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## Systematic Notes on Liberian Bats

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### ABSTRACT

Based on previously unreported material, 32 species of bats are recorded from Liberia, bringing the total species known for that country to 52. The following species are recorded from Liberia for the first time: *Rhinolophus guineensis*, *Hipposideros fuliginosus*, *Myotis tricolor* (first record for western Africa), *Pipistrellus eisentrauti*, "*Eptesicus*" *brunneus*, *Glauconycteris poensis*, *Mops brachyptera*, and *M. spurrelli*. Other noteworthy findings are the confirmation of an unusually large form of

*Rhinolophus clivosus* from tropical western Africa (here described as a new subspecies), the revelation of additional complexity in what is here called *Hipposideros ruber*, clarification of the distinction between *H. caffer* and *H. beatus*, and a discussion of the problems of distinguishing *Mops spurrelli* and *M. nanulus*. It is clear that a large number of forest species, some basically East African, have been able to extend as far west as Liberia and probably to the western limits of the high forest.

### INTRODUCTION

The receipt of an important collection of bats made by Mr. Andrew S. Voros in various parts of Liberia between December 16, 1982, and February 3, 1986, has prompted a study of all Liberian bats in the collection of the American Museum of Natural History. This study has revealed a number of new distributional records and raised several taxonomic problems and advanced our knowledge of far western tropical African bats beyond what was recorded by Kuhn (1965), supplemented by Verschuren (1976), Hill (1982), Wolton et

al. (1982), and, in a wider sense, by Rosevear (1965) and by Hayman and Hill (1971).

The Voros collections were made in several areas, both near the coast and in the interior, including two localities near the border of Guinea. Some of the other American Museum material is from near the Ivory Coast border. The specimens collected by Voros are accompanied by extensive fieldnotes which are on file in the Department of Mammalogy at the American Museum of Natural History. While many of the localities where Voros col-

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lected are specified in considerable detail, I have only given the large localities, which can be found on maps. For volant mammals, such as bats, which may forage several miles from the roost, this seems adequate. All the Voros bats were netted and therefore have no data concerning roosts. Though, except for a narrow band of coastal scrub, all of Liberia is mapped as High Forest (Rosevear, 1965), extensive man-made deforestation has occurred, as is clear from Voros' fieldnotes.

More recently we have received a small collection of Liberian bats made by Dr. Robert W. Dickerman between March 24 and April 11 of 1988 in Sinoe (Greenville, Juarzon) and Grand Gedeh (Jaoudi) counties. In the following accounts, I have taken up the various families, genera, and species in turn. Unless otherwise indicated, all specimens are in the American Museum of Natural History (AMNH). Where there is no AMNH material or where it does not add appreciably to what is already recorded in the References, the entries are brief. All measurements are in millimeters. I am extremely grateful to Mr. Andrew S. Voros for making this fine collection (with its fieldnotes) for us. Dr. Robert W. Dickerman of the Department of Ornithology, American Museum, is also thanked for making his small but valuable collection available to us. I am indebted to Dr. Richard G. Zweifel of the Department of Herpetology of the American Museum for introducing me to Mr. Voros and for sharing with me information he has received from him. Mr. John Hill, as always, made specimens at the British Museum (BM) available to me and rendered much additional assistance. Dr. Judith L. Eger gave me access to the Mammal collection at the Royal Ontario Museum (ROM) in Toronto, Canada. Dr. Rainer Hutterer loaned me a specimen of *Rhinolophus clivosus* from the Alexander Koenig Museum in West Germany (ZFMK). Dr. Dieter Kock and Dr. Duane Schlitter have read the manuscript and made useful suggestions.

## DISTRIBUTIONAL SURVEY

### FAMILY PTEROPODIDAE

Kuhn (1965) listed 9 genera (as currently recognized) and 10 species from Liberia.

Another genus and 2 additional species were added by Verschuren (1976). Besides the 10 species treated below, these include *Rousettus angolensis* and *Hysignathus monstrosus*. The only other species occurring in western Africa south of 12° and west of 0° are *Epomops franqueti* (which is also mentioned below), and *Epomophorus labiatus*, which is represented by specimens from Ghana in the Royal Ontario Museum, though Bergmans (1988) recognizes no records from west of Nigeria.

*Eidolon helvum*: Voros obtained a single female near Monrovia in November 1983. The American Museum of Natural History also has a male from Ganta (= Gahnpa) collected by G. W. Harley in September 1932.

*Rousettus aegyptiacus*: Voros collected two females at Ngilima in December 1982 and another female at Voinjama in August 1983. Though both Rosevear (1965) and Verschuren (1976) use the name *occidentalis* for the West African subspecies, Koopman (1966) clearly showed that *unicolor* was the oldest available name for this subspecies, and this was followed by Hayman and Hill (1971).

