Workshop
Spatial Management of Biodiversity
2013, March 25 – 26
Institut Henri Poincaré
quarterly thematic program MABIES
Mathematics of Bio-Economics

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Abstract

The objective of this interdisciplinary workshop is to present courses, tutorials and research articles related to spatial management of biodiversity. Both theoretical and more applied works typically focusing on fisheries, agro-ecology, forestry, epidemiology or wildlife management are presented.

The first morning is devoted to a tutorial. The afternoon and the next day are dedicated to research presentations, with a single session (no parallel session): 45 mn is allocated to each talk including 35 mn of presentation, and 10 mn for exchanges with the audience.

PLANNING

1 Monday 25, March 2013

- Monday 4, March, 9h00–12h00: tutorial by Alan Hastings
  Overview of Spatial Models in Ecology

  Spatial ecology encompasses questions where the answer either is changed or depends on space. Among the most important issues considered are questions of persistence or coexistence of species and how this depends on the impact of space and the role played by underlying spatial heterogeneity.

Other important questions concern the spread of species in space and the development of patterns in abundance in space and time. The study of spatial dynamics can provide ways of unraveling the processes that determine the distribution and abundance of species. Theoretical approaches need to make assumptions tailored to the question asked. I will cover a variety of different mathematical approaches, emphasizing how outcomes depend on underlying asumptions.

2 Monday 25 and Tuesday 26, March 2013

- Paul Armsworth
  Designing cost effective conservation payment programs

  Governments and conservation organizations invest billions of dollars each year in habitat conservation in efforts to slow ongoing losses of terrestrial biodiversity. I examine a commonly used investment strategy in which private landowners are paid to enhance conditions for biodiversity. I evaluate whether existing payment programs provide conservation benefits cost effectively and how they could be improved. I also evaluate whether alternative designs for payment programs being promoted in conservation writings (auctions and landowner cooperatives) are likely to work for biodiversity.

- Michael Bode
  Larval dispersal patterns and inter-community cooperation in Melanesian fishing communities

  Across many Pacific Island communities, sustainable fishing initiatives are complicated by the contrasting scales of population processes and customary marine tenure. With reference to a coral grouper fishery on Manus Island, Papua New Guinea, we show how a better understanding of both of these processes can help provide guidance to managers interested in fostering cooperative decision-making.

- Carlos Castillo-Chavez
  Spatial patterns of infection: from foot and mouth disease to influenza   paper

  The role of spatial heterogeneity will be explored in the context of epidemics including influenza and foot and mouth disease; we will explore the role of geographical distance, dispersal and travel on disease dynamics and the challenges that it poses to public policy and disease management.

- Christopher Costello
  Partial Enclosure of the Commons

We examine the efficiency, equity, and environmental consequences of assigning spatial property rights to part of a spatially-connected natural resource, a situation which we refer to as "partial enclosure of the commons." The model reflects on a large class of institutions and natural resources such as fisheries, groundwater, oil, forest resources, and game animals for which complete enclosure by a sole owner may be desirable, but is often institutionally impractical. When a sole owner is granted ownership to only a fraction of the spatial domain of the resource (the remainder of the resource being open access), interesting spatial externalities arise which are the source of market failure. We obtain sharp analytical results: While second best, partial enclosure always improves welfare relative to no property rights, all resource users are made better off, positive rents arise in the open access area, and the resource will maintain higher abundance. Under spatial heterogeneity, we are able to characterize patches that are ideal candidates for partial enclosure - society should seek to enclose those patches with high economic returns, high ecological productivity, and high out-of-patch migration. These results help inform a burgeoning trend around the world to partially enclose the commons.

- Luc Doyen
  Bio-economic models and land-use for biodiversity

- Alan Hastings
  Simple spatial approaches to persistence and eradication

  I will review conditions for persistence in a spatial context, and discuss how these can be used to guide management either for eradication or persistence. I will look at systems that are either constant or vary through time. Examples will be drawn from marine systems and invasive spartina.

- Michel Langlais
  A multi-stages and multi-hosts parasite / predator-prey system within a spatially fragmented environment

  We consider a predator-prey model system for spatially distributed species over a set of N patches. Predators disperse across the fragmented spatial domain under consideration. One assumes prey do not disperse at the predator spatio-temporal scale. Predator species are heterogeneous in two ways:

  1. on a given patch a *resident predator* species is a predator species whose individuals spend most of their life and reproduce therein. These individuals become *temporary predator* species while traveling to other patches,

  2. depending on the availability of local sustainable resources one distinguishes between *well-fed* vs *starving resident predators*.

The resulting mathematical model is a continuous deterministic dynamical system made of $N^2 + N$ ODEs. Various existence and stability results for predator free, semi persistent and / or persistent predator-prey stationary solutions are discussed in simplified setting. Slow-fast dynamics are also analyzed. A specific emphasis is put on a toy-model system with three patches and two resident predator species, the third patch being occupied only by prey.

- Hugh Possingham
  Problems in land-sea conservation planning

  We will look at formulating and solving spatial conservation planning problems that cover the three realms: land, freshwater and sea. These problems have become increasingly important as land-based activities are increasingly recognized as a major threat to marine ecosystems.

- Martin F. Quaas
  Efficiency and sustainability in territorial use rights in fisheries

  The presentation introduces the concept and a few case studies of territorial use rights in fisheries (TURFs). It discusses issues of efficiency and sustainability with TURFs. In particular, a mechanism is introduced that reconciles efficiency and sustainability by means of auctioning limited-tenure use rights for a stochastic natural resource to private resource managers.

- Scott Taylor
  A spatial approach to energy economics   paper

  We develop a spatial model of energy exploitation where energy sources are differentiated by their geographic location and energy density. The spatial setting creates a scaling law that magnifies the importance of differences across energy sources. As a result, renewable sources twice as dense, provide eight times the supply; and all new non-renewable resource plays must first boom and then bust. For both renewable and non-renewable energy sources we link the size of exploitation zones and energy supplies to energy density, and provide empirical measures of key model attributes using data on solar, wind, biomass, and fossil fuel energy sources. Non-renewable sources are four or five orders of magnitude more dense than renewables, implying that the most salient feature of the last 200 years of energy history is the dramatic rise in the use of energy dense fuels.