BiodivERsA 2012-2013 call for proposals

Invasive species and biological invasions

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The ERA-NET promoting European Research on biodiversity and ecosystem services

The BiodivERsA2 partners

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Department for Environment, Food and Rural Affairs (DEFRA), UNITED KINGDOM

Joint Nature Conservation Committee (JNCC), UNITED KINGDOM

Natural Environment Research Council (NERC), UNITED KINGDOM

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From the coordinator:

Xavier Le Roux,
BiodivERsA Coordinator and CEO

The import of the red-eared slider, the best-seller of pet stores for a long time, has finally been prohibited in 1997 in Europe. And for good reasons…

Originating from the United States, red-eared sliders have been massively imported in the 1970-80s in Europe and Asia. Between 1989 and 1997, US commercial farms exported at least 52 millions individuals. Attracted by its low price and small size at birth, many consumers bought these red-eared sliders as pet, not knowing that they can exceed 1.5 kg within 2-3 years. Many owners consequently released their turtles into the wild, where they harmed native fauna and flora.

Acclimating to our aquatic ecosystems, and in the absence of their natural predators, red-eared slider populations have expanded in Europe. This represents a threat to many native species and particularly to the endangered European pond turtle, which is now in competition for food and habitat with red-eared slider. Moreover red-eared sliders contribute to the spread of diseases and parasites that could affect native turtles and other aquatic wildlife and carry diseases harmful to humans and many other species, such as Salmonella. For these different reasons, red-eared sliders are considered among the hundred worst invasive alien species in Europe.

Biological invasions: a major component of global environmental change, promoted by our mobile society

The red-eared slider is just one example of invasive species that has spread into Europe during the last decades. Other well-known examples of invasive species include the tiger mosquito, or the common ragweed. Intentionally introduced, as it is the case for some plants or animals (including the red-eared slider) or unintentionally introduced through, for example, transport of goods (which is the case of the tiger mosquito and common ragweed), invasive species are species introduced by humans and that can spread outside their natural range.

Their number is increasing: in Europe, over 10,000 invasive species have been recorded and the number of introduction has increased by 76% over the past 30 years. This can be largely explained by the intensification of trade flows and human movements worldwide which has led to the removal of natural barriers and increased contacts between species, which are thus in competition for food and habitat. In the mid 1990s, Peter Vitousek and colleagues had already identified biological invasions

as a major component of global environmental change, indicating that our mobile society is redistributing the species on the earth at a pace that challenges ecosystems, threatens human health and strains economies.

"Invasive species may threaten biodiversity and have negative impacts on the economy and human health"

Ecological impacts of invasive species can be negative, but it cannot be presumed that all species invasions are damaging. However, biological invasions seem to have been a key factor in 54% of known animal extinctions and the only factor for 20% of extinctions. Invasive species are also impacting on economy and human health. The cost to control, prevent, monitor and respond to biological invasion in Europe has been estimated to more than 12,5 billion euro per year.

To address the challenges related to biological invasions, the international community has implemented policies and common strategies. The Convention for Biological Diversity (CBD) has adopted a strategic plan, which includes one specific target related to invasive species. At the European level, one of the six objectives of the EU Biodiversity Strategy for 2020, adopted in May 2011, is related to invasive alien species. In addition, a Regulation on the prevention and management of the introduction and spread of invasive alien species has been proposed by the European Commission and is under examination by the European Council and Parliament. Yet the European countries and the European Union efforts to build a consistent and comprehensive strategy to deal with invasive species challenges fall short of the challenges raised by the issue.

In parallel, research on biological invasions has generated much knowledge on many different aspects of this phenomenon, in particular causes of biological invasions and impacts of invasions. However, recent literature surveys – e.g. that of Edward Lowry and colleagues – highlight important gaps in areas of theoretical and practical importance.

Actually the significance of biological invasions does not always lead to the corresponding prioritization on the political agenda, either in terms of research programming, management actions, and policy making.

BiodivERsA is a network (ERA-Net) of currently 21 national organisations from 15 European countries that program and fund research on biodiversity and ecosystem services. Because the issue of biodiversity loss and ecosystem service degradation has to be tackled not only at the local but also regional and global scales, we clearly need to better integrate biodiversity research across borders, in particular in Europe. BiodivERsA partners identify pressing issues for research across Europe both in terms of cutting edge science and policy relevance. They define a common agenda, setting common priorities for research on biodiversity and ecosystem services. These priorities are notably addressed in the calls regularly launched by BiodivERsA since 2008.

"As a regular funding source of research on biodiversity and ecosystem services, BiodivERsA partners have raised 50 million euro since 2008"

"The 2012-2013 call allowed to fund nine projects for an amount of 8.8 million euro"

The launch of a BiodivERsA call on "Invasive species and biological invasions" reflected the high priority of this topic for the BiodivERsA partners and its importance at the European level. It aimed at providing new relevant knowledge and encouraging Europe to take concrete steps to improve the situation and to propose solutions to better understand and manage biological invasions.

The Norwegian BiodivERsA partner RCN was in charge of the Call Secretariat and contributed to the smooth implementation of the call and to its success. This was challenging because the call was extremely popular and attracted 77 full proposals. A large range of natural sciences as well as social sciences were mobilised through this call. Collaboration within cross-disciplinary teams is indeed needed to properly understand and ultimately propose guidelines to respond to the adverse effects of biological invasions on socio-ecosystems.

The necessity to consolidate the link between the researchers and relevant stakeholders including policy makers was also at the heart of this call. It was a crucial aspect for proposals to be selected.

Both the scientific excellence and the capacity to mobilize stakeholders of the submitted proposals were assessed by an independent team of experts. At the end, nine projects were selected for funding, for an amount of 8.8 million euro.

This brochure presents an overview of the selected projects. It also gives an insight in the development of the call, the profile of submitted proposals and the evaluation process of the proposals.

Xavier LE ROUX
Coordinator and CEO of BiodivERsA
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Lyon, France 14 August 2014

Red-eared sliders

Development of the call text

BiodivERsA2 partners have developed an innovative mechanism for the selection of top priorities in the biodiversity and ecosystem services research field. This scheme takes the form of a common rolling agenda built upon existing partner's research priorities, while accounting for national and international agendas and strategies and the identification of possible gaps in the scientific knowledge.

Considering different aspects, from the strategic relevance of the topic to its European added value and socio-political relevance, BiodivERsA partners have decided during the General Assembly of the ERA-Net held in May 2012 in Stockholm, to launch their fourth call on the theme "Invasive species and biological invasions".

11 funding agencies from 10 different countries joined this call:

- FWF – Austria
- BelSPO – Belgium
- BSF – Bulgaria
- ANR – France
- ONEMA – France
- DFG – Germany
- RCL – Lithuania
- RCN – Norway
- FCT – Portugal
- Formas – Sweden
- MFAL - Turkey

The Norwegian BiodivERsA partners, RCN, was hosting the Call Secretariat and hence greatly contributed to the success of the call.

The call was published on 1st November 2012 with a deadline for submission of full proposals on 13th February 2013. Projects were evaluated between end February and 23-24 May 2013, i.e. the final meeting of the Evaluation Committee.

The funding decision was published in the course of June, allowing an earliest possible starting date of the funded projects in the fall 2013.

Summary of the 2012-2013 BiodivERsA call

Designed around the major challenge of "Invasive species and ecological invasions", the call addressed the five following topics:

1) Demonstrating and characterising the impacts of biological invaders

Biological invaders are primarily defined through the presence of an impact (in particular ecological or economical, positive or negative), but definitions vary among scientists and stakeholders. Research should thus focus on better understanding of the different impacts of introduced species with the aim to increase awareness amongst decision-makers to help them decide, design and prioritise action plans.

2) Understanding mechanisms of biological invasions and levers for mitigating and/or reversing the impacts of biological invaders

Understanding why some species are successful invaders, and others are not and why some ecosystems are more vulnerable to invasions than others is crucial for developing efficient management plans preventing biological invasions or mitigating their negative impact. Research priority should be given to studying the key mechanisms that determine the success of invasion, and analysing approaches to prevent, mitigate or reverse the effects of biological invaders.

3) Evaluating the interactions between biological invasions and other global environmental changes

Biological invasions are one of the categories of global changes that affect biodiversity and ecosystem functioning. Yet, considering biological invasions in isolation is not relevant. Emphasis should thus be put on the interactions between biological invasions and other global changes (i.e. climate changes, land use changes or habitat degradation, urbanisation, global exchanges).

