competitive; aminobutyrate aminotransferase is concentrated along the brain blood vessels (*4*). The simultaneous administration of GABA and AOAA could mean that less AOAA is reacting with GABA-T than when AOAA is administered alone. In essence, we believe that there is some interaction between peripherally administered AOAA and GABA, but probably it is not due to alterations in the blood-brain barrier to GABA.

MORRIS A. FISHER
DUANE Q. HAGEN
ROBERT B. COLVIN
Psychiatric Research Department, Massachusetts General Hospital, Boston

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Gekkonid Lizards: Average Ages Derived from Tail-Loss Data

Abstract. *Information on the rate of tail loss by autotomy, obtained from mark and recapture data, was used to estimate the average ages of adult individuals of the geckos* Gehyra variegata *and* Heteronota binoei*; the ages calculated were 4.4 and 1.9 years, respectively.*

During a study by one of us of the population ecology of two species of gekkonid lizard, *Heteronota binoei* Gray and *Gehyra variegata* (Duméril & Bibron), which live in parts of the same habitat, several lines of evidence pointed to disparity in average longevity of individuals of the two populations. In particular, marking techniques used in conjunction with sampling showed a sharp reduction in the chance of recapturing *H. binoei*, but not *G. variegata*, about 20 months after the first large batch of lizards was marked. Estimates of recruitment of juveniles to the adult stage—considerably greater for *H. binoei* than for *G. variegata*—also suggested that individuals of the latter species lived longer.

Unable to find a method of determining the ages of living individuals after they had matured to maximum size, we explored the alternative of aging the "population" directly. This approach required some ecological event that marked permanently the individuals affected by it and that had a finite probability of occurrence per unit of time. It could then be argued that the proportion of individuals in a population that were unaffected by the event would be related to the rate at which the event occurred and the average age of the individuals observed. If in a population the rate of occurrence was approximately constant and known, the average age of individuals could be estimated.

The tail is lost quite frequently by the process of autotomy by such lizards as Lacertidae, Scincidae, and Gekkonidae; in many species the regrown portion of the tail is readily differentiated from the original by scale differences. Autotomy results from intraspecific and interspecific interactions [for example, combat associated with territorial behavior, and evasion of predators (*1*)], and it seemed possible that in a well-established population the probability of occurrence of such interactions would tend to have a steady average value per unit of time. Seasonal differences in the probabilities, especially in species that hibernate, require that any average value be estimated over a period of at least a year.

Geckos and other lizards that readily shed tails can lose and replace them many times. Each individual fracture [which occurs at a predetermined plane of weakness across a vertebra (*2*)] is proximal to the previous one. The number of times the tail can be autotomized is limited, but in practice it can be great. The past history of a regrown tail cannot be ascertained by examination because, once loss has occurred, one cannot say with certainty whether it was lost once or more times. Consequently, information on the rate of loss of tails can be obtained only from mark-and-recapture data from a population in which individuals can be frequently recaptured.

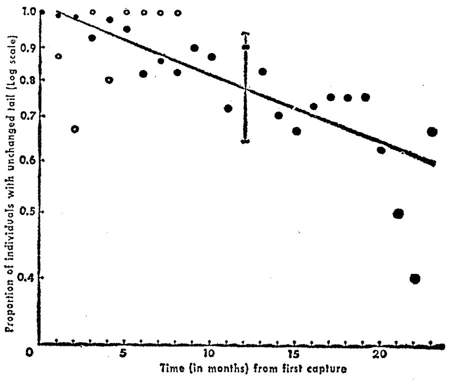

Fig. 1. Rate of tail autotomy in *G. variegata.*

The use of autotomy to estimate the average age of individuals of *Heteronota binoei* and *Gehyra variegata* was investigated. Collation of observations made on the tail of each individual on first capture showed the proportions with original tails caught in 1963–64 and 1964–65. The two species proved to be similar (Table 1). The comparable decline in tail persistence in the 2nd year may be related to the fact that, for reasons later outlined, only animals first captured as adults were used in the calculations. Efficiency of capture was high for lizards of all ages, so that little recruitment to the adult population of other than marked hatchlings could occur. In such circumstances the samples of adults used in the 2nd year should be approximately 1 year older than in the first.

Little difference between the proportions of original tails in the two sexes was recorded, the percentages being:

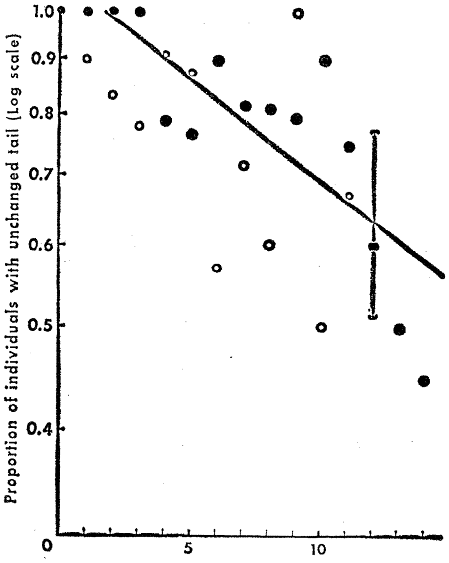

Fig. 2. Rate of tail autotomy in *H. binoei.*

Table 1. Tails of adult geckos at first capture (at Pilliga, N.S.W.). Percentages appear in parentheses.

