

Institut Henri Poincaré
quarterly thematic program MABIES
Mathematics of Bio-Economics
2013, January 7 – April 5

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11 rue Pierre et Marie Curie
75006 Paris

Mathematics of Bio-Economics
January 7th - April 5th 2013
Organized by Michel De Lara and Luc Doyen

Sustainable Management of Renewable Resources
Biodiversity Scenarios Modelling
Mathematics, Ecology and Economics

Mathematics Planet Earth 2013

Workshops
Mathematics and Ecological Economics 11-15/02
Risk and Learning in Biodiversity Management 4-8/03
Spatial Management of Biodiversity 25-29/03

CIRM Marseille 8-14/04
Programme post trimester
Stochastic control for
management of renewable
energies

Programme coordinated by the Centre Emile Borel of IHP
Registration is free however mandatory on <http://www.ihp.fr>
Participation of postdocs and Ph.D. students is strongly encouraged
Deadline for financial support: June 25th, 2012

For further informations, contact Claire Bérenger mabies@ihp.fr
Scientific programme on <http://cermics.enpc.fr/~delara/MABIES/MABIES/>

Supported also by: FSMP



The MABIES final report can be downloaded here
You can load the pdf version of this web page.

IHP MABIES website <http://www.ihp.fr/en/ceb/mabies>
MABIES website <http://cermics.enpc.fr/~delara/MABIES/MABIES/>
Poster

The quarterly thematic program *Mathematics of Bio-Economics* (MABIES) takes place at Amphithéâtre Darboux, Institut Henri Poincaré, 11 rue Pierre et Marie Curie, 75005 Paris (access details).

Abstract

The quarterly thematic program *Mathematics of Bio-Economics* (MABIES 2013, January 7 – April 5) emphasizes the interfaces of mathematics with, on the one hand, ecology and, on the other hand, economics. Our ambition is twofold. We aim to show that original mathematics can be inspired by issues from ecology and from economics of sustainable development. We also intend to display to a biological and economic audience how mathematics, with their concepts and methods, can contribute to the knowledge and to the sustainable management of biodiversity. We hope to jointly identify mathematical challenges related to ecology and sustainable development.

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1 Institut Henri Poincaré and Mathematics of Planet Earth 2013

The Institut Henri Poincaré (IHP) is an institution hosting visiting scientists in an environment of collaboration and scientific innovation, and is located in Paris. Over the years since its creation in 1928, IHP has established itself as an emblematic meeting place of French Mathematics and Theoretical Physics. Countless collaborations and mathematical innovations are born every year.

The North American Mathematical Science Institutes propose that 2013 be a year of Mathematics of Planet Earth - MPE2013.

The trimester MABIES is the contribution of IHP to MPE2013.

2 Motivations

Biodiversity and ecosystems are experiencing accelerating changes with some alarming trends and largely unknown consequences. A major cause of these threats on biodiversity observed in many ecosystems is related to man's development and anthropogenic activities including fishing, agriculture or hunting. The changes in biodiversity in turn affect human activities relying on it and alter important economic commodities (typically food, energy, drugs) or services (typically tourism, pollination, carbon cycle, water cycling) provided by the biological diversity and renewable resources. As a consequence, the sustainable management of biodiversity is now questioned and has become a major issue for national and international agencies involved in their regulation (ICES, FAO, IUCN, etc.).

In this context, the IPBES (Intergovernmental Science Policy Platform for Biodiversity and Ecosystem Services), an "IPCC-like" platform launched in 2010, will play a major role to articulate the scientific knowledge on the changes and degradation of the natural world, with knowledge on effective solutions and public policies. In particular, the effectiveness of management instruments including quotas, protected areas, taxes, etc. has to be considered in both ecological and socio-economic dimensions. Thus bio-economic quantitative methods, indicators, models, management and scenario methods are needed.