4) Biological invasions and public perceptions

Compared to other major causes of biodiversity loss, such as habitat destruction, climate change or environmental contamination, biological invasions are rarely taken into account by key actors nor by the general public, partly because they lack understanding of the causes, effects and impacts of invasive species. A special focus will be put on research allowing for a better understanding of public perceptions of biological invasions, and on possible conflicts between the public and the management.

5) Biological invasions and adaptation

One key issue of biological invasions is the maladaptation between newly introduced species and the recipient communities, a state that conditions the fate of the introduction. Research is therefore needed to better understanding the evolutionary mechanisms involved in biological invasions (for both invasive species and invaded communities).

Evaluation process

The evaluation of the research proposals was completed in two steps. First an evaluation committee (EC) was assembled made up of experts from the natural and social science field as well as professionals from the field of biodiversity. These experts were divided between two sub-committees, a scientific sub-committee assessing the scientific quality of the proposals and a policy subcommittee assessing the policy relevance, respectively led by Montserrat Vilà and Simon Gardner.

In addition to the assessment performed by the members of the EC, international peer reviews were organized and external reviewers assessed both scientific quality and policy relevance of the proposals within this framework.

The evaluation was implemented following specific guidelines and criteria established for each subcommittee: 11 criteria were defined for scientific excellence and 5 for policy relevance. Hence, two grades were assigned per proposal – one for scientific excellence and one for policy relevance, with a predefined slight emphasis on scientific excellence over policy relevance.

The final evaluation meeting took place on 23-24th May 2014. Each sub-committee first met separately to attribute grades to each proposal. They then gathered together to discuss about the proposals and to agree on the final ranking of the projects to propose to the Call Steering Committee (CSC).

Black rat (rattus rattus)

From the Evaluation Committee chairs

"Invasive species and biological invasions" was a timely and exciting BiodivERsA call tackling several aspects of this element of global change, which has not been as well studied as climate change or land-use change. Proposal topics received focused on: the ecology and evolution of invasive species, their ecological and socio-economic impacts, ways to mitigate and adapt to these impacts, and how society perceives and responds to them. Most proposals considered several of these topics, across a wide range of taxa, ecosystem types and geographical areas. This required expertise from many research fields (such as genetics, ecology, economy, conservation biology, forestry and sociology), highlighting the interdisciplinary nature of the call. Proposals also typically included a large variety of methodological approaches such as field and laboratory experiments, large-scale field surveys, remote sensing analysis and modelling.

Biological invasions have a strong environmental management and biodiversity conservation component. Therefore, the linkage to policy drivers, the need for well-planned stakeholder engagement and knowledge transfer, and a commitment for co-design and co-delivery were all important elements for a successful proposal. A shared awareness of the importance of these aspects made it easier for the scientific evaluation sub-committee and the policy relevance evaluation sub-committee to agree on the strongest proposals. Funded proposals will thus provide outstanding science as well as reinforce the European strategy on invasive species.

The BiodivERsA 2012-2013 call was extremely popular, and attracted 77 applications, i.e. +50% as compared to previous BiodivERsA calls. However, as the total funding was about the same as in previous years, only 9 of these proposals could get funded, probably leaving many high quality consortia disappointed. Nevertheless, the call itself has triggered significant multi-disciplinary collaborations, and has strengthened networking between academics and stakeholders with an interest in biological invasions. The call process has catalyzed research thinking in this important area, and will stimulate future European research collaborations.

We would like to congratulate the successful projects that have received funding, and to encourage unsuccessful consortia to pursue on their plans for multidisciplinary research on invasive species and biological invasions. We would also like to acknowledge the expertise and committed work undertaken by members of the Evaluation Committee and external reviewers. Special thanks is also due to the staff of the Research Council of Norway for their constant guidance and professionalism during the evaluation process, and to the BiodivERsA consortium for stimulating and supporting such an important research area.

Prof. Montserrat Vilà
Deputy Director, Estación Biológica de Doñana (EBD-CSIC), Sevilla

Dr. Simon Gardner
Evidence Manager, Environment Agency, Bristol

Composition of the Evaluation Committee

Scientific Evaluation sub-committee (SEC)

VILÀ Montserrat – SPAIN **(Chair of the SEC & Evaluation Committee)**
BANIULIS Danas – LITHUANIA
BOIVIN Thomas – FRANCE
BOLLACHE Loïc – FRANCE
CARRETE Martina – SPAIN
DE DEYN Gerlinde – THE NETHERLANDS
DUPAS Stéphane – FRANCE
EVANS Hugh – UNITED KINGDOM
FISCHER Markus – SWITZERLAND
GARCÍA-BERTHOU Emili – SPAIN
HODDLE Mark – USA
MEDLOCK Jolyon – UNITED KINGDOM
MOKSNESS Erlend – NORWAY
NIGHTINGALE Andrea – SWEDEN
RUIZ Gregory – USA
SJOTUN Inga Kjersti – NORWAY
STEDJE Brita – NORWAY
TAN Ayfer – TURKEY
WEISS Steven J. – AUSTRIA
WIRTH Christian – GERMANY

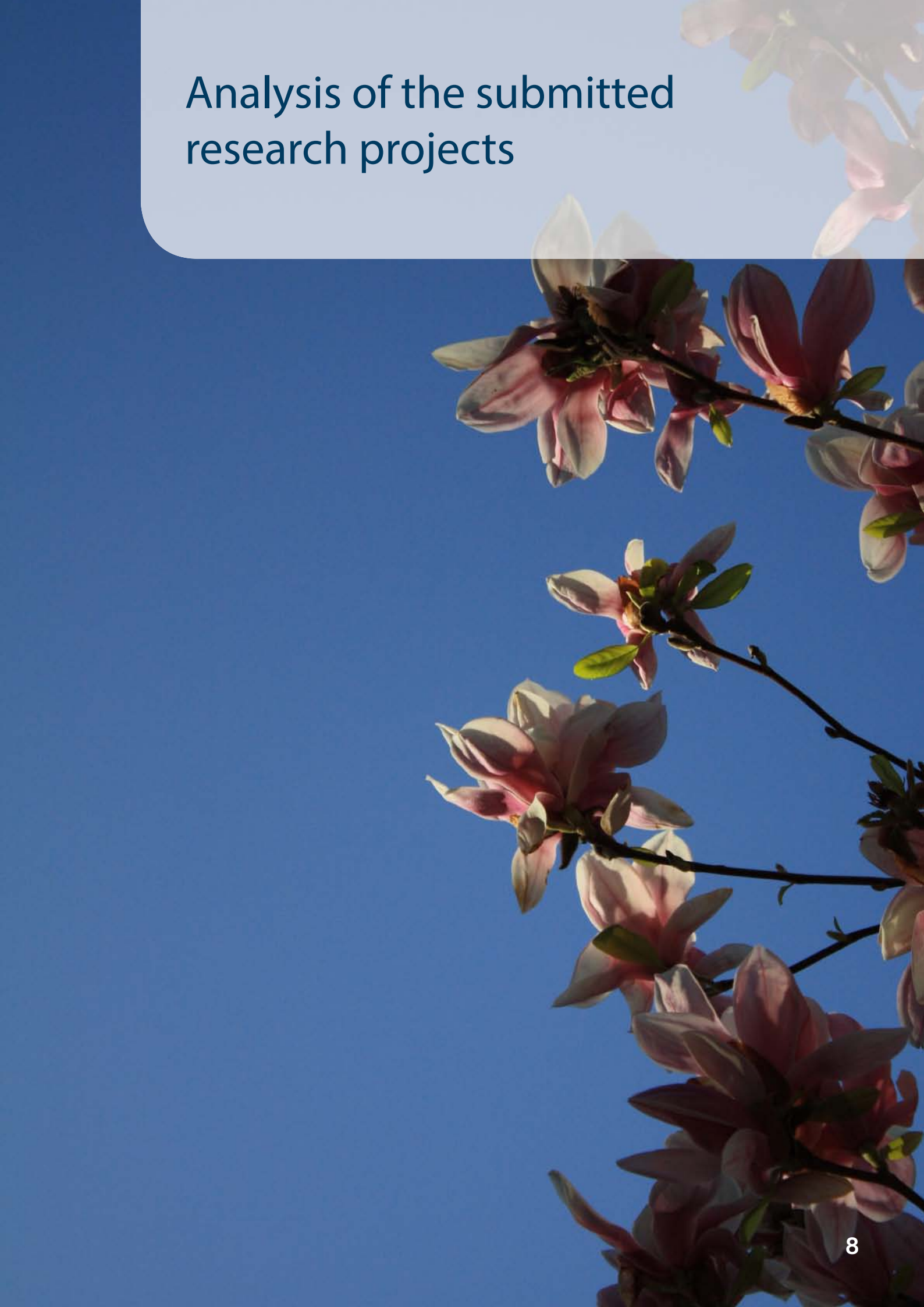
Policy Evaluation sub-committee (PEC)

