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Spotlight on ERC projects

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The European Research Council

The European Research Council (ERC) is a research funding body established by the European Commission in 2007, which funds individual scientists based in Europe who carry out research on the frontiers of knowledge. It aims to support the best and most creative researchers and help them identify and explore new opportunities and directions in any field of research.

The ERC provides attractive, long-term grants to pursue ground-breaking, high-risk/high-gain research in any field. Excellence is the sole criterion for selection; there are neither thematic priorities, nor geographical quotas for funding.

The ERC received a budget of over €13 billion under the European Union research programme Horizon 2020 (2014-2020).

In 2015, the ERC celebrates its 5000th grant, which is presented in this folder alongside other ongoing and finished projects funded by the ERC in life sciences; physical sciences and engineering; and social sciences and humanities.

Out of more than 43 000 proposals evaluated since 2007, these projects are a snapshot of the 5000 ERC grants that have been pursued in almost 600 institutions in 32 countries in the EU and Associated countries. So far, nearly 40 000 publication have derived from ERC projects, out of which 14 500 have been published in peer-reviewed high impact international journals.

The ERC expects that its grants will help bring about new and unpredictable scientific and technological discoveries - the kind that can form the basis of future industries, markets, and social innovations.

ERC core grant schemes

- **ERC Starting Grants** targeted at early-career, emerging research leaders: up to €1.5 million per grant
- **ERC Consolidator Grants** aimed at excellent researchers who are already independent: up to €2 million per grant
- **ERC Advanced Grants** for established top researchers: up to €2.5 million per grant

ERC Proof of Concept funding is an additional funding initiative, open only to ERC grantees to help them establish the innovation potential of ideas arising from their frontier research projects (up to €150 000 per grant).

More information

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NEWSPINDLEFORCE

"I am curious about how things work inside a living cell and love figuring out new things that are yet to be discovered."

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The driving forces of cell division

Cell division is a core process for life. Our body is constantly producing new cells to replace old or damaged ones, at the rate of millions per second. What is more, inside cells, there are forces and motor engines, and plenty of movement. Cells need these inner energies to replicate and to pass on their genetic material from one generation to the other. With her ERC project, the 5000th granted by the ERC, Dr Iva Tolić wants to push forward the frontiers of knowledge on these well-orchestrated forces.

During cell division, chromosomes are replicated, the cell separates in two and an identical set of chromosomes is inherited by each daughter cell. For this to happen, fibrous rods called microtubules play a decisive role. They are in charge of aligning the chromosomes and, eventually, of separating them with the highest precision. The task of these highly dynamic microtubules is to pull the chromosomes back and forth until they are attached to a spindle structure. Chromosomes are then dragged to the opposite sides of the cell before the cell actually splits.

We know that microtubules interact with each other and with kinetochores (protein structures in charge of controlling the movements of chromosomes during cell division) but these interactions have not yet been elucidated.

By combining a variety of techniques and theory, including imaging, optical engineering, computer science and theoretical physics, Dr Tolić wants to map out how the inner cell forces are generated, organised and how they act. In particular, she is interested in a specific new class of bridging microtubules that could drive the movements of sister kinetochores and, therefore, play a key role in chromosome segregation.

The results of her ERC-funded project could lead to new insight in cell and molecular biology. They could also be critical for the development of new therapies against cancer, as this disease results from a cell duplication process that, for some reason, is not regulated correctly.

Portrait: © Iva Tolić
Image: Microtubules in action during chromosome division © Iva Tolić

Dr Iva Tolić
Ruđer Bošković Institute, Croatia

ERC project:
A new class of microtubules in the spindle exerting forces on kinetochores (NEWSPINDLEFORCE)
Consolidator Grant 2014, €2.1 million for five years

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REGENERATEACROSS

"For me, the beauty of discovery is like art. Having the freedom to take your own approaches to explore your own ideas has been enormously rewarding."

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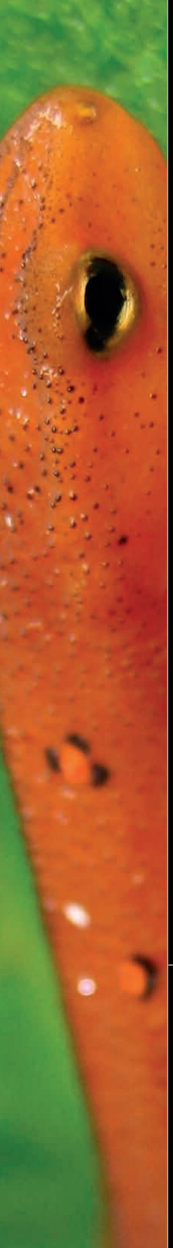

Salamanders: unearthing the mystery of limbs regeneration

Cellular regeneration allows wound healing in humans but in other vertebrates such as salamanders, it goes a step further: they can regenerate their limbs in their full complexity of bones, nerves, muscle and skin and can do it over and over again. Prof. Elly Tanaka studies these amazing capacities and, mirroring the process, has successfully grown a piece of mouse spinal cord in vitro.

Limb regeneration capacity varies greatly among vertebrates. Its molecular and cellular basis is still unknown, but researchers suspect that species variation could be linked by common mechanisms and cells. Prof. Tanaka and her team examine fibroblasts, cells of connective tissue that are important for limb regeneration in salamanders and wound healing in humans. Her objective is to identify cell subpopulations responsible for regeneration and molecules that prompt it.

