

Call for Research Proposals

Biodiversity and Global Change

The Ministry in charge of the environment instituted the Climate Change Management and Impacts umbrella programme (GICC) in 1998. The programme's overall aim is to assess the risks arising from climate change (in particular in France and in Europe) and the possibilities for preventing or managing them.

As scientific understanding and research issues evolved, it became necessary to place climate change within the context of global change, one which includes all of the major shifts triggered either by anthropogenic activity or by natural factors.

The French Institute for Biodiversity (IFB), in partnership with the Ministry of Ecology and Sustainable Development, put together an initial call for research proposals focusing on interactions between biodiversity dynamics and global change. The research proposals will be assessed by the IFB's Scientific Commission, which will oversee the project's scientific aspects, in conjunction with the GICC Programme.

Scientific Background

Global change encompasses all of the major changes triggered, whether by anthropogenic activity or by natural factors. There is no longer any doubt that climate change, and in particular, the increase in average temperature at the Earth's surface, is a reality. Even though controversy still exists with regard to its origin, many factors argue in favour of climate change's being correlated with an increase in temperature, itself resulting from human activity (increase in greenhouse gas production). The Earth's average temperature has increased over the past century with a marked rise over the past twenty years. There is every reason to believe that, due to the inertia of major climate systems at the scale of the globe, these changes will increase during the 21st century, with global warming on the order of 1.4°C to 5.8°C, a rise in sea level of around 50 cm, and heightening of the hydrological cycle. During the same period, atmospheric CO₂ concentration will probably have doubled.

However, global change is not limited to the climate and air composition alone. Significant shifts are expected or have already been observed, due to changes in the use of terrestrial and aquatic environments. These changes in use are of two types:

- intensification in use due to growing anthropic pressure (development, deforestation, clearing, intensification of farming, overuse, various forms of pollution, increase in international trade, introduction of species, GMOs, etc.);
- phasing-out of other uses (release of farmland, reforestation, etc.).

While global change is already perceptible and can only magnify, its consequences on the dynamics of biodiversity remain to be quantified to a much more detailed extent, whether in terms of species distribution, adaptation of individuals or populations, co-adaptation of biological systems (predation, parasitism, symbiosis, etc.) or genotype evolution and evolution on human societies. More broadly speaking, a study of the consequences of global change will focus preferably on the structure and dynamics of landscapes, the species distribution areas, extinction rates, phenology of main biological events structuring the annual cycle, the structure and dynamics of populations and interactions between species (competition, invasions, trophic networks, parasitism and symbioses, etc.). These changes will be modulated by the spatial structure at the level of various habitats and ecosystems, itself affected (fragmentation, etc.) by global changes. In studying and modelling current global change, it is essential that time be approached from these different perspectives. To measure the speed and duration of change, and understand and analyse their effects and consequences on living organisms, the time span, temporality of events and time steps of all observations must be taken into consideration.

Lastly, the changes in biodiversity caused by global change could retroact on services provided by the ecosystems, such as carbon storage in soils and forests, water purification, the usage or amenity value of the environments, etc. The interactions between global change and biodiversity must therefore be looked at from both ends, in order to understand and, if possible, predict changes to come.

Considering how complex the concept of biodiversity is, no comprehensive account of it can be delivered. Understanding all of the species present in a single location and assessing how the said location contributes to diversity at broader scales (from the regional to the global) is almost impossible. Analysis of biodiversity must be based on indicators: number of species or presence of a small number of well-known taxonomic groups representative of an operating mode, infra-specific variability, diversity and permanence of components in a landscape, etc.

Several different questions are to be taken into account:

- how to measure changes in biodiversity, at what spatial and temporal scales, and according to what metrics?
- can the extinctions and eliminations consecutive to past crises teach us something and help us better detail scenarios for changes to come?
- how can we test hypotheses and biodiversity development scenarios under the influence of global change?
- what processes need to be studied toward this end and according to what experimental approaches?
- how does modelling contribute? how can socio-economic parameters be incorporated into models on interactions between global change and biodiversity?
- how are societal decisions made with respect to global change? What are the consequences on changes in use?
- lastly, what consequences will changes in biodiversity caused by global change have on the services provided by the ecosystems?

This call for proposals focuses on four issues, from describing the patterns in play to understanding the mechanisms, establishing forecasts and, lastly, making decisions.

I – DESCRIBING PATTERNS

How can studying the dynamics of biodiversity at different scales of time, space and organisation help us suggest scenarios for change in biodiversity?

If we are to grasp the extent of the current crisis in biodiversity and the issues it raises, we need to draw upon a historic and prehistoric look at current biodiversity:

- the global changes that have been going on for a century or less can be associated with changes in distribution, or even extinction in species. It is sometimes possible to document them and specify their causes (climate change or change in land use). They can also be tied to changes in the traits of species' life history.
- the changes due to the impact of anthropisation over the course of the last 100 000 years also shed light on the incipient stages of the current crisis.
- the more long-standing systems, without direct current equivalents and having worked in different contexts, also make it possible to understand how other biodiversities have been subject to, and where applicable, overcome the crises of the past.

Though it is difficult to achieve fully-reliable documentation, it is clear that this information gathering and management effort is particularly important in the future assessment of the effects of global changes.

II – UNDERSTANDING THE MECHANISMS

How can one test the consequences of global change – diversity interactions?

The scenarios proposed must lead to the testing of hypotheses, drawing if possible, upon archives, experimental data and functional models.