*Myonycteris torquata*: Voros collected 11 specimens from the following localities: a female at Ngilima in May of 1983, a female at Saniquellie in July of 1983, a female at Juarzon in May of 1984, and Bomi Wood Concession in November of 1984 (2♀), December of 1985 (1♂, 4♀), and January or February of 1986 (1♀). The American Museum also has three specimens collected by L. W. Robbins near Tchien (Zwedru) in July (1♀) and August (1♂, 1♀) of 1971.

*Epomops buettikoferi*: Voros collected 23 specimens from the following localities: Saniquellie (2♀) in July of 1983, Voinjama in August (2♀) and September (3♂, 2♀) of 1983, Samoyea (1♂, 3♀) in January of 1984, Monrovia (2♂) in April of 1984, Juarzon (3♂, 4♀) in May of 1984, and Bomi Wood concession (1♀) January or February of 1986. Dickerman collected four specimens from Greenville (1♂) and Juarzon (1♂, 2♀) in March of 1988. The American Museum also has specimens collected by D. Weyer at Harbel, by H. H. Burgess from the Du River in February (1♀) of 1933, and by L. W. Robbins near Tchien (Zwedru) in August (3♀) of 1971. Though Kuhn (1965) treated *buettikoferi* as a subspe-

cies of *E. franqueti*, I agree with Rosevear (1965) in keeping it as a distinct species. Though the palatal ridge character may break down, the size difference is marked. The American Museum has single male and female specimens of both species from southern Ivory Coast. The condylobasal lengths for these four skulls (*franqueti* in each case first) are: males (43.9, 58.1), females (38.9, 49.3). The condylobasal measurements of adult skulls from Liberia are: males (55.4–58.5), females (49.0–50.0). It is clear that the Ivory Coast *buettikoferi* material falls within the variability of Liberian specimens, whereas the Ivory Coast *franqueti* specimens fall well outside it. Since the overlap zone extends from Sierra Leone (Royal Ontario Museum specimens) to western Nigeria (encompassing the entire range of *E. f. strepitans*), there seems no reason to treat them as conspecific. I am therefore in full agreement with Bergmans (1975).

*Epomophorus gambianus*: The only record of this species from Liberia is from Kuhn (1965) and this is questioned by Bergmans (1988). However, in view of the fact that all but one of the abovementioned specimens of *Epomops buettikoferi* collected by Voros were originally identified as *Epomophorus gambianus*, a few remarks on distinguishing the two similarly sized species are in order. The classical character for distinguishing *Epomops* from *Epomophorus* (flat vs. downturned posterior margin of the hard palate) is difficult to use in alcoholic specimens, even if the mouth is propped open, because it is so far back. However, in *Epomophorus gambianus* the maxillary tooth rows are almost parallel whereas in *Epomops buettikoferi* they are markedly diverging posteriorly. This can be expressed mensurally by the greater width across the last molars in *buettikoferi* (more than 15 vs. less than 15 in males, more than 15 vs. less than 14.5 in females). Since *Epomops buettikoferi* is basically a forest bat whereas *Epomophorus gambianus* is basically a savanna one, records of the former from Liberia would be expected to be far more numerous than the latter and this is indeed the case.

*Micropteropus pusillus*: Voros collected three males from Monrovia in November of 1983 and April of 1984. Dickerman collected

1 male and 1 female from Greenville in March of 1988.

*Nanonycteris veldkampii*: Voros collected a single male at Voinjama in October of 1983 and four more (3♂, 1♀) at the Bomi Wood Concession in December of 1985.

*Scotonycteris zenkeri*: Voros did not obtain this species but Dickerman obtained 1 male and 2 females from Juarzon in March of 1988. The American Museum also has a single specimen collected by L. W. Robbins near Tchien (Zwedru) in August of 1971.

*Scotonycteris ophiodon*: Voros did not obtain this species, but Dickerman obtained a single female near Jaoudi in April of 1988.

*Megaloglossus woermanni*: Voros collected a single female at Saniquellie in July of 1983, another female at Ngilima in August of 1983, a male at Voinjama in October of 1983, and four (2♂, 2♀) at Bomi Wood Concession in December of 1985. Dickerman obtained 1 male and 3 females near Jaoudi in April of 1988.

#### FAMILY EMBALLONURIDAE

Five members of this family are known from far western tropical Africa (west of 0° and south of 12°), but neither *Taphozous perforatus* nor *T. nudiventris* is known from countries adjacent to Liberia. *Coleura afra* is recorded from Guinea and *Taphozous mauritianus* from Sierra Leone, but only a single species is known from Liberia.

*Saccolaimus peli*: Voros did not obtain this species but the American Museum has two males and two females collected by L. W. Robbins near Tchien (Zwedru) in July of 1971.

