PhD position

Title

Land sharing versus land sparing revisited: Modelling the long-term dynamics of human populations, land use and ecosystem services.

Context

The world's population is largely urban and is continuing to grow, with estimates that by 2050 about 70% of the global population will live in cities. This purging of the rural population creates a positive feedback, further industrializing agricultural and natural resource extraction, which degrades the environment and forces individuals to relocate (Dandekar and Hibbard 2016). The link between human population growth and nature is often described as exogenous. However, the dependence of humans on nature is becoming increasingly clear, especially when it comes to feeding the growing population.

The land sharing versus sparing debate attempts to find a balance between agricultural and natural areas. Despite the breadth of the literature on this topic, there are many gaps in the context of increasing socio-economic globalization. Grau at al. (2013) suggested expanding theoretical and empirical research beyond the landscape and ecoregion scales by evaluating environmental heterogeneity and long-distance interactions in a globalized world.

Objective

This PhD project aims to determine what configuration of rural and urban populations and land compositions generates the most sustainable path in the future for humans and the environment; investigate how human populations and ecosystem services are impacted by patterns of land use at national or global scales; and determine how changes in biodiversity impact rural-urban relocation.

This project is part of a larger project aimed at building a theory of the long-term dynamics of human-nature interactions, in which feedbacks from changes in biodiversity through changes in ecosystem services are taken into account (Lafuite & Loreau 2016; Lafuite et al. 2017; Cazalis et al. 2018).

Methods

1. Analyse data on rural land change and urban land change; urban/rural population change; and transitions in agricultural practices.
2. Create a spatial model of urban and rural spaces, including the human population in each space. First on a national scale and then on a global scale.
3. Compare different configurations of land: urban, rural (intensive, organic, subsistence). Incorporate different sizes and patterns of rural and urban spaces.
4. Incorporate the impact of biodiversity on agricultural and natural resource exploitation and explore the effect on human dispersal patterns (see Fahrig 2001 for details).
5. Create a global network model with various connections between urban and rural spaces within two regions to compare the influence of globalization of land use on human population and ecosystem services maintenance.

Supervision

The PhD candidate will be supervised by Michel Loreau and Kirsten Henderson at the Centre for Biodiversity Theory and Modelling, based at the Theoretical and Experimental Ecology Station in Moulis, France (http://www.cbtm-moulis.com). The mission of the Centre is to foster and perform innovative theoretical research into the ecological and societal causes and consequences of biodiversity changes.

Student requirements

- Experience programming (R, SciLab, MATLAB, Python, etc.)
- Knowledge of calculus and modelling experience, spatial network models is an asset
- Creativity and independence
- Ability to read and write in English

Applications

To apply, e-mail a letter of application, a CV, a brief statement of research interests, and the names and email addresses of three references to Michel Loreau and Kirsten Henderson via Dalila Booth <dalila.booth@sete.cnrs.fr>.

References

1. Cazalis, V., Loreau, M. & Henderson, K. (2018). Do we have to choose between feeding the human population and conserving nature? Modelling the global dependence of people on ecosystem services. *Science of the Total Environment* 634: 1463–1474.
2. Dandekar, H. C. & Hibbard, M. (2016). Rural issues in urban planning: current trends and reflections. *International Planning Studies* 21: 225–229.

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4. Grau, R., Kuemmerle, T. & Macchi, L. (2013). Beyond 'land sparing versus land sharing': environmental heterogeneity, globalization and the balance between agricultural production and nature conservation. *Current Opinion in Environmental Sustainability* 5: 477–483.
5. Lafuite, A.-S. & Loreau, M. (2017). Time-delayed biodiversity feedbacks and the sustainability of social-ecological systems. *Ecological Modelling* 351: 96–108.
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Keywords: Modelling, Theoretical Ecology, Biodiversity, Land use, Rural vs urban, Human population