

## Possible combined effects of climate change, deforestation, and harvesting on the epiphyte *Catopsis compacta*: a multidisciplinary approach

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### Abstract

Climate change, habitat loss, and harvesting are potential drivers of species extinction. These factors are unlikely to act on isolation, but their combined effects are poorly understood. We explored these effects in *Catopsis compacta*, an epiphytic bromeliad commercially harvested in Oaxaca, Mexico. We analyzed local climate change projections, the dynamics of the vegetation patches, the distribution of *Catopsis* in the patches, together with population genetics and demographic information. A drying and warming climate trend projected by most climate change models may contribute to explain the poor forest regeneration. *Catopsis* shows a positive mean stochastic population growth. A PVA reveals that quasi-extinction probabilities are not significantly affected by the current levels of harvesting or by a high drop in the frequency of wet years (2%) but increase sharply when harvesting intensity duplicates. Genetic analyses show a high population genetic diversity, and no evidences of population subdivision or a past bottleneck. Colonization mostly takes place on hosts at the edges of the fragments. Over the last 27 years, the vegetation cover has being lost at a  $0.028 \text{ years}^{-1}$  rate, but fragment perimeter has increased  $0.076 \text{ years}^{-1}$ . The increases in fragment perimeter and vegetation openness, likely caused by climate change and logging, appear to increase the habitat of *Catopsis*, enhance gene flow, and maintain a growing and highly genetically diverse population, in spite of harvesting. Our study evidences conflicting requirements between the epiphytes and their hosts and antagonistic effects of climate change and fragmentation with harvesting on a species that can exploit open spaces in the forest. A full understanding of the consequences of potential threatening factors on species persistence or extinction requires the inspection of the interactions of these factors among each other and their effects on both the focus species and the species on which this species depends.

## Introduction

Climate change, land-use change, and harvesting are drivers of species extinction of global importance (Foley et al. 2005; Beever and Belant 2012). Therefore, understanding the effects of these factors is essential for the design of conservation, sustainable management, and restoration plans. In many cases, these factors act simultaneously on the species, but their combined effects need to be investigated. The little evidence available reveals that a common

species response to the combined effects of such factors is unlikely. For instance, habitat degradation and climate change are likely to decrease habitat specialists and benefit some mobile and generalist species of British butterflies (Warren et al. 2001). For exploited species, harvesting effects adds a further complication, which combined effects with other potential drivers of species extinction are yet to be explored.

Epiphytes comprise 10% of all vascular plants, and some epiphyte species are among the most vulnerable