#### FAMILY NYCTERIDAE

Of the nine species of the single genus (*Nycteris*) occurring in far western Africa, six are now known from Liberia. Of the three remaining, *N. nana* has been recorded from the Ivory Coast and *N. gambiensis* from both Guinea and Sierra Leone. *N. thebaica* has been recorded from Guinea, but since there has been confusion with *N. gambiensis*, the record may apply to the latter species. Besides the four discussed below, Kuhn (1965) recorded *N. intermedia* and *N. grandis*. The former was included by Rosevear (1965) in

*N. arge*, but I follow Cakenberghe and DeVree (1985) in keeping them as separate species.

*Nycteris arge*: Voros collected a single female at Ngilima in August of 1983.

*Nycteris major*: Voros collected a single male at Voinjama in September of 1983. This is apparently the westernmost record for the species and the first for Liberia. It was not unexpected, however, since Cakenberghe and DeVree (1985) recorded it from the western edge of the Ivory Coast.

*Nycteris hispida*: Voros did not obtain this species but Dickerman collected a male near Jaoudi in April of 1988. G. H. H. Tate collected a male near Monrovia in October of 1940.

*Nycteris macrotis*: Voros did not obtain this species but Dickerman collected a female from Juarzon in March of 1988. G. H. H. Tate collected 2 males and a female near Monrovia in October of 1940. I agree with Cakenberghe and DeVree (1985) in their inclusion of *aethiopica* in *N. macrotis*.

#### FAMILY MEGADERMATIDAE

The only species of this family occurring in western Africa is *Lavia frons*. It is not known from Liberia, though Miller (1905) did record it from neighboring Sierra Leone.

#### FAMILY RHINOLOPHIDAE

Three genera of this family occur in far western Africa, but the single species of *Asellia* in our area (*A. tridens*) is a dry-country species extending no farther south than the Sudan Woodland (north of 12°) and therefore does not approach Liberia. The other two genera (*Rhinolophus* and *Hipposideros*), however, each has several species that reach Liberia.

GENUS *RHINOLOPHUS*: Of the eight species of this genus from far western tropical Africa, only three are now known from Liberia. However *simulator* (incl. *alticolus*), *denti* (including *knorri*), *landeri* (not including *guineensis*), *maclaudi*, and *fumigatus* are all known from Guinea, *landeri* and *fumigatus* also from Sierra Leone. Kuhn (1965) mentioned no *Rhinolophus* from Liberia, but Verschuren (1976) recorded *alcyone* and Hill (1982) *clivusos*.

*Rhinolophus clivusos*: Voros collected a single female at Voinjama in October of 1983. This is only the third specimen of this species to be obtained from western Africa north of the equator (Hill, 1968, 1982). All three are unusually large for this species (forearm length, 52–58; condylocanine length, 20.5–21.7) and completely lack the vestigial anterior upper premolar. They are probably most closely related to *R. c. zuluensis* in Uganda and northeastern Zaire, which however, tends to be smaller (forearm length, 50–56 mm; condylocanine length, 19.1–20.5 mm) and usually retains the vestigial anterior upper premolar. Hill (1982) intimated that these West African *R. clivusos* specimens probably belong to a new subspecies. Another possibility that occurred to me was that these three specimens might represent the closely related *R. ferrumequinum*, which occurs in northwestern Africa (north of the Sahara). Judged by the only *R. ferrumequinum* skulls available at the American Museum from the western Palearctic (from Italy), however, the West African *clivusos* differs in its considerably broader rostrum. This has been confirmed by comparison of the British Museum Liberian skull with one of *R. ferrumequinum* from Algeria. All three specimens of *R. clivusos* have come from upland areas (Manenguba Mts. in Cameroon, Mt. Nimba, and the foothills of the Guinea highlands in Liberia). It is interesting to note that most East African records of *R. clivusos* are also in highland areas (see Koopman, 1975: 386; confirmed by the Kenya localities listed by Aggundey and Schlitter, 1984: 129). Since these three West African specimens are considerably more distinct from their closest relatives than several of the presently recognized subspecies of *R. clivusos* are from one another, I have decided to describe the West African form as new.

#### *Rhinolophus clivusos hillorum*

##### New Subspecies

HOLOTYPE: AMNH 257044, a female obtained by Andrew S. Voros (5924) in early October at the John Hegbe Farm near Zozoma, ca. 2 mi SW Voinjama in Lofa County, extreme northwestern Liberia at ca. 500 m elevation. This would place it at ca. 8°25'N, 9°35'W. The holotype consists of an entire

specimen preserved in alcohol with the skull extracted and cleaned.