GARDNER Simon – UNITED KINGDOM **(Chair of the PEC ; Vice-Chair of the Evaluation Committee)**
BARSIENE Janina – LITHUANIA
BECK Erwin – GERMANY
CAPDEVILLA-ARGÜELLES Laura – SPAIN
SÁNCHEZ Elías Dana – SPAIN
HAMMARSTEN Stig – SWEDEN
HUBERT Claire – FRANCE
JOSEFSSON Melanie – SWEDEN
KRUESS Andreas – GERMANY
MANUSADZIANAS Levonas – LITHUANIA
MARIS Virginie – FRANCE
MOORE Niall – UNITED KINGDOM
PENNANEN Taina – FINLAND
PLESNIK Jan – CZECH REPUBLIC
PÖCKL Manfred – AUSTRIA
ROCHE Philip – FRANCE
ROY Helen – UNITED KINGDOM
THOMAS Alban – FRANCE
VAN GOSSUM Hans – BELGIUM
ØDEGAARD Esten – NORWAY


Montserrat Vilà


Simon Gardner

Analysis of the submitted research projects



Analysis of the submitted research projects

Overall figures of the call

With 77 full proposals submitted, 541 participating teams and 1741 individual participants, the 2012-2013 BiodivERsA joint call was a real success. It attracted more applicants than in the previous BiodivERsA calls, which demonstrates the interest of the European research community for this call topic.

Reaching a success rate over 11%, this call resulted in the funding of nine excellent pan-European projects.

	No. of proposals (No. of eligible teams)	Budget
Submitted proposals	77 (541)	66.7M€
Selected proposals	9 (55)	8.9M€
Success rate	11.4%	13.4%

Thanks to a good anticipation of the required budget for each participating country and to the flexibility of several partners who agreed to increase their budget as appropriate, final funding figures were slightly above the total initial reserved budget.

Nationality of the applicants

BiodivERsA joint calls promote pan-European research although self-financed partners from other countries are allowed to take part in the consortia.

84% of the 541 teams who submitted proposals came from the 10 countries funding of call while 15.5% came from other geographical area (self-funded applicants) (Fig. 1).

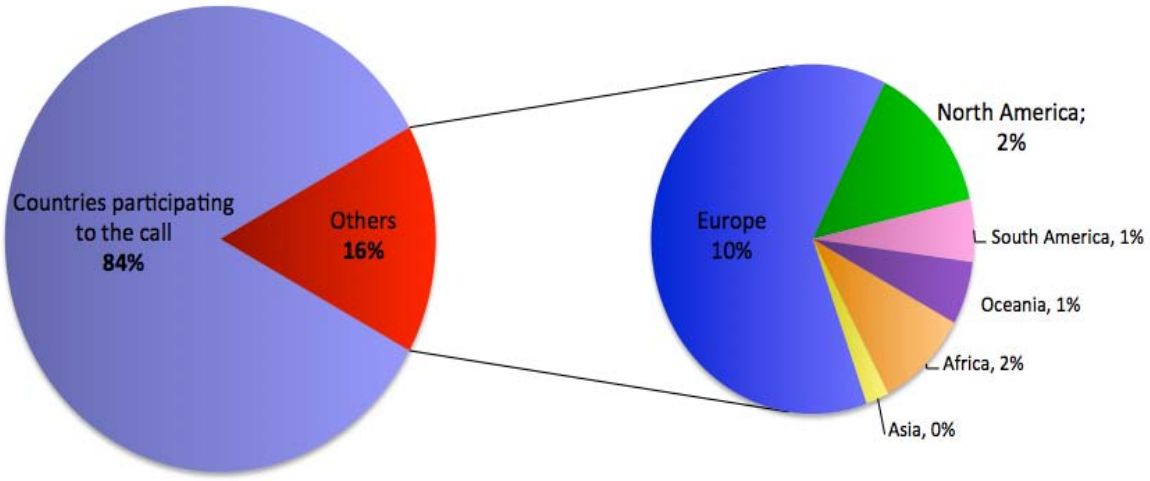


Fig.1: Geographical origin of the participating teams in the BiodivERsA 2012-2013 call

Countries participating to the call: Austria, Belgium, Bulgaria, France, Germany, Lithuania, Norway, Portugal, Sweden, and Turkey

Other European countries (EU28): Czech Republic, Denmark, Estonia, Finland, Greece, Hungary, Italy, Latvia, Spain, The Netherlands, United Kingdom,

Europe- other: Switzerland

Others: North America (Canada, USA); South America (Argentina, Bolivia, Peru); Oceania (Australia, New Zealand); Africa (Burkina Faso, Madagascar, Morocco, South Africa); Asia (Cambodia, Russia)

Reserved and requested budgets, and funding model

The reserved budgets per country were published during the announcement of the call, which might have influenced some of the budget requests made by applicants. The highest values of both reserved and requested budgets were indeed observed for France, Germany, and Sweden, and to a lesser extent for Austria and Belgium (Figs. 2 and 3).

Even when the reserved budget proved insufficient (as it was the case for the Belgian, French, German and Swedish partners), it did not cause an issue thanks to the flexibility of the partners. Ultimately, the nine top ranked projects could be funded, strictly following the ranking list established by the evaluation committee.

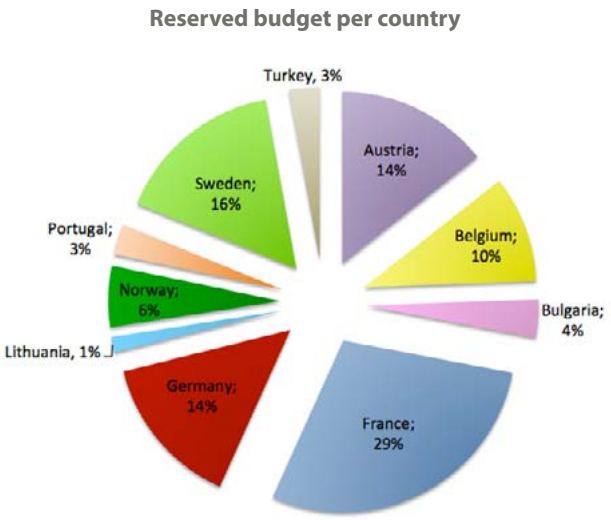


Fig. 2: Distribution of the reserved budget among participating countries

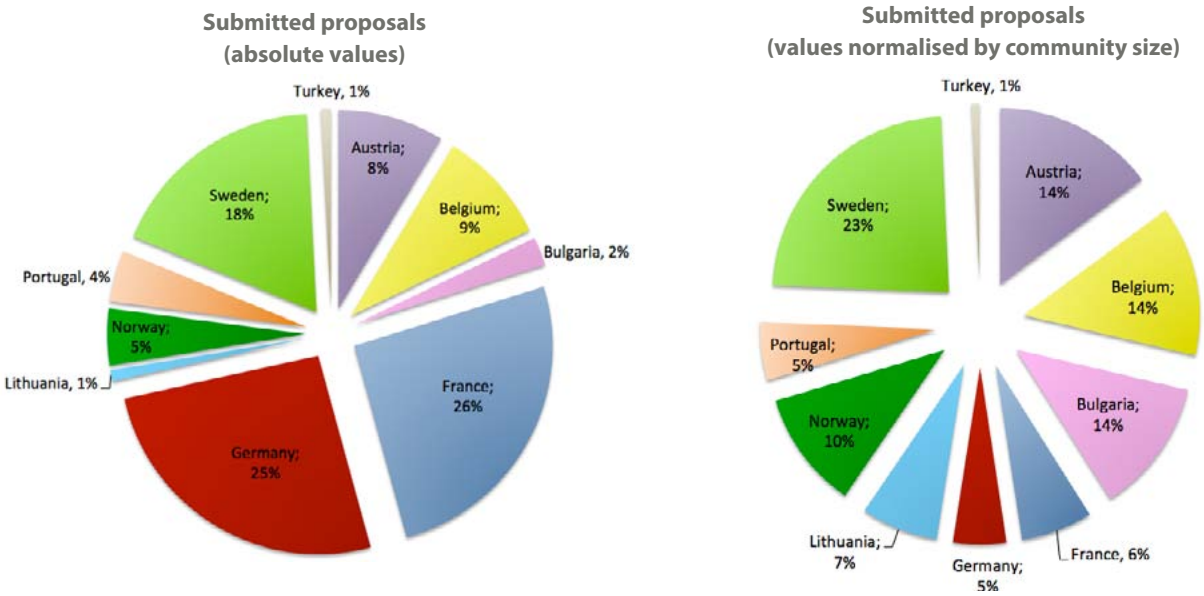


Fig. 3: Budget requested by applicants among countries in absolute values (left) and values normalised according to the size of the national scientific community (right) [Source: Eurostat 2011 – all sectors, Full Time Equivalent unit]

Despite a relatively low participation in terms of required budget (Fig. 3), the biodiversity scientific communities from Bulgaria and Lithuania seem to have responded well to this call once the budget requests are normalised according to the estimated number of researchers from all scientific areas in each country (Fig. 3). However, there is no available data to know precisely the size of the specifically targeted biodiversity research community within the overall research community of each country, which would have improved the normalization.

