International Institute for Applied Systems Analysis

IIASA

FAS research

Welcome to the 6th Viennese Talks on Networks & Resilience

Principles for Resetting a Post-Corona World

Vienna | 07.04.2021

Today´s Agenda

14:00 – 14:25	**Key Note** *The 'transformability' aspect of resilience* – **I. Darnhofer**
14:25-15:55	**Session 1: 4x15min Talks + 30min Discussion**
	Ecological Principles and Network Mutualism– **B.D. Fath** *Network Synergism: Ecology's Invisible Hand?*– **B.C. Patten** *Window of Vitality: A Robust World has Trade-Offs*– **R.E. Ulanowicz** *Is Most always Best? The Dynamics of Ecosystem Integrity and Services vs. Resilience and Adaptability*- **F. Mueller**
	Discussion – Chair **U. Scharler**
15:50-16:00	**Break**
16:00-17:40	**Session 2: 4x15min talks + 30min Discussion**
	Openness Management - Between Construction, Destruction and Re-Construction– **S.N. Nielsen** *What Ecological Principles can say about Sustainability*– **S. Bastianoni** *The Game of Possibilities for Sustaining Coastal Ecosystems under Global Climate Change*– **J.C. Marques** *Applying Ecosystem Principles on Designing Innovation Ecologies* – **H. Katzmair**
	Discussion – Chair **F. Morandi**
17:40-18:00	**Summary & Closing Remarks H. Katzmair**

The 'transformability' aspect of resilience

I. Darnhofer

Ika Darnhofer

Ika Darnhofer is associate professor at the Institute of Agricultural and Forestry Economics at the University of Natural Resources and Applied Life Sciences, Vienna. Her research focus is on management and decision making on family farms. She studied the various aspects of the decision to convert to organic farming. The multidimensionality of this choice led her to explore issues linked to resilience. The focus on resilience is strengthened by the recognition that we live in turbulent times which means that family farms need a high level of adaptive capacity to cope with rapid and often unpredictable change. She is member of the executive committee of the International Farming Systems Association (IFSA), as well as member of the editorial board of the ‚Journal of Rural Studies', ‚Agriculture and Human Values' and 'Agricultural Systems'.

Abstract: Resilience is fundamentally about the 'capacity to change in order to sustain identity'. In the context of ecosystems the emphasis has been on maintaining the biotic integrity, i.e. the function, structure and feedbacks of the ecosystem. At the heart of resilience thinking there is thus a somewhat ambivalent relationship between maintenance and change. Indeed, the ecosystem should be maintained within the current stability domain, even if some adaptive change is allowed for, so that the ecosystem may adjust its responses to changing external drivers and internal processes. However, transformative change, which by definition leads to a 'fundamentally new system', is usually unwelcome. While it may make sense to side-line transformative change in the ecological realm, doing so when applying resilience thinking in the social realm may constrain its usefulness. Indeed, the negative social and environmental impacts of the consumerist life style of the Global North are well-documented. Applying resilience thinking within the social realm should then less aim at maintaining current structures and feedbacks, and rather identify ways to use shocks such as the COVID-19 pandemic to engage in transformative change. This would call researchers engaged to find ways to conceptualize and apply resilience thinking in such a way as to enable novel developmental pathways.

Ecological Principles and Network Mutualism

B.D. Fath

Brian Fath

Brian D. Fath is Senior Research Scholar at the International Institute for Applied Systems Analysis (Laxenburg, Austria) and since 2011 the Scientific Coordinator of IIASA' s Young Scientists Summer Program. He is also Professor in the Department of Biological Sciences at Towson University (Maryland, USA) and has published over 200 research papers, reports, and book chapters on environmental systems modeling, specifically in the areas of network analysis, urban metabolism, and sustainability. He co-authored the books *A New Ecology: Systems Perspective* (2020), *Foundations for Sustainability: A Coherent Framework of Life–Environment Relations* (2019), and *Flourishing Within Limits to Growth: Following Nature's Way* (2015). He is also co-Editor-in-Chief for *Current Research in Environmental Sustainability*. He was the 2016 recipient of the Prigogine Medal for outstanding work in systems ecology and twice a Fulbright Distinguished Chair (Parthenope University, Naples, Italy, in 2012 and Masaryk University, Czech Republic, in 2019).

