International Conference on Ecological Sciences



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SYMPOSIA – Sfecologie 2018, International conference on Ecological Sciences

Title of symposium

All You Can Eat: Perspectives in Nutritional Ecology

Main organizer of the symposium

KOUSSOROPLIS Apostolos-Manuel, LMGE, CNRS UMR 6023-Université Clermont Auvergne, Clermont-ferrand, France ; Groupe de Recherche en Ecologie Trophique (GRET), GDR-CNRS 3716

Co-organizers of the symposium

DANGER Michael, LIEC, CNRS UMR 7360 - Université de Lorraine, Metz, France ; Groupe de Recherche en Ecologie Trophique (GRET), GDR-CNRS 3716
LEFEBVRE Sébastien, LOG, CNRS UMR 8187 - Université de Lille 1, Lille, France ; Groupe de Recherche en Ecologie Trophique (GRET), GDR-CNRS 3716

Session description

Nutrition is the cause of trophic fluxes and a primary driver of population dynamics, geographical distribution as well as temporal patterns of activity for many animals. The match between the nutritional supply of prey and the nutritional demands of consumers controls the structure and function of food webs. The field of nutritional ecology has evolved from numerous disciplines that work at different levels of biological organization, from animal physiology, plant defense, foraging ecology, population and community ecology, ecosystem ecology and biogeochemistry. Because of its diverse origins, nutritional ecology remained for a long time rather heterogeneous and segmented into several conceptual frameworks. Each of them, depending on the organization level or the biome of focus, considers different nutritional currencies ranging from (**i**) quantities or ratios of selected elements [C (carbon), N (nitrogen), P (phosphorus)…], (**ii**) essential biochemical [PUFA (Polyunsaturated fatty acids), Sterols, EAA (Essential Amino Acids)] to (**iii**) macronutrients (i.e. carbohydrates, lipids, proteins) and (**iv**) secondary metabolites. Recently however, efforts to bridge the different conceptual frameworks of nutritional ecology have emerged opening a wide field of new perspectives. This symposium, organized by the GDR-CNRS 3716 "Groupe de Recherche en Écologie Trophique (GRET)", aims to bring together experts of the

different frameworks that will give an overview of each field and their common perspectives of understanding and modeling consumer fitness in nutritionally complex environments.

Speakers

Talk 1. DANGER Michael, LIEC, UMR 7360 CNRS, Université de Lorraine, Metz, France
Groupe de Recherche en Ecologie Trophique (GRET), GDR-CNRS 3716
michael.danger@univ-lorraine.fr

"Thirty years of Ecological Stoichiometry: recent conceptual changes and research perspectives"

Ecological stoichiometry (ES) is a unifying conceptual framework that focuses on how proportions of elements affect organisms and ecosystems. At the beginning, ES mainly relied on three central assumptions: 1) each species - or population of a species – exhibit a singular elemental composition (e.g. C:N:P ratio), 2) metazoans are able to maintain a relatively strict elemental homeostasis and 3) chemical elements are neither created nor lost during ecological interactions. A central tenet of ES is that elemental imbalances between resources and the requirements of organisms determine properties and drive ecological processes at all levels of biological organization, ranging from ecophysiology to population and community dynamics to ecosystem processes. Since the publication of the ES book of Sterner and Elser in 2002 [1], many studies have confirmed numerous aspects of the initial framework, leading to original and important breakthroughs in ecological sciences. On the other hand, several aspects of the initial assumptions have been seriously questioned. My presentation will first focus on the main changes that must be applied to the initial ES concepts and their implications for ES research. In particular, organisms elemental ratios do not systematically give good proxies of organisms elemental requirements, and strict homeostasis cannot be generalize to all taxa. Consumers are also often far more selective than initially considered, and resource stoichiometric heterogeneity has too long been neglected. I will then briefly discuss what I consider as key findings that occurred in the past few years. First of all, while most ES studies primarily focused on elemental limitations, elemental excess might require particular attention, especially in the context of global eutrophication. Then, while initially applied to lacustrine herbivores, ES concepts are now more widely applied, in very diverse ecosystems and on very diverse taxa or trophic guilds. Finally, the importance of other interacting limiting factors (e.g. essential biomolecules such as some fatty acids or amino acids), is increasingly acknowledged. Far from being exhaustive, this presentation is aimed at demonstrating that ES is an important and powerful, but fast evolving conceptual framework. This discipline offers huge perspectives of work, and would clearly benefit from the inputs of other scientific disciplines.