The aim of the quarterly thematic program *Mathematics of Bio-Economics* (MABIES) is to foster cooperation and information interchange among those engaged in the mathematical modeling of systems related to the management of natural renewable resources and scenarios of biodiversity (marine and terrestrial). This includes specialists in control of dynamical systems, management of uncertainty and risk. Such goal requires interdisciplinary exchanges between mathematics, ecology, economics and computer sciences. Particular attention will be paid to the following applied fields: fisheries, agricultural systems, forest management, wildlife management and invasive species issues. Mathematics — by providing integrated concepts, models and methods — should favor the interactions between these applied disciplines. In particular, of interest will be the use of various methods in different mathematical domains such as optimal control, stabilization methods, viable control and invariance methods, stochastic and robust control, adaptive control, multi-criteria approaches, game theory.

3 Invited participants

- Michael Bode (quantitative ecologist, Australia) [2 March–2 April 2013]
- Carlos Castillo-Chavez (mathematician, USA) [19 February–3 April 2013]
- Christopher Costello (economist, USA)
- Michael Finus (economist, UK) [21 January–17 February 2013]
- Pedro Gajardo (mathematician, Chile) [15 January–16 February 2013]
- Eladio Ocaña (mathematician, Perú) [20 January–16 March 2013]
- Gerard Olivar (mathematician, Colombia) [7 January–5 April 2013]
- Hugh Possingham (quantitative ecologist, Australia) [10 February–30 March 2013]
- Martin F. Quaas (economist, Germany) [25 February–30 March 2013]
- Anders Skonhoft (economist, Norway) [15 January–15 February 2013]
- Tony Smith (ecologist, Australia) [26 February–5 April 2013]
- Scott Taylor (economist, Canada) [1–31 March 2013]
- Anastasios Xepapadeas (economist, Greece) [21 January – 22 February 2013]
- Georges Zaccour (mathematician, Canada) [11–15 February and 10 March–10 April 2013]

4 Organizing and scientific committees

4.1 Organizing committee

- Michel De Lara (CERMICS-École des Ponts ParisTech)
- Luc Doyen (CNRS)

4.2 Scientific committee

- Denis Couvet (ecologist, Muséum national d'histoire naturelle, Paris, France)
- Charles Figuières (economist, LAMETA, Montpellier, France)
- Bernard Cazelles (ecologist, Ecole Normale Supérieure, Paris, France)
- Michel Langlais (mathematician, Institut de Mathématiques de Bordeaux, France)
- Claude Lobry (mathematician, University of Nice, France)
- Michel Loreau (ecologist, Station d'Ecologie Expérimentale du CNRS à Moulis, France)
- Jean-Christophe Perea (economist, University Montesquieu Bordeaux IV, France)
- Katheline Schubert (economist, University Paris 1, France)
- Georges Zaccour (mathematician, GERAD, HEC Montréal, Canada)

5 MABIES Planning

The quarterly thematic program *Mathematics of Bio-Economics* has followed the path of progressively introducing mathematical concepts and methods, woven with sustainable management issues and applications. Every two week on Monday morning, the organizers delivered a course (also open to Master students), followed on the next week by a computer practical session. The theme gave the mathematical color of the two coming weeks: dynamical systems, controlled dynamics and equilibria, optimal control and sustainability, viability. During the last month, more advanced material was provided: stochastic control, game theory. Every week, but for workshops, tutorials by invited professors were programmed to provide the participants either with more specialized theoretical material or with applications in biodiversity management: fisheries, agricultural systems, forest management, wildlife management and invasive species, epidemiology. Every Friday afternoon was devoted to talks by students participants on their research topics. Three regularly spaced workshops were the opportunity for researchers to present their recent results on Mathematics of Ecological Economics, Risk and Learning in Biodiversity Management, Spatial Management of Biodiversity.

5.1 Introduction to decision modelling for the management of renewable resources [2013, January 7 - January 11]

- Monday 7, January 9h00–10h00: *Opening welcome talk* by Michel De Lara
- Monday 7, January 10h00–13h00: course by Luc Doyen
Introduction to decision modelling for sustainable management of natural resources slides
- Tuesday 8, January 9h30–11h30: conference by Christopher Costello
Overcoming the tragedy of the (spatial) commons (paper 1 – paper 2 – paper 3 – paper 4)
- Thursday 10, January 10h00–11h00: conference by Michel Loreau
Ecosystem services: key to overcoming the biodiversity crisis?
- Friday 11, January 14h00: open seminar

