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Experimental evidence for bird pollination and corolla damage by ants in the short-tubed flowers of *Erica halicacaba* (Ericaceae)

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Abstract

Unrelated plants pollinated by similar animals tend to show convergent evolution of floral traits. Floral syndromes have been used successfully to develop hypotheses about pollination systems but can be misleading when plants have unusual floral morphology or mechanisms of pollen transfer. A case in point is *Erica halicacaba,* a local endemic shrub on the Cape Peninsula of South Africa. Its short-tubed greenish-yellowish flowers with a narrow aperture have been considered to be insect pollinated. However, field observations, selective exclusion experiments and analysis of pollen loads all indicate that its primary pollinator is the Orange-breasted Sunbird (*Anthobaphes violacea*). These sunbirds were common visitors and netted individuals carried large numbers of *E. halicacaba* pollen tetrads on their culmens, rather than on their head plumage as is typical for Cape *Erica* species with longer tubular flowers. Plants of *E. halicacaba* from which vertebrates were excluded had a lower incidence of anther tripping and set significantly fewer seeds than those exposed to both birds and insect visitors. Nectar in *E. halicacaba* is present in small concentrated amounts and, typical of sunbird-pollinated plants, is dominated by sucrose. Flowers often had holes in their corollas and we identified ants, specifically *Myrmicaria nigra*, as the likely agents. This was supported by reduced rates of corolla damage on branches from which crawling insects such as ants were experimentally excluded. These findings indicate that considerable caution should be applied when attempting to predict pollinators from floral syndromes, and highlight the role that crawling insects can play in damaging flowers.

Keywords: *Anthobaphes violacea*; Bird pollination; *Erica halicacaba*; Ericaceae; Floral Syndromes; Nectar Robbing; Nectar; Pollination Biology

1. Introduction

The concept of floral syndromes can be traced to Kölreuter's (1761) descriptions of plant-pollinator interactions and floral morphology (Fenster et al., 2004). It has been controversial on account of its association with a typological school of pollination biology that was not grounded in evolutionary biology, and because there has been uncertainty about the degree of specificity in pollination systems (Johnson and Steiner, 2000; Pauw, 2006; Waser et al., 1996). Fenster et al. (2004) defined a floral syndrome as "a suite of floral traits, including rewards, associated with the attraction and utilization of a specific group of animals as pollinators", and further emphasised the importance of classifying pollinators into functional groups according to the selective pressures they exerted, as these typically influence evolution of suites of floral traits. It is in this sense that Hargreaves et al. (2004) proposed that "floral syndromes can be seen as patterns of convergent evolution that are useful for developing testable hypotheses about pollination systems".

Workers have emphasised the usefulness of floral syndromes (De Merxem et al., 2009; Hargreaves et al., 2004; Pauw, 2006) and it is a feature of many pollination studies that pollinators are initially inferred from the floral morphology

