($N = 278$ days). Bats were evicted by closure to nearby roost sites ($\bar{x} = 105.8$m, $SE = 9.94$, $N = 75$ moves). There was a tendency for fewer young to be produced in colonies evicted prior to parturition compared to control sites (.86 young/adult $N = 6$, versus .36 young/adult $N = 2$). Thirty-six percent of the bats left four seconds or less after the previous departure ($N = 1110$ departures on 30 nights). On 10 nights, only 8.9% of the members left within four seconds and left in the same direction as the previous individual. I found no evidence for individual feeding areas. Bats foraged unpredictably up to 4.1km from the day of roost. There was no significant difference in the time spent, direction taken, or areas used by individuals from control versus evicted colonies. My results suggest that *E. fuscus* roost communally for thermoregulatory reasons to enhance young production. The short roost switch distances suggest that minimizing commuting costs may be important, but the unpredicatable foraging patterns do not support this suggestion.

Copulation Without Intromission in the Pallid Bat *Antrozous pallidus**

Patricia E. Brown

During the winter of 1978, twelve copulations were observed among captive pallid bats. In each case, the female was torpid and the male mounted her from behind. They would remain in this position several hours or until disturbed by observers. The penis of the pallid bat is a mushroom-shaped affair which when engorged with blood enlarges to 12mm in length and forms a cup at the apex. This "coital cup" is placed over the vagina and the male ejaculates into it. Following "extromission" (since the penis does not penetrate the vagina) a pool of semen is present in the "cup," and a sperm plug forms at the entrance to the vagina. On subsequent days, the same female was observed again *in copulo*, but since a sperm plug was already present it is unlikely that new semen entered the vagina. In June several of the females observed mating delivered healthy babies. Other species of Vespertilionid bats appear to share a common penial morphology. Both *Nyctophilus* from Australia and New Guinea and *Otonycteris from Africa and Asia are similar to Antrozous* not only in appearance, but in other behavioral aspects such as foraging. It is possible that they also use the penis as an "extromittant" organ. What is the adaptive behavior in light of the use of the rat baculum as a taxonomic tool?

Low Frequency Hearing in the Pallid Bat *Antrozous pallidus**

Patricia E. Brown, Alan D. Grinnell, and Peter M. Narins

Echolocating bats exhibit exceptional high-frequency auditory capabilities in response to the ultrasonic frequencies contained in their orientation sounds. Some bats also appear to use low frequencies to locate calling frogs and insect prey. Several species communicate with audible (to humans) sounds. Using behavioral techniques, Poussin and Simmons (JASA 72:340, 1982) have documented a low frequency sensitivity at 1 kHz in *Eptesicus fuscus*. Pallid bats *Antrozous pallidus*, use high frequency signals for echolocation, but also appear to utilize lower frequency prey-produced sounds while foraging on or near the ground arthropods and moths (Bell,

Behav. Ecol. Sociobiol. 10: 217-223, 1982, and Brown, unpubl. data). We now present neurophysiological evidence that bats of this species detect sounds as low as 1 kHz, and are extremely sensitive at 9-11 kHz. Adult pallid bats were anesthetized with Nembutal and the inferior colliculus exposed. Tungsten electrodes were used to make multi-unit recordings from known depths below the surface in response to tone bursts for which the frequency was incremented in 100 Kz steps and presented via free-field calibrated loudspeakers (an ADS-300 with output equalized ±5dB from 200 kHz and a Polaroid ultrasonic transducer from 15kHz to 90kHz). For each frequency, the threshold for multi-unit responses was determined. The frequency of peak sensitivity increased systematically with electrode depth. At or near the surface, maximum sensitivity was seen at frequencies as high as 40-50 kHz. A behavioral audiogram of *Antrozous* is now being determined using techniques similar to those employed by Simmons and Poussin for *Eptesicus*. Our evidence of low frequency sensitivity in the pallid bat is consistent with the behavioral observations of the passive use of prey-produced sounds in foraging and the active use of low frequency communication signals (Brown, Zeit. Tierpsychol. 41:34-54, 1976).

Sexual Maturity and Reproductive Endocrinology in *Myotis lucifugus lucifugus*†

G. Dale Buchanan

Many nulliparous *M. lucifugus* in a hibernaculum at Craigmont, Ontario appear sexually immature, although most have been inseminated. These bats, believed to be young-of-the-year, have small uteri and lack mature ovarian follicles. Other nulliparous bats, thought to be yearlings, have swollen, but essentially symmetrical, uteri and a mature follicle of hibernation in one ovary. The reproductive status of the female bats in this colony was examined as described below. Plasma progesterone levels, measured by radioimmunoassay, showed episodic fluctuations with a periodicity of about 60 days during hibernation; however, no differences were seen between parous and nulliparous bats of either type. Ovarian histochemistry revealed that steroid synthesis was confined to the interstitial tissue, even in bats with mature follicles. Uterine estrogen receptor levels rose during the last half of hibernation, but did not differ among bats of different uterine types. In contrast, progesterone receptor levels increased dramatically near the end of hibernation in nulliparous bats with swollen uteri and parous bats, but not in bats with small uteri. Since all the female bats in Craigmont appear to be endocrinologically equivalent, it is suggested that young female *M. lucifugus* do reach puberty, become estrous and mate at the end of their first summer, as previous studies have indicated. However, due to the relatively short active season at this latitude (45°30'N) there is insufficient time to complete folliculogenesis before entering hibernation. Thus, young females are anovular as yearlings and only become pregnant their second year. This study was supported by a Medical Research Council of Canada grant.

Additional Notes on the Systematics of Afro-Asian Nycteris*

Victor Van Cakenberghe and Frits De Vree

In the genus *Nycteris* Geoffrey and Cuvier, 1795 five species groups can be distinguished, based on a number of morphological characters. On a previous occasion (Bonn, 1983) the systematics of two African groups (the *N. arge* and the *N. macrotis* groups) was already discussed. In a third entirely African group, the *N. hispida* group, three distinct species are distinguished: an extremely large *N. grandis* Peters, 1865, which occurs in the rain forests and the coastal forests of East Africa, and two smaller ones, including *N. hispida* (Schreber, 1774), with a very wide distribution throughout the continent and *N. aurita* (Andersen, 1912), limited to East and Northeast Africa. It is difficult to distinguish the two smaller species by univariable techniques, but multivariate statistical analyses always separate them with skull dimensions. A last African group, which also occurs in the Arabian Peninsula, is the *N. thebaica* group. *N. thebaica* Geoffrey, 1813 has the widest distribution of all *Nycteris* species. In West Africa, our analyses clearly substantiate the presence of a second species: *N. gambiensis* (Andersen, 1912). Literature data indicate that *N. vinsoni* Dalquest, 1965 can be regarded as a distinct species in East Africa. Although the Southeast Asian representatives have very variable morphological characters (i.q. the shape of the upper incisors), they are considered to be members of one group: the *N. javanica* group. Based on size differences and distributional data, two species are retained: *N. javanica* Geoffroy, 1813, which is restricted to the isle of Java and a somewhat larger *N. tragata* (Andersen, 1912), occuring on the isle of Borneo and the Malaysian Peninsula.

A Study Model: The Bat Colony of Cefalu Cathedral in Sicily, Italy*

Valeria Calandra

This report points out some of the possibilities for research that are offered by bats colonies in monuments, cathedrals, and other large man-made structures, such as Cefalu Cathedral in Palermo, the site of our study. A general introduction will present information on the two species of bats (*Rhinolophus ferrumequinum* and *Myotis emarginatus*), the number in the colony, habitat type, and the kind of investigations carried out concerning this colony. The data and results of four years of observation of the colony and its roost will be reported. These data document increases and decreases in the population, behaviour of young and adults, interactions between the two species, and between individuals of the same species. In addition to these observations future research proposals concerning this colony will be discussed, and its significance in assessing ways of dealing with such colonies. The limitations of the present study as well as the inadequate equipment available will hopefully be overcome in our future studies on this colony. Data and observations are also included on the possible adverse effects of bat droppings and excretia on stone, wood, and marble components of these historic structures, in an attempt to avoid the elimination of such colonies by those in charge of maintaining these buildings. The conclusions point out the importance of research on bats and their roosting and nursery colonies, which in a large part of Italy are still poorly understood. In Italy there are many bat colonies in such historic structures, and these colonies are believed to be detrimental to the buildings in which they occur, and increasing efforts are being made to destroy or remove these bats. It is hoped that studies such as this will help guarantee that only these colonies that are truly destructive of their roosting sites will be disturbed, and colonies in such public monuments and cathedrals that are not destructive or a health hazard will remain unmolested.

Ed. note: I have taken the liberty of rewriting part of the author's abstract to render it in somewhat better English, without changing the actual content of the abstract. I hope that I have faithfully transmitted her concepts and intentions. GRH

Tonotopic Organization in the Inferior Colliculus of *Eptesicus Fuscus* and its Relation to Afferent Projections†

J.H. Casseday and Ellen Covey

We examined tonotopic organization of the inferior colliculus (IC) in *Eptesicus* by two methods: 1) ascending projections from different tonotopic areas in the anteroventral cochlear nucleus (AVCN); and 2) electrophysiological recording in the IC to determine the characteristic frequency (CF) and location of single cells. To visualize the projections from AVCN to IC, the CF of neurons at the injection site was determined by electrophysiological recording, and then wheat germ agglutinin conjugated to horseradish peroxidase was deposited at the recording site. An injection in a low frequency region results in a sheet of transport which wraps around the outside of the central nucleus and is seen in frontal sections as a semicircular band located laterally and dorsally. An injection in a high frequency region results in a sheet of transport which appears in frontal sections as a band located ventromedially. These projections coincide precisely with the tonotopic map of the IC. We conclude that the isofrequency contours in the IC of *Eptesicus* are arranged as concentric hemispheres with low frequencies on the outside, i.e., dorsal and lateral in frontal sections, and high frequencies on the inside, i.e. ventral and medial in frontal sections. Work supported by NIH grant NS 21748 and NSF grant 8217357.

Connections of the Nuclei of the Lateral Lemniscus in *Eptesicus Fuscus:* Tonotopic Compression in the Columnar Area*

E. Covey and J.H. Casseday

Anterograde and retrograde transport of neuronal tracers and electrophysiological recording were used to study the connections between the anteroventral cochlear nucleus (AVCN), the nuclei of the lateral lemniscus, and the inferior colliculus (IC) in *Eptesicus*. Pathways from AVCN diverge to at least four different targets in the nuclei of the lateral lemniscus. These pathways converge again at the IC. The cytoarchitecture of each nucleus is distinct, and in one, the columnar division of the ventral complex, cells are organized into an orderly matrix of rows and columns. The connections of this nucleus are parallel to the rows and are precisely related to the tonotopic organization of AVCN and the IC. Projections from low frequency areas of AVCN diverge across a sheet comprised of all the dorsal rows of cells, which extend in the rostrocaudal dimension. Retrograde transport from a low frequency area of the IC labels a sheet of cells in the same location. These sheets are in successively more ventral locations as the best frequency at the injection site increases. The entire range of frequencies audible to the bat is represented along the dorsal-ventral dimension of the columnar area. Because each column is only 20-30 cells in height, frequency must be compressed in this dimension. The other nuclei of the lateral lemniscus have a less precise relation to the tonotopic arrangement of the system. Work supported by NIH grant NS 21748 and NSF grant BNS 8217357.

The Conservation Status of New Zealand Bats*

M. J. Daniel

New Zealand's endemic bat fauna, consisting of only three species, continues to be threatened by an unusual combination of factors. These include lowland forest clearance for farms and exotic pine plantations, predation by introduced mammals such as feral cats, mustelids (particularly stoats) and three species of rats and possible accidental poisoning from baits laid for brushtail possums. The status of the long-tailed bat (*Chalinolobus tuberculatus*) is secure; this forest-edge species is widespread in a variety of habitats in both the North and South Islands and occurs on Stewart Island and three off-shore islands. The status of the two species of short-tailed bats of endemic family Mystacinidae gives cause for great concern. *Mystacina robusta*, recently elevated to specific status, has not been seen since 1965 when ship rats reached its last two previously rat-free island refuges, and it is feared to be extinct. Subfossils of this species found in both the North and South Islands confirm that its range was once much wider. The Polynesian rat, introduced by the Maori about 1000 years ago, is believed to be implicated in the extinction of *M. robusta* over most of New Zealand within this period. *Mystacina tuberculata*, at present known from a few lowland and montane forests in the North Island and on Little Barrier Island, apparently only survives in one area of the South Island and on Codfish Island off Stewart Island. The unique terrestrial foraging behaviour of the short-tailed bats on the forest floor, perhaps more marked in the larger *M. robusta*, makes these species particularly vulnerable to introduced predators such as cats, stoats and rats. *Mystacina* is also partially a fruit eater, and fruit-lured cyanide baits and green-dyed carrot baits containing sodium monofluoroacetate (compound 1080), both widely used possum control in forests, are other potential dangers facing these remarkable bats.

Fluttering Target Detection in Hipposiderid Bats†

Gerhard von der Emde

Two species of Hipposiderid bats, *H. speoris* and *H. lankadiva*, which both emit short cf-fm echolocation calls, were trained in a two-alternative forced-choice procedure to discriminate an oscillating target from a motionless one. Two different targets were used: 1) the membrane of a low-frequency loudspeaker, producing sinusoidal frequency- and amplitude-modulations, and 2) a small rotating propeller, which produced short acoustical "glints." *H. lankadiva* learned to discriminate the moving loudspeaker-membrane from the motionless one. Thresholds for minimal modulation depths at different oscillation frequencies were determined. *H. speoris* could not be trained to react to the moving membrane, even at very high oscillation amplitudes. When using the rotating propeller as a positive target, however, *H. speoris* learned very quickly to discriminate it from a motionless one. By decreasing the rotation speed it was possible to measure the minimal detectable glint-frequency for each bat. During the discrimination task both bat species increased their duty-cycle just prior to a decision by emitting long sequences of echolocation calls with short interpulse-intervals. The duration of individual pulses remained relatively constant.

Use of Space (Foraging Areas and Roosts) By Insectivorous Bats*

M. Brock Fenton

Radio-tracking studies have permitted the collection of data about how insectivorous bats use space. The initial data sets deal with species which fly and continuously in search of flying prey, apparently detecting and reacting to targets at relatively short (5m) range. Two species of about 20g mass, the African *Scotophilus leucogaster* and the North American *Eptesicus fuscus*, regularly forage over and elliptical area with a long axis of up to 5 km. Roosts, which may be consistently occupied or unpredictably switched, are located on the edges of the foraging areas. Data from other studies indicate that bats with other foraging and echolocation strategies exhibit different patterns of use of space.

Predation on Flocking *Tadarida Plicata* in Sabah*

Charles M. Francis

Avian predators were observed feeding on bats at Gomantong Caves in Sabah, Malaysia. The feeding behaviour of the birds depended on the behaviour of the bats. On some nights *Tadarida plicata* left the caves in large spectacular flocks before dusk, while other nights they dispersed out of the caves after dark. Up to 15-20 birds of seven species fed on *Tadarida* when they formed large flocks and an estimated 100-200 bats were captured per night. Only Bat Hawks, *Machaerhamphus alcinus* continued to feed on bats on other nights, and they often captured species other than *Tadarida*. The high rate of predation on flocking *Tadarida* suggests that flocking confers advantages such as improved foraging efficiency which offset the increased risk of predation.

Sensory Ecology of Moths and Bats: Zoogeography and Neuroethology*

James H. Fullard

The predator/prey interactions of moths and bats can be conveniently simplified on the basis of which sensory modality is responsible for mediating their behaviours. Since only sound forms this basis, it has allowed for the proposition of a series of hypotheses which deal with the sensory ecology of these animals. Which acoustic situations signal an attacking bat for a listening moth and how bats have altered their echolocation design to minimize their reception will be discussed. Moths face certain signal ambiguity problems in receiving and correctly identifying the calls of bats. For every theoretical acoustic avenue for reduced signal detection, there is a bat which has developed an echolocation pulse apparently designed to exploit that parameter. The atypically high frequency signals of certain African bats and the faint "whispering" calls of Panamanian bats provide a zoogeographic basis for examining the possible mechanisms to reduce a bats' acoustic conspicuousness to sympatric, auditive moths. The resultant physiological and biophysical auditory adaptations in moths studied in Cote d' Ivoire, Zimbabwe, Hawaii and Panama to circumvent these acoustic ambiguities will also be discussed. The neural bases responsible for central processing of bat calls by moths will be described and neuroethological models for the moth defenses of flight alteration and sound production in alerted moths will be proposed.

Horizontal and Vertical Target Localization in the Mustache Bat†

Zoltan M. Fuzessery

An insectivorous bat must accurately determine the location of its prey in three-dimensional space, based on spatial information contained in the echoes of its emitted pulse. In the mustache bat (*Pteronotus p. parnellii*), the frequency-dependent directionality of the external ears generates monaural and binaural spectral cues which provide horizontal and vertical spatial information. When measured over a range of frequencies found in the emitted pulse, the directionality of the ears shifts about 30 degrees in the vertical plane, thus generating spectral cues with elevational information. Within the central auditory system, the vertical spatial selectivity of a neuron is determined by the frequency to which it is tuned, reflecting the directionality of the ear at this frequency. A neuron's horizontal spatial selectivity is determined by its sensitivity to the intensity differences generated between the two ears. This sensitivity shifts the neuron's spatial selectivity along the horizontal axis, either towards or away from the center of the bat's frontal sound field. The horizontal and vertical target location to which a neuron is most sensitive is therefore determined by its frequency tuning and sensitivity to interaural intensity disparities. A binaural comparison of the power spectrum of the returning echo can potentially provide the bat with a bi-coordinate system for target localization.

