

Site productivity classification for secondary evergreen dipterocarp forests in South-Eastern Vietnam

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Reliable forest site productivity estimation is key to site-specific forest management. Many studies have investigated the estimation of forest site productivity based on species-specific height-age equations for monoculture plantations, and on height-diameter equations for mixed-species forests. However, research into estimation of productivity in secondary forests is scarce. This research classified site productivity, based on a distance-independent individual-tree growth model, to simulate management regimes in native secondary forests in monsoonal Southern Vietnam. The model was based on the spatial variation and vegetation stage at the microsite scale, which was in turn associated with soil and topographic properties, which limit the natural climax vegetation type. Recovery stage of vegetation, after a known logging event, was entered into the model to determine site productivity class. The climax vegetation types (evergreen, deciduous and bamboos), and time to recovery were identified using: the year that the normalized difference vegetation index (NDVI) at the site achieved the asymptote (from 1988 to 2017, 199 sample plots [1000 m²]), and the maximum ratio of evergreen:pioneer basal area (reference from old-growth forest sites). We assumed that climax stage was evergreen mixed dipterocarp forest. Finally, both soil and topographic and stage of recovered vegetation were identified in terms of their capacity for supporting high productivity evergreen dipterocarp forests. We classified the stages of vegetation recovery based on the productivity of dipterocarp trees, and the presence of invasive species (bamboos), and based on this, we describe the recovery potential of each site.

Gaps and challenges for SF owners in Central America to build bankable forest businesses

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The sustainable development is driven by several national and international agendas such as Sustainable Development Goals, Green Growth, Low-Emission Development Strategies and other. Those initiatives look for public and private commitments to achieve their aims, the public and political sector are engagement, but it is important that the private embrace those initiative. The possibilities of private sector to contribute to reach SDG is huge, because of that it is possible to see initiative such as SDG Business Hub, Business for 2030 and SDG Business Forum. Moreover, it is necessary to move capital for develop small and medium rural business, the international efforts are focus on microfinance (mainly on financial inclusion), impact investment and other. The study focus on analysis of 42 forest business opportunities, the key findings are structuring in business case to show the main gaps and challenges of the forest owner in Central America to build bankable forest businesses cases. The analysis use business case approach as framework to explore viable alternatives, coherence between policies and business strategies, review the stakeholder and risk analysis, to build recommendation for forest owners and practitioners.

C7p: DEVELOPING SUCCESSFUL BIOLOGICAL CONTROL PROGRAMS IN FOREST PLANTATIONS

The parasitoid *Psyllaephagus blastopsyllae* (Hymenoptera: Encyrtidae), as potential control of the eucalypt psyllid *Blastopsylla occidentalis* (Hemiptera: Psylloidea), in Brazil

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In view of future release for the control of the eucalypt pest *Blastopsylla occidentalis*, the parasitoid *Psyllaephagus blastopsyllae* was imported from South Africa into Brazil in 2015, where the specimens were kept in quarantine for preliminary bioecological studies. Within a few months, the specimens died and the establishment of a viable culture failed. While another introduction was planned, the parasitoid was found in eucalyptus plantations in Minas Gerais. This changed the focus of the project to monitor the population in the plantations in Minas Gerais and to search for the parasitoid in other areas in Brazil with eucalypt plantations. The monitoring of the parasitoid showed that the pest is associated with various eucalypt clones, especially those of *Eucalyptus camaldulensis*. The occurrence of the parasitoid was positively correlated (0.82) with the pest population but indifferent to the type of clone. The percentage of parasitism was higher between June and August, the dry season, coinciding with the population peak of the pest. Besides Minas Gerais, the parasitoid was also found in São Paulo and Mato Grosso do Sul. In a survey in SP in October 2018, the observed percentage of parasitism was around 9%. A similar survey in Três Lagoas, MS, in August, yielded a percentage of parasitization of about 11%. Our data represent a small sampling in terms of total eucalypt plantations in Brazil. For promoting biological control, we suggest to increase the number of areas to be surveyed for the occurrence of the parasitoid and to study its control potential.

Selectivity of mycoinsecticides and a pyrethroid to the egg parasitoid *Cleruchoides noackae* (Hymenoptera: Mymaridae)

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Thaumastocoris peregrinus (Hemiptera: Thaumastocoridae), is an exotic pest of great importance for Eucalyptus plantations. The use of the egg parasitoid *Cleruchoides noackae* (Hymenoptera: Mymaridae), is the most used control method. However, other techniques are studied, such as use of entomopathogenic fungi and chemical insecticides. The compatibility of chemical and biological control methods favors integrated pest management. The objective was to evaluate the action of mycoinsecticides and insecticides on the parasitoid *C. noackae* and its parasitism on *T. peregrinus* eggs. Two bioassays were performed: 1) cage surfaces (IOBC standard) were submitted to the application of *Beauveria bassiana* (Boveril) and *Metarhizium anisopliae* (Metarril), both with concentrations of 1 x 10⁸ conidia/g, Bifenthrin (Capture), with a concentration of 400 g/L, and control (water); after drying, 20 adults of the parasitoid were released per replicate (cage); 2) in this bioassay eggs of *T. peregrinus* were submitted to the same treatments; after drying 10 eggs of *T. peregrinus* treated by cage, and released a

couple of *C. noackae* by replicate. Parasitism was allowed for 24 hours ($T=25\pm 2^\circ\text{C}$; $UR=70\pm 10\%$ and photophase= 12h). The statistical desing was completely randomized with four treatments and five replicates. Mortality, parasitism and viability were evaluated. *B. bassiana* was selective to parasitism and viability, and slightly harmful to adults of *C. noackae*; *M. anisopliae* was innocuous to adults and the viability of offspring, but it reduced parasitism; and bifenthrin was non-selective to *C. noackae* in all bioassays.