**DIAGNOSIS:** Larger than other subspecies of *R. clivosus*. Much larger than any of the northern subspecies (*bocharicus*, which many regard as a separate species, *clivosus*, *brachygnathus*, *schwarzi*, *acrotis*) and somewhat larger than the eastern and southern *keniensis*, *zuluensis*, and *augur*. Selected measurements are as follows (range of *hillorum* followed by combined range of *keniensis*, *zuluensis*, and *augur*): forearm length (52–57, 50–56); condylocanine length (20.5–21.7, 18.7–20.5); zygomatic breadth (12.7–13.3, 11.1–12.2); mastoid width (10.8–11.5, 9.7–11.1); width across last upper molars (9.0–9.4, 7.6–8.6); maxillary toothrow length (8.9–9.4, 7.6–8.8). The size difference is particularly evident in the breadth of the palatal area and the volume available for the temporalis musculature as shown by the width across the molars and the zygomatic breadth. Going along with this are the larger teeth of *hillorum* and the absence in all three known specimens of the anterior upper premolar. This tooth is almost always present, albeit greatly reduced in *keniensis*, *zuluensis*, and *augur* (only 1 out of 40 skulls examined for this character). It seems evident that even if the very similar *keniensis*, *zuluensis*, and *augur* were combined into one subspecies, *hillorum* would still remain distinct.

**ETYMOLOGY:** I name this subspecies after the two (often confused) eminent mammalogists named John E. Hill: J. Eric (1907–1947), and J. Edwards (1928–). I have known both of them and feel that each, in different ways, has been important in my understanding of African bats, to which both made outstanding contributions.

**LOCALITY RECORDS: LIBERIA:** Voinjama: AMNH 257044; Tokadeh, Nimba, 600 m: BM 79.459. **CAMEROON:** Lake Manenguba, Manenguba Mountains, 1800 m: ZFMK 69.485. All three specimens are preserved in alcohol with the skulls extracted and cleaned.

*Rhinolophus guineensis*: Voros collected two specimens at Voinjama in September of 1983. This taxon was described as a subspecies of *R. landeri* by Eisentraut (1960), who gives extensive measurements comparing it with *R. l. landeri* and *R. l. lobatus*. This was followed by Rosevear (1965), who, however,

recorded both *l. landeri* and *guineensis* from Sierra Leone. Böhme and Hutterer (1979) concluded that, in view of the sympatry, the two taxa should be considered separate species. I find myself in full agreement and note a marked size difference between a female collected by Voros (condylocanine length 17.4) compared to a male *l. landeri* from Ghana (condylocanine length 15.7). This in spite of the fact that Eisentraut's measurements show males averaging larger in both taxa. *R. guineensis* indeed seems to occupy a middle range between the small *R. landeri* and the large *R. alcyone*.

**GENUS HIPPOSIDEROS:** At least nine (and possibly 10) species are known from far western Africa, of which seven are now recorded from Liberia. Aside from *H. lamottei* (which is discussed below in the *H. ruber* account), *H. jonesi* is known from Guinea and Sierra Leone, but *H. abae* has not been recorded from west of Upper Volta and Ghana, though the Royal Ontario Museum has specimens so identified from the Ivory Coast and Sierra Leone. Besides the four species discussed below, Kuhn (1965) lists *H. marisae*, *H. caffer*, and *H. commersoni* from Liberia.

*Hipposideros fuliginosus*: A single adult female collected by Voros at Voinjama in September of 1983 is tentatively referred here. Though originally identified as *H. ruber*, it is markedly larger than any representative of that species available (forearm length 53, condylocanine length 17.9, maxillary toothrow length 7.7, width across last molars 7.7) and I can find no frontal sac. It is clearly smaller than the range of measurements given by Rosevear (1965), but in view of the relatively small number of museum specimens, I don't consider this a serious objection. If correctly identified this would appear to be the first record of *H. fuliginosus* west of Ghana.

*Hipposideros ruber*: Voros collected four specimens from Voinjama in April (1♂) and September (1♂, 2♀) of 1983. The American Museum also has a male collected by L. W. Robbins near Tchien (Zwedru) in July of 1971. The skulls of all have been extracted and cleaned and show considerable variation in size and proportions. The two smallest were originally identified as *H. caffer* but are markedly larger than four *caffer* from Ghana. When

the five Liberian specimens are keyed out in Rosevear (1965), the smaller ones fall into *caffer angolensis*, the larger into *caffer guineensis*. Both these taxa are currently included in *H. ruber*. Nevertheless, the five Liberian skulls show considerable heterogeneity (condylocanine length 15.3–17.0 vs. 13.8–14.0 for the four abovementioned *caffer* from Ghana). Four Ivory Coast skulls all measure large (condylocanine length 17.0–17.4), but two Ghana skulls of *ruber* are medium (condylocanine length 16.3–16.5). All this suggests that two or three species are included under the currently recognized taxon *H. ruber*.

In this connection, it should be pointed out that Brosset (1984) has described a new species (*H. lamottei*) from the mountain grasslands on the northern (Guinea) side of Mt. Nimba. The most important character Brosset gives for distinguishing the two species is the width of the cranium, best shown (according to his bar graphs) by the zygomatic width and the width across the last upper molars.