The Life of Bats in a Town*

Jiri Gaisler and Zdenka Bauerova

In 1957-1985, data were collected on the bat community in a central European town, covering an area of 230 km^2 and inhabited by 370,000 humans. The information is derived from 1934 records of captured bats and approximately 500 observations of flying ones. In all, 15 species were ascertained; *P. pipistrellus*, *E. serotinus* and *P. austriacus* were most abundant. The three species inhabit the town throughout the year and have also been identified when flying; they are most abundant in the inner area of the city. *M. myotis* and *R. hipposideros* have also occurred throughout the year. Their roosts are situated in peripheral parts of the town. The remaining species were found in small numbers, in different areas and seasons, only *N. noctula* throughout the year. Most summer roosts were found in older buildings, *E. serotinus* was also found in new panel-built houses. Underground spaces in the territory of the town are used as hibernacula by five species of bats. In 1979-1985, the winter occurrence of *P. pipistrellus* was monitored in aboveground spaces of a church tower neighboring a heated building. This hibernaculum is inhabited from early November till late March on average. Direct observations and trappings were used to study bat activity and shifts in the population, including a considerable vertical range from ground to 12th floor, and a considerable temperature range.

Songflight in Male Pipistrelle Bat (*Pipistrellus pipistrellus*)†

R. Gerell and K. Lundberg

Three neighboring territorial males of the pipistrelle bat were studied in South Sweden from April to October 1984. The mating system in the pipistrelle bat is a "resource defence polygyny" (Gerell and Lundberg 1985). The aim of this study was to determine the relative importance of the potential resources, food and roost sites (in this case bat boxes), for the males in getting access to females. The results obtained show that from June to mid-August, the males only visited their territories occasionally during night time and mostly without foraging. From mid-August to the end of September, i.e. the mating period, their territorial attendance increased. This was due to territorial advertisement by a songflight display. The flight consisted of a fixed, circular or elliptical path (100-200m), which always touched the roost site. The song is emitted exclusively by territorial males during the songflight. The call is similar to the common social call (18 kHz) but is followed by an after-call consisting of a series of V-shaped frequency variations between 32-37 kHz. The song is usually repeated regularly (1.7 times/s). The extraordinary amount of flying connected with the songflight resulted in a weight decrease of the males. The results show that the roost site is the most important resource for the male's chances to get access to females. A comparison between the three males studied shows that the male who spent most time in songflight display was visited by the greatest number of females.

Migratory Patterns of Some Indian Bats*

A. Gopalakrishna

The migratory patterns of *Taphozous melanopogon*, *Rhinopoma microphyllum* and *Hipposideros lankadiva* in some localities in India are described. All these species live in large colonies in the dungeons and underground towers of old forts. *Taphozous melanopogon* migrates from Daulatabad, Chikalda and Narnala to Burhanpur and Asirgarh in December and returns to the original colonies early in June. *Rhinopoma microphyllum* migrates from Osmanabad (colony in cave temples) to Burhanpur, Asirgarh and Gwalior during March and returns to Osmanabad in August. *Hipposideros lankadiva* migrates from Mandu to Balharshah in April and early in May and returns to Mandu in January. The migratory activity coincides with the onset of the breeding season in all these species.

Activity Patterns of Jaw Muscles During Mastication in *Pteropus Giganteus**

Greet De Gueldre and Frits De Vree

High-speed cinematography was synchronized with quantified electromyograms from the jaw closing and opening muscles, while freely feeding pteropids were masticating apple. Although food is reduced by nearly orthal movements, pteropids generally masticate on one side at a time and reversals frequently occur. At the start of jaw closure, the mandible initially continues to move toward the working side by activities of the balancing side AD (anterior) and PD (posterior digastric) and working side LPT (lateral Pterygoid), and ZM (zygomaticomandibularis). Soon thereafter all adductors become bilaterally active, except the ST (superficial temporalis) and SM (superficial) and DM (deep masseter). Initially higher levels of activity in the balancing side ZM, MPT (medial pterygoid), DT and the working side LPT move the mandible toward the midline during slow closing. ST, SM and DM become bilaterally active at tooth-food-tooth contact. This coincides with a short rise in activity of both AD and low activity levels in both GH (geniohyoids). All adductors and both LPT simultaneously reach peak activities near the middle of slow closing. During slow opening low activity levels in SM, DM, LPT and MPT account for the small protrusion seen in this phase. In addition, activity in both AD and PD increases bilaterally and both GH reach peak activity. All working side muscles are more active, resulting in a small deflection toward the balancing side. Near the end of opening, the mandible is swung towards the working side by higher levels of activity in the balancing side AD, PD, MPT and LPT. Both AD and PD reach peak activities just before maximum gape.

Binding of Sex Steroids to Plasma Proteins: Relation to Androgen Resistance and Asynchronus Reproductive Patterns in Hibernating Bats*

A.W. Gustafson and D.A. Damassa

The male reproductive cycles of the Old and New World bats that hibernate are distinguished collectively by an asynchronous, annual recrudescence of the testis and the accessory reproductive organs. This asynchrony results in testicular accessory organ cycles which are out of phase with each other. Although it has been shown that total plasma testosterone (T) concentrations increase concurrently with the onset of testicular activity in spring, the accessory organs do not increase in weight or show other signs of seasonal reactivation until considerably later when the T levels attain maximal or near maximal values. This delayed responsiveness on the part of the T-dependent accessories suggests some form of androgen "resistance" — be it either a change in hormone sensitivity of these targets or a change in hormone availability to their cells and tissues. However, since some limited experimental evidence suggests that the glandular tissues are responsive to exogenously administered androgens, the more likely cause for this "resistance" would appear to be due to variations in the availability of these hormones rather than to changes in target sensitivity. In the blood of mammals, T circulates mostly bound to plasma proteins with the result that only a very small percentage of this steroid exists as unbound or free hormone. Although nonspecific binding of T by albumin undoubtedly occurs universally in the circulation of mammals, the specific binding of T by a sex steroid-binding protein (SBP) has also been identified in many species. Together, these two plasma proteins account for the majority of the androgen-binding activity in the circulation. A current model concerning the role of the binding of sex steroids to plasma proteins in relation to androgen action holds that the low affinity binding of T by albumin has relatively little influence on androgen availability or activity, whereas the high affinity binding of T by SBP renders this hormone essentially unavailable for physiological action. Consequently, the free and the albumin-bound T fractions represent the biologically active signals. Thus, increases or decreases in plasma levels of SBP would markedly influence the action of T by altering this hormone's extra- and intracellular distribution and availability. Recently, a specific SBP has also been identified in the circulation of several New World vespertilionid bats that hibernate including *Myotis lucifugus lucifugus*, *Myotis keenii septentrionalis*, and *Eptesicus fuscus fuscus*. In *M. l. lucifugus*, plasma concentrations of this protein were found to undergo marked seasonal increases during the onset of spermatogenesis resulting in low levels of unbound and albumin-bound T, even though total T concentrations were rising. Only when the non-SBP-bound T fractions increased did the accessory organs show evidence of androgen stimulation. Therefore, the hypothesis is presented that elevated levels of SBP may be a major factor in the apparent androgen "resistance" observed in bats that hibernate, and thus play an important role in the delayed response of the accessory organs which characterizes their asynchronous reproductive patterns. This is supported by PHS Grant HD-16535.

Short-Term-Rhythm of Motor Activity and Feeding in the Neotropical Freetailed Bat *Molussus molussus pallas**

Ursel Haeussler

Single individuals as well as pairs and small social groups of *M. molussus* kept under artificial lighting conditions during the circadian activity phase show well pronounced ultradian changes between activity bouts and short rest times. The mean period length of this short-term-rhythm amounts to about one hour (67.8 ± 19.5 min.). This rhythm also persists when the circadian activity rhythm freeruns under constant conditions. It is influenced by the light intensity and ambient temperature as well as by social factors, and varies depending on age and body weight of the bats. Each burst of activity consists of a series of certain behavioral patterns appearing in a fairly predictable sequence which depends on the phase of the circadian cycle. Since the short rest times exceed the short activity times (x = 43.8 vs. 22.4 min.), only 35%, i.e. only about four hours of the whole daily (circadian) activity phase are spent in activity. A distinct short-term-rhythm superimposed to the circadian activity rhythm is thought to represent a primitive character in mammals. It may enable the small insectivorous *M. molussus* to exploit its discontinually available resources in the most economical way.

Abundance of *Pipistrellus pipistrellus* and *Pipistrellus kuhlii* Foraging at Street-Lamps†

Marianne Haffner and Hans-Peter Stutz

Foraging habits of *P. pipistrellus* and *P. kuhlii* were studied along streets in southern Switzerland. While *P. kuhlii* forages mainly at street-lamps, *P. pipistrellus* forages in the same proportion at street-lamps and apart from them. Both species significantly prefer lamps with high UV-proportion and luminosity which are known to be attractive to insects. Interactions occur only in regions with equal abundance. There, *P. kuhlii* dominates the preferred lamps, while *P. pipistrellus* shifts randomly to other lamps but keeps the proportion of foraging similar at lamps and apart from them. These two species with similar roosting behaviour but distinct foraging behaviour are therefore differently adapted to man-made structures.

Correlative Value and Biogeographic Significance of Australian Tertiary Bats†

S. Hand and M. Archer

Since 1976, eleven new fossil bat taxa have been recovered from Tertiary-aged freshwater limestones on Riversleigh Station, northwestern Queensland, Australia. These internationally-shared groups of bats have provided the first good opportunity for intercontinental correlation of Australian Tertiary mammal-bearing deposits. Other species of Tertiary Australian bats and rodents have provided no correlative information because they are so poorly understood phylogenetically. Of the eleven Riversleigh fossil taxa, four are species of *Hipposideros* (*Brachipposideros*); two species are placed in the genus *Macroderma*; and one is referred to in the genus *Mormopterus*. Another two megadermatid species, including a *Lavia*-like animal, appear to lie outside the Australian *Macroderma* lineage. A rhinolophid and a species of *Hipposideros* are also represented. Surprisingly close phylogenetic relationships between Australian, European and north African Tertiary species of the Hipposideridae and Megadermatidae suggest that the Riversleigh sediments are of middle Miocene age. The new Australian molossid is compared with other molossids for the first time and its biogeographic significance discussed. The Riversleigh bat fauna is diverse and suggests that bats first entered Australia well before the middle Miocene. Representatives of the Pteropodidae, Emballonuridae and Vespertilionidae are conspicuous by their absence.

The Acoustic Behavior of Two British Bats and Doppler Radar for Flight*

David J. Hartley

The open-air acoustic emissions of noctules *(Nyctalus noctula)* and pipistrelles *(Pipistrellus pipistrellus)* were examined with regard to social calls, general echolocation behavior and to the specific sonar properties of the sound pulses produced during the detection and interception of prey (deduced by full ambiguity analysis). Previously unreported social sounds were found in the noctule, including a possible collision warning. When approaching a target, both bats altered the sonar characteristics of the sounds produced in a highly systematic way, such that the skew of the ambiguity ridge was related linearly to time and (probably) to bat-to-target distance. During the course of this study, an analogue system allowing real-time frequency analysis of signals was developed, the operating principles of which are used in the frequency-meter demonstrated by QMC Instruments at this meeting. Previous studies of the potential of low-power Doppler radars for the analysis of bird and bat flight were extended, and as an example an analysis of a lanner falcon *(Falco biarmicus)*, tracked by such a radar, is presented.

Simultaneous Recording of Flight and Echolocation Behavior in Bats†

Klaus Heblich

Flight, landing and echolocation behaviour in *Rhinolophus ferrumequinum* were studied in the laboratory. Flying bats were photographed by two 16mm high-speed motion-picture cameras running synchronously. The orientation sounds were picked up with a microphone and recorded on a tape recorder. Simultaneously a microprocessor-generated binary synchronization code was recorded on film and tape, enabling the correlation of the bats flight behaviour and the corresponding echolocation sounds. Flight paths were reconstructed three-dimensionally from corresponding pairs of frames of the two cameras, using a photogrametric procedure. The presented results demonstrate that this method enables a quantitative analysis and a precise correlation of flight parameters (flight paths, flight speed, distance to a target, wing beat) and echolocation parameters (pulse pattern, duty cycle, frequency and Doppler shifts) in free flying bats.

The Echolocation Calls of 12 Syntopic Rhinolophid Species *(Rhinolophus, Hipposideros)*†

Klaus-Gerhard Heller

Tropical rain forests display a high diversity of species, and also a large number of Microchiroptera, most of them hunt insects by means of ultrasonic sounds. The influence of such an intense competition on the structure of the echolocation calls is to be exemplified by 12 species of the family Rhinolophidae; all of them can be found in the Kerau Game Reserve, Malaysia. The constant frequencies of the calls of the individual species (during the recording the animals were kept in the hand) are as follows: *Rhinolophus macrotis* 48 kHz, *R. trifoliatus* 52 kHz, *R. affinis* 76 kHz, *R. stheno* 86 kHz, *R. refulgens* 98 kHz, *R. luctus* 42 kHz (Roberts 1972), *Hipposideros diadema* 55 kHz, *H. ridleyi* 61 kHz, *H. cervinus* 126 kHz, *H. bicolor* 141 kHz, *H. sabanus* 200 kHz, *H. armiger* 66 kHz (Gould 1980). In addition to the general inverse proportional dependency of frequency to body size, the following can be said: The Rhinolophus species (together with the Malaysian *R. sedulus*, which has not been found in Kerau: 64 kHz) cover almost the whole frequency range from 40 to 100 kHz. In comparison to 'normal' species, the forms with the biggest and most modified noseleaves have conspicuosly low frequencies. The Hipposideros species do not show such a homogeneous picture. Only by taking into account other Malaysian species, which have not been found in Kerau (*H. cineraceus* 151kHz, *H. galeritus* (?) 145 kHz, both Gould 1980), this genus turns out to cover the range between 100 and 200 kHz. There are, however, distinct overlappings, gaps and exceptions.

Echolocation in the Megachiropteran Bat, *Rousettus aegyptiacus*†

Horst Herbert

The echolocating bat *R. aegyptiacus* only produces echolocation sounds in darkness. The bats' echolocation sounds are clicks produced with the tongue. The clicks always occur in pairs. The interclick-interval within the pair is between 15 ms and 20 ms. The duration of a single click is about 0.6 ms to 1.0 ms. The frequency range extends from 12 to 70 kHz with a maximum in intensity at about 20-40 kHz. Depending on the flight situation *R. aegyptiacus* alters its click pair emission

rate. In free flight the emission rate is between 7 Hz and 9 Hz, during approach flight it increases up to 11-16 Hz. Recordings with a highspeed movie camera revealed a correlation between wing beat and pulse emission. *R. aegyptiacus* produces one or two click pairs per wing beat. In free flight one pair is produced in the middle of the downstroke. In approach flight two pairs per wing beat occur. The first pair is emitted during downstroke, the second during upstroke.

Systematics of the New Zealand Short-Tailed Bat *Mystacina* Gray, 1843 (Chiroptera: Mystacinidae)*

J. E. Hill

Specimens of the short-tailed bat *Mystacina* Gray, 1843 from several localities in New Zealand show that this endemic genus consists of two species. The smaller of these, *M. tuberculata* Gray, 1843, apparently occurs throughout New Zealand, extending to at least some of the associated small islands to the south. The specimens available indicate some intraspecific variation with altitude and latitude and three subspecies are defined, two being described as new. The larger species, *M. robusta* Dwyer, 1962, found until 1965 only on two small southern offshore islands, has not been reported since and is now believed extinct. This species has not been found live on North, South or Stewart Islands since European settlement in the early part of the nineteenth century. The initial description of *M. tuberculata* and other early accounts of this species have been examined in an attempt to establish the original material seen by Gray. The early literature also shows that the other endemic New Zealand bat, *Chalinolobus tuberculatus*, should be ascribed to Gray (1843) and not to Forster (1844) as is customary.

Mating Systems in *Myotis blythi* (Tomes, 1857)*

Ivan Horacek and Jiri Gaisler

Observations on mating system of *M. b. punicus* (Algeria) and *M. b. blythi* (Yirghizia) are described and compared with those on *M. b. oxygnathus* and *M. myotis* (Mid- and SE-Europe). Breeding colonies of the former two are regularly accompanied by males which roost territorially, in particular along entrance corridors of breeding chambers. Since late summer (to October in Algeria) females join the males to form harem groups (1-7 females per male). Males occupy their territories prior to morning arrival of a colony (30% 60 min., 85% 15 min.), during or immediately after which most harems are formed. Females land in a male's territory and move slowly towards the male until being fixed and wrapped by his wings. Then, intensive facial strikes (performing scent marking) occured. The same behaviour was performed when a female tended to leave a harem group. Some males remain solitary: 60% (morning) to 36% (late afternoon). The males which were regularly successful in attracting females showed little acoustic activity and few flying displays, while males that engaged in more frequent acoustical and flying displays appeared to be two-year-olds. These younger males (upon dissection) had enlarged testes but their facial glands were, as yet, poorly developed. Males with prolonged attachment of females (some of which remained with these males up to three hours after the rest of the colony departed) had in fact formed their harems within an hour of the colony's arrival, suggesting that females are more receptive to scent sensations than active display. The significance of these differences in mating systems among the forms studied is discussed briefly. The incomplete sexual segregation during the breeding period and the prolonged phase of harem organization observed in the southern forms of *M. blythi* suggest an intermediate state between the more "ancient" social organization as seen in *M. bocagei* and that we observed in the European bats.

