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RESEARCH PAPER

Reproductive biology and nectar production of the Mexican endemic *Psittacanthus auriculatus* (Loranthaceae), a hummingbird-pollinated mistletoe

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ABSTRACT

Many mistletoe species produce ‘bird’-pollinated flowers; however, the reproductive biology of the majority of these species has not been studied. *Psittacanthus auriculatus* is a Mexican endemic mistletoe, most common in open, dry mesquite grassland. Knowledge of the reproductive biology of *P. auriculatus* is essential for understanding species formation and diversification of *Psittacanthus* mistletoes, but it is currently poorly understood. Thus, we studied floral biology and phenology, nectar production and breeding system and pollination of this species. The hermaphroditic red-pink flowers open from the middle to the tip and petals are curly, but remain partially fused forming a floral tube of *ca.* 20-mm long. Flowers are partially protandrous, produce large amounts of nectar, last 2 days, and stigma receptivity is highest during the second day. We recorded hummingbirds (*Cynanthus latirostris, Hylocharis leucotis, Amazilia beryllina*, *A. violiceps*, *Calothorax lucifer, Archilochus colubris*) and less commonly butterflies (*Agraulis vanillae*, *Anteos clorinde*, *Papilio multicaudatus*, *Phocides urania*, *Phoebis sennae*) as floral visitors. *P. auriculatus* flowers are self-compatible. However, this mistletoe is an obligate animal-pollinated species, as the sensitive stigma avoids self-pollination. Under natural conditions, reproductive success was higher than in manually selfed or cross-pollinated flowers, likely due to the traplining foraging behaviour of hummingbirds. We suggest that the apparent efficient foraging behaviour of hummingbirds maintains gene flow among *P. auriculatus*, promoting outcrossing.

INTRODUCTION

The exceptional species richness and increased diversification rates of angiosperms have frequently been associated with a number of floral features for biotic pollination (Stebbins 1970; Vamosi & Vamosi 2010). The functional significance of floral traits and the plant reproductive consequences of the foraging behaviour of animal pollinators have been a traditional subject in pollination biology. Recently, a plethora of studies of modern research programmes describing the reproductive biology of different plants have appeared in special issues of botanical and evolution journals (*e.g.* Ayasse & Arroyo 2011; Hiscock 2011; Karron *et al.* 2012; Van der Niet *et al.* 2014). The suites of morphological and chemical plant traits in those studies are viewed as the result of adaptation to specific pollinators. However, the reproductive system of many angiosperms is not known and the accumulated knowledge for the studied species is still insufficient to understand the potential role of pollinators in driving modification and specialisation of floral traits in most plant families (Harder & Johnson 2009; Johnson 2010; Armbruster 2014).

The recognition of broad associations between particular pollinator groups and floral character suites across all angiosperms (so-called pollination syndromes; Faegri & Van der Pijl 1979) provides the basis to start investigations of a particular system in which floral diversity is high. In the context of pollination syndromes, well-known examples include those associating hummingbird pollination with diurnal tubular red or orange flowers (*e.g.* Martén-Rodríguez *et al.* 2009). While the utility of pollination syndromes has been re-evaluated (Rosas-Guerrero *et al.* 2014), the finding of effective pollinators not predicted by the syndrome in many plant species (reviewed in Rosas-Guerrero *et al.* 2014) highlights the need for field studies of plant species pollinated exclusively by one functional group. In groups of plants with highly specialised pollination systems, floral traits responsible for the maintenance of the specific interaction (*e.g.* flower size, amount of floral reward) are expected to be strongly correlated with the pollinator morphology and its behaviour for floral reward collection, enhancing the syndromes.

Loranthaceae is the largest and most diverse family (73 genera and *ca.* 990 species) distributed in the Old and New World tropics (Vidal-Russell & Nickrent 2008a; Nickrent *et al.* 2010). Most Loranthaceae species are dependent exclusively on a bird agent for pollination and dispersal, whereas entomophily and autonomous pollination are less frequent