I have taken these measurements on several small series of West African *Hipposideros* (agreeing with the general concept of *H. ruber*) with the following results. From Western Cameroon (nearer the type locality of *guineensis* than that of *lamottei*), one large skull (condylocanine length 17.1) agrees with *ruber* in both measurements; of two medium skulls (condylocanine length 15.9–16.1), one agrees with *ruber* in one measurement but is intermediate in the other, one agrees with *lamottei* in one measurement but is intermediate in the other; one small skull (condylocanine length 15.2) agrees with *lamottei* in both measurements. Of the two abovementioned medium-size Ghana skulls, one agrees with *ruber* in both measurements, the other with *ruber* in one but is intermediate in the other. Of the four abovementioned large Ivory Coast skulls, three agree with *ruber* in both measurements but the fourth is like *ruber* in one measurement but is intermediate in the other. Finally, among the five abovementioned Liberian skulls, the large one agrees with *ruber* in both measurements, but of the two medium, one agrees with *lamottei* in both measurements, the other is intermediate in both. Summing up, it is evident that the larger skulls tend to agree with *ruber*, the smaller with

*lamottei*. This is to be expected, of course, since large skulls will tend to have larger width as well as length measurements. However, it is clear that the skulls do not all clearly fall into two groups and that the validity of *lamottei* as a distinct species is in some doubt. It would, however, be premature to synonymize *lamottei* without a full revision of the entire *fuliginosus-ruber-caffer-beatus* complex in West Africa and preferably the entire continent. This is obviously outside the scope of this paper. For the present, therefore, I am including all five Liberian specimens in *Hipposideros ruber*, but it should be recognized that the true picture is likely to be more complex.

*Hipposideros beatus*: Voros did not obtain this species, but Dickerman collected a male and a female near Jaoudi in April of 1988. Comparison of the skulls of these with four *H. caffer tephrus* from southern Ghana in the American Museum shows that the two species can be distinguished more clearly than has hitherto been indicated. Though there is not a great difference in overall size (condylocanine length 14.2–14.3 vs. 13.8–14.0), *beatus* has a markedly broader rostrum (width across last upper molars 6.4–6.5 vs. 5.3–5.7). This reflects the much broader molars of *beatus* and I suspect that this species can feed on harder shelled insects than can *caffer tephrus*. The character that Hill (1963) used (size of the anterior upper premolar) is clearly unreliable and my (Koopman, 1975) use of the angularity of the posterolateral corner of the inflated nasal area is rather subtle. Clearly the two species, at least in far western Africa, can be more clearly distinguished on the basis of the width across the last upper molars.

*Hipposideros cyclops*: Voros collected a single male from Voinjama in September of 1983. The American Museum also has two collected by L. W. Robbins near Tchien (Zwedru) in August of 1971.

#### FAMILY VESPERTILIONIDAE

Ten genera are known from far western tropical Africa as recognized here and most of them have at least one species that has been recorded from Liberia. These 10 genera will be taken up in turn with Liberian records and American Museum specimens indicated where relevant.

GENUS *KERIVOULA*: Three species occur in far western tropical Africa. Two species, *lanosa* (= *harrisoni*) and *phalaena* are recorded from Liberia by Kuhn (1965) and *cuprosa* extends west to Ghana.

*Myotis tricolor*: Previously, only a single species of *Myotis* (*M. bocagei*) had been recorded from Liberia (see Kuhn, 1965) or from anywhere else in far western tropical Africa. However, Voros collected a single male of a much larger species from the Bomi Wood Concession in December of 1985. This proves to be referable to *M. tricolor* which was previously known from no closer to Liberia than Rwanda and southeastern Zaire. Clearly larger than either *M. bocagei* or *M. scotti* and smaller than *M. welwitschii* (from which it also differs in its unpatterned wings), the Liberian specimen has been compared with the few American Museum specimens of *M. tricolor* (all from South Africa) and with the description, measurements, and photographs of the type and only known specimen of *M. morrissi* (Hill and Morris, 1971, who also give measurements of several specimens of *M. tricolor* from both southern and eastern Africa). The Liberian specimen agrees with *tricolor* in the ways in which *morrissi* is distinguished from it. Except for its slightly shorter forearm (46 vs. 47–51), it agrees well with eastern African *tricolor* and I have no hesitation in referring the Liberian specimen to this species.

GENUS *PIPISTRELLUS*: Of the five species of this genus known from far western tropical Africa, all have now been recorded from Liberia. Besides the three treated below, Hill (1982) lists specimens of both *kuhlii* and *rusticus*.

*Pipistrellus nanulus*: Voros collected a male from Saniquellie in July of 1983. The American Museum also has a female collected by L. W. Robbins from Tchien (Zwedru) in August of 1971.