Generic Status of *Pipistrellus savii* (Bonaparte, 1837) and Remarks on Systematics of the Genus *Pipistrellus**

Ivan Horacek and Vladimir Hanak

Classification of the genus *Pipistrellus* (s. lat.) represents one of the most complicated topics in chiropteran taxonomy. It seems clear that the traditional concept of that genus (which makes the name applicable to any small-sized, short-eared vespertilionid with P2/P2 dentition and no particularly striking characters) delimits quite well one of the grades of vespertilionid organization but does not prove monophyly of this complex. To avoid future confusion, a new diagnosis of the genus is to be proposed in respect to the available criteria of real phylogenetic significance. An attempt in this direction has been undertaken in connection with a study of the forms referred to as *P. savii* (alashanicus, aristoniamus, caucasicus, coreensis, tamerlani, velox, etc.). They differ from most *Pipistrellus* spp. in almost all characters examined except for those common to the *Pipistrellus*-grade. Similar differences also appear against most of the other genera. Such a state could be expressed in classification in two ways. One has been already proposed by Kuzyakin (1950, 1974) and Sokolov (1973) who arranged all problematic genera (*Pipistrellus, Eptesicus, Vespertilio, Glischropus, Ia, Tylonycteris, Philetor, Leaphotis, Histiotus*) under common name *Vespertilio*. If *Nyctalus* would be included also (because of its relationship to *Pipistrellus* and *Philetor*) this concept might be provisionally accepted, at least until paraphyly of the group is factually proven. Nevertheless, such a classification would express nothing concerning factual diversity of the group and appears to be a retrograde solution. Hence, we suggest another alternative: to arrange all the problematic taxa into separate genera, diagnoses of which would make their content clearer though narrower than commonly used. For such a case, name *Hypsugo* (Kolenati), 1856 is available for *savii* (and related forms: *cadornae, pulveratus*) and a new genus *Parastrellus gen. n.* is proposed for *Pipistrellus hesperus* (Allen, 1864). Differential diagnoses of all the respective genera are given and their relationships are briefly discussed.

The Relationship Between Renal Structure and Function in Chiroptera: A Re-Examination*

G. Roy Horst

It has become traditional to make predictions about renal conservation of water based on calculations of the relative thickness of the renal medulla. While such predictions agree in some cases with measured urine osmolar maxima, in *Desmodus* such calculations fall short by nearly one-half. Several other factors are equally (or more) significant and when all are considered together, a more reliable prediction of renal limits are obtained. The establishment of high osmotic gradients in the countercurrent loop of Henle-collecting duct-capillary rete is a function of sodium transport efficiency by the cells lining these segments. Flow rate through these tubular elements must not exceed the wash-out rate of the established osmotic gradient. This flow rate is determined primarily by tubular radius since flow rate varies as the fourth power of radius but only linearly with tube length. Pressure gradients are small and viscosity remains nearly constant. Two species with similar relative medullary dimensions may have different tubular radii, even a twenty percent increase in

tube radius would result in a two-fold increase in flow rate. Water reabsorption (and conservation) is directly dependent on levels of circulating vasopressin (anti-diuretic hormone), which is in turn dependent on synthesis rates of this neuropeptide by the supra-optic and paraventricular nuclei of the hypothalamus. Transport of vasopressin by the hypothalamo-hypophyseal tract and release by the neurohypophysis may be a limiting factor. Finally, in temperate zone bats that enter torpor, renal arterial blood pressure may fall to near or below the oncotic pressure of the plasma and filtration would cease, with profound effects on concentration. Admittedly determinations of circulating vasopressin levels, rates of vasopressin synthesis, and glomerular filtration rate require sophisticated techniques and are generally impossible in the field. However tubular dimensions in the renal medulla, and size and complexity of the supraoptic and paraventricular nuclei can be examined using carefully fixed tissues. These basic anatomical techniques can be satisfactorily initiated in the field. Some of these additional considerations combined with traditional measurements of the renal medulla would allow more accurate indications of the water economy of the species in question. Ideally, of course, one could simply measure urine concentration and flow rate; unfortunately this too is often difficult if not impossible under natural conditions.

Progress on Conservation of Bats in Britain*

A. M. Hutson

The Wildlife and Countryside Act, 1981, protects all bats in Britain. The Act gives bats greater protection than any other wild animals in Britain, in that any action that might disturb bats has to be discussed with the Nature Conservancy Council, the government conservation body. This even applies to buildings including privately owned houses and includes efforts to remove bats, as well as structural alterations and remedial timber treatment. It allows the opportunity to discuss the special roosting requirements of bats, to dispel misunderstandings about bat biology and to recommend ways in which any necessary action can be carried out with minimum disturbance to bats. The publicity given by the law made many people aware of bats and their problems and encouraged the appointment of the first non-governmental Bat Conservation Officer in June 1984. In that position I have received nearly 2000 letters from members of the public interested in further information (800 in the last two months). To help the NCC make the law effective, interested people have formed local bat groups. There are now over 50 such groups in Britain, willing to investigate bat problems, to make efforts to educate the public and to carry out survey work on their local bat fauna. The success of the system developed to investigate bat "problems" is demonstrated in Tony Mitchell-Jones' poster exhibit. Of people wishing to have their bats removed, 75% were persuaded to take no action. Of people visited to discuss remedial timber treatment, most treated as advised at times of low sensitivity and with chemicals with low bat toxicity, and most others did not carry out treatment. Newspapers and magazines, television and radio, have continually given publicity to the plight of bats and the work of bat groups. The statutory obligations of the law and the growth in interest in bats have resulted in more manpower and money, both public and private, being devoted to research and conservation. The work of the bat groups is coordinated through a central panel, Bat Groups of Britain. This panel discusses research and conservation projects and helps in the production and distribution of literature, an educational slide-pack, identification guides, newsletters, posters, stickers, exhibition material, guides to equipment and techniques; thereby helping the bat groups and advancing public awareness of conservation and research. 1986 will be National Bat Year — organized as a major effort towards public awareness, involvement and fund-raising for bats.

Basic Data For Bat Conservation in Northern Germany*

Ulrich Judes

Thirteen bat species have been found in Schleswig-Holstein (N. Germany) until today, but in total very few data are available, even from the last 10-15 years (Pieper and Wilden 1980). Like in many other areas nearly nothing is known about the actual status of these bats, including details of their regional distribution, their population densities, habitats and places for hunting, breeding and hibernation, contamination with insecticides and other ecological questions. In one region of Schleswig-Holstein (district Hzgt. Lauenburg) a special program was started in 1981, which has three main components (Judes 1985): 1) information for and communication with the public to make everybody familiar with bats as important and very interesting animals and to get more hints of flying bats and bat roosts; 2) scientific research projects on distribution of bats and some ecological problems using different methods of field work, e.g. bat detecting by ultrasound calls, mist netting, and laboratory work, on insecticide contamination; and 3) conservation activities, e.g. protection of known and potential bat roosts, hanging of bat boxes, construction of artificial winter roosts, development and improvement of potential feeding habitats. Strong relations are tried to be developed between these three components with a positive feedback resulting in new data and new ideas, which may stimulate a concept for successful bat conservation.

References:

Pieper, H., Wilden, W. (1980): Die Verbreitung der Fledermause (Mamm.: Chiroptera) in Schleswig-Holstein und Hamburg 1945-1979. Faun.-Okol. Mitt., Suppl. 2, 1-31.
Judes, U. (1985): Fledermause und ihr Schutz. Kiel.

Post Implantation Development of the Indian Rhinopomatid, *Rhinopoma hardwickei hardwickei* (Gray)*

K. B. Karim and Mohammad Fazil

Implantation of the blastocyst is superficial and circumferential. There is an enormous hypertrophy of the endoderm of the bilaminar omphalopleure and the entry of the endodermal layer into the crypts of the trophoblast layer. At the early limb-bud stage of development the diffuse placenta is recognized into: a chorio-allantoic placenta on the mesometrial side, a chorio-vitelline placenta on the lateral sides and an extensive bilaminar omphalopleure on the abembryonic side with hypertrophied endodermal cells. The diffuse placenta at the late limb-bud stage can be recognized into a horse-shoe shaped chorio-allantoic placenta and a small segment of the disorganized placenta which forms ridges protruding into the yolk-sac cavity, the hypertrophied endodermal layer investing the ridges and forming villi in between the ridges. Some hypertrophied endodermal cells are seen engulfed within the ridges of the disorganised placenta. Mid-pregnancy is characterized by the presence of degenerating placental pads, the extensive bilaminar omphalopleure being closely juxtaposed to the pads. The chorio-allantoic placenta at advanced pregnancy is deep saucer-shaped. At term, the chorio-allantoic placenta is mesometrial, discoidal, labyrinthine and endotheliochorial. The yolk sac occurs as a gland-like structure abutting the placenta. The yolk-sac cavity persists as streak-like spaces. A few endodermal acini become pinched off from the endodermal layer and lie in the mesodermal matrix. Both the endodermal and mesodermal cells are hypertrophied.

Echoes of Fluttering Insects*

Rudi Kober

Insects were mounted in the acoustical beam of an ultrasonic loudspeaker and the returning echoes were recorded and analyzed. Results: 1) The echo of a non-flying insect contains the carrier frequency with constant amplitude; the echo of a flying one is characterized by frequency and amplitude modulations. The spectrum shows broadenings in the rhythm of the wing beat, which are accompanied with short peak intensities (= glints). The peak echo intensity of a flying insect is up to 30 dB higher than the echo intensity of a non-flying one. 2) The angular orientation of a flying insect in relation to the sound source is encoded in the echo. 3) Insects could be classified with the aid of the following echo parameters: a. The glint frequency encodes the wing beat frequency. b. The width of the sidebands in the spectrum is at a given wing beat frequency a clue for the wing length. c. The echo intensities of a flying insect at an orientation of 90° and 0° to the sound waves may be a clue whether the wings are moved more in a vertical or horizontal plane (wing beat type). d. The echo intensity is a rough clue for the insect size.

Environmental Effects on Thermoregulation and Metabolic Rate in the Little Brown Bat (*Myotis Lucifugus*)*

Allen Kurta

Will *M. lucifugus* use the added insulation of clustering and of wooden roosts in order to maintain a high body temperature (TB), throughout the day, under average environmental circumstances? Bats captured just before dawn were placed as groups of eight or nine animals into a hollowed-out wooden beam, resembling a mortice, that served as a metabolic chamber. The design of this chamber was such that the bats consistently clustered around a central thermocouple. Continuous recordings of cluster temperature (TC) and oxygen consumption (OC) were obtained as the air temperature (TA) inside an incubator was gradually changed throughout the day. The schedule of TA changes represented average temperatures for an unoccupied roost at that time of year; 16 pregnant, 10 lactating, and 7 post-lactating clusters were monitored between sunrise and sunset. Cluster temperature averaged about 32° C indicating that the bats were not falling into daily torpor. Mean OC over the 15-h time span was 24.52 ± 0.61 ml O_2/bat/h for pregnant clusters and 19.93 ml O_2/bat/h for the lactating groups. Mean TB at the end of the day-long experimental runs was 36.94° C for both pregnant and lactating clusters. After simulating a night of inclement weather that prevented foraging activity, OC fell 61% and 46% for pregnant and lactating clusters, respectively. Mean TB at the end of these runs was 29.35 ± 0.48° C for pregnant bats and 30.40 ± 0.46° C for the lactating animals. Similar effects on OC and TB were noted for bats captured after foraging bouts that had been interrupted by rain.

Physiology of Thermoreception in Vampire Bats*

Ludwig Kurten and Uwe Schmidt

The vampire bat *Desmodus rotundus* has been shown to be capable of detecting temperature differences. They respond in behavioral experiments to infrared radiation as low as 5×10^{-5} W cm². The animals are able to detect the radiation of human skin at a distance of 13 cm. In electrophysiological recordings from the infraorbital nerve numerous specific cold and warm receptors have been found. Seventy-four of the total 77 receptors were situated on the central nose-leaf or on the rostral part of the upper lip. The cold receptors exhibit a static discharge at constant temperatures between 10 and 40° C. Twenty of 27 cold receptors tested had a maximal static activity at 25° C. The frequency at this peak temperature ranged in the different neurons between 7.9 and 24.2 impulses/s. The maximal dynamic responses were found at the temperature step from 30 to 25° C with peak frequencies between 31 and 160 imp./s. Warm receptors exhibit a static discharge between 20 and 40° C, the maximal static activity was in most cases at 40° C with frequencies between 19 and 66 imp./s. The maximal dynamic response was found at the temperature step from 35 to 40° C (62 – 156 imp./s). Thus, compared to other mammals the properties of thermoreceptors in *Desmodus* are quite different. The cold receptors represent a homogeneous population and exhibit a high static activity. The range of warm receptor discharge is shifted to lower temperatures. Receptors with a static activity below 28° have never before been observed in mammals, but can be found in boid or crotalid snakes. Even single receptors are very sensitive to temperature changes. They respond to the radiant heat of a human finger held 2 mm apart from the surface of the nose-leaf with a dynamic decrease (resp. increase) of frequency and a significant change of static discharge. The great number of thermal receptors in the central nose-leaf suggests that this area is responsible for the astonishing thermoreceptive performance of the vampire bats.

The Progress of Research and Conservation of Bats in Jersey and the Other Channel Islands*

Mr. D. d'A. Lafferty

Until comparatively recently little was known about the bat populations of these islands. Research carried out since 1979 supplemented by historical records, show that five species occur in the islands. Commonest is the Pipistrelle (*Pipistrellus pipistrellus* (Schreber)) which is distributed throughout. In Jersey, the Grey Long-eared (*Plecotus austriacus* (Fischer)) is the second commonest species. One breeding roost of around forty females is known. Other species recorded are the Serotine (*Eptesicus serotinus* (Schreber)), Barbastelle (*Barbastella barbastellus* (Schreber)), and the Greater Horseshoe bat (*Rhinolophus ferrumequinum* (Schreber)). This latter species has bred in two of the islands earlier this century, and did so in Jersey until a few years prior to 1950. Recent research has detailed the distribution of bat roosts in Jersey but has not solved where the island's bats hibernate in the winter, and possible exchange of bats with France or other Channel islands should be considered. Legal protection of bats is the worst in Western Europe, ranging from very limited protection in Jersey to literally none in the other islands. Better laws need to be introduced soon to prevent the disturbance of bats, or destruction of roosts, that has occurred in the past.

Folliculogenesis in *Rhinopoma Kinneari* Wroughton (Microchiroptera: Mammalia) and Histochemical Profile of 5-3B- Hydroxysteroid Dehydrogenase in the Ovary During Nulliparous and Gravid State*

S. B. Lall

The breeding phase of *Rhinopoma kinneari* is of limited duration (October-March). Pregnant and lactating females were collected in December and May respectively. Both ovaries are functional and the uterus is bicornuate. However, a single conceptus develops to full term. Active folliculogenesis occurs during late October–early December. Primary, secon-

dary, pre-antral, antral follicles and a single mature Graafian follicle can be observed during this period. Follicular atresia is extensive. Follicles were classified on the basis of total diameter, meiotic stage, number of granulosa cells and nuclear size. A single introverted corpus luteum was discerned in the ovary which released an ovum of pregnant bats. During this state no sign of folliculogenesis were discerned. Histochemical profile of a steroidogenic 'marker' enzyme 3-3B-hydroxysteroid dehydrogenase (3-3B-HSDH) varied considerably in bats exhibiting folliculogenesis and ones which were pregnant. Sites of 3-3B-HSDH showed intense accumulation of diformazon granules in the ovary of pregnant bats. This was funded by UGC.

Investigations on the Olfactory System in *Carollia perspicillata**

M. Laska and U. Schmidt

Three male *C. perspicillata* were trained in a flight tunnel to locate an olfactory stimulus. The odour source (3g mashed ripe banana fruit on a 14cm² glass plate; spreading of scent by diffusion) was presented at random at three different positions. When the animals had learned to respond correctly (after 200 trials) the amount of banana and the diffusing surface were gradually reduced. Positive reactions could be registered down to 50mg banana at 0.2%cm². The bats did not show a positive transposition to iso-amylacetate, one of the major components of natural banana flavour, nor did they respond to natural mango flavour. Another series of experiments gave evidence for a dramatic dependence of the olfactory abilities on the relative humidity. The analysis of the v.t.e. behaviour and other parameters during the flights gave detailed information about the strategies used by the animals when depending on the sense of smell for locating a food source.

Hunting Habitats of a Northern Bat Community†

Rudolf Lehmann

I have studied a summer bat community consisting of the three species *Myotis brandti*, *M. daubentoni* and *Eptesicus nilssoni* since 1981. The study site is in Tvarminne at the southern coast of Finland (59°51' N, 23°15' E) and includes a peninsula of about 1.5km². About 70% of the study area is covered by forests. The localities where hunting bats were observed during line transects were marked in the field for later description. The bat species were determined with the help of an Uppsala bat-detector. The results indicate that the three species differ markedly in their hunting habitat choice. *E. nilssoni* prefers open places and *M. brandti* not too dense forest, whereas *M. daubentoni* forages over water.

