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Evolving immunity, across fast to slow life-cycles

C. Jessica E. Metcalf ([Homepage](#))

Department of Ecology and Evolutionary Biology, Princeton University, USA

Abstract: Pathogens shape host mortality patterns across the tree of life. Immunity is the key line of defense against pathogens, and is thus under strong selection. To date, a rich body of work has considered how much of a hosts' limited resources should be allocated towards immunity as opposed to other fitness components such as reproduction. Relatively little work has addressed the fact that a functioning immune system is both fundamentally dynamic, and fundamentally dangerous, and that its impact plays out in a context of varying life-spans, age varying fertility and age varying infection risk. Framing the question of immune evolution in this context yields new insight into evolution of maternal immunity and immune discrimination, and how this is modulated by both host and pathogen life history.

Biography: Jessica Metcalf is a demographer and evolutionary biologist who uses a combination of mathematical and statistical models and data to explore patterns and outcomes in natural populations. Her work has ranged from disentangling evolutionary drivers of timing of flowering in monocarpic plants, to evaluating the evolutionary drivers of maternal immunity and the evolution of immune discrimination.

Unravelling the coevolution of pregnancy and immune defence

Olivia Roth ([Homepage](#))

GEOMAR Helmholtz Centre for Ocean Research Kiel (Evolutionary Ecology of Marine Fishes Research Group: Parental Investment and Immune Dynamics), Germany

Abstract: Pregnancy has evolved in most vertebrate groups as the most extreme reproduction strategy. Its evolution required drastic changes of the body anatomy and genomic reorganisations. One of the key adaptations is the tolerance of the embryonal non-self tissue in the womb. In mammals gene expression changes in the immune system are associated with pregnancy and placentation. Within teleosts, the most basal groups of vertebrates, we find one remarkable group of fishes, the syngnathids (pipefishes and seahorses), displaying a gradient from external fertilisation to two different forms of full pregnancy. Equally unique in this group is that males are the pregnant sex. We deduced the genetic basis of trait loss and gain required for pregnancy evolution. In contrast to immune modulation displayed by mammals, suppression of the embryonal rejection in syngnathids is realized by progressive loss of key genes of the adaptive immune system. This reveals that evolution has taken multiple routes to achieve the goal of immunological tolerance.

Biography: Olivia Roth studied at the University of Basel and did her PhD at the ETH in Zurich in 2009. She did a postdoc at the GEOMAR Helmholtz Centre for Ocean Research in Kiel where she has her independent Junior Group since 2012. Olivia Roth's research focuses on the evolution of parental investment, sex, immunity and host-microbe interactions. Currently she aims to understand the coevolution of (male) pregnancy with the immune system and the microbiota.

Does host-parasite coevolution generate genetic diversity?

Dieter Ebert ([Homepage](#))

Universität Basel, Zoological Institute, Basel, Switzerland

Abstract: Hosts evolve to minimize the fitness reduction caused by parasites, while parasites optimise the exploitation of their hosts. In models of this process high genetic specificity in host – parasite interactions is assumed. These interactions are in the centre of theory of host – parasite coevolution and determine important aspects of the coevolutionary process, such as its tempo and mode, the occurrence of cyclic allele frequencies, and the potential for evolutionary novelty. They are also crucial for the consequences of coevolution, such as the maintenance of sex and of genetic variation. In my presentation I will test predictions about phenotypic and genetic diversity at resistance loci in the crustacean *Daphnia*, interacting with a bacterial pathogen. Our data from a world-wide collection of population samples are in strong support of balancing selection at resistance loci, matching predictions of elevated levels of genetic diversity at these loci.

Biography: Ebert pursued his undergraduate studies in Munich, Germany and at the University of South Alabama, USA. He received my PhD with Stephen Stearns at Basel University in 1991, followed by research stays in Russia and Panama (STRI) and two postdocs in the UK with William (Bill) Hamilton and John Lawton. From 1996 he was assistant professor at Basel University and from 2001 professor at Fribourg University, Switzerland. In 2004 he returned to Basel University as chair of Zoology and Evolutionary Biology. Ebert's interest is in microevolution, with emphasis on rapid evolutionary change. Most research of his group focuses on the evolution of host-parasite interactions, using *Daphnia*, bacteria (including microbiota) and microsporidians as study systems. Central to this work is the link between phenomena observed in the field and the elucidation of the evolutionary mechanisms behind them. This work includes ecological, evolutionary and genomic approaches.

Frightful flyers: How to deal with mosquitoes carrying emerging viruses?

Carla Saleh ([Homepage](#))

Institut Pasteur, Paris, France

Abstract: In recent years, we have witnessed an alarming increase in deadly virus transmission from mosquitoes to humans. For example, it is predicted by the WHO that about half the population of the world is now at risk for diseases such as dengue fever. Insects have an immune system that allows them to remain asymptomatic when they are infected with a virus that is deadly when transmitted to humans. How is this possible and how does this immune system work? Can we remodel this insect immunity to protect humans from devastating insect-borne viral diseases? The mission of the Saleh Lab is to search for a new way of eliminating the transmission of viral infectious disease from insects to humans. Many scientists are trying to understand the way that diseases spread or how viruses can be altered to transform them into safe vaccines. We have chosen an alternate approach, to redefine immunity. Our goal has been and is to understand the intricate relationship between the immune system of infected insects and the viruses in order to control it. The approach we use to tackle the problem is interdisciplinary and multidisciplinary: experimental viral infections are performed on *Drosophila melanogaster*, for which there is powerful genetics, and the mechanisms identified are then validated in mosquitoes; concepts and techniques are from classical and molecular virology, immunology, biochemistry and cell biology; next-generation sequencing and state-of-the-art bioinformatics tools are also applied. We believe, therefore, that our scientific strategy offers new perspectives on emerging viral disease transmission and will inspire a new way of thinking about immunity.

Biography: Maria Carla Saleh was born in Argentina, where she finished her Masters degree in Biology at the National University of Cordoba. She obtained her PhD on Cellular and Molecular Physiopathology at the University of Paris 6, and then went to United States, where she worked as a postdoc at UCSF focusing on insect antiviral immunity. In 2008, she secured a position as a junior group leader at the Institut Pasteur of Paris and was tenured in 2013. Carla Saleh's research dissects the immune system of insects to answer how they remain asymptomatic while being infected with viruses that are deadly when transmitted to humans, and how to manipulate this immune system to prevent transmission of viruses to humans from insect bites. With her team, she develops a unique combination of basic science and bioinformatics that allow them to tackle several projects in ill-studied areas of insect antiviral immunity, host-pathogen biology and emerging viral disease transmission.

Updated*: From functional ecology to human risk of infection: Examples around tick-borne diseases in Belgium and Norway

Sophie Vanwambeke ([Homepage](#))

Université catholique de Louvain, Belgium

Abstract: The spatial distribution and prevalence of tick-borne diseases are influenced by environmental conditions. Understanding the environmental determinants of the presence or incidence of these diseases is valuable as it may allow more efficient control and forecasting, in particular in the current context of global environmental change. We will see how a resource-based habitat concept can help us frame existing and new models by making better use of existing data, formalizing hypothesis, and structuring existing knowledge. We will draw examples from ongoing research on Norway and Belgium.

** Unfortunately Sarah Reece University of Edinburgh, UK, had to cancel her talk "Once upon a time: The role of circadian rhythms in malaria infection". We are grateful that Sophie Vanwambeke from Université catholique de Louvain, Belgium steps in on short notice!*

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