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AGE DETERMINATION AND OCCURRENCE OF INCREMENTAL  
GROWTH LINES IN THE DENTAL CEMENTUM OF THE  
COMMON VAMPIRE BAT (*DESMODUS ROTUNDUS*)

The number of incremental growth lines in tooth dentin and cementum, and in periosteal bone, are indicative of age in a number of mammalian species. Their deposition occurs with age (as does a narrowing of the pulp cavity) and results from periodic development of cellular cement. The formation of growth lines has been attributed to periodic or seasonal changes in nutrition, hormonal activity, and growth rates (Klevezal' and Kleinenberg, Age determination of mammals from annual layers in teeth and bones, Israel Program Sci. Translations, Jerusalem, TT 69-55033, 128 pp., 1969, translated from Russian). Although



FIG. 1.—Longitudinal sections of the root tip from incisors of *D. rotundus*: A, from a young bat in which cementum is still lacking and the pulp cavity is large (210 $\times$ ); B, from an older bat showing three incremental growth lines (210 $\times$ ). Abbreviations: c, cementum; 1,2,3, incremental growth lines; d, dentin; d/c, dentin-cementum interface; pc, pulp cavity; pl, remnants of periodontal ligaments.

the presence of incremental growth lines in the teeth of *Eptesicus*, *Myotis*, and *Nyctalus* has been noted by Christian (Amer. Midland Nat., 55:66-95, 1956) and Klevezal' and Kleinenberg (*op. cit.*), it is surprising that the technique has not received more attention as a possible method of aging in Chiroptera, particularly because the most pronounced growth lines are found in the hibernating mammalian species.

I have had the opportunity to examine the teeth from 99 vampire bats (*Desmodus rotundus*) collected in Mexico and Argentina. Upper incisors were extracted (by boiling) from the skulls of 97 bats of unknown age collected from an abandoned mine located near the village of San Juan de Viejo, approximately 128 kilometers southeast of Oaxaca, Mexico, on 5 November 1969. The two bats from Argentina (both females) were captured, banded, and released in the province of Misiones, and recaptured and killed 16 and 19 months later, respectively. One was banded as a juvenile on 13 January 1969 and recaptured on 24 July 1970. The second was banded as a subadult on 2 April 1969 and taken again on 3 July 1970. Weight and forearm measurements were taken at time of banding. Based on unpublished juvenile growth rate data (Burns, Tecn. Pecuaria 20: in press, 1973), their approximate ages at the time of banding were 3 and 5 months, and ages at recapture were about 21 and 22 months, respectively.

Teeth were decalcified in a solution of three parts formalin, five parts formic acid, and 20 parts water for 48 hours. The crowns were cut off and the root portions were placed back in the decalcifying solution for an additional 3 to 4 hours. The tissue was soaked in water for a minimum of 4 to 5 hours and the roots were longitudinally sectioned at 12  $\mu$  on a cryostat. Sections were placed on slides and dried for approximately 15 minutes on a slide warmer, after which they were stained with Paragon multiple stain for frozen sec-

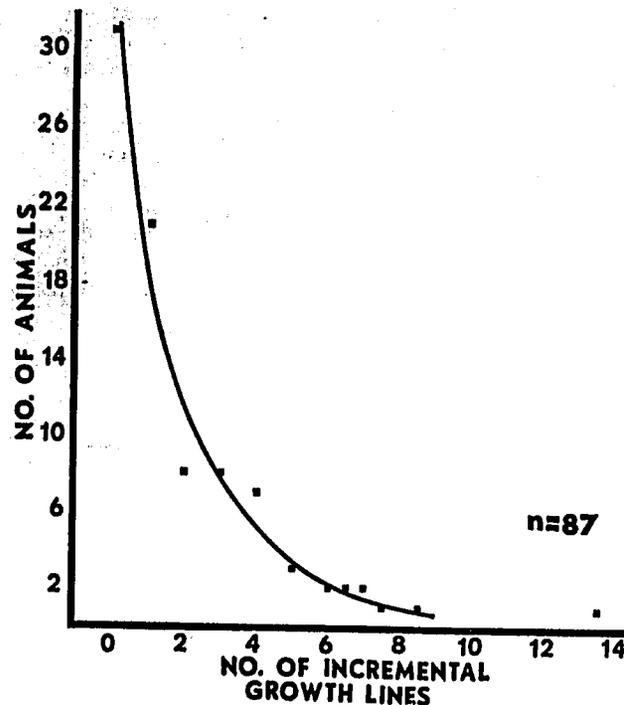


FIG. 2.—Survival curve based on incremental growth lines in the tooth cementum of 87 vampire bats from Oaxaca, Mexico (line fitted by eye).

tions (Paragon C. and C. Co., 190 Willow Ave., Bronx, New York, 10454), dried, and mounted in Permount. Five to 15 sections of each incisor were prepared, as growth lines are not readily observable in all sections and the handling of such small sections renders some unsuitable for observation. Sections were examined at 100 $\times$  under transmitted light.

The presence or absence of incremental growth lines could be determined in 87 of the 97 Mexican specimens. Of these, 31 were characterized by large pulp cavities, thin dentin, and either a lack of cementum, or, if present, only as a thin layer on the extreme tip of the root (Fig. 1). Fifty-six specimens had incremental growth lines present in the cementum (Fig. 1). In some cases, lines were not well defined, making accurate counts difficult. The number of growth lines present in the teeth of 10 of the 97 vampires could not be determined because of unsuitable sections; however, all 10 appeared to be older animals from the size of the tooth pulp cavity, the width of the dentin, and the presence of cementum.

A frequency distribution of the growth lines counted in the cementum of the Mexican vampire bats is shown in Fig. 2. If a single growth line is deposited for each year of life, the mean age (both sexes) can be calculated at about 2.6 years, with the oldest animal (a female) having an age of 13 to 14 years. When the data are examined by sex, differential survival is suggested. The mean age of 56 females was 3.0 years, whereas that for 25 males was 1.5 years. The maximum number of growth lines in a male was four. The sex of six bats was not determined. However, Trapido (J. Mamm., 27:217-219, 1946) indicated that males may have a longer life span, because seven of the eight oldest vampire bats living more than 5 years in a captive colony were males, the oldest of which was 12 years and 9 months of age.

One of the two 21- to 22-month-old vampires collected in Argentina had a single growth line present in the cementum, whereas the other had one growth line with a possible second being formed, lending support to the likelihood that one line is formed near the end of each year of life.

Additional known-age material should be examined to determine if incremental growth lines in the tooth cementum of vampire bats are laid down annually, biannually, or simply in response to stress and age. The teeth examined were collected from the southern and northern extremities of the geographic range of this species and it would be interesting to examine specimens collected from the central portion of their range to determine the presence or absence of incremental growth lines.

I would like to thank Merle L. Kuns, Abel Fornes, and F. T. Szatalowicz for providing the bats from Argentina. Allem Berhanu and Jerry D. Roberts sectioned the teeth, and Brad E. Johns took the photomicrographs. Reference to trade names does not imply endorsement of commercial products by the Federal Government. This research was supported by funds provided to the Bureau of Sport Fisheries and Wildlife by the Agency for International Development PASA RA(ID) 1-87—SAMUEL B. LINHART, *Denver Wildlife Research Center, Denver, Colorado 80225. Accepted 29 November 1972.*