Activity, Food, and Foraging of the Lesser Horse Shoe Bat (*Rhinolophus hipposideros*) at Nursery Roosts in Co. Clare*

Kate McAney

A three-year study of the activity, food, and foraging of the Lesser Horse shoe bat during the summer commenced April 1983. To-date results obtained have undergone preliminary analysis only. Bats were present in the area from April until October each year and roosted along rafters in farm buildings and along barge boards and soffits in dwelling houses. Colony size varied throughout the season with the highest number emerging in August. Pre-emergence behaviour involved vocalization and frequent flights to the exit point. At the onset of emergence bats were seen to leave the roost and re-enter almost immediately, with the peak rate of emergence occurring midway through the exodus. Those exiting from soffits flew away directly. A variation in ultrasonic emission occurred between roost types as did the level of activity during the night. The first bats to return at dawn repeatedly flew past the roost before entering as opposed to the later arrivals who entered directly. Young were present by early July and on the wing by mid-August. Insects eaten included Lepidoptera, Nematocera, Hymenoptera, Trichoptera and Neuroptera. Foraging was observed at lakes, rivers, roadways, woods and near the roosts, with lakes appearing to be the preferred sites. A distribution survey of the species in the county has begun and will continue until October 1985. Due to the status of the species all research undertaken has been designed to cause minimum disturbance.

The Morphometrics of the Bat Lung*

J.N. Maina and A.S. King

The bats (order, Chiroptera) and the birds (class, Aves) are unique among the vertebrates in being capable of active sustained flight. The energetic demands for flight are known to be high and similar in bats and birds. The bats, which in principle have a typical mammalian lung, would nevertheless be expected to have acquired cardio-pulmonary adaptations to facilitate a gas exchange capacity equivalent to that provided by the much more elaborate avian lung. In an attempt to elucidate this, the lungs of six species of bat differing in body weight and mode of life have been analyzed. The lungs were fixed, sampled and processed for both light and electronmicroscopy. The requisite structural parameters were quantified using the standard morphometric techniques. The bat lung was found to be structurally better adapted for gas exchange than the lungs of birds and terrestrial mammals, mainly by having a relatively larger lung, a relatively more extensive surface area for gas exchange, and a remarkedly thin blood-gas barrier, adaptations which confer a superior anatomical pulmonary diffusing capacity for oxygen. When these anatomical adaptations are coupled with physiological modifications, including a large cardiac output, high haematocrit and haemoglobin concentration, they evidently combine to meet the extreme oxygen demands of powered flight.

Recent Developments in Bat Detector Field Instrumentation†

Keith Maries

Even the most compact high-speed instrumentation tape-recorder is heavy, bulky, and expensive in tape. Dynamic range is limited, the results are not instantly available and spoken commentaries become garbled at slow replay speeds. Recent developments from QMC Instruments have been aimed at overcoming these problems. The S200 Bat Detector enables most parameters of an ultrasound signal to be retained on audio cassettes for subsequent analysis, by recording both the frequency divider output, which retains the amplitude and frequency pattern of the principal component, and the heterodyne output, which allows the full bandwidth and harmonics of the signal to be explored. The new QMC period-frequency meter has improved accuracy, frequency range and flexibility compared to existing devices. It can be used with a portable oscilloscope for real time field monitoring and recognition of signals, either at ultrasound or at detector-processed audio frequencies. In the laboratory, it can be used with a storage oscilloscope and tape loops to provide hard-copy output much more accurately and rapidly than with a Sonagraph. The most recent development is a digital memory device which

takes complete samples of the signal *at the time of recording* and digitizes them for storage in RAM and immediately replay at reduced speed through a loudspeaker or recorder line. With pulsed signals of low duty cycle as are emitted by 'cruising' bats and many rodents, efficient on/off triggering of the sampler can permit all signals to be replayed to audio cassettes during the silent intervals. Further advantages over existing methods include inherently high signal-to-noise, expandable memory and a digitized signal available for direct transfer to a microcomputer for further analysis.

Roosting Behaviour Among Megachiroptera*

Adrian G. Marshall

Bats spend over half their lives at roost, and therefore the sites they choose for roosting are of the greatest importance to them. Roosts are used for resting, grooming, food ingestion and digestion, protection from inclement weather, and for social interactions — mating, rearing of young, dissemination of information about food supplies. Old World phytophagous bats, Megachiroptera, roost by day in a variety of enclosed and external sites; in addition, some species may roost briefly at night in trees to consume food. Diurnally, eight genera (19% of the 43 recognized genera) with 29 species (17% of the 174 recognized species) roost in caves and other enclosed sites, 22 genera (51%) with 126 species (72%) roost in trees, and the roosting sites of the remaining 13 genera (30%) with 19 species (11%) are unknown, though most likely to be in trees. Some aspects of roosting behaviour are discussed.

Some Aspects of the Social Behavior of *Artibeus jamaicensis*†

Elise Mayrand and Georg Baron

The social behavior of *Artibeus jamaicensis* was investigated in a group of captive animals at the Centre de Recherches Caraibes, Martinique. Two males and four females were housed in an outside wire enclosure communicating with a wooden roosting-box. Most social interactions were directed from male to male and from males to females. Male-to-male interactions were mainly aggressive, such as head or wing striking which resulted in the displacement of the protagonist. Cohesive behaviors (sniffing, lateral contact) were chiefly observed between males and females. Mounting and forelimb apposition were also frequently initiated by males and directed towards the other male or the females, but the significance of these two patterns is not clear since the response was very variable. Social interactions were rarely seen between females, which did not appear to compete or maintain social contact. In the roost-cage, social groups were often composed of one male (M-1) with two or three females (usually F4-F5 and F2-F4-F5), and of two males with several females. The latter groups may reflect a certain degree of tolerance between males. In fact, keeping watch on a competitor was probably less expensive than continually displacing him because of the low competition pressure (there was only one potential intruder) and the poor quality of the roosts (compared with hollow trees in nature). It was concluded that the basic social system was polygynous. Males defended relatively stable territories, while females often moved from one roost to another and changed partners. The fact that females did not form stable social units excluded the possibility of a male joining and defending an already established female group. Therefore, the polygynous system seemed to be based on defense of resources rather than of females. Resource-polygyny may evolve when a resource needed by females is limited or of variable quality. In the first situation, only some of the males can have territories; in the second, some males have better territories than others. In such cases, females may prefer associating with already mated males which defend favorable habitats than joining unmated males that protect poorer resources or none at all (Orians, 1969). In the enclosure, the variable quality of the roosts appeared to be a possible explanation of the polygynous system, but other factors could also have determined the females' choice. Harems were maintained even during the non-reproductive period. As harem maintenance adds 50% to the energy expenditure of a male (Morrison and Morrison, 1981), some benefit should be obtained from this situation. Facilitation of future mate access might be a factor as is the possible lower cost of maintaining a territory instead of establishing a new one twice a year. There are at least two reasons why *Artibeus* could not establish harems in the flight-cage: 1) the large concentration of fruits at only one location in the enclosure made defense of a territory unnecessary and too expensive; 2) since females foraged independently, males were not able to defend a female group.

Reproductive Asymmetry in Some South African Bats*

M. Van Der Merwe

According to Wimsatt (1975) the Chiroptera as a group show a higher incidence of reproductive asymmetry, and carry it farther than any other mammalian order and expressed asymmetry as a unilateral dominance of the ovary, the uterus or both. Knowledge about reproduction in the 74 species of bats, occurring in the Southern African Subregion, is fragmentary with only a few species being studied in detail. With our present knowledge, South African bats can be divided into three categories. 1) Uterine horns equal (i.e. implantation may occur in either of the two). In this category the ovaries may both function simultaneously or they may alternate. 2) Right uterine horn dominant. In this category both ovaries may be equal in function or, either the right or left ovary may be dominant. 3) Uterine horns not 100% equal. In this category both ovaries are equal in function but a difference may be found in the number of fetuses carried in each of the uterine horns.

Reference

Wimsatt, W. A. (1975). Some comparative aspects of implantation. *Biol. Reprod.* 12: 1-40.

The Lateral Lemniscus in the Rufous Horseshoe Bat, *Rhinolophus rouxi*†

W. Metzner and S. Radtke-Schuller

A very complex but hitherto hardly investigated processing level within the ascending auditory pathway in mammals is the Nucleus of the Lateral Lemniscus (NLL). It is located in the midbrain region just ventral to Inferior Colliculus (IC) and rostrodorsal to Cochlear Nucleus (CN) and Superior Olivary Complex. NLL can be divided into 3 subnuclei: the dorsally located DNLL, the intermediate INLL and the ventral VNLL. The subnuclei show very distinct connection patterns with other auditory nuclei. The simplest input-output pattern is found in VNLL whereas DNLL is connected in the most complex manner. In the ceylonese Rufous Horseshoe bat, *Rhinolophus rouxi*, used in this study, echolocating behaviour is expressed in a hypertrophy of the whole acoustic system. Especially those neurons tuned to the main cf-component of the echolocation signal (78kHz) are numerically and spatially overrepresented along the entire auditory pathway from

cochlea to cortex. This population of "filter neurons" shows an exceptionally sharp tuning. Q_{10dB}-values were as high as 400. Particularly in VNLL these neurons were disproportionally represented and showed the highest Q_{10dB}-values compared to filter neurons in INLL or even DNLL. The different complexity of connection patterns of the subnuclei is reflected in physiological results: 1) simple response patterns were much more common in VNLL, complex discharges more often found in DNLL. Compared with other auditory nuclei, neuronal properties of DNLL resemble those of IC and properties of VNLL resemble those of CN; 2) complex tuning curves occured more often in DNLL than in INLL or even VNLL; 3) neurons with 2 or 3 harmonically related excitation maxima were only found in DNLL and INLL. Best frequencies (BF) of some neurons, however, could not be correlated to any harmonic components of the echolocation signal known so far; 4) in the average, neurons in VNLL encoded small sinusoidally frequency modulated (SFM) signals until 515Hz modulation frequency whereas in DNLL and INLL the maximal modulation frequency encoded was about 300Hz. Again, this neuronal property of neurons in DNLL resembles rather that found in IC and the answer characteristic in VNLL that found in CN. Uni-directional tonotopy could be found in INLL. High BF were located medially and low BF laterally. In DNLL the same tendency of tonotopic arrangement could be seen, but to a much weaker extent. In addition, high BF predominated in the more rostral parts of DNLL and low BF in caudal areas of INLL and DNLL. In VNLL filter neurons were located throughout the lateral, central and most dorso-medial parts. All other BF were distributed medially. In context with anatomical speculations concerning echolocation-specific auditory nuclei some of the data imply that particularly VNLL may be one of the most interesting candidates. Results of studies still in progress using horseradish peroxidase as a tracer may yield further information.

Arctiid Moth Clicks and Bat Echolocation: Jamming or Warning?†

Lee A. Miller and Annemarie Surlykke

Many arctiid and ctenuchid moths produce clicking sounds in response to the ultrasonic cries of bats. Likewise, many species of these moths are known to be toxic. Work carried out in the 1960's suggested that the clicking sounds functioned as warning (aposematic) signals. Later it was suggested that the clicks may actually "jam" the bat's echolocation system. The goal of our studies was to test these two possibilities using pipistrelle bats (*Pipistrellus pipistrellus*) in target ranging experiments. We trained the bats to echolocate the nearer of two targets, which had built-in loudspeakers for playing back arctiid clicks (*Pheosia gnoma, Arctia caja*). In a final series of experiments, we used noxious rewards associated with clicks. The minimum difference in range that the bats could detect at the 75% level was about 15 mm. The clicks had no effect on the bats' performance; if anything the bats performed better in the presence of clicks. No acoustical parameters of the cries were affected except for intensity. The bats apparently interpreted the clicks as noise. They quickly learned to associate the clicks with an unpleasant experience. The function of arctiid clicks (at least clicks from the species we used) is to warn the bat of the moth's distastefulness, and not to "jam" the bat's sonar system. This report is in press: J. Comp. Physiol. 156, 1985.

The Effects on Legal Protection on Bat Conservation in Britain†

A. J. Mitchell-Jones

The Wildlife and Countryside Act 1981 protects all species of bat in Britain and includes a requirement to seek advice from the Nature Conservancy Council before action is taken which might affect bats or their roosts. Records are kept of all requests for advice and provide a source of information about the types of conservation problems that arise and the effectiveness of legal protection. The most common problems are householders discovering bats roosting in their roof and remedial timber treatment in areas known to be used by bats.

The Role of Pinna Movements for Obstacle Avoidance in the Greater Horseshoe Bat (*Rhinolophus Ferrumequinum*)†

Joachim Mogdans

The obstacle avoidance ability of Greater Horseshoe Bats with freely movable and immobilized pinnae was measured as the percentage of free flights through vertical and horizontal wires with intervals of 15 cm and varying diameters of 0.5-0.06 mm. Sound emission and flight behavior were registered by recording the sounds emitted during flight and by photographing the bats when passing the obstacle. The alternating ear movements were eliminated by cutting off the motor nerves and some ear muscles. Bats with freely movable pinnae scored between 70 and 95% free flights both with vertical and horizontal wires, depending on the wire size. After immobilizing the pinnae the avoiding performance with vertical wires was similar to that before surgery. With horizontal wires the number of free flights diminished significantly by 8-10% with wire diameters of 0.5-0.08 mm. There was no observable difference in sound emission and flight behavior after surgery.

Sperm Storage in the Female Reproductive Tract of *Pipistrellus abramus* and *P. endoi*†

T. Mori and T. A. Uchida

The present study revealed the site and mode of prolonged sperm storage in the Japanese house bat *Pipistrellus abramus* and the Endo's pipistrelle *P. endoi*. In *P. abramus*, spermatozoa were stored in the uterus and the uterotubal junction. In the uterus, many microvilli of the epithelial cells had well-developed fuzz filaments with a strong affinity for ruthenium red (Luft, 1971), and the spermatozoa whose heads were in contact with this fuzz appeared to have a high viability ratio, compared with that of the spermatozoa remaining free in the uterine lumen, which was confirmed by using the vital stain trypan blue (Tablot and Chacon, 1981). In the uterotubal junction, the heads of live spermatozoa telescoped into indentations between the microvilli with a few fuzz. Dead spermatozoa which have been surrounded by the epithelial pseudopodia and which had been engulfed within the epithelial cells had a high electron-density after tannic acid fixation (Mizuhira and Futaesaku, 1972). In *P. endoi*, on the other hand, all uterine spermatozoa were dissociated. The principal site of sperm storage was the caudal isthmus of the oviduct where

the spermatozoa established close relationships with indentations of the epithelial cells, although engulfment of dead spermatozoa by the epithelial cells was recognized. The conspicuous differences in the sperm storage site and its mode between the two species belonging to the same genus are worthy of note. In addition, the absence of polymorphonuclear leucocytes in the uterus and the oviduct of the two species is different from other bats examined so far.

Foraging and Echolocation in *Rhinolophus rouxi**

G. Neuweiler, W. Metzner, U. Heilmann, R. Rubsamen, M. Eckrich, R. Fernando, A. Wijesinghe, A. Link and H.H. Costa

In October 1984 a field study was carried out at a cave close to Koslanda in Sri Lanka. This cave serves as a nursery roost for about 130,000 *Rhinolophus rouxi*. The preferred foraging sites of the horseshoe bats were within dense forests and jungles. We rarely found them foraging in cultivated land and clear forests. Horseshoe bats flew to their foraging sites at low levels (close to ground – ca. 3 m above ground) and under cover through bushes and forests. During the first 60-90 min of activity the bats hunted on the wing close to and within foliages. During the rest of the night they preferred to hang on conspicuous leafless twigs protruding from the canopy of trees and bushes and echolocated for flying prey passing by. Individual bats were found to stay within a foraging site (ca. 20 m Ø), however, these individual sites were not defended against intruders. Horseshoe bats relentlessly echolocated throughout the night at high rate (av. sound duration 46 ms, av. repetition rate 9.8 sounds/s, av. duty cycle 45%, longest pause in a sequence 1010 ms). During foraging the sounds mainly consisted of the pure tone component only. During flight or while leaving the cave the final and even more so the initial frequency modulated components became prominent. Typically sounds consisted of two harmonics, a strong second one at about 77 kHz and a weak first one. However, the intensity relation between the two harmonics could be also reversed with the second harmonic even missing.

Factors Affecting the Distribution and Feeding Ecology of Bats in Scottish Forests*

P.A. Neville

Insectivorous bats are thought to have evolved in close association with natural woodland and the present study was designed to evaluate and compare diverse woodland habitats in relation to bat activity with the overall aim of defining those sites capable of supporting large populations of bats. I asked two specific questions: 1) In which sites is highest bat activity predicted, ie. where is insect abundance/diversity highest? 2) Where do bats exhibit highest activity, i.e. is activity dependent on or independent of insect abundance/diversity? In three habitats, a young Birchwood, an ancient Beechwood and a coniferous plantation, ultrasonic receivers connected to an instrumentation tape recorder, mist nets and insect traps monitored the activity of bats and their food respectively. Data will be presented to compare insect abundance, diversity and dry weight obtained at two heights (canopy and two metres from ground), for each of the three habitats on a twice monthly basis, through May until September, over a two year period. Similarly data on bat activity, defined as the total of bat 'passes' plus 'feeding buzzes,' will be presented to show both preferred feeding sites and preferred feeding heights within each habitat. The relationship between bat activity and water requirements will also be discussed.

