Course

Qualitative Mathematical Modelling for Socio-Ecological Systems

Jeffrey Dambacher, 24th to 28th of February 2020

Institute of Marine Science (ICM-CSIC)
Passeig Maritim de la Barceloneta, no. 37-49. Barcelona, Spain
Assisted by Marta Coll and Vanessa Stelzenmüller

About the course

Qualitative mathematical modelling will be introduced as a means to understand and predict the dynamics of complex biological and socio-economic systems.

The technique poses the question: if all we know of a system is the general nature of the relationships between species and environmental or human variables, but not the precise intensity of these interactions, then what do we know?

It turns out that we know not everything, but quite a lot. Qualitative mathematical modelling describes complex systems through only the sign $(0, +, -)$ of the effect or interaction between variables, and thus can easily include variables and processes that are important, yet difficult to measure.

Calculations of system stability and predictions of perturbation response proceed through analysis of the feedback properties of a system.

While model predictions are imprecise, there are nonetheless rigorously derived and readily testable.

This approach leads to many interesting, practical, multidisciplinary, and surprisingly overlooked applications to complex dynamical systems. Coursework will be divided between lecture and use of modelling software (provided); students will need access to computer laptops (or share with a partner) and at times will work in groups on applied problems.

Topics covered in the course include:
- Introduction, history and philosophy
- Derivation of community (Jacobian) matrix & defining relevant subsystem
- Modified (nonlinear) interactions & split variables
- Model building examples (Yellowstone Park wolves & urchin barrens)
- Press perturbation analysis
- Socio-economic & biophysical systems
- Qualitative measures of Lyapunov stability
- Predicting change in life expectancy
- Application to Bayes nets

Presented by Dr. Jeffrey Dambacher

Jeff's background was originally in the ecology of stream fishes. A desire to understand the complex relationships of fish communities, rivers and watersheds led him to the method of qualitative mathematics as a tool to address complex systems. With CSIRO this work has been expanded to address problems of integrated monitoring and management of socio-ecological systems such as the Great Barrier Reef, marine ecosystems of Australia's exclusive economic zone, Mediterranean fisheries and aquaculture systems in Tasmania, Chile and France.

Course fees

This course is part of the COST Action 15121 'Advancing marine conservation in the European and contiguous seas' (MarCONS) and is **free of charge**.

A limited number of trainees **can be financially supported** by the MarCons Action Cost with a maximum of 600 euros /each.

Participant from a **COST country** can apply for the support: https://www.cost.eu/who-we-are/members/

How to register to the course?

Due to the practical and 'hands-on' nature of this event, the number of participants will be **limited to 20**.

Participants will be selected based on their motivation to attend. The course is open to PhD students, early career and senior researchers from a marine science discipline, providing that their research is related to coastal and marine research.

Please complete the questions below in the **Registration Form** and send them, along with a **short CV** (in English, two pages maximum) to Marta Coll (mcoll@icm.csic.es, marta.coll.work@gmail.com) by **15ᵗʰ December 2019**. Results of the selection will be available by 31st December 2019.

Registration Form
Background
Name:
Email Address:
Institution and country:
Nationality:
Gender (male/female/prefer not to specify):
Year PhD completed:
Affiliation to networks and associations (e.g. MarCons):
Selection criteria
Please describe your research area and interests (100 word max).

Please describe your motivation for attending (100 word max.).
Please outline any previous experience or training that you have had in relation to the course.
Financial
Limited funding support is available to support travel and local expenses. If you wish to apply for funding support, please indicate the amount requested (in Euro) and a justification for this request.

Please note that all information requested in this application will be treated confidentially.