Abstract: Viewing systems as networks of interacting, interrelated, and inter-dependent nodes has exposed important and unexpected aspects about the roles and relations within the network. For example, the distal influences of the system, i.e., those not involving direct transactions between pair-wise nodes typically have more total weight and impact on system flows. We also see that cycling is prevalent and contributes substantially to the overall system behavior, consistent with our current interest in circular economy and industrial symbiosis. Specifically, our analysis reveals that positive, mutualistic relations are common, even dominant in most well connected ecosystems. Too often, we are rushed into making piecemeal or incomplete assessments that inevitably fail to give a proper understanding of the system, and our actions to intervene can exacerbate the situation. A question remains whether socio-economic systems are designed in ways that also benefit from network indirectness and mutualism. This presentation gives a background to the network methods aiming to promote greater use these ecological principles to address the resilience of socio-economic systems.

Network Synergism: Ecology's Invisible Hand?

B.C. Patten

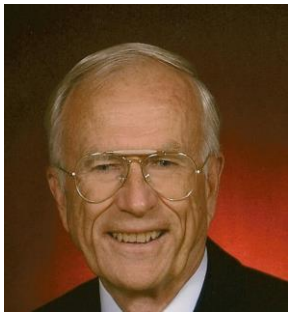
B.C. Patten

Abstract: Adam Smith's classic, The Wealth of Nations (1776), laid down the foundations for free-market, and later growth, economics. Goals, resources, currencies, labor, and skills in human enterprise all have parallels in the economy of nature. Smith's "invisible hand", generating greatest goods for the greatest many, is reflected in the utility theory and mathematics of ecology's network environ analysis (NEA). I will summarize NEA's Janus Hypothesis (2016) as a candidate theory, with physicists' particle and field elements. These elements self-organize to maximize biological and environmental fitness in the transactional economy of nature.

Window of Vitality: A Robust World has Trade-Offs

R.E. Ulanowicz

Robert E. Ulanowicz



Robert E. Ulanowicz is Professor Emeritus from the University of Maryland Center for Environmental Science and Courtesy Professor at the Arthur R. Marshall Center, University of Florida. He is the author of three monographs, *Growth and Development: Ecosystem Phenomenology* (1986), *Ecology, the Ascendent Perspective* (1997) and *A Third Window: Natural Life beyond Newton and Darwin* (2009) as well as over 200 articles in refereed journals. He is the 2007 recipient of the Ilya A. Prigogine Medal for excellence in ecosystem dynamics.

Abstract: The mechanical approach to ecosystem dynamics is incapable of determining the behaviors of strongly heterogeneous systems of irreversible processes. An alternative tactic might be to investigate phenomenological, or data-driven representations of ecosystems as weighted networks of trophic transfers. Such configurations are usually replete with many internal cycles, some of which may act in autocatalytic fashion to select from among impinging contingencies those that augment efficient autocatalytic action or enhance those cycles that incorporate ever more resources into the system (centripetality). Such development eventually wanes, however, as the system becomes dominated by a very few highly efficient pathways, which increasingly are vulnerable to novel disturbances. Sustainable systems, therefore, persist by trading off some system efficiency for a complement of less-efficient routes that can assume some functioning of the impacted pathways. The distribution of activity between efficient transfers and redundant routes is quantifiable using information theory. Surprisingly, sustainable ecosystems tend to cluster around 40% efficient activity and 60% redundant insurance – a region called the "Window of Vitality". Simple differential calculus can reconfigure arbitrary networks to move them towards the window of vitality. Thereby engineers can design networks that mimic ecosystem sustainability in a variety of distribution systems, such as supply chains. This fail-soft desideratum portends significant changes to economic theory.

