POLLINATION AND SEED DISPERSAL SYNDROMES IN PLANT COMMUNITIES ON IRONSTONE OUTCROPS, SE BRAZIL.

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INTRODUCTION

Mountain environments and, within these, rock outcrops have proven to substantially contribute to regional plant diversity. This is no exception in the case of the Espinhaço Range, spreading longitudinally from Bahia to southern Minas Gerais. In this last region, known as Quadrilátero Ferrífero (Iron Quadrangle), a typical ecosystem, much overlooked until recently, are ironstone outcrops, characteristic iron ore crusts on the mountain tops. Although the plant communities established here share some common characteristics with sandstone outcrops, the former were overlooked until recently for a series of reasons, ranging from misconceptions regarding their diversity to difficult access. Only few and recent floristic studies have dealt with these last outcrops exclusively (Jacobi *et al.*, 2007, Mourão & Stehmann 2007, Viana & Lombardi 2007), and the lack of an identity that differentiates their plant communities has precluded further actions towards their protection, much needed since, differently from other rock types such as granite and sandstone, they are the target of heavy mining activities in the area. Floristic surveys have already shown that ironstone outcrops contribute substantially to the plant diversity in the Quadrilátero Ferrífero. To further demonstrate the difference between ironstone outcrop plant communities and other rock types, one important issue is which pollen and seed dispersal strategies have succeeded to get established in these edaphically - controlled environments. With this in mind, our work was directed by two questions: (1) Which pollination and seed dispersal syndromes predominate in ironstone outcrop plant communities and in which proportion? (2) Is the proportion different among habitats? It is expected that more favourable (e.g. nutrient rich) environments will have a larger proportion of zoophily and zoochorory, which are more expensive dispersal structures than those related to abiotic agents. It is also expected that open areas have larger proportion of wind - dispersed pollen and seeds. The predictive value of dispersal syndromes, especially pollination, has been criticized because it is more restrictive than reality shows (Howe & Smallwood, 1982, Hingston & Mcquillan, 2000). Nevertheless, at the community level, and specifically for comparison purposes, it is a necessary first step to reveal important patterns.

OBJECTIVES

The aims of this study were to identify the pollination and seed dispersal syndromes in plant communities on ironstone outcrops, to compare the profile of two main habitats, and to associate these profiles to their environmental characteristics.

MATERIAL AND METHODS

We based our analysis on the current three publications which have exclusively dealt with floristics of ironstone outcrops in SE Brazil: Jacobi *et al.*, (2007), Mourão & Stehmann (2007), and Viana & Lombardi (2007). All three study areas are subjected to 4 - 5 dry months. Our analysis of the syndromes was based on the examination of voucher specimens, field observations, and extensive use of literature. The species included only phanerogams, and the taxonomic classification was according to APG II (2003).

Although a large array of microhabitats has been associated with ironstone outcrops (Jacobi *et al.*, 007) only two major habitats were considered: open - herbaceous and low forest - shrub vegetation. In the first, limiting nutrients and water stress are common because of the prevalence of exposed rock or a thin layer of soil, the second thrives in large rock depressions which have allowed organic matter to accumulate.

Each species was assigned to only its main pollination or dispersal syndrome. Pollination syndromes (Faegri & van der Pijl, 1979) were: wind, insects (several groups), bees, flies, moths, birds, bats, and ambophily (pollination by both wind and insects). For the sake of comparison between the

two habitats these categories were later simplified. Three seed dispersal syndromes (Howe & Smallwood, 1982) were considered: anemochory, autochory (including gravity and ballistic), and zoochory. Syndrome proportion differences between both habitats were tested with a G - test available in software BioEstat 3.0 (Ayres *et al.*, 003).

RESULTS AND DISCUSSION

We recorded 353 angiosperm species, belonging to 70 families. Several species were found in both the herbaceous and low forest habitats, and were allocated to the habitat where they occurred most frequently. Thus, 248 species were associated to the first habitat, while 105 species occurred in the latter. Ten families accounted for 56% of all species, and weighed heavily in the outcome of syndrome proportions. Since this study did not analyze syndromes by predominance of individuals, our analysis is subjected to biases regarding the success of each syndrome in terms of density or biomass. Also, as noted by Arbeláez & Parrado - Roselli (2005), these analyses usually lack the necessary independence because of phylogenetic relations. Six of these ten most speciose families are primarily zoochorous, although this syndrome accounts for only 81 species. This is because of the high species richness of the anemochorous families, namely Asteraceae, Orchidaceae, and Apocynaceae, and autochorous families, in particular Poaceae. As for pollination syndromes, in these ten families there was a prevalence of entomophily in a broad sense, including non - specialized flowers pollinated by several insect families, such as Asteraceae, and those exclusively melittophilous (bee - pollinated), corresponding to special anther openings (Solanaceae, Melastomataceae) or resource offered (oil in Malpighiaceae), which demand specific skills. Grasses and sedges were exclusively pollinated by wind.

Regarding the whole species list, entomophily predominated in both habitats, but it accounted for more than 90% in low forest habitats and only 71% in open areas, where the second and third most representative categories were wind (16%) and bird (13%) pollination. The syndrome distribution proved significantly different (G - test = 26.32, df = 3, p <0.0001). In both habitats, only four species were ambophilous or bat pollinated. Among those pollinated by insects, melittophily prevailed in both habitats. Associating each species to only one pollination category must have hidden the well - known generalist ability of both plants and floral visitors (Waser *et al.*, 996). Zoochory was predominant in low forest habitats (83%), with important families such as Myrtaceae, Solanaceae and Rubiaceae, but was ranked last in open areas (18%), where autochory (41%) and anemochory (41%) dominated. Again, both profiles were significantly different (G - test = 94.25, df = 2, p <0.0001).

CONCLUSION

The profiles of pollination and dispersal syndromes between low forest/shrub and open herbaceous vegetation are considerably different, and overall they respond to both habit (e.g. trees vs. herbs) and phisiognomy (forest/shrub vs. herbaceous), which in turn are the product of edaphic conditions. As anticipated, anemochorous species predominate in the open environment, but there was an unexpected high percentage of zoophilous species, particularly insect - pollinated, in this environment. Low forest islands on ironstone outcrops had a syndrome profile poorly related with outcrop ecosystems, recognized as open systems; rather, they showed closer affinity with the surrounding forests.

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