Looking across species, salamanders, frogs and mice in particular, she also wants to understand what the differences in cells and molecular signals are. Why can salamanders regenerate limbs while mammals or even closer related animals such as frogs cannot? Why has evolution optimised, or inhibited this regeneration function?

Even among salamanders, the researchers have shown that there is more than one mechanism of muscle tissue regeneration. While the Mexican salamander, the axolotl, produces tissue from existing stem cells, the newt salamander displays a mechanism previously unknown: muscle cells "forget" what they were and become new stem cells that regenerate muscle tissue. This observation opens new possibilities and could, one day, help to design therapies for diseases such as muscular dystrophy, in which the body cannot keep up with the loss of muscle tissue.

Inspired by axolotls that can regenerate their spinal cord in three dimensions following injury, Prof. Tanaka's team also started reconstructing mammalian tissue in vitro. Last year, they succeeded in making a 3D patterned spinal cord from mouse stem cells. This achievement brings researchers a tiny step closer to the idea of constructing pieces of spinal cord for transplantation in humans.

Prof. Elly Tanaka
Dresden University of Technology, Germany

ERC project:
A cross species approach to understand the mechanism and evolution of limb regeneration capacity (REGENERATEACROSS)
Advanced Grant 2011, €2.4 million for five years

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BRAINDEVELOPMENT

"Becoming a researcher was not a conscious decision, but each time I worked on a specific research question, I got excited about new questions, so it was a natural flow in a way. I still enjoy it very much!"

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What happens in teenagers' brains?

Adolescence is marked by significant physical, cognitive and socio-emotional changes. Despite these well-known developments, the neural mechanisms supporting this phase of growth in the life of human beings remain unknown. Prof. Eveline Crone has carried out for the first time a longitudinal study to investigate the brain processes underlying the behaviour of teenagers.

With her ERC grant, Prof. Crone has led a comprehensive study on a sample group of 299 teenagers, boys and girls, over a period of four years. The teens were observed during two different sessions, with a three-year interval. This longitudinal approach, tracking the same individuals over time, allows, rather than age comparisons, the examination of developmental trajectories in a single person and gives extensive information about individual development.

The neuroscientist has carried out her research work in schools, with questionnaires and computer-based tests, as well as in her laboratory at the University of Leiden, using brain imaging methods such as magnetic resonance imaging (MRI) and hormone assessments.

Prof. Crone's objective is to elucidate some important questions such as: how does the maturation of the brain relate to changes in our capacity to hold information in mind? Does brain development precede or follow major milestones in behaviour? How do changes in the environment (such as friendships and relations with parents) support changes in the developing brains?

She focuses on the way in which changes in cognitive and social-emotional teenagers' behaviour are linked to functional brain development, structural brain changes and hormonal levels. Her first findings, suggesting that there are imbalances in adolescent brain development, could contribute to increasing current knowledge of cognitive and social-emotional development during adolescence. Once completed, this project could open new scientific horizons for understanding the underlying factors in adolescent growth can have an impact on the education and psychology fields.

Prof. Eveline Crone
University of Leiden, The Netherlands

ERC project:
How brain development underlies advances in cognition and emotion in childhood and adolescence (BRAINDEVELOPMENT)
Starting Grant 2010, €1.5 million for five years

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MESOLIGHT

"The discovery of solar cells that mimic the light reaction in photosynthesis has been a very exciting experience. The fact that these cells have found unique applications is most rewarding."

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Solar cells: on the road to a technological revolution

The Sun provides a steady source of power that could make solar energy a sustainable alternative to conventional sources of energy, provided that technological advances can actually reduce energy production costs. Prof. Michael Grätzel modified the composition of dye-sensitized solar cells to significantly increase their efficiency, including for indoor use. His result laid the ground for paradigm shifts that could revolutionise solar cells technology.

Efforts to improve the efficiency of photovoltaic solar cells have been going on for decades. The challenge is to boost their capacity to convert sunlight into electrical power, while making them cheaper to produce. Conventional solar cells indeed require very pure silicon, an expensive material. Prof. Grätzel works on dye-sensitized solar cells (DSCs). In these cells, silicon is replaced by a dye or a coloured pigment used as a light harvester. As sunlight touches the cell, an exchange of electrons from the dye to the substrate produces electricity. When they were developed in 1991, DSCs had an efficiency of about 7%.

With his ERC project, Prof. Grätzel set a "revolution" in motion by fine-tuning the composition and colour of the cells. He replaced the standard dye components (ruthenium and iodine) with cobalt and porphyrin (a dye whose structure resembles that of chlorophyll). Solar cells could better mimic plants photosynthesis, including their greenish colour, and their energy conversion rate jumped to 12%. Their performance became comparable to silicon-based solar panels on the market.

This result, published in 2011, has opened the door to other European research groups to further improve DSCs using "perovskites" (a metal halide material with a crystal structure of the calcium titanium oxide mineral), pushing their efficiency to 20%. The combination of technologies promises to boost this figure even further.

In parallel, Prof. Grätzel has been working on applications, integrating state-of-the-art technologies. A Proof of Concept grant supports solar cells commercialisation for use indoors, in appliances with low energy needs such as digital music players, cell phones and hearing aids. The cells can also be used to create flexible and transparent solar panels: glass smart windows converting sunlight into energy.