Is Most always Best? The Dynamics of Ecosystem Integrity and Services vs. Resilience and Adaptability

F. Mueller

Felix Müller

Felix Müller has studied Biology and Geography at the Universities of Kiel and Regensburg. His PhD thesis about soil-geographical investigations on the fate of pesticides and nutrients in ecosystems was published in 1987. Since that time he has been working at the Ecology Centre of the University of Kiel. FM was the scientific coordinator of the long-term R&D project "Ecosystem Research in the Bornhöved Lakes District" and has since that time participated in several national and international research projects. Since 2010 FM was affiliated as leader of the Department Ecosystem Management at the Institute for Natural Resource Conservation of Kiel University. In August 2020, Müller has been officially retired. The main research interests are ecosystem analysis, ecosystem modeling, ecosystem services and ecosystem theories, applications of ecosystem approaches at the landscape scale and the derivation of holistic indicator sets for the management of human-environmental systems. During the last years, ecosystem service investigations have become dominant in the working group and the investigation systems were expanded towards coastal and marine ecosystems. FM has been editor or co-editor of more than 20 books and special issues and has published more than 220 scientific papers. He was editor-in chief of the journal "Ecological Indicators" and board member of a number of journals. In 2010 FM received the Prigogine Medal of the Wessex Institute of Technology and the University of Siena. FM was the president of the German chapter of the International Association of Landscape Ecology and Secretary of the German Chapter of the International Long-Term-Ecological Research Program.

Abstract: In the beginning of this presentation, the central objectives and questions of the paper are introduced. They are related to some relativizations of the orientor principle, distinguishing states with maximum expressions of ecosystem features from states with optimum parameter combinations. Thereafter, the main system characteristics used are defined and the orientor principle is briefly described as an outcome of self-organized dynamics. To follow the initial question, orientors are discussed with regard of efficiencies, flexibilities, vulnerabilities and system viability. Afterwards, the orientor behaviour ideas are applied to the concept of ecosystem services, showing high risks that can result from unilateral growth dynamics. Basing upon these facts, resilience and adaptability are inspected in the context of ecosystem analysis, environmental management, and human-environmental systems policy. Finally, the initial question will be tentatively answered and the outcome is discussed with relation to the actual problems of corona pandemics.

Discussion

Chair **U. Scharler**

Ursula Scharler

Ursula Scharler is currently Professor at the School of Life Sciences, University of KwaZulu-Natal (UKZN), in Durban, South Africa. Her research focuses on systems analysis and ecosystem modelling on estuarine, marine and socio-economic systems, and she teaches at under-and postgraduate level. She fulfils several editorial positions for journals and works of reference. Furthermore, she chairs and is a member of national and international advisory boards and committees, including the South African IIASA-National Member Organisation (NMO) committee that strives to expand systems analysis in South Africa and the SADC region.

Break - *10 Minuten*

Openness Management - Between Construction, Destruction and Re-Construction

S.N. Nielsen

Søren Nors Nielsen

Søren Nors Nielsen: Teaching experience since 1985 in systems analysis and modelling, physical chemistry, philosophy of science, environmental systems and management, toxicology and pharmacokinetic models, ecological engineering, ecological economics, approx. 60 courses, of which more than 30 have been abroad, all given in English/American. 50+ papers published (peer reviewed), 5 books og 7 book chapters. Project experience from projects in Portugal, Italy, China, Philippines, Tanzania, Ghana.

Abstract: Ecosystems as most other of the levels in the biological hierarchy expand their living spaces as a compromise between two apparently contradicting forces both semantically referring to a concept of openness. Both types are of great importance to our understanding of ecosystems as complex adaptive systems. The first type of openness is the principle given within the framework of thermodynamics. In this context openness refers to the fact that ecosystems are open to both energy and material flows which allows them to (self-)organize and grow. This form of openness is also important as it puts focus on the central function of (photo-)autotrophic components which are the only components where energy is passing the boundary into the system by their ability to capture the "high quality" energy from the sun.