Talk 2. WACKER Alexander, Theoretical Aquatic Ecology and Ecophysiology, University of Potsdam, Germany
alexander.wacker@uni-potsdam.de

“Co-limitation in action: how nutritional traits affect individual performance, populations and communities”

My presentation focuses on the impact of nutrition constraining the energy and nutrient flow in (aquatic) food webs. By using a fruitful interplay of fieldwork, laboratory experiments and modelling, I show how nutritional traits such as the composition of minerals, fatty acids, and sterols of phyto- and zooplankton affect individual performance, populations and diverse communities. I will give examples how phytoplankton functional traits such as their defense and biochemical composition can drive consumers into resource co-limitation (simultaneous limitation by two or more resources). Furthermore, I will explain causal links between species diversity and consumer performance, and why the distribution of functional traits among species is highly decisive for their coexistence.

Talk 3. ARGANDA CARRERAS Sara, Área de Biodiversidad y Conservación, Universidad Rey Juan Carlos, Madrid, Spain
sarijuela@gmail.com

“Geometrical framework applied to ant nutrition”

Feeding the adequate amount of the appropriate nutrients is fundamental to ensure vital functions in all organisms. And this is not an easy task: organisms need to find the nutrients—most of the time in complex mixtures with others—and simultaneously eat them at the correct proportion. In addition to these complications, the nutritional needs of an individual change over time and might also enhance some functions while depressing others. The nutritional geometry framework is an integrative approach that allows studying the nutritional regulatory strategies of organisms, even of groups of organisms. In this regard, the study of social insects adds an additional challenge: while individuals in solitary species deal only with their own individual needs, social insect colonies must satisfy those of all their members through the action of a small proportion of them (the foragers). In this talk, I will present the advances that the geometrical framework has produced in the study of communal nutrition in ants and how ants can help us better understand widespread effects of nutritional imbalances.

Talk 4 : KOUSSOROPLIS Apostolos-Manuel, LMGE, UMR 6023 CNRS, Université Clermont Auvergne, Clermont-Ferrand, France ; Groupe de Recherche en Ecologie Trophique (GRET), GDR-CNRS 3716
a-manuel.koussoroplis@uca.fr

“Feeding in fluctuating nutritional environments”

Consumers face the challenge of feeding within highly variable environments both in terms of nutrition and abiotic factors (e.g. temperature). Understanding how this understudied variance in nutritional quality and other factors affect physiological performance is central in aquatic ecology and ecology in general. I will present a novel theoretical framework on how the effects of the variances of multiple factors, and even more importantly, how the

covariance among the different fluctuating factors can be addressed. The framework opens new perspectives for (1) predicting the performance of consumers in nutritionally fluctuating environments, (2) understanding the effects of environmental grain and (3) detecting potential adaptations to dietary variability.

Talk 5. PECQUERIE Laure[1] & LEFEBVRE Sébastien[2,3]
[1]LEMAR UMR 6539, UBO, CNRS, IRD, Ifremer, Plouzané, France
[2]LOG, UMR 8187 CNRS, Université de Lille 1, Lille, France
[3]Groupe de Recherche en Ecologie Trophique (GRET), GDR-CNRS 3716

"Trophic Ecology and Dynamic Energy Budget (DEB) theory: concepts, recent developments and perspectives"

Dynamic Energy Budget theory aims to specify commonalities underlying metabolic organization for all life. The standard DEB model is the simplest non-degenerated model implied by the theory. It considers a single type of food (and a single reserve), and describes how variations in temperature and food density impact growth, development and reproduction of an animal, throughout its life cycle. The conceptual framework this theory provides allowed recent developments, key to the field of trophic ecology. Diet reconstruction, prey selection and isotopic dynamics are examples of these applications.

Homeostasis and stoichiometry being pillars of DEB theory, a recent review (Sperfeld et al. 2017) showed how this theory could bridge Ecological Stochiometry and Nutritional Geometry, the current predominant frameworks addressing nutritional ecology. Further developments of multi-reserve DEB models could provide powerful tools to predict how animal nutrition influences individual and trophic interactions in food webs. Ecotoxicology also being one of the key domains of applications of DEB theory, this framework also opens new perspectives for trophic ecology studies in disturbed environments.