*Pipistrellus africanus*: As I previously pointed out (Koopman, 1975: 399, 400), this is the earliest name for the species better known as *P. nanus*. I have been reluctant to make the name change since this is a common well-known species. However, in view of the fact that Robbins (1978) has made a somewhat more radical change in the application of the well-known name *Scotophilus nigrita* and this seems to have been generally

accepted, I suggest that strict application of priority may well be the best policy. Dr. Dieter Kock disagrees and regards *africanus* Rüppell as nomen nudum. However, though the "description" (Ganz gleiche Grösse und Verhältnisse wie bei den europäischen *V. Pipistrellus*, nur der Bauch etwas mehr gelbbraun gefärbt.) is clearly inadequate and would be unidentifiable if there was not an extant type, it is, I believe a valid indication under the rules. Dr. Kock also suggests that *Vespertilio hesperida* Temminck is a still earlier name but, in view of the uncertainty of its application, I do not use it. Voros did not obtain this species, but the American Museum has a male and two females collected by G. W. Harley at Ganta (= Gahnpa) in August of 1932.

Both Rosevear (1965) and I (Koopman, 1975) have discussed some of the taxonomic problems in this species. Briefly, the situation is that though there is a high degree of variability (chiefly in size), both interlocality and intralocality, a clear separation of *africanus* (= *nanus*) from a number of nominal species based on smaller-size forms (including *stampflii* described from Liberia) has not been possible. In western Africa, the problem has been compounded by the relatively small number of specimens from single localities. Rosevear (1965: 268) believed that specimens from the Ivory Coast west had shorter forearms (27 or less) than those from Ghana east (28 or more). However, the seven adults from Liberia and the Ivory Coast for which I have forearm measurements range from 25 to 31. I am therefore uncertain about the pattern of variation in *P. africanus* from West Africa or even whether a single species is involved.

*Pipistrellus eisentrauti*: This species was described by Hill (1968) from Cameroon and a subspecies (*P. e. bellieri*) by De Vree (1972) from the Ivory Coast. As far as I am aware, the four specimens listed in these two papers have been the only ones recorded to date. However, Dr. Duane Schlitter informs me that a number of additional specimens have been collected ranging as far east as Somalia and Kenya. Voros, however, collected a female from Voinjama in April of 1983. It has been compared with descriptions, measurements, and photographs in both papers and

identification with species is clear. A few selected measurements are: forearm length (33), condylobasal length (12.6), mastoid width (7.6), maxillary tooththrow length (4.5), width across last molars (6.3). It seems to agree best with *P. e. bellieri*.

GENUS *EPTESICUS*: [According to Hill and Harrison (1987), all the species mentioned below are referable to *Pipistrellus* (*Neoromicia*): Five species are known from far western tropical Africa of which all but one are now recorded from Liberia and *E. guineensis* is known from Guinea. *E. somalicus* probably also occurs and may even be known from Liberia under the name of *minutus* (see Kuhn, 1965), but the allocation of this name is uncertain. Besides the two species treated below, Verschuren (1976) lists *E. capensis* and Kuhn (1965) *E. rendalli* from Liberia.

*Eptesicus brunneus*: Voros collected a female from Voinjama in September of 1983. This was at first identified as *E. capensis* and only after extraction and comparison of the skull did it become evident that it had the concave forehead and high braincase of *brunneus* rather than the relatively flat forehead and low braincase of *capensis* (well shown in fig. 68 of Rosevear, 1965). The status and characters of *E. brunneus* have been confused, both by its external resemblance to *capensis* and by the erroneous (I believe) allocation by Rosevear (1965) of this name to a series of white-winged *Eptesicus* (probably *tenuipinnis*) from Nigeria in the British Museum (Natural History). The American Museum also has single specimens of *E. brunneus* from Cameroon and northwestern Zaire. This seems to be the first record from Liberia.

*Eptesicus tenuipinnis*: Voros did not obtain this species, but the American Museum has a female collected by G. H. H. Tate near Monrovia in June of 1940.

*Mimetillus moloneyi*: Voros collected two males from near Monrovia in November of 1983 and ten (4♂, 6♀) from Voinjama in January of 1984.

*Glauconycteris poensis*: I reluctantly use this generic name (in place of *Chalinolobus*) in deference to Hill and Harrison (1987) who separated the two genera on bacular characters. Voros obtained a female from Saniquellie in July of 1983 and six others from Voinjama in August (1♀) and September (1♂,

2♀) of 1983 and January (1♀) of 1984. These appear to be the first records of *Glauconycteris* from Liberia, though *G. poensis* was previously known from the Ivory Coast to the east and Sierra Leone to the west. Two other forest species are known from far western Africa, *G. beatrix* west to the Ivory Coast and *G. superba* west to Ghana. The fourth far western African species, *G. variegata* is confined to savanna areas farther north.