Wing Form and Flight Mode in Bats*

Ulla M. Norberg

Wing shape in bats is a result of different flight demands, and minimization of flight costs might not always be the most important criterion. The optimal wing shape might be dictated by a combination of different factors, such as flight behaviour, habitat selection, and size of prey, and the selection pressures for the various demands may sometimes be conflicting, necessitating compromise solutions. The maximum range speed or minimum power speed need not necessarily be optimal for the bat. The optimal speed (like the wing shape) instead varies with the flight goal, food choice, and foraging behaviour. Wing loading also influences the flight speed. High wing loadings (necessitating high flying speeds) and low wing loadings (permitting low flying speeds) can be obtained with high as well as low aspect ratio wings. Different combinations of wing loadings and aspect ratios are required for different niches and habitat selection. For instance, high aspect ratio wings are an advantage for migratory bats, but their wing loading can be low since they need not necessarily have to fly fast (as in *Lasiurus* and *Lasionycteris*). Bats with the need of both enduring flight and time-saving, for instance in commuting flights, benefit from both a high aspect ratio and a high wing loading (e.g. molossids). Flight within vegetation requires slow speeds and high maneuvrability but also short wings (e.g. nycterids, megadermatids, and some rhinolophids and vespertilionids). Insectivorous bats need to be more maneuvrable than frugivorous bats, which puts higher demands on low mass and low wing loading.

The Reproductive Phenomena Relating to Fertilization in the Japanese Greater Horseshoe Bat, *Rhinolophus ferrumequinum nippon*†

Yung Keun Oh

Temperate hibernating bats exhibit "prolonged sperm storage" type in the reproductive pattern. However, no ultrastructural studies on this pecular mode of reproduction have been made, except for some European rhinolophid bats. Thus, the present studies examined such reproductive events relating to fertilization as spermiogenesis, sperm storage, prolonged survival of Graafian follicle and fertilization, vaginal plug formation, and aberrant means of sperm elimination in the female reproductive tract. The nuclear ring formation was characterized by an appearance of a dense matrix derived from the inner leaflet of the plasma membrane and by the subsequent formation of microtubules from the dense matrix. Sertoli cell-ectoplasmic specializations consisting of the filaments and flat smooth ER cisternae seemed to play a dual role, i.e. grasping and releasing the spermatids. Most of the spermatozoa introduced by the fall copulation (mid- or late October) were stored mainly in the caudal isthmus of the oviduct and appeared to be clustered with their heads oriented towards the epithelial cells, and some dead spermatozoa were engulfed by the pseudopodia. Only the right ovary was functional and a single Graafian follicle persisted from the copulatory stage to the ovulatory stage (about 10 April). During this period, the ovum was in prophase (pachytene or diplotene) of the meiosis I with many large lipid droplets as a nutrient source. The block to polyspermy seemed to reside in the zona pellucida. The vaginal plug was derived from the stratum disjunctum of the vaginal mucosa. Sperm invasion into the lamina propria occurred in the caudal isthmus, and fibroblastic phagocytosis of invaded spermatozoa and the subsequent sloughing of the endometrial connective tissue together with degenerated spermatozoa were first found in the uterine wall.

The Processing of Temporal Cues in the Auditory Systems of Echolocating Bats*

W. E. O' Neill

Temporal cues are important for at least three aspects of sonar analysis by echolocating bats. Monaural temporal cues are important for target ranging in all species, while in bats using narrow-band (constant-frequency) biosonar signals, they may also be important for target identification. The role of binaural temporal cues is not clear at present in ultrasonic echolocation. The temporal cue used for target ranging is the interval between the emission of the sonar pulse and the reception of the echo. One behavioral estimate in FM bats (Simmons, JA. *Science* 204, 1979) suggests an ability to discriminate time intervals in the 0.5 (mu) sec range (0.1 mm target distance). In the auditory system, two special mechanisms have been discovered which encode either the precise time of occurrence of sonar pulses and echoes, or the actual time interval between pulses and echoes. The first mechanism has been described primarily in FM bats and involves time coding via rather invariant action potential latencies in midbrain neurons with extreme onset response patterns to FM stimuli. The second mechanism has been discovered in both FM and long CF-FM bats, and involves facilitation of responses in individual neurons at particular pulse-echo time intervals. These neurons are tuned to particular target ranges. In some species, entire subdivisions at the cortical or thalamic levels of the brain are occupied by such neurons. In mustached bats, target range is represented systematically along a neural axis in the auditory cortex. In narrow-band bats which employ long-duration constant-frequency sonar signals, small movements of the target, e.g., flapping of the wings by flying insects, cause minor periodic shifts in the frequency of the echo due to the Doppler effect. Many neurons in CF-FM bats are exquisitely sensitive to small frequency modulations of pure-tone carrier signals, and some of these appear tuned to modulation rates characteristic of many species of flying insects that are pursued by these bats. Such encoding may be the primary reason for the existence of so-called "acoustic foveae" in CF-FM bats, and may be important in identification of different prey species.

Acoustic Communication in the Vampire Bat, *Desmodus rotundus*†

S. R. Park

The vocal repertoire of the vampire bat was studied in small groups of captive animals. Acoustic properties of the social signals are analysed on the basis of situation that elicit them. Seventeen basic call types could be identified according to call duration, separation time between consecutive calls, principal frequencies, rhythmicity and contexts. All vocalizations are within a frequency range of 4-70 kHz; the call duration varies between about 1 ms and 1.5 s. Echolocation calls are widespread in most social situations beside other calls; they may have a function in acoustic communication. The quantity of vocalizations and the preference for certain call types clearly depend on the social status of an animal. Harem males, for example, often emit warble calls. The behavioral context suggests that warbles serve as appeasing signals between sexes, especially the harem male and its females. Further vocalizations distinctly occur during aggression, threat, play and greeting contexts. The investigations have shown that acoustic signals are a major part of a subtle and complex communication system in this highly social animal.

Reproduction in *Rousettus aegyptiacus* in the Kruger National Park

B. L. Penzhorn and I. L. Rautenbach

Reproduction in *Rousettus aegyptiacus* is being studied at the northern tip of the Kruger National Park, a locality in the austral tropics. The bats forage in riparian forest in a semi-arid area with a single well-defined rainfall peak during summer. Mating takes place during mid-winter (from June onward), with parturition 3½ months later during the early summer (October-November). Virtually all females conceive every year.

Rhinopoma is a Rhinolophoid Bat*

Elizabeth D. Pierson

Rhinopoma has often been characterized as a morphologically primitive bat, and regarded as an early offshoot of the chiropteran lineage. Although Gray, in 1866, associated it with the rhinolophoids, since Dobson (1875) it has been placed with the emballonurids, and since 1945 (Simpson's classification) has been included in the Superfamily Emballonuroidea. Biochemical evidence, obtained by an immunological comparison of blood proteins, indicates: 1) *Rhinopoma* is no closer to emballonurids than are a number of other taxa (e.g., vespertilionids, megadermatids, rhinolophids); 2) *Rhinopoma* associates with the rhinolophoid clade, and within that group most likely with the megadermatids and nycterids.

Analysis of Some Cochlear Components From Surface Preparations†

Ade Pye

The cochlea from five species of bats have been investigated. The animals were collected alive from Malaysia in 1981 and were chosen from different families (or sub-families) to represent different modes of life. They comprised *Hipposideros diadema* (2), *Scotophilus kuhlii* (3) and *Tadarida mops* (3) from the Microchiroptera and *Cynopterus brachyotis* (3) and *Eonycteris spelaea* (3) of the Megachiroptera. All the specimens were intra-vitally perfused and subsequently fixed in osmium tetroxide for surface preparations of their cochleae. All cochleae were micro-dissected, noting the number of turns for each species, and the sensory hair cells were mapped onto cochleograms. The following cochlear components were measured and analyzed: the length of the basilar membrane, the total numbers of inner and outer hair cells, their relationship to each other and their distribution and density along the cochlear spiral. Other special features were also noted. Various correlations will be carried out of the cochlear measures in these and other species. It is also hoped to correlate the above features with results from serial sections of the same or closely related species, as well as discussing their echolation pulses where appropriate.

Recording Bat Sounds By New Techniques†

J. David Pye and Festo A. Mutere

Instruments for detecting ultrasonic signals from animals were first proposed in 1879 but were only achieved in the late 1930's. Such "bat detectors" produce an audible sound from

a loudspeaker or earphones, or more rarely a visual display on an oscilloscope. Several different principles can be used but all necessarily involve a simplification of the original signal and therefore a loss of information. A current trend is to use two complementary methods simultaneously and to record both on a stereo-cassette recorder for later comparison. Nevertheless, a complete analysis demands that the real, untransformed signals are recorded on a high-speed instrumentation recorder for subsequent time-expansion. Even with miniaturised equipment, this method is cumbersome in the field, has high power consumption and is very expensive both to acquire and to run. It also yields results only after rewinding and tedious replay, long after the event. New developments, in collaboration with QMC Instruments Ltd., try to combine the advantages of all these techniques and to minimize their drawbacks. They also permit a considerable degree of analysis during actual recording so that acoustic behaviour can be related to its context, greatly improving the value of observation. Initial results will be presented, including field-trials undertaken in Kenya this summer.

Bioenergetics of Pregnancy and Lactation in British Vespertilionid Bats

P. A. Racey and J. R. Speakman

Animals faced by increases in energy demands by reproduction may respond in one of two basic ways. Firstly by increasing food consumption, or alternatively by decreasing expenditure on some other component of the energy budget. Estimates of free-living energy expenditure of pregnant and lactating brown long-eared bats (*Plecotus auritus* L.) in Northeast Scotland (57°N) were made using the doubly-labelled water technique ($D_2{}^{18}O$) in an attempt to evaluate the strategy used by the bats to cope with the excess demands of reproduction. During pregnancy there was an exponential increase in both absolute energy expenditure and expenditure relative to basal metabolism (BMR), from approximately 2.5 × BMR to a peak of 4.3 × BMR at parturition. This pattern suggests bats responded to energy demands of pregnancy by increasing food consumption. During lactation daily energy expenditures fell in the same range as during pregnancy (3-4.2 × BMR). Since theoretically, and from empirical studies of other mammals, lactation energy demands would be expected to greatly exceed those during pregnancy these data suggest some compensation was being made in the energy budget. Possible mechanisms include relaxation and homeothermy.

Homeostatic Control of Body Food Reserves in Hibernating Greater Horseshoe Bats (*Rhinolophus ferrumequinum*, Schreber)*

R. D. Ransome

Hibernating Greater Horseshoe bats were studied in Gloucestershire and Somerset hibernacula as previously. Forearm measurements, wing surface area and weight data were collected over six winters from 1978/9. Visits were made in October, January and April in each winter. A method was developed from these data to estimate % body food reserves. All age and sex groups, apart from adult males, showed the same mean % body reserves in October, January and April. Adult males showed lower reserves in all three months, but the mean levels became closer to the other groups as winter progressed. In all age and sex groups, and in all months, wide variation in the levels of individual's reserves was evident. However, standard deviations fell from October to April. Linear regressions between % body reserves present in October, and rates of loss of reserves up to April, showed strong positive correlations. Bats with large reserves lost them rapidly, and vice versa. There is therefore homeostatic control of utilization of body food reserves. Survival of individuals is related to successful homeostatic control of reserves, rather than to high initial reserves at any stage of the winter. Homeostatic control of body food reserves implies the existence of a body reserve assessment system linked to its circannual rhythm.

Flying Mammals on Postage Stamps†

Jeremy M. V. Rayner

Bats and other flying mammals are featured on the postage stamps from countries throughout the world, for reasons ranging from the eradication of pests (vampire bats and rabies in Jamaica) to the celebration of anniversaries (Hong Kong in 1935). Many of these stamps are illustrated in this poster.

Aerodynamics of Bat Flight*

Jeremy M. V. Rayner

The wing movements of animals in flapping flight are configured so that the aerodynamic lift of the wings provides thrust or propulsion appropriate to the speed and acceleration of flight, while maintaining sufficient vertical force to support the weight. The wingbeat gait must be consistent with minimization of mechanical and metabolic energy consumption, with reduction of the risk of mechanical failure of the bones and muscles, and with the need for muscle contraction dynamics to remain close to the optima for which the muscles are adapted. The results of high-speed photography of flying microbats and of experiments to visualize the structure of the wake vortices are used to derive a mechanical model of energy flows in flight and of the forces and moments acting at the wing root and on the surface of the wings; this permits estimation of power, speed and other aspects of performance in flight, and from comparison with electrophysiological recordings shows how wing mechanics are correlated with muscle activity. These factors can be combined with constraints imposed by manoeuvring and prey capture to suggest likely pressures influencing the evolution of chiropteran flight morphology.

Interspecific Karyological and Morphometric Variation in an Unknown and Three Known Species of *Eptesicus* in the Kruger National Park (South Africa)†

I. L. Rautenbach and Duane A. Schlitter

Inter- and intraspecific variation within the genus *Eptesicus* (Microchiroptera: Vespertilionidae) in Africa appear to be more complex than is reflected in the taxonomic literature. Considerable clinical size variation, previously not recorded in the taxonomy of this genus, has, for instance, recently been found in certain taxa (notably *E. capensis*). It is postulated that an understanding of variation within and amongst species coexisting at a single locality would facilitate interpretation of the results of a Pan-African revision. This study consequently focuses on the interspecific karyological and morphological variation demonstrable between an as yet unnamed form, and three taxa recognized in accordance with the contemporary taxonomy of the genus (i.e. *E. zuluensis*, *E. capensis* and *E.*

hottentotus) co-existing at a single locality (Pafuri, northern Kruger National Park, Republic of South Africa). This unnamed form is morphometrically intermediate in size between *E. capensis* and *E. hottentotus*, and consequently agrees to the phenetic description of *E. melckorum*. However, the said taxon is karyotypically distinct from *E. zuluensis*, *E. capensis* as well as *E. hottentotus*. On the other hand, specimens answering to the description of *E. melckorum* agree karyotypically with *E. capensis*, which is in accord with work in progress which suggest that *E. melckorum* is a synonym of *E. capensis* as result of as yet undocumented clinal variation within the latter species. In addition, it is foreseen that the results of this study would enhance clarification of the relationship between *E. zuluensis* and *E. somalicus*. At present no attempt is made to allocate a name to the unknown taxon reported from Pafuri, pending a Pan-African revision of the genus.

Nightly Dispersal of Daubenton's Bats (*Myotis daubentoni*) From a Summer Roost Site*

P. W. Richardson

A population of Daubenton's bats (*Myotis daubentoni*) was monitored in summer over a three year period. The main roost site is adjacent to a canal along which the bats disperse each evening. The movements were monitored using a variety of simple techniques which are briefly discussed. This highlighted main feeding areas along the canal which often related to overhanging vegetation and emerging water weed. It also became apparent that bats travelled considerable distances along the canal each night, not necessarily for feeding. They regularly moved 2 km, often 5 km and occasionally appeared to travel over 10 km along the canal. The long distance movements caused mingling of adjacent populations of Daubenton's bats on the canal system.

Concerning the Present Situation of the Population Density of the Mouse-eared Bat (*Myotis myotis* Bork) in the North-West European Border Area*

H. Roer

Since the beginning of the 1950's the mouse-eared bat population in the Middle European region has become much reduced, although this has not occurred to the same extent in all regions. In a 700 km section of South Thuringia for example, according to Henkel and Tress (1980) the population diminished from 1800-3300 to 60 adult females in 1976. In the Netherlands, where *M. myotis* is faced with extinction, Voute, Sluiter and Heerdt (1980) could report only five individuals in winter quarters 1977/78. On the other hand there is a sizeable population in the nursery colonies 60-170 km southeast to east, in the Rhine area. In this area there is a nursery colony in which around 250 adult females have raised their young for many years. The population growth of 12 Rhineland nursery colonies are shown. The comparatively good survival rate of the mouse-eared bats is due to the good feeding conditions and good climate in the Rhineland coupled with an intensive protection of the roosts.

The Anatomical Basis for an Organization of Binaural Response Properties in the Inferior Colliculus of the Mustache Bat†

L. S. Ross, J. Wenstrup and G.D. Pollak

The inferior colliculus of the mustache bat, *Pteronotus parnellii*, is specialized to process the 60 kHz component of its constant frequency echolocation call, having an enlarged isofrequency region which corresponds to the anatomically defined dorsoposterior division (DPD) of the central nucleus of the inferior colliculus. Neurons within this isofrequency DPD are narrowly tuned to 60 kHz and have a characteristic functional organization in which cells having similar binaural response properties are found grouped together, with each binaural class occupying a specific portion of the DPD. The inferior colliculus is the site of convergence of the ascending projections of at least seven separate brainstem auditory nuclei, each of which displays a unique response to binaural stimuli. Hypothesizing that their projections onto the DPD might impose this organization of binaural response properties, we made deposits of horseradish peroxidase into physiologically defined regions of the DPD. We have determined that the DPD receives projections from each of the brainstem nuclei which project to the central nucleus, and these projections appear to originate in the appropriate 60 kHz regions of the lower auditory centers. These projections are not uniformly distributed within the DPD, with the topography of inputs generally corresponding to the organization of binaural regions. Projections to monaural regions of the DPD include monaural nuclei such as the cochlear nuclei and the intermediate and ventral nuclei of the lateral lemniscus. Binaural brainstem nuclei tend to project to more binaurally dominated portions of the DPD. Supported by a grant from the NIH (NS 21286-03).

