Retreat on Mathematical Ecology and Evolution

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Objectives

The aim of the 2-day BIRS retreat was to bring together faculty, post doctoral fellows (PDF) and graduate students from several groups that are involved in the *PIMS Collaborative Research Group in Mathematical Ecology and Evolution*. The six organizers nominated one PDF and four students from their corresponding research groups to participate in this retreat. The format of the workshop was chosen primarily to initiate discussion, promote exchange of ideas, and encourage collaborations. Each student and some of the PDFs were asked to bring a new and open research problem and present it to a working group of about 8 participants to discuss and work on each problem for about 2 hours. The faculty members of each discussion group guided the discussions so as to encourage students to participate and express their ideas. Although complete solutions of the problems were not expected, progress on the problems was made, while introducing the students to new mathematical approaches to problem solving and science.

The format of the workshop was based on the very successful Woods Hole Oceanographic Institute (WHOI) Nantucket Annual Retreat in Mathematical Ecology, run by WHOI scientists Hal Caswell and Mike Neubert.

Scientific Topics

The topics of this 2-day retreat were exclusively chosen by the students through their contributed research problems. These included questions about predator-prey interactions, harvesting problems, competition, invasion problems, pattern formation, infectious diseases, crop control, fish behavior, and climate change. During discussion many different forms of models were considered: stochastic models, random walks, ordinary differential equations, partial differential equations and integro-differential equations. Most of the problems were concerned with spatial distribution of species and hence a partial differential approach seemed natural.

In many cases the use on integro-differential equations (IDE) was discussed. This confirmed the need for a more theoretical understanding of IDEs. The theory of IDEs is still not as nearly developed as the theories for reaction-diffusion equations, for example. Almost all of the participating groups of the *PIMS CRG in Mathematical Ecology and Evolution* have published research papers about IDE's, are currently working with IDE's, or have used them for modeling. In fact, the theoretical understanding of IDEs seems to be one of the common grounds of this CRG.

Through the discussion of different problems and different modeling tools the students were exposed to a large variety of methods and solution strategies. For all of the discussion groups, several possible model ideas were generated. In many cases a stochastic model was contrasted with a continuous deterministic model and/or with a discrete time model. This showed the students that, in general, there is not a single correct

model that must be used, but there maybe many models of very different types that could be used to describe a biological phenomenon. This insight made the students aware to look beyond their own area of expertise and to be open to new methods and ideas. Each participant contributed his knowledge and experiences to the workshop and benefited greatly from each other.

Outreach

The format of the workshop created an intense interactive atmosphere and supported the exchange of ideas between the involved PIMS University groups on all levels (faculty, PDFs, graduate students). The 2-day retreat strengthened the collaborations between Ed McCauley at (U. Calgary) and M. Lewis (U. Alberta) on the modeling of water ecosystems, and many visits took place during the past year. Another collaboration developed between M. Doebeli (UBC), T. Hillen (U. Alberta) and F. Lutscher (U. Calgary and U. Alberta) on the evolution of biodiversity.