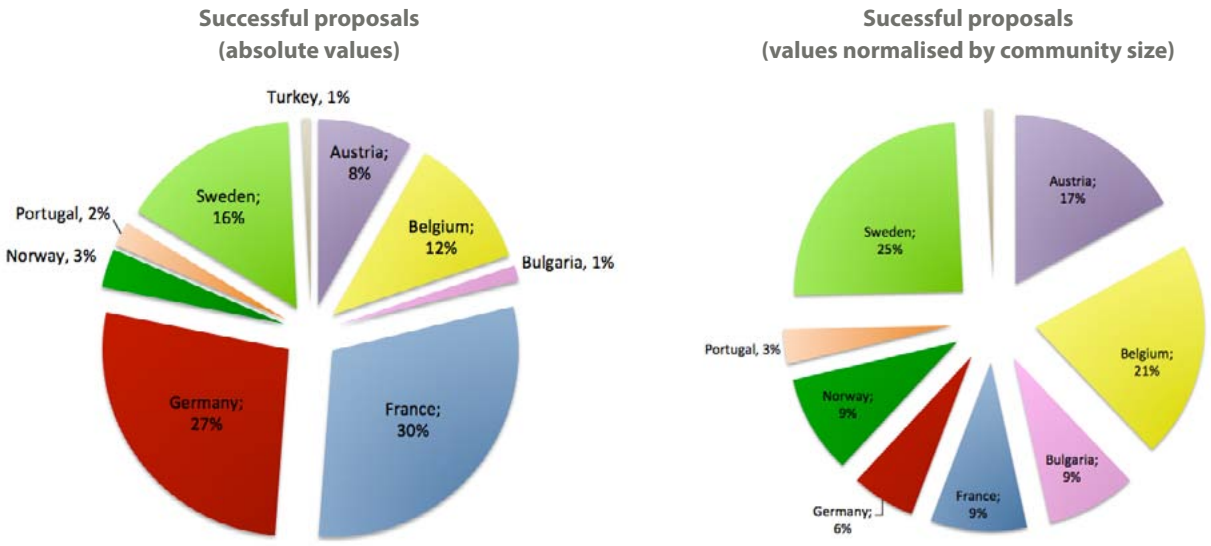


Fig. 4: Distribution of awarded budget to the successful applicants among countries (left) in absolute value and (right) in value normalised according to the size of the national scientific community [Source: Eurostat 2011 – all sectors, Full Time Equivalent unit]

Funded teams come from nine different countries (Fig. 4). A large number of funded teams come from countries providing the largest amounts of funding, namely France, Germany and Sweden. Again, it is worth comparing the funding amounts between countries in terms of both absolute values and amounts normalised according to the estimated number of researcher from all scientific area in each country (both panels of Fig. 4), This better highlights the success observed for other countries as Austria, Belgium, Bulgaria and Norway. Despite the participation of Lithuania to the call, none of the nine funded projects involved a research team from this country, likely due to the too low number of proposals including Lithuanian teams.

The Belgian, French and German research teams applying to this call had a particularly good success rate, i.e. ratio of granted to requested funded amounts (Fig. 5). The figures should be viewed with caution for some countries given their low number of submitted proposals.

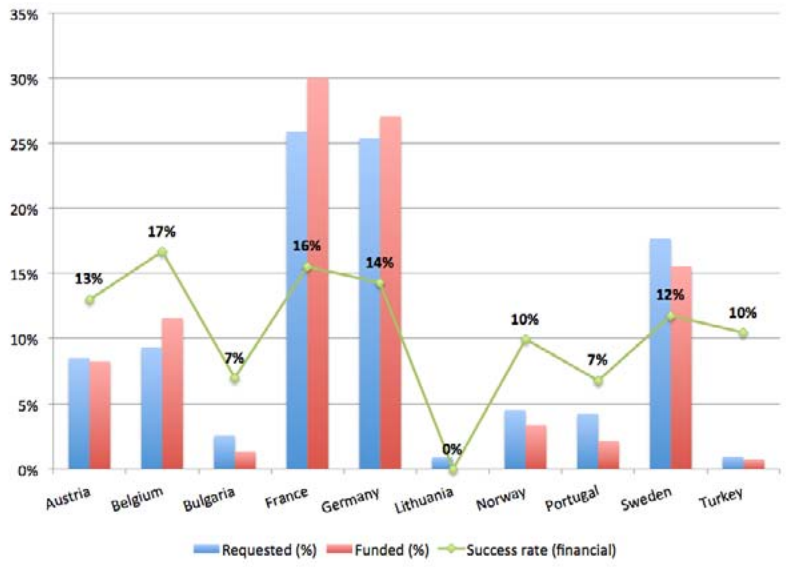


Fig. 5: Comparison of the percentage of budgets in the proposals between countries at the submission phase (requested – blue bars) and after selection (funded – red bars), along with the financial success rate (green line).

Proposal coordination

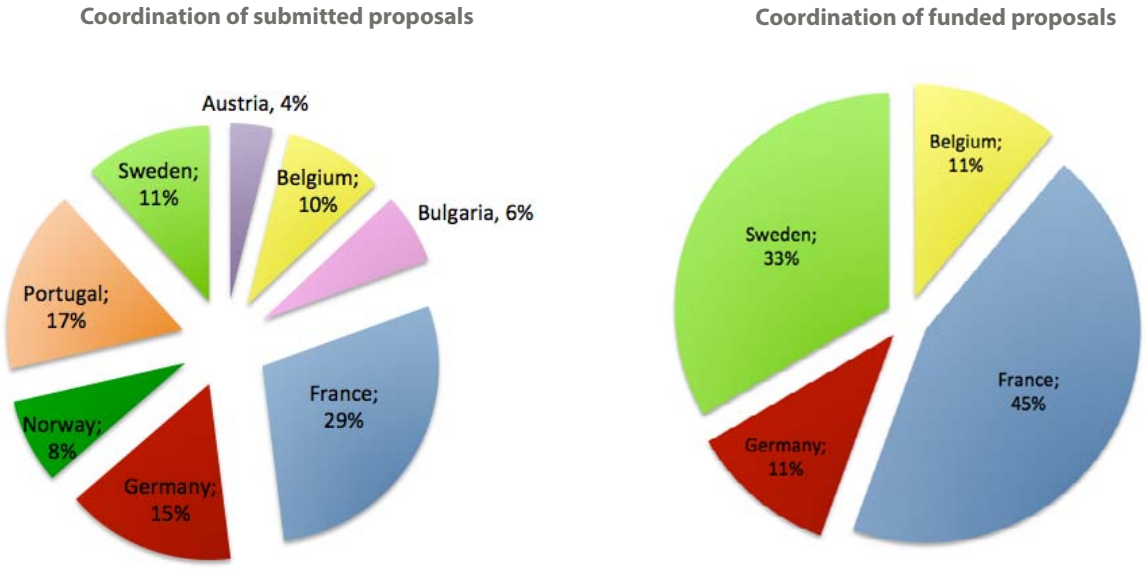


Fig. 6: Percentage of total requested budget according to the country of the coordinators for submitted (left) and funded (right) proposals.

At the submission stage, the proposed project coordinators represented all countries participating in the call, except for Lithuania and Turkey (Fig. 6). The coordinators of the proposals ultimately funded came from Belgium, France, Germany and Sweden. Again, these figures should be viewed with caution as they represent the geographical spread of coordinators (respectively 77 and 9 for the submission and funding phases) only and not of all teams involved in the project (respectively 541 and 55 for the submission and funding phases).

Call themes addressed by the proposals

During the submission phase, the project' coordinator gave an indication of the relative importance of the theme(s) addressed by each proposal. This provided a clear view of the way each theme was considered (Fig. 7). Themes 1, 2 and 5 were predominant whereas theme 3 and even more so theme 4 were less represented.