This capture represents and Aristotelian efficient cause driving the whole ecosystem, and in a thermodynamic sense ecosystems are bottom-up regulated. Following this capture everything going on in the ecosystem deals with transfer and investment of chemically bound energies as well as dissipations (respiration) and retaining resources by recirculation. Meanwhile, hardly any ecosystem experiences a perfectly constant or stable environment. Thus, ecosystem together with its composing elements need to be able to adapt and meet the requirement of change by alterations in its complexity – its compartments, connections and controls (sensu Patten). The changes in first two sets of elements are dealt with within diversity studies and network theory, while the cybernetic perspective has received only little interest. This need for ability to change is offered by another type of openness referred to as ontic openness – which is a basic feature of heterogenous, conglomerate systems suggested by the quantum physicist W.M. Elsasser. When calculating the combinatorial combinations in heterogenous systems – a class to which biological systems and thus also ecosystem belong – the calculations run into numerical explosions and the number of possibilities become immense, i.e. in orders of magnitude that are not easy to comprehend. This provides an essential explanation to the variational element which is a presumption in (Neo-)Darwinian theory but the causal origin to this variability is only rarely discussed, it is just assumed to be there. The feature of ontic openness is a common feature possessed by all levels of biological hierarchy. Meanwhile, while providing the possibility to change and therefore improve the system, a feature of ontic openness also serves to disorganize the system. This means that ecosystem development and evolution become a dialectical compromise between on one hand - the organizing principles of Schrödinger – order from disorder and order from order, and on the other hand a constant force serving to rearrange informational contents of the ecosystem components. Following this ontic openness strongly impacts the possibilities that an ecosystem has to react to both outside and inside "disturbances". At the same time no variation, no possibility to react and adapt. In order to manage ecosystems properly we need to understand this interaction much better. In particular, we are limited in our knowledge of what exactly shapes ecosystem behavior. What are the regulatory mechanism and how do they get expressed in the various elements? Such an understanding will be of utmost importance in projects involving mitigation, remediation and general management of ecosystems.

What Ecological Principles can say about Sustainability

S. Bastianoni

Simone Bastianoni

Simone Bastianoni is currently full professor of Environmental Chemistry, Chair of the PhD School in Environmental, Geological and Polar Sciences and Provost for Sustainability at the University of Siena. He has 30 years experience in investigating sustainability indicators, adopting a holistic view, common to thermodynamics and ecology, including the evaluation of eMergy, eXergy, Ecological Footprint, Life Cycle Assessment (LCA), greenhouse gases balance. He is Past-President of the Emergy Society, Member of the Standard Committee of the Global Footprint Network and Member of the Scientific Board of the International Society of Ecological Modelling. He has published more than 200 papers and is co-author of monographs among which: Jørgensen S.E., Fath B.D., Nielsen S.N., Pulselli F.M., Fiscus D.A., Bastianoni S., 2015. Flourishing within limits to growth - Following nature's way, Routledge, Padstow, UK, 288 pp. and Pulselli F.M., Bastianoni S., Marchettini N., Tiezzi E., 2008. The road to sustainability, WIT Press, Southampton, UK; 197 pp.

Abstract: A thermodynamics-based Input-State-Output representation of sustainability has been recently proposed to investigate different systems by means of systems indicators representative of three components: input indicators show the material and energy flows feeding the system; state indicators represent structural and organizational features of the system; output indicators quantify what systems produce in terms of outflows.

The I-S-O framework has been applied to investigate and categorize different kinds of systems. It can be applied to ecosystems quantifying what is needed for the systems to survive; its structural characteristics; and ecosystem services produced. The same framework can be used to study national economies, in accordance with the typical sustainability pillars, namely the environmental, social and economic.

We can connect the two levels obtaining a double I-S-O framework to encompass all the elements supporting human activity, production of goods and services and, ultimately, generation of economic wealth.