GENUS *NYCTICEIUS*: The only African species of this genus (*N. schlieffeni*, allocated by Hill and Harrison, 1987, to a new genus, *Nycticeinops*) occurs in far western Africa but is confined to savanna areas, the closest approach to Liberia being in southwestern Upper Volta.

GENUS *SCOTOECUS*: This genus has been revised by Hill (1974), who recognized two far western African species. Neither is known from Liberia, but *S. albofuscus* is recorded from the Ivory Coast and Sierra Leone, *S. hirundo* from Ghana and Sierra Leone.

*Scotophilus leucogaster*: Voros obtained a female from Voinjama in January of 1984. The systematics of the African members of this genus has been very much in dispute with numerous changes in both the species to be recognized and the names by which they are to be called. Two radically different treatments have recently appeared, by Robbins et al. (1985) and by Koopman (1984). As far as western Africa is concerned (where the greatest complexity exists), Robbins et al. recognize six species: *viridis* (= *nigritellus*), *leucogaster*, *nucella* (see Robbins, 1984), *dinganii* (= *colias*), *nux*, *nigrita* (= *gigas*). On the other hand, I (Koopman, 1984) would recognize only three: *borbonicus* (= *viridis*, *nigritellus*), *leucogaster* (= *nucella*, *dinganii*, *colias*, *nux*), *nigrita* (= *gigas*). Of the six taxa that Robbins et al. recognize, *borbonicus* (= *viridis*), *leucogaster*, and *dinganii*, are savanna forms, while *nucella* and *nux* are forest forms. The very distinct *nigrita* apparently occurs in both habitats.

In my view, *nucella* is the forest variant of *leucogaster* while *nux* is the forest variant of *dinganii*. I would also unite *leucogaster* (with *nucella*) and *dinganii* (with *nux*) into one species because I believe they intergrade in Ethiopia. It should be emphasized, however, that in western Africa they are broadly sym-

patric and clearly act as separate species. Thus in the forest we have both *nucella* and *nux* and in the savanna both *leucogaster* and *dinganii* (as well as *viridis* which I would agree is another savanna species, though I would call it by a different name). The Voros specimen is clearly what I would call *S. leucogaster nux*. Hill (1982) has recorded "*dinganii*" from the Mount Nimba region of Liberia (like Voinjama in the northern uplands but not at a high altitude). Hill's forearm measurements (58–59) agree best with the Voinjama specimen (58) and with *nux* from the Ivory Coast (54–57). The other forest taxon (*nucella*) may also occur in Liberia since an American Museum specimen from near Abidjan in the southern Ivory Coast is clearly referable to this subspecies. The three strictly savanna forms are less likely, *b. nigritellus* in the northern Ivory Coast, *l. leucogaster* in the northern Ivory Coast and Sierra Leone, and *l. dinganii* (or perhaps *colias*) in the Ivory Coast and Sierra Leone. The large *S. nigrita* is known no closer to Liberia than southern Ghana.

*Miniopterus inflatus*: The American Museum has no material, but Hill (1982) recorded *M. inflatus* from Liberia. The only other species known from far western Africa is *M. schreibersi*. The subspecies *M. s. villiersi* was described from Guinea.

#### FAMILY MOLOSSIDAE

Using the generic concepts of Freeman (1981), there are three genera of this family in far western tropical Africa. Two of these (*Chaerephon* and *Mops*) are known by several species each in Liberia and are treated below. The third is *Myotis* of which I would recognize two species, both occurring in far western tropical Africa. The first is *M. whitleyi* which extends as far west as Ghana. The second was originally described as *M. daubentonii* (= *senegalensis*) from Senegal. The same or a closely similar species was described much later as *M. albatu*s from north-eastern Zaire. Recently specimens from the Ivory Coast have been allocated by Brosset and Vuattoux (1968) to *senegalensis* and by Hill (1969) to *albatu*s. While there may be some differences among specimens from the three regions, I see no reason to recognize

more than a single species which I would call *M. daubentonii*. Occurrence in Liberia is probable.

GENUS *CHAEREPHON*: Six species of this genus are known from far western Africa but three (*nigeriae*, *russata*, *aloyisabaudiae*) extend only as far west as Ghana. The other three (*bemmelini*, *major*, *pumila*) have been recorded from Liberia (Kuhn, 1965; Hill, 1982; Verschuren, 1976) but *bemmelini* is known west of Cameroon only by the type (a zoo specimen) and Kuhn was sceptical that it really came from Liberia.

*Chaerephon major*: Voros collected four males and four females from near Monrovia in April of 1983.