Portrait: © Alain Herzog / EPFL
Image: The Swiss Tech Convention Center in Lausanne, Switzerland, featuring a glass façade made of dye sensitized solar cells to provide electric power to the building. © Alain Herzog / EPFL

Prof. Michael Grätzel
Swiss Federal Institute of Technology Lausanne, Switzerland

ERC project:
Mesoscopic Junctions for Light Energy Harvesting and Conversion (MESOLIGHT)
Advanced Grant 2009, €2.5 million for five years
Indoor Dye Sensitized Solar Cells (IDSC)
Proof of Concept 2011, €150 000

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LONG-TERM RISKS

"My dream is to contribute to the building of an effective and perennial academic institution in Europe that could compete for the world intellectual leadership."

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Our impact today on tomorrow's world

Most of our actions can have an impact on the environment, be it minor, long-lasting or simply irreversible. But how can this effect be measured, avoided, predicted? What are the specificities of long-term risks and how can collective decisions be taken effectively to tackle those threats?

Prof. Christian Gollier is interested in risks and with his ERC grant, he aims to provide a new scientific approach to evaluating and managing collective long-term risks on the environment, including climate change, biodiversity, deforestation, nuclear wastes and many others. His research should contribute to identifying the right policies to confront long-term risks and to help collective decision-making at the right time. To meet these objectives, Prof. Gollier and his team are the first to have combined various disciplines, from environmental economics to theory of finance and modern decision theory, to psychology.

Today, the debate on global warming and climate is no longer restricted to the scientific spheres. Economists are also looking at the issue but remain divided regarding the most efficient approach to tackling environmental long-term risks. There is also a lack of consensus on the degree of impact that our actions of today will have on future generations. Moreover, some believe that action should only be taken upon scientific evidence and experts also disagree on the tools to effectively measure long-term risks on the environment.

At present, environmental projects and policies are mostly based on a cost-benefit analysis, a tool that assesses net economic effects. Prof. Gollier aims to polish this methodology, taking into account the specificities and uncertainties linked to environmental long-term risks. His research also focuses on providing evaluation tools for ever-present concepts in the business world, such as corporate social responsibility and socially responsible investments. The aim is to translate these general concepts into efficient guidelines for collective decision making.

Prof. Christian Gollier
Fondation Jean-Jacques Laffont, Toulouse School of Economics (TSE), France

ERC project:
Evaluation and management of collective long-term risks (LONG-TERM RISKS)
Advanced Grant 2008, €1.4 million for five years


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SINOXYGEN
"My greatest achievement as a researcher is the part I have played in helping some amazing young minds develop."
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What you make is important, but also how you make it

Faster, greener and more sustainable: our world is thirsty for innovative processes that meet these demanding criteria. While natural resources can offer part of the solution, the biggest challenge lies in cleaning-up chemical synthesis. Prof. Georgios Vasilikogiannakis and his team have been looking for answers.

How can we keep up with the ever-increasing demand for novel products, materials, drugs and responsive technologies in a world of ever-dwindling resources? How can complex molecular architectures, such as those found in nature, be synthesised in an efficient and clean way? Prof. Georgios Vasilikogiannakis has focused his research on looking for new ways to transform simple raw materials rapidly, neatly and cheaply into complex molecular architectures - searching out methods as close as possible to the ideal synthesis, as it has been called. And he has begun to find the promising chemistry he was looking for.

Singlet oxygen is an electronically excited state of molecular oxygen. Highly reactive and yet one of the greenest oxidants of all, when generated within solutions of simple substrates, it can bring about a cascade of chemical reactions through which dramatic increases in molecular complexity can occur. These processes offer new synthetic routes considerably shorter and cleaner than those presently in use, ready for application across disciplines - from natural products to new materials and pharmaceuticals.

Although singlet oxygen might be described as a non-classical tool in organic chemistry, it offers a promising alternative to the synthetic methods currently used, including toxic heavy metal oxidants. It produces no waste and can often be used in water. For Prof. Vasilikogiannakis and his team, new challenges lie ahead: while singlet oxygen has already proven to be a remarkable reagent, small changes to the reaction cascades allow them to occur in hundreds of different ways providing a constantly changing skyline for the research team.

Prof. Georgios Vasilikogiannakis
University of Crete, Greece

ERC project:
Advancing the green chemistry of singlet oxygen and applying it to synthetic challenges (SINOXYGEN)
Starting Grant 2011, €1,3 million for five years

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MUSDIG

"MUSDIG is the highpoint of my research career, a source of great challenge and immense pleasure. For the first time I can work at a large scale with a group of incredibly talented researchers. The outcome is much more than the sum of its parts."

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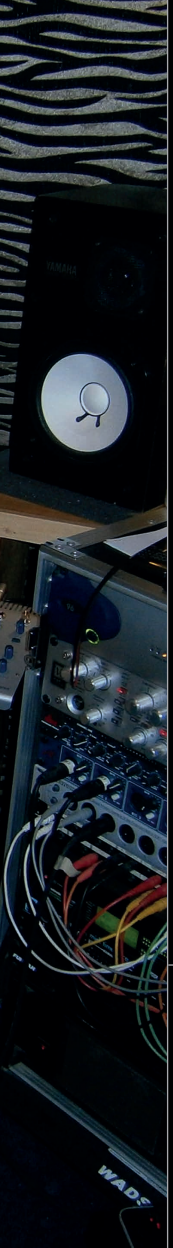


Music's transformation in the digital era

Music has been a vital part of human cultures for millennia, and today it continues to evolve, taking vastly different forms around the world. Proceeding from the rich diversity of human music-making, Prof. Georgina Born has been investigating its transformation in the current digital era.