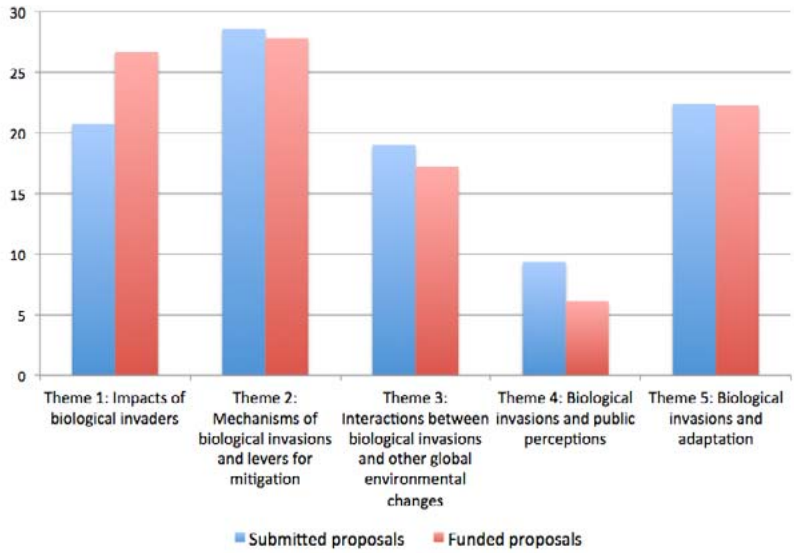


Fig. 7: Proportion of the proposed research themes addressed between submitted and funded proposals. Note that one proposal can address several themes.

Types of studied environment

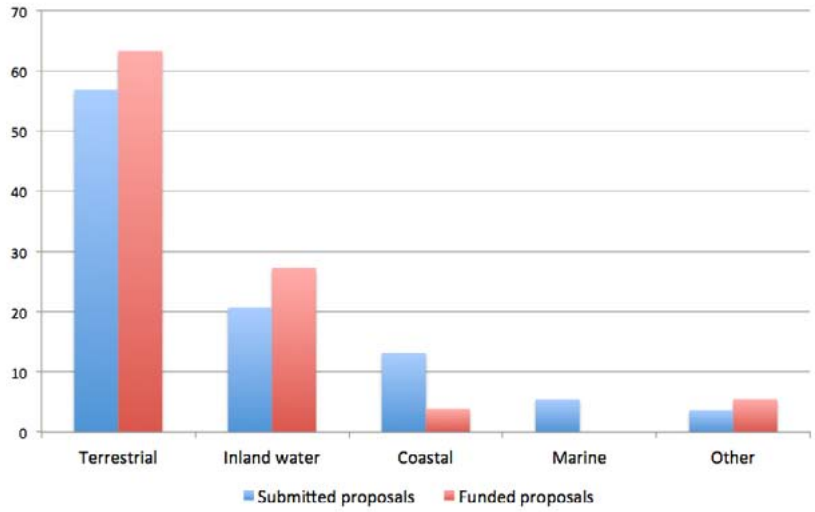


Fig. 8: Distribution of budgets of submitted and funded proposals according to the studied environment. One proposal can focus on several environments.

The majority of submitted and funded proposals focused on terrestrial ecosystems (Fig. 8), whereas those focusing on inland water and marine/coastal environments were fewer. Nevertheless, inland water environment was still reasonably well represented in the funded proposals.

Again, we remind the reader that the figures for funded projects should be viewed with caution given the small number of selected projects (9).

It is clear that few researchers in marine fields applied to this call. Likely, this is due to the fact that there are other well-known funding resources available for marine biodiversity research at the European level. Moreover, it should be noted that applicants were informed that the German and Norwegian funding agencies would not fund studies in marine environments, which partly explains the few number of proposals including these environments.

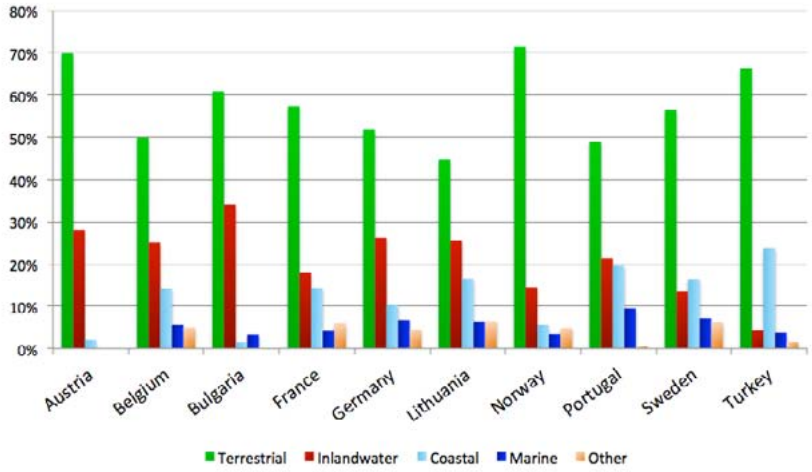


Fig. 9: Percentage of requested budget in the submitted proposals by country according to the studied environment

Figure 9 shows that Austria, Norway and Turkey had the highest proportion of submitted proposals focusing on terrestrial environments, even if this is the main environments studied among other countries as well.

Austria, Bulgaria and to a lesser extent Belgium, Germany and Lithuania had the highest proportion of inland water-focused projects, while Portugal and Turkey had the highest proportion on coastal environments (and marine environments for Portugal).

Conclusion

The above analysis provides much insight into the implementation and results of the BiodivERsA 2012-2013 call, which can be useful for future ones:

- The topic of this call has proven to be of great interest to the European research community: it mobilised several national agencies across Europe, with substantial funds involved, and mobilised a high number of pan-European research consortia.
- Among the five themes covered by this call, four have been well addressed by the submitted and funded proposals. The theme on public perception of biological invasion was, however, less often addressed.
- Similar to previous calls, the funding amount reserved by a given country is linked to the number of applicants for this country. This can be explained by the fact that BiodivERsA partners know well the relative weight of the biodiversity research community across Europe, but also that the funding amount reserved by a given country can influence applicants' responses from this country.
- Given the initial balance in the amounts of funding reserved by countries, and thanks to agencies' funding flexibility, as it was also the case for previous calls, BiodivERsA partners were able to fund the nine top-ranked proposals.

Scientific and administrative follow-up of the funded projects and dissemination of results

The kick-off meeting of the projects funded by this joint call has been held in Paris (France) on October the 3rd, 2014. All the funded projects have a duration of 3 years (with possible extension if the need is justified). The scientific and administrative follow-up of projects is performed by the Call Steering Committee with support of the Secretariat of this call located in RCN (Norway).

In addition to all the activities led by the research consortia on their own, project results and highlights are disseminated through the BiodivERsA website (http://www.biodiversa.org). BiodivERsA is also developing policy briefs around the themes addressed by funded projects once they have sufficiently progressed in order to disseminate hands-on results and key information to European policy-makers and other stakeholders. The Principle Investigators of funded projects can pro-actively contact BiodivERsA if they think that they have interesting and substantial material for a policy brief to be developed: BiodivERsA can then decide to allocate additional resources and skills for allowing the production of a policy brief.

For more information on the BiodivERsA policy briefs:
http://www.biodiversa.org/policybriefs

Funded projects

Presentation of the 9 funded projects

DIARS – Detection of invasive plant species and assessment of their impact on ecosystem properties through remote sensing

The biodiversity conservation policy of the European Commission includes the development of warning and rapid response systems for biological invasions and urges further investigations of their impacts on ecosystem function and services. However, accurately detecting and mapping invasive plant species distributions based on commonly used field surveys is a very time consuming process, often subject to observations biases. Furthermore, some consequential impacts, particularly at the ecosystem level, are not readily detected using traditional approaches. Also the limited potential for generalization of impacts from the plot scale to the landscape- and the regional scales remains a serious drawback of the classical field survey approaches.

Remote sensing technology provides a systematic, objective and synoptic view of the Earth's surface, offering the capacity to generate large, statistically valid predictions of species distributions. It is yet largely underexplored and underused by ecologists, although it offers a great opportunity to target biological invasion and their impact at various spatial and temporal scales. By bringing together ecologists and remote sensing specialists, DIARS will contribute to increase interdisciplinary links and to fill the gap between these field and remote sensing approaches.