Period	Adults captured (No.)	Original tails (No.)
	Gehyra variegata	
1963–64	282	92 (32.6)
1964–65	101	26 (25.8)
	Heteronota binoei	
1963–64	131	55 (42.0)
1964–65	54	15 (27.8)

Gehyra, males 28 percent, females 32 percent; *Heteronota*, males 38 percent, females 43 percent. The slightly greater loss of tails by males of both species probably reflects territorial interactions (*3*).

Five hundred and ninety six *Gehyra* adults were recaptured as late as 23 months after first capture; 241 *Heteronota* adults, as late as 21 months. By referring each first capture to zero time we could record the proportion of individuals in subsequent monthly assemblages of recaptures that had the same tails as when they were first captured (Table 2).

Graphs of this proportion (on a log scale), against time from first capture, showed the reality of an average rate of autotomy (Figs. 1 and 2). Since the numbers of recaptures after long periods were fewer than those after short periods, it was necessary to weight the proportions of unchanged tails observed in each monthly cohort according to the total number of animals recaptured.

Table 2. Numbers of adults that on subsequent recapture had the same tail (original or other) as at first capture.

After first capture (mo)	*G. variegata* (No.)		*H. binoei* (No.)	
	Recaptured	Same tails	Recaptured	Same tails
1	72	71	48	48
2	57	56	20	20
3	48	44	13	13
4	40	39	19	15
5	34	32	17	13
6	26	21	20	18
7	33	28	22	18
8	33	27	21	17
9	27	24	10	8
10	29	25	10	8
11	36	26	12	9
12	28	25	10	6
13	17	14	10	5
14	17	12	9	4
15	21	14	14*	5*
16	22	16		
17	12	9		
18	12	9		
19	8	6		
20	8	5		
21	8	4		
22	5	2		
23	3	2		

* 15–20 months combined

Because adult individuals were first captured at all seasons of the year, the seasonal variation in rate of tail loss was randomized with respect to time; juveniles were excepted, being more liable to first capture during the summer. At this time the probabilities of tail loss and of predation were at their highest, and about 6 months later they were lowest; for this reason the juvenile data (open circles) were not randomized with respect to season and could not be used in the calculations. Weighted regression coefficients, calculated for the adult data only, were used to estimate an approximate value for the yearly survival of tails. (A more precise solution seems possible.)

Assuming exponential rates of tail loss, we calculated as follows (approximate fiducial limits at the 5-percent level are given in parentheses):

Gehyra variegata: From Fig. 1, the estimated probability of tail survival per year: $p = .774$ (.933, .642). From Table 1, the probability of a gecko having an original tail in 1963–64 (for adult lizards of average age T years): $P = .326$. Assuming a constant rate of tail survival (p) per year, we can derive the average age of adults from $(p)^T = P$; therefore $T = 4.38$ years (15.75, 2.53). Survival in 1964–65 of original tails in adult lizards of average age ($T + 1$) years: $P = .258$. Similarly then the average age $T + 1 = 5.30$ years (19.10, 3.06).

Heteronota binoei: From Fig. 2, the estimated probability of tail survival per year: $p_1 = .631$ (.772, .516). The probability of original-tail survival recorded during 1963–64 for adult lizards of average age T years was $P_1 = .420$. Again assuming a constant rate of tail survival (p_1) per year, we found the average age of adults to be $T = 1.88$ years (3.32, 1.31). From Table 1, the probability of original-tail survival in 1964–65 for adult lizards of average age ($T + 1$) years: $P_1 = .278$. Similarly then the average age $T + 1 = 2.79$ years (4.91, 1.94).

For these calculations of the average age of adults we assumed that the rate of tail loss is constant for juvenile and adult individuals (see Figs. 1 and 2). The relative "ages" of the two populations are consistent with the evidence on longevity available from other sources (*4*), and the difference between the calculated mean ages of the same individuals in successive years closely approximates 1 year.

Such use of tail-loss data for other species of lizards may be worth consideration, and extensions of the method to other groups of animals, using other types of events, may well be possible.

H. ROBERT BUSTARD
R. D. HUGHES
Department of Zoology, Australian National University, Canberra

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Thyroglobulin: Evidence for Crystallization and Association

Abstract. *Crystals of thyroglobulin have been obtained from ammonium sulfate solutions and have been examined by electron microscopy as shadowed carbon replicas. Unit size in the crystal is 228 ± 9 angstroms, which corresponds to a molecular weight of 5,300,000. Data are in accord with the possibility that this unit represents a polymer of thyroglobulin.*

Crystalline preparations have been obtained of thyroglobulin, the major protein found in aqueous extracts of thyroid tissue. The protein has been studied extensively and is known to have a molecular weight of 660,000 and a frictional ratio of 1.5 (*1*). It is easily dis-

Table 1. Sedimentation pattern of thyroglobulin at high concentrations of salt. Centrifugation of 2.5 percent thyroglobulin was at 20°C in 1.5*M* $(NH_4)_2SO_4$ and 0.015*M* histidine at *p*H 7.0 Sedimentation rates are uncorrected; the component sedimenting at 8.1*S* actually has an $s_{20,w}$ of 19.

Sedimentation rate (*S*)	Fraction in peak
8.1	0.36
10.0	.28
12.6	.25
Faster*	.11

* The boundary of this component is too broad to permit calculation of a rate but is faster than that of the other components and separable from them.