From musical performance and composing, through recording and mixing, to circulating and listening, in recent decades, music has been intensively exposed to digitisation. Access to the Internet has spread worldwide, and new media platforms foster radical changes in the environments for creating and consuming music. Prof. Born investigates these developments, aiming systematically to advance the state of contemporary music research, while also contributing to social and media theory.

The core of this project entails six ethnographic studies of music and digitisation in six countries: Argentina, Canada, Cuba, India, Kenya and the UK. The comparative analysis of the resulting research data reveals some striking trends.

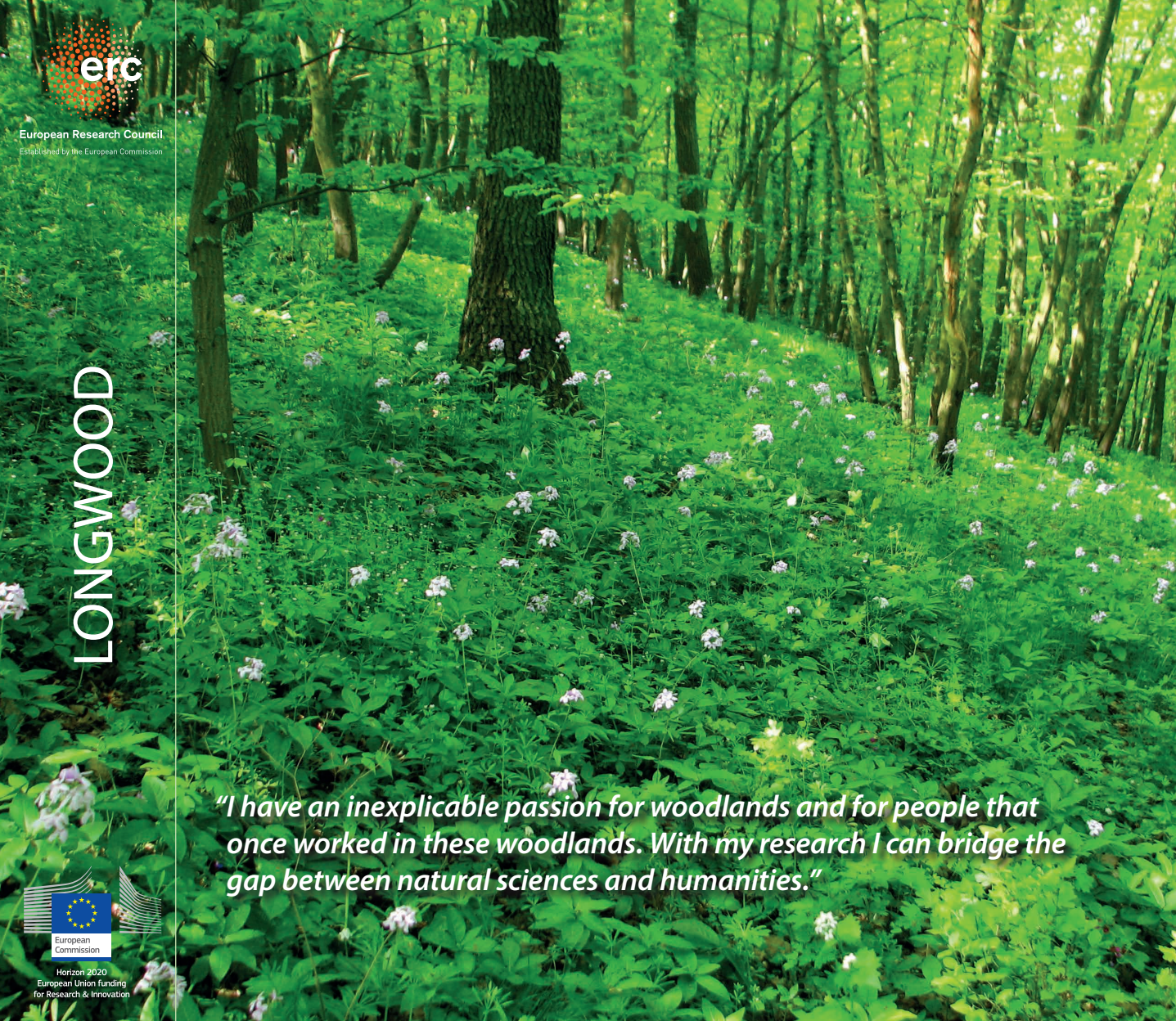
The line between professional and amateur musician is eroding, and musicians find it increasingly difficult to make a living. Informal music economies are expanding, while copyright law lags behind these realities. Music consumption oscillates between online and offline spheres and music's social dimensions are transforming. Ideas of "digital heritage" encourage local recording and online archiving of traditional musics, while the Internet is changing our relationship to music history. Popular and art digital genres that were dominant in recent decades (e.g. electronica, academic electroacoustic music) are being eclipsed by new trends (e.g. microsound, glitch and noise). Post-digital and hacking practices with the use of analogue media including vinyl, tape and basic electronics have emerged in reaction to the digital.

Based on this work, Prof. Born is developing a new framework for contemporary music studies. The interdisciplinary nature of the project will result in the creation of an innovative theory focused on music's mediation, integrating elements of social, anthropological and media theory.

Portrait: © Georgina Born
Image: Kenyan music producer Eric Musyoka at his studio in Nairobi.