DIARS aims at better demonstrating and characterizing the impact of invasive species on ecosystems through the combined use of field data and data obtained through remote-sensing technologies. It also aims at supporting monitoring, prediction of spread and risk assessment of invasive plant species through remote sensing as preconditions for taking management measures for mitigation.

To achieve these goals, DIARS will study the following aspects:

- Quantify, study and better understand the effects of biological invasions (for plants) on ecosystem properties/functioning, through remote sensing approaches
- Develop and validate an approach to create accurate fine-resolution baseline maps and scenarios of the distribution of invasive plant species at the landscape scale
- Assess possibilities and constraints for generalization of the proposed advanced remote sensing approaches across ecosystems and invasive species
- Develop and disseminate a toolbox for remote sensing-based mapping, warning and impact assessment for invasive species.

In the course of the project, three different plant life forms (a bryophyte, an herbaceous species and a tree species) and three different ecoregions (Atlantic – Flanders, Belgium; continental – central-Germany and Mediterranean – South France) will be studied, allowing to identify methodological problems that might be encountered in this kind of investigation and to assess the generalization potential of this approach.

The project outputs will be disseminated and a knowledge transfer will be implemented through the organization of hands-on training for ecologists, conservation biologists, policy makers and landscape managers across Europe.

Campylopus introflexus hidden under an indigenous species on the island of Sylt (Germany)

Partners:

Flemish Institute for Technological Research - BELGIUM (Coordinator)

Katholieke Universiteit Leuven – BELGIUM

CNRS - University of Picardie Jules Verne – FRANCE

Friedrich-Alexander-Universität Erlangen-Nüremberg – GERMANY

Karlsruhe Institute of Technology – GERMANY

Fondazione Edmund Mach - Research and Innovation Centre – ITALY

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Duration:

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Total grant:

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EXOTIC – EXperimentally Orientated genomics to Tackle Insects' adaptive Challenges during bioinvasions: the ladybird Harmonia axyridis as model species

The ladybird Harmonia axyridis

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12-2013 to 11-2017
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Invasive species raise evolutionary questions as well as ecological and economical problems, but few research programs have considered the specific genetic mechanisms underlying the evolutionary forces that lead aliens species to a better adaptation in the introduced environment.
The Asiatic ladybird *Harmonia axyridis (HA)* originates from Southeast Asia and has been used as a biological control agent in North America and Europe. Yet, it is now considered as an invasive species in these areas. *HA* has indeed been introduced into new areas since 1916 but established populations were not observed before 1988 in the USA and 2001 in Europe. The main negative impacts include the loss of biodiversity through intraguild predation, infestation in homes resulting in allergies, and deterioration of fruit and wine quality.
EXOTIC aims at understanding the adaptive changes that have taken place during *HA* invasion through genome-wide comparison of native, biocontrol and invasive populations. This will be done through an interdisciplinary approach integrating ecology, evolution, analytical chemistry and genomics at several biological levels (genes, phenotypes, individuals and populations).
Both experimental studies and population genomics will be conducted to investigate the contemporary evolutionary shifts of several life-history traits that could affect the invasive success of *HA*. This will allow deciphering the adaptive pathways underlying the global invasive success of *HA* and assessing the negative impacts on native ladybird species.
EXOTIC may be considered as a pilot project using the model species *HA*. The proposed lines of research are expected to be extended to other species of agroeconomic interest.
On a policy and socioeconomic perspective, EXOTIC could have several impacts. For example, information concerning evolutionary shifts and the genetic basis of traits linked to invasiveness could help identifying biocontrol agents that will not likely become invaders. The project is also expected to help addressing the numerous negative impacts of *HA* invasion by promoting the development of effective management strategies.
Besides, EXOTIC could have some consequences concerning the development of new anti-infective drugs or pathogen-resistant plants. It has indeed recently been shown that *HA* hemolymph (i.e. the circulatory fluid of various invertebrate animals that is functionally comparable to the blood and lymph of vertebrates) contains strong and constitutive antibacterial activity that is not present in native ladybirds. In addition, studies demonstrated that *HA* has the highest diversity of antimicrobial peptides (defence molecules) reported in insects.
To optimize the use of the projects outputs by policymakers and relevant stakeholders, EXOTIC will benefit from the experience of the French participants, who took part in the BIOFIS project aiming notably at formalizing recommendations in management practices against bioagressors and invasive species. EXOTIC will capitalize on this growing network (mainly national services such as ANSES, technical institutes, producers) to boost the dissemination of its research results to other scientists, to non-scientific stakeholders and the general public.

FFII – Forecasting Future Invasions and their Impacts

It is now widely accepted that prevention and early responses are the best strategies to mitigate the impacts of invasive alien species. Consequently, research efforts must focus on prediction, both of the likely distribution of invasions and of their impact in newly invaded areas. Accounting for global environmental changes is obviously crucial for these predictions. It is also important to combine a better understanding of robust, general outcomes from global studies with a finer, more detailed understanding of mechanisms from specific communities.
FFII aims at better forecasting the future of invasions and their impacts worldwide. To reach this goal, particular attention will be paid to patterns, processes and the impacts of biological invasions.
FFII will implement the following activities:

1. Studies of large-scale patterns of biodiversity

Studies that encompass a range of scales, model systems and types of methodologies will be performed. Large-scale patterns of biodiversity (macroecology) will be analysed, using global model systems such as the 35 biodiversity hotspots, the network of 138 000 Protected Areas and the database of >5000 islands worldwide. A very large number of species will be analysed, including the IUCN's list of "100 of the World's Worst Invasive Species", the list of the 800 invasive alien species in the Global Invasive Species Database (GISD) and the 60 000 IUCN Red-Listed species.

2. Development of invasive alien species distribution models

Bioclimatic species distribution models on large samples of invasive alien species will be developed to predict their current and future potential distributions worldwide and consequently the potential effects of global changes in climate and land use on biological invasions. This combination of activities will allow assessment of patterns in the global spread and impact of the invasive alien species worldwide, and thus provide a global assessment of the future impact of invasive alien species on the 60,000 species in the IUCN Red List Database.

3. Ants as a model taxonomic group

To complete this approach, FFII will focus on ants as a model example of a large and homogeneous taxonomic group at a finer scale. The objective is to incorporate ecological components to complement the bioclimatic modelling approaches described above to predict the future distribution of ant species, as well as the mechanisms and magnitude of their likely impact in invaded areas. To this end, FFII will combine modern species distribution models with field and lab experiments, as well as statistical analyses of a unique database of 25 ecological traits of the 14000 ants worldwide. In parallel, FFII will work on several study models (including models on spread of invasive ant species in New Caledonia and worldwide, their invasion processes and impacts). The results will be used to develop an innovative control method for invasive ants that is based on dominance hierarchies among species.
Results will be disseminated in a variety of ways in order to best target a range of societal groups. Stakeholders will be regularly informed as the work progresses through specific deliverables and events. A concluding meeting will for example be organized in New Caledonia addressing invasive species management in small island states, and specifically targeting New Caledonian stakeholders. Further, given the importance of FFII results for other stakeholders (notably the managers of protected areas in Europe), strong links with the chief representatives of major stakeholders, including the ISSG of the IUCN, the Bern Convention (run by the Council of Europe), the WWF and the PNF (Parcs Nationaux de France) will be developed.

Ants as a model taxonomic group

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Swedish University of Agricultural Sciences – SWEDEN (Coordinator)
CNRS - University of Paris Sud – FRANCE
IRD - University of Marseille, IMBE – FRANCE
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01-2014 to 12-2016
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GC-INVAMOFECT – Global change and invasive mosquitoes as infectious disease risks in Europe

Tiger mosquito nymphes

Invasive, non-indigenous species have repeatedly been recognized as one of the most important factors in the extinction or displacement of native species on a global scale. In addition, they cause significant economic and health damage which, in a recent report by the EU Commission, was estimated at 9.6 to 12.7 billion € per year for Europe.
Invasive mosquitoes are a source of worldwide concern because of their utmost importance as vectors of a wide range of viral and parasitic pathogens affecting both humans and animals. Understanding current distribution and possible future expansion of invasive and native mosquito species is essential to guide coherent policy vector control in articulation with biodiversity conservation as well as environmental, human and animal health.

In addition to insect genome per se, it is now recognized that microbial symbionts constitute a key factor for insect's adaptation to novel environments.
In this context, GC-INVAMOFECT aims to investigate the contribution of the microbiota on the proven capabilities of mosquitoes to rapidly adapt to local environments, and thus to promote their successful invasiveness and to increase the risk for pathogens' transmission in colonized territories.