Sensory Prevalence During Multimodal Conditioning in *Phyllostomus discolor*†

G. Rother

Three male Lesser Spear-nosed Bats (*P. discolor*) were trained in a two-choice apparatus to choose the stimulus marked side for food reward. As stimuli were used: a) 2-38 kHz pseudo-random noise; intensity 70dB SPL (30 cm); b) white light, 6 cm in diam.; brightness 1.35, (0.13, 0.02 and 0.002) cd/m²; c) 5 ml/s airstream fully saturated with grass or banana fruit-flavour respectively. The positive assignment consisted of these three simultaneously presented signals. The animals mastered this task after surprisingly short time (180 runs each). In the following test runs with separately presented acoustical, optical and olfactory signals, the optical task turned out to have been learned best, followed by the noise signal. No attention was paid to the olfactory stimulus at this time but after some 1500 runs of extra-training for each, all three animals performed very well on olfactory cues (i.e. grass-flavour) only. Thus all three parameters could be tested against one another in direct bimodal comparisons to evaluate the sensory prevalence. In all combinations tested the strong optical stimulus was answered best followed by the acoustical one. Step by step attenuation of the optical signal (see b above) accordingly led to increasing choice rates of the other two parameters. Transposition of the grass-flavour with the more accustomed banana fruit-flavour, which was easily done in less than 20 runs, only slightly improved the choice rates of the olfactory stimulus in comparison to acoustical and optical signals. In a separate olfactory test the animals showed a scarcely surprising preference of banana versus grass odour.

An Ultrastructural Study of Megachiropteran Spermatozoa: Implications for Chiropteran Phylogeny†

Greg Rouse and Simon Robson

The sperm of all species were found to be very similar. The head is extremely flattened and spatulate; the nucleus is capped by a long acrosome that comprises the proximal half of the head and covers two-thirds of the nucleus area, and a prominent sub-acrosomal space possesses a unique 'anvil-like' shape. Redundant nuclear envelope forms a 'scroll' in a restricted region of the neck, next to the base of the proximal centriole and the most proximal of the mitochondria. The axoneme is atypical for mammals, the central singlets arising distal to the outer doublets. Coarse fibers 1, 5, 6 and 9 are larger than the remainder, a feature shared with the microchiroptera, most insectivores and the primates. The large sub-acrosomal space of the megachiropteran sperm is significantly different from that of the microchiroptera. These results are consistent with a large phylogenetic distance between the two chiropteran sub-orders.

The Processing of Complex Echolocation Sound Elements in Bats: A Behavioural Approach*

R. C. Roverud

Bats of the species *Noctilio albiventris* and *Rhinolophus rouxi* were trained to discriminate differences in target distance. Loud, free-running artificial pulses, simulating the bat's natural CF/FM echolocation sounds, interfered with distance discrimination. Systematic modifications in the temporal and frequency structure of the artificial pulses resulted in orderly changes in the degree of interference. Artificial pulses simulating the natural CF or FM components alone had no effect. These findings indicate that CF/FM bats use both the CF and FM components of their CF/FM echolocation sounds for distance discrimination. The CF onset activates a gating mechanism that, during a narrowly defined subsequent time window, enables the nervous system to process FM pulse-echo pairs for distance information.

The Ability to Discriminate Sugar Concentrations in Glossophagine Bats†

H. J. Rubbelke and O. V. Helversen

Flower visiting bats of the subfamily Glossophaginae (*Glossophaga soricina* and *Anoura caudifer*) were kept in captivity and their behaviour was studied by means of artificial flowers with different concentrations and portions of sugar solutions. The feeders could be exploited only during hovering flight. When given a choice between different concentrations of sucrose solution the bats preferred concentrations of 20-35% compared to those of 10 or 50%. To analyze their ability of discrimination between different concentrations their visits at two feeders were observed, with one feeder having a constant concentration of 10% and the other a variable concentration. (At each visit — monitored by a light trap — a portion of 20 (mu)l was pumped into the glass vessel of the feeder; the electric control of the pumps and the counting of visits was performed by means of a micro-processor device). The activity pattern of the bats was constant over the night when plotted in 15-minute intervals, but "bursting" when observed at a finer scale. Beginning with trial and error visits (50% choice level) each evening, within about half an hour the animals preferred the feeder with the more concentrated solution. Even a one-percent difference in concentration was discriminated significantly.

Ontogeny of the Echolocation System in the Rufous Horseshoe Bat *(Rhinolophus rouxi)**

Rudolf Rubsamen

In a maternity colony of many thousands rufous horseshoe bats (*Rhinolophus rouxi*) in Sri Lanka the young bats were born within a period of two weeks in the beginning of October. During the first month the new born bats were left back inside the cave at night while the adults left foraging. The baby bats then crowded together in large clusters at the walls of the cave and emitted isolation calls with energy partly in the human hearing range. In the first days after birth the spectra of these calls, exclusively emitted through the mouth, showed a harmonic structure with a fundamental frequency between 7-12 kHz and two up to four harmonics. Within the first week the pattern of vocalization remained constant but the frequency increased and reached values between 16-20 kHz for the fundamental frequency of the call. In bats of this age the ability of hearing could be demonstrated neither by behavioural tests nor by electrophysiological recordings of evoked potentials in the inferior colliculus. From the 9th day on audiograms could be measured, broadly tuned to a frequency range between 20-50 kHz. After two weeks the bats still emitted harmonic isolation calls through the mouth with a fundamental frequency of about 20 kHz, but in between these calls short sequences of vocalizations were detectable which, like echolocation calls in adults, are emitted through the nose. These pulses were higher in frequency when compared with the oral vocalizations in the same animals. The fundamental frequency of about 29 kHz was heterodyned by two harmonics at 58 kHz and 87 kHz. Audiograms in the same bats showed that the hearing range had shifted towards higher frequencies and elucidated an increased hearing sensitivity in the frequency band of the second harmonic of the calls emitted through the nose. In the course of the 3rd up to the 5th week after birth the second harmonic of the echolocation calls increased from 58 kHz to reach the frequency range of 73-78 kHz, vocalized by the adult bats. While initially sound energy had been equally distributed in all bands of the harmonic call, in four week old bats the second harmonic was emphasized by at least 20 dB. In all steps of the development audiograms could be recorded that showed an increased sensitivity tuned to the second harmonic of the echolocation calls. This hearing filter shifted from 58 kHz up to 78 kHz continuously covering narrower frequency bands.

Defense of Feeding Sites by Northern Bats *(Eptesicus nilssoni)*†

Jens Rydell

A nursing colony of 26 female northern bats, all individually marked, was studied in South-Central Sweden. Observations on foraging bats were made on three distinct feeding sites within 250 m from the roost. The bats foraged individually and established territories at feeding sites around trees and buildings. Each feeding site was used regularly by two to four females. Other females and non-members of the colony used the feeding sites occasionally. Intrusions into already occupied feeding sites resulted in territorial conflicts (47%), passive departure by one or both opponents (43%) or mutual acceptance (11%). Territorial conflicts were initiated primarily (90%) by the females who visited the feeding site in question regularly. These individuals were dominant over non-reproducing females and non-members of the colony. A rank order occurred among the "regular visitors" at each feeding site. Territorial conflicts were settled by means of aggressive chases and/or audible vocalizations and possibly by mutual avoidance of the territories. Conflicts occurred throughout the summer, but became less frequent in July when the insect abundance increased.

Biochemical Studies on the Male Accessory Structures of *Rousettus leschenaulti**

V. M. Sapkal

Although the adult males are sexually active from October to April, the testis exhibits two peaks of spermatogenetic activity during this period, once during October-November and a second time during February-March. Sialic acid cycle in the epididymis, prostrate and Cowper's gland runs parallel to the spermatogenetic activity in the testis. The amount of sialic acid is, however, negligible in the seminal vesicles. Alkaline phosphatase activity runs closely parallel to the spermatogenetic activity in all the accessory reproductive organs. The acid phosphatase activity in seminal vesicles, prostrate and Cowper's glands runs parallel to the spermatogenetic activity in the testis, but has a single peak of activity in the epididymis in December after which there is a gradual decline. The physiological role of these metabolites is discussed.

Acoustic Significance of Rigid Tracheal Pouches and Inflated Nasal Chambers in the Echolocating Horseshoe Bat, *Rhinolophus hildebrandti**

Roderick A. Suthers and Jeffrey J. Wenstrup

Horseshoe bats have three rigid, cartilagenous, air-filled chambers which connect to the trachea behind the larynx. Two of these are located on each side of the trachea immediately behind the larynx, the third is dorsal to the trachea, opening into it by a short duct. These bats also have inflated nasal cavities. *R. hildebrandti* normally emit long duration constant frequency sonar pulses through their nostrils. Most of the energy is in the second harmonic at about 47 kHz with the fundamental and higher harmonics suppressed. We have investigated the effect, on the acoustic wave form in the trachea and on the emitted sonar pulse, of selectively filling these cavities and of forcing the bat to vocalize through its mouth by sealing its nostrils. Filling all three tracheal pouches had no consistent significant effect on the vocal output but increased the fundamental component in the trachea about 15 dB. Forcing the bat to vocalize through its mouth had no effect on the subglottal acoustic waveform but the fundamental of the emitted waveform was increased up to 20 dB with the 3rd and 4th harmonics increased about 10 to 15 dB, compared to nasal emission. The 2nd harmonic was unaffected in three cases but attenuated 16 dB in a 4th case. Partially filling the inflated nasal cavities caused a 7-11 dB increase in the nasally emitted fundamental, but fusing the two nasal cavities by perforating the bony septum had no effect on the amplitude of harmonic components in the emitted pulses. We conclude that the tracheal pouches attenuate the amplitude of the fundamental transmitted to the lungs, perhaps to safeguard pulmonary perfusion, and that nasal passages suppress the fundamental plus 3rd and 4th harmonics of the emitted sonar pulse. This project is supported by NSF grant BNS 82-17099.

Activity Patterns of Non-Breeding Communities of *Nyctalus noctula (Mammalia, Chiroptera)* in Switzerland‡

Hans-Peter Stutz and Marianne Haffner

The seasonal and nocturnal activity patterns of *N. noctula* were studied along rivers during the years 1982-1985. The activity patterns of flying *N. noctula* were registrated by event recorders (ZE 631) which were connected with ultrasonic detectors (QMC mini). The seasonal presence was established by observation of emerging *N. noctula* and foraging individuals in riparian areas. The relation between day-roosts and foraging sites as well as the relation between registrated flight activity and presence in day-roosts were proofed by observations of reflex marked individuals at roost sites (emerging, returning bats) and in foraging areas. There is no evidence for reproduction of *N. noctula* in the study area. Most of the known day-roosts were abandoned during summer. Occupied roosts consisted of males only and only males were caught in riparian foraging areas during this time of the year. With the exception of November, December and January, *N. noctula* foraged regularly on warm evenings throughout the year. In spring *N. noctula* foraged mainly in the evening at sunset. A second foraging period was regularly observed at sunrise during summer. A single foraging period at sunset was the rule in autumn. Foraging periods at sunset and sunrise lasted about 20 to 90 minutes each. There is no significant difference of foraging time between communities of both sexes and those which consisted of males only. The change from unimodal to bimodal foraging patterns can not be explained by the reproductive status of *N. noctula* because there occurs no breeding in the study area. The foraging period at sunrise seems to depend on weather conditions.

Apparent Competition Between Two Species of West African Fruit Bats

D. W. Thomas

In Ivory Coast, West Africa two species of pteropodid fruit bats (*Micropteropus pusillus* and *Epomops buettikoferi*) show extreme overlap in habitat use and diet. Both species remain in the savanna zone throughout the year and during the dry season minimum of fruit availability both species rely heavily on a single fruit species, *Ficus capensis*. When the biomass of ripe *F. capensis* drops to its minimum at the height of the dry season, the resident population of *E. buettikoferi* requires all the available fruit resources. At this time mark-recapture estimates of the *M. pusillus* population show that it suffers over a 50% reduction in numbers. The population subsequently recovers through two birth/recruitment periods when fruits are superabundant during the wet season. *E. buettikoferi* and *M. pusillus* appear to compete for the same limiting fruit resource; however, this period of competition is too brief to result in the extinction of *M. pusillus*. Annual cycles of fruit abundance appear to be critical in permitting coexistence.

An Automatic and Remote Method of Observing Summer Colonies of Bats†

Virginia M. Tipton and David C. Derowitsch

These observational techniques were developed to provide minimal disturbance of a maternity colony of *Plecotus townsendii virginianus*. We wished to determine the patterns of nightly seasonal activity and observe the bats in the roost during the daytime. Observation of the bats is done entirely in near infrared (IR) light, which cannot be detected by the animals. Because humans also cannot detect this infrared illumination, an IR-sensitive image intensifier tube is used. The detected illumination is then converted to composite video and recorded on tape for later viewing and analysis. The entire setup is portable and is powered remotely by a 12V DC source. The equipment can be used for either short- or long-term recording. With this system, observers can be as far as 500 feet from the bats, can sleep through the night if desired, and do not have to be alert at the time of the bats' activity. Two possible kinds of lights are miner's rechargable lead-acid lamps fitted with Kodak No. 87 IR filters and light-scattering lenses or high output IR light-emitting diodes

(LEDs). The miner's lamps will operate for about 14 hours maximum and are most useful for overnight viewing of large areas. The LEDs can easily be connected to the remote power source that can be recharged throughout the season. Thus, an observer would only have to enter a maternity site twice: once to set up and once to remove the equipment. The image intensifier, video camera and zoom lens are in a waterproofed tube which is mounted on a motorized tripod. All optical adjustments and directional positioning are accomplished through remote-controlled motor drive mechanisms. An image enhancer, time/date generator, and high resolution monitor along with the motor drive controls are located remotely with the VHS video recorder.

Echolocation: Detection of Phantom Targets in Noise by Serotine Bats; Negative Evidence for the Coherent Receiver Hypothesis†

N. Troest, B. Mohl, and A. Surlykke

Using a yes/no paradigm, three serotine bats (*Eptesicus serotinus*) were trained in a target simulator to report the presence or absence of a phantom target. The echolocation cries were intercepted by a microphone, amplified, and returned by a loudspeaker as artificial echoes with a delay of 3.2 msec and a level determined by the overall gain and cry amplitude. The peak amplitude of each pulse was measured, and the echo level received by the bat calculated. Gain was adjusted as in conventional up/down audiometry. The target was presented in 50% of the trials, chosen pseudorandomly. False alarm rates ranged from seven to 16%. Under these conditions the three bats required echo levels of 40, 44, and 48 dB peSPL (S.D. $\pm$ 13 dB) for 50% detection. The relatively high levels were found to be due to the cluttering effect of the real echo from the loudspeaker. Subsequently, the phantom target was masked with continuous, white noise (N_O) at -19 dB re. 20 microPa*$Hz^{-1/2}$. Thresholds increased by seven, nine and 14 dB. Energy flux density (S_E) of a representative cry at threshold amplitude was computed to estimate signal to noise ratios. (S_E/N_O). The ratios found were 36, 47 and 49 dB. At a similar rate of false alarms, a coherent receiver requires a S_E/N_O) of about two dB. We conclude that our findings do not support the hypothesis of a coherent receiver for the echolocation signals by bats.

Progress Through Bat Conservation International*

Merlin D. Tuttle

Current conservation problems and progress will be reported, and a new 15 minute slide/tape program, "Why Save Bats," will be shown. The program consists of 75 slides of 27 genera and 34 species, illustrating bat values and conservation needs worldwide. It is designed to promote a better public understanding of bats and will be available in appropriate foreign language editions.

Prolonged Storage of Spermatozoa in Hibernating Bats*

T. A. Uchida and T. Mori

There have been excellent and extensive reviews of this problem (Racey, 1975, 1979). The present paper deals chiefly with the sites and mode of sperm storage, based on our own ultrastructural observations. In the table, "Survival," refers to live sperm which have established a special orientation towards the epithelium and close relationships with the microvilli or indentations of the epithelial cells in the principal sites. "Life" indicates live sperm lacking such orientation and association. Infiltration of polymorphonuclear leucocytes does not occur in the storage sites, although engulfment of spermatozoa by the epithelial cells is observed in the survival sites with the exception of the uterus and colliculus tubaricus of *P. abramus*.

Narrow Band Frequency Analysis by Echolocating Bats*

Marianne Vater

Neurophysiological data on the tuning characteristics of the peripheral and central auditory system of bats are summarized. These comparative data are discussed in relation to results obtained in non-echolocating mammals in order to work out basic similarities and to define structural and functional differences which can be interpreted as adaptations to the echolocation tasks. Particular attention will be paid to the two most sharply tuned mammalian auditory systems found in horseshoe bats and mustache bats. New results correlating specialized cochlear morphology with sharp tuning characteristics derived by the HRP-technique to map the frequency representation in the cochlea will be presented.

Differences in the Localisation of Nucleolus Organizer Regions in Chromosomes of European Vespertilionid Bats*

Marianne Volleth

There are only few, but distinct differences in the chromosome structure of European Vespertilionid bats. With certain staining techniques (Q,G), the differences of the then visible banding patterns can in most cases be analysed as translocations of complete chromosomal arms. To one's surprise, however, the nucleolus organizer regions (NORs) of various species are to be found on different chromosomes. The location of the NORs does not only differ between genera, but also between individual species within some genera. Using the results of $AgNO_3$ staining of air dried chromosome preparations, the European Vespertilionids can be divided into two large groups: I. Species with a secondary constriction on chromosome 15, which can be proved as a NOR. Some species possess a further pair of chromosomes bearing an additional NOR. Amongst them are: *Eptesicus serotinus, Pipistrellus savii, P. kuhli* and *P. nathusii; Nyctalus leisleri* and *N. noctula* (additional NOR on chromosome 8); *Vespertilio murinus* (additional NOR on chromosome 23). II. Species without secondary constriction. Here the NORs are located above the centromere of several acrocentric chromosomes. Sequential staining ($AgNO_3$ after Q banding) shows that different chromosomes are concerned with different genera (and subgenera). Amongst them are: *Pipistrellus pipistrellus*, genus *Myotis*, genus *Plecotus*. On the one hand these results prove the hypothesis of T.C.HSU (1975), which states that a single, long NOR is more ancestral than the occurrence of many small NOR-sites. On the other hand it can be said that such rearrangements took place independently several times within the investigated genera. The position of the NORs can therefore be used as a criterion for the judgment of phylogenetic relationships.