Prof. Georgina Born
University of Oxford, United Kingdom

ERC project:
Music, digitisation, mediation: towards interdisciplinary music studies (MUSDIG)
Advanced Grant 2009, €1.7 million for five years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LONGWOOD
"I have an inexplicable passion for woodlands and for people that once worked in these woodlands. With my research I can bridge the gap between natural sciences and humanities."
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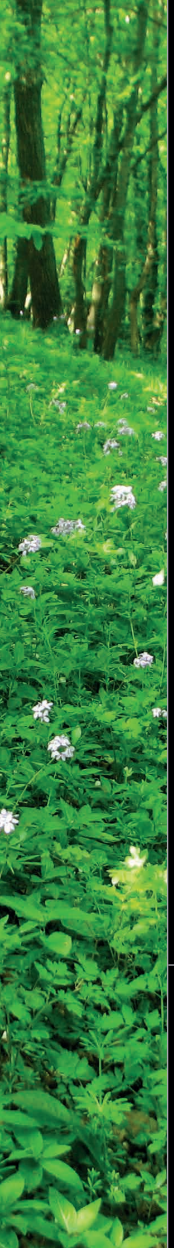


Exploring the history of Central European forests

Significant changes in woodland vegetation pose a long-term threat to native flora and fauna. To understand the functioning of current ecosystems, we need detailed knowledge on management history and on the driving forces of historical forest changes.

Central Europe was dominated by forests eight thousand years ago. Nowadays woodland covers only a third of this territory. The remaining woodlands have been profoundly influenced by and have co-evolved with human communities. However, the details of this complex process are poorly known.

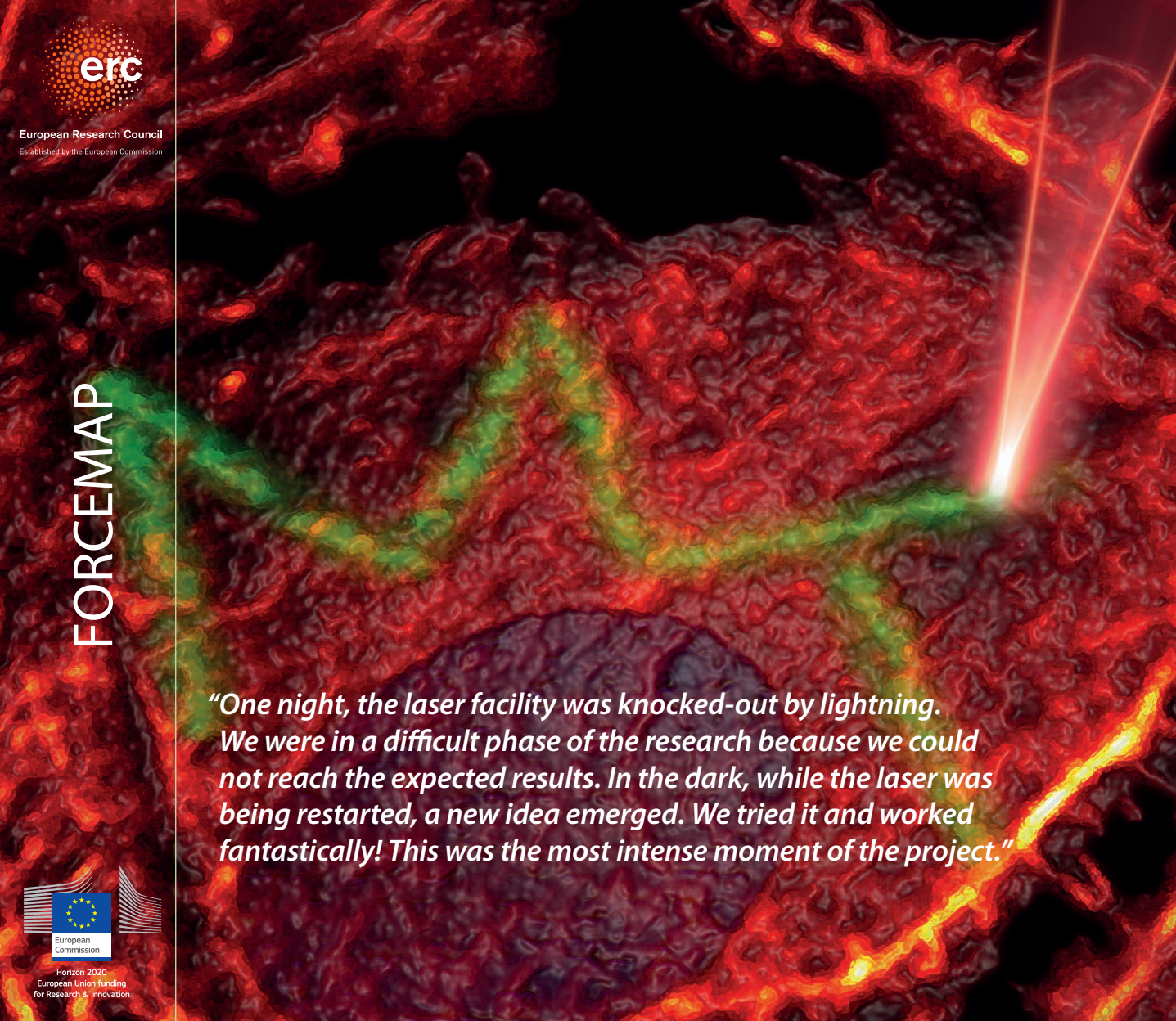
Dr Péter Szabó and his team have taken a widely interdisciplinary approach aiming at the reconstruction and analysis of the long-term dynamics of woodland cover, structure and species composition of a 27 000 km^2 area in the Czech Republic. Data from historical, ecological, archaeological and palynological sources have been collected in a common geo-database. The researchers have been working on a detailed spatio-temporal model of the development of wooded landscapes.