5.2 [2013, January 14 - 18]

- Monday 14, January 14h00–17h00: computer session by Luc Doyen
Introduction to the scientific software Scicoslab [click here](#)
- Tuesday 15, January 14h00–17h00: tutorial by Gerard Olivar
Introduction to dynamical systems slides
- Wednesday 16, January 14h00–17h00: tutorial by Gerard Olivar
Bifurcations in dynamical systems slides

- Friday 18, January 14h00: open seminar
Non-linear phenomena in socio-economical systems with natural resource management,
Jorge A. Amador (PhD Candidate, Universidad Nacional de Colombia, sede Manizales)

5.3 **Controlled dynamics and equilibria** [2013, January 21 - 25]

- Monday 21, January 9h00–12h00: course by Michel De Lara
Controlled dynamics and equilibria slides
- Tuesday 22, January 9h00–12h00: conference by Anastasios Xepapadeas
Controlled spatio-temporal dynamics of resources slides
- Wednesday 23, January 14h00–16h00: conference by Anders Skonhoft
MSY MEY in bio-economics and their extension to class-structured population or metapopulations slides
- Thursday 24, January 10h00–12h00: conference by Bernard Cazelles
Nonlinearity and nonstationarity in population dynamics (ecology and epidemiology)
slides
- Friday 25, January 14h00: open seminar
Kate Helmstedt (PhD Candidate, the University of Queensland, Australia)
Christopher Severen (PhD Candidate, University of California, Santa Barbara, USA)

5.4 [2013, January 28 – February 1]

- Tuesday 29, January 10h00–12h00: tutorial by Pedro Gajardo and Eladio Ocaña
Introduction to optimization slides 1 slides 2
- Wednesday 30, January 15h00–18h00: computer session by Michel De Lara
Equilibria and Stability in the Management of a Renewable Resource [click here](#)
- Thursday 31, January 10h00–12h00: Room 314, conference by Michael Finus
Analysing international environmental agreements: approaches and equilibrium concepts slides.pdf slides.pptx references.pdf slides.docx
- Friday 1, February 14h00: open seminar
Ecosystem Based Fisheries Management of Northern Bay of Bengal, India, Sachinandan Dutta (Jadavpur University, Kolkata, India)

5.5 **Optimality and sustainability** [2013, February 4 - 8]

- Monday 4, February 9h00–12h00: course by Michel De Lara
Optimality and sustainability slides

- Wednesday 6, February 14h00–17h00: tutorial by Pedro Gajardo
Optimization, sustainable indicators and application to the design of a recovery program for overexploited fish species summary slides slides
- Thursday 7, February 14h00–17h00: tutorial by Mabel Tidball
Sustainability criteria: between efficiency and equity slides
- Friday 8, February 14h00: open seminar
Viability and resilience for fisheries in Salomon Islands, Pierre-Yves Hardy (PhD candidate, MNHN)
Kunal Chakraborty (Indian National Centre for Ocean Information Services, Hyderabad, India)

5.6 **Workshop Mathematics of Ecological Economics** [2013, February 11 – February 15]

- Workshop Mathematics of Ecological Economics webpage
- Friday 15, February 14h00: open seminar
Fleet diversity is a double-edged sword in fisheries,
Matthew G. Burgess (PhD Candidate, Department of Ecology, Evolution and Behavior University of Minnesota, USA)

Kunal Chakraborty (Indian National Centre for Ocean Information Services, Hyderabad, India)
(Note ! Room 01 on Ground floor)

5.7 **Viability** [2013, February 18 -22]

- Monday 18, February 9h00–12h00: course by Luc Doyen
Viability
- Tuesday 19, February 14h00–17h00: tutorial by Hugh Possingham
Optimal monitoring
- Thursday 21, February 14h00–17h00: tutorial by Eladio Ocaña
Applications of viability theory in fisheries management
- Friday 22, February 14h00: open seminar

5.8 [2013, February 25 – March 1]

- Wednesday 27, February 9h00–12h00: tutorial by Hugh Possingham
Problem formulation in conservation decision making

