WELCOME TO THE

THE Crafoord PRIZE

Crafoord *Days* 2011

9-11 MAY

Programme

Abstracts

The Crafoord Prize in Biosciences 2011

Anna-Greta and Holger Crafoord Fund

Cover photo: Niclas Fritzén

THE FUND WAS ESTABLISHED in 1980 by a donation to the Royal Swedish Academy of Sciences from Anna-Greta and Holger Crafoord. The Crafoord Prize was awarded for the first time in 1982. The purpose of the Fund is to promote basic scientific research worldwide in the following disciplines:

- Astronomy and Mathematics
- Geosciences
- Biosciences (with particular emphasis on ecology)
- Polyarthritis

Support to research takes the form of an international prize awarded annually to outstandig scientists, and of research grants to individuals or institutions in Sweden. Both awards and grants are made according to the following order:

year 1: Astronomy and Mathematics
year 2: Geosciences
year 3: Biosciences (with particular emphasis on ecology)
year 4: Astronomy and Mathematics
year 5: Geosciences
year 6: Biosciences (with particular emphasis on ecology)
and so on

The Prize in Polyarthritis is awarded only when a special committee has shown that scientific progress in this field has been such that an award is justified.

Part of the Fund is reserved for appropriate research projects at the Academy's institutes. The Crafoord Prize presently amounts to SEK 4 million. In addition to the prize, financial support is granted to other researchers in the same field in which the prize is awarded for that year.

The Crafoord Prize is awarded by the Royal Swedish Academy of Sciences.

Content

Patches of diversity in increasingly fragmented habitats

This year's Crafoord Prize Laureate has established himself, in his more than 30-year career, as one of the world's most eminent ecologists. He receives the prize for developing a range of new analytical methods and mathematical models in ecology. Today, these are widely used to help scientists investigate how animal and plant species are affected when their habitats undergo splitting owing, for example, to urbanisation, deforestation and climate change.