They have already created a new method for modelling human presence in prehistory, the outcome of which was compared with landscape models based on palaeoecological data. Their findings suggest strong connections between human occupation and the spread of oak and provided evidence for the presence of open landscapes for the past 11 000 years. The team have also mapped the distribution of different forest management types since the Middle Ages, which helps explain current patterns in herbaceous vegetation. They have documented and analysed dramatic changes in forest biodiversity since the mid-20th century, connected partly to climate change and partly to the abandonment of traditional management. Through experiments with such management techniques, the researchers have established the pros and cons of their possible reintroduction.

These new insights into the role of humans in shaping forest environments may, moreover, foster a paradigm shift in ecology by positioning humans as an internal, constitutive element of ecosystems.

Dr Péter Szabó
Institute of Botany CAS, Czech Republic

ERC project:
Long-term woodland dynamics in Central Europe: from estimations to a realistic model (LONGWOOD)
Starting Grant 2011, €1.4 million for five years



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FORCEMAP

"One night, the laser facility was knocked-out by lightning. We were in a difficult phase of the research because we could not reach the expected results. In the dark, while the laser was being restarted, a new idea emerged. We tried it and worked fantastically! This was the most intense moment of the project."

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Molecular tattooing for local, targeted drug-delivery

Dr Málnási-Csizmadia focuses on enzymes, proteins essential for body functions, and the largely unexplored intricate mechanisms underlying their activity. His recent findings could open the way to a ground-breaking development in pharmacology, especially in targeted cancer therapy.

Enzymes can be found in large numbers in cells where they play a significant role as catalysts: they accelerate chemical reactions in processes such as digestion or blood coagulation. With his ERC project, Dr Málnási-Csizmadia aimed to investigate what drives the functioning of enzymes and to develop specific techniques to measure these phenomena with high spatial and temporal resolution. In particular, his highly interdisciplinary research team applied a series of novel experimental and theoretical approaches combining molecular biology, organic chemistry and computational physics to create detailed maps of forces and energy flows in enzymes. These maps could help scientists to design new drugs that could influence enzymatic processes.

While working on these mapping techniques, the researchers discovered a new photochemical reaction - induced by laser - which led to the development of a pioneering technology they called molecular tattooing. The technology can confine permanent drug effects precisely and locally, without any side effects outside the targeted area. The team synthesized specific photoreactive drugs and performed experiments in vitro and in vivo: they succeeded, for the first time, in localizing permanent drug effects in live animals. Since the drug effect is exerted exclusively in the "tattooed" region, even toxic compounds could be locally applied for treatments which are otherwise lethal for the whole organism.

Following these results, Dr Málnási-Csizmadia was awarded a Proof of Concept grant to establish a spin-off company providing for technology transfer in research and to the health industry. Based in Hungary, the company will develop novel photochemical drugs and scanning microscopy tools.

Portrait: © András Málnási-Csizmadia
Image: Illustration of Molecular Tattoo © András Málnási-Csizmadia's lab

Dr András Málnási-Csizmadia
Eötvös Loránd University, Hungary

ERC projects:

Intramolecular force mapping of enzymes in action: the role of strain in motor mechanisms (FORCEMAP) Starting Grant 2007, €700 000 for five years

Molecular tattooing: azidated compounds pave the path towards light-activated covalent inhibitors for drug development (AZIDRUGS). Proof of Concept Grant 2013, €150 000

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FORCE

"Whenever I describe the mysteries of the Dark Universe, I marvel at how far our understanding has come, and how much further we have to go."

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Setting eyes on the dark side of the universe

More than 95% of our universe comes in the mysterious form of dark matter and dark energy that we can neither explain nor directly detect. Dr Catherine Heymans leads a team of researchers who were the first to "map" dark matter on the largest of scales. She now uses her research to confront Einstein's theory of general relativity in an attempt to explain the nature of dark energy.

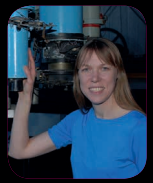
Early in the twentieth century, Einstein revolutionised our understanding of fundamental physics by concluding that mass can warp the very fabric of space and time. Using a powerful new astronomical technique called gravitational lensing, astronomers can directly observe the way in which the light from very distant galaxies is bent as it passes through large structures of matter in the universe.

With her FORCE project, Dr Heymans uses this light-bending effect to map the invisible dark matter in the universe. She collected the most comprehensive data from one of the world-leading surveys of the universe: the Canada-France-Hawaii Telescope Lensing Survey (CFHTLenS). When analysing the deep astronomical imaging, Dr Heymans and her team looked at the light from over ten million galaxies, some six billion light years away. Their images provided a very first glimpse of the intricate cosmic web of dark matter and galaxies, spanning more than one billion light years across.

Progress in probing and mapping the dark universe may have far-ranging implications. It is indeed widely believed that, in order to understand its nature, we will need to invoke new physics that will forever change our cosmic view, bringing into question our knowledge of fundamental physics.

By combining observations of the motion of galaxies and light in different gravitational fields, Dr Heymans' team found their measurements to be in full agreement with Einstein's theory of general relativity. This was the first time the theory of gravity had been tested on some of the largest cosmological scales in the universe.