- Friday 1, March 9h00–12h00: tutorial by Carlos Castillo-Chavez
Disease dynamics slides
- Friday 1, March 14h00: open seminar
The Economics of Ecosystems and Biodiversity (TEEB),
Andrea Kaim (student, University of Leipzig)
Rocket Science and Strategic Decision Concepts for the Management of Biological Populations,
Professor B. S. Goh (Curtin University Sarawak, Malaysia)

5.9 Workshop Risk and Learning in Biodiversity Management [2013, March 4 - 8]

- Monday 4, March, 9h00–12h00: course by Michel De Lara
Uncertainties and sustainable decision-making slides and slides
- From Monday 4, March, 14h00 to Wednesday 6, March, 13h00: Workshop *Risk and Learning in Biodiversity Management* webpage
- Thursday 7, March 14h00–17h00: special afternoon
Optimization, smart grids and renewable energies
 - 14h00–14h45: Michel De Lara
Smart Power Systems: the Optimization Challenge slides
 - 14h45–15h30: Pierre Girardeau
The value of smart grids from the optimizer's viewpoint
Maxime Chammas
A multi-scale optimization model to assess the benefits of a smart charging policy for electrical vehicles
 - 15h30–16h00: coffee break
 - 16h00–16h15: Laurence Grand-Clement and Antoine Nogier
Optimizing a pumping station to store wind and solar energy
 - 16h15–16h30: Michel De Lara
presentation of the CIRM School *Stochastic Control for the Management of Renewable Energies*
 - 16h30–17h00: roundtable and discussion
- Friday 8, March 14h00: open seminar
When do ecosystem services provide an economic incentive to protect biodiversity?,
Laura Dee (PhD Candidate, Bren School of Environmental Science & Management,
University of California, Santa Barbara)
Quantifying biting rates of Trypanosoma cruzi infected triatomine vectors on sylvatic

hosts,

Kamuela E. Yong (Postdoctoral Research Associate, Arizona State University, Mathematical, Computational & Modeling Sciences Center (MCMSC), School of Mathematical & Statistical Sciences (SoMSS))

5.10 **Game theory, coordination, strategic interactions and trade** [2013, March 11 -15]

- Monday 11, March, 9h00–12h00: tutorial by Jean-Christophe Pereau
Game theory and renewable resources management
- Monday 11, March, 14h00–17h00: tutorial by Scott Taylor
Trade and Renewable Resources: An Introduction to the Three Core Hypotheses slides
- Thursday 14, March, 9h00–12h00: tutorial by Martin F. Quaas
Consumer preferences for seafood diversity and multi-species fisheries
- Thursday 14, March, 14h00–17h00: tutorial by Georges Zaccour
Differential games and environmental applications slides
- Friday 15, March 14h00: open seminar
The socio economic impact of forest certification in the Congo Basin,
Jonas Ngouhou Poufoun (PhD Candidate, Laboratory of forest Economics, Nancy, The University of Lorraine, the University of Yaoundé 2)

5.11 **Ecosystems and biodiversity indicators** [2013, March 18 – March 22]

- Monday 18, March, 14h00–17h00: tutorial by Tony Smith
New strategies to support biodiversity management and sustainable fisheries
- Tuesday 19, March, 9h30–12h00: tutorial by Hugh Possingham
Two tools: Information-gap theory and the Gini coefficient in Natural Resource Management
- Tuesday 19, March, 14h00–17h00: tutorial by Charles Figuières
Biodiversity indicators, decision-making and conceptual premisses slides
- Thursday 21, March, 9h00–12h00: tutorial by Carlos Castillo-Chavez
Indicators in epidemics control (to be confirmed)
- Thursday 21, March, 14h00–16h00: conference by Jianhong Wuz
Decision systems and geo-simulation tools for infectious disease spread: contributions to the prevention and control of H5N1 outbreaks
- Friday 22, March 14h00: open seminar (exceptionally in room 314)

5.12 Workshop Spatial Management of Biodiversity [2013, March 25 - 29]

- From Monday 26 to Tuesday 27, March: Workshop *Spatial Management of Biodiversity* webpage

5.13 [2013, April 1 - 5]