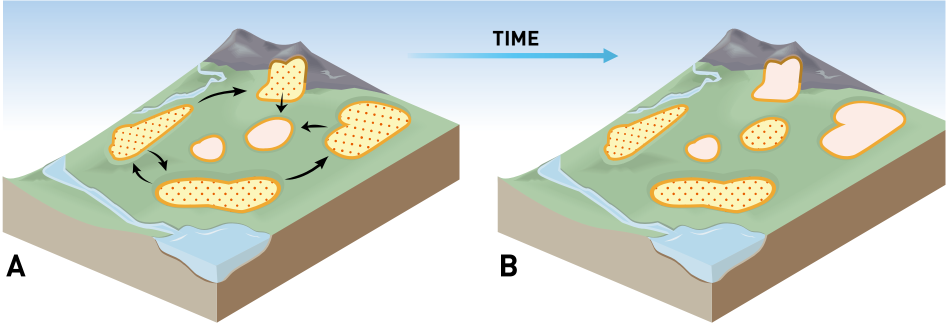


Illustration: Jimmy Blomqvist/©The Royal Swedish Academy of Sciences

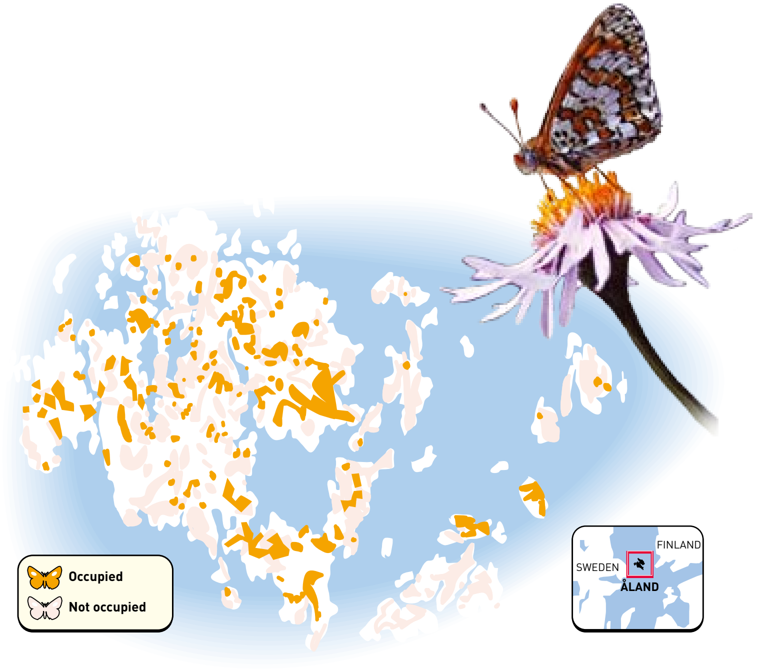
Metapopulation of a particular plant or animal species consists of a network of several populations that are patchily dispersed among various places or habitats (A) in the landscape. The local populations are partially isolated from one another, but some flow of individuals and exchange of genes nonetheless take place. In the range of such a metapopulation, at any given time, only a certain proportion of the suitable habitats are occupied (dotted areas), while others are unoccupied (light-coloured areas). Movements take place among the various habitats (as shown by the arrows in the diagram) and may result in suitable new areas being colonised by the species. At the same time, there is a risk of certain local populations becoming entirely extinct. After a while, the distribution of the metapopulation in the landscape has therefore changed (B). Thus the two processes of local populations, colonisation and extinction, give rise to the metapopulation's dynamics.

ILKKA HANSKI'S studies – on animals ranging from butterflies, dung beetles and water fleas to voles, lemmings and bears – have made metapopulation ecology a substantial research area. It focuses on species that inhabit fragmented habitats, in order to assess the risk of local extinction and discern what may help the species to survive in a landscape subject to growing human influence. Today, Hanski's metapopulation theories are among the cornerstones of research on biodiversity, and also have a major bearing on practical management of the natural environment and on conservation policy.

Despite Hanski's numerous expeditions to such exotic places as Borneo, Madagascar and Greenland, his most acclaimed studies have been carried out virtually on his own home ground, the Åland islands in the Baltic Sea. There, his research team has spent more than 20 years conducting extensive surveys of the Glanville Fritillary (Melitaea cinxia), which has been declining in Northern Europe over the past few decades owing to the transformation of the landscape due to modern farming. Today, the species is no longer found on the Finnish mainland, but survives in split metapopulations in the dry meadows of the Åland islands, where Spiked Speedwell (Veronica spicata) and Ribwort Plantain (Plantago lanceolata) are the key host plants for the butterfly larvae.

One of the best-known phenomena in Hanski's research is extinction debt. This means that species may persist for a while in fragmented, isolated populations despite being doomed to become extinct in time, owing to the great changes in their habitats that have already taken place. The butterflies Hanski himself has long studied have, for example, suffered from inbreeding and deteriorating flying ability when their subpopulations have become too isolated. This has impaired the long-term survival potential of the species and its capacity to cope with environmental changes. Similar patterns have been observed for many other species when human land use has resulted in progressive disintegration of the landscape and splitting of habitats.

Butterfly photograph: Niclas Fritzén
Illustration: Jimmy Blomqvist/©The Royal Swedish Academy of Sciences



Map showing the range of the Glanville Fritillary (Melitaea cinxia) in the Åland islands. The dark patches represent areas where this butterfly species is found, while the light ones show habitats that are suitable for the species but nevertheless uninhabited. Ilkka Hanski's research team has been surveying these split habitats in the Åland islands annually since 1993. This long time series has yielded an extensive understanding of metapopulation ecology and important new knowledge of how survival of plant and animal species can be achieved in an increasingly fragmented landscape.

The Crafoord Prize Laureate in Biosciences 2011

Foto: Tapio Vanhatalo

ILKKA HANSKI, University of Helsinki, Finland, *"for his pioneering studies on how spatial variation affects the dynamics of animal and plant populations"*.

