The 6th Leading Seminar Report

Date: November 21, 2013, 14:30–16:00

Venue: Lecture Hall

Number of participants: 62

Student organizer:

- Mohamed Moustafa (Laboratory of Wildlife Biology and Medicine, DC2)

■ Seminar title: A community ecology perspective on co-infection in fluctuating rodent populations

Lecturer: **Prof. Xavier Lambin**

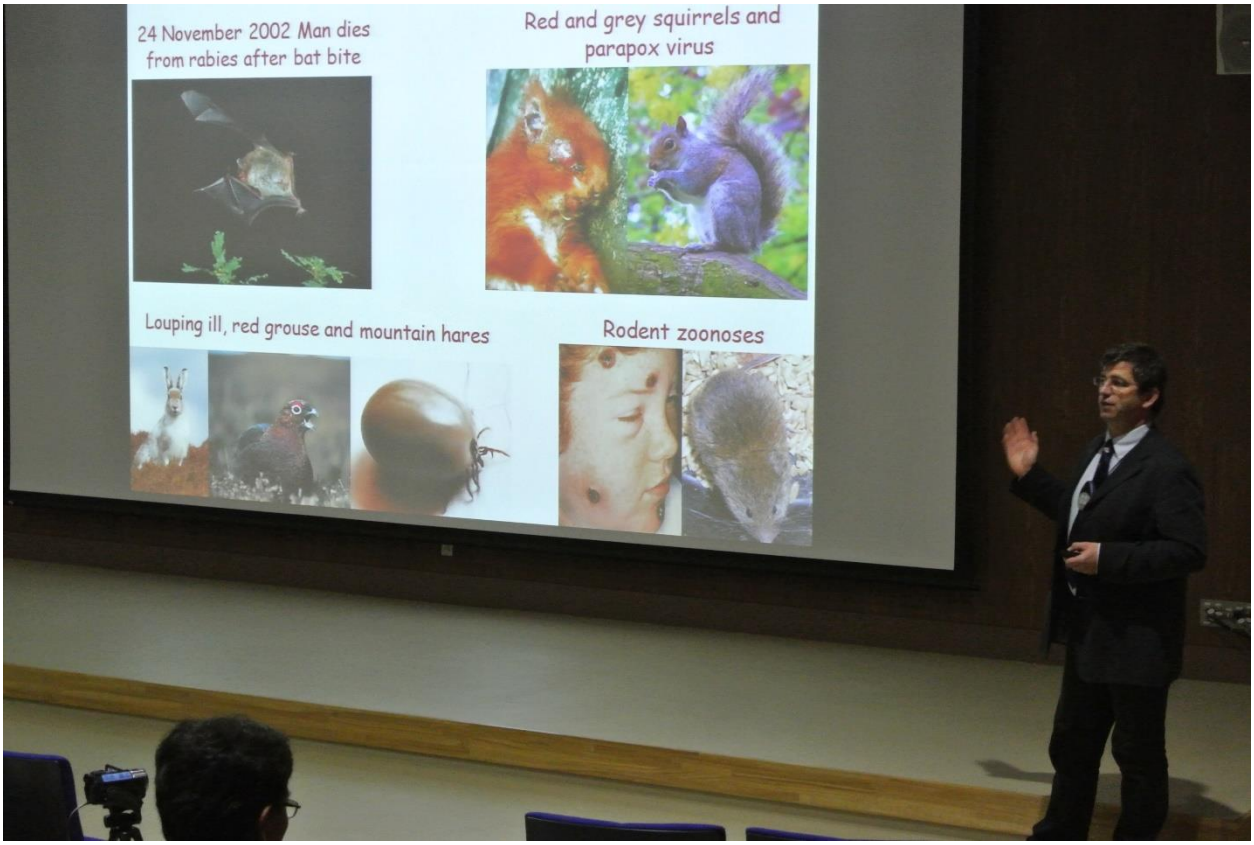
School of Biological Sciences, the University of Aberdeen

Abstract:

Understanding the reciprocal relationships between the fluctuations in space and time in the size of animal populations and the prevalence of pathogens is both a key goal in population ecology and in attempts to predict the risk from zoonotic diseases. The prevalence of multiple zoonotic agents in populations and that of co-infections by multiple pathogens within hosts may vary dramatically according to the dynamics of their host, the makeup of vector and alternative host communities and the degree of connectivity of host populations. In this talk, I apply a community ecology perspective to the dynamics of co-infection, and draw on several empirical and theoretical studies conducted with collaborators using rodent populations as model systems. Our basic approach has been to assemble time-series data from individual field vole *Microtus agrestis* hosts, typically sampled monthly, in natural populations to analyze patterns of infection risk for a micro-parasite community consisting of cowpox virus, *Babesia microti*, *Bartonella* spp. and *Anaplasma phagocytophilum*, as well as their tick and flea vectors. Micro-parasite infection was assessed by serology for cowpox and PCR for the remainder. Field vole populations fluctuate multi-annually and densities span 20 to 750 voles/ha. A separate study uses water vole *Arvicola amphibius* with a metapopulation structure and that live in small colonies of 2-15 individuals at much lower densities of 4-5 individuals/km^2. The focus here is on elucidating spatial patterns of infection by the same pathogens as above, and on the occurrence of different scale of dispersal limitation that may constraint the composition of pathogen assemblages in metacommunities. The dynamics of many pathogens of field voles had a seasonal component as well as being influenced by variation in current or past density. There was strong evidence that communities of micro-parasites were structured by strong interactions between species, with the risk infection depending on both the probability of encountering an infectious dose and host susceptibility which was strongly influenced by other

micro-parasites. There were large positive and negative effects of other infections that were often of greater magnitude than the effects sex or season more commonly considered. The most likely explanation for these effects is that interactions between these microparasites within individual hosts, some immune mediated, have a large impact on host susceptibility. Our study with *Anaplasma phagocytophilium* (AP) revealed hitherto cryptic diversity and associated vector specificity in this zoonotic agent. We found that rather than acting as a bridging vector transmitting AP from field voles and shrews (*Sorex araneus*) to deer and potentially human hosts, larvae and nymphs of the tick *Ixodes ricinus* often feed on field voles, but do not acquire or transmit the variant of AP that infects small mammals. Thus AP transmission in a multi-vector system consists of two discrete but co-existing transmission cycles one "variant" of AP variant is maintained in a natural cycle involving larger mammals and *I. ricinus* another "variant" of AP is maintained in a natural cycle involving small mammals and *Ixodes trianguliceps.* Here co-infection is precluded by vector specificity.A different scenario plays out in fragmented landscapes and metapopulations where not all patches colonized by a host may be reached by their parasites and a critical community size may not be reached in habitat patches with few hosts. Starting with ticks and fleas, we found that the distribution of 3 out 5 ecto-parasites depended on vole spatial distribution within neighborhood at different scales constrained what ecto-parasite species assemblages became established in transiently occupied water vole colonies. Only a subset of these became infected by each vector and only a subset of these was infected by *Babesia microti* and/or *Bartonella*. In addition, colony size either amplified or diluted the risk of infection for flea or tick borne micro-parasites respectively. These examples illustrate the ecological complexity that underlies patterns of infection and co-infection in natural populations. As new studies rapidly accumulate, it is opportune to formulate testable

hypotheses on how individual-level, environmental and spatial influences contribute to shape parasite communities at different scales.



■ Questions and Answers (partially paraphrased)

Q1: Do the pathogens, which are involved in co-infection, cause mortality or they are not pathogenic in this study?

A1: We only studied cowpox and we found that it causes 20% decline of animal population.

Q2: Why does co-infection occur in animal populations?

A2: Some pathogens such as Cowpox decreases the fitness of the animals when it infects them and that will lead to a decrease in their immune response against other pathogens.

Q3: How did you know which pathogen infected the animal first during the study of co-infection?

A3: By examining for the previous infection then re-examining the same animals for the second infections so that we could know which infection occurred first.

Comment from the organizing student:

Mohamed Moustafa (Lab. Wildlife Biology and Medicine, DC2)

The invitation of Professor Xavier Lambin was like a dream that came true. When I knew about the program of leading seminar, I did not imagine that I would be selected for the 6th leading seminar to invite Professor Lambin. I have gained a lot of experience out of this event. From the first few minutes after we met at the airport, Professor Lambin started asking me about my research and provided me with valuable advices. He is a very friendly person that he could break the ice so early with my laboratory colleagues and me. Because Professor Lambin has great experience about wildlife medicine, ecology and biology, he could provide us all

with great ideas about our researches. His short stay at Sapporo made his schedule full with our scientific consultations and discussions.

I really appreciate the effort that been given by the school to make such event possible. As an international student, every day I learn a new skill here. This program is really doing a great job in teaching us the moral of collaboration and teamwork. I am so happy that I had the opportunity to join this program and to study in our prestigious school, not only because of the high quality education I receive here, but also because it feels like I am attaching to several cultures and different study systems from around the globe.

Thanks!

Photographs

- **Nopporo forest field trip**

The 6th Leading Seminar





- Discussion session.


- The seminar.

The 6th Leading Seminar

- Group photo with Professor Xavier Lambin.