Silva-Matos, Dalva M.; Fonseca, Giovana D.F.M.; Silva-Lima, Leonardo
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Revista de Biología Tropical, vol. 53, núm. 1-2, marzo-junio, 2005, pp. 1-4
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Available in: http://www.redalyc.org/articulo.oa?id=44918946001
Differences on post-fire regeneration of the pioneer trees Cecropia glazioui and Trema micrantha in a lowland Brazilian Atlantic Forest

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Abstract: A study of natural post-fire succession was carried out in a disturbed vegetation around fragments of the Atlantic Rain Forest (National Biological Reserve of Poço das Antas (22°30'-22°33'S, 42°15'-42°19'W), Rio de Janeiro State). All the pre-fire individuals of Cecropia and Trema in the area were numbered with plastic labels. In order to check for the presence of new sprouts and mortality, two other censuses were carried out, at 3 and 12 months after the fire. The dominant species were: Pteridium aquilinum, Panicum maximum, Trema micrantha and Cecropia glazioui. Few days after the passage of fire, grasses and ferns spread their area, while the stands of Trema and Cecropia were completely burned. Most of individuals of Cecropia produced some sprouts while most of individuals of Trema died. However, a great number of seedlings of Trema were recruited while only one single seedling of Cecropia were observed during a period of one year. Most of these seedlings died through the year while the sprouts were already reproducing. The uses of Cecropia in places where fire is recurrent could be more appropriate because of its higher chance of survival and faster recovering ability after fire. Rev. Biol. Trop. 53(1-2): 1-4. Epub 2005 Jun 24.

Key words: Post-fire, succession, recruitment, cecropia, Trema, Brazil.

The knowledge of how the species respond to fire is fundamental for the understanding of the population and community changes in response to a fire event or regime. According to Whelan (1995) the survivorship of individuals that experienced the fire will be determined by various life-history, anatomical and physiological characteristics. Survival can be earned through different ways: 1) by the ability to resist the direct effects of fire and 2) by the ability to tolerate the changed post-fire conditions (Whelan 1995). Post-fire flush of seedlings and sprouting are adaptative traits for recovery after fire that can produce changes in the community. However, the ability to resprout and recruitment from the soil seed bank will also depend on the characteristics of fire (in terms of frequency, extent, intensity and season of burning).

The Atlantic Rain Forest, in the southeastern of Brazil, is one of the richest world ecosystems (Myers et al. 2000) which has been reduced to 7% of its original area (SOS Mata Atlântica 1998). Consequently, many forest fragments are surrounded by new vegetation types where fire can easily spread (e.g. grasses and ferns). As fire is still not considered a common event in the Atlantic Rain Forest, the responses of species during a fire and consequences at community level have not been issues of research. This study reports the effect of fire in a matrix of grasslands and pioneer tree species where fragments of Atlantic Rain Forest are located. Three main processes...
affecting the pioneer trees are examined: 1) adult mortality caused by fire; 2) density of germination after fire, and 3) survivorship of seedlings and sprouts over time after fire.

The study was carried out in the National Biological Reserve of Poço das Antas (22°30’-22°33’ S, 42°15’-42°19’ W), Rio de Janeiro State. The Reserve covers about 5000 ha and a maximum elevation of 205 m above sea level. Pastures, agriculture and secondary forests surround the area. The regional climate is classified as Walter and Lieth’s Equatorial type (Walter 1971). The vegetation is typical of Atlantic Rain Forest of low altitude, being formed by fragments in different successional stages (Lima et al. 1997) surrounded by dense stands of invasive species (Cecropia glaziouii, Trema micrantha, Pteridium aquilinum var. arachnoideum (Klf.) Herter and Panicum maximum Jacquin. Lima et al. (1997) argued that this reserve is one of the few remnants of lowland Atlantic Rain Forest in Rio de Janeiro State, and is also the habitat for the largest natural population of the golden lion tamarin, Leontopithecus rosalia (Primates: Callithrichidae).

Within the reserve 1.0 hectare was chosen within a matrix between a group of forest fragments (islands). The soil of the site is peat and the vegetation is exclusively formed by grasses (Panicum maximum) and ferns (Pteridium aquilinum) and the tree species, Cecropia glaziouii Sneth. (Cecropiaceae) and Trema micrantha (L.) Blume (Ulmaceae). However, the area was totally burnt in the August 1997 when the vegetation became apparently destroyed. Although fire at this site can’t be predicted because is caused by antropic actions only (in general criminal actions), it can be considered frequent. Five other large fires were registered: 1984, 1986, 1990, 1991 and 1993 (Oliveira 2001). As soon as the fire was extinguished the regeneration process in terms of seedling recruitment and sprouting was quantified. All the pre-fire individuals of Cecropia and Trema in the area were numbered with plastic labels. In order to check for the presence of new sprouts and mortality, two other censuses were carried out, at 3 and 12 months after the fire. Three months after the fire grasses were tall and had already expanded. No seedlings of any other species were found under these grasses except in some sparse sites where Panicum and Pteridium were absent. Eight plots (1m x 1m) were randomly set up within these sites in which all seedlings found were similarly sampled. No other woody species were found in the study area. Seedlings were checked at three and twelve months later in order to quantify their survivorship.