Habitat loss and the dynamics of biodiversity

ILKKA HANSKI, CRAFOORD LAUREATE 2011
UNIVERSITY OF HELSINKI, FINLAND

In this talk, I address two related topics, the spatial dynamics of species in heterogeneous environments and how to protect habitat to stop the decline of biodiversity. Habitat loss remains the greatest threat to biodiversity [1], but habitat loss and changing habitat composition may also lead to microevolutionary changes in natural populations with consequences for their long-term viability. With my colleagues, I have constructed and analysed a model that combines ecological metapopulation dynamics with the dynamics of local adaptation [2]. Depending on the strength of local selection, the amount of additive genetic variance, the demographic cost of maladaptation, the spatial scale of migration and the level of habitat heterogeneity, the model predicts adaptation at different spatial scales, from strictly local to network-level adaptation. I illustrate with examples how the combined eco-evolutionary dynamics may affect the responses of species to habitat loss and fragmentation.

The UN biodiversity conference in Nagoya in October 2010 agreed on the targets of protecting 17% on land and 10% on coastal and marine areas by 2020. At present, the protected areas tend to be located at high latitudes and altitudes, and there is little opportunity to protect large continuous areas in the more productive regions that are densely populated by people. How can we, then, reach the Nagoya target to protect "especially areas of particular importance for biodiversity and ecosystem services, (...) ecologically representative and well connected systems of protected areas (...) integrated into the wider landscapes" (www.cbd.int/decision, strategic goal C)? Based on considerations of extinction thresholds for forest specialist species as an example, I propose a third-of-third approach to landscape-wide habitat conservation [3]: a third of the land area is managed as multiuse conservation landscapes, within which a third of the area is protected. This approach is cost-effective, it provides large-scale connectivity to allow species to shift their ranges with climate change, and it brings biodiversity and ecosystem services close to people.

References

[1] Hanski, I. 2005. *The Shrinking World: Ecological Consequences of Habitat Loss*. International Ecology Institute, Oldendorf/Luhe, Germany, 307 pp.

[2] Hanski, I., Mononen, T. & Ovaskainen, O. 2011. Eco-evolutionary metapopulation dynamics and the spatial scale of adaptation. *American Naturalist* 177: 29–43.

[3] Hanski, I. 2011. Habitat loss, the dynamics of biodiversity and a perspective on conservation. *Ambio* 40: 248–255 (available in the Crafoord symposium).

Plant diversity and dispersal in a patchy environment: lessons from Californian serpentine 'islands'

SUSAN HARRISON
UNIVERSITY OF CALIFORNIA, DAVIS, CA, USA

Outcrops of serpentine or ultramafic rock, and the nutrient-poor soils formed from these rocks, appear in the landscape as island-like patches of sparse vegetation with a distinctive floristic composition. In the Californian Floristic Province, as in many parts of the world, plants endemic (restricted) to serpentine and other unusual substrates form an important part of biological diversity. Here I review studies asking whether the spatial structure (e.g. size, isolation) of serpentine outcrops, alone or in combination with other factors, contributes to the distribution and maintenance of diversity in the Californian serpentine flora.

Studies at small scales (on the order of 1 km) find evidence for effects of outcrop isolation on plant species diversity and persistence. However, studies at larger scales (10^1-10^3 km), find no influence of spatial structure on either local or regional diversity; instead, the dominant influence on diversity is regional climate. Dispersal syndromes in serpentine plants are not evidently adapted to a patchy environment; there is greater wind dispersal, less vertebrate dispersal, and equal long-distance (wind + vertebrate dispersal) in serpentine floras compared with neighboring floras on normal soils.

Given its patchy distribution and lack of obvious dispersal adaptations, the serpentine flora may be at exceptional risk under climate change. This is confirmed by distribution models showing that Californian serpentine endemics will have to make minimum dispersal 'jumps' of 600–8,000 m to colonize newly climatically suitable outcrops. However, research in other systems suggests that plants on low-nutrient soils have functional traits that render them relatively insensitive to climate change. We are testing this hypothesis with historical, observational, and experimental analyses of serpentine vs nonserpentine floras, as well as examining the feasibility of and limits to assisted migration for serpentine plants.

