

GENETIC VARIATION AND DIFFERENTIATION IN TWO SPECIES OF THE FOSSORIAL AFRICAN SKINK *TYPHLOSAURUS* (SAURIA: SCINCIDAE)

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CORRELATIONS between genetic variability within populations and habitat are of interest to ecological geneticists in the search for evolutionary generalizations. There are published claims that among mammals a subterranean mode of life is correlated with low levels of heterozygosity (e.g., Nevo et al., 1974) and refutations of such claims (e.g., Selander, 1976). Recently, we reviewed and discussed genetic variability based upon electrophoretic data for noninsular lizard populations (Gorman et al., 1977). We noted that fossorial species had lower levels of individual heterozygosity than other species of lizards sampled. This observation was admittedly based upon few data points, and we were anxious to extend our studies to other subterranean species. Recent fieldwork in southern Africa by one of us (RBH) enabled us to obtain samples of 2 species of the fossorial scincid genus *Typhlosaurus*, *T. lineatus* and *T. garipeensis*. Ecological aspects of the interaction between these 2 species have been studied by Huey and Pianka (1974) and by Huey et al. (1974). *Typhlosaurus* are superficially very similar to the New World anneliids, a family whose genetics have recently been analyzed (Bezy et al., 1977). *Typhlosaurus* thus form a welcome addition to our continuing studies of genetic variability in reptiles. The electrophoretic data utilized to examine variability in these lizards can also be used to assess degree of genetic divergence between the species. This, too, is of some interest, because the species are morphologically similar and have been confused in the past (Broadley, 1968).

MATERIALS AND METHODS

Live *Typhlosaurus* were shipped to our laboratory by air freight. A series of 26 animals was used for electrophoretic analysis. The specimens were maintained at -68°C until ready for processing. Mixed tissue extracts of liver, muscle, lung, and heart were used. Although the specimens used for electrophoresis were not saved, fresh frozen material from the collecting sites is stored at the Museum of Vertebrate Zoology. Electrophoretic procedures, calculation of genetic distance and heterozygosity follow methods utilized in this laboratory (e.g., Kim et al., 1976; Gorman and Kim, 1976; Adest, 1977). A total of 34 presumptive gene loci was scored for each specimen.

RESULTS AND DISCUSSION

The results of the analysis appear in Table 1. Ten specimens of *Typhlosaurus lineatus* from Leeudril, Botswana had an average individual heterozygosity of 1.8%. One individual at 2 loci (MDH-1, FUM) and a second individual at a single locus (PEPT-2) were scored as rare homozygotes (i.e., appeared homozygous for alleles not otherwise observed in either species). If these were scored incorrectly, that is, if these were heterozygotes, the estimate would be raised to 2.7%.

Genetic variability appeared to be even lower in *T. garipeensis*. There were only 2 observed heterozygotes in the individuals from Leeudril ($H = [2 \text{ heterozygotes}] \div [6 \text{ individuals} \times 34 \text{ loci}] \approx 1\%$), and 2 observed heterozygotes in 10 individuals from Farm Bloukranz ($H = 0.6\%$).

TABLE 1.—Allele frequency distribution in *Typhlosaurus lineatus* and *Typhlosaurus gariensis*.

- A. The following loci were fixed identically in all 3 population samples:
LDH-1, LDH-2, MDH-2, IDH-2, XDH, α -GPDH, PGM-1, GOT-2, MPI-1, MPI-2, PGI, ME-1, ME-2, IPO-1, IPO-2, LAP, general proteins 1, 2, and 3, esterase-3, and GDH.
- B. The following loci were fixed differently between *T. gariensis* and *T. lineatus*:
6-PGDH, PGM-2, hexo, general proteins 4 and 5, esterases 1 and 2.
- C. The following loci were variable in 1 or more populations:

Locus and allele*	<i>T. lineatus</i>	<i>T. gariensis</i> (Leeudril, Botswana)	<i>T. gariensis</i> (Farm Bloukranz, South Africa)
	N = 10	6	10
Allele frequencies			
MDH-1			
S	.10**	0	0
M	.90	1.0	1.0
Pept-3			
S	.05	0	0
S	.90	0	0
M	.05	0	.05
F	0	1.0	.95
Pept-1			
M	1.0	.083	.05
F	0	.917	.95
Pept-2			
S	.90	0	0
M	0	.083	0
F	.10**	.917	1.0
GOT-1			
M	.20	1.0	1.0
F	.80	0	0
FUM			
S	.10**	0	0
M	.90	1.0	1.0
D. Observed heterozygosity	1.8%	1.0%	0.6%

* Relative electrophoretic mobilities of alleles are designated F (fastest), M (intermediate), S (slow), S' (slowest).

** One individual scored as homozygous for the allele otherwise not observed in the *T. lineatus* sample.

Although individual population sample sizes are small, heterozygosity estimates are far less influenced by number of individuals sampled than by number of loci sampled

(Nei and Roychoudhury, 1974), and are sufficient to indicate that *Typhlosaurus*, like the fossorial *Anniella* and *Bipes*, are less variable than almost all nonfossorial lizard populations that have been sampled (Gorman et al., 1977).

Despite morphological similarity, the 2 species of *Typhlosaurus* are easily distinguished with electrophoresis. At 7 of 34 loci they differ absolutely; at 3 additional loci the most common allele differs in the 2 species. The standard genetic distance (Nei, 1972) is 0.36. The 2 samples of *T. gariensis*, separated by > 80 km (airline distance) and a major river bed, have essentially zero genetic distance.

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THE THERMAL ECOLOGY OF TWO SYMPATRIC, NOCTURNAL COLEONYX (LACERTILIA: GEKKONIDAE)¹

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ABSTRACT: To describe the diurnal thermal ecology of *Coleonyx brevis*, field and laboratory data were recorded on body temperatures, substrate temperatures, and temperatures of rocks used as shelters. The strong correlation between body and rock cover temperatures, as well as laboratory observations of geckos elevating their bodies into contact with a warmer rock cover, suggests that these lizards behaviorally thermoregulate while under cover. On cool, sunny days when solar radiation raises rock temperatures higher than air and substrate temperatures, this behavior results in higher body temperatures and possibly in increased metabolic efficiency. To contrast thermal strategies of active *C. brevis* and *Coleonyx reticulatus*, activity and preferred temperature data were considered. It is concluded that *C. brevis* is active at night at suboptimal temperatures and has adopted a eurythermic strategy, an adaptation that has enabled successful exploitation of nocturnality. *Coleonyx reticulatus* is active at temperatures considerably lower than *C. brevis*. Field observations suggest that *C. reticulatus* inhabits a highly sheltered, crevice microhabitat which may be important in maintaining a low temperature, mesic environment for this species.

Most studies of the thermal ecology of lizards have been on diurnal species (Rand and Humphrey, 1968; Ballinger et al., 1970; Clark and Kroll, 1974; Huey, 1974a,b; Huey and Webster, 1975; Huey and Slatkin, 1976); few have considered the problems

associated with being a nocturnal ectotherm. Pianka and Pianka (1976) studied air and body temperatures and discussed the significance of preferred temperatures in 12 species of Australian geckos (subfamilies Gekkoninae and Diplodactylinae). Marcellini (1976) examined the thermal ecology of an arboreal gekkonine. How-

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