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Striped rabbits in Southeast Asia

The Annamite mountains of Laos and Vietnam have yielded several important mammalian discoveries¹. We have found a striped rabbit of the previously monospecific genus *Nesolagus*, extending its known range more than 1,500 km north from the island of Sumatra into mainland Southeast Asia. The Sumatran and mainland Annamite populations are morphologically similar, but genetic data indicate that they have been isolated for millions of years.

The first evidence of *Nesolagus* in the Annamite mountains came from freshly captured animals offered for sale in a food market in the rural town of Ban Lak, Laos (18°11' N, 104°58' E) between December 1995 and February 1996 (Fig. 1). The rabbits have since been found at other sites in the Annamite mountains of Vietnam.

The only previously known striped lagomorph was the critically endangered *Nesolagus netscheri*, a monotypic rabbit genus endemic to forest habitat within the Barisan



Figure 1 Map of Southeast Asia showing the Sunda islands of Sumatra, Borneo and Java. The site of the first discovery of a striped rabbit in the Annamites of central Laos is marked, as is the Kerinci Seblat National Park in Sumatra, where *Nesolagus netscheri* was photographed in the wild.

mountains and further north to Mount Leuser in Sumatra. There had been just one confirmed sighting of *N. netscheri* since 1916 and only around 15 museum specimens of the species exist, all of which were collected between 1880 and 1929 (ref. 2). In early 1998, *N. netscheri* was photographed by an automatic camera trap in the Kerinci Seblat National Park in Sumatra by Fauna and Flora International³. Externally, the Annamite rabbits closely resemble *N. netscheri*, having black or dark brown dorsal stripes, ferruginous rumps and short tails and ears (Fig. 2).

Morphological analysis of 30 characters (including pelage elements, external proportions, postcranial characters, tooth morphology and cranial morphometrics) in both Annamite and Sumatran rabbits reveals that there is a significant difference in the minimum interorbital distance as a percentage of condylobasal length (Annamite, range 19.0–23.6, mean(±s.d.) 20.5(±1.6), $n=10$; Sumatran, 16.9–18.7, 17.5(±0.7), $n=6$; $P<0.001$, Wilcoxon–Mann–Whitney test).

Genetic analysis was undertaken of 653 continuous base pairs of the mitochondrial gene encoding 12S ribosomal RNA prepared from three museum specimens of *N. netscheri* and three rabbits from Laos. The results indicate that *N. netscheri* and the Annamite specimens (Genbank accession numbers AF176583 to AF176589) are sister taxa within a phylogenetic framework of lagomorph genera⁴. There is considerable divergence between them: the genetic distance (Kimura two-parameter) is 0.0552, which falls outside the range observed between other congeneric leporid species (0.0226–0.0427, mean 0.0324, from six species in two genera), but within that between different leporid genera (0.0469–0.1199, mean 0.0748, from seven genera). Assuming a steady rate of divergence over time at this gene⁵, the Sumatran and Annamite rabbits would have been diverging genetically for approximately 8 million years.

Despite an apparently high degree of conserved morphology, the large genetic divergence between these two taxa of striped rabbit indicates that they separated in the Pliocene epoch. In this region, glacial periods were cool and dry, characterized by expanding grassland, whereas forest cover increased during interglacial periods⁶. During glacial maxima, sea levels over the Sunda shelf were almost 150 metres lower than today, connecting Sumatra, Java and Borneo to the Asian mainland⁷. The ancestral *Nesolagus* may have been distributed over areas of this region at a time of lower sea level in the Pliocene, and its range would have been repeatedly dissected by periodic changes in both sea level and forest habitat.

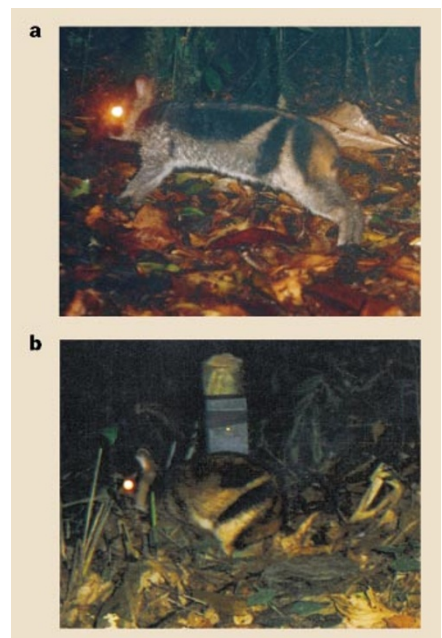


Figure 2 Automatic camera-trap photographs of the striped rabbits. **a**, *Nesolagus netscheri* in Kerinci Seblat National Park in Sumatra (photograph from FFI). **b**, The striped rabbit from the Annamite mountains, photographed in the Pu Mat Nature Reserve, Vietnam (photograph from SFNC EC).

The existence of refugia for forest species during dry glacial periods has been postulated for both the Annamite mountains and Sumatra⁸. The contraction and expansion of ranges in and out of such allopatric refugia can generate divergence, with the sister genomes being protected by hybrid zones if they make contact, leading to speciation⁹. Our discovery of the rabbit in the Annamite mountains may provide insight into the factors governing current patterns of biodiversity in Southeast Asia, leading to its protection into the future.

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