Reproductive Activity of Female Bats from Northeast Brazil

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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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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-