CONCLUSION

CEMAGREF'S CONTRIBUTION TO THE STRATEGY FOR BIODIVERSITY RESEARCH

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Biodiversity landed on the political agenda as the result of a social and scientific process to construct the topic and it now contributes to driving progress in and enhancing the institutional recognition of the various branches of ecology and the social sciences that address biodiversity.

The topic is well suited to the organisation of this special issue in three parts, i.e. the knowledge required to formulate public policies, their monitoring which involves a number of measurement difficulties and evaluation of public policies and the corresponding management practices.

This issue is open to academics and researchers from other research institutes, but highlights elements of the interface between biodiversity and public policies for which research at Cemagref can make a particularly valuable contribution and this conclusion will focus primarily on that. Our work is organised with the scientific community, above all the community federated by the Foundation for biodiversity research (FRB) in France, and with the observation networks which must still be reorganised to address the new issues. Some 70 researchers, located in six regional centres spanning the country, are active in various biodiversity compartments and specific sectors studying the following main topics:

- Biodiversity and forest management in Nogent-sur-Vernisson and, for the Mediterranean forest, in Aix-en-Provence, and for the moutain forest, in Grenoble;
- Biodiversity in landscapes and soils (mid and high altitudes) in Grenoble and in Aix-en-Provence ;
- Biodiversity and management of aquatic environments, notably support for the European Water framework directive, in Lyon, Aix-en-Provence, Antony and Bordeaux;
- Biodiversity, invasive species and migratory fish on one hand, biodiversity economics on the other, in Bordeaux;
- Biodiversity and environmental connectivity (National biodiversity network) in Montpellier, in collaboration with Grenoble and Aix-en-Provence.

The originality of the work at Cemagref lies in the fact that it is intended above all to assist in public and private decision-making for land and water management. Two complementary approaches are used, first analysis of the relations between public policies and biodiversity, secondly development of practical solutions for problems encountered during policy implementation, which is the field covered by ecological engineering. The work at Cemagref closely links biodiversity and bioindication in that it analyses the structural and functional aspects of biodiversity. It also calls on the human and social sciences in studying economic valuation of biodiversity, in analysing of the motivations and the process of social construction of the topic, and in placing technical results in their socio-economic context.

We will not reiterate here the importance of measurements which are a major issue for the scientific community and that the introductory documents in this issue already discussed. One of the articles underscores the need for public policies to organise monitoring of the various compartments of biodiversity, notably by specialised national structures, e.g. the botanical conservatories, without neglecting citizen monitoring which must be included, taking into account its limitations.

The articles of this issue also draw attention to the methodological difficulties involved in using old data series spanning long periods, notably those of interest precisely for the topics studied at Cemagref. Other articles look at data sources designed for certain polices that do not exclusively address biodiversity, such as the Water framework directive which has set up a system of standards and thus makes necessary new data systems to monitor its application.

In addition to the necessary conceptual discussions on the notions of biodiversity, species and measurements, there are three aspects of the "public policies and biodiversity" issue to which the research at Cemagref can make a particularly useful contribution:

- diversified analysis of public-policy goals;
- analysis of their effects;
- development of tools to accompany implementation of biodiversity-management policies and stakeholder action.

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Quantification of the ecological value of mountain grasslands.

The importance of analysing public-policy goals

The intermediate and overall goals of public policies, examined from different angles and methodological approaches, constitute a particularly useful field of research in view of providing assistance in public decision-making.

Precise identification of goals in favour of biodiversity contained in the main international agreements and their relation to certain values (existence value or more materialist values related to the notion of ecosystem services) constitutes a useful first step.

The sociology of public action is the means to identify the origins of policies, to determine the emergence conditions for goals and to study how they are selected and transformed over time. These approaches are useful for an overall analysis of the emergence of biodiversity as a political and scientific problem on the national and international levels. They also serve to study less general measures such as the conservation of deadwood in forests.

Analysis of the potential contradictions between the goals of different public policies is required to foresee such contradictions and reinforce consistency between policies.

Such contradictions may arise between the goals of biodiversity-conservation systems and those of other sectoral policies which include economic aspects and occasionally environmental aspects, e.g. concerning natural hazards or attenuation of climate change. Examples are policies to prevent natural hazards in mountain regions or to modify forest management to increase the production of fuel wood.

Before analysing these potential conflicts, it is vital to learn about the ecological processes put into motion by policy goals. Excellent knowledge on management issues and on the interaction between productive activities and biodiversity is a further advantage for Cemagref, likely to enhance the value of its results.

The capacity to analyse compatibility between production goals and biodiversity-conservation goals is an important feature to ensure that the new National biodiversity strategy currently being drawn up will truly contribute to the general policy for sustainable development. Thanks to its array of competencies, Cemagref can contribute significantly to this effort.

Moreover, to ensure the effectiveness of public policies, it is indispensable to re-evaluate certain assumptions concerning conservation goals that have turned out to be wrong, if we are to fully take into account the effects of global change. That is particularly the case for the often implicit assumption on a static equilibrium and the lack of internal dynamics. The example of diadromous fish makes clear the need to take into account potential changes in distribution areas if biodiversity-conservation goals are to be met.

Finally, this issue also discusses the role of participative procedures in formulating and adopting the goals of biodiversity policies and not only in their implementation. Addressed in an article on joint management of migratory fish, this aspect requires further development.

The need to foresee the effects of public policies

In light of the impressive impact of the Stern report in raising awareness of climate change on the part of public opinion and public policy makers , the scientific and socio-political community working to promote biodiversity is of the opinion that economic valuation constitutes a decisive argument to push biodiversity higher up the ladder of priorities than it already stands.