GENUS *MOPS*: Eight species of this genus are known from far western tropical Africa. Of the two subgenera I would recognize, *M. (Xiphonycteris)* includes all the species known from Liberia. *M. (Mops)* is represented by only three species (*condylura*, *demonstrator*, *congicus*); *M. condylura* is known (by British Museum specimens) from both the Ivory Coast and Sierra Leone, but *M. demonstrator* is known no farther west than Ghana except for a British Museum specimen from "at sea off Gambia"; *M. congicus* is not known west of Ghana. The members of *M. (Xiphonycteris)*, which have been keyed out by El-Rayah (1981), are now all known from Liberia with the exception of *petersoni*, which again, has not been recorded from west of Ghana. The Royal Ontario Museum, however, has a specimen so identified from Sierra Leone.

*M. brachyptera*: This is the species which in West Africa has usually been called *leonis*. However, I follow El-Rayah (1981) in considering this a subspecies of the East African *brachyptera*, though I realize that a full revision involving restudy of the type of *brachypterus* Peters would be desirable. Voros did not collect this species, but the American Museum has a single male obtained by R. S. Bray near Harbel in March of 1956. This appears to be the first Liberian record, though the species was originally described from adjacent Sierra Leone.

*M. thersites*: Voros obtained a single male from Voinjama in January of 1984.

*M. spurrelli*: Voros collected four males and six females of what I would call this species from Voinjama in January of 1984. Study of

these specimens in comparison with others of *spurrelli* and the closely related *M. nanulus* in conjunction with El-Rayah's (1981) key reveals considerable variation in several characters which have been used taxonomically. Part of the variation is clearly sexual. I have investigated the following characters which have been used to separate the two species, sometimes (e.g., Rosevear, 1965) regarded as separate genera: size of upper canine cingula, extent of projection of upper incisors in front of upper canines, degree of extension of inner cingula of lower canines, and extent of elimination of outer lower incisors. All these characters show some correlation with one another, which is far from perfect. Males of the two species are easier to tell apart than are females. All male *spurrelli* have wider upper canine cingula, less upper incisor projection, and wider inner cingula of the lower canines which meet in the midline (never meeting in *nanulus*). However, either species may retain outer lower incisors. Females are more difficult to distinguish. Females of neither species have enlarged upper canine cingula and the difference in upper incisor projection is rather arbitrary, subtle at best. Females of *spurrelli* do not have lower canines with inner cingula that meet in the midline, though they may come close. Loss of outer lower incisors is variable. My results agree well with those of De Vree (1969). While I am not prepared at present to synonymize *nanulus* and *spurrelli*, I feel that distinction is far from certain. Clearly separate generic status is completely untenable. If the two are separate, the Voros specimens are the first records from Liberia. *M. nanulus* was recorded from Liberia by Verschuren (1976).

#### DISCUSSION

Of the 90 odd species known from far western tropical Africa, 52 have now been recorded from Liberia (8 for the first time). With a few exceptions (e.g., *Epomophorus gambianus*, *Hipposideros caffer*, *Pipistrellus rusticus*) they are all either widespread or high forest species. It is evident that in spite of the extensive deforestation that has occurred in Liberia (well documented by Voros' notes), strictly savanna species have had limited success in colonizing these man-made habitats.

Presumably because of the position of Li-

beria near the western end of the high forest belt, nearly one-third of the bat species known from Liberia appear (on present published evidence) to reach their western limits (south of the Sahara) in that country (17 out of 52 species). These 17 include the following: *Scotonycteris zenkeri*, *S. ophiodon*, *Megaloglossus woermanni*, *Saccolaimus peli*, *Nycteris intermedia*, *N. major*, *Rhinolophus clivosus*, *Hipposideros fuliginosus*, *H. beatus*, *Kerivoula phalaena*, *Myotis tricolor*, *Pipistrellus kuhlii*, *P. rusticus*, *P. eisentrauti*, *P. brunneus*, *Miniopterus inflatus*, *Chaerephon bembelini* (if the Liberian record is valid), *Mops spurrelli*. None of these are confined to far western tropical Africa and most are widespread, at least in the west. Most interesting, however, are four species (*Rhinolophus clivosus*, *Myotis tricolor*, *Pipistrellus kuhlii*, *P. rusticus*) which are basically East African (at least south of the Sahara). All four seem to be confined to upland areas in Liberia.

While it is quite possible (indeed likely) that some of the species that now appear to have their western limits in Liberia will be found still farther west (particularly in Sierra Leone), it is probable that additional species will be found in Liberia besides the 52 already known. The following are particularly likely since they are known both east and west of Liberia: *Epomops franqueti*, *Nycteris gambiensis*, *Rhinolophus simulator*, *R. denti*, *R. landeri*, *R. maclaudi*, *R. fumigatus*, *Hipposideros jonesi*, *H. abae*, *Pipistrellus guineensis*, *Scotoecus albofuscus*, *S. hirundo*, *Scotophilus borbonicus*, *Miniopterus schreibersi*, *Myotis daubentonii*, *Mops petersoni*, *M. condylura*. In addition, *Nycteris nana* and *Glauconycteris beatrix* are known as far west as the Ivory Coast and may well extend still farther to Liberia.

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