Metapopulation dynamics in plants

JOHAN EHRLÉN
STOCKHOLM UNIVERSITY, SWEDEN

Metapopulation theory has become very influential in the study of spatial population dynamics of animals. Plants, however, differ from most animals in several respects that are important to their spatial dynamics, for example by having restricted dispersal ability. I will review plant traits that are related to the ability to disperse among habitat patches, persist in suitable habitats and resist habitat change. Based on plant traits, general predictions are made about spatial population dynamics of perennial plants, in terms of the ability to colonize empty but suitable habitat, the risk of population extinction within suitable habitat due to stochastic events, and the ability to survive deterministic changes of the environment. These predictions are examined by available empirical evidence about patch occupancy and population extinction rates. In particular, the importance, design and interpretation of transplantation experiments which are vital to assess habitat suitability and patch occupancy in plants will be discussed. Lastly, based on available information I will discuss how the relative importance of classical and patch-tracking metapopulation dynamics is related to differences in traits among plant species.

References

Dupré, C. & Ehrlén, J. 2002. Habitat configuration, species traits and plant distributions. *Journal of Ecology* 90:796–805.

Ehrlén, J., Münzbergova, Z., Diekmann, M. & Eriksson, O. 2006. Long-term assessment of seed limitation in plants – results from an 11-year experiment. *Journal of Ecology* 94:1224–1232.

From metapopulation dynamics to distribution change: predicting species' responses to climate change

CHRIS D. THOMAS
UNIVERSITY OF YORK, UK

The metapopulation (colonisation and extinction) framework was mainly developed to understand how species survive in landscapes that are naturally patchy or that have been degraded and fragmented by human activities. The same approach can also be applied to understand responses to climate change. Using a metapopulation framework, I show how species have shifted their distributions under climate change, spreading faster in landscapes where more habitat is available. The consideration of how species respond to the combined effects of habitat fragmentation and the climatic suitability of habitats provides an approach to begin to predict how species may respond to the combined pressures of future land use and climate changes.

From metapopulations to metacommunities and metaecosystems

MATHEW LEIBOLD
UNIVERSITY OF TEXAS AT AUSTIN, TX, USA

I. Hanski's work on metapopulations developed and illustrated many of the various ways that population dynamics of organisms could be better understood by taking into account the spatial setting in which they occurred. Among those findings were insights into the dynamics of strongly interacting sets of species that exploit highly defined patches in a landscape and thus also illustrated how spatial effects could affect ecological communities and thus also introduced the topic of 'metacommunities'. Here I will describe how progress on the idea of metacommunities has evolved to provide insights into a range of topics including coexistence, diversity, stability, trophic structure, and the links between community and ecosystem processes (thus also connecting to the idea of 'metaecosystems').

References

Leibold, M.A., M. Holyoak, N. Mouquet, R.D. Holt, D. Tilman and 7 others. 2004. The metacommunity concept: a framework for large scale community ecology? *Ecology Letters* 7:601–613.

Urban MC, Leibold MA, Pantel JH, Loeuille N, Vellend M, and 9 others. 2008. Evolutionary ecology of metacommunities. *Trends in Research in Ecology and Evolution* 23:311–317.

Is Ilkka Hanski a Landscape Ecologist?

LENORE FAHRIG
CARLETON UNIVERSITY, OTTAWA, ON, CANADA

Landscape ecology is the study of the spatial pattern of the environment: its measurement, its formation and change, and its effects on individuals, populations, communities, and ecosystems. One of the most important aspects of landscape ecology revolves around the question: how do wildlife populations respond to changes in the amount, configuration, and diversity of habitats in the landscape? In this presentation I summarize work in this field, relying mainly on results from my laboratory. In doing so, I introduce and discuss some important concepts in landscape ecology, including landscape composition and configuration, landscape extent, landscape complementation, and landscape heterogeneity; and I present some important population-level findings, including the extinction threshold, the role of reproductive rate, the relative effects of habitat loss and fragmentation per se, the prevalence of and explanations for positive effects of fragmentation, and the intermediate heterogeneity hypothesis. Throughout, I show the concurrence, and in some cases the anticipation, of these findings within the writings of Ilkka Hanski and his collaborators over the past 30 years, lending support to the hypothesis that Ilkka Hanski is a landscape ecologist. I end by suggesting next steps for both theory and data in population-level landscape ecology.