Portrait: © Catherine Heymans
Image: NASA, ESA, the Hubble Heritage Team (STScI/AURA), J. Blakeslee (NRC Herzberg Astrophysics Program, Dominion Astrophysical Observatory), and H. Ford (JHU). www.spacetelescope.org



Dr Catherine Heymans
University of Edinburgh, United Kingdom

ERC project:
Fine observations of the rate of cosmic expansion: combining the powers of weak gravitational lensing and baryon acoustic oscillations as probes of dark energy (FORCE)
Starting Grant 2009, €1.2 million for five years

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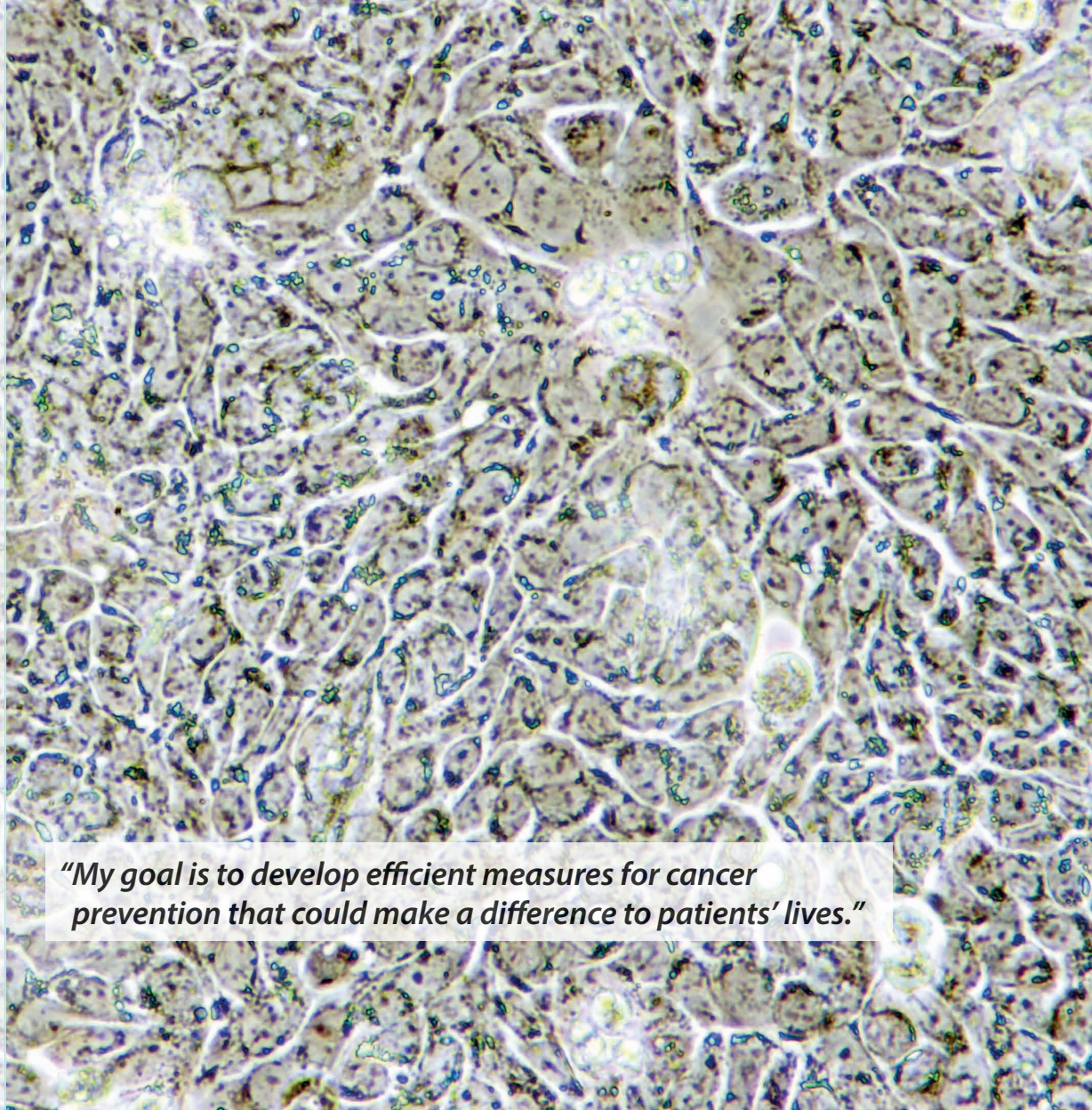
EPISUSCEPTIBILITY



"My goal is to develop efficient measures for cancer prevention that could make a difference to patients' lives."

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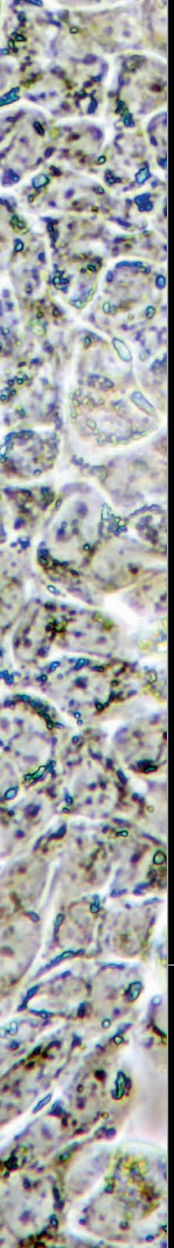

An early detection kit for colorectal cancer

Prevention and early detection largely determine the outcome of most cancers. Prof. Päivi Peltomäki studies how tumours arise and progress, with a view to identifying biomarkers of our susceptibility to developing cancer. With the ERC grant, the team has created a single-step, early diagnosis kit for colorectal cancer.