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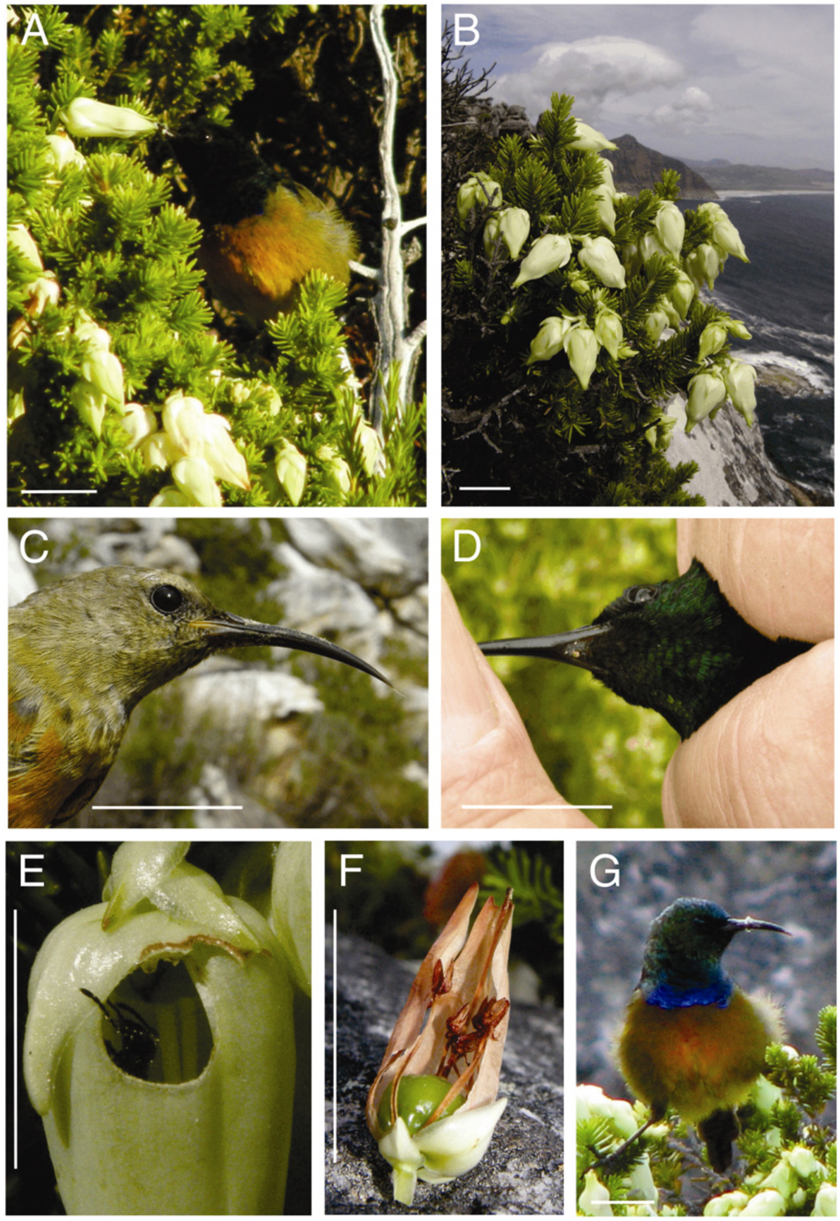

Fig. 1. (A) *Anthobaphes violacea* pollinating *E. halicacaba*. Scale 20 mm. (B) *Erica halicacaba* in typical habitat. Scale 20 mm. (C) Pollen on culmen of juvenile Orange-breasted Sunbird. Scale 20 mm. (D) Scalloped area on underside of culmen with pollen amalgam. Scale 20 mm. (E) *Myrmicaria nigra* causing floral damage to an *E. halicacaba* flower. Scale 10 mm. (F) Fertilised flower. Scale 20 mm. (G) Male visitor with pollen on culmen. Scale 20 mm. All photos R.C. Turner, except (G) Rob Simmons.

of plants (e.g. Kleizen et al., 2008; Manning and Goldblatt, 2005; Turner et al., 2011). In the majority of these studies, predictions have been confirmed by later observation, thus the predictive value of floral syndromes can be high. However, the utility of floral syndromes has been questioned (Ollerton et al., 2009) and several studies have demonstrated that there are limits to the power of predictive paradigms, especially in specialised single-pollinator mutualisms (Castellanos et al., 2003; De Merxem et al., 2009; Johnson, 1995; Olesen and Valido, 2003; Pauw, 1998). A case in point is Pauw's (1998) study of bird-pollinated in *Microloma sagittatum* (L.) R.Br. (Apocynaceae), a species which possesses some traits consistent with bird-pollination, such as the firm-textured, unscented, tubular, red flowers with accessible perching posts, but, also traits usually associated with insect pollination, such as a short floral tube with a narrow entrance. Ollerton (1998) noted that these traits had "excluded *M. sagittatum* from being recognized as a bird-pollinated plant — these characteristics did not fit preconceived ideas of what such a plant should look like". Similarly, de Merxem et al. (2009) concluded their study of variable flower tube length in *Tritoniopsis revoluta* (Burm.f.) Goldblatt by commenting that "although syndromes may provide clues about prospective pollinators, they are not always a fail-safe way of predicting all of a flowers' important visitors".

Bird-pollinated flowers typically have brightly coloured flowers, often red, orange and sometimes pink (Anderson,