Programme Crafoord Days

Monday

9 MAY, STOCKHOLM **09:00–16:15**

Prize Symposium in Biosciences

PLANT AND ANIMAL POPULATIONS IN A CHANGING LANDSCAPE

Lectures by the Crafoord Laureate 2011,
ILKKA HANSKI, and invited speakers: Lenore Fahrig, Johan Ehrlén, Susan Harrison, Mathew Leibold and Chris D. Thomas.

THE BEIJER HALL
ROYAL SWEDISH ACADEMY OF SCIENCES
LILLA FRESCATIVÄGEN 4A, STOCKHOLM

Registration at www.crafoordprize.se or
http://kva.se

Tuesday

10 MAY, STOCKHOLM **16:20–17:20**

Prize award ceremony

Presented by His Majesty the King of Sweden

THE BEIJER HALL
ROYAL SWEDISH ACADEMY OF SCIENCES
LILLA FRESCATIVÄGEN 4A, STOCKHOLM

No registration

Wednesday

11 MAY, LUND **15:30–17:15**

The Crafoord Prize Lecture 2011

THE GLANVILLE FRITILLARY, EXTINCTION THRESHOLDS, AND A PERSPECTIVE ON CONSERVATION

Held by the Laureate **ILKKA HANSKI**

BLUE HALL
ECOLOGY BUILDING, LUND UNIVERSITY
SÖLVEGATAN 37, LUND

No registration

Prize symposium in Biosciences

PLANT AND ANIMAL POPULATIONS IN A CHANGING LANDSCAPE

Open to the public

THE BEIJER HALL
THE ROYAL SWEDISH ACADEMY OF SCIENCES
LILLA FRESCATIVÄGEN 4A, STOCKHOLM

Monday 9 MAY

CHAIRS : OVE ERIKSSON AND BIRGITTA TULLBERG

09:00	*Registration*	
09:30	*Opening address*	*Staffan Normark,* Permanent Secretary of the Royal Swedish Academy of Sciences
09:40	*Habitat loss and the dynamics of biodiversity*	Crafoord Laureate 2011 **ILKKA HANSKI** University of Helsinki, Finland
10:30	*Plant diversity and dispersal in a patchy environment: lessons from Californian serpentine 'islands'*	*Susan Harrison,* University of California, USA
11:15	*Dispersal limitation and metapopulation dynamics in plants*	*Johan Ehrlén,* Stockholm University, Sweden
12:00	Lunch	
13:30	*From metapopulation dynamics to distribution change: predicting species' responses to climate change*	*Chris D Thomas,* University of York, UK
14:15	*From metapopulations to metacommunities and metaecosystems: how spatial effects matter*	*Mathew Leibold,* University of Texas at Austin, TX, USA
15:00	Coffee break	
15:30	*Is Ilkka Hanski a landscape ecologist?*	*Lenore Fahrig,* Carleton University, Ottawa, ON, Canada
16:15	End of the symposium	

Crafoord Prize Lecture in Biosciences

THE GLANVILLE FRITILLARY, EXTINCTION THRESHOLDS, AND A PERSPECTIVE ON CONSERVATION

Open to the public

BLUE HALL
ECOLOGY BUILDING, LUND UNIVERSITY
SÖLVEGATAN 37, LUND

CHAIR : HENRIK SMITH, LUND UNIVERSITY

Wednesday 11 MAY

15:30	*Welcome and practical information*	*Henrik Smith,* Lund University, Sweden
15:35	*Opening address*	*Staffan Normark,* Permanent Secretary of the Royal Swedish Academy of Sciences
15:40	*Introduction of the Crafoord Laureate in Biosciences 2011*	*Birgitta Bergman,* Chair of the Crafoord Committee in Biosciences
15:50	*Crafoord Prize lecture 2011:* The Glanville fritillary, extinction thresholds, and a perspective on conservation	Crafoord Laureate 2011 **ILKKA HANSKI,** University of Helsinki, Finland
16:20	Refreshments	
16:30	*Panel discussion and questions:* Conservation and biodiversity – do we really need more science	Crafoord Laureate 2011 **ILKKA HANSKI** *Henrik Smith,* Lund University, Sweden *Frank Wätzold,* University of Leipzig, Germany and Lund University, Sweden *Brita Svensson,* Uppsala University, Sweden
17:15	End of day	