Prof. Peltomäki aims to shed light on the interactions between our genes and our environment as cancer arises. She looks, in particular at epigenetic variations - changes at cellular or physiological level that are not caused by genetic modifications. Unlike changes in our DNA, epigenetic alterations are potentially reversible, which makes them promising targets for prevention and future treatments.

Her team focuses on colorectal cancer and it has shown that one of its main causes is a defect in our "DNA mismatch repair" (MMR) system, which, in normal circumstances, recognises and corrects errors that can occur when our DNA replicates. With a Proof of Concept grant, the researchers looked into an inherited MMR deficiency known as Lynch syndrome and could develop a diagnosis kit for this condition. People with Lynch syndrome have a dramatically increased risk of developing colorectal cancer in their lifetime: up to a 70% chance compared to 6% in the general population. They also have a higher risk of developing several other cancers.

The diagnostic strategy proposed by Prof. Päivi Peltomäki consists of a single step: the detection of decreased MMR capacity in a normal tissue. It could replace the traditional diagnostic workflow, usually including tumour studies, blood tests and a biopsy of an already established tumour. The method is also effective for people who do not have family members with cancer and whose genetic tests show no detectable change.

A spin-off company is now testing this one-step diagnosis kit. If successful, it could constitute an attractive, cost-efficient tool for healthcare providers to identify inherited cancer predisposition.

Prof. Päivi Peltomäki
University of Helsinki, Finland

ERC projects:

Epigenome and cancer susceptibility (EPISUSCEPTIBILITY), Advanced Grant 2008, €2.5 million for five years

Functional DNA mismatch repair assay on normal tissue for the detection of hereditary cancer predisposition (DIAGMMR), Proof of Concept Grant 2011, €150 000


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BIOCOM
"We must develop tools to monitor drylands' ecosystems, forecast their evolution and detect desertification before it becomes irreversible."
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Minimizing the effects of climate change on drylands

Drylands cover 41% of the Earth's land surface and support some 38% of the human population for goods and services. However, because of their aridity, they are highly vulnerable to global environmental changes. Prof. Fernando T. Maestre studies how biodiversity enhances the ability of drylands to maintain their essential functions and their ecosystems worldwide.

Climate change has been the subject of many scientific studies, but Prof. Maestre and his team have chosen a rather unusual approach to their study. Instead of focusing on the impact of environmental change on the evolution of ecosystems in terms of biodiversity, their starting point is the study of the inherent species in drylands, including their spatial distribution.

These spatial patterns may have an important influence on the functional processes of the ecosystem, such as nutrient cycling and water infiltration in soils or the regulation of CO_2 exchanges with the atmosphere. Laboratory experiments have suggested that biodiversity allowed drylands to maintain these multiple functions simultaneously, with positive follow-up effects, such as a better control of soil erosion. With his ERC grant, Prof. Maestre has, for the first time, provided empirical evidence of the relationship between the ecosystem's community attributes and its functional processes at the global level.

His team surveyed 224 dryland areas in 17 countries across all continents except Antarctica. Their results show that plant species' diversity may contribute to maintaining the multi-functionality of drylands. On the other hand, increased aridity will reduce carbon and nitrogen in the soil, and raise phosphorus levels. Plants, however, need these elements in the right balance. If temperatures rise, as currently predicted, drylands' essential soil processes could be affected, and their productivity reduced.

By studying different biotic communities and combining multiple modelling schemes, Prof. Maestre hopes to generalize the results. His objective is to establish concrete mitigation actions to contain the negative effects of global warming on drylands, including loss of soil fertility and desertification.

Portrait: © María Dolores Puche Herrero
Image: Semiarid landscape in Argentina © Juan Gaitán

Prof. Fernando T. Maestre
King Juan Carlos University, Spain

ERC project:
Biotic community attributes and ecosystem functioning: implications for predicting and mitigating global change impacts (BIOCOM)
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The role of civil society in democratization processes

What do the Velvet revolution, the transitions in Baltic countries in the 1990s and the Gezi Park protests in Istanbul have in common? Prof. Donatella Della Porta is leading an ambitious project to compare the most relevant democratization processes led by social movements of the last 25 years.

Civil society studies have lately gained a lot of momentum. Prof. Della Porta is particularly interested in analysing the role of civil society organizations in the recent democratization processes across Europe and its neighbouring countries. Her research team has carried out a comparative analysis of a wide variety of cases, ranging from social movements that broke under authoritarian regimes, such as the transitions in the former USSR and in ex-Yugoslavia in the 1990, to those developed during progressive democracy consolidation stages, such as the 2011 Egyptian revolution in the midst of the Arab Spring.

This ERC project looks, for the first time, at democratization processes through the lens of social movements' research. According to Prof. Della Porta, so far, social movements' studies have missed the importance of social perceptions when addressing the recent pro-democracy protests.

In order to understand the role played by civil society organizations in the different democratization stages, the researchers analysed both the contextual and historical characteristics as well as the actors' strategies. The first results confirmed the importance of social mobilization in transitions to democracy and showed that, in the cases studied, despite the variety of contexts, there are strong similarities in the participation of civil society in these processes.

Besides focusing on the intervention of social movements during democratic transition periods, Prof. Della Porta has also studied the long-term participation of civil society actors in democracy consolidation processes and the effects of mass mobilization on the quality of democracy.

Prof. Donatella Della Porta
European University Institute, Italy

ERC project:
Mobilizing for democracy: democratization processes and the mobilization of civil society (MOBILIZING4DEMOCRACY)
Advanced Grant 2010, €1.7 million for five years