At Cemagref, the recent increase in work and competencies in biodiversity economics has put the institute in a position to supply useful data on the economic value of biodiversity, within certain methodological limits, but also with definite progress in view. This knowledge may be used for ex ante evaluations to decide among a number of projects or ex post evaluations as part of an economic assessment on the effects of a given policy (programme or specific measure).

The effectiveness of various economic incentives (taxes, subsidies, regulations, emissions permits, voluntary agreements, etc.) used for biodiversity issues constitutes another potential field of activity for Cemagref and is currently under study.

Generally speaking, as mentioned in the forward-looking scientific analysis on French research in biodiversity, carried out in 2009 at the request of the Research ministry, “a wide array of measures is being implemented, including a National ecological network, laws regulating access to, management and use of biodiversity, compensation for damage, etc., but there is little parallel development of research efforts to analyse and guide those measures”.

The article on the pros and cons of ecological corridors is part of those efforts. It serves as a timely reminder of the assessment criteria for corridors, clearly lays out the methodological difficulties and underscores the need to compare the effectiveness of corridors with other possible solutions to achieve the same results.

Closely related to the indispensable work to assist in preparing and implementing new systems for biodiversity, notably for ecological continuity, there is an entire field of study on the consequences of these policies that attempts to isolate their specific effects, above and beyond the modifications caused by the internal dynamics of ecosystems and global change.

Detailed analysis of those effects is improved when carried out in conjunction with analysis of goals in view of comparing different systems likely to achieve similar goals. Research efforts on new biodiversity policies should pursue detailed analysis of their overall and intermediate goals and of how the various parts are linked together. Also required is systematic study of policy "action theories", i.e. the causal assumptions concerning the problems to be solved, their basis and scope. A final requirement is to reinforce the existing monitoring systems, including establishing zones not covered by the systems in order to monitor their specific effects.

Ecological engineering to develop the necessary policy tools

Robert Barbault noted in the introduction of this issue that the Nagoya objectives will require the development of ecological engineering and of restoration ecology. Cemagref intends to be a major player in the development of these fields, but we will not go into the distinction between the two here (see Barnaud et Chapuis, 2004[1]). Ecological engineering attempts to solve environmental problems using knowledge on how living organisms function and suitable techniques. Thanks to its life-science engineers and scientific know-how in a array of fields, notably in ecology, and its close contacts with other stakeholders, Cemagref has the means to become a central figure in the development of ecological engineering in France.

1. BARNAUD, G., CHAPUIS, J.-L., 2004, Ingénierie écologique et écologie de la restauration : spécificités et complémentarités, *Ingénieries-EAT*, numéro spécial 2004, p. 123-138.

Cemagref has for years been developing its very specific know-how. More recently, it launched a study on itself to clarify its position and capitalise on its strong points. This in-house study resulted in the publication of a special issue of the review Ingénierie, eau, agriculture, territoires in 2004, under the title "Ecological engineering. Research and practices for work on ecological systems". Cemagref also took part in study groups working during the same period on the development of ecological engineering in the sectors of teaching and research. The institute contributed to the design of the course on the topic at Agro-ParisTech and joined forces with the CNRS Institut Ecologie et Environnement to set up the INGECO multi-disciplinary research programme in 2007, which subsequently became INGECOTECH in 2010.

The goal of the programme (**http://www.cnrs.fr/prg/PIR/programmes/IngECOTech/ingenierieeco/ingenierieeco.htm**) is to contribute to the emergence of more integrated research to assist in developing answers to the challenges facing our planet. The programme defines ecological engineering as "the use, generally in situ, of populations, communities or ecosystems to modify one or more biotic or physico-chemical dynamics in the environment in a manner favourable for society and compatible with the maintenance of ecological balances and the adaptive potential of the environment". Life forms are thus both an overriding objective and a means.

The goal of this work at Cemagref is to accompany public action in preserving or restoring biodiversity, whether in direct support of creating policies or in supplying stakeholders with the tools and knowledge required for their work. It deals with a wide array of environmental problems related to biodiversity, such as invasive plants, fixing of agricultural pollutants by grassy banks and strips, restoration of damaged ecosystems, particularly aquatic environments and in mountain regions, changes in forest and mountain-pasture management techniques to better protect biodiversity, etc. The work at Cemagref in ecological engineering ranges far beyond the fields mentioned in this issue, but the examples here throw light on a number of interesting facets. That is notably the case for the work on ecological corridors and the creation of the National ecological network, on management of diadromous fish and on maintaining deadwood in forests. These articles highlight the fact that ecological engineering is not a peripheral component of ecology or simply an applied form of ecology, but a discipline in itself whose development calls on contributions from a wide range of disciplines, including not only the life sciences, but also geomatics, the human and social sciences, etc.

Observation networks and participation in the international community

Implementation of public policy requires data on the status of biodiversity and how it changes. Cemagref has set up its own observation systems which have evolved in step with the emergence of new issues as noted by Spiegelberger et al. in their contribution to this issue. But over the past few years, observation networks have undergone significant organisational efforts on the national and European levels. Cemagref is particularly involved in Alter-net, a network of excellence funded by the European commission through its Framework 6 research programme.

The network (**http://www.alter-net.info/**) pursues a double goal of developing a set of long-term observation sites for biodiversity, spread throughout Europe, and contributing to raising political and public awareness of biodiversity issues. In this context, Cemagref has joined forces with CNRS Institut Ecologie et Environnement to establish a new Workshop Zone dedicated to monitoring biodiversity in the Alps.

For all the above issues, which will require mobilising not only ecology, but also the human sciences and life-science engineering, Cemagref can make a truly useful contribution. ■

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