Anna-Greta and Holger Crafoord

Holger Crafoord (1908–1982) was prominent in Swedish industry and commerce. He began his career with AB Åkerlund & Rausing and devoted a larger part of his working life to this company. In 1964, Holger Crafoord founded Gambro AB in Lund, Sweden, where the technique of manufacturing the artificial kidney was developed. This remarkable dialyser soon became world famous. Since then, a series of medical instruments has been introduced on the world market by Gambro.

HOLGER AND ANNA-GRETA CRAFOORD

In 1980, Holger Crafoord founded the Crafoord Foundation, which annually contributes greatly to the Anna-Greta and Holger Crafoord Fund.

Holger Crafoord became an honorary doctor of economics in 1972 and in 1976 an honorary doctor of medicine at the University of Lund.

Anna-Greta Crafoord (1914–1994) took, as Holger Crafoord's wife, part in the development of Gambro AB. Through generous donations and a strong commitment in the society around her, she contributed to the scientific and cultural life. In 1986 she founded the Anna-Greta Crafoord foundation for rheumatological research and in 1987 Anna- Greta Crafoord became an honorary doctor of medicine at the University of Lund.

Over the years, the Crafoords have furthered both science and culture in many ways and it is noteworthy that research in the natural sciences has received an important measure of support from the Anna-Greta and Holger Crafoord Fund.

THE ROYAL SWEDISH ACADEMY OF SCIENCES founded in 1739, is an independent, non-governmental organisation whose aim is to promote the sciences and strengthen their influence in society. Traditionally, the Academy takes a special responsibility for the natural sciences and mathematics, but in its work it strives to increase exchanges between different disciplines.

The activities of the Academy are aimed mainly at:

- *spreading knowledge of discoveries and problems in current research*
- *providing support for young researchers*
- *rewarding outstanding contributions in research*
- *stimulating interest in mathematics and the natural sciences in schools*
- *spreading scientific and popular-scientific information in various forms*
- *offering unique research environments*
- *maintaining contact with foreign academies, learned societies and other international scientific organizations*
- *representing the sciences in society*
- *carrying out independent analyses and evaluations, based on scientific grounds, of issues of importance for society*

The Academy has about 420 Swedish members and 175 foreign members. The Swedish members are active within Classes and Committees. They initiate investigations, responses to government proposals, conferences and seminars. Once a month the Academy holds a General Meeting and in connection with this a public lecture. (Visit http://kva.se for the programme.) The Academy´s own institutes offer unique research environments for botany, ecological economics, the history of science, astrophysics, mathematics and other subjects. Besides the prominent Crafoord Prize, the Academy awards annually a number of prizes, the best known of which are the Nobel Prizes in Physics and Chemistry and the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel. Other important prizes are the Söderberg Prize and the Göran Gustafsson Prizes. The latter are awarded to outstanding young researchers and are a unique combination of a personal prize and a research grant. The Academy also supports researchers who have been researching actively for five to ten years after taking their doctorate by providing a salary for five years through the support of external foundations. Through its various Committees the Academy also works for the development of a society based on scientific grounds. Great interest is paid to educational issues and a major school development program, NTA (Natural Sciences and Technology for All), is organized in collaboration with the Royal Swedish Academy of Engineering Sciences.

KUNGL. VETENSKAPS-AKADEMIEN
THE ROYAL SWEDISH ACADEMY OF SCIENCES

THE CRAFOORD PRIZE IS AWARDED BY
THE ROYAL SWEDISH ACADEMY OF SCIENCES

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