Topographic Representation of a Sound Localization Cue Within Frequency-Band Representations of the Mustache Bat's Inferior Colliculus†

Jeffery J. Wenstrup, Linda S. Ross and George D. Pollak

The mustache bat's auditory system contains a greatly enlarged representation of the 60 kHz constant frequency (CF) component of its biosonar signal. In the auditory midbrain, the 60 kHz representation fills roughly one-third of the central nucleus of the inferior colliculus, thus providing a massive, accessible representation of a narrow frequency band for detailed physiological study. Within this region, we examined the topographic organization of binaural responses. We focused our study on EI neurons — neurons excited by the contralateral ear, inhibited by the ipsilateral ear, and whose response is a function of the interaural intensity disparity (IID). We observed that EI responses were spatially segregated from other binaural response types, located within the ventromedial part of this 60 kHz representation. We also found a systematic shift of IID sensitivity within this EI region: EI responses inhibited only by relatively intense ipsilateral stimulation are located dorsally, with a systematic decrease in the relative ipsilateral intensity required for inhibition at more ventral recording sites. We also examined the topographic organization of binaural responses in frequency-band laminae from other parts of the mustache bat's inferior colliculus. As in the 60 kHz region, EI units were spatially segregated. Moreover, we found evidence of a similar topographic organization of IID sensitivity within these frequency-band laminae. Our results suggest that a topographic representation of IID sensitivity may be common in the auditory system of mammals.

Reproductive Biology of *Pteropus rodricensis**

Chris West

Data are presented on the behaviour of a group of *Pteropus rodricensis* maintained in captivity under a reversed light/dark regime at the Jersey Wildlife Preservation Trust. Attention is focussed on maternal care-giving behaviour and infant development from birth to independence in eight mother/infant dyads, as well as social interactions and sexual activity within the group over the same period. Data are also presented on gestation periods, inter-birth intervals and synchrony of breeding. The reproductive biology of this captive group is compared with that of the same species in the wild and the effects of captivity on the social organization and reproduction of the group are discussed.

Altruism and Cooperation in Bats*

Gerald S. Wilkinson

Bats provide a unique opportunity to conduct comparative studies of social behaviour because closely related species roost in groups of different sizes some of which contain close relatives and others, unrelated individuals. This paper discusses methods for discriminating between the evolutionary mechanisms, kin selection and reciprocity, one or both of which must operate to permit either cooperative (donor and recipient benefit from act but recipient benefits more) or altruistic (donor pays a cost while recipient benefits) behavior to persist in a population. To obtain a first approximation of the likelihood for kin selection to operate in a particular species, a modified version of Sewell Wright's island model is used to estimate the average level of relatedness within female groups with group sizes, survival rates, and dispersal rates chosen to be representative of most bat social systems. Next, methods are discussed for estimating the costs and benefits of particular behaviors. These techniques are then used on published and unpublished data to compare six Phyllostomatid bat species — *Desmodus rotundus, Phyllostomus hastatus, P. discolor, Carollia perspicillata, Glossophaga soricina,* and *Artibeus jamaicensis* — in terms of type of altruistic and cooperative behavior each species is known to perform and the actual or probable level of relatedness within female groups. These results show that average level of relatedness within a group across species does not correlate well with expression of altruistic behavior; however, the compositional stability of female groups does appear to correlate with altruistic behavior. Although this result does not preclude the possibility that individuals in some species may preferentially interact only with close relatives, thereby implicating kin selection, it suggests that reciprocal exchanges of aid may also occur. These results are use to suggest bat species which may prove fruitful for further research on complex social behavior.

Echolocation Pulse Design in Bats and Dolphins†

Karl Zbinden

Bats and dolphins have adopted different strategies in sonar signal design. Bats have developed a considerable range of different pulse types adapted to different tasks. Hunting bats of many species can vary their pulse types in due course whenever the echolocation requirements change. Dolphins however have developed only two basic sonar pulse types. The basic pulse structure is species independent and remains almost unaltered when the pulses are used under various echolocation conditions. Useful sonar pulses have a defined range of physical characteristics. This range is substantially restricted or influenced by the propagation characteristics of the different media air and water. In air the most seriously limiting factor is the high, frequency dependent sound attenuation, whereas in water it is the high absolute sound velocity. In order to optimize the sensitivity of their sonar system, bats have to emit relatively long pulses at low ultrasound frequencies. Since underwater sound attenuation is much smaller, dolphins do not need to resort to long pulses. On the contrary, they use short clicks with a rather high dominant frequency. If they were using long, low frequency pulses, other important requirements for a well designed sonar system could not be met: accurate ranging and adequate resolution of target structure. Indeed the overall sensitivity might not even be increased by such a measure, because underwater biological noise is most important in the low ultrasound range. A good range resolution is generally obtained by using broadband signals. A large bandwidth is inherent to dolphin pulses which generally have durations less than 200 (mu)s, in many cases even only 30-50 (mu)s. With their long pulses, bats have to use frequency modulation in order to increase the bandwidth. Similar to dolphins they achieve target resolutions in the order of a few centimeters with these signals. Apart from being capable of target detection and target ranging a useful sonar system should allow target recognition and discrimination and ideally also the measurement of the target velocity. Recognition and discrimination are again best met by pulses of a large bandwidth, whose echos are most 'colourful.' Accurate velocity discrimination is only possible by means of narrowband pulses with a high number of cycles. Such pulses are used by horseshoe bats and may be important for specialized hunters in the first line. The pulses of other bats allow only moderate velocity resolution or are even designed to be doppler tolerant. All dedicated echolocation pulses used by dolphins do not allow relative velocities to be measured on a single pulse

basis. In order to be useful for this purpose they would have to be 4.5 times longer or of much higher frequency than pulses in air with the same resolving capacity. If at all of biological importance, underwater velocity measurements would have to be made by means of coherent pulse trains or other types of signals, such as whistles.

Mechanoreceptors of the Chiroptera Wing†

John M. Zook

Fine tactile discrimination of the hand-skin is generally limited to mammals with highly dextrous hands, such as primates or raccoons. In the evolution of the forelimb into an airfoil, Chiroptera have sacrificed digital dexterity for flight. However, the tactile sensitivity of the bat hand-wing is in fact very well developed. Eight microchiroptera species were examined with a combination of histological techniques and physiological recordings from somatosensory cortex and wing primary afferents. Two general populations of mechanoreceptors are of interest. The first set is predominantly fast-adapting, with large receptive fields centered at points of apparent intersecting stress-lines: where two or more elastin bands come together. Concentrations are also found at points in the membrane where flying insects are most commonly caught, such as the region below and distal to the elbow. A second set of receptors are predominantly slow-adapting, with small, circumscribed receptive fields centered at raised-epithelial dome structures resembling touch domes. Morphological and physiological evidence suggests that the dome mechanoreceptors are Merkel cell-disk complexes. Domes are distributed over both sides of wing in orderly patterns that vary between species. Dome receptors are mechanically isolated, active only on direct contact of the dome or movement of the single hair which protrudes from each dome structure. Air puffs are excellent stimuli. Somatosensory cortex which is principally devoted to the slow-adapting dome receptors, also has independent topographic representations of the dorsal and ventral surfaces of the wing membranes. The preliminary hypothesis from these data is that the dome mechanoreceptors might supply feedback on airflow patterns over the wing and thus cue a flying bat to the changing lift properties of the wing under different flight conformations. This project is supported by Ohio University OURC 715.

Improvements of Portable Systems for Ultrasonic Detection†

Ingemar Ahlen and Lars Pettersson

During the past few years it has become generally accepted that it is possible to identify and census bats in the field with acoustic techniques. However, in order to make the methods efficient and the results reliable, some basic requirements must be fulfilled: 1) a portable system which allows unrestricted mobility and also makes it possible to detect and store all signals needed for identification and subsequent analysis; 2) bat sonar and other frequently used sounds must be sufficiently species specific to permit recognition by the observer; 3) a good knowledge of variation in bat flight activity is needed to avoid periods with a low probability of encountering bats; 4) efficient procedures in census work must be developed. To make results comparable between areas or over time the methods have to be standardized. **Detector Systems:** In Bonn 1983 a detector with a new, linear frequency division system (D-920) was described, including their applications. The D-920 detector contains two ultrasound conversion systems; a frequency division system with preserved amplitude information and a superheterodyne system. For maximum accuracy the tuned frequency is shown on an LCD display. The D-960 detector contains, in addition to the two systems mentioned above, also a time expansion system. A sequence of the ultrasonic signal is stored in a digital memory and may read out at a reduced speed. The use of an ordinary cassette tape recorder instead of an instrumentation recorder is thus possible, with essentially no loss of information. **Species Identification:** In a study which included all Scandinavian species (Ahlen, 1979, 1980, 1981) it was possible to demonstrate that sonar and social vocalizations were species specific for at least 13 of the 14 species. The conclusion is still valid since 23 species from Europe have been recorded. Species identification is often easier when hearing is combined with sight observations of the flying bat. It is possible to use strong spot-light (short moments to avoid disturbance) to get a better look and flash photos for documentation. A cassette with sounds from more than two-thirds of the European bat fauna processed by two conversion systems is being prepared together with documentation. **Variation in Flight Activity:** Data collected by a set of instruments for automatic recording of bat flight activity are shown. All stored bat cells can be identified and the tapes are scanned at high speed using instrumentation tape recorder, a digital memory oscilloscope and an FFT analyser. **Census Based on Acoustics:** Data from a province in Sweden (12 400 km^2) which was censused for bats are shown.

The Seventh International Bat Research Conference at Aberdeen, Scotland

PARTICIPANTS

AHLEN, INGEMAR, Department of Wildlife Ecology, Swedish University of Agricultural Sciences, Box 7002, S-75007 Uppsala, Sweden

ALDRIDGE, HUGH, Department of Biology, Carleton University, Ottawa, Canada

ALTENBACH, J. SCOTT, Department of Biology, University of New Mexico, Albuquerque, New Mexico 87131, USA

ANDERSON, MOIRA ELIZABETH, 13 Kingsholm Square, Gloucester GL1 2QJ, England

ANTHONY, EDYTHE, Department of Biology, Rhode Island College, Providence, Rhode Island 02908, USA

ARNOLD, HENRY RICHARD, Windybridge, Shillow Hill, Bury, Huntingdon PE17 1NX, England

BAAGOE, HANS J., Zoological Museum, Department of Vertebrates, Universitetsparken 15, DK-2100 Copenhagen 0, Denmark

BAIN, JAMES R., 1311 N. Indian Springs Way, Flagstaff, Arizona 86001, USA

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

BARON, GEORG, Departement de Sciences Biologiques, Universite de Montreal, C.P. 6128 "A," Montreal H3C 3J7, Canada

BAUER, KURT, Natural History Museum, Vienna A 1014, P.O. Box 417, Austria

BEASLEY, LAURA J., Psychobiology Department, University of California, Irvine, CA 92717, USA

BEER, ANGELA, 41 Meadowgate, Bourne, Lincolnshire PE10 9EY, England

BELL, GARY P., Department of Biology, University of California, 405 Hilgard Avenue, Los Angeles, CA 90024, USA

BELWOOD, JACQUELINE, Deparment of Nematology and Entomology, University of Florida, Gainsville, Florida 32611, USA

BENZAL, JESUS, Catedra de Zoologia (Vertebrados), Facultad de Biologia, Universidad Complutense, 28040 Madrid, Spain

BERNARD, RICHARD, Department of Zoology, Rhodes University, Grahamstown 6140, Republic of South Africa

BHATNAGAR, KUNWAR, Department of Anatomy, University of Louisville School of Medicine, Louisville, Kentucky 40292, USA

BHIWGADE, DAYANAND, Institute of Science, Bombay 32, India

BLAKE, MARY, 15 Stratfield Road, Summertown, Oxford OX2 7BG, England

BOGDANOWICZ, WIESLAW, Mammals Research Institute, Polish Academy of Sciences, 17-230 Bialowieza, Poland

BRAUN, MONIKA, Landessammlungen for Naturkunde, Postfach 4045, D-7500 Karlsruhe, West Germany

BRAUN, HARALD, Durlacherstrasse 38, D-7520 Bruchal, West Germany

BRIGHAM, R. MARK, Department of Biology, Carleton University, Ottawa K1S 5B6, Canada

BROWN, PATRICIA E., 658 Sonja Court, Ridgecrest, CA 93555, USA

BRUNNER, HARALD, Mattenstrasse 10, 7800 Freiburg, West Germany

BRUYLANTS, BRUNO, Beekvelden 91, 2638 Reet, Belgium

BUCHANAN, G. DALE, Faculty of Health Sciences, McMaster University, 1200 Maine Street W., Room 2J32, Hamilton, Ontario L8N 3Z5, Canada

BUKO-BUCHANAN, MARIA MAGDALENA, 121 Hunter Street W., Apt. 710, Hamilton, Ontario L8P 3Z5, Canada

CAKENBERGHE, VICTOR VAN, Department of Biology, University of Antwerp – UIA, Universiteitsplein 1, 2610 Wilrijk, Belgium

CALENDRA, VALERIA, Via Liberta No. 95, 90143 Palermo, Italy

CASSEDAY, JOHN H., P.O. Box 3943, Duke University Medical Center, Durham, NC 27710, USA

COVEY, ELLEN, P.O. Box 3943, Duke Univeristy Medical Center, Durham, NC 27710, USA

CRICK, HUMPHREY, Culterty Field Station, University of Aberdeen, Newburgh, Aberdeen, Scotland

DANIEL, MIKE JOHN, Ecology Division, DISR, Private Bag, Lower Hutt, New Zealand

DAVIES, NICOLA, BBC, Natural History Unit, Broadcasting House, Whiteladies Road, Bristol BS8 2LR England

DER EMDE, GERHARD VON, Universitat Tubingen, Lehrstuhl Zoophysiologie, Auf der Morgenstelle 28, D-7400 Tubingen, West Germany

ESCHE, MARTINA, Scharnhorststrasse 26, D-7835 Teningen, West Germany

EVANS, PETER G.H., EGI, Zoology Department, South Parks Road, Oxford OX1 3PS, England

FENTON, M. BROCK, Biology Department, Carleton University, Ottawa K1S 5B6, Canada

FLINDERS, IAN, 9 Church Close, Hartwell, Northants NN7 2HU, England

FOWLER, PAUL A.F., Department of Zoology, University of Aberdeen, Tillydrone Avenue, Aberdeen AB9 2TN, Scotland

FRANCIS, CHARLES, Department of Biology, Queens University, Kingston, Ontario, Canada

FULLARD, JAMES, Departmen of Biology, Erindale College, University of Toronto, Mississauga, Ontario L5L 1C6, Canada

FUZESSERY, ZOLTAN M., Department of Zoology, Patterson Laboratory, University of Texas, Austin, TX 78712, USA

GAISLER, JIRI, Department of Biology of Animal and Man, Faculty of Science, Purkyne University, Kotlarska 2, 611 37 Brno, Czechoslavakia

GARDNER, RUSSELL A., Department of Biological Sciences, University of Salford, Salford M5 4WT, England

GAUR, B.S., Department of Zoology, University of Jodhpur, Jodhpur 342001, India

GEBHARD, ERIKA, Naturhist. Museum, Augustinergasse 2, CH-4001 Basle, Switzerland

GEBHARD, JURGEN, Naturhist. Museum, Augustinergasse 2, CH-4001, Basle, Switzerland

GERRELL, RUNE, Department of Animal Ecology, Ecology Building, S-223 62 Lund, Sweden

GODFREY, TABITHA SOPHIE, 32 Park Town, Oxford OX2 6SJ, England

GOLDSMITH, JOHN, Natural History Department, Castle Museum, Norwich NR1 3JU, England

GOPALAKRISHNA, A., 39 Vijayanagar, Chaoni, Nagpur 440 013, India

GREENHALL, ARTHUR M., Office of Scientific Authority, U.S Fish and Wildlife Service, Washington, D.C. 20240, USA

GUELDRE, GREET DE, Universitaire Instelling Antwerpen, Universiteitsplein 1, 2610 Wilrijk, Belgium

GUNTON, MICHAEL, BBC, OUPC, Walton Hall, Milton Keynes MK7 6BH, England

GUSTAFSON, ALVAR, Department of Anatomy and Cellular Biology, Tufts University Schools of Medicine, 136 Harrison Avenue, Boston, MA 92111, USA

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

HAEUSSLER, URSEL, Universitat Tubingen, Lehrstuhl Zoophysiologie, Auf der Morgenstelle 28, D-7400 Tubingen 1, West Germany

HAFFNER, MARIANNE, Zoologisches Museum der Universitat Zurich-Irchel, Winterthurerstrasse 190, 8057 Zurich, Switzerland

HALL, JOHN S., RD 1, Box 289, Leesport, Pennsylvania 19533, USA

HAND, SUZANNE, School of Zoology, University of New South Wales, P.O. Box 1, Kensington, New South Wales 2033, Australia

HANEKAMP, BERT G., Hulstlaan 29, 3852 GA Ermelo, The Netherlands

HARDCASTLE, RAYMOND, 32 Hauptstrasse, 6791 Boersborn, West Germany

HARTLEY, DAVID, 6777 Kerr Creek Road, Bloomington, Indiana 47401, USA

HEBLICH, KLAUS, Universitat Tubingen, Inst. Biol. III, Lehrstuhl Zoophysiologie, Morgenstelle 28, D-7400 Tubingen, West Germany