GC-INVAMOFECT will conduct investigations of native and invasive mosquito species, their symbionts and the pathogens they transmit, in the context of global changes. This will allow providing predictions on the spatial and temporal distribution of native European and invasive mosquito species according to climatic, trade and vehicle traffic conditions and using advanced ecological niche and migration modelling approaches.

The following questions will be addressed by studying the occurrence of two invasive mosquito vectors (*Aedes albopictus* or tiger mosquito, and *Ochlerotatus japonicus*), their associated microbiota, and infectious risks in Europe:

1. What are the current niches of the two invasive mosquito species in Europe accounting for climate change and anthropogenic pressure?
2. What are the potential functions and the diversity of the microbiota (symbionts and pathogens) associated with invasive wild mosquitoes in Europe?
3. Do microbes facilitate or constrain mosquito adaptation to a changing environment?
4. How pathogens-symbionts interactions evolve in European invasive mosquitoes?
5. Can we understand the links between mosquito spreading, microbiota content, and environmental conditions and human activities to guide coherent policy for vector control in articulation with biodiversity conservation and human and animal health?

This research will thus answer strong expectations of society and economic players, and concerns both expert and non expert public that will be informed by an ad hoc communication plan in particular towards identified practitioners and managers and the general public. This will ensure that the outputs are accessible to a wide audience and will achieve their maximum impact.

Partners:
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University of Veterinary Medicine, Vienna - AUSTRIA
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INVAXEN – INVAsive biology of XENopus laevis in Europe: ecology, impact and predictive models (INVAXEN)

Xenopus laevis is one of the world's most widely distributed amphibians with invasive populations that have become established on four continents. Invasions are due to both accidental escape and voluntary release of laboratory animals in many cases. Although impacts of invasive *X. laevis* on native populations of amphibians and fish have been documented, systematic studies examining the impact of this species on both vertebrate and invertebrate communities are lacking. Moreover, *X. laevis* has been implicated in the global transmission of disease including chytridiomycosis, a disease cited as one of the principal causes for the global decline in amphibians. Yet, landscape level data on the presence of *X. Laevis* across Europe are lacking. Alarmingly, a recent study suggested that the invasion potential of *X. laevis* has been severely underestimated and that many areas, both globally and in Europe, were potentially threatened by invasion. In particular, this species is of serious concern in Europe as it is known to be invasive in at least four countries (France, Portugal, Italy and the U.K.) and the suggested suitable climatic space for *X. laevis* covers over one million square kilometers, making this species of pan-European concern.

INVAXEN aims at better understanding the biology, dispersal patterns, physiology, invasive potential, and impact on local populations, of *X. laevis*.

1. Study of the biology of *X. laevis*

The ecology, physiology, and population genetics of both invasive and native South-African populations will be studied. The comparison with the populations of origin in South Africa is crucial to understand how animals have adapted to novel and different environments, key to their invasive success. Moreover, an evaluation of the impact of *X. laevis* on local vertebrate and invertebrate communities will be conducted. The presence/absence of chytridiomycosis in known invasive populations in Europe will also be investigated. To assess the mobility and movement patterns of the species in the wild, mark-recapture studies will be conducted as well as experimental measurements of mobility in large enclosures. The temperature and hydric (humidity) effect on locomotion of native and invasive populations will also be studied. Finally, the genetic diversity of native and invasive populations as well as gene flow within and between populations will be quantified.

2. Modeling future distribution of the species

The data obtained on movement patterns, gene flow, and physiology will be used to establish species distribution models allowing an assessment of the potential future distribution of the species in few European countries, in particular France and Portugal, at a landscape level. It will also allow predictions of the potential future spread of this species outside of its current invasive range under different scenarios of global change that incorporate temperature and rainfall data. As such, the project will allow identifying areas of primary concern for future invasions.

3. Development of a reinforced eradication program

INVAXEN will contribute to the follow-up and improvement of ongoing eradication programs of this species in Portugal and France in collaboration with relevant stakeholders. These data will help policy makers at the local, national and European levels in deciding how to restrict the ongoing invasion and prevent future invasions.

Xenopus Laevis freshly equipped with an ID transponder

Partners:
MNHN - CNRS Paris – FRANCE (Coordinator)
Royal Belgian Institute of Natural Sciences – BELGIUM
Zoologisches Forschungsmuseum Alexander Koenig – GERMANY
Fundação da Faculdade de Ciências da Universidade de Lisboa – PORTUGAL
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Duration:
06-2014 to 06-2018

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PROBIS – Heterogeneity of patterns and processes along biological invasion successions

The parasite Tracheliastes polycolpus anchored on the dorsal fin of its fish host, the dace.

Partners:
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CNRS – Université Paul Sabatier de Toulouse – FRANCE
IRD Montpellier – FRANCE
GEOMAR/Helmholtz Centre for Ocean Research, Kiel – GERMANY
Umea University – SWEDEN
Mugla University – TURKEY
University of Aberdeen – UNITED KINGDOM
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Biological invasions occur when barriers limiting species distributions are broken-down, allowing species to extend beyond their natural range areas. In the last century, rates of biological invasions severely increased due to human activities, and are major components of global changes. Species invasions lead to worldwide redistribution of species, sometimes generating severe economical and societal disequilibrium.

Important processes remain to be elucidated regarding the ecological and evolutionary dynamics of non-native populations over the course of invasion. In such a context, characterizing intrinsic biological drivers underpinning invasions is a crucial step towards predicting future patterns of invasion.

A classical approach is to identify relevant biological traits that underpin a species ability to invade a new environment. This ability is species-specific, and depends on certain traits. The identification of relevant biological traits underpinning successful invasions has mainly been conducted at the interspecific level, but rarely at the intraspecific (i.e. within and among populations) level.

However, recent theoretical studies suggest that traits beneficial in the early phase of an invasion might differ from those favoured at later stages. Such trait variation along the invasion succession should be visible at both the phenotypic and genetic levels, and should differ between the recently invading populations and the older ones.

For example, at the front of invasion, populations may have higher dispersal rates and/or reproductive strategies favouring the settling of new populations, while more recent populations may have a reduced dispersal propensity or a relaxed competition leading to reproductive strategies favouring population growth and stability. Overall, evolutionary theory predicts an individual or a population to display a specific trait at key steps for a successful invasion to occur and an increased rate of evolution for specific traits selected at the front of colonization. However, the hypothesis of dynamic patterns and the genetic basis of traits' variation arising along the invasion succession have never been empirically tested.

In this context, PROBIS aims at characterizing patterns of traits variation, and test for the underlying evolutionary processes along an invasion succession. More generally, PROBIS aims at determining how the genetic and phenotypic heterogeneity of invasive populations along an age-gradient of invaded habitats is expressed, and how this may influence the invasion success and rate of non-native species establishment.

A combination of field surveys covering all Europe, genomic tools, large-scale semi-natural experiments and computational modelling will be implemented for the project. Three model organisms (a fish, *Pseudorasbora parva*, a parasite, *Tracheliastes polycolpus* and an insect, *Crocothemis erythraea*) that have clear ecological and socio-economic impacts and for which a detailed characterization of invasion history across Europe already exists will be studied.

The project outputs will be disseminated through diverse media including a website dedicated to the project as well as public conferences and brochures for a large audience public. The relevant stakeholders (mainly freshwater managers including regional and national agencies) will be provided with an effective tool (i.e. a friendly-user modelling platform) that should help them prioritizing and anticipating actions limiting the spread of non-native species.

RESIPATH - Responses of European Forests and Society to Invasive Pathogens

Invasive alien species pose a serious global threat to biodiversity by competing with native organisms for limited resources and by their ability to modify entire landscapes. Invasions of forest pathogens generally occur at a large scale affecting tree species with a widespread distribution in Europe.

RESIPATH will work on tree species currently threatened by different invasive pathogens (i.e. elm, ash, alder and oak). The selected tree species are not only an integral part of their ecosystems but are also economically important and supply crucial environmental services to European society, such as biodiversity, watershed protection, stabilisation of river banks, as well as recreational and cultural values.

Although widespread, the different invasive pathogens to be studied here have not yet affected the entire tree population in Europe. Working at a European scale will allow studying invasions at different stages and along gradients far exceeding those obtained at a national scale. Due to different mortality patterns, it is possible to study the differential effects on both host and pathogen population in terms of demographics and evolution.

RESIPATH aims at studying how European forest communities have been affected by and responded to invasive pathogens and also to develop means to mitigate their impact. More specifically, RESIPATH aims at achieving the following goals:

- Developing an early detection system for invasive fungal and oomycete pathogens
- Investigating how the pathogens are introduced and spread.
- Assessing whether the selected pathogens threaten the long term sustainability of tree populations in Europe
- Understanding the mechanisms involved in adaptation of forest tree populations to new pathogens
- Assessing the mechanisms of hybridisation of invading organisms in Europe
- Gaining knowledge on know how public perception are related to objective data and how mass media messages influence citizen opinions about pathogens invasion.