Effect of mycoinsecticides and insecticides on emergence of the pupae parasitoid *Tetrastichus howardi* (Hymenoptera: Eulophidae)

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Tetrastichus howardi (Hymenoptera: Eulophidae) is a gregarious endoparasitoid and a facultative hyperparasitoid. This parasitoid has potential to use to control lepidopterous pests in *Eucalyptus* plantations in Brazil. The use of mycoinsecticides and insecticides in pest management may have deleterious effects on non-target organisms. The recommendation of selective insecticides has great appeal to the conservation of natural enemies and parasitoids. Therefore, the objective of the work was to evaluate the action of mycoinsecticides and insecticides used to *Eucalyptus* pests on the emergence of *T. howardi*. Pupae of *Diatraea saccharalis* were offered to *T. howardi* parasitoids, with parasitism allowed for 48 hours, after which they were individualized in glass tubes and maintained under controlled conditions ($25 \pm 2^\circ\text{C}$; $UR = 70 \pm 10\%$ and 12 h photophase). The statistical design was completely randomized with seven treatments and 10 replicates. When the pupae were close to emerging the treatments were prepared: *Beauveria bassiana* and *Metarhizium anisopliae* (both with concentrations of 1×10^8 conidia/g), tiamethoxam, bifenthrin, imidacloprid and clorfenapyr (under higher recommended doses) and control (water). The pupae were immersed in the treatments for 10 seconds. After drying, they were transferred to polystyrene tubes until the parasitoids emerged. It was evaluated the number of parasitoids emerged and were retained in pupa. The insecticides were classified according to the International Organization for Biological Control (IOBC). None of the treated pupae affected the emergence of parasitoid adults, therefore, all products classified as innocuous. However, studies to verify the direct effect on the parasitoid still need to be done.

A phylogeographic approach for *Glycaspis brimblecombei* (Hemiptera: Aphalaridae) and its parasitoids in Brazil

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Eucalyptus red gum lerp psyllid, *Glycaspis brimblecombei* (Hemiptera: Aphalaridae) is one of the most important *Eucalyptus* exotic pests. Its first report in Brazil was in 2003, in the state of São Paulo, damaging *Eucalyptus camaldulensis* plantations. The parasitoid, *Psyllaephagus bliteus* (Hymenoptera: Encyrtidae), was reported together with the psyllid and a new introduction of parasitoids from Mexico was performed to improve the efficiency of biological control programs of this pest. Our objectives were to evaluate the genetic diversity of the psyllid and its parasitoid in Brazil using mitochondrial genes sequencing. Insects of both species were collected from different regions in Brazil. Thirty-four individuals of *G. brimblecombei* and twelve samples of *Psyllaephagus* spp were successful sequenced. A single COI gene haplotype was found in *G. brimblecombei* populations from Brazil and this is the same haplotype that occurs in Portugal samples, indicating one (or few) introduction events of *G. brimblecombei* in Brazil is originated from an invasive lineage distributed in other regions from the world. This fact suggests that the invasion routes of *G. brimblecombei* in the world are interconnected, which seems to be a standard for invasive *Eucalyptus* pests. Two distinct haplotypes, with a high genetic distance between them, were identified for the parasitoid. It confirms the presence of two parasitoid species in Brazil, one already identified, *P. bliteus*, and a second species of *Psyllaephagus* not morphologically identified. However, we can confirm that both parasitoid species collected in Brazil are exotic species originated from Australia.

Population dynamics of bronze bug, red gum lerp psyllid and its parasitoid in *Eucalyptus* plantations in three regions of São Paulo, Brazil

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The aim of this study was to evaluate the population dynamics of *Thaumastocoris peregrinus* (Hemiptera: Thaumastocoridae), *Glycaspis brimblecombei* (Hemiptera: Aphalaridae) and its parasitoid *Psyllaephagus bliteus* (Hymenoptera: Encyrtidae) in three distinct regions of São Paulo State (Mogi Guaçu, São Simão, and Altinópolis) during 2014 to 2017. The pests and parasitoid monitoring was correlated with meteorological data: maximum temperature (T_{max}), minimum temperature (T_{min}) and average (T_{med}); rainfall (P); daily solar radiation (R) and vapor pressure deficit (DPV). The insects monitoring was carried out with yellow stick traps (12.5 x 10 cm) monthly during for four years, totaling 275 sample sites. *T. peregrinus* population index declined over the years, differing from *G. brimblecombei* and *P. bliteus*, which ones increased. The correlation between *T. peregrinus* and meteorological data was positive with the considering T_{max} , T_{med} , R and DPV. Rainfall and T_{min} was negative for *G. brimblecombei*, but positively for T_{max} , R and DPV. *P. bliteus* population had positive correlation for the population increasing and T_{max} , R and DPV. These results were similar to field observations, demonstrating monitoring may be essential in decision making for pest control.