

Lichen fallback food in nonhuman primates at high altitudes, a unique ecological adaptation and evolutionary development

Hao Pan¹, Rong Hou², He Zhang², Zhipang Huang¹, Yanpeng Li¹, Liangwei Cui³, and Wen Xiao¹

¹Dali University

²Northwest University

³Southwest Forestry University

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Abstract

Fallback foods (FBF), classified into staple and filler types, are low-quality food resources chosen by animals due to a shortage of preferred food during a specific period. The selection of lichens as FBF for Yunnan snub-nosed monkeys (*Rhinopithecus bieti*) represents a unique ecological adaptation and evolutionary development in the animal kingdom. This study investigates the yearly dietary selection of five *R. bieti* groups to address the issues and elucidate the nutritional value and ecological selection of lichens for this monkey species, which resides at the highest altitude among nonhuman primates. The results indicate that the consumed lichens serve as the staple FBF. Two main lichen species taken by the monkeys are *Bryoria* spp. and *Usnea longissimi*, with *Bryoria* spp. being the primary choice ($67.25 \pm 12.20\%$ compared to $15.79 \pm 11.66\%$ from *U. longissimi*). *Bryoria* spp. provides a higher level of digestible fiber (NDF) and a lower level of tannin, fat, ADF, and energy compared to *U. longissimi*, which offers higher availability. Lichens are the dominant food and nutritional resource for the monkey species during the dry season, while they serve as a primary food source rather than a nutritional resource during the wet season. Therefore, they compensate for nutrients from other food types, such as fruits, seeds, and leaves. Compared to other Asian colobine counterparts, this species consumes the highest amount of lichens but the lowest proportions of leaves, flowers, and seeds. This dietary pattern demonstrates a specific type of ecological selection and evolutionary development during the Quaternary. The biomass of lichens in the monkeys' habitat has significantly decreased due to environmental degradation. This study also provides evidence and information to develop or amend conservation strategies and guidelines for the dietary management of captive Yunnan snub-nosed monkeys.

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