Archives from the past can be used to test hypotheses on adaptability in crisis situations. For instance, when studying older situations, use can be made of conservation biology approaches and questionings and, with regard to habitat fragmentation, one can consider the barriers, spatial scales of variation and speed of species migration, latitudinal gradients, etc. For example, during a climate fluctuation documented over a sufficiently-lengthy period, what are the migratory gradients and changes in fauna and flora at the scale of an ocean or continent?

Regarding the current environment, experiments need to lead to functional understanding of the influence of global change on biodiversity. Priority needs to be given to identifying groups of species that might have the same type of response to changes in their environment and share common traits (functional groups). This approach could apply to all taxonomic groups and all ecosystems: soil, sediment, forests, pelagic environments, etc. Analysis, at the scale of the landscape, the structuring or disrupting effects of habitats is, there too, an important factor in understanding and how the systems work. Diachronic or comparative analysis of the relationship between biodiversity and transformation in landscapes provides a means of analysing almost-experimental situations at an appropriate scale.

In order to experimentally test interactions between global change and biodiversity, effort will be made to:

- work from hypotheses and predictions derived from modelling;
- develop consistent (and, if possible, contrasting) scenarios for change, taking into account two distinct aspects, namely the climate/atmosphere and land use (or aquatic environments);
- adjust model systems (if possible, contrasting biodiversity) in accordance with the scenarios;
- study the main mechanisms likely to couple global change with biodiversity at the spatial and temporal scales under consideration;
- study the main biological adaptations in play in the system studied;
- assess the consequences of interactions between global change and biodiversity on the services provided by the ecosystems under consideration.

III – ESTABLISHING FORECASTS

Determining Approaches

The interactions between global change and biodiversity are so diverse that we are still very far from a reliable prediction system. For we must deal with the whole set of uncertainties regarding: i) scenarios (on the climate, environment use, etc.); ii) adaptations in the biological systems under study; iii) the sensitivity of biodiversity and its components (specific and functional diversity, etc.) to the said changes.

The aim of the modelling processes used must be to reduce uncertainties, by striving to improve the methodologies selected and take advantage of the progress achieved in complementary areas. Coupling between climate and/or socioeconomic models with the dynamics of biodiversity is appreciable.

- the use of regionalised climate scenarios that match up with the climate transition over the course of this century for different greenhouse gas emissions scenarios should be encouraged;
- land and aquatic environment use scenarios will also need to be regionalised in order to be adapted to the modelling of continental or marine ecosystems;
- Approaches to modelling functional biodiversity need to be articulated in order to move from global scales (such as the DGVM, Dynamic Global Vegetation Model) to more limited spatial scales, better suited to clearly-defined ecosystems.

The models used must lend themselves to parameterisation and assessment, on the basis of archival or experimental data.

IV MAKING DECISIONS IN THE FACE OF GLOBAL CHANGE

The issue of how global change and biodiversity relate is rooted in large part in perception: perceptions of the pace, intensity and nature of change, which directly influences decision-making and changes in use.

There is no single perception across the world and its different human groups, or one representation of global change, but many. Is the change experienced as a crisis? What is the perception threshold that makes an individual, group or society shift from the concept of change to the concept of crisis?

Likewise, biodiversity is not experienced by all as a global public good or a part of human heritage (and thereby, as belonging to a species that takes ownership of all others). The significant changes in how resources are used and mined, and the ability to adapt to those changes will all act as constraints on public policy. Social demand is important but often contradictory.

Different questions emerge: how does the decision-making process develop, as governed by different conflicts, and by players' respective power, including economic, and ability to adapt to the said global changes? How are the various European Directives, such as Habitat 2000 or the international agreements, implemented? How will the conflicts in resource use, such as marine halieutic resources, be overcome, in a global change setting? Will the international systems push parties to take into account the effects of global change? What is the role of scientific expertise?

What action can be taken to protect biodiversity at a time when transformation of the environment has become the norm? How effective can reserve or protection zone systems be? Can and should action be taken to transport and re-establish habitats or species in areas that will become more climatically favourable? Are the corridor systems provided for in certain European projects a feasible solution?

Recommendations

Projects shall cover at least two of the issues set out above, and take an interdisciplinary approach. Responses shall substantiate the choice of tools and models made.

The databases resulting from the selected projects shall be made available to the scientific community at the end of the programme.

The junction between the projects and other national-level (OREs, workshop zones, ECLIPSE, ACI, etc.), European and international initiatives in this area shall be pointed out and explicitly stated.

How to Submit a Research Proposal

Project Title

Five key words

Name and Surname of Proposing Party

Laboratory address

Telephone number

Fax number

Secretariat telephone

E-mail address

Laboratory Director stamp and signature

Partners

Names

Laboratories

Telephone numbers

Fax numbers

E-mail addresses

Total budget for proposal

Amount sought for a 24-month period

Other sources of funding

Half-page project abstract

5 to 10 publications from participants in relation to the topic

Project overview

The project overview shall not exceed 15 pages (it shall be based on explicit research issues and situate the project with respect to the state of the art, at the national, European and international levels.

Deadline and mailing address

Research proposals are to be sent **by 15 April 2003** at the latest, in **electronic format**, to the IFB website: <http://www.gis-afb.org>, under section "Calls for Tender still open: Biodiversity and Global Change"

and

by postal mail, in 5 copies, to:

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