INTERFACE PROJECT: RELATIONSHIPS AMONG LANDSCAPE STRUCTURE, ECOLOGICAL PROCESSES, BIODIVERSITY, AND ECOSYSTEM SERVICES

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FAPESP Process 2013/23457-6 | Term: May 2014 to Apr 2019

Figure 1. Pollinator exclusion experiment in coffee bushes in Poços de Caldas (MG). Photo: Adrian David Gonzáles Chaves.

Faced with the challenge of planning multifunctional landscapes to ensure the retention of both original biological diversity and ecosystem functions, as well as agricultural production, this project aims to investigate how parameters of landscape structure directly or indirectly regulates key ecosystem services through influencing a series of distinct ecological processes and specifically investigate the likelihood of both thresholds and trade-offs in service provision. We will do this by relating rates and stocks measurements of key ecosystem services, including regulatory (e.g. pollination, pest and disease control), provisioning (i.e. water storage) and supportive services (i.e. carbon stocks) with parameters associated with landscape structure, including the proportion of native habitat, the proximity and number of edges between native vegetation and agricultural areas, and landscape composition. By considering these relationships for 40 landscapes located in distinct agricultural matrices (i.e. coffee, extensive cattle pasture, and eucalyptus), within a highly biodiverse and threatened biome (Brazil's Atlantic Rainforest), we can assess the generality of these relationships, compare landscape-service relationships for multiple services across within the same matrix type, as well as single service across different matrices. It is expected that: (i) regulating and supporting ecosystem services demonstrate non-linear threshold dynamics along gradients of habitat loss, (ii) these thresholds are governed by a series of ecological processes related to both movement patterns of the biodiversity associated with service provision, and changes (usually non-linear) in landscape configuration associated with habitat loss, and (iii) that thresholds in service decline occur at lower levels of forest cover for those landscapes with more forested matrix habitat. Taken together, these related datasets will provide a critical scientific subsidy to ongoing political land-use planning processes, and the maintenance of ecosystem services in the working agricultural landscapes of the Atlantic Rainforest.

SUMMARY OF RESULTS TO DATE AND PERSPECTIVES

Pollination: The presence of bee pollinators in coffee plantations can increase coffee productivity in 28%. Therefore, fruit set is especially enhanced in farms where coffee cover is low and nearby forest remnants. Moreover, coffee management (organic vs conventional) and the diversity of flower resources interspersed among coffee lines are determinants of flower visitors in coffee plantations.

Pest control: Agricultural matrices containing coffee plantations might facilitate biological movement among forest patches postponing species loss within patches. A substantial proportion of the species pool of forest dependent birds (25%) can spillover into coffee plantations promoting pest control services. Exclusion experiments in coffee plantations (birds and bats) demonstrate that herbivory was lower in landscapes with higher amounts of forest cover, and new evidences are indicating ants as important predators of the coffee borer beetle (Hypothenemus hampei).

Disease control: Landscape structure and both social and climatic factors are associated to hantavirus infection risk. Future scenarios are indicating that sugar cane expansion and expected increase in temperature can increase up to 34% the population at risk for infection in São Paulo state. Contrary to our expectations, parasite regulation services in cattle pastures was increased in landscapes with larger pasture expansion. Moreover, disease transmission may be a strong threat to native biodiversity as well due domestic dog invasion, especially in less forested landscapes.

Water supply: More forested areas are associated with increased rainwater interception, increased groundwater recharge, and a longer time of rainwater residence in watersheds. These results highlight the importance of vegetation cover maintaining hydrological resources quality and regulating the basin streamflow.

Carbon storage: Both deforestation and fragmentation processes have led to important carbon stock's losses in our study system. The above-ground carbon stored is lower at patch edges compared to patch inners. By its turn, the carbon stored below-ground responds to land use intensity, where more intensive land uses (e.g. pastures) are carbon poor.

Public Policies: The enrollment on Payment for Environmental Services programs (PES) influences the on-farm extent of native forest cover. PES engaged rural properties had a higher rate of forest regeneration after PES implementation, when compared to non-engaged similar properties.

MAIN PUBLICATIONS

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