The Game of Possibilities for Sustaining Coastal Ecosystems under Global Climate Change

J.C. Marques

João Carlos Marques

João Carlos Marques received a graduate degree in biology from the University of Lisbon in 1980, and earned a PhD in ecology from the University of Coimbra (Portugal) in 1989. He was vice-rector for Scientific Research at the University of Coimbra from 2003 to 2007. Professor Marques, Full Professor at the Coimbra University, in Portugal, is presently Director of the Marine and Environmental Sciences Centre (MARE), and scientific coordinator of MAREFOZ, the advanced laboratory of MARE at Figueira da Foz. A marine and estuarine ecologist, he has worked on biological and ecological processes in marine and estuarine ecosystems, systems ecology, and ecological modelling. Since 1990, he has coordinated 24 large research projects both funded by the Portuguese Agencies and European Union Programs, and has also participated as a member of the research team in 30 others. Thus far, he has authored or co-authored more than 300 scientific papers in international refereed journals, 7 books, and 20 book chapters (international editions), and supervised (thesis concluded) 51 MSc and 33 PhD students in Portugal and abroad. He is Editor-in-Chief of the Ecological Indicators Journal – Elsevier since 2016, and also Editor-in-Chief of the Environmental and Sustainability Indicators Journal since

Abstract: To achieve ecological sustainability and sustainable development represents a crucial challenge for the human kind, which depends on numerous driving forces, frequently opposing each other. Nevertheless, when dealing, for instance, with estuaries and coastal areas, three major drivers may in any case be identified, which are the search for human well-being in its several aspects, the conservation of environmental equilibrium, essential to ecological sustainability, and systems' resilience in face of an increasing human pressure, resulting from population size and prosperity demand.

To build and test environmental management scenarios involves therefore complex conceptual problems, demanding appropriate conceptual tools as for example the Ecological Sustainability Trigon (EST). Conceptually, the EST allows addressing the referred main drivers by using the human society view as a common currency, and to describe our behaviour, energetics (economy), and dynamics based on ecological theory. Besides, the EST behaves promisingly as a gap analysis tool and a mean to address new research questions. Since its proposal, the EST has been further tested, namely in relation to the functioning and management of estuarine ecosystems and coastal areas, taking the Mondego Estuary (western Portugal) as core case study.

Applying Ecosystem Principles on Designing Innovation Ecologies

H. Katzmair

Harald Katzmair

Harald Katzmair is founder and director of FASresearch, a Vienna-based consulting firm for Social Networks & Ecosystem Mapping with more than 25 years of cross-industry experience in the application of network and resilience research.

Born in Linz, he studied sociology and philosophy at the University of Vienna and completed his doctorate in philosophy in 1996. Katzmair has taught at various universities in Vienna, including the University of Vienna, the Vienna University of Economics and Business Administration and the University of Applied Arts. He has also been a guest lecturer at Harvard and Oxford several times.

Due to his international experience and the knowledge acquired in more than 2000 international projects, Harald Katzmair is today one of the world's leading experts in the field of applied social network analysis and the analysis of power, relationship and communication networks.

Discussion

Chair **F. Morandi**

Fabiana Morandi

Fabiana Morandi: Mathematician with a PhD in Chemical Sciences - Environmental curriculum, focused on sustainability assessment of systems and processes. Many years of international experience on sustainability assessment and part of different international research projects.

Author of several scientific papers, both on theoretical aspects and on real case studies, on sustainability assessments for territorial systems (urban systems, regional systems, etc.), for logistics and for different kinds of production processes, including food production systems and (bio)fuels production systems.

Summary & Closing Remarks

H. Katzmair

International Institute for Applied Systems Analysis

IIASA

FAS research

Contact for inquiries:

Valerie Streibel
Chief Operating Officer
Porzellangasse 2/34,
1090 Vienna, Austria
www.fas-research.com

+43-1-319 2655-35
valerie.streibel@fas.at