To address the challenges of the high ecological and economic impact caused by invasive pathogens RESIPATH will develop an early detection and warning system and contribute to increase knowledge on the importance of different pathways for their introduction and spread.

RESIPATH also aims at encouraging fast response from the society in front of invasive pathogens, considering that an efficient response from society to mitigate the impact of invasive pathogens depends on the public perception and the communication between researchers and stakeholders in society. Part of the work conducted will therefore consist in investigating how the public perceive invasive pathogens in different European countries, how the perceptions are related to objective data and how mass media messages influence citizen opinions.


Oaks infested with Phytophthora cinnamomi in Spain

Partners:
Swedish University of Agricultural Sciences - SWEDEN (Coordinator)
Federal Research and Training Center for Forest Natural Hazards and Landscape – AUSTRIA
Institute for Agricultural and Fisheries Research – BELGIUM
AgroBioInstitute – BULGARIA
Anses, Plant Heatlh Laboratory – FRANCE
INRA Bordeaux – FRANCE
INRA Nancy – FRANCE
Julius Kühn Institute – GERMANY
Norwegian Forest and landscape institute – NORWAY
Norwegian Institute for Agricultural and Environmental Research – NORWAY
University of Algarve – PORTUGAL
Centre Tecnològic Forestal de Catalunya - SPAIN
Swedish University of Agricultural Sciences - SWEDEN
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Duration:
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SalmoInvade - Causes and consequences of invasions of aquatic ecosystems by non-native salmonids

Experimental release of Atlantic salmon (Salmo salar) fry in a tributary to the Imsa river in Norway

Partners:
University of Gothenburg - SWEDEN (Coordinator)
Leibniz Institute of Freshwater Ecology and Inland Fisheries – GERMANY
Nowegian Institute for Nature Research – NORWAY
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Millions of non-native fishes (both species and genotypes) are regularly released into the wild in Europe, either intentionally by stocking or non-intentionally by escapes from aquaculture. Non-native fishes can become invasive and constitute a continuous threat to biodiversity.

Salmonids are an iconic fish family of great socio-economic and cultural importance in Europe. They are widely distributed in marine, coastal and freshwater ecosystems, and are also cultured and released in large numbers into the wild. Often non-native genotypes are transferred across catchments resulting in ecological and genetic impacts on wild fish. Overall, salmonids constitute an excellent model system to study the causes and consequences of invasions, which this project uses in an integrated approach that combines ecological, evolutionary, fisheries biological and socio-economic approaches.

SalmoInvade aims at studying salmonid fishes as potentially invasive species/genotypes, and at understanding the psychological, economic and governance conditions and pathways by which humans relate to these fishes. Ultimately, the SalmoInvade project is willing to develop the foundation for sustainable salmonid management in Europe in light of the societal desire to curtail their invasion potential.

SalmoInvade will concentrate on the following issues:

1. Understand the invasion potential of non-native salmonids in nature, including genetically modified and non-native genotypes, and their ecological and genetic impacts
2. Reveal the biological and social mechanisms of establishment of non-native salmonids
3. Understand how the public and stakeholders in various European cultures conceptualize and rationalize biological invasions and their own engagement in the spread of non-natives in light of their perceptions about complex concepts such as biodiversity and biological invasions.

To reach these goals, SalmoInvade will bring together experts with complementary competences in genetics, ecological, human dimensions and environmental economics, revolving around the important model systems "salmonid species".

The projects outputs will be disseminated to relevant stakeholders and SalmoInvade will provide well-informed, integrated recommendations for policy and management of salmonid invasions.

WhoIsNext - Climate change and escaping ornamentals: Predicting the next generation of European plant invaders

Most naturalized and harmful invasive alien plant species in Europe have once been intentionally introduced for ornamental purposes. Thus, it is likely that future plant invaders will also be recruited from those ornamental plants currently growing in our gardens. Ongoing climate change might create increasingly suitable conditions for many ornamental plants, particularly those with origins in warmer regions with more variable rainfall patterns. This may result in new invasions by formerly unproblematic ornamental plants. Identifying such "sleeping invaders" before they spread is highly desirable, and would give stakeholders (in particular invasive-plant managers and the ornamental plant industry) a head start in preventing future invasions.

WhoIsNext will combine modelling with experiments to study a large number of ornamental plants. The project will assess which of these species will most likely establish and become invasive, and which regions of Europe will most likely be affected by invasions, under climate change.

The work along the project period will be conducted as follow:

1. Development of a database
The project will start by making a comprehensive overview of those ornamental alien species that are currently frequently grown in Europe as garden plants. The database will be used to test which species characteristics are associated with current naturalization success in Europe, and which ones are already known to be naturalized in other parts of the world. Most importantly, this database will be used to select a core set of 50 ornamental alien plants that will be included in the experimental and modelling studies.

2. Implementation of experimental and modelling studies
Experimental tests will be conducted to study how ornamental alien plants respond to warming and changes in precipitation. In addition, an invasion-simulation model will be developed, and landscape-simulation modelling and spread-modelling approaches will be used to assess the probability that certain ornamental species will establish at the landscape- and European-wide scale, respectively. These models will also allow assessing which types of habitats and which regions will be most vulnerable to invasions. The modelling studies will help to design the experiments and will provide predictions to be tested in the experimental studies. The experiments, on the other hand, will provide parameters for the modelling studies, and a ground truth for the model findings.

3. Dissemination of results
The project's results will be synthesized and disseminated to the relevant stakeholders, such as the ornamental-plant industry, garden-plant retailers, horticultural societies and policy makers. This goal will be achieved by presenting our results at horticultural trade shows (e.g. The RHS Chelsea Flower Show), by presenting our results on our webpages, and by organizing a workshop for stakeholders.

Experimental studies to test the shading tolerance of the studied species

Partners:
University of Konstanz – GERMANY (Coordinator)
University of Vienna - AUSTRIA
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Perspectives for BiodivERsA

Establishing common priorities for research programming across Europe, and developing and launching calls to fund pan-European research projects on biodiversity and ecosystem services is at the heart of BiodivErsA. However, the work of our consortium does not stop with the funding of the projects. The final – most important – step of all is the dissemination of research results. The BiodivERsA's endeavor will only be truly effective if the knowledge generated is leveraged and made quickly accessible to a wide range of scientists, but also to relevant stakeholders including policymakers.

In particular, BiodivERsA can allow members of funded projects to participate to key events organised at the European scale. Aiming at transforming research results into concrete tools and actions in response to societal challenges, BiodivERsA has also engaged in professional knowledge brokerage activities to produce policy briefs based on its funded-projects' findings. In this case, BiodivERsA can offer additional resources and skills to some selected projects so that a policy brief can be produced to better disseminate their key results and make clear implications for European policies. This will hopefully be the case for most of the nine pan-European projects presented above.

In November 2013, BiodivERsA launched its fifth call jointly with the FACCE-JPI

Beyond the 2012-2013 call, and following its objective of launching annual calls for proposals on topics that correspond to the most pressing strategic issues for biodiversity and ecosystem services, BiodivERsA has launched in November 2013 its fifth call on "Promoting synergies and reducing trade-offs between food supply, biodiversity and ecosystem services". This call was launched jointly with the FACCE-JPI initiative* and was a real success. It allowed addressing a cross-sectoral issue, promoting integrative science and mobilizing funders from 14 countries. Although the final funding decision is still pending, it is already clear that 8 to 10 projects, involving teams from ten different European countries, will be funded for a total amount of 9.2 to 10.3 million euro (for further information, please consult: http://www.biodiversa.org/578).

This call was the last one to be launched during the second phase of BiodivERsA project that will end in late 2014. Since its beginning in 2005, BiodivERsA has launched five joint calls and funded around 45 pan-European research projects for a mean total cost of 2 million euro per project (including 1M€ of new money directly raised by BiodivERsA partners).

BiodivERsA partners are willing to pursue their participation in the network and its activities, in the context of Horizon 2020. In this perspective, BiodivERsA will try to expand its network, to develop interactions with other European and international initiatives addressing biodiversity and ecosystem services issues. This would allow BiodivERsA to launch calls of higher amplitude in the future, to continue contributing to the reinforcement of the European Research Area on biodiversity and ecosystem services, and to foster the impact of the European research community at the global scale.

NOTES

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