HEILMANN, UTE, Lehrstuhl fur Zoophysiologie, Auf der Morgenstelle 28, D-7400 Tubingen, West Germany

HELLER, KLAUS-GERHARD, Institut fur Zoologie der Universitat Erlangen-Nurnberg, Lehrstuhl II, Bismarckstrasse 8 u. 10, 852 Erlangen West Germany

HECKENROTH, HARTMUT, Niedersachsisches, Landesverwaltungsamt, Fachbehorde fur Naturschutz, Scharnhorstrasse 1, 3000 Hannover 1, West Germany

HELLIWELL, LESLEY M., 87 East Parade, Heworth, York Y03 7YD, England

HERBERT, HORST, Zoophysiologie/Biologie III, Auf der Morgenstelle 28, D-7400 Tubingen, West Germany

HILL, JOHN E., Mammal Section, Department of Zoology, British Museum (Natural History), Cromwell Road, London SW7 5BD, England

HODGES, NICHOLAS R., 18 Stanley Road, Oxford OX4 1Q7, England

HONGELL, KARIN, Department of Genetics, University of Helsinki, P. Rautatiekatu 13, SF-00100 Helsinki 10, Finland

HORST, G. ROY, Department of Biology, Potsdam College, Potsdam, NY 13676, USA

HORACEK, IVAN, Vokacova 1182/4, 14100 Praha 4, Czechoslavakia

HUTSON, ANTHONY M., Fauna and Flora Preservation Society, c/o Zoological Society of London, Regents Park, London NW1 4RY, England

HUMBY, RODERICK, UWIST Field Centre, Newbridge-on-Wye, Llandrindrod Wells, Powys, Wales

ILIOPOULOU-GEORGUDAKI, JOAN, University of Patras, faculty of Natural Science, Department of Biology, Section of Animal Biology, Patra, Greece

JUEDES, ULRICH, IPN/University of Kiel, D-2300 Kiel, West Germany

JOERMANN, GERHARD, Zoologisches Institut, Poppelsdorfer Schloss, D-5300 Bonn 1, West Germany

JONES, GARETH, Department of Zoology, University of Bristol, Woodlands Road, Bristol BS8 1UG, England

KANDULA, SRIPATHI, School of Biological Sciences, Madurai Kamaraj University, Madurai 625021, India

KARIM, KAMAR BANU, 'Noorain,' Second Floor, Samiullah Khan Marg, Sadar Bazar, Nagpur 440 001, India

KLINGHAMMER, KIRSTEN, c/o Wolf Park, Battle Ground, IN 47920, USA

KOBER, RUDI, Behringstrasse 10, 7410 Reutlingen, West Germany

KOOPMAN, KARL F., Department of Mammalogy, American Museum of Natural History, New York, NY 10014, USA

KONSTANTINOV, A.L., A.A. Ukhtomsky Institute of Physiology, Leningrad State University, 7/9 University Embankment, Leningrad 199164, USSR

KRETZSCHMAR, FRIEDRICH, Marchstrasse 1, D-7800 Freiburg, West Germany

KUNZ, THOMAS H., Biological Science Centre, Boston University, 2 Cummington Street, Boston, MA 92215, USA

KURTA, ALLEN, Department of Biology, Boston University, Boston, MA 92215, USA

LAING, BOB, Department of Plant Science, University of Aberdeen, St. Machar Drive, Aberdeen, Scotland

LALL, SURESH B., Associate Professor of Zoology, R-20, University (New Campus), Udaipur - 313 001, India

LAFFOLEY, DANIEL d'A., Department of Biological Sciences, University of Exeter, Exeter EX4 4PS, England

LARSEN, S.A., Department of Anatomy, University of Louisville School of Medicine, HSC, Louisville, KY 40292, USA

LASKA, MATTHIAS, Zoological Institute of the University, Poppelsdorfer Schloss, D-5300 Bonn, West Germany

LEE, KAREN, Department of Biology, UCLA, Los Angeles, CA 90024, USA

LEHMANN, RUDOLPH, University of Helsinki, Department of Zoology, P. Rautatiekatu 13, 00100 Helsinki 10, Finland

LIEGL, ALOIS, Handelstrasse 20 Zi 322, 7800 Freiburg, West Germany

LINA, PETER H.C., Ministry of Agriculture and Fisheries, (Nature Conservation, Environmental Protection and Wildlife Management), P.O. Box 20401, 2500 ED The Hague, The Netherlands

LIPMANOVA, EUGENIE, 205 Walden Street, Apartment 5T, Cambridge, Massachusetts 92140, USA

LOKKI, JUHANI, Department of Genetics, University of Helsinki, Arkadiankatu 7, SF-00100 Helsinki, Finland

LUNDBERG, KARIN, Department of Animal Ecology, Ecology Building, S-223 62 Lund, Sweden

MCANALLY, KEN, 2/17 Earle Lane, Toowona, Queensland 4066, Australia

MCANEY, KATE, 114 LR Main Street, Ballybay, Co. Monaghan, Ireland

MCCARTHY, TIMOTHY J., 25-30 30th Road 6-K, Astoria (Queens), New York 11102, USA

MCCRACKEN, GARY F., Department of Zoology, University of Tennessee, Knoxville, TN 37996, USA

MCOWAT, THOMAS P., 19 Park Puw, Drefach Velindre, Llandysul, Dyfed, Wales

MCWILLIAM, ANDREW, Department of Zoology, University of Aberdeen, Tillydrone Avenue, Aberdeen AB9 2TN, Scotland

MAHDAVAN, ARAKKAL, Department of Zoology, Bharata Mata College, Cochin-682 021, India

MAINA, JOHN N., Department of Veterinary Anatomy, University of Nairobi, Box 30197, Nairobi, Kenya

MARIES, KEITH, QMC Instruments Ltd., 229 Mile End Road, London E1 4AA, England

MARIMUTHU, G., Department of Animal Behaviour, Madurai Kamaraj University, Madurai - 625 021, India

MARSHALL, ADRIAN G., Department of Zoology, University of Aberdeen, Tillydrone Avenue, Aberdeen AB9 2TN, Scotland

MARTIN, ROBERT L., 39 High Street, Farmington, Maine 04938, USA

MARVEN, NIGEL, 10 Rosebery Terrace, Clifton, Bristol BS8 1DP, England

MASSON, DIDIER, Residence Val Notre Dame, 33 rue de la Liberte, 78200 Mantes-la-Jolie, France

MAYER, FRIEDER, Im Mannlehenfeld 15, D-7110 Ohringen, West Germany

MAYRAND, ELISE, Departement des Sciences Biologiques, Universite de Montreal C.P. 6128 Succ. "A," Montreal H3C 3J7, Canada

MERWE, MEINHARDT VAN DER, Department of Zoology, University of Pretoria, Pretoria 0002, Republic of South Africa

METZNER, WALTER, Zoologisches Institut, Luisenstrasse 14, D-8000 Munchen 2, West Germany

MICKLEBURGH, SIMON, Fauna and Flora Preservation Society, c/o Zoological Society of London, Regents Park, London NW1 4RY, England

MILLER, LEE, Biologisk Institut, Odense Universitet, Campusvej 55, 5230 Odense M, Denmark

MITCHELL-JONES, ANTHOHY J., Nature Conservancey Council, Northminster House, Peterborough PE1 1UA, England

MOBLEY, EMILY DAVIS, Box 333, Wilbraham, MA 01095, USA

MOGNDANS, JOACHIM, Institut fur Biologie III, Auf der Morgenstelle 28, 7400 Tubingen, West Germany

MORENO, EULALIA, Catedra de Zoologia de Vertebrados, Facultad de Biologia, Univ. Complutense, 28040 Madrid, Spain

MORI, TAKAYUKI, Zoological Laboratory, Faculty of Agriculture, Kyushu University 46-06, Fukuoka 812, Japan

NEUWEILLER, GERHARD, Department of Zoology, Luisenstrasse 14, D-8000 Munchen, West Germany

NEVILLE, PHILIP A., Department of Zoology, University of Aberdeen, Tillydrone Avenue, Aberdeen AB9 2TN, Scotland

NORBERG, ULLA, Department of Zoology, University of Goteborg, Box 250 59, S-400 31 Goteberg, Sweden

OH, YUNG KEUN, Department of Zoology, College of Liberal Arts and Sciences, Yonsei University, Kangwon-do 220-13, Korea

OKONIEWSKI, MARIA, Box 16484, Knoxville, TN 37996-4900, USA

O'NEILL, WILLIAM, Centre for Brain Research, University of Rochester Medical School, Rochester, New York 14642, USA

PADIAN, KEVIN, Department of Palcontology, University of California, Berkeley, CA 94720, USA

PAYNE, NICHOLAS H., East Bursea Farm, Holme-on-Spaulding Moor, York YO4 4DB, England

PARK, SHI-RYONG, Zoological Institute, Poppelsdorfer Schloss, D-5300 Bonn 1, West Germany

PENDHARKAR, YOGESH D., Department of Zoology, S.N. Government P.G. College, Khandwa 480001, India

PENZHORN, BAREND L., P.O. Box 12580, Onderstepoort 0110, Republic of South Africa

PERRIN, LAURENT, Naturhistorisches Museum Basel, Augustinergasse 2, CH-4001 Basel, Switzerland

PIERSON, ELIZABETH D., Museum of Vertebrate Zoology, University of California, Berkeley, CA 94720, USA

POLLAK, GEORGE, Department of Zoology, University of Texas, Austin, TX 78712, USA

POPPITT, SALLY, Department of Zoology, University of Aberdeen, Tillydrone Avenue, Aberdeen AB9 2TN, Scotland

PYE, ADE, Department of Audiology, Institute of Laryngology and Otology, 330 Gray's Inn Road, London WC1X 8EE, England

PYE, J. DAVID, School of Biological Sciences, Queen Mary College, Mile End Road, London E1 4NS, England

RACEY, PAUL A., Department of Zoology, University of Aberdeen, Tillydrone Avenue, Aberdeen AB9 2TN, Scotland

RAINEY, WILLIAM E., Museum of Vertebrate Zoology, University of California, Berkeley, CA 94720, USA

RANFT, RICHARD, National Sound Machine, 29 Exhibition Road, London SW7 2AS, England

RANSOME, ROGER D., Moorings, 14B Dursley Road, Woodfield, Dursley, Gloucester, England

RAUTENBACH, IGNATIUS L., Transvaal Museum, P.O. Box 413, Pretoria 0001, Republic of South Africa

RAYNER, JEREMY M.V., Department of Zoology, University of Bristol, Woodland Road, Bristol BS8 1UG, England

RESLER, CARL, Department of Zoology, University of Texas, Austin, TX 78712, USA

RICHARDSON, PHILIP, Northants Bat Group, 10 Bedford Cottages, Great Brington, Northampton NN7 4JE, England

ROBSON, SIMON, Department of Oral Biology and Oral Surgery, University of Queensland, St. Lucia, 4061, Australia

ROER, HUBERT, Zool. Forschungsinstitut und Museum Alexander Koenig, Adenauerallee 150-164, D-5300 Bonn 1, West Germany

ROSS, LINDA S., Department of Zoology, University of Texas, Austin, TX 78412, USA

ROTHER, GEORG, Meerehauseeuerstrasse 65, 5300 Bonn 3, West Germany

ROVERUD, ROALD, Zoologisches Institut der Universitat Munchen, Luisenstrasse 14, D-8000 Munchen 2, West Germany

RUBBELKE, HERMANN-JOSEF, Lehrstuhl II, Bismarckstrasse 8 u. 10, 852 Erlangen, West Germany

RUBSAMEN, RUDOLF, Lehrstuhl Allgemeine Zoologie, Ruhr Universitat Bochum Postfach 10 21 48, 4630 Bochum 1, West Germany

RYZRALST, CHARLES, Rabies Unit, The Wistar Institute, 36th Street at Spruce, Philadelphia, PA 19104, USA

RYBAR, PETR, Prazska 232, 500 02 Hradec Kralove 4, Czechoslovakia

RYBERG, OLOF E., Trastvag 14A, Lund, Sweden

RYDELL, JENS, Department of Animal Ecology, Ecology Building, S-223 62 Lund, Sweden

SACHTELEBEN, JENS, Karl-Hugel-Strasse 18, 8580 Bayreuth, West Germany

SANDHU, SATWANT, Department of Zoology, Institute of Science, Nagpur 440 001, India

SAPKAL, VATSALA, Zoological Institute of Science, Nagpur 440 001, India

SCHLAPP, GEORG, Institut fur Zoologie der Universitat Erlangen-Nurnberg, Lehrstuhl II, Bismarckstrasse 8 u. 10, 852 Erlangen, West Germany

SCHMIDT, CHRISTEL, Zoological Institute, Poppelsdorfer Schloss, D-5300 Bonn 1, West Germany

SCHMIDT, UWE, Zoological Institute, Poppelsdorfer Schloss, D-5300 Bonn 1, West Germany

SCHNITZLER, HANS-ULRICH, Institut fur Biologie III, Auf der Morgenstelle 28, D-7400 Tubingen, West Germany

SPEAKMAN, JOHN R., Department of Zoology, Univesity of Aberdeen, Tillydrone Avenue, Aberdeen AB9 2TN, Scotland

STEBBINGS, ROBERT E., I.T.E. Monks Wood Experimental Station, Abbots Ripton, Huntingdon PE17 2LS, England

STJERNBERG, TORSTEN, Zoological Museum, University of Helsinki, Norra Jarnvagagatan 13, SF-00100 Helsingfors, Finland

STUTZ, HANS-PETER, Zoologisches Museum, Universitat Zurich-Irchel, Winterthurerstrasse 190, CH-8057 Zurich, Switzerland

SOWLER, SANDRA, 28 Southfields Road, Strensall, York YO3 8UA, England

SWIFT, SUSAN M., Drumore, Blacklunans, Blairgowrie, Perthshire PH10 7LA, Scotland

SURLYKKE, Institute of Biology, Odense University, DK-5320 Odense M, Denmark

SUTHERS, RODERICK A., Medical Sciences Program, Indiana University, Bloomington, Indiana 17405, USA

THOMAS, DONALD W., Colelge of Forest Resources AR-10, University of Washington, Seattle, WA 98195, USA

THOMAS, STEVEN P., Department of Biology, Duquesne University, Pittsburgh, PA 15282, USA

THOMPSON, MICHAEL J.A., Firbank, 118 Strensall Road, Old Earswick, York YO3 9SJ, England

TILFORD, TONY, Mulberry House, 3 Newmarket Road, Cringleford, Norwich NR4 6UE, England

TIPTON, VIRGINIA M., Department of Biology, Radford Univerity, Radford, VA 24142, USA

TUPINIER, YVES, 5B rue Claude Baudrand, F-69300 Caluire, France

TUTTLE, MERLIN, Vertebrate Division, Milwaukee Public Museum, Milwaukee, WI 53233, USA

UCHIDA, TERU AKi, Zoological Laboratory, Faculty of Agriculture, Kyushu University 46-06, Fukuoka 812, Japan

URBANCZYCK, ZBIGNIEW, Os. J. III Sobieskiego 26D/142, PL-60-683 Poznan, Poland

VANN, CYNTHIA, 32 Hauptstrasse, 6791 Boersborn, West Germany

VATER, MARIANNE, Zoologisches Institut LMU, Luisenstrasse 14, 8 Munchen 2, West Germany

VERNIER, EDOARDO, Via Dante 5, 35139 Padova, Italy

VOLLETH, MARIANNE, Institut fur Zoologie II, Bismarckstrasse 10, D-8520 Erlangen, West Germany

VOUTE, ALDO M., University of Utrecht, Laboratory for Animal Ecology and Taxonomy, Plompetorengracht 9-11, 3512 CA Utrecht, The Netherlands

WALLACE, CHRISTOPHER, QMC Instruments Ltd., 229 Mile End Road, London E1 4AA, England

WENSTRUP, JEFFREY, Department of Zoology, University of Texas, Austin, TX 78712, USA

WEST, CHRISTOPHER, J.W.P.T., Les Augres Manor, Trinity, Jersey, Channel Islands

WIEBEMEIER, PATRIK, Mattacherstrasse 61, CH-8052 Zurich, Switzerland

WILKINSON, GERALD S., Institute for Behavioural Genetics, Campus Box 447, University of Colorado, Boulder, CO 80309, USA

WILLIAMS, SERENA, 29 South Canterbury Road, Canterbury, Kent CT1 3LH, England

WILLIAMSON, BRIAN, 15 Stratfield Road, Summertown, Oxford OX2 7BG, England

WOODSIDE, DEDEE, Taronga Zoo, P.O. Box 20, Mosman, New South Wales 2088, Australia

ZBINDEN, KARL, Garbenweg 3, CH-3027 Berne, Switzerland

ZOOK, JOHN M., Department of Zoological and Biomedical Science, Ohio University, Athens, Ohio 45701, USA

ZUBER, SUZANNE, Winterthurerstrasse 316, CH-8057 Zurich, Switzerland


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FRONT COVER

The King's College Tower, University of Aberdeen, Scotland, where the Seventh International Bat Research Conference and the Third European Bat Research Symposium held their joint meeting from 19-24 August, 1985. The historic University at Aberdeen will celebrate its 500th anniversary in 1995. It is one of the oldest universities in Britain and is one of the finest. The campus is grouped around the sixteenth century chapel and buildings of King's College.