The number of individuals of Cecropia and Trema in the area before the fire were 187 and 126 ha$^{-1}$ respectively. Individuals of both species were about 5 m height. After the fire, no green leaves were observed, suggesting that all of the trees were dead. Two weeks later, the first species found in the area were Panicum maximum followed by Pteridium aquilinum. Both species were re-sprouting rather than germinating from seeds. New leaves of Panicum
were about 10 cm in height. Three months after the fire most individuals of *Cecropia* (83.4%) had re-sprouted with an average of 3.0 sprouts/individual (total sprouts= 476). Practically all of them had sprouted from roots (99.4%, N= 473) while only 0.6% sprouted from stems. Conversely, most adult plants of *Trema* were dead (98.4%), only 1.6% individuals of *Trema* had some sprouts at the 3-month census (Table 1). The 1-year census revealed that most adult plants of *Cecropia* and their sprouts survived during the period of study (Table 1). Some of these sprouts were already producing fruits and 85 new sprouts (in individuals already sprouting) were found by the end of one year. No new deaths and no new sprouts of *Trema* were found at the 1-year census.

In terms of seedling regeneration, three months after fire, 405 seedlings of *Trema* were found in the eight plots (about 50 seedlings/m²) while a single seedling of *Cecropia* was found in the whole study area (1 ha). No seedlings of *Trema* or *Cecropia* were found in areas dominated by *Panicum* or *Pteridium*. Three months later, most seedlings of *Trema*: (96.3%) died and 28 new seedlings were found within the plots. The single seedling of *Cecropia* also died during this period. No new seedlings were found for either species at the 1-year census.

*Cecropia* can be considered a sprouter with vegetative regeneration while *Trema* is an obligate seeder from seeds storage in soil (*sensu* Whelan 1995). Holthuijzen and Boerboom (1982) showed that the amount of seeds of the congener *Cecropia sciadophylla* and *C. obtusa* sharply decreases with depth and that most viable seeds germinated from the 0-1 cm soil layer. Consequently, those seeds buried in the soil surface experienced high soil temperatures during and after the passage of fire. As *Trema* is commonly found in larger gaps while *Cecropia* in small gaps (Brokaw 1987), it is plausible that *Trema* seeds are more resistant to moderate heat than seeds of *Cecropia*. This resistance might be due to its ability to germinate in larger gaps where temperature is expected to be greater. The removal of competing vegetation could also have improved the recruitment while the high rate of seedling mortality was expected because of the rapid growth of competing vegetation over them. Sprouting, in the case of *Cecropia*, is a successful strategy of “escape” as sprouts of *Cecropia* are located over the fast growing vegetation present in the study site. In terms of community level, fire had a profound effect on the successional process by keeping the vegetation in a state in which grasses and ferns dominate the landscape. Fire destroyed the dense stands of adult *Trema* and *Cecropia* favouring the penetration of grasses and ferns in areas where they had already left (the subcanopy of these stands).

**ACKNOWLEDGMENTS**

The author thanks the Brazilian Government for the financial support through the CNPq, FAPERJ, Fundação “O Boticário de Proteção a Natureza”, IBAMA for the logistic support for field work, Pedro Carauta for the identification of *Cecropia*, Solange A. V. Pessoa, L. Fernando Moraes, Elidiomar R. da Silva and Michael Swaine for their important comments on the manuscript.

**RESUMEN**

Se realizó un estudio sobre la sucesión natural después del fuego en una vegetación alrededor de fragmentos de la selva lluviosa atlántica (Reserva Biológica Nacional de Poço das Antas (22°30'-22°33' S, 42°15'-42°19' W), Estado de Río de Janeiro). Todos los individuos de *Cecropia* y *Trema* previos del fuego en el área fueron...
Las especies dominantes fueron: *Pteridium aquilinum*, *Panicum maximum*, *Trema micrantha* y *Cecropia glazioui*. Pocos días después del paso del fuego, los pastos y helechos se dispersaron por el área, mientras que los troncos de *Trema* y *Cecropia* estaban completamente quemados. La mayoría de los individuos de *Cecropia* produjeron algunos rebrotes mientras que la mayoría de los individuos de *Trema* murieron. Sin embargo, un gran número de plántulas de *Trema* fueron reclutadas mientras que únicamente una plántula de *Cecropia* fue observada durante el periodo de un año. La mayoría de estos plántulas murieron a lo largo del año, mientras que los brotes se estan ya reproduciendo. Los usos de *Cecropia* en lugares donde el fuego es recurrente puede ser más apropiado debido a su mayor chance de sobrevivir y a su habilidad de recuperarse más rápido después del fuego.

**Palabras clave:** Fuego, sucesión, reclutamiento, *Cecropia*, *Trema*, Brasil.

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